Minamata Initial Assessment (MIA) in the Republic of Yemen



Minamata Convention

The Republic of Yemen

Foreword

The Minamata Convention on Mercury was the first new global Convention on environment and health adopted for close to a decade. It is named after the place in Japan where, in the mid-20th century, mercury-tainted industrial wastewater poisoned thousands of people, leading to crippling symptoms that became known as the “Minamata disease”.

Mercury (Hg) is a highly toxic heavy metal that poses a global threat to human health and the environment. Together with its various compounds, it has a range of severe health impacts, including damage to the central nervous system, thyroid, kidneys, lungs, immune system, eyes, gums and skin. Victims may suffer memory loss or language impairment, and the damage to the brain cannot be reversed. There is no known safe exposure level for elemental mercury in humans, and effects can be seen even at very low levels. Fetuses, newborn babies and children are amongst the most vulnerable and sensitive to the adverse effects of mercury. Mercury is transported around the globe through the environment, so its emissions and releases can affect human health and environment even in remote locations.

No country can control transboundary effects of mercury alone. It can be effectively tackled only through international cooperation. With the adoption of the Minamata Convention, Governments from around the world have taken a major step in dealing with worldwide emissions and releases of mercury, which threaten the environment, and the health of millions.

In support of global measures to address the increasing level of mercury in the environment, the Republic of Yemen joined the rest of the world to negotiate the Minamata Convention, and having agreed the text of the Convention, signed it on 21 March 2014. Yemen is now working towards ratification and implementation of the treaty.

Prof. Ezzi Habet Allah Sharem
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The objective of the Minamata Convention is to protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. Mercury poses both local and international contamination problems. Although some mercury is released into the environment through natural phenomena, approximately 70% of the mercury now found in the environment comes from human activities.

In the framework of the implementation of a GEF-funded project entitled “Minamata Convention Initial Assessment in Yemen”, and with the support of the United Nations Industrial Development Organization (UNIDO) as the implementing agency and the United Nations Institute for Training and Research (UNITAR) providing coordination and technical support, Yemen has committed to completing pre-ratification activities under the Minamata Convention and to enable policy and strategic decision-making that prioritizes areas for future interventions on mercury-related issues.

The development and adoption of this Minamata Initial Assessment (MIA) in Yemen is a practical demonstration of the commitment of the Government of Yemen towards the implementation of the provisions of the Minamata Convention on Mercury.

This document is presented to the relevant stakeholders, Yemenite civil society, and our development partners to encourage the widest possible engagement with the Ministry of Water and Environment (Environmental Protection Authority; EPA), serving as the coordinating ministry for the implementation of the Minamata Convention and the achievement of its objective to protect human health and the environment from the anthropogenic emissions and releases of mercury and mercury compounds.

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Abbreviations and acronyms

%	Percent
‰	Per thousand
ASGM	Artisanal and small-scale gold mining
CCFL	Cold Cathode Fluorescent Lamp
CVM	Vinyl chloride monomer
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
GEF	Global Environment Facility
LPG	Liquefied Petroleum Gas
ha	Hectare
Hg	Mercury
kg	Kilogram
km	Kilometre
km^2	Square kilometre
l	Litre
LFC	Compact Fluorescent Lamp
m^3	Cube meter
MW	Megawatt
NGO	Nongovernmental organization
OECD	Organisation for Economic Co-operation and Development
SDGs	Sustainable Development Goals
t	Metric ton
UN	United Nations
UN Environment	United Nations Environment
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
USD	US Dollar
WHO	World Health Organization

Executive summary

Originally a naturally occurring chemical element in the environment, mercury has become a significant component in many processes including the manufacturing of products. It is also emitted and released from the processing of materials with trace concentrations of mercury, such as coal fired power plants; zinc, lead, and copper production; and cement clinker production. This increased presence of mercury in anthropogenic activities is of global concern because of its harmful properties and impacts on human health and the environment. Indeed, mercury can, once emitted into the atmosphere, travel global distances and settle in areas far from its original emission point. In addition, there are properties of bioaccumulation and biomagnification of several of forms of mercury, for example methylmercury, which represents a significant danger because it is present in the food chain and therefore hazardous to human health.

In order to fight against this growing pollution of mercury, the Minamata Convention was adopted on 10 October 2013 in Japan. The Convention is a binding legal instrument that includes specific directives concerning, in particular, mercury flows, mercury emissions and releases, and the management of mercury-containing wastes. Ultimately, its main objective is to protect human health and the environment from the harmful effects of mercury through its entire life cycle.

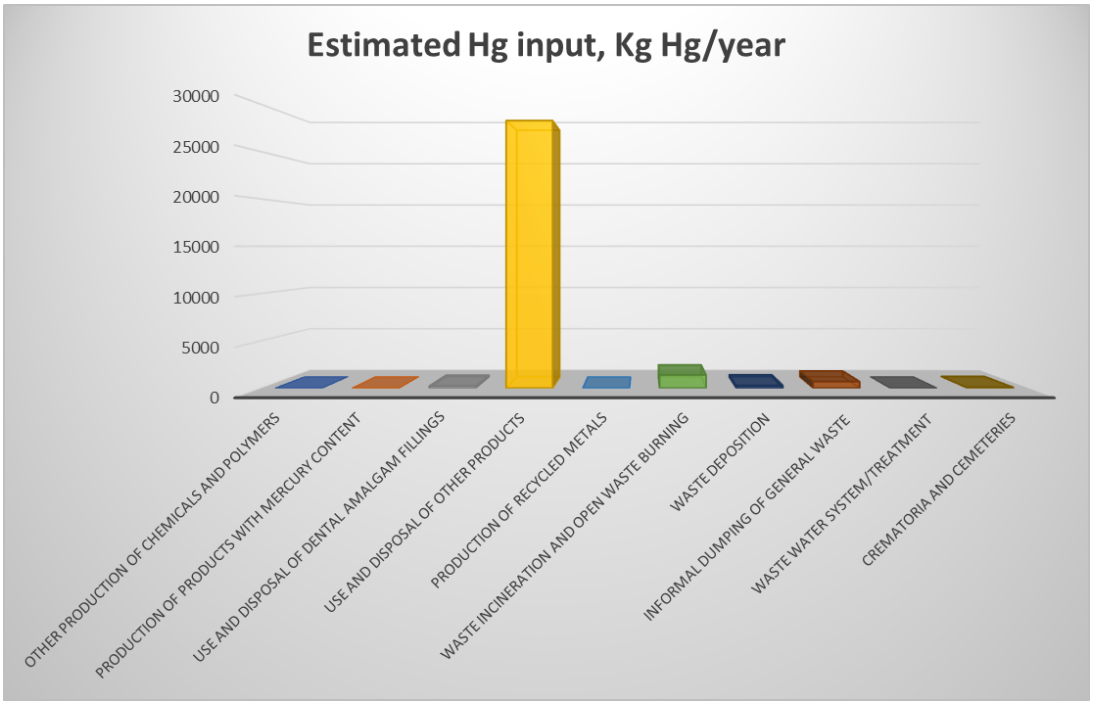
Mindful of the magnitude of the adverse effects of mercury on human health and the environment and the need to combat it globally, Yemen signed the Minamata Convention on Mercury on 21 March 2014. As a signatory to this Convention, Yemen was eligible to receive financial assistance from the Global Environment Facility (GEF), with UNIDO as the implementing agency and technical assistance provided by UNITAR, to carry out a "Minamata Initial Assessment" (MIA). The MIA facilitates political and strategic decision-making and establishing priorities for necessary interventions for the various obligations of the Minamata Convention.

As a component of the project, a national mercury inventory was conducted in the Republic of Yemen (Section 2). The total inputs of mercury in the Yemenite society is estimated at 32,320 kg Hg/year. The assessment reported that most of the inputs, emissions, and releases of mercury and mercury compounds in the country come from the following groups of categories: (i) use and disposal of mercury-containing products; (ii) waste incineration; (iii) waste deposition/landfilling and waste water; (iv) fuel production; and (v) energy consumption. The estimated inputs of mercury are presented in the figure below.

The following sub-categories contribute to the major mercury inputs:

- Use and disposal of batteries with mercury (26,885 kg Hg/year)
- Open burning of waste (14,000 kg Hg/year)
- Informal dumping of general waste (7,000 kg Hg/year)
- Controlled landfills/deposits (2,650 kg Hg/year)
- Natural gas extraction and processing (784 kg Hg/year)
- Cement production (383 kg Hg/year)
- Use and disposal of dental amalgam fillings (229 kg Hg/year)

Figure 1: Estimated mercury inputs



Reference: National mercury inventory in Yemen, 2018

In addition, according to the inventory, the total mercury emissions into air are 22,240 kg Hg/year. The total releases into water and land are respectively 1,330 and 7,070 kg Hg/year.

Based on the inventory results, impacts of mercury and mercury compounds on human health and the environment range from the inhalation of vapour containing mercury by workers involved in specific activities (e.g. during the open burning of waste) and by surrounding populations (e.g. when the atmosphere is polluted) to the consumption of seafood contaminated with methylmercury. The latter is one of the most toxic forms of mercury formed in aquatic environments (when mercury and mercury compounds are released in waters).

In terms of the institutional and legal framework, an assessment of the existing tools in Yemen (Section 3) revealed that the country has taken positive steps in the area of chemicals and waste management, although the measures in place are insufficient to adequately reduce and manage the risks of mercury, its various compounds, and hazardous waste in an environmentally sound manner. However, a comprehensive set of legal and institutional gaps have been identified along with recommendations for future integration of the provisions of the Minamata Convention into the national framework. The recommendations include:

- Enhancing coordination and collaboration between the EPA and other relevant institutions when planning and conducting activities at the national level;
- Re-activating the national chemicals committee's role and expanding it's scope of work to include hazardous wastes;
- Provide training to legal staff and others to deepen their knowledge on chemicals (particularly mercury) and their impacts on human health and the environment and guide the decision-making processes in terms of new legislation and regulations to be proposed;
- Amending the Environmental Protection Law, and other laws as appropriate, to reflect the duties of the EPA with respect to the Minamata Convention, and developing and executing implementing regulations for international conventions and protocols;

- Giving priority to establishing an EPA central laboratory for chemical analysis, as well as rehabilitating sub-laboratories and its staff at the national level, who may assist with the efficient execution of the committee's tasks;
- Updating the rules of occupational safety and health and increasing provisions related to measures and precautions against the risks of mercury and mercury wastes;
- Undertaking awareness campaigns on the role of different conventions in protecting human health and the environment, including the Minamata Convention; and
- Promoting cooperation and coordination with international bodies and organizations.

Priorities and intervention plans (Section 5) were developed and are in line with the Sustainable Development Goals. They address four key areas:

i. capacity building and strengthening political, legal, and institutional frameworks;
ii. reduction of the import and use of mercury-containing products;
iii. sound management of wastes, including mercury wastes; and
iv. reduction of mercury emissions and releases.

1. Introduction

1.1 Mercury as an issue

Mercury, commonly known as quicksilver, is a chemical element with the symbol Hg and atomic number 80. It is a dense, silver-white metal that is liquid at ordinary temperatures. It occurs in its elemental form in the earth's crust but is more commonly found in the form of cinnabar or mercury sulphide (HgS). It may occur with other non-ferrous sulphide minerals (e.g. zinc, lead, arsenic, and gold) and in trace quantities or as an impurity in many other economically valuable materials, including fossil fuels such as coal, gas, and oil. Mercury combines with most metals to form alloys called *amalgams* and these decompose when heating, with volatilisation of the metallic mercury.

Liquid elemental mercury expands and contracts very precisely in response to changes in temperature and maintains its volume in response to change in atmospheric pressure. These unique properties have made it useful in devices designed to measure temperature and pressure.

As an element, mercury is persistent in the environment. It is naturally released into the air as vapour during processes such as volcanic activity, weathering of rock, water body movement, forest fires, and biological processes. While natural releases continue, they do not account for the considerable increase in environmental mercury levels since the onset of the industrial age. It is clear that significant mercury is released from a range of human activities. It is now estimated that roughly 10% of the emissions of mercury to the atmosphere are from natural emissions; a further 30% is generated by current human activity; and the remaining 60% is re-emissions (e.g. through evaporation) of mercury already in the environment, mostly as a result of previous human activity (UNEP, 2013a).

Activities contributing *anthropogenic* mercury releases include the processing of some base metal ores; burning of some coals and hydrocarbon fuels; open use of mercury in industrial processes and in artisanal and small-scale gold mining (ASGM); and breakage and improper disposal of mercury-containing products.

Once in the atmosphere, mercury may cycle globally before being deposited to land and water where it may be further transported, re-emitted to the atmosphere, or transformed by a variety of biological processes. This global transport of mercury means that even regions with no significant mercury releases, such as the Arctic, are known to be adversely affected by mercury.

There are three forms of mercury in the environment: elemental, inorganic, and organic mercury. Elemental mercury can combine with other elements to form inorganic mercury compounds (e.g. mercuric chloride, mercuric nitrate, mercuric oxide, mercuric sulphide). In addition, mercury may be subject to biotransformation by aquatic microorganisms into organic forms such as methyl mercury and ethyl mercury. Both organic and inorganic mercury compounds can also be synthesized technically.

Mercury is now present in various environmental media and food (especially some fish) all over the globe. Mercury bioaccumulates in natural food chains and this can result in concentrations in food resources at levels that adversely affect humans and wildlife. Furthermore, exposure to mercury may be enhanced where current or past economic activities have resulted in landfills, mine tailings, factory sites, and soils and sediments contaminated with mercury.

Mercury is considered by the World Health Organization (WHO) as one of the top ten chemicals or groups of chemicals of major public health concern (WHO, 2017). Elemental and methylmercury are toxic to the central and peripheral nervous systems. The inhalation of mercury vapour can produce harmful effects on the nervous, digestive, and immune systems, lungs and kidneys, and may be fatal. The inorganic salts of mercury are corrosive to the skin, eyes, and gastrointestinal tract, and may induce kidney toxicity if ingested.

Neurological and behavioural disorders may be observed after inhalation, ingestion, or dermal exposure of different mercury compounds. Symptoms include tremors, insomnia, memory loss, neuromuscular effects, headaches, and cognitive and motor dysfunction. Mild, subclinical signs of central nervous system toxicity can be seen in workers exposed to an elemental mercury level in the air of 20 μg/m^3 or more for several years. Kidney effects have been reported, ranging from increased protein in the urine to kidney failure (WHO, 2017).

Ecological effects of mercury include harmful effects on microorganisms even at low concentrations, toxicity to aquatic organisms and birds, and physiological, reproductive, and biochemical abnormalities in fish exposed to sub-lethal concentrations of mercury. A wide variety of birds fed inorganic mercury show a reduction in food intake and consequent poor growth. Other (subtler) effects in avian receptors have been reported such as increased enzyme production, decreased cardiovascular function, blood parameter changes, immune response, kidney function and structure, and behavioural changes (Boening, 2000).

1.2 The Minamata Convention on Mercury

In 2001, the Governing Council of UNEP invited the Executive Director of UNEP to undertake a global assessment of mercury and its compounds, including information on the chemistry and health effects, sources, long-range transport, and prevention and control technologies relating to mercury. That first Global Mercury Assessment (UNEP, 2002) was considered by Governing Council in 2003 and it was decided that there was sufficient evidence of significant global adverse impacts from mercury and its compounds to warrant further international action to reduce the risks to human health and environment from the release of mercury and its compounds to the environment. Governments were encouraged to adopt goals for reduction of mercury emissions and releases and UNEP initiated technical assistance and capacity building activities, through a Global Mercury Partnership.

In 2009, the Governing Council agreed that voluntary actions to date had not been sufficient to address the concerns on mercury and decided on the need for further action on mercury, including the preparation of a global, legally binding instrument. An Intergovernmental Negotiation Committee (INC) to prepare the treaty was established and began its work in 2010. The INC concluded its fifth session in Geneva, Switzerland, in January 2013 by agreeing the text of the Minamata Convention. The Convention was adopted and opened for country signature later that year at a Diplomatic Conference (Conference of Plenipotentiaries), held in Kumamoto, Japan (UNEP, 2013b).

The overall objective of the Convention is to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. It was adopted to promote the use of alternatives and best available techniques and environmental practices across a wide range of products, processes, and industries where mercury is used, released, or emitted, and provides for the control and phasing out and or phasing down of mercury and mercury-added products (UNEP, 2013b).

As of 1 March 2019, 128 countries have signed the Convention, including Yemen, which signed on 21 March 2014, and 102 countries are Parties. The Convention entered into force on 16 August 2017.

1.3 Summary of key provisions of the Minamata Convention

Major highlights of the Minamata Convention include a ban on new mercury mines; phase-out of existing ones; phase out and phase down of mercury use in a number of products and processes; control measures on emissions to air and on releases to land and water; and regulation of the informal sector of ASGM. The Convention also addresses interim storage of mercury and its disposal once it becomes waste, sites contaminated by mercury, as well as health issues.

1.4 Minamata Initial Assessment

The Minamata Convention established a financial mechanism to provide adequate, predictable, and timely resources to support developing country Parties and Parties with economies in transition in implementing their obligations under the treaty. The Global Environment Facility (GEF) is identified as a key element of the financial mechanism.

As a result, the GEF has allocated funding to support implementation of the Convention and established a programme of Minamata Initial Assessments (MIAs) to strengthen national decision-making towards ratification of the Convention and to build national awareness and capacity towards implementation of future obligations. Initial guidelines for the MIA (UNDP, 2017) recommend consideration of the following components:

- ***National background information***: A brief country profile in order to place MIA strategies and action plans in a country-specific context, summarising key information on geography and population; the country's political, institutional, legal, and economic profile; membership of regional and international organisations and agreements; and environmental conditions and priorities;
- ***Mercury inventory***: Using the UNEP Toolkit for the identification and quantification of mercury releases (UN Environment, 2017) to identify sources of mercury emissions to air and sources of releases to land and water, trade in and stocks of mercury and mercury-added products, and industries intentionally using mercury;
- ***Policy, regulatory, and institutional framework assessment***: To identify existing relevant domestic legislation and additional legal and administrative actions that might be necessary on ratification; institutions responsible for implementing relevant legislation and their current capacities; and national stakeholders whose engagement will be necessary for the successful implementation of the treaty;
- ***Identification of populations at risk and gender dimensions***: To prepare a preliminary review of potential populations at risk and to assess potential gender dimensions related to the management of mercury;
- ***Review the level of awareness of mercury risks*** among stakeholders and identify existing education and training opportunities for target groups and professionals; and
- ***Implementation plan and priorities for action***: Summarising the activities and actions that the country is going to undertake to meet its future commitments under the Convention.

1.5 MIA project

The GEF-funded project, "Minamata Initial Assessment in Yemen", was approved by the GEF Council on 9 June 2014. The project was developed with the assistance of UNIDO as GEF Implementing Agency, and UNITAR as the international executing agency. The Ministry of Water and Environment was designated as the national executing agency. The following outputs were delivered under the project:

- **Output 1**: Project coordination mechanism and identification of institutional gaps;
- **Output 2**: Review of existing mercury-related regulations and identification of needed policy reforms to prepare for implementation of the Minamata Convention;
- **Output 3**: Establishing a national mercury profile based on an initial inventory and key sectors identified for intervention and investment to reduce and where possible, eliminate, mercury use, release, and emissions; and
- **Output 4**: Dissemination of information among relevant stakeholder groups (e.g. public and private sectors, academia, and civil society).

A MIA Validation Workshop was held in Cairo, Egypt, 25-28 March 2019, to review and finalise the draft MIA and agree on key recommendations (see Section 8). The MIA project activities were targeted towards understanding the national situation with regard to mercury and, in particular, in relation to the relevant Articles of the Minamata Convention. The Convention sets out a series of obligations that Parties must address in order to comply with its key provisions.

2. National mercury profile

2.1 Geography and population

2.1.1 Geography[1]

Yemen is located on the southwestern end of the Arabian Peninsula. With an area of 460,000km^2, the country is bordered by Saudi Arabia in the North, Oman in the East, the Arabian Sea and the Gulf of Aden in the South, and the Red Sea in the West.

Figure 2: ***Map of the Republic of Yemen***



The geography of Yemen is characterized by various landscapes and climates. The coastal plain ranges of low and high-altitude mountains. *Wadis* or river valleys receive rainwaters during rainy seasons and there are deserts from the East to the North.

Climate is characterized by high temperatures and humidity during summer and moderate during winter. Moderate weather is rather in the western slopes, plateaus and flat lands. The annual rainfall is between 300 and 1000 mm. Yemen is also affected by monsoon winds that are accompanied by rain in summer and lesser rain in winter.

The agriculture sector is one of the major consumers of water. It consumes around 90% of the total consumed water. Agriculture is widespread across many regions, including the plains, highlands, coastal areas, and mountains.

[1] http://www.yemenwater.org/wp-content/uploads/2015/08/SwESA_Report.pdf

2.1.2 Population[2]

The population of Yemen is also growing fast. While the country had 12 million inhabitants in 1990, it grew to 27.6 million people in 2016. The annual population growth rate is 2.6% and the population density in 2016 was 52.2 people per km^2. Despite growing urbanization, most populations remain in rural areas.

Between 1990 and 2016, the life expectancy increased from 58 years to 65 years and the fertility rate decreased from 8.6 to 4 children per woman. The population is also more educated, as 92.4% of the population has been enrolled in primary school.

2.2 Political and legal profile

2.2.1 Political profile

The Republic of Yemen is a new state that was created in 1990, with the unification of Yemen Arab Republic (North Yemen) and People's Democratic Republic of Yemen (South Yemen). Twenty-one governorates and one municipality form the administration of Yemen and the governorates are divided into 333 districts.[3]

Due to political turmoil, a temporary capital has been established in the main city of the south, Aden, with the support of loyalist forces and Saudi-led troops. The Houthis claim that their revolutionary council in Sanaa, headed by Mohammed Ali al-Houthi, is the legitimate government, but the international community backs Mr Hadi.[4]

2.2.2 Legal profile

The legal system of Yemen was elaborated at the creation of the country in 1990. It is based on the practice of the Islamic Shari'ah Law. The population vote for the members of the different branches of government (namely Executive, Legislative, and Judicial). The composition of each branch is as follows:

- **Executive entity**: The President who is one of the most, if not the most, important members of the government is part of this entity. Among others, the President is in charge of declaring a state of emergency, naming members of the National Defense Council, and approving capital punishments. The second component of the executive power is the council of ministers (including the Prime Minister, who is the head of the Government). The third component is represented by the local bodies of authority.[5]
- **Legislative entity**: This branch is composed of the 301 members of the house of representatives that are responsible for monitoring the respect of the Shari'ah Law.
- **Juridical entity**: The juridical branch is independent. The courts are in charge of solving criminal and civil disputes at national level. The supreme court is the highest entity of this branch and is responsible for reviewing laws and cases, but can also remove members such as the President, Vice-President, and Prime Minister.[6]

Yemen has passed many laws and regulations that include provisions and rules for the protection of the environment, pollution control and management of chemicals, and the reduction of its risks. Classified qualitatively as basic laws, general laws, or laws of each stakeholder (laws supporting the general laws).

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[2] http://databank.worldbank.org/data/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=YEM

[3] https://www.acaps.org/country/yemen/country-profile

[4] https://www.bbc.com/news/world-middle-east-14704852

[5] http://www.presidentsaleh.gov.ye/shownews.php?lng=en&_newsctgry=2

[6] http://www.al-bab.com/yemen/gov/con94.htm

The most relevant laws and implementing regulations, described in detail in Section 4, are the followings:

- **Environment Protection Law No. (26) of 1995:** The implementing body of this law is the EPA, as the official organ of the state responsible for the protection of the environment, combating pollution, and the protection of society and human health, as well as other tasks specified in this law. This law and its Executive Regulations make up the pillar of the legal environmental system, which addresses national environmental protection, combating pollution, management of chemicals and hazardous wastes, risk control, and other important topics.
- **Chairman of the Council of Ministers' Decree No. (148) of 2000 on the Executive Regulations of the Environment Protection Law:** This decree includes extremely important details, as in Part One, Chapter Two: Hazardous Wastes and Materials, with its general provisions regarding the restrictions imposed on the production and handling of hazardous materials, handling licenses, method and conditions of prohibiting the materials, transferring conditions, storage safety rules, procedures imposed to ensure the safety of all employees, the need for awareness of their risks, and the proper handling of these materials and wastes in accordance with the requirements of the environment and the safety of workers.
- **Chairman of the Council of Ministers' Decree No. (132) of 2010 on the Regulations of the Environmental Protection Agency:** Recognizing the importance and the gravity of the subject, the EPA started a new department under the name of the "General Administration of Chemical Safety and Hazardous Wastes" in 2010. Article 26 of this decree identifies the tasks of the department under the Environment Protection Law and its Executive Regulations as well as the Regulations of the EPA.
- **Presidential Decree No. (101) of 2005 on the establishment of the Environmental Protection Agency:** The EPA undertakes its tasks and functions based on its decree of establishment as well as the Regulations under which the General Administration of Chemical Safety and Hazardous Wastes was established. The EPA is the national focal point for most of the regional and international conventions related to chemicals, as well as a link with regional and international organisations, along with some of the relevant national parties.
- **Law No. (32) of 1992, Concerning Practice of Health Professions:** The texts of the law include terms and conditions put forward by legislators in order to maintain the health and safety of workers during their direct handling of chemicals and to ban the sale of any medicines after they expire to safeguard the health and safety of the community as a whole.
- **Law No. (25) of 1999, Regulating the Circulation and Trade of Plant Pesticides:** The competent authority is the Ministry of Agriculture and Irrigation, in addition to Customs and Ports of Entry, Ministry of Industry and Trade, security and armed forces, and post offices, each in their places to prevent, eliminate, and control any plant pesticides through extermination or removal, through the arrangement and regulating the handling and trade of pesticides, importation, and exportation of pesticides, in order to prevent their danger, hazards, poisonous, and toxic effects to the public health, animals, and environment.
- **The Implementing Regulation of Law No. (25) of 1999, Regulating the Circulation and Trade of Plant Pesticides:** The competent authority is the Ministry of Agriculture and Irrigation. This regulation controls the legitimate trade and entry of pesticides, providing that no person shall trade pesticides without a prior license from the Ministry of Agriculture and Irrigation, as well as prior approval of the Ministry on the type and quantity of pesticide and that the pesticide must be registered with the Ministry.
- **Labour Law No. (5) of 1995, amended by Law No. (25) of 1997:** This law includes important provisions to secure the occupational safety and health conditions for workers.

- **Law No. (12) of 1994, Concerning Crimes and Penalties:** The law (Article 40) considers handling chemicals illegally as a crime punishable under the law to be executed by the Attorney General through public proceedings.
- **Law No. (13) of 1994, Concerning the Criminal Procedures**

2.3 Economic profile

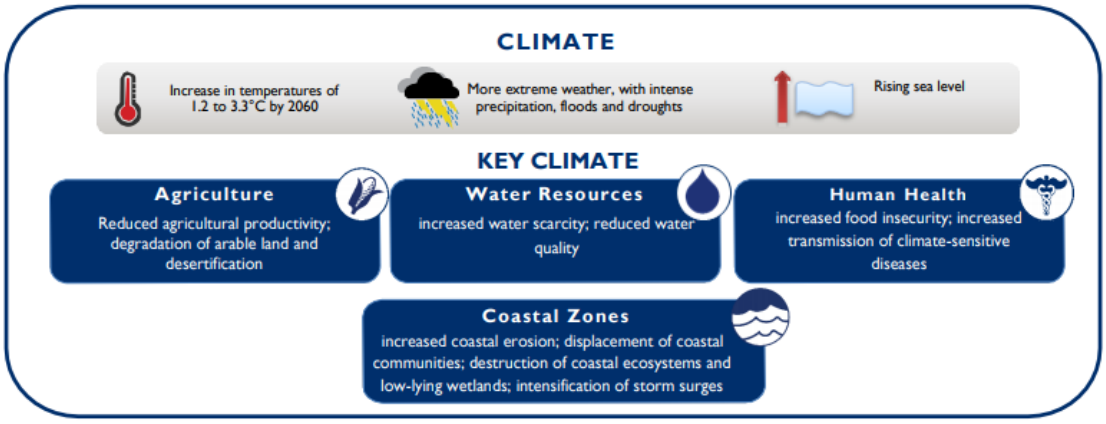
Yemen is classified among the least developed countries; however, it is viewed as a country of promised blessings and important economic resources. There are resources that have not so far been exploited economically, particularly in the field of oil, gas, fish, and different mineral wealth. The gross domestic product (GDP) was 29.031 billion USD in 2010 and 25.374 billion USD in 2018. In 2018, agriculture, industry, and services and other activity made up 15.4%, 31%, and 5.36% of Gross Value Added respectively. Employment is 47.7%, 12.2%, and 40.1% respectively.[7]

Regarding international trade, exports have decreased from 6.437 billion USD in 2010 to 0.637 billion USD in 2018. Imports have decreased from 9.255 billion USD in 2010 to 7.162 billion USD in 2018. The main trading partners are Saudi Arabia and the United Arab Emirates.[8]

2.4 Environmental profile

According to recent studies, in terms of environmental aspects, Yemen is seriously at risks and will potentially face climate change issues in the future. As a consequence of climate change, the figure below presents the following possible impacts.[9]

Figure 3: ***Potential climate change impacts***



The following concerns will also be of high importance:

- **Water scarcity:** Yemen faces water scarcity due to geographical factors as well as climate change. Oil industry, untreated sewage, and salinization also lead to water pollution. Moreover, while the nation has 4.1 km^3 of renewable water resources, 92% of its waters are used for farming activity and 1% for industrial purposes.
- **Soil erosion, land degradation, and desertification:** While agriculture is a relevant source of income, natural forests in mountainous areas have been destroyed by agricultural clearing and livestock overgrazing. This results in soil erosion and land degradation. Water scarcity,

[7] http://data.un.org/en/iso/ye.html
[8] http://data.un.org/en/iso/ye.html
[9] https://www.climatelinks.org/sites/default/files/asset/document/2016_USAID%20GCC%20Office_Climate%20Risk%20Profile_Yemen.pdf

climate change, and industrial activities intensify these environmental concerns as well as desertification.

- **Extinction of species:** Wildlife is important in Yemen, but species are threatened. In 2001, five mammal species and 13 bird species were listed as threatened. Endangered species include the northern bald ibis, South Arabian leopard, and slender-billed curlew. Two species of turtle and wild gazelles are extinct.

In order to integrate international dynamics to address these various environmental issues and to have legally binding instruments at the national level, Yemen has ratified a number of multilateral environmental agreements (MEAs) (see Table 1 below).

Table 1: Key relevant multilateral environmental agreements ratified by Yemen

Title	Place and date of adoption	Depositary	Date of accession or ratification	Implementing institution
Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat	Ramsar 1971	UNESCO	8 Feb 2008	EPA
Convention on International Trade in Endangered Species of Wild Fauna and Flora	Washington 1973	Switzerland	5 May 1997	EPA
Vienna Convention for the Protection of the Ozone Layer	Vienna 1985	UN	26 Jan 1994	EPA
Montreal Protocol on Substances that Deplete the Ozone Layer	Montreal 1987	UN	6 Feb 1989	EPA
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Basel 1989	UN	21 Feb 1996	EPA
Convention on Biological Diversity	Nairobi 1991	UN	21 Feb 1996	EPA
United Nations Framework Convention on Climate Change	New York 1992	UN	21 Feb 1996	EPA
United Nations Convention to Combat Desertification	Paris 1994	UN	14 Jan1997	EPA
Kyoto Protocol to the United Nations Framework Convention on Climate Change	Kyoto 1997	UN	15 Sep 2004	EPA
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	Rotterdam 1998	UN	4 Feb2006	EPA
Stockholm Convention on Persistent Organic Pollutants	Stockholm 2001	UN	9 Jan2004	EPA

In addition to all these MEAs, there is the Minamata Convention, which is the subject of this report. Yemen signed it on 21 March 2014 in order to participate in the control, reduction and/or elimination of mercury at the national and international levels. It has not been ratified yet.

3. National mercury inventory in Yemen

3.1 Introduction

Due to the security situation in Yemen in the years when this inventory was being prepared, it was impossible to undertake inventory activities on site in the territory of Yemen. Related to this, initial inventory training of two participants from Yemen was conducted in Jordan in 2017.

This inventory is therefore based on data available on the Internet, and while such data include many of the largest potential mercury sources, the inventory cannot be considered complete. This inventory is also informed by the 2008 mercury inventory that Yemen prepared in 2005-2008. The current mercury inventory will be supplemented in the future.

Some special precautions were taken in the light of the current situation of instability in Yemen:

- It is evident from the data available that the activity rates in the various sectors fluctuate quite strongly. These fluctuations have been interpreted as real changes from year to year due to the security situation and related instability. Therefore, averages of activity rates in three-year periods have been used wherever possible; in most cases for the years 2013-2015, but in some specified cases for earlier years.
- Mercury source sub-categories that were not included in this inventory due to a lack of data are marked as perhaps present with a "?". The same was applied to sub-categories that are most likely present, but where no data is available. This approach was undertaken rather than marking them as present, but with a result of zero emissions and releases.

3.2 Methodology

This inventory was developed in April-May 2018 with the use of the "Toolkit for identification and quantification of mercury releases" made available by the Chemicals and Waste Branch of UN Environment. The Toolkit is available at UN Environment's Toolkit website.[10]

The inventory was developed using the Toolkit's Inventory Level 1 guidance and templates, as data justifying the use of the potentially more accurate Inventory Level 2 were not available. The Toolkit is based on mass balances for each mercury release source type. Inventory Level 1 works with pre-determined factors used in the calculation of mercury inputs to society and releases (the so-called default input factors and default output distribution factors). These factors were derived from data on mercury inputs and releases from the relevant mercury source types from available literature and other relevant data sources. Further descriptions of these estimations are provided in the relevant source type sections.

The inventory was developed under the GEF-funded MIA project, which was implemented by UNIDO, with UNITAR as the international executing agency and the Ministry of Water and Environment as the national executing agency.

For all of the tables shown in this chapter, it is important to consider the notes below:

- To avoid double counting of mercury in products produced domestically and sold on the domestic market (including oil and gas), only the part of mercury inputs released from production are included in the input "TOTAL".
- To avoid double counting of mercury inputs from waste and products in the input "TOTAL", only 10% of the mercury input to waste incineration, waste deposition, and informal dumping is included in the total for mercury inputs. This 10% approximately represents the mercury input

[10] https://www.unenvironment.org/explore-topics/chemicals-waste/what-we-do/mercury/mercury-inventory-toolkit

to waste from materials, which were not quantified individually in Inventory Level 1 of the Toolkit.[11]

- The estimated quantities include mercury in products, which have 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 "TOTAL".
- The estimated input and release to water include mercury amounts, which have also been accounted for under each source category.
- To avoid double counting, input to, and release to water from, wastewater system/treatment have been subtracted automatically in the "TOTAL".
- Total inputs do not necessarily equal total outputs due to corrections for double counting and because some mercury follows products/metal mercury, which are not sold in the same country or in the same year.
- To avoid double counting, fossil fuel mercury contributions to cement production was subtracted automatically in the "TOTAL".

3.3 Mercury inputs to the Yemenite society

Table 2 below presents the different sources of mercury inputs, emissions, and releases found or assumed to be present (but not identified) in the national territory. Only existing sources in the country were quantitatively assessed. The categories with confirmed absences have been presented in the inventory spreadsheets in Annex 3 of this document.

Mercury inputs to society under this inventory are the total amounts of mercury made available and likely to be potentially emitted when certain economic activities are carried out in the country. This includes energy consumption and fuel production that can be a source of mercury inputs, and mercury intentionally used in production processes or contained in items such as thermometers, blood pressure monitors, and compact fluorescent lamps, among others. It also takes into account mercury mobilized in fuel and cement production.

Table 2: Mercury inputs to Yemenite society

Source category/subcategories	Source present?	Estimated Hg input, Kg Hg/y
	Y/?	Standard estimates
Energy consumption		
Coal combustion in coal fired industrial boilers	Y	22
Other coal uses	?	?
Combustion/use of petroleum coke and heavy oil	Y	44
Combustion/use of diesel, gasoil, petroleum, kerosene, LPG and other light to medium distillates	Y	23
Use of raw or pre-cleaned natural gas	Y	**100**
Biomass fired power and heat production	Y	11
Charcoal combustion	?	?
Fuel production		
Oil extraction	Y	19
Oil refining	Y	8
Extraction and processing of natural gas	Y	**784**
Other materials production		
Cement production	Y	**383**

[11] For more details, see "Appendix 1 - Notes to calculation spreadsheet for Inventory Level 1" of the Mercury Toolkit.

Source category/subcategories	Source present? Y/?	Estimated Hg input, Kg Hg/y Standard estimates
Production of products with mercury content		
Hg thermometers (medical, air, lab, industrial)	?	?
Electrical switches and relays with mercury	?	?
Light sources with mercury (fluorescent, compact, others: see guideline)	?	?
Batteries with mercury	?	?
Manometers and gauges with mercury	?	?
Biocides and pesticides with mercury	?	?
Paints with mercury	?	?
Skin lightening creams and soaps with mercury chemicals	?	?
Use and disposal of products with mercury content		
Dental amalgam fillings (“silver” fillings)	Y	**229**
Thermometers	Y	**575**
Electrical switches and relays with mercury	?	?
Light sources with mercury	Y	43
Batteries with mercury	Y	**26,885**
Polyurethane (PU, PUR) produced with mercury catalyst	Y	**275**
Paints with mercury preservatives	?	?
Skin lightening creams and soaps with mercury chemicals	?	?
Medical blood pressure gauges (mercury sphygmomanometers)	Y	0
Other manometers and gauges with mercury	Y	46
Laboratory chemicals	Y	92
Other laboratory and medical equipment with mercury	Y	**367**
Production of recycled of metals		
Production of recycled mercury (“secondary production”)	?	?
Production of recycled ferrous metals (iron and steel)	Y	2
Waste incineration		
Incineration of municipal/general waste	?	?
Incineration of hazardous waste	?	?
Incineration/burning of medical waste	?	?
Sewage sludge incineration	?	?
Open fire waste burning (on landfills and informally)	Y	**14,000**
Waste deposition/landfilling and waste water treatment		
Controlled landfills/deposits	Y	**2,650**
Informal dumping of general waste	Y	**7,000**
Waste water system/treatment	?	?
Crematoria and cemeteries		
Cemeteries	Y	88
TOTAL of quantified inputs (Double counting subtracted; see notes above)		**32,320**

Reference: National mercury inventory in Yemen, 2018

3.4 Mercury emissions and releases

Estimates of sources of mercury emissions and releases are the result of the use of mercury inputs in various anthropogenic activities, as mercury is released to the atmosphere through various manipulations. The main media to which mercury is released are air, water, and soil. Table 3 below summarizes mercury releases from all identified source categories and subcategories.

Table 3: Mercury emissions and releases

Source category/subcategories	Estimated Hg releases, standard estimates, Kg Hg/y					
	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment/ disposal
Energy consumption						
Coal combustion in coal fired industrial boilers	22.4	0.0	0.0	0.0	0.0	0.0
Other coal uses	?	?	?	?	?	?
Combustion/use of petroleum coke and heavy oil	43.9	0.0	0.0	0.0	0.0	0.0
Combustion/use of diesel, gasoil, petroleum, kerosene, LPG and other light to medium distillates	22.9	0.0	0.0	0.0	0.0	0.0
Use of raw or pre-cleaned natural gas	99.5	0.0	0.0	0.0	0.0	0.0
Biomass fired power and heat production	11.4	0.0	0.0	0.0	0.0	0.0
Fuel production						
Oil extraction	0.0	3.8	0.0	0.0	0.0	0.0
Oil refining	1.9	0.1	0.0	0.0	0.0	1.1
Extraction and processing of natural gas	**117.6**	**156.8**	0.0	**235.2**	0.0	**274.4**
Other materials production						
Cement production*3	287.3	0.0	0.0	95.8	0.0	0.0
Production of products with mercury content						
Hg thermometers (medical, air, lab, industrial, etc.)	?	?	?	?	?	?
Electrical switches and relays with mercury	?	?	?	?	?	?
Light sources with mercury (fluorescent, compact, others: see guideline)	?	?	?	?	?	?
Batteries with mercury	?	?	?	?	?	?
Manometers and gauges with mercury	?	?	?	?	?	?
Biocides and pesticides with mercury	?	?	?	?	?	?
Paints with mercury	?	?	?	?	?	?
Skin lightening creams and soaps with mercury chemicals	?	?	?	?	?	?
Use and disposal of products with mercury content						
Dental amalgam fillings (“silver” fillings)	4.6	100.7	18.3	13.7	45.8	45.8
Thermometers	**114.9**	**172.4**	**114.9**	0.0	**172.4**	0.0

Source category/subcategories	Estimated Hg releases, standard estimates, Kg Hg/y					
	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment/ disposal
Electrical switches and relays with mercury	?	?	?	?	?	?
Light sources with mercury	13.0	0.0	13.0	0.0	17.3	0.0
Batteries with mercury	**6,721.3**	0.0	**6,721.3**	0.0	**13,442.7**	0.0
Polyurethane (PU, PUR) produced with mercury catalyst	55.0	27.5	110.0	0.0	82.5	0.0
Paints with mercury preservatives	?	?	?	?	?	?
Skin lightening creams and soaps with mercury chemicals	?	?	?	?	?	?
Medical blood pressure gauges (mercury sphygmomanometers)	0.0	0.0	0.0	0.0	0.0	0.0
Other manometers and gauges with mercury	9.2	13.8	9.2	0.0	13.8	0.0
Laboratory chemicals	0.0	30.3	0.0	0.0	30.3	31.2
Other laboratory and medical equipment with mercury	0.0	121.0	0.0	0.0	121.0	124.7
Production of recycled of metals						
Production of recycled mercury (“secondary production”)	?	?	?	?	?	?
Production of recycled ferrous metals (iron and steel)	0.5	0.0	0.5	0.0	0.5	0.0
Waste incineration						
Incineration of municipal/general waste	?	?	?	?	?	?
Incineration of hazardous waste	?	?	?	?	?	?
Incineration/burning of medical waste	?	?	?	?	?	?
Sewage sludge incineration	?	?	?	?	?	?
Open fire waste burning (on landfills and informally)	**14,000.0**	0.0	0.0	0.0	0.0	0.0
Waste deposition/landfilling and waste water treatment						
Controlled landfills/deposits	26.5	0.3	0.0	-	-	-
Informal dumping of general waste	**700.0**	**700.0**	**5,600.0**	-	-	-
Waste water system/treatment	?	?	?	?	?	?
Crematoria and cemeteries						
Cemeteries	0.0	0.0	87.7	-	0.0	0.0
TOTAL of quantified releases (Double counting subtracted; see notes above)	**22,240.0**	**1,330.0**	**7,070.0**	**340.0**	**13,930.0**	**480.0**

Reference: National mercury inventory in Yemen, 2018

3.5 Description of the types of results

Table 4: Description of the type of results

Calculation result type	Description
Estimated Hg input, Kg Hg/y	The standard estimate of the amount of mercury entering this source category with input materials; for example, calculated mercury amount in coal used annually in the country for combustion in large power plants.
Air	Mercury emissions to the atmosphere from point sources and diffuse sources from which mercury may be spread locally or over long distances with air masses; for example, from: - Point sources such as coal fired power plants, metal smelter, and waste incineration - Diffuse sources such as small-scale gold mining, and informal burning of waste with fluorescent lamps, batteries, and thermometers
Water	Mercury releases to aquatic environments and waste water systems; point sources and diffuse sources from which mercury will be spread to marine environments (oceans) and freshwaters (rivers, lakes, etc.). For example, releases from: - Wet flue gas cleaning systems on coal fired power plants - Industry, households, etc. to aquatic environments - Surface run-off and leachate from mercury-contaminated soil and waste dumps
Land	Mercury releases to the terrestrial environment: general soil and ground water. For example, releases from: - Solid residues from flue gas cleaning on coal fired power plants used for gravel road construction - Uncollected waste products dumped or buried informally - Local unconfined releases from industry such as on site hazardous waste storage/burial - Spreading of sewage sludge with mercury content on agricultural land (sludge used as fertilizer) - Application on land, seeds, or seedlings of pesticides with mercury compounds
By-products and impurities	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 - Sulphuric acid produced from desulphurization of flue gas (flue gas cleaning) in non-ferrous metal plants with mercury trace concentrations - Chlorine and sodium hydroxide produced with mercury-based chlor-alkali technology; with mercury trace concentrations - Metal mercury or calomel as by-product from non-ferrous metal mining (high mercury concentrations)
General waste	Also called municipal waste in some countries, this is typically household and institutional waste where the waste undergoes a general treatment, such as incineration, landfilling, or informal dumping. The mercury sources to waste are consumer products with intentional mercury content (batteries, thermometers, fluorescent tubes, etc.) as well as high volume waste such as printed paper, plastic, etc., with small trace concentrations of mercury.
Sector specific waste treatment/ disposal	Waste from industry and consumers which is collected and treated in separate systems, and in some cases recycled; for example: - Confined deposition of solid residues from flue gas cleaning on coal fired power plants on dedicated sites - Hazardous industrial waste with high mercury content which is deposited in dedicated, safe sites - Hazardous consumer waste with mercury content, mainly separately collected and safely treated batteries, thermometers, mercury switches, and lost teeth with amalgam fillings - Confined deposition of tailings and high-volume rock/waste from extraction of non-ferrous metals

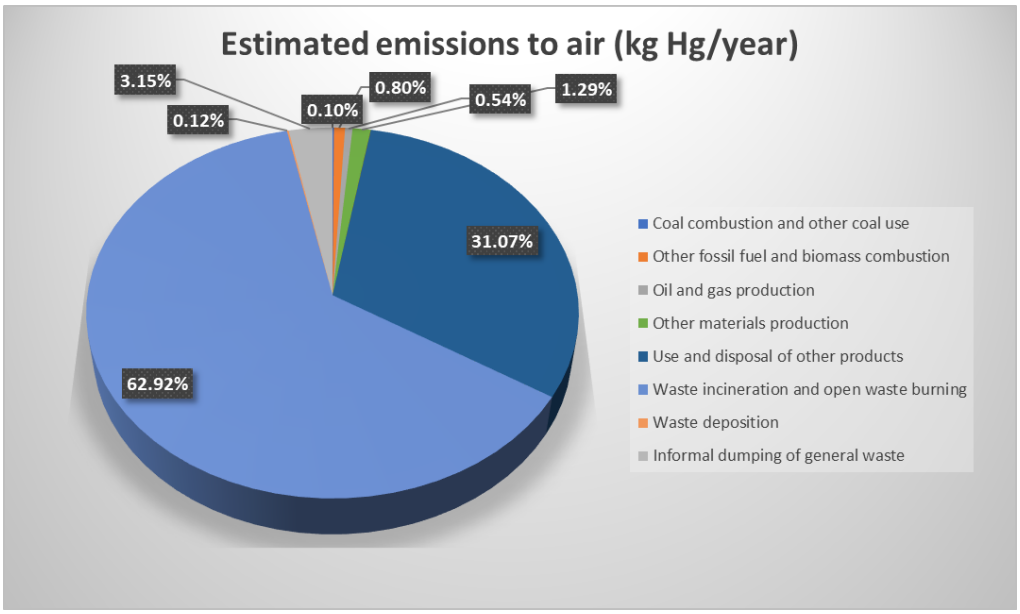
The individual mercury release sub-categories contributing the highest mercury emissions to the atmosphere are:

1. Open burning of municipal waste
2. Informal dumping of municipal waste
3. Use and disposal of batteries (note that this would be heavily affected by any misreporting of mercury oxide batteries, as described above)
4. Cement production
5. Natural gas production

3.5.1 Emissions to air

Mercury emissions to air are shown in Figure 4 below. Air emissions are any evaporation of mercury in the form of gas/steam that may result from heating.

Figure 4: Estimated mercury releases to air



Reference: National mercury inventory in Yemen, 2018

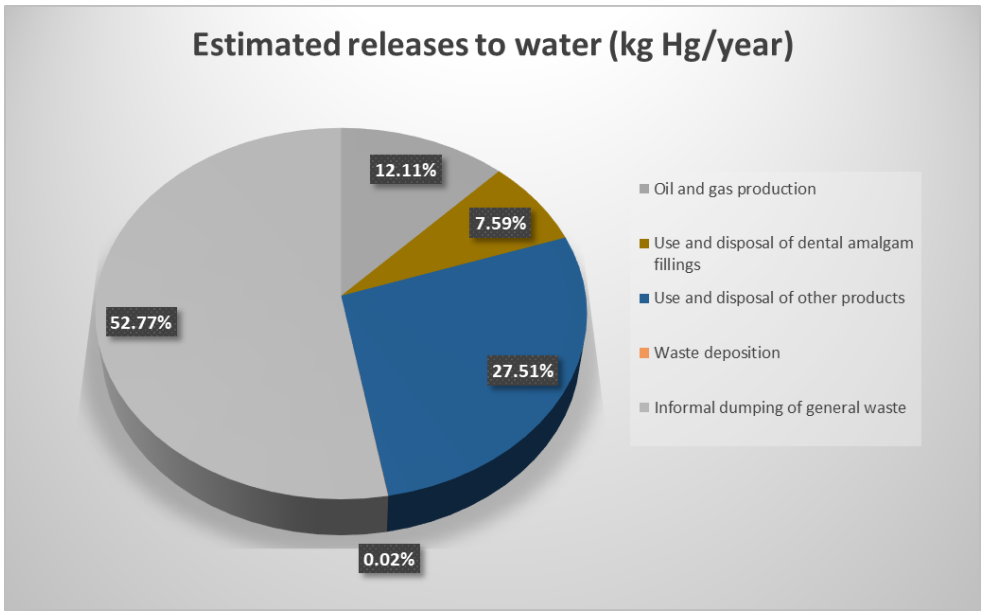
The main source categories that contribute to mercury emissions to air are:

- Waste incineration and open waste burning
- Use and disposal of other products
- Informal dumping of general waste
- Other material production, such as cement production

3.5.2 Releases to water

The subcategories that contribute to mercury releases to water are presented in Figure 5 below, which includes all releases to aquatic environments, surface and ground waters, and wastewater systems. Sources of releases can be of two natures: sources located at a fixed point or diffuse sources from which mercury can disperse and reach marine environments (oceans) and fresh waters (rivers and lakes).

Figure 5: Estimated mercury releases to water



Reference: National mercury inventory in Yemen, 2018

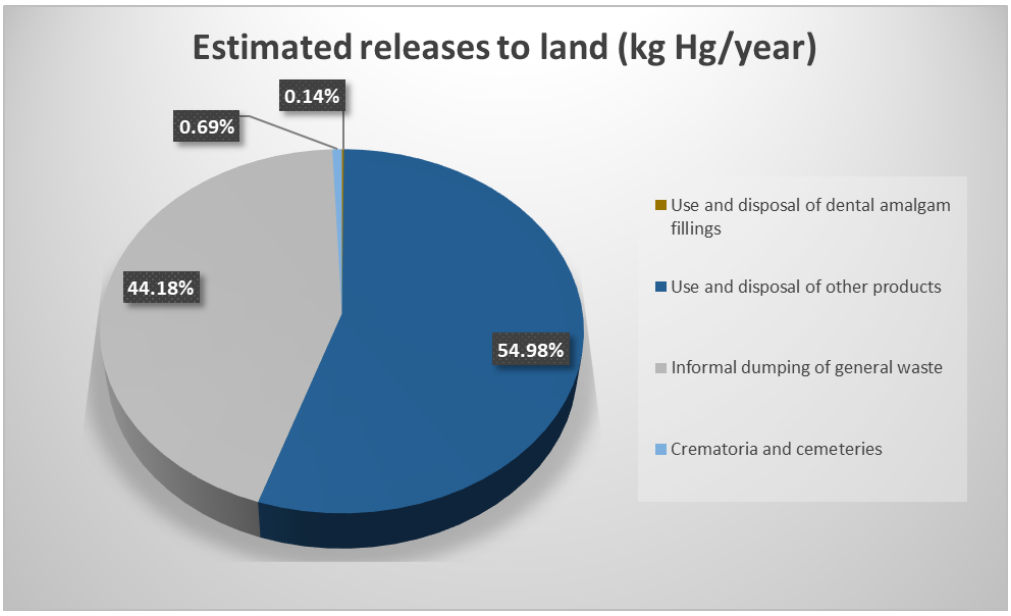
The category sources that contribute most to the releases to water are the following:

- Informal dumping of general waste
- Use and disposal of other products
- Use and disposal of dental amalgam fillings
- Oil and gas production

3.5.3 Releases to soil

Mercury releases to land are summarized in Figure 6 below. All types of releases to soils are considered. Similar to sources of releases to water, sources of releases to land are of two natures: sources at a fixed point or diffuse sources from which mercury may disperse.

Figure 6: Estimated mercury releases to land



Reference: National mercury inventory in Yemen, 2018

The categories of sources that contribute the most to mercury releases to soil are the following:

- Use and disposal of other products
- Informal dumping of general waste

3.6 Data and inventory on energy consumption and fuel production

3.6.1 Coal uses

According to data from the International Energy Agency (IEA, 2018), only minor coal use was reported to have taken place in Yemen, and this was in industry. Coal is also used as a fuel for cement production in two of the six facilities..

The coal use in Yemen in 2013 and 2014 was reported at 185,000 t/y, whereas for 2015 it was 133,000 t/y (IEA, 2018). The average coal consumption in the period was thus calculated at 167,667 t/y, and this number was used as the activity rate for coal combustion in industrial boilers.

3.6.2 Coal combustion in coal fired industrial boilers

No data is available.

3.6.3 Combustion/use of petroleum coke and heavy oil

No data is available.

3.6.4 Combustion/use of diesel, gasoil, petroleum, kerosene, LPG and other light to medium distillates

No data is available.

3.6.5 Use of raw or pre-cleaned natural gas

Available data on gas consumption and production in the period 2013-2015 are shown in the Table 5 below. Data is from IEA (2018). The averages for the period were used in the mercury emissions/releases estimation, converted with the use of the Toolkit Unit Conversion tab converting TJ (terajoule) to the approximate amount of normal cubic meters (NM^3) required as activity rate unit in the Toolkit. As gas use is only reported for electricity production (IEA, 2018), and as it is produced domestically, it is assumed to be only of pre-cleaned quality, and this fact was used in the calculations.

Table 5: Natural gas consumption and production

	2013	2014	2015	Average
Consumption (for electricity production)	40,890	37,684	38,085	38,886
Production	414,119	390,467	114,254	306,280

Reference: IEA (2018)

3.6.6 Biomass fired power and heat production (combustion of biomass)

Available data on wood consumption for fuel use, including charcoal production, in the period 2013-2015 are shown in Table 6 below. Data in cubic meters per year (m^3/yr) were from FAO (2017) and were converted to t/y assuming a density of 0.75 t/m^3, as recommended by FAO for hardwood. The average in t/y for the period was used in the mercury emissions/releases estimation. These data do not include other biomass fuels, such as straw or other agricultural wastes, so they likely underestimate the mercury emissions/releases from this source.

The 2008 mercury inventory for Yemen (Al-Reiashi et al., 2008) states that although fuel oil and gas are present in some cities and provinces, woods and charcoals are still popularly used due to their lower cost compared to fuel oil or gas. Wood and charcoal was reported to account for approximately 90% of the total energy supply in Yemen, especially as the main domestic source of energy for cooking (General Population Census of Yemen, 1995).

Table 6: Wood use for fuel, including for charcoal production, in Yemen

	2013	2014	2015	Average
Fuel wood, incl. for charcoal production, m^3/y	489,000	506,000	523,000	506,000
Fuel wood, incl. for charcoal production, converted to t/y (assuming a density of 0.75 t/ m^3, as recommended by FAO for hardwood)	366,750	379,500	392,250	379,500

Reference: FAO (2017)

3.7 Fuel production

3.7.1 Extraction and processing of natural gas

Available data on gas consumption and production in the period 2013-2015 are shown in Table 7 below. Data were from IEA (2018). The averages for the period were used in the mercury emissions/releases estimation, converted with the use of the Toolkit Unit Conversion tab converting TJ (terajoule) to the approximate amount of normal cubic meters (NM^3) required as activity rate unit in the Toolkit. As gas use is reported only to be used for electricity production (IEA, 2018), and as it is produced domestically, it is assumed to be only of pre-cleaned quality, and this fact was used in the calculations.

Table 7: Natural gas consumption and production, t/y, according to IEA (2018)

	2013	2014	2015	Average
Consumption (for electricity production)	40,890	37,684	38,085	38,886
Production	414,119	390,467	114,254	306,280

No major data gaps were identified. Production and consumption statistics could potentially be associated with higher than usual uncertainties due to the present conflict in Yemen.

3.8 Other materials production

According to USGS (2016), there was no production of non-ferrous metals in Yemen in recent years (up to 2014 at least), but USGS mentions the presence of gold deposits in the country, for which exploitation was planned. There is no data about the presence of paper pulp production from new materials in Yemen.

3.8.1 Cement production

Production of cement takes place in six facilities in Yemen, and all facilities have their own clinker production kilns. Currently, only two are in operation.. USGS reports the cement production as stated in Table 8 below.

Table 8: Cement production in Yemen

	2011	2012	2013	2014	Average (rounded)
Cement production from own	2.8	2.8	3.0	2.5	2.8

clinker, million t/y					

Reference: USGS (2016)

The raw materials used in cement production contain trace levels of mercury. The origin of this mercury comes from mercury naturally present in virgin raw materials used (e.g. lime, coal, oil), solid residues from other sectors (e.g. fly ash and gypsum from coal combustion) in which the mercury content can be high compared to primary materials, and in waste that is sometimes used as fuel in cement manufacture. The use of waste as raw material can significantly increase total mercury uptake in cement production. It should be noted that for the initial inventory, there was a focus on the production of clinker (which is a component of cement composed of limestone and aluminosilicates) because it is this manufacturing step that is the main source of mercury releases to the environment (UNEP, 2015).

3.9 Use and disposal of products with mercury content

3.9.1 Dental amalgam fillings ("silver" fillings)

In the 2008 mercury inventory for Yemen (Al-Reiashi et al., 2008), the consumption of mercury for dental amalgams was roughly estimated as follows:

> *"Detailed information on mercury use for dental amalgam was collected from public and private dental clinics in 4 big provinces and two municipality in Yemen.*
>
> *According to information from the Department of Health, the total number of dental clinics in the country is approximately 3,290. Assuming as a very rough estimation that the remaining dental clinics of the country also have an average of two chairs per clinic, the survey made covers approximately 1,200. Accordingly, a rough estimate of the national consumption of amalgam capsules is 35,000 capsules per year in maximum estimation.*
>
> *Similarly, a rough estimate of the free metal mercury consumption for dental fillings* [if capsules were not used] *is 2,0000-30,000 grams or 20-30 kg Hg/year in maximum calculation.*
>
> *There is no report on mercury contains in each capsule by weight or percentage, which is enabled to calculate the total amount of mercury use for tooth fillings nor the emission by media. Nevertheless, to enable for calculation for the release of mercury into the environment, it is assumed that one amalgam capsule contains an average amount of mercury of 0.8g (based on UNEP Toolkit data per filling from Denmark), resulting in a calculated mercury consumption with capsules of 35,000 x 0.8 g = 28,000 g or equal to 28 kg Hg/year (around year 2005-2007) in maximum. So that the total amount of mercury use in Yemen for dental fillings can thus be estimated at around 20-30 Kg Hg per year in maximum.*
>
> *This is a very low input of mercury with dental amalgam compared to western countries (reference to Toolkit). A major reason for this is likely a much lower frequency of dental restorations (restorations are expensive compared to daily economy in Yemen), in combination with the apparently widespread use of other filling materials.*
>
> *Regarding mercury releases from dental clinics and dental amalgam use, the contacted clinics were asked about their waste management, but no response was received on this issue. Both solid and suspended amalgam drilling waste is most likely lost directly to the sewer/drainage system, or other on-site sewage disposal method. No information was identified indicating special collection of excess amalgam from the insertion of new fillings, or of extracted teeth. As the silver in these materials does represent some value, it is not deemed unlikely that such collection or re-sale could perhaps take place. Even if this is the case, and the metal is re-melted in the country, the mercury content is most likely lost directly to the atmosphere from the furnaces. Quantification of any such processes is deemed beyond the scope of this study*

considering the lack of actual data on the issue. In conclusion it must be assumed that most of the mercury used in dental amalgam is lost to the environment either directly, or via the disposal of general waste. For larger cities where there is the highest concentration of dental clinics, mercury from dental clinics may likely be detectable in sewer sludge (based on consultation with Jakob Maag, January 2008)."

In the present updated inventory, the (now) standard Inventory Level 1 approach was used, where the dental amalgam consumption is calculated automatically using standard data for amalgam used per capita, the total population number, and the WHO estimate of the density of dental personnel. This yields an estimated mercury consumption for dental amalgam fillings of 229 kg of mercury per year. Considering the current situation in Yemen, the real number could likely be between the 2008 and the 2018 estimates.

3.9.2 Thermometers

The 2008 mercury inventory for Yemen (Al-Reiashi et al., 2008) states that in Yemen medical thermometers are well known by most people, but not the risk to human health when containing mercury. Such thermometers are generally used at hospital and clinic, and some at home. It also states that according to information from the Ministry of Health & Population, for period from 1 January to 31 December 2007, 1,500 thermometers had been supplied to 20 hospitals throughout Yemen and 200 for industrial use.

As no additional data were available, as a conservative assumption all of these thermometers were considered to be mercury-filled medical thermometers. Using the Toolkit Unit Conversion tab, the average net import of 2,298 kg/y was converted to approximately 574,583 thermometers imported per year.

As the imports might very well include alcohol-filled thermometers as well, this is likely an over-estimation. However, this number was used in the mercury emissions/releases estimation, because the 2007 numbers appear very small and likely incomplete for the total Yemen market (e.g. it does not include small clinics' and private purchases of thermometers).

3.9.3 Light sources with mercury

Table 9 below gives data for the net import in 2013-2015 of the following lamp types:

- The sum of linear fluorescent tubes (LFs) and compact fluorescent lamps (CFLs), which are both mercury-containing (Harmonised System (HS) Code 853931). For simplicity, these are assumed to have a distributed 50/50 on a weight basis, which gives a 33/67 split on an item basis when using the conversion factors in the Toolkit Unit Conversion tab.
- The sum of mercury vapour lamps, sodium vapour lamps, and metal halide lamps (HS code 853932), which are all considered mercury-containing.
- The sum of ultra-violet and infra-red lamps (HS Code 853949), of which only the ultraviolet are mercury-containing, but the share of these is not known and the group is thus conservatively considered all mercury-containing.
- Other discharge lamps (HS Code 853939), which is a mixed group of unknown composition, but where most are likely mercury-containing, and they are considered as such here.

As the Comtrade units for these lamps were given as kg/y, an approximate conversion to items/y (the unit required in the Toolkit) was done using the Toolkit's Unit Conversion tab for LFs and CFLs, and by assuming that the other lamp types have approximately the same average weight as LFs (reasonable for ultraviolet lamps, but perhaps an underestimation for some of the others). The resulting activity rates entered in the Toolkit spreadsheet are shown in Table 9 below.

Table 9: Activity rates for mercury-containing lamps

Lamp type	Average net import 2013-2015, items/y	Remarks
Fluorescent tubes (double end)	583,882	See remarks above
Compact fluorescent lamp (CFL single end)	1,167,763	See remarks above
Other Hg containing light sources	754,140	Sum of Hg vapour lamps, Na vapour lamps, metal halide lamps, ultra-violet lamps, and "other discharge lamps"; see remarks in text

Reference: Comtrade (2017)

3.9.4 Batteries with mercury

The following battery types were considered:

- **Mercury oxide batteries**: These are specialty batteries with about 32% w/w mercury. They are normally used in small amounts per capita, and the amounts registered in Comtrade seem unlikely high, except if mercury oxide batteries still have a significant role in military equipment (they were earlier regarded as highly reliable batteries, and as such some military uses have been indicated). These batteries constitute the largest quantified inputs of mercury to the Yemen economy (assuming the data is correct; even though the recorded import for one year has been omitted in the average consumption rate as it appears to be a high outlier). It is quite possible that a significant amount of these recordings are misreporting of other button cell battery types. As no other data exists, they have therefore been counted as mercury oxide batteries.
- **Zinc-air and silver oxide batteries** (usually most used in button cell sizes): Here mercury concentration are much smaller (generally 1.2 and 0.4% mercury, respectively, according to the Toolkit Reference Report). The battery types can today be produced without mercury, but it is assumed that the mercury-containing types are still dominating in the Yemen market (as they are less costly).
- **Manganese oxide batteries**: These batteries exist in two overall types: alkaline batteries (the most common) and plain (very cheap, but with low capacity). Global brands of cylindrical alkaline batteries are today mercury-free, but some brands may still exist with moderate mercury concentrations (mercury contents around 0.25% w/w). Most alkaline button cells are likely still mercury-containing (around 0.5% w/w mercury). Plain manganese oxide batteries still contain mercury according to Lin et al. (2013), but their market share in Yemen is unknown. In the mercury emissions/releases estimation conducted here, they are all considered as mercury-containing (non-button cell) alkali batteries. This introduces an uncertainty, but the mercury contribution is moderate due to the low concentration of mercury in them.

3.9.5 Polyurethane (PU, PUR) produced with mercury catalyst

This category contributes with an input of 275 kg Hg/year.

3.9.6 Other laboratory and medical equipment with mercury

This category contributes with an input of 367 kg Hg/year.

3.10 Production of recycled of metals

3.10.1 Production of recycled ferrous metals (iron and steel)

According to the 2008 mercury inventory for Yemen (Al-Reiashi et al., 2008), it was known that recycled iron production was undertaken as small-scale handicraft. The iron scrap recycling/production sources comprised three locations; and most of them were located in Hodeidah and Aden Province. According to their estimation, the amount of iron annually produced was about 720 tons. The most common recycling kiln was a cylinder with a height of 1 meter and a diameter of 0.7 meters. It was processed by charcoal. The production of iron scrap recycling was made for other products, especially spare parts for vehicles and any metallic machines. The recycling kiln was reported as generally made of iron on the inside and bricks on the outside (though construction was most likely the opposite). Such handicrafts had no temperature controller or air pollution control system applications applied. Under these conditions, most likely no potentially mercury-containing parts (switches and lights) would actually enter the melting furnace. To the extent that cars with mercury-containing parts (e.g. older cars from Europe and Arab Gulf states) are present in the Yemen society, these parts may be collected for re-sale as spare parts or be lost to scrap heaps at the car scrappers or go with general waste to landfills. However, they may eventually be lost with resulting releases.

Based on the above data from the 2008 inventory, and assuming roughly for simplicity a steel weight of 0.5 t/vehicle, the activity rate of 1,440 vehicles recycled per year is used in the inventory. This is likely a gross underestimation of the number of vehicles scrapped per year, but on the other hand, the number of scrapped cars actually having mercury switches or other mercury-containing parts may likely be minimal today.

The 2008 mercury inventory for Yemen (Al-Reiashi et al., 2008) also mentions that recycling of copper, lead, and aluminium is taking place, but no mercury emission calculations were made for these activities.

3.11 Waste incineration and waste deposition/landfilling and waste water treatment

As no national data were available, literature data from Wiedinmeyr et al. (2013) have been used. They reported the following estimates for waste production and fate for Yemen, based on other available national or regional data on waste production per capita and the standard IPPC methodology for estimation of waste amounts and fates (used in climate gas inventories). Wiedinmeyr et al. (2013) estimated a municipal waste production in Yemen of 4.8 million t/y, of which 2.8 million t/y was estimated as burned informally and on landfills (open burning of waste), while 0.53 million t/y was deposited in controlled conditions, and 1.4 million t/y was dumped informally.

The data were used here in the estimation of mercury emissions and releases from general (municipal) waste management.

The 2008 mercury inventory for Yemen (Al-Reiashi et al., 2008) assumed that medical wastes accounted for approximately 2% of total waste production, and was composed of needles, syringes, glass bottles, glasses, surgical wastes, and other pharmaceutical wastes. They mentioned that medical waste was generally reasonably managed in terms of waste classification, collection, storage, and disposal/burning and the remaining composed with municipal wastes. This estimate is however deemed very uncertain, and likely a gross over-estimation, and was therefore not used in the current inventory.

3.11.1 Crematoria

The human body contains mercury, mostly from dental amalgam, but also from the diet. This mercury is released to the environment when human corpses are buried.

According to the UN Demographic Yearbook (2016), 28,569 persons died in 2012, while 35,066 died in 2013 (there are no newer numbers). The 2013 number, as the latest available, was used as activity rate.

3.12 Contaminated sites

A contaminated site is any type of soil, air, water, sediment, or a combination of two or more of these elements that may contain mercury, mercury compounds, or mercury waste. On the basis of this definition, it is important to take into account that mercury contamination may be associated with a wide range of other chemical pollutants and therefore may be complex to analyse. Mercury, when released into the atmosphere, can travel long distances and settle in remote areas far from the original emission site. Similarly, mercury released to land and water can be released over large areas beyond the original area of spread. Therefore, contaminated sites may also be areas that are remote from the sites where activities that use, emit, and release mercury occur.

The Level 1 inventory does not address the issue of contaminated sites in detail. However, this problem remains essential because contaminated sites are the direct result of human activities involving mercury or mercury compounds and therefore mercury emissions and releases into the environment.

Currently, there is no inventory of sites contaminated with mercury or mercury compounds in Yemen. However, based on the national mercury inventory, we can already cite cement production sites or sites where waste is stored and burned as potentially contaminated sites. Further investigations should be carried out to provide a full description of contaminated sites present at the national level so that appropriate remediation solutions can be considered.

3.13 Data gaps

Major data gaps were the following:

- Collecting updated national data, both from statistics and importers, for all products of relevance could be a priority in future mercury inventories. The import of batteries needs to be investigated further.
- In case gold production has been initiated in Yemen, or is going on informally, this could influence the mercury emissions and releases significantly.
- Intentional use of mercury in production or other processes in Yemen have not been investigated in depth and this could be a priority for future updates.
- No data were available on amounts of medical or hazardous waste, nor on waste water sludge incineration. These could be prioritised in follow up work.
- Collecting updated national data for waste generation and fate covering the whole of Yemen (not only registered amounts) would be an important improvement in future inventories.
- Collecting updated national data for medical and hazardous waste generation and fate covering the whole of Yemen (not only registered amounts) could be prioritised in future inventories.

3.14 Implications for Yemen as a Party to the Minamata Convention

Taking into account the results of the inventory, Yemen, as a signatory to the Minamata Convention, will have to meet the requirements of the following Articles of the Convention.

Article 3: Mercury supply sources of trade addresses mercury stockpiles at the national level. It has been listed that there are no significant stockpiles of mercury in the national territory, which implies that this article is not a priority for the country. However, it would be necessary to identify and quantify mercury stocks for this sector but also to investigate further the entry of mercury into the national territory while considering the legal framework governing these imports and exports.

With regard to ***Article 4: Mercury-added products***, Yemen has listed a number of products listed in Annex A (Part I) of the Convention, namely thermometers, batteries, dental amalgams, polyurethane, and light sources for the most important ones. The current inventory has provided the first estimates of the national situation. However, concerning these categories and the categories that have not been assessed yet, a more detailed investigation would be necessary in order to define more precisely the quantities present in the national territory in order to be able to decide on the best actions to be undertaken to prohibit the manufacture, import, and export fixed for these products after the date of final abandonment. Also, with regard to dental amalgams, this is an important source of mercury in Yemen since the use of these products is explicitly detailed in Annex A (Part II) of the Convention and Parties will have to take appropriate measures to meet obligations including the elimination of dental amalgams. Similarly, all other mercury-containing medical products and devices (except those tools not listed in the Convention) used in public hospitals, private clinics, and other practices will need to be the subject of an appropriate strategy to ensure their replacement.

The national inventory identified numerous sources of mercury emissions into the air in Yemen, namely energy consumption, biomass combustion, use and disposal of mercury-containing products, open burning of waste, and informal dumping of wastes. Therefore, ***Article 8: Emissions*** of the Convention is relevant for the country, which must therefore take adequate measures "controlling and, where feasible, reducing emissions of mercury and mercury compounds".

Article 9: Releases concerning mercury releases to water and soil follows the same principle as Article 8. Subcategories that release mercury and/or mercury compounds in Yemen should be adequately addressed to meet the obligations of this Article.

Article 11: Mercury Wastes and ***Article 12: Contaminated Sites*** are two important aspects for Yemen, which has mercury waste notably through the use of medical instruments or other products and devices containing mercury. All this waste is, most of the time, assimilated to general waste and thus treated together. It is therefore necessary to establish environmentally sound waste management in which mercury waste in particular will be considered and treated separately. Similarly, mercury contaminated sites should be understood as an integral part of a comprehensive investigation of chemical contaminated sites. For now, there is no in-depth study on contaminated sites in Yemen. It is therefore essential to develop an adequate strategy to identify, characterise, and assess contaminated sites in order to conduct such an investigation.

4. Impacts of mercury on human health and the environment and identification of populations at risks

4.1 Introduction

This chapter deals with the routes of human exposure and contamination, and the various symptoms and diseases that result and endanger human health. It also discusses the issue of vulnerable populations according to their activities and thus exposure to mercury, including the gender dimension. Finally, it describes the environmental compartments that are exposed and affected, directly or indirectly, by the use, emissions, and releases of mercury in Yemen.

4.2 Impacts of mercury on human health

Reducing the health impacts of mercury and its compounds is the main focus of the Minamata Convention, whose primary objective is to protect human health. Article 16 expressly deals with health aspects. It stipulates that the Parties are encouraged to:

(i) "*Promote the development and implementation of strategies and programmes to identify and protect populations at risk, particularly vulnerable populations [...*]".
(ii) "*Promote the development and implementation of science-based educational and preventive programs on occupational exposure[...]*".
(iii) "*Promote appropriate health-care services for prevention, treatment and care for populations affected by the exposure to mercury[...*]".
(iv) "*Establish and strengthen, as appropriate, the institutional and health professional capacities for the prevention, diagnosis, treatment and monitoring of health risks related to the exposure to mercury and mercury compounds*."

The effects of mercury on the health of Yemeni populations can be organized as such:

- Populations may be exposed to elemental mercury vapor. Open burning and incineration of waste, general waste disposals, and, to a lesser extent, thermometers, electrical switches and relays, and charcoal combustion contribute to mercury emissions to air. This means that during combustion or heating, mercury evaporates as elemental mercury and thus essentially enters the body through respiration. Regular exposure to mercury vapor can cause nervous system disorders, nerve problems, brain damage, or allergic reactions.
- Exposure to organic mercury can result from various activities that lead to the release of mercury into water. The sources listed in Yemen are thermometers and informal waste disposal. Mercury contained in these products and wastes can leach into the water or simply be discharged into the wastewater that would be sent to the water reservoirs. Still, once in water, mercury can be converted to methylmercury. This form has important bioaccumulation and biomagnification properties in the food chain and will enter fish and seafood consumed by communities. Apart from this, especially in rural areas, people are likely to use water from rivers and lakes for cooking, washing, and other daily tasks, increasing the routes of exposure and contamination. Mercury consumed or in direct contact with the skin will cause nervous disorders, brain damage, memory loss, ataxia, chromosomal damage, or reproductive disorders.
- The inorganic form of mercury can also cause adverse health effects. This form is found in soils through waste disposals such as mercury-containing electrical switches and relays, thermometers, and informal general waste disposals. This deposited inorganic mercury contaminates arable land since it can easily attach to organic matter. The effects of inorganic mercury on individuals are mainly at the kidney level.

All of these direct or indirect health effects of mercury raise a global concern that requires joint action to address mercury contamination in an effective, environmentally sound, and sustainable manner. In Yemen, the inventory made it possible to target the places where contamination and therefore the effect on health are most pronounced. The next step will therefore be to quantify these effects and put in place a national plan with appropriate measures to meet the requirements of the Minamata Convention.

4.3 Identification of population at risks and gender dimension

Elemental mercury and methylmercury are toxic to the central and peripheral nervous systems. The inhalation of mercury vapour can produce harmful effects on the nervous, digestive, and immune systems, lungs, and kidneys, and may be fatal. The primary health effect of methylmercury is impaired neurological development. The inorganic salts of mercury are corrosive to the skin, eyes and gastrointestinal tract, and may induce kidney toxicity if ingested. Neurological and behavioural disorders may be observed after inhalation, ingestion, or dermal exposure of different mercury compounds (WHO, 2017).

In Yemen, the following groups are particularly exposed to the effects of mercury:

- ***Women and children*:** Among the routes of contamination for women and children, the consumption of foodstuffs likely to be contaminated by mercury or the use of cosmetic products containing added mercury can be cited. Account must also be taken of the use of charcoal in households where women are most often in charge of cooking. In pregnant women, ***foetuses*** are also very vulnerable because mercury can seriously harm a baby's brain development and nervous system. They are exposed through the passage of methylmercury into the placenta. High foetal exposure is the result of high maternal exposure, usually from occupational exposure or consumption of fish and crustaceans.
- ***Workers in cement production plants*:** Workers involved in handling processes and working without safety equipment especially will be directly exposed to fumes containing mercury. Moreover, agricultural land as well as rivers will be affected and at the same time will reach the surrounding populations.
- ***Groups engaging in waste management activities***, typically including a significant proportion of women and children, are likely to be at risk of mercury exposure. Uncontrolled scavenging, informal recycling of discarded mercury-containing products, and open burning of wastes at solid waste dumpsites are likely to put women and children at particular risk. Despite the risks to the health of women and young families, communication with these groups about the health risks they face, including from mercury exposure, is often targeted at the male heads of households, and may not reach those at particular risk. Even where it does, families may have few options to mitigate such risks or avoid the activities giving rise to exposure. It follows that communications will need to consider mercury exposure within wider aspects of the socio-economic disadvantages of these groups and not target mercury exposure risk alone.
- Mercury is also used in a variety of devices and measuring instruments in the healthcare sector. ***Healthcare workers*** may be exposed to mercury through the breakage of equipment or while bougie tubes and other devices are being filled. Improper disposal of the remains from a spill from broken devices containing mercury results in the contamination of solid waste streams and further environmental contamination. Furthermore, mercury is also used widely for dental amalgam so that ***dental workers*** may become contaminated through the preparation of amalgam. Waste amalgam, either remaining from preparation or removed from patients, is mostly discarded into solid waste or enters waste water systems, potentially contaminating waste disposal and water treatment facilities and posing risks to workers there.

- ***Civil society in general***: A large number of households and most inhabitants in Yemen use charcoal combustion, natural gas or diesel, gasoil, petroleum, and kerosene for any energy consumption, particularly cooking, heating, or other domestic activities, which involves the evaporation of mercury-containing vapours directly into the ambient air breathed in by the populations. In addition, private consumers use mercury-containing products, including thermometers, light sources, and batteries with mercury, that, if broken, may spill mercury and have thus direct harmful impacts on the health of the civil society. Mention should also be made of cosmetic products used by private consumers that may contain mercury, although the inventory was not able to collect data concerning this category. All these aspects should therefore be taken into account when identifying populations at risk.

4.4 Impacts of mercury on the environment

Environmental impacts are a consequence of all activities that involve the use of chemicals such as mercury and its compounds. Moreover, one of the objectives of the Minamata Convention is the preservation of the environment. To this end, Article 11 on mercury waste (as a whole) is important because it sets out provisions for the management of mercury waste. Articles 8 and 9 of the Convention, on mercury emissions and releases respectively, are also essential as they call for the following actions:

- In terms of controlling and reducing air emissions, countries that identify relevant sources of mercury emissions to air should develop a national plan to identify and implement adequate measures to control and reduce emissions of mercury and mercury compounds to the atmosphere. In this national plan, Parties are encouraged to assess the feasibility of these measures in the light of the national situation and the technical and economic resources available no later than ten years after the date of entry into force of the Convention.
- Similarly, for releases of mercury and mercury compounds to water and land, a Party with relevant sources of mercury releases in its territory is required to identify and apply best available techniques and best environmental practices to control and reduce releases and effects of mercury on different media.

Mercury is a naturally occurring metal in the environment. It enters the environment when minerals break naturally in rocks and soil exposed to wind and water. The dispersion of mercury from natural sources has remained about the same over the years. However, the concentration of mercury in the environment is constantly increasing; this is to be attributed to human activity. Mercury used in human activities is released to the environment. All environmental compartments are affected, namely air (atmosphere), soil, water, and sediment. Forms of mercury can be very toxic, even at trace levels, to the environment. Most mercury released from human activities is released to air through fossil fuel combustion, smelting, and solid waste combustion. Some activities release mercury directly to land or water, such as the application of agricultural fertilizers and industrial wastewater discharges. All mercury released to the environment eventually ends up in soils or surface waters where it can accumulate in living organisms. For example, the mercury in the soil that accumulates in mushrooms.

Elemental mercury, also known as metallic mercury, is likely to be released into the atmosphere and, more importantly, likely to remain there for a long time. Elemental mercury particles emitted to the atmosphere can then travel greater or lesser distances and settle far from where they were originally emitted. On the other hand, when activities involving mercury are conducted in enclosed areas, the evaporated mercury remains on site in the ambient air that is breathed. However, it can be oxidized to a water-soluble form (Hg^{2+}) from which it can return to soil and water.

In water, mercury is present in organic and inorganic forms Hg^{0} and Hg^{2+} with a high Hg^{2+} content. It binds rapidly to suspended matter. Reduction and methylation compete in this environment.

Reduction reactions promote its atmospheric recycling and methylation reactions are the basis for its bioaccumulation. In aquatic systems, one of these Hg^{2+} reactions will therefore influence its behaviour and modify its mobility, bioavailability, and toxicity to the species present. In aquatic systems, mercury has a very high potential for bioaccumulation. Acidic surface waters can contain significant amounts of mercury. When the pH is between 5 and 7, mercury concentrations in the water increase because mercury is mobilized from the soil. Once mercury has reached surface water or soil, micro-organisms can convert it to methylmercury, a substance that can be rapidly absorbed by most organisms and known to cause nerve damage. Fish are organisms that absorb significant amounts of methylmercury from surface waters every day. As a result, methylmercury can accumulate in fish and the food chains to which they belong. The effects of mercury on animals include kidney and intestinal problems, stomach and reproductive disorders, and DNA alteration.

In soil, mercury is rapidly bound by oxides of iron, aluminium, and manganese and by organic matter. The main factors influencing speciation and behaviour of mercury in soil are pH, organic matter concentration, redox potential, cation-exchange capacity, chloride concentration, aeration, soil mineralogical composition and texture.

4.5 Summary of the impacts of mercury on human health and the environment

Table 10: Summary of the impacts of mercury on human health and the environment

Subject	Waste incineration and waste deposition/landfilling and waste water treatment	Fuel production	Other materials production	Use and disposal of products with mercury content
a) Source strength	These two categories represent two of the most important sources of mercury with the following sub-categories: Open fire waste burning (14,000 kg Hg/year), Informal dumping of general waste (7,000 kg Hg/year), and Controlled landfills/deposits (2,650 kg Hg/year).	The most important subcategory is the extraction and processing of natural gas (784 kg Hg/year).	For this category, the national inventory reported mercury input from cement production (383 kg Hg/year).	This category is the most important in terms of sub-categories that, when put together, contribute the most to mercury inputs. The most important contributions are: Batteries with mercury (26,885 kg Hg/year), thermometers (575 kg Hg/year), other laboratory and medical equipment with mercury (367 kg Hg/year), polyurethane (PU, PUR) produced with mercury catalyst (275 kg Hg/year), and dental amalgam fillings (229 kg Hg/year).
b) Main emission/release pathways	The main direct emission pathway to the environment from these sources sub-categories is via the atmosphere especially for the open fire waste burning. Informal dumping and controlled landfills contribute to releases to water and land as well.	Water (156.8 kg Hg/year), by-products and impurities (235 kg Hg/year), and waste treatment/disposal (274.4 kg Hg/year) are major pathways for mercury releases to the environment from this sub-category.	Direct emissions from this source sub-category mostly happen to the atmosphere (287.3 kg Hg/year).	The main releases from these mercury-added products happen during waste treatment practices, but releases can also occur in case of breakage or other open exposure while in use.
c) Exposure risk; environment	The surrounding environment of the sites where the open fire burning occurs are directly impacted. The vapour resulting from the burning contains mercury. The surrounding atmosphere/land/water are therefore highly exposed to mercury contamination.	The aquatic environments that are directly impacted are exposed to mercury contamination.	The surrounding environment of the cement production facility will be directly affected by emissions to the atmosphere.	In case these products/devices are disposed of with general waste, the immediate surroundings of the disposal sites will be affected depending on the disposal methods used.

f) Exposure risk; Exposure risk; general population, workers and their families	Persons/communities directly engaged in the open waste burning in question, or living within the work area, may be severely affected by mercury exposure.	In water, mercury can be transformed into methylmercury, one of its most toxic forms that can bioaccumulate in the food chain, starting with aquatic species, particularly fish, consumed by local populations.	Persons directly engaged in the cement production and communities living within the work area, may be affected by the air contaminated by the vapour containing mercury.	Mercury-added products like these may cause direct exposure of consumers during use and disposal.
i) Priority for follow-up assessment and potentially actions	An intervention plan on the sound management of waste, including waste containing waste and medical waste, should be developed. This intervention plan would propose mitigation methods to address the adverse effects on the populations and the environment.	This mercury source sub-category may be of potential importance and further assessment, when feasible, is recommended.	Concerning cement production, the sector does not represent the largest source of mercury input, emissions/releases. However, actions to reduce mercury emissions to the atmosphere should be considered.	Actions should be taken to reduce and/or eliminate, where possible, the production, import, and use of mercury-containing products. The use of mercury-free alternatives should also be encouraged.
j) Linkage with Sustainable Development Goals[12] (SDG)	*SDG 3: Ensure healthy lives and promote well-being for all at all stages* *SDG 6: Ensure availability and sustainable management of water and sanitation for all* *SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable* *SDG 12: Ensure sustainable consumption and production patterns* *SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development* *SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss*			

[12] https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

4.6 Implications of the assessment results for Yemen as a Party to the Minamata Convention

This chapter presents the impacts of mercury on human health and the environment. Thus, the following relevant articles of the Convention are related to this important issue.

Article 4: Mercury-added products encourages mercury-free alternatives products, where possible combined with the removal of mercury-added products from the marketplace. Where products remain in use, in particular within the healthcare sector, training in handling breakages and spillages of mercury, information on exposure risks, and revised procurement arrangements favouring mercury-free alternatives should be promoted. With regard to dental amalgam, the measures set out in Part II of Annex A form the basis of a phase-down initiative. Therefore, this article is relevant for the country because products containing added mercury listed in the inventory are used by the population and therefore have a direct impact on their health. In addition, the disposal of these products raises an environmental concern since most are dumped in informal landfills or burned in the open air. This article encourages Yemen to promote mercury-free products and to take appropriate measures to limit mercury exposure in products containing mercury. Therefore, appropriate strategies will have to be developed for exceptions that remain tolerated in the national territory in order to reduce the risks of exposure and limit the contamination of populations, in particular the exposure of women directly exposed to certain products.

With regard to ***Article 16: Health aspects***, the inventory highlights the potential exposure to mercury of a number of population groups including those engaged in informal activities dealing with waste, and those handling mercury-containing products, including dental amalgam, and people working in the health sector. Yemen should consequently consider strategies and programmes to identify and protect all populations at risk pursuant to Paragraph 1.

5. Political, legal, and institutional assessments

5.1 Introduction

The review of the national legislation in Yemen and careful consideration of the legal framework of the organisation of chemicals and hazardous waste risk management, included mercury, shows that the objective of the legislation is to protect humans, animals, and the environment. The analysis reveals that Yemen has taken positive steps in the area of chemicals and waste management, although the measures in place are weak and insufficient compared with many countries that have already taken legal actions over the past years to reduce and manage the risks of mercury and hazardous waste in a proper way.

Yemen has included within its legal system some regulations on the management of chemicals substances including mercury, suggesting ways to avoid its risks and address the negative effects on human health and the environment. Furthermore, Yemen was a forerunner in joining international environmental conventions of relevance, due to the awareness of decision-makers on the importance of international cooperation in the management of chemicals to reduce its negative impact and to benefit from the experiences of international parties, in addition to mutual cooperation in order to safeguard the human health and the environment.

There is no doubt that the massive expansion in the production of large quantities of hazardous chemicals and the increasing number of these hazardous chemical compounds per year is the result of the international phenomenal industrial expansion, especially in the chemical industry. Petrochemicals, paper, paint, plastics, pesticides, fertilizers, and other materials have become an urgent need for the conduct of human life and wellbeing. However, the industrial exposure to these various chemicals can lead to unhealthy work environments, resulting in hazards for the individuals dealing with such dangerous chemicals, especially mercury, which have effects on human health and the environment.

It is therefore necessary to impose strict legal obligations that establish procedures and measures to address these risks and reduce its impact, including but not limited to the identification of data showing the nature of the chemical used, the potential hazards, and proper method of use.

One of the threatening risks of mercury is the immediate or long-term toxic and harmful effects of human health and environment. Here lies the danger of these substances and the need of having adequate systems to manage and regulate the use of such substances, as well as the required provisions, measures, and actions to reduce the risk of these hazardous chemicals including mercury.

The EPA is aware of the importance and gravity of such issues, and after gathering the legal provisions regarding chemicals and hazardous wastes and address its risks, this primary study has been put together to examine and evaluate the existing legal framework in Yemen and to make necessary recommendations to develop and strengthen the legal system to address the size of the challenges posed by these risks. Also, it is expected that such a legal system will meet the aspirations of the national specialists in environmental protection, to overcome the weaknesses in the legal system so as to have a strong national legislation proportionate to the risks to human and environmental health and safety in general to regulate the management of those chemicals, especially mercury and hazardous waste and limit its risks.

5.2 Political and legal framework

The study addresses and evaluates the legislation system according to its importance, which is distributed into basic laws, supporting laws, judicial protection laws, regional and international environmental conventions, most notably the Environmental Protection Act, and its implementing regulations, followed by less important laws in accordance with the following.

5.2.1 Environment Protection Law No. (26) of 1995

The implementing body of this law is the EPA, as the official organ of the state responsible for the protection of the environment, combating pollution and the protection of society and human health, as well as other tasks specified in this law. This law and its Executive Regulations is the pillar of the legal environmental system and the most important law pertaining to the national environmental protection, combating pollution, the management of chemicals and hazardous wastes, risk control, and other important topics regulated by the law and outlined in the Regulations.

One of the objectives of this law is combating all types of pollution arid to avoid any damages or negative impacts, direct or indirect of long term or immediate resulting from implementation of economic, agricultural, industrial, construction development programs, or other development programs which aim to improve the standard of living and to increase its welfare.

Part Two, Chapter Two of this law is dedicated to the Use of Pesticides, and stipulates that:

> *"It is not permissible to handle pesticides without a license from the competent body and in accordance with the prevailing laws."*

Also, Article 16 provides that:

> *"The competent body shall, in coordination with the Environmental Protection Agency, propose the regulations that define and control the following issues: The types of pesticides for plant pests and other types of pesticides and chemicals and their import permissions. These include conditions and procedures of the pesticides handling licenses, their import permissions, procedures for pesticides registration and re-registration, the method of selection samples of pesticides and its analysis and the means of challenging and objecting results of the analysis, and the method of the disposal of the expired pesticides and empty bottles and packages."*

Part Three, Chapter Four addresses the Handing of Hazardous Wastes and Materials.

Article 46 (1) stipulates that:

> *"It shall be permissible for the competent body for the sake of assessment of the extent of risk of the composition of the toxic materials or products that contain such material, to require and ask any public or private party the following information: The compositions of the material or product, its quantity and its different uses and such to be through the official laboratories and also the following: a) The composition of the toxic materials and the produced materials, b) The spread or the remaining of such material in the environment and its resistance to decompositions, c) To what extent it is capable to integrate in the organic tissue and structure and its capability to inflict damages to the organic operations, d) The available means to reduce the produced and used quantities or that is disposed of in the environment, e) The environmentally safe methods and means of disposed and treatment and f) Any other information, the council may see essential.*
>
> *2) The competent body shall undertake the analysis, and assessment of the obtained information and to publish the results of the research of the relevant experiments of toxic or hazardous materials or which may be as such or the product which contain this material.*

This article regulates important provisions relating to assessing the risk of toxic chemicals, and requires important and clear information on that substance and its nature and impact, in order to prevent or reduce its risk and to take appropriate measures and arrangements to reduce those risks and damages, and put forward proper treatment in accordance with the environmental conditions.

Article (53) stipulates that:

> *"It shall be absolutely prohibited for any public or private party or any natural or juridical person to import, enter, dump, bury or store toxic, radioactive and hazardous wastes or the disposal of it by any means in the Yemeni environment."*

This is a powerful text, which completely bans the use of the Yemeni territory or its territorial waters to bury, dump, or store hazardous wastes or toxic chemicals because of their extreme danger to the environment and for the purpose of preserving the environment and the safety of the community.

5.2.2 Chairman of the Council of Ministers' Decree No. (148) of 2000 on the Executive Regulations of the Environment Protection Law

The decree includes accurate and extremely important details, as in Part One, Chapter Two: Hazardous Wastes and Materials, with its general provisions regarding the restrictions imposed on the production and handling of hazardous materials, handling licenses, the method and conditions of prohibiting the materials, transferring conditions, storage safety rules, procedures imposed to ensure the safety of all employees, the need for awareness of their risks, and the proper handling of these materials and wastes in accordance with the requirements of the environment and the safety of workers.

Part One of Annex 3 of the Regulations deals with the hazardous wastes and materials that are prohibited to be handled or transferred without a prior license from the competent authority. This part also outlines the wastes and pollutants whose chemical composition overlaps in 27 chemical compounds, in addition to pesticides, petroleum products, radioactive materials, and explosive and flammable materials which lead to significant dangers.

As for Part Three of the same Annex, it provides a detailed table of harmful and foul chemicals that should not be handled without a prior license from the competent authority. The Regulations set forth specific handling conditions and prior licensing procedure.

Looking at all of the aforementioned legal provisions governing the management of hazardous chemicals, wastes, and toxins within the framework of the Environment Protection Law, it seems that the law and its Executive Regulations has successfully organised and managed such materials, making it the most important legislation that has regulated the binding provisions of chemicals management and proper handling to reduce the risks. All such provisions and procedures are approved by the competent authorities.

5.2.3 Chairman of the Council of Ministers' Decree No. (132) of 2010 on the Regulations of the Environmental Protection Agency

Recognizing the importance and the gravity of the subject, the EPA started a new department under the name of the "General Administration of Chemical Safety and Hazardous Wastes" (the "Department") in 2010. Article 26 of this decree identifies the tasks of the department under the Environment Protection Law and its Executive Regulations as well as the Regulations of the EPA as follows:

- Develop and execute environmental plans, policies, and programs related to chemical safety and hazardous materials.
- Review the technical aspects of international and regional conventions on hazardous materials, submit recommendations on the importance of joining such conventions, and follow-up relevant procedures in coordination with the competent authorities.
- Follow up the decisions of the Intergovernmental Forum on Chemical Safety and develop proposals and scenarios to take advantage of them.
- Prepare comprehensive and integrated studies of hazardous wastes, which include methods of separation, collection, storage, transport, and final safe disposal of these wastes in coordination with the competent authorities.

- Design a detailed database on the possible types of hazardous, toxic, and chemicals materials that affect the environment.
- Develop studies and research to monitor industrial chemical contaminants and the arising environmental pollution, and design training programs on how to deal with chemical contaminants, hazardous materials, and industrial pollution.
- Participate in spreading environmental awareness about the dangers of chemicals and determinants of use.
- Depict a mechanism of action for the management of chemical safety through coordination with international organizations.
- Develop necessary reports on chemical safety and hazardous wastes.
- Develop lists for the classification of chemicals and hazardous and toxic wastes in accordance with the relevant international agreements.

Other tasks of the Department include coordination and communication with international organizations, enforcement of regional and international conventions, and execution of its tasks and functions in coordination with the relevant authorities in Yemen, as emphasized by the Regulations of the EPA.

The inception of the Department is a significant step as well as an important achievement, as it is authorized to assume the abovementioned crucial and key tasks. The EPA, along with other relevant authorities, with its law, executive regulations, establishment decision and regulations, is the cornerstone in the system of sound management of chemicals and hazardous wastes in a way that reduces the risk of these hazardous wastes and materials.

Also, the EPA is the competent authority and the official organ of Yemen, which protects the environment and human health, in accordance with the Environment Protection Law and its Executive Regulations that outlines the provisions of the management of chemicals and hazardous waste and pollution control.

5.2.4 Presidential Decree No. (101) of 2005 on the establishment of the Environmental Protection Agency

The EPA undertakes its tasks and functions based on its decree of establishment as well as the Regulations under which the General Administration of Chemical Safety and Hazardous Wastes was established. The EPA is the focal point for most of the regional and international conventions related to chemicals, as well as a link with regional and international organisations, along with some of the relevant national parties.

It is worth mentioning that the EPA is currently working on the modernisation and development of the Environment Protection Law in order to reach a modern legislation that copes with the rapid developments in environment affairs. The EPA will certainly bear in mind to update and strengthen the provisions for the risk management of chemicals and hazardous wastes, ensure the proper handling of these materials and chemicals, and endorse provisions that deal decisively with the gravity of these materials and hazardous waste and manage their impacts.

Moreover, the Executive Regulations will be updated to outline all the provisions governing the sound management of chemicals and hazardous waste. The adoption of such law and its executive regulations will be a great achievement that will enable the EPA to perform all of its functions efficiently and effectively and with full coordination with the competent parties.

5.2.5 Law No. (32) of 1992, Concerning Practice of Health Professions

Articles 12, 16, and 17 encompass restrictions and special requirements for health professionals, prohibiting the sale of any expired medicines or cosmetics, and assigning the responsibility for implementing those provisions to the Ministry of Public Health.

The texts of the law include terms and conditions put forward by legislators in order to maintain the health and safety of workers during their direct handling of chemicals and to ban the sale of any medicines after they expire to safeguard the health and safety of the community as a whole. However, according to those texts referred to, this law is weak and needs to be reinforced to include safety regulations for storage and transport of medicines, as well as provisions on proper method of handling and disposal of such medicines upon expiry in accordance with the EPA stipulations. This requires a reminder of the importance of coordination between the EPA and other relevant competent authorities.

5.2.6 Law No. (25) of 1999, Regulating the Circulation and Trade of Plant Pesticides

The competent authority is the Ministry of Agriculture and Irrigation, in addition to Customs and Ports of Entry, Ministry of Industry and Trade, security and armed forces, and post offices, each in their places to prevent, eliminate, and control any plant pesticides through extermination or removal, through the arrangement and regulating the handling and trade, importation, and exportation of pesticides, in order to prevent their danger, hazards, poisonous, and toxic effects to the public health, animals and environment. Such terms and arrangements are contained in Articles 3-8, 11-12, 14-16, 21, 22, 24, 25, 27, and 28.

5.2.7 The Implementing Regulation of Law No. (25) of 1999, Regulating the Circulation and Trade of Plant Pesticides

The competent authority is the Ministry of Agriculture and Irrigation. These regulations control the legitimate trade and entry of pesticides, providing that no person shall trade with pesticides without a prior license from the Ministry of Agriculture and Irrigation, as well as a prior approval of the Ministry on the type and quantity of pesticide and that the pesticide must be registered with the Ministry.

The Regulations stress on imposing the penalties specified in the law, prohibiting the entry of any pesticides through the Sanaa International Airport. This can be found in Articles 3-10, 13-16, 21-30, and 32-35 of Law No 25 of 1999. These legal texts explicitly contain provisions and rules that are necessary to control the entry of pesticides into Yemen. Such entry cannot take place without a prior license from the competent authority, namely the Ministry of Agriculture and Irrigation.

These texts also classify and test pesticides to ensure their effectiveness, and to determine their safety period, the importance of registration, expiry date, all of the data that these pesticides should contain, and the cost of the procedures to avoid the dangers of these pesticides and toxins to maintain the health of the community and the environment in general.

Review of these texts reveals that the security measures for these pesticides are not sufficient and this law is in urgent need of amendment to focus on the development of more strict provisions with respect to the safety rules for handling, transport, and storage of pesticides.

The law should include safety procedures and precautions for handling pesticides to control its risks, in addition to texts on the environmental requirements in handling or disposal of pesticides in a healthy and safe manner away from the risks, and with the prior coordination with the EPA. The Ministry of Agriculture and Irrigation, in cooperation with EPA, has already started to amend this law, which is currently under debate. The EPA proposed making amendments, adding some of the articles that emphasize on the foregoing, so as to have a law that promotes the conservation of health of society and environment away from the effects of those pesticides.

5.2.8 Labour Law No. (5) of 1995, amended by Law No. (25) of 1997

Articles 113-118 of this law provide for the right of the Ministry of Labour to ensure compliance with appropriate occupational safety and health requirements and conditions to protect workers and ensure their safety against such hazards as may arise from their work and the machinery in use.

The law includes important provisions to secure the occupational safety and health conditions for workers. Article 114, for example, stipulates that workplace health and safety conditions shall be maintained, including: properly ventilated and adequately lighted during working hours in accordance with the standards established by the authorities responsible for occupational safety and health; taking the necessary to protect workers from such damage to their health as may be caused by gas, dust, smoke, or any other emissions or waste likely to be discharged by the industry; taking the necessary precautions to protect workers against the hazards of equipment and machinery and the hazards of conveyors and handling, including any risks of collapse; taking the necessary precautions against natural hazards and damage, including health, humidity and cold; and taking the necessary precautions against the hazards of excessive light, noise, harmful or dangerous radiation, vibration, variation in atmospheric pressure inside the workplace, including any risk of explosion.

In other words, Article 14 contains important rules and guidelines to address the potential chemical hazards as may be caused to workers while handling chemicals and pollutants, as well as the necessary measures and precautions to protect workers from any potential chemical risks.

Article 115 stipulates that employers shall provide all equipment to protect workers from exposure to occupational injuries and diseases, including chemical hazards. Other articles detail actions and measures undertaken by the Ministry of Labour to protect workers against any hazards and to establish subsidiary occupational safety and health committees in the capital and other governorates.

Under this law, the Ministry of Labour has provided judicial protection through the formation of arbitration committees to settle workers' complaints and grievances and guarantee risk insurance and the necessary compensation for the damages sustained during work as a result of such risks.

Such specific legal texts in the labour law are good and commendable, as they include several provisions that ensure occupational safety of workers, require employers to take precautionary measures against the potential dangers that workers might be exposed to, which certainly include measures for the protection of workers against the chemical hazards while handling such chemicals.

It will be advisable when modifying this law to enforce the precautions and measures against the risks of chemicals and hazardous wastes as to make them more explicit. This would greatly secure safety requirements and reduce the risk of those chemicals and hazardous waste that workers are exposed to in industrial plants while handling such materials. Also, any amendment to the law should emphasize taking further precautionary measures to protect workers against chemical contaminants and hazardous waste in order to avoid these risks on the one hand, and to address and reduce their impact on the other hand.

5.2.9 Law No. (12) of 1994, Concerning Crimes and Penalties

The law (Article 40) considers handling chemicals illegally a crime punishable under the law to be executed by the Attorney General through public proceedings.

Article 140 stipulates that “Anyone who exposes the lives and safety of people by the placement of poisonous or damaging material in the territorial waters and the ports of Yemen or in a water well or water tank, or another similar object that is set up for public use, which causes the death or severe damages to the public health, shall be subject to a maximum of ten years imprisonment.”

The aim of this article is to safeguard the right of the public to health and safety and to reduce damage and threats to the environment and the community. The punishment may be more severe than ten years imprisonment if prescribed by other law such as Environmental Protection Law.

5.2.10 Law No. (13) of 1994, Concerning the Criminal Procedures

Article 296 on the urgent trial proceedings shall be undertaken in a number of cases, including crimes involving environmental pollution.

This law has not been covered by a previous study of the legislation system governing or affecting the management of chemicals and the environment. The current study includes this law as an important instrument in the judicial protection context. Yemeni legislators call for urgent trial proceedings to be undertaken to consider crimes causing damage to the environment as well as being extremely dangerous to public health.

This is a fair and even decisive measure in punishing the perpetrators of pollution of any source, whether chemicals or other pollutants, calling for an urgent trial to address those risks that require urgent proceedings and a decisive ruling of imprisonment, in addition to commanding perpetrators to pay for the damages and treatment of pollution, in accordance with the penalty stated in the Environment Protection Law which stipulates that a polluter shall pay for damages.

The study of the legislation system governing chemicals management contains legal texts detailing the tasks and responsibilities of each stakeholder separately, as it is normal for each party to have separate tasks to perform, as well as specific tasks that intersect with tasks of other parties in terms of provisions governing the management of chemicals and addressing the arising risks.

These laws also need to be updated and enforced, and joint coordination between different stakeholders should be a key priority. Examples of these laws include:

- Law No. (15) of 1994 Concerning Maritime Transport, to be implemented by the Ministry of Transport.
- Law No. (37) of 1997 Concerning Tariff, to be implemented by the Ministry of Finance/Customs Authority.
- Law No. (42) of 1991 Concerning the Organisation of Fishing and the Exploitation and Protection of Aquatic Organisms, with the Ministry of Fisheries being the competent authority.
- Law No. (50) of 1990 Concerning Mining and Quarrying; competent authority is the Ministry of Oil and Mineral Resources.
- Law No. (24) of 1993 On Free Zones; competent authority is the General Authority for Investment.
- Law No. (39) of 1999 On Public Hygiene Law, to be enforced by the Ministry of Public Works.
- Law No. (1) of 1992 Concerning Foreign Trade, implemented by the Ministry of Commerce.
- Law No. (4) of 2011 Concerning the Amendment of Some Provisions of Law No. (25) of 1999, Regulating the Circulation and Trade of Plant Pesticides.
- Republican Decree of the year 2005, concerning the approval of a Memorandum of Understanding between the Government of the Kingdom of Saudi Arabia and the Government of the Republic of Yemen for cooperation in the management of hazardous materials and wastes.
- Republican Decree the year 2009, concerning the approval of a Memorandum of Understanding between the Republic of Yemen and the Arab Republic of Egypt for cooperation in environmentally sound management of hazardous materials and waste and solid waste and control of illegal trading of hazardous chemicals and hazardous wastes.
- Council of Ministers Resolution No. (28) of 2005 on the approval of the national strategy for the integrated management of hazardous waste and the application of the Basel Convention in the Republic of Yemen approved by the Council of Ministers.
- Council of Ministers Resolution No. (76) of 2005 on the prevention of handling, trade, importation and exportation of organic pollutants.
- Minister of Agriculture and Irrigation Resolution No. (10) of 2002, concerning the issuance of the Implementing Regulations of Law No. (25) of 1999, Regulating the Circulation and Trade of Plant Pesticides.
- Minister of Agriculture and Irrigation Resolution No (73) of 2001 on the formation of Plant Pesticides Registration Committee, and its amendments by ministerial Resolution No. (8) of 2002, Resolution no. (35) of 2003, Resolution No. (4) of 2005 and Resolution No. (4) of 2006.

- Ministerial Decree No. (18) of 2002, on the delegation of authority to grant licenses for pesticides trading profession by agriculture and irrigation offices in the capital and other governorates.
- Minister of Agriculture and Irrigation Resolution No. (35) of 2006, which was amended by Ministerial Decree No. (26) of year 2007, concerning the issuance of a list of pesticides that should not be traded or handled and are severely restricted in the Republic of Yemen, including (349) effective materials of pesticide formulations. The list included the pesticides contained in the lists of relevant international conventions (Rotterdam Convention, Stockholm Convention) and severely hazardous, restricted and prohibited pesticides by relevant international organisations (WHO, Food and Agriculture Organisation, the United States Agency for Environmental Protection, Cancer Research Center, the European Union), taking into account the privacy of the bad situation for the use of pesticides in our country, especially on crops that are consumed fresh.
- Minister of Agriculture and Irrigation Resolution No. (15) of 2007, on some amendments in the procedures of importation permits of pesticides.
- Minister of Agriculture and Irrigation Resolution No. (4) of 2007, on the Pesticide Testing Fees in laboratories of the General Directorate for Plant Protection.
- Minister of Agriculture and Irrigation Resolution No. (9) of 2007, on the amendment of certain paragraphs of the resolution on license of pesticides trading.
- Minister of Agriculture and Irrigation Resolution No. (6) of 2008 on the amendment of the registration requirements of plant pesticides.
- Minister of Justice Resolution No. (247) of 2008, Granting a number of employees of the Ministry of Agriculture and Irrigation the status of judicial officers.
- Chairman of the Environmental Protection Council No. (22) of 2000 on the establishment of Toxins and Hazardous Waste Unit – a focal point of the Basel Convention.

The rest of the laws and regulations should be also updated and coordination between different stakeholders should be a top priority.

5.2.11 International Conventions and protocols ratified by the Republic of Yemen

The following are some of the environmental Conventions that were ratified by Yemen, which are related directly or indirectly to chemicals management and govern international obligations aiming at reducing the risk of these materials in terms of the regulation or prohibition of its circulation or movement across borders and other provisions and commitments:

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
- Vienna Convention for the Protection of the Ozone Layer (1985)
- Montreal Protocol on Substances that Deplete the Ozone Layer of (1987), in particular Chlorofluorocarbons
- Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
- Stockholm Convention on Persistent Organic Pollutants
- Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal
- Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction
- Convention on Psychotropic Substances of 1971, ratified by Law No. (176) of 1995
- The United Nations Convention against Illicit Traffic in Narcotic Drugs and Psychotropic Substances, ratified by Law No. (177) of 1995
- Single Convention on Narcotic Drugs of 1961, amended by the Protocol signed in 1972 and ratified by Law No. (178)

Yemen has taken significant strides towards the implementation of some of these conventions and protocols, and more work needs to be done to implement others in terms of issuing regulations and enforcement legislations as well as the technical support needed to assist the country to fulfil its commitments in the manner required.

Furthermore, other requirements needed to enforce these conventions and protocols are adapting and modifying national legislation that may not comply with certain provisions and articles of these liabilities and commitments, thereby removing any potential conflict. This would have a significant impact on the international efforts for the implementation of the conventions and protocols and to achieve the sound management of chemicals and hazardous wastes and risk reduction.

Yemen has also signed the Minamata Convention on Mercury on 21 March 2014 and is working to ratify this agreement in accordance with the constitutional procedures which is as follows: (i) ratification of the Convention by the Council of Ministers based on recommendation of the Minister of Water and Environment; (ii) ratification of the Convention by the parliament based on the recommendation of the EPA; and (iii) referring to the President of Yemen for approval and issuing by a presidential decree.

Yemen, through the EPA, also participated in the intergovernmental negotiating committee (INC) to prepare the Minamata Convention as well as the Conference of the Parties (COPs). There is an understanding within the government of the importance of the signing and ratifying the Convention for Yemen. The proceedings of the ratification of the Convention, however, have been delayed because of the political circumstances experienced by Yemen in recent years, but is currently underway

5.3 Institutional framework

5.3.1 National institutions

Environmental Protection Agency, Ministry of Water and Environment

The EPA is the competent authority for the enforcement and implementation of most of the Conventions listed previously, with some of its specialised cadres forming focal points for such conventions and organisations. It is worth mentioning that among the requirements for the enforcement of these agreements is issuing implementing regulations for each agreement separately.

The EPA is responsible for the general administration of chemical safety and hazardous wastes, with the following functions and terms of reference:

- Develop and execute environmental plans, policies, and programs related to chemical safety and hazardous materials.
- Review the technical aspects of international and regional conventions on hazardous materials, submit recommendations on the importance of joining such conventions, and follow-up relevant procedures in coordination with the competent authorities.
- Follow up the decisions of the Intergovernmental Forum on Chemical Safety and develop proposals and scenarios to take advantage of them.
- Conduct comprehensive and integrated studies of hazardous wastes, which include methods of separation, collection, storage, transport, and final safe disposal of these wastes, in coordination with the competent authorities.
- Design a detailed database on the possible types of hazardous, toxic, and chemicals materials that affect the environment.
- Conduct studies and research to monitor industrial chemical contaminants and the environmental pollution resulting from health-care waste, agricultural waste, public health pesticides and general waste, and propose appropriate solutions.

- Design training programs on how to handle chemical contaminants, hazardous materials, and industrial pollution.
- Participate in spreading environmental awareness about the dangers of chemicals and determinants of use.
- Depict a mechanism of action for the management of chemical safety through coordination with international organizations, such as UNEP, WHO, etc.
- Develop necessary reports on chemical safety and hazardous wastes to follow up the implementation of the recommendations of the national report of chemicals and follow up the global assessment of mercury, lead, and other elements.
- Develop lists for the classification of chemicals and hazardous and toxic wastes in accordance with the relevant international agreements, in order to study them with the competent scientific authorities and revise them in the light of scientific and technical progress.
- Any other duties or functions required by the nature of the Unit or as assigned to them by the EPA Chairman.

Customs Authority, Ministry of Finance

The Customs Authority, under the Ministry of Finance, has the following functions and terms of reference:

- Responsible for the entry of all the chemicals through the main ports, and under the supervision of the Customs Authority, using the International Trade Classification. (Most of the imported chemicals are raw materials for various industries, with no exports of chemicals except of limited quantities of damaged pesticides to be disposed according to international conventions.)
- Customs Authority has professional teams in all ports.
- Importation of pesticides requires a prior approval of the Ministry of Agriculture and Irrigation.
- Importation of psychotropic substances affecting the ozone layer requires a prior approval of the EPA and with coordination with the Customs Authority. The technical staff has been trained.

Ministry of Labour

The General Administration of Health and Occupational Safety is responsible for chemicals management under the Labour Law and health and occupational safety regulations. The Occupational Toxicology Department assumes the following tasks:

- Evaluation of chemical and biological hazards at the workplace.
- Conduct of laboratory tests of occupational toxicology.
- Participation in studies and research in this area
- Development of work and procedures in the toxins lab.
- Provisions of technical advice on carcinogenic chemicals.
- Raise farmers' awareness about the dangers of the pesticides they use, method of use, and first aid training (such pesticides must be used only by persons trained on method of use and risk prevention).

Ministry of Public Works and Highways

In pursuance of the role of the Ministry of Public Works and Highways in environmental sanitation and disease and environmental pollution control, the Ministry strives to provide all outstanding services in the environmental sanitation in the capital and all other provinces. Key tasks carried out by the Ministry include:

- Import various pesticides specialised in public health, poisons for rabid stray dogs, and distribute these pesticides to all Ministry offices in the provinces.
- Coordinate with the Ministry of Agriculture (General Directorate of Plant Protection) to examine and match technical specifications for public health pesticides and the extent of usability.

- Participate in national campaigns to combat various diseases and epidemics, dispatch a number of specialists to oversee spraying sites, and train staff on how to use the pumps and deal with pesticides during spraying.
- Launch campaigns to spray some of the affected areas in all provinces.
- Treat stagnant water caused by rainwater, especially in locations where there are no drainage pipes, and spray markets and public places with pesticides for the prevention of malaria and creation of a zero-disease environment.
- Prepare and train staff responsible for pesticides spraying and users of public health pesticides. Short training sessions are held each year to train at least (30) specialists and equip them with control scientific methods and selection of pesticides appropriate to the elimination of the different phases of disease carrying insects.
- Coordinate with international organisations for support in environmental sanitation.
- Adopt guidance and awareness programmes through field visits to the infected areas, organise direct meetings and lectures with citizens, and distribute posters and leaflets urging citizens to pay attention to environmental sanitation and create a healthy and clean environment.

Ministry of Agriculture and Irrigation

The Ministry of Agriculture and Irrigation controls and monitors the imported agricultural pesticides and fertilizers and veterinary medicine. Agricultural pesticides fall under the following conditions described in the Implementing Regulations of Law No. (25) of 1999, Regulating the Circulation and Trade of Plant Pesticides, specifically:

- Part Two: Registration of Pesticides, contains 10 articles.
- Part Three: Trade, Circulation, Importation, Exportation, Selling and Storage of Plant Pesticides.
- Part Four: Control and Inspection of Pesticides and Penalties.

Ministry of Public Health and Population

Under the Ministry of Public Health and Population, there is more than one institution responsible for chemicals. Key institutions include:

- General Directorate of Pharmaceutical and Medical Supplies
- Medicine Control Laboratory

The General Directorate of Pharmaceutical and Medical Supplies assumes responsibilities of registration, importation licenses, supervision, and control over the domestic pharmaceutical factories and quality control to make sure the specifications and the components of the Medicine Control Laboratory are met. The General Directorate of Pharmaceutical and Medical Supplies provides information on treatments and diagnostic chemicals and certain petrochemicals such as acids (potassium permanganate), precursor chemicals and flavourings. But most of the chemicals used in the industry as well as waste hazardous and pesticides do not fall under the responsibility of the General Directorate of Pharmaceutical and Medical Supplies.

The Medical Supply Unit is responsible for storage, transport, control, and regular supervision over the institutions involved in trading and handling of medicines.

Ministry of Petroleum and Minerals

Ministry of Higher Education and Scientific Research

Ministry of Justice

Ministry of Social Affairs and Labour

The General Directorate for Occupational Health and Safety practices the management of chemicals through labor law and occupational health and safety legislation. The Department of Occupational Poisons is responsible for the following tasks:

- Assessment of chemical and vital risk in the work environment.
- Performing laboratory analyses of occupational poisons.
- Participating in studies and research in this area and all matters relating to this aspect.
- Developing the work in the poisons laboratory.
- Providing professional advice in all matters relating to chemical carcinogens.
- Educating farmers about the dangers of pesticides they are using and the proper use of first aid to be taken in case of poisoning and to not use these pesticides except by persons well trained to use properly and capable of preventing risks.

Ministry of Communications

National Committee for Chemicals Management/National Chemical Profile Committee

The National Committee for Chemicals Management/National Chemical Profile Committee was established in XXXX. It includes representatives from the following stakeholders:

- EPA (Mercury and SAICM Unit)
- National Coordinator of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
- National Coordinator of the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
- National Coordinator of the Stockholm Convention on Persistent Organic Pollutants
- Ministry of Social Affairs and Labour/Occupational Health and Safety
- Ministry of Oil and Minerals
- Ministry of Public Works and Highways/environmental sanitation
- Ministry of Agriculture and Irrigation/General Directorate of Plant Protection
- Ministry of Public Health and Population
- Ministry of Industry and Trade
- Yemeni Association for Consumer Protection
- Chamber of Commerce and Industry
- Yemeni Importers of Agricultural Materials Society

It has the following functions

- Overcome all the difficulties and obstacles hindering the preparation of the national chemical profile
- Collaborate and coordinate between members of the Committee and with the National Coordinator to conduct successful activities for the preparation of the national chemicals management profile
- Implement the tasks entrusted to them by the National Coordinator or the Committee itself
- Provide the committee and the National Coordinator with any data or information required for the national chemicals management profile
- Attend meetings and workshops related to the national chemicals management profile
- To work together for completion of the national chemicals management profile

National Coordination Committee on Capacity-Building for the Preparation of the National Implementation Plan concerning Stockholm International Convention on Persistent Organic Pollutants

This committee was established in XXXX and includes representatives from the following stakeholders:

- EPA
- National Coordinator of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
- National Coordinator of the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
- National Coordinator of the Stockholm Convention on Persistent Organic Pollutants
- Ministry of Public Health and Population
- Ministry of Social Affairs and Labour/Occupational Health and Safety
- Ministry of Industry and Trade
- Ministry of Agriculture and Irrigation
- Nongovernmental organisations (NGOs)
- Ministry of Electricity
- Customs Authority
- Ministry of Public Works and Highways

The functions of the committee are:

- Supervise the implementation of project events and activities
- Review, evaluate, and approve project activities and events
- Provide the Project National Coordinator with advice and guidance that facilitate the implementation of the project
- Overcome the difficulties and facilitate access to any information or data from institutions and ministries required to execute the project
- Attend meetings and workshops related to the project
- Coordinate with each other and with their ministries and institutions with respect to the project activities and events.
- Adopt and approve the national implementation plan upon completion

Regulation of Plant Pesticides and Fertilizers Trading Committee

This committee is chaired by the Ministry of Agriculture and Irrigation (General Directorate of Plant Protection), with the membership of:

- EPA
- Customs Authority
- Ministry of Industry and Trade
- Agricultural Supplies Trading Society (private sector)
- Consumer Protection Association
- Agricultural Cooperative Union

World Trade Committee

The World Trade Committee seeks to help Yemen join the World Trade Organisation (WTO) and is by the resolution of the Minister of Trade and Industry and Minister of Finance (Customs Authority). Its membership includes all the relevant authorities, and it has prepared the Prohibited and Restricted Substances List.

Public Health Pesticides Committee

This committee aims to prepare a draft law for public health pesticides, and is headed by the EPA with the membership of the following stakeholders:

- Ministry of Agriculture and Irrigation (General Directorate of Plant Protection)
- Customs Authority
- Ministry of Industry and Trade
- Ministry of Public Health and Population
- Ministry of Labour/Occupational Health and Safety

- Agricultural Supplies Trading Society (private sector)
- Consumer Protection Association

Chemical Weapons Convention Committee

This is a special committee on Chemical Weapons Convention (CWC), chaired by the Ministry of Foreign Affairs. Its membership includes the following stakeholders:

- Ministry of Defence
- Ministry of Interior
- Ministry of Water and Environment/ EPA
- The Ministry of Agriculture and Irrigation (General Directorate of Plant Protection)
- Customs Authority
- Ministry of Industry and Trade
- The Ministry of Public Health and Population
- Yemeni Industrialists Association

5.3.2 International institutions, organizations, and programmes

The following international institutions, organizations, and programmes support Yemen in the area of chemicals and waste management.

- **United Nations Industrial Development Organization (UNIDO):** UNIDO aims to reduce global poverty by promoting sustainable and inclusive industrial development. In particular, under the MIA project UNIDO serves as the GEF Implementing Agency. It oversees coordination between UNITAR, as the international executing agency, and national agencies and institutions in Yemen and coordinates all regional seminars organized under the project. UNIDO will continue to play a key role in the further implementation of the Minamata Convention, including for other GEF-funded projects.
- **United Nations Institute for Training and Research (UNITAR):** UNITAR's Chemicals and Waste Management Programme serves as the international executing agency for the MIA project and provides technical assistance in various areas such as training on the Toolkit for the national mercury inventory, and technical support for the revision of the various individual reports, in particular the evaluation of the policy, legal, and institutional frameworks and the inventory report.
- **World Health Organization (WHO):** As its name indicates, the WHO represents the leading international entity for all aspects related to health. As part of this MIA project, WHO led a study on the use and waste management of health sector products and tools in order to estimate health effects on populations. WHO will therefore play an important role in the implementation and compliance stages of the Articles of the Convention related to health aspects.
- **United Nations Environment (UNE):** UNE is the United Nations agency specializing in the field of the environment and aims to: coordinate United Nations activities in the field of the environment; assist countries in the implementation of environmental policies and encourage sustainable development. Through its mercury programme, UNE plays a significant role in the management of mercury. In particular, Yemen used the Toolkit made available by this organization to conduct the national mercury inventory. For the continuation of activities under the Minamata Convention, it will be necessary to involve UNE in all aspects related to environmental protection and the management of chemicals, including mercury, and waste in particular.
- **United Nations Development Programme (UNDP):** The sound management of chemicals and wastes is an important component of UNDP’s efforts to achieve sustainable, inclusive and resilient human development and the Sustainable Development Goals (SDGs). UNDP advocates for integrating chemicals management priorities into national environmental and poverty

reduction planning frameworks, helps countries access financial and technical resources, and provides assistance and implementation support to improve the holistic management of chemicals and waste at national, regional and global levels. UNDP tackles unsustainable consumption and production patterns, including poor design and material choices, which lead to resource depletion, waste generation, and pollution. UNDP assists vulnerable Yemenis to meet their most urgent needs, while also helping to restore livelihoods, strengthen resilience to future challenges, and prepare for long-term development.

- **Food and Agriculture Organization of the United Nations (FAO):** FAO assistance to Yemen focuses on five strategic priorities: Policy development, strategic planning, and strengthening agricultural information systems; Improved efficiency of the agro-food sector and enhanced agricultural and fisheries production and productivity, food safety and food and nutrition security; Development, conservation and sustainable management, and efficient utilization of natural, agricultural and marine resources; Value addition, agro-processing marketing and trade, and promoting private sector role of these spheres; Sustainable livelihoods and enhanced food and nutrition security for vulnerable rural communities, and improved disaster risk reduction.

5.4 Identification of gaps and recommendations

There are positive aspects in terms of coordination and cooperation between all stakeholders. However, there are gaps need to be addressed and resolved, including the following.

Legal aspects

- The EPA is currently working on procedures for controlling the import and export of mercury and mercury-added products, but is not yet complete and will enter into force only after ratification of the Convention. It will be included in the amendment to the law of environmental protection.
- Facilities involved in cement production and using fossil fuels or coal need to be subjected to strict requirements on hazardous emissions and waste including mercury. For example, the need for a special filter to capture mercury emissions and safe storage of mercury as well as the proper disposal of mercury waste.
- Laws and regulations on chemicals and hazardous waste need to be adjusted and amended, as more attention should be drawn on such instruments in accordance with the State's commitment locally and internationally (including ratification of the Minamata Convention).
- Key legislative aspects are missing, with the exception of those on agricultural pesticides. Although there are some regulations or provisions contained in some overlapping laws, they are inactive. There are no clear penalty regulations for violations of chemicals and hazardous wastes law, except for pesticides.
- There is a lack of a clear mechanism for the regulation and trading of public health pesticides, which raises many problems between importers and stakeholders.

Coordination

- There is a lack of clear mechanisms for coordination and cooperation between civil society organisations, government agencies, and research centres on chemicals and hazardous wastes.
- There is also a lack of coordination of some of the relevant authorities responsible for the safety of chemical and hazardous waste and too much overlap in the tasks of stakeholders (with the exception of pesticides as there is a clear mechanism, a list, and cooperation between government authorities concerned with the importation of pesticides and disposal of obsolete pesticides).

Information on chemicals management

- There are clear gaps in the reference materials containing information, as some references are not provided on a regular basis and most of the stakeholders do not have access to them. There is no evaluation of actual effects of chemicals and hazardous wastes. There are no chemicals management databases in the various government agencies and community-based organisations. If such databases exist, they are very limited and access is restricted to personnel within the same organisation or ministry.
- There is a lack of accurate and comprehensive information on the quantities of the chemicals used in Yemen, as well as lack of rigorous studies. This indicates the absence of a documentation and trading system of these chemicals and hazardous wastes.
- Available information is scarce and from limited sources from the agricultural sector only. There is a lack of complete data on toxic and hazardous substances, and there are no detailed studies on the size of pollution and resulting effects of toxic and hazardous substances.
- There is a lack of information necessary to determine the precise priorities, and limited sources of such information, which are restricted to the Ministry of Agriculture and Ministry of Health. There is sufficient information on decisions and resolutions seeking to reduce the risks of pesticides and some industrial materials and harmful substance to the ozone layer, due to the cooperation between Customs Authority and the EPA.
- There is a lack of adequate research on the impact of chemicals on the surrounding environment.
- There is no clear classification of chemicals at all stakeholders, except Ministry of Agriculture and Customs Authority.
- There is a lack of information on chemicals registration and licensing, except that held by the Ministry of Agriculture and Ministry of Industry and Trade, but in a limited manner.
- There is some clear information on agricultural pesticides and supplies, but there is no information available on how to handle chemicals in the event of incidents.
- There is a lack of information from toxins centres to follow cases of poisoning, except those coming from Ministry of Health, Civil Defence, Ministry of Public Works and Highways and local councils, and there is no information on chemicals that emit hazardous gases.
- There is no information on monitoring and supervising factories, and there is no clear and specific mechanism on environment, health, and profession control.
- There is a lack of clear education and awareness raising programmes for those working in the various industrial establishments, and the general public has limited access to information concerning chemicals management.
- There is a limited provision of information to the general public.
- There is a lack of classification and labelling of mercury and mercury wastes, as well as registration, license, and entry of chemicals (with the exception of the Ministry of Agriculture)
- There are no clear lists of mercury products affecting health and the environment communicated at the national level.
- Accurate statistics on mercury accidents, how to handle accidents, and how to control and contain poisonings are not available.

Skills, training, and awareness

- A lack of financial resources has led to a shortage of specialised technical personnel to handle toxic and hazardous substances from various sources. There is also a lack of training and preparation on handling chemicals and hazardous waste. There are no clear awareness raising programmes or contingency plans in case of chemicals and hazardous wastes incidents.
- Awareness raising campaigns on chemical safety are limited and do not cover all Yemeni districts. There are mainly brochures and pamphlets containing information on chemicals and hazardous waste, chemical safety, and hazardous waste programmes. Media coverage is typically poor.
- The awareness role of NGOs is very limited, especially regarding chemicals and hazardous waste, toxic and hazardous substances, and safe handling at all levels.
- Workers in various industrial institutions handling mercury do not have access to information concerning mercury and mercury wastes.
- Capacity for mercury waste management and assessment of mercury impacts on human health and the environment is limited.

Technical infrastructure

- There are numerous of laboratories that have the potential and equipment capable of handling the analysis of chemicals and hazardous waste effectively, such as the laboratories of the Ministry of Agriculture and Irrigation and Ministry of Public Health and Population. Some laboratories however are in need of maintenance and personnel training, in addition to support needed for operating expenses and consumables such as glassware and chemicals.
- There are several hardware and equipment that do not function properly due to poor maintenance. Hence, a high-level training and rehabilitation programme should be in place for lab maintenance engineers.
- Laboratories should observe confirmatory factor analysis in order to obtain certificates of recognition, and there is a need to have reference laboratories; i.e. water and environment, chemicals and hazardous waste, etc. Furthermore, there is poor coordination between the various laboratories.

The sound management of chemicals included mercury and hazardous wastes can reduce the economic and health burden and contribute to improving livelihoods, supporting ecosystems, reducing pollution, and developing green technologies. Nevertheless, the benefits for using chemicals should not be at the expense of human health and the environment. The risks arising from those materials, including pollution and diseases such as malignant diseases resulting from the misuse of these materials, will surely hinder progress towards the achievement of the basic objectives of development, as such risks endangers environment, water, food security, and productivity.

It is therefore important to address the following recommendations.

Coordination

- Form a national committee, by a decision of the Minister of Water and Environment, headed by the EPA and with membership of all the relevant authorities, to undertake tasks of mercury and mercury wastes management and risk reduction and amend and update the legislative system for articles relative to mercury risk reduction. In particular, coordination between Customs Authority, EPA, and the National Committee for the Prohibition of Chemical Weapons should be ensured and prevention of any duplication of jurisdiction between the administrative authorities should be achieved.

- Establish a mechanism for cooperation and coordination between government agencies and NGOs on the management of chemicals and hazardous waste in terms of exchange of information and experiences.
- Establish clear guidelines for all stakeholders on which authority to contact regarding all matters related to the importation and use of mercury.

Legal aspects

- Draft provisions that strengthen the management of mercury and mercury hazardous wastes and reduce the risk of this material, by amending the Environment Protection Law and its Implementing Regulations; which is being updated at the moment, to produce strong and explicit provisions that enforce the leading role of the EPA in controlling mercury.
- Expand the provisions regulating and managing pesticides included mercury, chemical toxins, and hazardous waste through the amendment carried out by the Ministry of Agriculture and Irrigation to the law in force.
- Activate the laws and regulations governing the trading of pharmaceuticals and agricultural and industrial substances to combat the entry of any of banned substances.
- Update the rules of occupational health and safety for workers and increase provisions related to measures and precautions against the risks of mercury and mercury wastes.
- Develop and execute implementing regulations for international conventions and protocols, modify national laws in accordance with those treaties, and promote cooperation and coordination with international bodies and organisations.

Skills building, information strengthening and exchange, strategy development, and awareness raising

- Raise awareness and education of the community through various media about the risks of mercury and how to address and reduce risks, and encourage scientific studies and research related to this matter. Establish a public awareness campaign related to the management of mercury and mercury wastes, establish a national information centre for mercury with a special unit dedicated to raising awareness on mercury and mercury waste, and exchange experience and information among the various stakeholders.
- Adopt a national programme to build capacity regarding mercury and mercury hazardous waste in the country, and benefit from the experiences, research, and studies of private and public universities, Gulf Cooperation Council (GCC), and other Arab countries that have awareness raising programmes in relation to Minamata Convention.
- Develop appropriate budgets, seek technical support from donor countries to provide sophisticated monitoring networks, devices, and tools that prevent the risks of mercury and mercury waste, and design training and capacity building programmes for the EPA cadres and those of competent authorities.
- Developing a strategy for handling mercury and mercury waste and form a team of inspectors equipped with necessary means and tools to carry out related tasks.
- Developing a comprehensive national contingency plan on the management of chemicals and hazardous materials and waste to respond to chemical accidents, involving all relevant stakeholders and secure the necessary funds for the training of supervisors.
- Establish a centre for toxins and a centre for cleaner production and establish a documentation system for poisonings arising from pesticides included mercury and mercury wastes in selected hospitals in order to conduct studies and develop the necessary plans for outreach and risk reduction.

- Encourage employers to develop awareness raising plans for workers in all mercury industrial facilities in coordination with the Ministry of Labour (Occupational Health and Safety) and the EPA in all provinces.
- Secure financial support for the implementation of safety programmes regarding mercury and mercury waste in all industrial plants and other sectors and form outreach teams to conduct field visits to industrial plants, agricultural and oil facilities, and other sectors with the provision of transport and financial incentives.
- Establish coordination and exchange of expertise between current laboratories, especially in the area of mercury safety, and provide support to laboratories including regular training of technical personnel and obtaining international recognition certificates for the laboratories. Ensure laboratories develop capacity to specialise in identifying pesticides included mercury and its effect on agricultural products, and to identify the maximum limits of mercury in pesticide residues and other chemicals in various produced and imported agricultural and food crops.

5.5 Implications of the legal assessment for Yemen as a Party to the Minamata Convention

Article 3: Mercury Supply Sources and Trade		
Description of the Article and applicability in the context of Yemen		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
3.3	Not allow new primary mercury mining	Not applicable
3.4	Phase out existing primary mercury mining within 15 years	
	Prevent the import and use of mercury from primary mercury mining for artisanal and small-scale gold mining (ASGM)	
3.5(a)	Obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons (MT), and mercury supply generating stocks exceeding 10 MT/year	Applicable
3.5(b)	Restrict the use of excess mercury from decommissioning chlor-alkali plants, and require environmentally sound disposal	Not applicable
3.6	Not allow the export of mercury unless the importing country provides written Consent and the mercury is for an allowed use under the convention or environmentally sound storage, and all other conditions of Article 3.6 are met	Not applicable
Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions		
Title, ref. no. and date of relevant Policy and Regulatory Measure	*What aspects of the above provisions are being addressed by policy/regulatory measure*	
Law No. (25) of 1999 regulating the Circulation and Trade of Plant Pesticides		
Law No. (1) of 1992 Concerning Foreign Trade		
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions • Law No. (1) of 1992 Concerning Foreign Trade to be extended to mercury and its compounds and implemented by the Ministry of Commerce • Identify mercury or mercury compound stocks greater than 50 metric tonnes, as well as mercury supply sources producing stocks greater than 10 metric tonnes per year • Prevent the import of mercury		
Relevant National Stakeholder		
Name of the institution/stakeholder and its role with respect to the above-listed provisions	***Relevant institutional capacity in place to comply with the above listed provisions***	
EPA Ministry of Water and Environment	• In collaboration with the Custom Authorities, in charge of the approval of the importation of any hazardous chemicals with potential severe impacts on human health and the environment	
Ministry of Agriculture and Irrigation	• Prevent, eliminate and control any plant pesticides through extermination or removal, through the arrangement and regulating the handling and trade of pesticides, importation and exportation of pesticides, in order to prevent their danger, hazards, poisonous and toxic effects to the public	

	health, animals and environment
Custom authorities	• Control of the entry of all chemicals using the International Trade Classification • In collaboration with the EPA, in charge of the approval of the importation of any hazardous chemicals with potential severe impacts on human health and the environment
Ministry of Commerce/Ministry of Industry and Trade	
Remaining capacity gaps at national level that need to be addressed before provisions can be met • Training of customs personnel to identify and seize possible imports/exports of mercury • Training of personnel in charge of monitoring internal and external trade flows on the obligations of the Minamata Convention (and any other relevant Conventions)	

Article 4: Mercury-Added Products		
Description of the Article and applicability in the context of Yemen		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
4.1	Not allow the manufacture, import, and export of products listed in Part I of Annex A not otherwise excluded following the phase out date listed in the Annex	Applicable
4.3	Phase down the use of dental amalgam through two or more measures listed in Part II of Annex A	Applicable
4.5	Take measures to prevent the incorporation of products listed in Part I of Annex A (i.e., switches and relays, batteries) into larger, assembled products	Applicable
4.6	Discourage the manufacture and distribution of new mercury product types	Applicable
Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions		
Title, ref. no. and date of relevant Policy and Regulatory Measure	***What aspects of the above provisions are being addressed by policy/regulatory measure***	
Environment Protection Law No. (26) of 1995	• Article 46 enhance the assessment of products that may contain toxic materials to identify the followings: the composition of the hazardous material, its characteristics and possible effects on the environment and potential environmentally safely remediation or disposal methods. Other relevant information regarding the content of the products will also be valuable.	
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions • Explicitly list mercury-containing products that circulate at national level • Reinforce the procedures for controlling the import and export of mercury and mercury-added products (in progress at national level) • Prohibit, gradually and definitively from 2020, the manufacture, import and export of products listed in Part I of Annex A not excluded from the final abandonment list • Phase-out the use of dental amalgam through the use of two or more measures from the list in Part II of Annex A or others more relevant to the national context • Prevent the incorporation of products listed in Part I of Annex A (i.e. switches and relays, batteries) assembled into larger products • Discourage the manufacture and distribution of new types of mercury-containing products		
Relevant National Stakeholder		
Name of the institution/stakeholder and its role with respect to the above-listed provisions	***Relevant institutional roles and capacities in place to comply with the above listed provisions***	
EPA Ministry of Water and Environment	• Controls and monitors activities that have an impact on the environment and health • Participates in the various interventions of sectoral ministries in the field of the environment • Monitor the application of environmental regulations	
Ministry of Finance/Customs authorities	• In charge of the supervision of the fluxes of chemicals and products containing chemicals at national level	

Ministry of Public Health and Population	• Responsible for addressing effects of chemicals on human health • Particularly for medical supplies, the General Directorate of Pharmaceuticals and Medical supplies is in charge of the transport, storage and regular supervision of pharmaceutical and medical supplies • Existence of a health policy •
Ministry of Commerce/Ministry of Industry and Trade	
Remaining capacity gaps at national level that need to be addressed before provisions can be met • Training of personnel in charge of supervising the industrial fabric on the obligations of the Minamata Convention • Training of personnel in charge of monitoring the handicraft sector on the obligations of the Minamata Convention • Training of personnel in charge of monitoring internal and external trade flows on the obligations of the Minamata Convention • Development and implementation of a procedure for the gradual elimination of dental amalgam	

<table>
<tr><th colspan="3">Article 8: Emissions</th></tr>
<tr><td colspan="3">Description of the Article and applicability in the context of Yemen</td></tr>
<tr><td>Article No</td><td colspan="1">Succinct summary of provisions of the Article</td><td>Applicability</td></tr>
<tr><td>8.4</td><td colspan="1">Require best available techniques/best environmental practices (BAT/BEP) or associated emission limit values (ELVs) for new (as defined in Article 8.2(c)) sources listed in Annex D (coal-fired power plants, coal-fired industrial boilers, non-ferrous metal smelting and roasting processes, waste incineration, and cement production)</td><td>Applicable</td></tr>
<tr><td>8.5</td><td colspan="1">Require one or more measures identified in Article 8.5 to control/reduce mercury emissions from existing sources listed in Annex D, which shall be operational at the source within 10 years</td><td>Applicable</td></tr>
<tr><td>8.7</td><td colspan="1">Require monitoring/reporting and other wise establish a mercury emissions inventory for sources listed in Annex D</td><td>Applicable</td></tr>
<tr><td colspan="3">Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions</td></tr>
<tr><td colspan="1">Title, ref. no. and date of relevant Policy and Regulatory Measure</td><td colspan="2">What aspects of the above provisions are being addressed by policy/regulatory measure</td></tr>
<tr><td colspan="1">Environment Protection Law No. (26) of 1995</td><td colspan="2">• Pillar of the legal environmental system and the most important law in terms of environmental protection, management of chemicals and risks control</td></tr>
<tr><td colspan="1"></td><td colspan="2"></td></tr>
<tr><td colspan="3">Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention’s provisions
• Identify and apply best available techniques/best environmental practices (BAT/BEP) or emission limit values (ELVs) from new sources (defined in Article 8.2(c)) listed in Annex D
• Address one or more of the measures identified in Article 8.5 to control/reduce mercury emissions from existing sources listed in Annex D, which must be in operation at the source within 10 years
• Elaborate a monitoring/reporting system and develop an inventory of mercury emissions from sources listed in Appendix D</td></tr>
<tr><td colspan="3">Relevant National Stakeholder</td></tr>
<tr><td colspan="1">Name of the institution/stakeholder and its role with respect to the above-listed provisions</td><td colspan="2">Relevant institutional roles and capacities in place to comply with the above listed provisions</td></tr>
<tr><td colspan="1">EPA
Ministry of Water and Environment</td><td colspan="2">• Controls and monitors activities that have an impact on the environment and health
• Participates in the various interventions of sectoral ministries in the field of the environment
• Monitor the application of environmental regulations
• Proposes preventive measures (regulations, standards, action plans) to the government to reduce environmental pollution;
• Monitor and control the application of environmental regulations;
• Samples and analyses all environmental matrices (air, water, effluent, sediment, soil and waste) in collaboration with any other relevant structure;</td></tr>
</table>

	• Coordinate the environmental police; • Integrates environmental pollution monitoring into an appropriate system for environmental protection • Existence of a focal point on the Minamata Convention on Mercury; Existence of a department in charge of pollution management; Existence of an agency in charge of the effective implementation of the government's environmental policy; Existence of a programme in charge of air pollution issues; Existence of the Mercury Initial Assessment Project (MIA)
Remaining capacity gaps at national level that need to be addressed before provisions can be met • Definition and application of an implementation plan for the Minamata Convention; • Capacity building of the Directorate in charge of pollution management on best available techniques/best environmental practices (BAT/BEP) to control mercury emissions from relevant sources; • Integration of mercury emissions monitoring into the activities of the EPA.	

Article 9: Releases to Land and Water		
Description of the Article and applicability in the context of Yemen		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
9.3, 9.6	Require reporting or otherwise obtain information as needed to identify significant sources of mercury/mercury compound releases to land or water, and to maintain an inventory of releases from the sources identified	Applicable
9.5	Take one or more measures specified in Article 9.5 to control/reduce mercury and mercury compound releases to land and water from significant sources it identifies	Applicable
Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions		
Title, ref. no. and date of relevant Policy and Regulatory Measure	*What aspects of the above provisions are being addressed by policy/regulatory measure*	
Environment Protection Law No. (26) of 1995	• Pillar of the legal environmental system and the most important law in terms of environmental protection, management of chemicals and risks control	
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions		
Relevant National Stakeholder		
Name of the institution/stakeholder and its role with respect to the above-listed provisions	***Relevant institutional roles and capacities in place to comply with the above listed provisions***	
EPA Ministry of Water and Environment	• Controls and monitors activities that have an impact on the environment and health • Participates in the various interventions of sectoral ministries in the field of the environment • Monitor the application of environmental regulations • Proposes preventive measures (regulations, standards, action plans) to the government to reduce environmental pollution; • Monitor and control the application of environmental regulations; • Samples and analyses all environmental matrices (air, water, effluent, sediment, soil and waste) in collaboration with any other relevant structure; • Coordinate the environmental police; • Integrates environmental pollution monitoring into an appropriate system for environmental protection; • Existence of a focal point on the Minamata Convention on Mercury; Existence of a department in charge of pollution management; Existence of an agency in charge of the effective implementation of the government's environmental policy; Existence of a programme in charge of water and soil pollution issues; Existence of the Mercury Initial Assessment Project (MIA).	

Remaining capacity gaps at national level that need to be addressed before provisions can be met

- Definition and application of an implementation plan for the Minamata Convention
- Capacity building of the Directorate in charge of pollution management on best available techniques/best environmental practices (BAT/BEP) to control mercury releases from relevant sources
- Design of a multi-pollutant control strategy that would have co-benefits in terms of controlling mercury releases, and formalization of an appropriate institutional framework for its implementation
- Integration of mercury emissions monitoring into the activities of the EPA

<table>
<tr><th colspan="3">Article 11: Mercury Wastes</th></tr>
<tr><td colspan="3">Description of the Article and applicability in the context of Yemen</td></tr>
<tr><td>Article No</td><td>Succinct summary of provisions of the Article</td><td>Applicability</td></tr>
<tr><td>11.3 (a)</td><td>Parties shall take measures to manage mercury wastes in an environmentally sound manner, taking into account guidelines developed under the Basel Convention and in accordance with COP requirements to be developed.</td><td>Applicable</td></tr>
<tr><td>11.3 (b)</td><td>Parties shall take measures to restrict mercury derived from the treatment or re-use of mercury waste to allowed uses under the Convention or environmentally sound disposal</td><td>Applicable</td></tr>
<tr><td>11.3 (c)</td><td>Require transport across international boundaries in accordance with the Basel Convention, or if the Basel Convention does not apply, consistent with international rules, standards, and guidelines</td><td>Applicable</td></tr>
<tr><td colspan="3">Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions</td></tr>
<tr><td colspan="2">Title, ref. no. and date of relevant Policy and Regulatory Measure</td><td>What aspects of the above provisions are being addressed by policy/regulatory measure</td></tr>
<tr><td colspan="2">Environment Protection Law No. (26) of 1995</td><td>The fourth chapter of the third part of this law addresses the handling of hazardous wastes and materials:
• As an example, Article 53 prohibits the import, dumping, burial and storage of toxic and/or radioactive wastes
The regulations of this chapter ban the use of the Yemeni territory or its territorial waters to bury, dump or store hazardous wastes or toxic chemicals because of their extreme danger to the environment and for the purpose of preserving the environment and the safety of the community.</td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="3">Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention’s provisions
• Elaborate a sound management system for waste treatment
• Define and specifically take into account mercury waste as defined by the Convention.</td></tr>
<tr><td colspan="3">Relevant National Stakeholder</td></tr>
<tr><td colspan="2">Name of the institution/stakeholder and its role with respect to the above-listed provisions</td><td>Relevant institutional roles and capacities in place to comply with the above listed provisions</td></tr>
<tr><td colspan="2">EPA
Ministry of Water and Environment</td><td></td></tr>
<tr><td colspan="2">Ministry of Public Health and Population</td><td></td></tr>
<tr><td colspan="3">Remaining capacity gaps at national level that need to be addressed before provisions can be met
• Definition and application of an implementation plan for the Minamata Convention;
• Development, with the various stakeholders, of an environmentally sound procedure for managing wastes, particularly mercury waste (including medical wastes)</td></tr>
</table>

Article 12: Contaminated Sites		
Description of the Article and applicability in the context of Yemen		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
12.1	Develop strategies for identifying and assessing mercury/mercury compound contaminated sites	Applicable
12.2	If risk reduction activities are taken at contaminated sites, they are taken in an environmentally sound manner, incorporating risk assessment where appropriate	Applicable
Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions		
Title, ref. no. and date of relevant Policy and Regulatory Measure	***What aspects of the above provisions are being addressed by policy/regulatory measure***	
Environment Protection Law No. (26) of 1995		
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions • Develop appropriate strategies to identify and assess mercury/mercury compounds contaminated sites • If risk reduction activities are undertaken at contaminated sites, they should be carried out in an environmentally sound manner, including, if necessary, a risk assessment		
Relevant National Stakeholder		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	***Relevant institutional capacity in place to comply with the above listed provisions***	
EPA Ministry of Water and Environment		
Remaining capacity gaps at national level that need to be addressed before provisions can be met • Definition and application of an implementation plan for the Minamata Convention; • Development, with the various stakeholders, of an environmentally sound procedure for assessing and reducing the risks induced by mercury-contaminated sites.		

<table>
<tr><th colspan="3">Article 13: Financial Resources and Mechanism</th></tr>
<tr><td colspan="3">Description of the Article and applicability in the context of Yemen</td></tr>
<tr><td>Article No</td><td>Succinct summary of provisions of the Article</td><td>Applicability</td></tr>
<tr><td>13.1</td><td>Access domestic resources as may be needed to implement Convention obligations</td><td>Applicable</td></tr>
<tr><td>13.2</td><td>Access financial resources available under the Convention financial mechanism and other resources available from multilateral, regional, and bilateral funding sources</td><td>Applicable</td></tr>
<tr><td colspan="3">Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions:</td></tr>
<tr><td colspan="2">Title, ref. no. and date of relevant Policy and Regulatory Measure</td><td>What aspects of the above provisions are being addressed by policy/regulatory measure</td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="3">Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention’s provisions
• Access to the necessary national budget to implement the obligations of the Convention</td></tr>
<tr><td colspan="3">Relevant National Stakeholder</td></tr>
<tr><td colspan="2">Name of the institution/stakeholder and its role with respect to the above-listed provisions</td><td>Relevant institutional capacity in place to comply with the above listed provisions</td></tr>
<tr><td colspan="2">Ministry of Finance</td><td>• Ensures the preparation of the general budget of the State;
• Seeks and mobilizes external and internal resources for the financing of programmes, projects and budgetary support, and ensures their proper management;
• Monitor the implementation of agreements and financing arrangements relating to projects, programmes and budgetary support of external partners.
• Existence of a unit for monitoring economic and financial programmes;
• Existence of a department in charge of the budget.</td></tr>
<tr><td colspan="2">Ministry of Water and Environment</td><td>• Participates in the fundraising for the implementation of policies, plans, programmes and projects in the environmental sector.</td></tr>
<tr><td colspan="3">Remaining capacity gaps at national level that need to be addressed before provisions can be met
• Information to the departments in charge of the budget, programming and monitoring of public investments, and development financing on the specificities of the implementation of the Convention;
• Capacity building on the Convention's financial mechanism and other financing potentially available from multilateral, regional and bilateral sources, and skills for resource mobilization.</td></tr>
</table>

Article 16: Health Aspects		
Description of the Article and applicability in the context of Yemen		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
16.1(a)	Promote the development and implementation of strategies to identify and protect populations at risk, such as developing fish consumption guidelines	Applicable
16.1(b)	Promote occupational exposure educational and prevention programs	Applicable
16.1(c)	Promote prevention, treatment, and care services for affected populations	Applicable
Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions		
Title, ref. no. and date of relevant Policy and Regulatory Measure	***What aspects of the above provisions are being addressed by policy/regulatory measure***	
Law No. (32) of 1992, Concerning Practice of Health Professions	The texts of the law include terms and conditions put forward by legislators in order to maintain the health and safety of workers during their direct handling of chemicals and to ban the sale of any medicines after they expire to safeguard the health and safety of the community as a whole	
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions • Policy on hazardous waste, including mercury, in relation to health and environmental aspects		
Relevant National Stakeholder		
Name of the institution/stakeholder and its role with respect to the above-listed provisions	***Relevant institutional roles and capacities in place to comply with the above listed provisions***	
Ministry of Public Health and Population	• Promotes public health and basic hygiene and sanitation services; • Provides epidemiological and health surveillance; • Collaborates in the definition of basic training in the field of health; • Collaborates in the training of trainers in the field of health; • Contributes to the definition and implementation of the national policy on continuing training and retraining of health personnel, in collaboration with the other departments and ministries in charge of basic health training; • Existence of a Health Focal Point on the Minamata Convention on Mercury; Existence of a national directorate in charge of public health and a national directorate in charge of research and training.	
Remaining capacity gaps at national level that need to be addressed before provisions can be met • Definition and implementation of a communication and public awareness plan on vectors and risks of interference from mercury or its compounds; • Definition and implementation of an action plan to strengthen the capacities of health actors on mercury exposure and management in case of illness.		

<table>
<tr><th colspan="3">Articles 17: Information Exchange</th></tr>
<tr><td colspan="3">Description of the Article and applicability in the context of Yemen</td></tr>
<tr><td>Article No</td><td>Succinct summary of provisions of the Article</td><td>Applicability</td></tr>
<tr><td>17.1, 17.3 and 17.5</td><td>Each party shall facilitate the exchange of information referred to in paragraph 17.1. Each Party shall designate a national focal point for the exchange of information under this Convention. Share information on the health and safety of humans and the environment as non-confidential, in accordance with Article 17.5</td><td>Applicable</td></tr>
<tr><td colspan="3">Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions</td></tr>
<tr><td colspan="2">Title, ref. no. and date of relevant Policy and Regulatory Measure</td><td>What aspects of the above provisions are being addressed by policy/regulatory measure</td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="3">Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention’s provisions
• Make all information on the Minamata Convention and on mercury available at national level</td></tr>
<tr><td colspan="3">Relevant National Stakeholder</td></tr>
<tr><td colspan="2">Name of the institution/stakeholder and its role with respect to the above-listed provisions</td><td>Relevant institutional roles and capacities in place to comply with the above listed provisions</td></tr>
<tr><td colspan="2">Ministry of Communications</td><td></td></tr>
<tr><td colspan="2">Ministry of Higher Education and Research</td><td>• Elaborate an effective plan for the development of research in science, technology and innovation, and monitor its implementation at national level
• Existence of a department in charge of scientific research and innovation;
• Existence of research and development centers specialized in monitoring environmental pollution and its effects on human health</td></tr>
<tr><td colspan="3">Remaining capacity gaps at national level that need to be addressed before provisions can be met
• Establishment of a communication and information exchange plan between national and international stakeholders.</td></tr>
</table>

Article 18: Public information, awareness and education		
Description of the Article and applicability in the context of Yemen		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
18.1	shall promote and facilitate provision to the public of available information referred to in paragraph 18.1 and education, training and public awareness related to the effects of exposure to mercury and mercury compounds on human health and the environment	Applicable
18.2	shall use existing mechanisms or give consideration to the development of mechanisms, such as pollutant release and transfer registers where applicable, for the collection and dissemination of information on estimates of its annual quantities of mercury and mercury compounds that are emitted, released or disposed of through human activities.	Applicable
Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions		
Title, ref. no. and date of relevant Policy and Regulatory Measure	***What aspects of the above provisions are being addressed by policy/regulatory measure***	
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions		
Relevant National Stakeholder		
Name of the institution/stakeholder and its role with respect to the above-listed provisions	***Relevant institutional roles and capacities in place to comply with the above listed provisions***	
Ministry of Communications		
Ministry of Higher Education and Research	• Elaborate an effective plan for the development of research in science, technology and innovation, and monitor its implementation at national level • Existence of a department in charge of scientific research and innovation; • Existence of research and development centers specialized in monitoring environmental pollution and its effects on human health	
Remaining capacity gaps at national level that need to be addressed before provisions can be met • Establishment of a communication and information exchange plan between national and international stakeholders.		

Article 19: Research, Development and Monitoring		
Description of the Article and applicability in the context of Yemen		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
19.1	shall endeavor to cooperate to develop and improve, (a) Inventories of use, consumption, and anthropogenic emissions to air and releases to water and land of mercury and mercury compounds; (b) Modelling and geographically representative monitoring of levels of mercury and mercury compounds in vulnerable populations and ecosystems, (c) Assessments of the impact of mercury and mercury compounds on human health and the environment;(d) Harmonized methodologies for the activities undertaken under subparagraphs (a), (b) and (c);(e) Information on the environmental cycle, transport, transformation and fate of mercury and mercury compounds in a range of ecosystems	Applicable
19.2	build on existing monitoring networks and research programmes in undertaking the activities identified in paragraph 19.1.	Applicable
Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions		
Title, ref. no. and date of relevant Policy and Regulatory Measure	***What aspects of the above provisions are being addressed by policy/regulatory measure***	
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions • Establish an appropriate system for research, development and monitoring; • Promote research in the field of science, in particular chemicals (including mercury).		
Relevant National Stakeholder		
Name of the institution/stakeholder and its role with respect to the above-listed provisions	***Relevant institutional roles and capacities in place to comply with the above listed provisions***	
Ministry of Higher Education and Research	• Elaborate an effective plan for the development of research in science, technology and innovation, and monitor its implementation at national level • Existence of a department in charge of scientific research and innovation; • Existence of research and development centers specialized in monitoring environmental pollution and its effects on human health	
EPA Ministry of Water and Environment	• Monitor the implementation of Yemen's sustainable development commitments and multilateral environmental agreements; • Promotes environmental information, education and communication; • Promotes research for the preservation of the environment; • Develop and update the national profile of environmental pollution and nuisances, in collaboration with all the structures concerned.	

Remaining capacity gaps at national level that need to be addressed before provisions can be met

- Establishment of a communication and information exchange plan between national and international stakeholders on the findings of the research.

Article 21: Reporting		
Description of the Article and applicability in the context of Yemen		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
21.1	shall report to the Conference of the Parties, through the Secretariat, on the measures it has taken to implement the provisions of this Convention and on the effectiveness of such measures and the possible challenges in meeting the objectives of the Convention	Applicable
21.2	shall include in its reporting the information as called for in Articles 3, 5, 7, 8 and 9 of this Convention	Applicable
Policy and regulatory measures in place that enable Yemen to comply with the above listed provisions		
Title, ref. no. and date of relevant Policy and Regulatory Measure	***What aspects of the above provisions are being addressed by policy/regulatory measure***	
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions • Establish an effective and regular communication with the Minamata Secretariat and stakeholders to inform on progress made on mercury issues		
Relevant National Stakeholder		
Name of the institution/stakeholder and its role with respect to the above-listed provisions	***Relevant institutional capacity in place to comply with the above listed provisions***	
EPA Ministry of Water and Environment	• Existence of a national focal point for the Minamata Convention on Mercury • Existence of a department in charge of chemical and pollution issues • Existence of an agency in charge of the implementation of existing legal instruments on the environment	
Remaining capacity gaps at national level that need to be addressed before provisions can be met • Formation of a permanent coordinating committee/mechanism in charge of issues related to the management of mercury and mercury compounds • Definition and operationalization of an implementation plan for the Minamata Convention • Definition and implementation of a communication and information exchange plan between national and international stakeholders		

6. Awareness-raising among targeted groups

6.1 Training and education of target groups and professionals

Yemen is a Party to many of the internationally agreed chemicals and waste related conventions and has shown its intention to become a Party to the Minamata Convention on Mercury by signing the accord. It follows that public authorities with mandates related to sound chemicals management, including mercury management, will require its core officers to be trained in the development and implementation of policies, strategies, and programmes, including monitoring and enforcement activities, designed to protect human health and the environment from the adverse effects of chemicals and waste. Initial activities undertaken as part of the MIA project represent a first stage in such training, but further work will be required if the implementation of the convention in Yemen is to be a success. Training will need to extend beyond officials in the ministries to those within regional and local authority.

Attempts by the public sector to change the behaviour of industrial sectors engaged in mercury use and trade or implicated in the inventory as sources of mercury emissions and releases will depend on sensitising them to their responsibilities to reduce and eliminate the risks they are posing in terms of occupational health and safety, as well as broader public health and environmental degradation. Training of key groups and professionals in those industries, including through local chapters of the professional associations to which they belong, will be critical.

Civil society organisations play an important role in representing communities and raising their awareness of issues such as the risks posed by mercury. They too can be instrumental in changing behaviour and in ensuring that the design of strategies and programmes addressing mercury risks is appropriate to the communities they target. Yemen is fortunate in having civil society organisations that are already closely engaged in seeking to reduce mercury risks and that have participated in the MIA project. Engaging additional NGOs, particularly those engaged with local communities, through training and awareness activities will greatly assist effective implementation.

6.2 Implications of the assessment results for Yemen as a Party to the Minamata Convention

In order to satisfy most provisions of the Minamata Convention, particularly ***Article 3: Mercury supply sources and trade***, ***Article 4: Mercury-added products***, ***Article 5: Manufacturing processes in which mercury or mercury compounds are used***, ***Article 8: Emissions***, ***Article 9: Releases*** and ***Article 10: Environmentally sound interim storage of mercury, other than waste mercury***, officials in ministries with responsibilities for the implementation of mercury management will require training and capacity building. Campaigns to provide information and engage key economic sectors with regard to the replacement of mercury-containing products and processes and related to the reduction of mercury emissions and releases will be important in order to change their behaviour.

According to ***Article 11: Mercury wastes***, it will be necessary to deliver awareness, information, and education to communities engaged in informal waste management. Awareness raising is also an important step to teach communities and all relevant stakeholders about how to separate wastes from waste products containing mercury.

In accordance with ***Article 12: Contaminated sites***, advice to the public on how to avoid risks of exposure to mercury from contaminated sites would also result from guidance that will be adopted by the Conference of the Parties as set out in Paragraph 2 of the Convention (http://www.mercuryconvention.org/Meetings/COP2/tabid/6355/language/en-US/Default.aspx).

As stated in ***Article 18: Public information, awareness and education***, it will be important to take advantage of existing mechanisms available through the Ministry of Information, NGOs, and the

media to deliver well-coordinated campaigns of information to key stakeholders and vulnerable populations.

7. Priority areas and intervention plans

This MIA project has highlighted the priorities to be addressed first in order to align with the Minamata Convention and meet the requirements of the Convention. For Yemen, four priorities have therefore been selected:

- Capacity building and strengthening political, legal, and institutional frameworks
- Reduction of the use of products containing mercury
- Sound management of wastes, including mercury wastes
- Reduction of mercury emissions and releases

7.1 Priority area and intervention plan 1: Capacity building and strengthening political, legal, and institutional frameworks

Analysis of the national situation

Through the national assessment of policy, legal, and institutional frameworks, a number of legally binding tools for the management of chemicals including mercury have been identified. Yemen has also joined other nations in signing various relevant chemicals and waste related conventions with the aim of protecting human health and the environment.

Despite the instruments already in place, it is necessary to strengthen the political, legal, and institutional frameworks to incorporate specificities that will meet the requirements of the Minamata Convention. This would include, but is not limited to:

- Finalizing the procedures for controlling mercury (and mercury compounds) fluxes – import and export – across the country.
- Reviewing and amending existing legal tools for the management of chemicals, particularly mercury. For example, it would be practical to include provisions in relation to the Articles of the Convention that are relevant to Yemen (among others: Article 8 on emissions to air; Article 9 on discharges to water and land; Article 11 on waste; and Article 12 on contaminated sites).
- Specifically on mercury added-products, elaborating or finalizing procedures for controlling quantifying their import.
- In areas where there is a lack of legislative instruments, identifying the needs and developing legislation accordingly, including penalties for violations of the rules.
- Ensuring that sectors or aspects that require strengthening are covered (e.g. involvement of all stakeholders at all levels, dissemination of information, technical infrastructure, and practical management of chemicals including mercury).
- Designing regulations for violations of laws on hazardous chemicals and wastes.

Objective

Development of an effective legal and institutional framework for the implementation of the Minamata Convention.

Outputs

- Minamata Convention ratified
- National policy on mercury management developed
- Mechanisms for coordination established
- Continuous collaboration with civil society organisations, government agencies, and research centres promoted
- Responsibilities of each institution and stakeholder involved is well defined, avoiding overlaps

- Legal and regulatory changes to address the Minamata Convention and the obligations set out in its articles enacted
- Administrative responsibilities assigned
- Sustainable control systems for maintaining a comprehensive inventory and reporting established

Table 11: Intervention Plan 1: Capacity building and strengthening political, legal, and institutional frameworks

Intervention Plan 1: Capacity building and strengthening political, legal and institutional frameworks			
Relevant SDGs 2030: 3, 6, 11, 12, 14, 15, 16			
Relevant Articles of the Minamata Convention: 3, 4, 5, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19			
Key Institutions: EPA, Ministry of Water and Environment			
Other relevant national institutions: Ministry of Petroleum and Minerals, Ministry of Agriculture and Irrigation, Ministry of Justice, Ministry of Information **Potential international partners:** UNIDO, UNITAR, UN Environment, UNDP, UNIDO, WHO, Minamata Convention Secretariat, Global Mercury Partnership, ILO, OECD, and relevant companies with experience in the use of BAT/BEP			
Risks: Lack of political and institutional support, financial resources, and interest and participation of actors and stakeholders; and political, economic, and security crises			
Proposed activities	**Description**	**Expected outcomes**	**Relevant institutions and stakeholders**
1. Ratify and domesticate the Minamata Convention	Yemen is in the legal and administrative process of ratifying and domesticating the Minamata Convention on Mercury.	Yemen has ratified the Minamata Convention	EPA, Ministry of Water and Environment
2. Establish mechanisms for coordination and competent teams to coordinate the amendment/development of the necessary legal instruments according to the relevant Articles of the Minamata Convention. Each team could be in charge of addressing one specific aspect of the Convention.	The members of the team are trained and have the necessary skills to identify and develop the relevant instruments to be implemented.	The team in place identified and developed the appropriate legal instruments	EPA, Ministry of Water and Environment, Ministry of Petroleum and Minerals, Ministry of Agriculture and Irrigation, Ministry of Justice, Ministry of Information, and relevant stakeholders from private sector and NGOs
3. Conduct capacity building and training for each team according to the distribution of responsibilities. Details regarding each aspect of the Convention with regards to the current national frameworks should be given in order to emphasize the needed inputs.	The distribution of responsibilities and tasks within the administrative institutions, and related capacity building, should be undertaken to ensure relevant inputs to the national frameworks and consequently the full and effective implementation of the	All responsibilities regarding the management of mercury have been assigned to all relevant administrative institutions and capacity of respective institutions is	Ministry of Justice in close collaboration with EPA, Ministry of Water and Environment, Ministry of Petroleum and Minerals, Ministry of Agriculture and Irrigation, Ministry of Information, and relevant stakeholders from private sector and NGOs

	Minamata Convention.	strengthened	
4. Strengthen the existing national policy addressing the management of mercury: (i) finalize the regulations regarding the controlling of mercury and mercury compound fluxes across the country; (ii) include regulations regarding mercury in energy and cement production, considering BAT for reducing mercury emissions and releases; (iii) update rules regarding occupational safety and health for workers, including the adoption of safety measures for preventing the risks of contamination; and (iv) put in place and/or update regulations for addressing relevant aspects of international conventions such as the Basel Convention along with the Minamata Convention.	National regulations addressing the import and use of mercury in all relevant activities and sectors should be developed in accordance with the Minamata Convention	A national policy composed of specific regulations addressing the management of mercury at national level is developed and implemented	Ministry of Justice in close collaboration with EPA, Ministry of Water and Environment, Ministry of Petroleum and Minerals, Ministry of Agriculture and Irrigation, Ministry of Information, and relevant stakeholders from private sector and NGOs
5. In developing the necessary regulations that include the requirements of the Minamata Convention, ensure that enhancing regular data gathering and updating as well as access to information (on the effects of hazardous chemicals for example) are included.	The Minamata Convention and its obligations set out in its articles are closely consulted and relevant regulations for Yemen are included in national legal and institutional frameworks.	All relevant national regulations, laws, and amendments needed to comply with the Convention are developed and implemented at national level	Ministry of Justice in close collaboration with EPA, Ministry of Water and Environment, Ministry of Petroleum and Minerals, Ministry of Agriculture and Irrigation, Ministry of Information, and relevant stakeholders from private sector and NGOs
6. Establish sustainable control/monitoring systems (with competent personnel accordingly trained) to ensure the application of the updated legal instruments on mercury and mercury compound fluxes, use, , emission, release, and disposal to ensure compliance with the Convention	Sustainable and comprehensive systems for monitoring the application of national regulations are in place and regular reports to national stakeholders, government, and Conference of the Parties are delivered	Sustainable control/ monitoring systems for regular comprehensive reporting are established	Ministry of Justice, EPA, Ministry of Water and Environment

7.2 Priority area and intervention plan 2: Reduction of the import and use of mercury-added products

Analysis of the national situation

The use and disposal of mercury-added products is one of the most important categories identified in the country. Yemen has identified the use and disposal of the following products in its territory: dental amalgams (229 kg Hg/year); thermometers (575 kg Hg/year); light sources with mercury (43 kg Hg/year); batteries with mercury (26,885 kg Hg/year); polyurethane (275 kg Hg/year); other manometers and gauges with mercury (46 kg Hg/year); laboratory chemicals (92 kg Hg/year); and other laboratory and medical equipment with mercury (367 kg Hg/year).

The Minamata Convention states the phase-out date of mercury-containing products, outlining that manufacture, import, or export are not allowed after 2020 (Article 4 and Annex A, Parts I and II). Regarding dental amalgams, each country has to take relevant measures to eliminate the use of dental amalgams progressively, taking into account the national situation and international guidance.

Objective

The objective of this intervention plan is to put in place appropriate measures to reduce and, if possible, eliminate the use of mercury-containing products in the Yemen in accordance to the obligations of the Minamata Convention.

Outputs

- Further research conducted for collecting more accurate information regarding the import, use, and disposal of each category of mercury-added products in collaboration with customs and other relevant entities
- Existing alternatives to dental amalgams are identified and progressively introduced in dentistry; dental amalgams containing mercury are phased down
- Mercury-free thermometers are promoted to enhance the reduction of mercury-added thermometers on the market
- Alternatives for other mercury-added products, such as batteries, light sources, and other manometers and gauges, are identified and promoted to reduce the use of mercury-added items

Table 12: Intervention Plan 2: Reduction of the use of products containing mercury

Intervention Plan 2: Reduction of the use of products containing mercury			
Relevant SDGs 2030: 3, 6, 11, 12, 14, 15, 16			
Relevant Articles of the Minamata Convention: 4, 16, 18, 19			
Key Institutions: Ministry of Public Health and Population, EPA, Ministry of Water and Environment			
Other relevant national institutions: Customs authority, Ministry of Information, Ministry of Social Affairs and Labour, Ministry of Information, Ministry of Higher Education and Scientific Research, Ministry of Public Works and Highways, Ministry of Justice **Potential international partners:** UNIDO, UNITAR, UN Environment, UNDP, WHO, Minamata Convention Secretariat, Global Mercury Partnership, ILO, OECD, and relevant companies with experience in the use of BAT/BEP			
Risks: Lack of political and institutional support, financial resources, and interest and participation of actors and stakeholders; and political, economic, and security crises			
Proposed activities	**Description**	**Expected outcomes**	**Relevant institutions and stakeholders**
1. Set mechanisms for coordination and identify relevant actors (ministries, stakeholders) to be part of a "Products Advisory Committee" (PAC).	The members of the PAC should be chosen on the basis of their expertise and the added value they can bring to the process of reducing the use of mercury-containing products.	Mechanisms of coordination are in place; PAC is formed, and responsibilities are distributed among its members according to their expertise.	Ministry of Public Health and Population, EPA, Ministry of Water and Environment in collaboration with any other relevant entities (from private and/or public sectors)
2. PAC inception meetings for (i) identifying and discussing best strategies to address existing issues, (ii) classifying the priorities, (iii) defining the objectives, (iv) identifying the needs, and (v) setting timing and project milestones. Financial and technical aspects should also be considered.	The meetings will enable the members of the PAC to have an overview of the current national situation regarding mercury-containing products with regards to the regulations of the Minamata Convention. This will help setting the priorities and proposing needed inputs and actions to comply with the Convention.	Inception meetings are held; issues, priorities, activities, frameworks, and all relevant aspects (including financial and technical aspects) are discussed for moving efficiently forward	Ministry of Public Health and Population, EPA, Ministry of Water and Environment in collaboration with any other relevant entities (from private and/or public sectors)
3. Improve the knowledge of the fluxes of mercury-containing products in the country. Develop a detailed inventory as	Identify the imports and quantities (inventories) of all mercury-containing products in collaboration with Customs	Imports of mercury-containing products are identified and quantified	Customs Authority, Ministry of Information, Ministry of Social Affairs and Labour

well as comprehensive classification of the products.	and all relevant institutions (if and where possible).		
4. For each category of mercury-added products, identify the matching alternatives and select the most cost-effective ones to be promoted in the country.	Identify mercury-free products and tools for replacing mercury-containing items. Best options should be selected through a cost-effective analysis, among others, and promoted at national, regional, and local levels.	Research is conducted to identify mercury-free alternatives for dental amalgams containing mercury as well as for other mercury-containing products. Alternatives are available and promoted to replace mercury-containing products, including dental amalgams with mercury	Ministry of Public Health and Population, EPA, Ministry of Water and Environment
5. Elaborate and propose a national strategy for prohibiting the import of mercury-containing products, reducing the use of already imported ones that could be collected and disposed of in an environmentally sound manner. Also, propose guidelines to facilitate the transitions to mercury-free alternatives.	The strategy should be targeting the phase out of all mercury-containing products such as batteries, thermometers, light sources and polyurethane, and. guidelines should also be proposed for a soft transitioning to the alternatives, including mercury-free dental amalgams.	National strategy and to enhance the phase-out of mercury-containing products and phase-down of dental amalgams with mercury are developed and available	Customs Authority, Ministry of Information, Ministry of Social Affairs and Labour, EPA
6. Capacity-building through training of health professionals (including dentists) and dissemination of information through awareness-raising campaigns on mercury issues and effects on human health and the environment with the aim of discouraging the use of mercury-containing products in favour of available alternatives.	Raise awareness of the impacts of dental amalgam and mercury-containing products on human health and the environment and promote the use of cost-effective and durable alternatives.	Awareness raising activities are conducted and the population is informed of the adverse effects of the use of mercury-containing products on their health and the environment. Also, health care professionals are trained and encouraged to use mercury-free tools/products.	Ministry of Public Health and Population, EPA, Ministry of Water and Environment
Steps towards the reduction of mercury-added products: Specific activities to be undertaken for each category of mercury-containing products, including dental amalgams			
7. Dental amalgams containing mercury: (i) regular national dissemination of preventive measures for caries aiming at	These activities aim at phasing-down the use of dental amalgams in accordance with the regulations of Article 4 and Annex A	Dental restoration is reduced, but when necessary, mercury-free dental amalgams are used. Dental	Ministry of Public Health and Population, EPA

reducing the number of dental interventions; (ii) identify existing mercury-free fillings and select the most cost-effective one(s) for the country; and (iii) elaborate a strategy to enhance the transition from policies in favour of mercury dental amalgams to mercury-free ones.	(Part II) of the Minamata Convention.	amalgams with mercury are phased-down.	
8. Other mercury-containing products such as medical instruments (thermometers, manometers and gauges), light sources, batteries: further elaborate on the inventory of the MIA, trying to provide more accurate data on mercury-containing products imported and circulating in the country; according to the intervention plan 1, review and update the legal framework for these products, identify targeted groups for awareness-raising and training on best practices for handling mercury.	These activities will enhance the transition to mercury-free products. The aim is to raise awareness regarding the effects of the use and inappropriate disposal of mercury-containing products on human health and the environment to progressively change attitudes and habits.	Mercury-containing products are progressively phased-out in favour of mercury-free products.	Ministry of Public Health and Population, EPA
9. Develop a monitoring system to control the use of alternatives instead of mercury-containing products.	Once alternatives are available, awareness and information campaigns are conducted, and the process of reducing the import and use of mercury-containing products has begun, it is essential to set up a monitoring system to monitor the proper functioning of the practices and rules put in place.	A monitoring system to control the use of alternatives instead of mercury-containing products is put in place	Ministry of Public Health and Population, EPA, Ministry of Information, Ministry of Justice

7.3 Priority area and intervention plan 3: Sound management of wastes, including mercury wastes

Analysis of the national situation

Open fire waste burning (14,000 kg Hg/year), informal dumping of general waste (7,000 kg Hg/year) and controlled landfills/deposits (2,650 kg Hg/year) are the most significant sources of emissions and releases of mercury in air and soil. Therefore, the sound management of waste represents one of the essential priorities that require an effective intervention plan. Sound waste management approaches will also need to distinguish the mercury waste from all general waste in order to apply appropriate methods for their treatment.

The development of actions to reduce the mercury-related impacts will need to be addressed in coordination with all stakeholders (outlined in the table below) throughout the national territory within a broader context of improving waste disposal practices and services in the country.

Objective

The objective of this intervention plan is to establish an appropriate system for the management of waste, including mercury-containing waste. This will encourage environmentally sound waste management in accordance with the Article 11 of the Minamata Convention.

Outputs

- A competent team with relevant capacities is formed for leading the waste management strengthening process
- Training and awareness-raising activities are conducted for strengthening stakeholders' capacities and to inform the civil society
- Appropriate mechanisms of coordination as well as guidelines are developed for achieving the sound management of waste in the country
- Several inventories are conducted for identifying the bodies involved with mercury and mercury-containing devices, including medical care services
- Sustainable systems for sound management of waste are progressively introduced where:
    - Mercury-containing products are separated from municipal waste streams
    - Discarded medical devices containing mercury are separated from clinical wastes
    - Techniques are applied to e-waste management practices that minimize or prevent mercury emission and releases
    - Environmentally sound interim storage is developed for mercury waste prior to disposal under the terms of the Basel Convention

Table 13: Intervention Plan 3: Sound management of wastes, including mercury wastes

Intervention Plan 3: Sound management of wastes, including mercury wastes			
Relevant SDGs 2030: 3, 6, 11, 12, 14, 15, 16			
Relevant Articles of the Minamata Convention: 11, 12, 16, 17, 18, 19			
Key Institutions: EPA, Ministry of Water and Environment, Ministry of Public health and Population			
Other relevant national institutions: Ministry of information, Ministry of Higher Education and Scientific Research **Potential international partners:** UNIDO, UNITAR, UN Environment, UNDP, WHO, Minamata Convention Secretariat, Global Mercury Partnership, ILO, OECD, and relevant companies with experience in the use of BAT/BEP			
Risks: Lack of political and institutional support, financial resources, and interest and participation of actors and stakeholders; and political, economic, and security crises			
Proposed activities	**Explanation**	**Expected outcomes**	**Relevant institutions and stakeholders**
Preliminary activities: Setting the context for a sound waste management system			
1. Identify relevant stakeholders and institutions to form a leading committee	A leading team composed of different stakeholders from various national (and international if needed) bodies with relevant background and experience in the field of waste management, chemicals uses, and pollution (and other relevant aspects identified at national level).	A leading committee is formed with relevant and competent stakeholders.	EPA, Ministry of Water and Environment in collaboration with all relevant national (and international) bodies (private and public)
2. Undertake capacity building, training, and awareness-raising of the leading committee	The team will be trained and sensitized on different aspects regarding waste management, including the consequences of an inappropriate waste management system on human health and the environment, the advantages of a sustainable and environmentally sound waste management system, the overall objectives, and the required actions to be taken.	Required training is conducted and awareness was raised among the members regarding the necessity of putting in place a sound waste management structure. Capacities are strengthened.	EPA, Ministry of Water and Environment (in collaboration with Ministry of Information or other relevant body as needed)
3. Analyse the current national	A detailed analysis of the current situation will help	The national situation is studied,	EPA, Ministry of Water and

situation regarding the waste management system and develop a detailed planning for strengthening the waste management sector, including financial and technical aspects.	the team in charge to draw up a portrait of the national system in place, identify gaps and priorities useful for classifying the actions to be undertaken, conduct an analysis of costs to propose a budget, and search for financing options.	gaps and priorities are identified, and budget, timeline, and milestones are discussed.	Environment in collaboration with all relevant national (and international) bodies (private and public)
4. Elaborate mechanisms for coordination and develop strategies for conducting identified activities in an efficient manner in close consultation with the legal and institutional frameworks updated following Intervention Plan 1.	Mechanisms for coordination will be useful for structuring the project. Developing appropriate strategies for each selected activity will be helpful for targeting specific aspects and taking relevant decisions regarding the implementation of the strategies/activities developed.	Mechanisms for coordination are established based on the findings of the various analyses conducted, appropriate strategies are proposed, and relevant decision-making process is engaged for the implementation of actions	EPA, Ministry of Water and Environment in collaboration with all relevant national (and international) bodies (private and public)
Activities to be undertaken for strengthening the waste management system			
5. Identify and develop and inventory of all industries, laboratories, hospitals, and other medical entities where mercury and mercury-containing tools/products are used.	It is necessary to identify and conduct an inventory of all medical institutions, meteorology institutions, civil aviation, and other relevant structures that store and incinerate devices and products that contain mercury. The following can be considered: all types of thermometers containing mercury, and laboratory and medical equipment containing mercury.	An inventory of all institutions that use mercury-containing devices is developed	EPA, Ministry of Water and Environment in collaboration with custom services, Ministry of Health as well as all relevant bodies identified by the leading committee
6. Identify and develop a database on all mercury and mercury compounds used in the previously listed entities as well as all the mercury-containing devices used	The database on all mercury-containing devices used in these bodies will be useful to provide an overview of the type of mercury involved as well as the different pathways of contamination of human health and the environment.	Mercury-containing devices as well as mercury forms used in the various bodies are identified, quantified, and gathered in a database	EPA, Ministry of Water and Environment in collaboration with custom services, Ministry of Health as well as all relevant bodies identified by the leading committee
7. Identify and develop an inventory of all of the waste systems in place, including medical waste and dental	Information on waste sites and informal dumping sites where open burning is practised should be gathered in cooperation with the relevant entities.	All waste sites, as well as waste treatment systems, are identified across the country.	EPA, Ministry of Water and Environment in collaboration with Ministry of Health

amalgams waste treatment.	Other existing systems for medical and dental amalgam waste treatment should be identified as well. The detailed inventory of mercury-containing products conducted under Intervention Plan 2 could be consulted if ready.		
8. Define national guidelines on the sound management of wastes, including mercury-containing wastes (using the database and the inventory of waste treatment facilities identified).	The guidelines aim at supporting the team and professionals involved in the implementation of waste management system strengthening activities by providing specific advice on each step to be taken. The guidelines should be developed in accordance with the political, legal, and institutional frameworks elaborated in intervention plan 1.	National guidelines on the sound management of wastes are developed and used.	EPA, Ministry of Water and Environment
9. Undertake awareness raising campaigns to inform civil society as well as all relevant stakeholders on inappropriate waste management issues and consequences on human health and the environment. These campaigns should be organized on a regular basis.	Awareness raising campaigns are useful to inform about the current situation regarding waste management systems, the impacts on human health and the environment, foster changes in practices and habits, and to share experiences and ideas.	Awareness raising campaigns are conducted across the country and results (changes in practices and habits) are visible in society.	EPA, Ministry of Water and Environment, Ministry of Public Health and Population, Ministry of Information, Ministry of Higher Education and Scientific Research
10. Develop an appropriate collection and storage system for waste, including mercury-containing waste	When developing the system, it is important to consider: separation of mercury-containing products from other general waste; and in medical, civil aviation, and other concerned institutions, devices and other products containing mercury should be separated from other waste.	An appropriate system that takes into account mercury-containing products as well is developed	EPA, Ministry of Water and Environment
11. Separate mercury-containing products from municipal waste streams	Separate mercury-containing products from municipal waste streams, which otherwise harm human health and the environment as well as produces mercury emissions and releases once disposed or incinerated.	Mercury-containing products separated from municipal waste streams	EPA, Ministry of Water and Environment, Ministry of Public Health and Population

12. Separate discarded medical devices containing mercury from clinical wastes	Separate discarded medical devices containing mercury from clinical wastes, which otherwise harm human health and the environment as well as produces mercury emissions and releases once disposed or incinerated.	Discarded medical devices containing mercury separated from clinical wastes	EPA, Ministry of Water and Environment, Ministry of Public Health and Population
13. Apply BAT/BEP to e-waste management practices that minimize or prevent mercury emission and release	Encourage application of BAT/BEP to e-waste management that minimize or prevent mercury emissions and releases.	Techniques that minimize or prevent mercury emissions and releases are applied to e-waste management	EPA, Ministry of Water and Environment
14. Develop environmentally sound interim storage for mercury waste prior to disposal under the terms of the Basel Convention	It is essential to set up an environmentally sound system for the storage of waste, particularly mercury-containing waste that has previously been separated from general waste.	Environmentally sound interim storage developed for mercury waste prior to disposal under the terms of the Basel Convention	EPA, Ministry of Water and Environment
15. Elaborate a monitoring system with a competent team in charge of ensuring the proper functioning of the systems set up and compliance with established guidelines.	Regular monitoring of ongoing activities not only helps to ensure that activities are running smoothly, but also to take swift action in the event of unexpected events or challenges. Periodic reports on the progress of activities could be published.	A reliable and useful monitoring system is in place to assess the proper functioning of the systems and the progress made.	EPA, Ministry of Water and Environment

7.4 Priority area and intervention plan 4: Reduction of mercury emissions and releases

Analysis of the national situation

All mercury source categories identified in Yemen can lead to emissions and releases of mercury to air, water, and soil. For example, emissions into the atmosphere have been identified from activities and products such as extraction and processing of natural gas (117.6 kg Hg/year); cement production (287.3 kg Hg/year); thermometers (114.9 kg Hg/year); batteries with mercury (6,721.3 kg Hg/year); open burning of waste (14,000 kg Hg/year); and informal dumping of general waste (700 kg Hg/year). Regarding releases to water, the most important sources are extraction and processing of natural gas (156.8 kg Hg/year); informal dumping of general waste (700 kg Hg/year); and thermometers (172.4 kg Hg/year). Regarding releases to soil, the most important sources are batteries with mercury (6,721.3 kg Hg/year); informal dumping of general waste (5,600 kg Hg/year); and thermometers (114.9 kg Hg/year). In total, mercury emissions and releases are 22,240 kg Hg/year, 1330 kg Hg/year, and 7070 kg Hg/year for air, water, and soil respectively.

Objective

The objective of this intervention plan is the reduction of mercury emissions and releases in most sources in line with Articles 8 and 9 of the Minamata Convention.

Outputs

- A competent team with relevant capacities is formed for leading the waste management strengthening process
- Training and awareness raising activities are conducted for strengthening stakeholders' capacities and informing civil society
- Appropriate mechanisms of coordination as well as guidelines are developed for achieving the sound management of waste in the country
- The most important facilities/practices causing mercury emissions and releases are further investigated based on the findings of the national mercury inventory developed under the MIA project:
    - Steps where mercury is emitted and/or released are identified in energy, fuel and cement productions
    - Informal waste dumping, waste incineration and open air burning practices are also targeted
    - Best Available Techniques and Best Environmental Practices (BAT/BEP) are identified for each sector and implemented accordingly

Table 14: Intervention Plan 4: Reduction of mercury emissions and releases

Intervention Plan 4: Reduction of mercury emissions and releases			
Relevant SDGs 2030: 3, 6, 7, 11, 12, 13, 14, 15, 16			
Relevant Articles of the Minamata Convention: 8, 9, 10 11, 12, 16, 17, 18, 19			
Key Institutions: EPA, Ministry of Water and Environment			
Other relevant national institutions: Ministry of Petroleum and Minerals, Ministry of labour, Ministry of Public Works and Highways **Potential international partners:** UNIDO, UNITAR, UN Environment, UNDP, WHO, Minamata Convention Secretariat, Global Mercury Partnership, ILO, OECD, and relevant companies with experience in the use of BAT/BEP			
Risks: Lack of political and institutional support, financial resources, and interest and participation of actors and stakeholders; and political, economic, and security crises			
Proposed activities	**Description**	**Expected outcomes**	**Relevant institutions and stakeholders**
Preliminary activities: Setting the context for managing mercury emissions and releases into air, water, and soil			
1. Identify relevant stakeholders and institutions for conducting activities related to chemicals (especially mercury) emissions and releases	The identified stakeholders should come from different bodies and have the required expertise in chemicals pollution, industrial activities, waste management techniques, and other relevant fields previously discussed at national level.	A team of relevant experts is formed	EPA, Ministry of Water and Environment, Ministry of Energy in collaboration with other relevant bodies
2. Organize workshops and training for discussing the issue of environmental pollution resulting from anthropogenic activities (especially the ones identified in the national mercury inventory), identifying mechanisms of coordination, objectives, priorities, and discussing milestones and budget.	Inception and regular workshops as well as initial training activities would help exchanging information, strengthening team members capacities on the matter, and defining a detailed and structured work plan (including budget).	Workshops and training activities are organized; the team agrees with its responsibilities, and all aspects regarding mercury emissions and releases in the country are discussed	EPA, Ministry of Water and Environment, Ministry of Energy in collaboration with other relevant bodies

3. Define national guidelines for identifying and reducing mercury emissions and releases (using the findings of the mercury inventory developed under the MIA project as a basis), in close consultation of the legal and institutional frameworks.	The guidelines support the team and the professionals involved in the implementation activities aiming at reducing mercury pollution by providing specific advice on each step to be taken. The guidelines should be developed in accordance with the political, legal, and institutional frameworks elaborated in Intervention Plan 1.	Guidelines are developed and used when conducting activities	EPA, Ministry of Water and Environment, Ministry of Energy in collaboration with other relevant bodies
4. On the basis of the mercury inventory developed under the MIA project, select the most important facilities and practices involved in mercury emissions and releases and conduct awareness raising activities among the professional personnel. Regarding waste deposition and incineration as well as open air burning, awareness raising should be extended to civil society.	Awareness raising campaigns are useful to inform about the current situation regarding mercury emissions and releases, the impacts on human health and the environment, foster changes in practices and habits, and facilitate the sharing of experiences and ideas.	All important facilities involved in mercury emissions and releases are identified and approached; awareness raising activities are conducted among relevant professionals and civil society	EPA, Ministry of Water and Environment, Ministry of Energy in collaboration with other relevant bodies
Activities to be undertaken for preventing/reducing mercury emissions and releases into air, water, and soil			
5. Energy consumption: based on the national mercury inventory, conduct a detailed assessment of the energy consumption sector, identifying and quantifying the sources and pathways of emissions and releases.	Energy consumption produces large amounts of mercury emissions and releases. The inventory developed under the MIA gives preliminary estimates that should be further elaborated to give an accurate overview of the situation and identify the steps needed to limit emissions and releases.	Accurate information on emissions and releases in the energy production sector is available and actions to be undertaken to limit pollution are identified	EPA, Ministry of Water and Environment, Ministry of Energy
6. Fuel production: Clearly identify the implication of mercury in fuel production and the steps in the production that lead to environmental pollution.	Mercury in present in fuel and therefore is susceptible of being emitted and/or released to the environment during fuel production. Identifying and quantifying the steps where mercury is emitted/released and the level of pollution will help in choosing the appropriate measures for prevention.	Fuel production processes are analysed, mercury implications are identified, and steps where actions should be taken for preventing environmental pollution are highlighted.	EPA, Ministry of Water and Environment, Ministry of Petroleum and Minerals

7. Cement production: Identify the mercury content of raw materials and fuels used to produce clinker for cement.	Mercury is present in raw materials and fuels used to produce the clinker needed for cement. Identifying the mercury content of the element used, the steps of the production where mercury is emitted, as well as the factors that contribute to mercury emissions will facilitate the choice of BAT for preventing the pollution.	Mercury concentration in the materials used is identified and the path of mercury in the production process is traced in order to identify the steps to be targeted for reducing emissions into the environment	EPA, Ministry of Water and Environment, Ministry of Labour, Ministry of Public Works and Highways
8. In collaboration with the leading committee for the sound management of waste, propose strategies and alternative methods for replacing informal waste dumping, waste incineration, and open air burning with environmentally sound practices.	Informal dumping of waste, waste incineration, and open air burning are among the most important sources of mercury emissions and releases to the environment. Therefore, the sound management of waste elaborated under Intervention Plan 3 as well as the identification of BAT for eliminating waste will help prevent environmental pollution.	BAT are identified and implemented under the sound management of waste for limiting the emissions and releases of mercury in the environment.	EPA, Ministry of Water and Environment in collaboration with other relevant bodies
9. Based on the findings of the assessments conducted for each of the activities listed above, propose BAT/BEP for preventing mercury emissions and releases into the environment.	Appropriate techniques and methods targeting each of the key steps previously identified should be proposed and implemented for preventing pollution from the source.	BAT are identified and implemented in energy, fuel, and cement production	EPA, Ministry of Water and Environment in collaboration with other relevant bodies
10. Elaborate a monitoring system with a competent team in charge of assessing the application of BAT/BEP identified for each sector mentioned above.			EPA, Ministry of Water and Environment

8. General conclusions and Validation Workshop recommendations

The Minamata Initial Assessment is a document that brings together various assessments to understand the situation in Yemen regarding the national use, emissions, and releases of mercury and its compounds. This project was carried out following the signing of the Minamata Convention by Yemen on 21 March 2014. The activities of this project and the results achieved are as follows:

- **National mercury inventory and impacts on human health and the environment:** The categories that contribute to mercury inputs to Yemen and are therefore responsible for mercury emissions and releases to air, water, and land are energy consumption, fuel production, use and disposal of mercury-containing products, and waste disposal and incineration. All of these flows have negative impacts on the health of populations, particularly those involved in any of the activities mentioned above and using mercury-containing products. Similarly, emissions and discharges pollute different ecosystems. As a result, Articles 4 (mercury-added products), 8 (emissions), 9 (releases), 11 (mercury waste), 12 (contaminated sites), and 16 (health aspects) of the Minamata Convention are relevant for the country.
- **Political, legal, and institutional assessments:** Yemen does not have a sufficiently robust framework to manage chemicals, particularly mercury and mercury compounds. Therefore, it is essential to strengthen existing capacities and instruments in order to integrate the relevant provisions of the Minamata Convention into the national political, legal, and institutional frameworks.
- **Identification of populations at risks and awareness-raising among targeted groups:** Based on the findings of the mercury inventory, populations directly in contact with any element or activity containing or involving the use of mercury can be considered at risk. Following Articles 16 to 18 (which respectively promote health aspects, information exchange, and public information, awareness, and education), it is essential that awareness raising strategies and campaigns are put in place to prevent the contamination of populations.
- **Identification of priorities and intervention plans:** Capacity building as well as policy, legal, and institutional frameworks, reduction and elimination of mercury-containing products, environmentally sound management of waste, particularly waste containing mercury, and reduction of mercury emissions and discharges into the environment comprise the content of the four intervention plans that are based on the results obtained through the various assessments. These plans have been proposed to meet the provisions of the abovementioned Articles of the Convention. The implementation of these plans should also consider Article 19, which promotes research, development, and monitoring.

During the MIA Validation Workshop, held in Cairo, Egypt, 25-28 March 2019, the following recommendations were agreed:

1. Emphasize the existence of a national entity responsible for developing public policies related to chemicals and hazardous wastes management, developing strategies and programmes of action consistent with the country development plans, and coordinating the stakeholders in this regard.
2. Re-activate the EPA Chemicals Committee role:
    - Consider expanding the committee’s scope of work to include hazardous wastes.
    - Consider expanding the committee's field of work to include reviewing the international, regional, and sub-regional chemicals and wastes conventions’ obligations, as well as preparing the technical, legal, and procedural procedures related to chemicals and hazardous wastes constitutional procedures, for presenting to the parliament.

- Work on establishing a dispute resolution mechanism to deal with tasks overlapping between parties.

3. Raise awareness on the potential risks of non-safe management of chemicals and hazardous wastes to the environment, public health, and the national economy, using the technical support and resources available from the aforementioned conventions, giving high priority to technical methods for the environmentally sound management of hazardous wastes, including the most appropriate environmental and economic methods of disposal.
4. Address the need for high-level joint coordination between the EPA and other bodies, working to ensure continuous coordination, and clearly define the bodies' responsibilities.
5. Review the relevant national common laws to study the proposed amendments in accordance with the terms of the conventions.
6. Conduct periodic meetings between all concerned parties to solve any problems in the national implementation of the conventions.
7. Develop a technical and legal manual, for the committee focal points, on the criteria for estimating the necessary compensation for environmental damage.
8. Update the national chemicals lists issued by the various conventions, and work on a timetable for reducing mercury emissions.
9. Develop policymaking training programmes for technical and legal staff.
10. Examine the optimal means of benefiting from the funding mechanisms available in these conventions' funds, and the related international organizations and financial institutions, in order to develop a strategic plan for activating domestic and international financial resources. Give priority to establishing an EPA central laboratory for chemical analysis, as well as rehabilitating sub-laboratories and its staff at the national level, who may assist with the efficient execution of the committee's tasks.
11. Undertake awareness campaigns on the role of different conventions in protecting human health and the environment, including Minamata Convention.

Implementing the proposed intervention plans will ensure that the provisions of the Minamata Convention are integrated into the various relevant national frameworks. The results obtained after the implementation of the plans would also be disseminated among relevant stakeholders and institutions and contribute to other national strategies and plans, particularly in the areas of health care, poverty alleviation, waste management, and industrial development, in order to establish a more concrete link with the SDGs and other objectives or partnerships to promote sustainable development.

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Annex 1. Relevant stakeholders

Names	Function	Institution

Annex 2. Spreadsheets of the Toolkit

Country information

BACKGROUND DATA NEEDED FOR DEFAULT CALCULATIONS AND RANGE TEST			
Compulsory: Click cell below and select country from list	Population in 2010 (or as recent as available data allow; UNSD, 2012)	Dental personnel per 1,000 inhabitants	Electrification rate, % of population with access to electricity
Yemen	23,154,000	0.041	40

Energy consumption and fuel production

Source category	Source present?	Activity rate			Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y					
Energy consumption	**Y/N/?**	**Annual consumption /production**	**Unit**	**Include Hg controls in estimation? (y/n)**	**Standard estimate**	**Air**	**Water**	**Land**	**By-products and impurities**	**General waste**	**Sector specific waste treatm. /disposal**
Coal combustion in large power plants	N		Coal combusted, t/y		-	-	-	-	-	-	-
				Relevant pollution abatement options (guide: click white cells)		0: No filters used	1: Simple particle filters	2: Fabric filters	3: Efficient APC	4: Very efficient APC	5: Mercury specific
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		0	100				
Coal combustion in coal fired industrial boilers	Y	167 667	Coal combusted, t/y	N	22	22.4	0.0	0.0	0.0	0.0	0.0
				Relevant pollution abatement options (guide: click white cells)		0: No filters used	1: Simple particle filters	2: Fabric filters	3: Efficient APC	4: Very efficient APC	5: Mercury specific
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		100					
Other coal uses	?		Coal used, t/y		?	?	?	?	?	?	?
Combustion/use of petroleum coke and heavy oil	Y	798 000	Oil product combusted, t/y		44	43.9	0.0	0.0	0.0	0.0	0.0
				Relevant pollution abatement options (guide: click white cells)		No filters used	ESP or scrubber	cESP and FGD			
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		100					

Combustion/use of diesel, gasoil, petroleum, kerosene, LPG and other light to medium distillates	Y	4 159 667	Oil product combusted, t/y		23	22.9	0.0	0.0	0.0	0.0	0.0
				Relevant pollution abatement options (guide: click white cells)		No filters used	ESP or scrubber	cESP and FGD			
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		100					
Use of raw or pre-cleaned natural gas	Y	995 490 133	Gas used, Nm^3/y		100	99.5	0.0	0.0	0.0	0.0	0.0
Use of pipeline gas (consumer quality)	N		Gas used, Nm^3/y		-	-	-	-	-	-	-
Biomass fired power and heat production	Y	379 500	Biomass combusted, t/y		11	11.4	0.0	0.0	0.0	0.0	0.0
Charcoal combustion	?		Charcoal combusted, t/y		?	?	?	?	?	?	?
Fuel production											
Oil extraction	Y	5 549 667	Crude oil produced, t/y		19	0.0	3.8	0.0	0.0	0.0	0.0
Oil refining	Y	2 250 000	Crude oil refined, t/y		8	1.9	0.1	0.0	0.0	0.0	1.1
Extraction and processing of natural gas	Y	7 840 768 000	Gas produced, Nm^3/y		784	117.6	156.8	0.0	235.2	0.0	274.4

Domestic production of metals and raw materials

Source category	Source present?	Activity rate			Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y					
	Y/N/?	Annual consumption/production	Unit	Include Hg controls in estimation? (y/n)	Standard estimate	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatm. /disposal
Primary metal production											
Mercury (primary) extraction and initial processing	N		Mercury produced, t/y		-	-	-	-	-	-	-
Production of zinc from concentrates	N		Concentrate used, t/y		-	-	-	-	-	-	-
				Relevant pollution abatement optio(guide: click white cells)		No filters used or coarse, dry PM retention	Wet gas cleaning	Wet gas cleaning and acid plant	Wet gas cleaning, acid plant and Hg specific filter		
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		0		100			
Production of copper from concentrates	N		Concentrate used, t/y		-	-	-	-	-	-	-
				Relevant pollution abatement options (guide: click white cells)		No filters used or coarse, dry PM retention	Wet gas cleaning	Wet gas cleaning and acid plant	Wet gas cleaning, acid plant and Hg specific filter		
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		0	0	100	0		
Production of lead from concentrates	N		Concentrate used, t/y		-	-	-	-	-	-	-

				Relevant pollution abatement options (guide: click white cells)		No filters used or coarse, dry PM retention	Wet gas cleaning	Wet gas cleaning and acid plant	Wet gas cleaning, acid plant and Hg specific filter		
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		0		100			
Gold extraction by methods other than mercury amalgamation	N		Gold ore used, t/y		-	-	-	-	-	-	-
Alumina production from bauxite (aluminium production)	N		Bauxit processed, t/y		-	-	-	-	-	-	-
Primary ferrous metal production (pig iron production)	N		Pig iron produced, t/y		-	-	-	-	-	-	-
Gold extraction with mercury amalgamation - from whole ore	N		Gold produced, kg/y		-	-	-	-	-	-	-
				Relevant pollution abatement options (guide: click white cells)		No retorts used	Use of retorts				
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		100.0					
Gold extraction with mercury amalgamation - from concentrate	N		Gold produced, kg/y		-	-	-	-	-	-	-
				Relevant pollution abatement options (guide: click white cells)		No retorts used	Use of retorts				

			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		100.0					
Other materials production											
Cement production	Y	2 800 000	Cement produced, t/y	N	383	287.3	0.0	0.0	95.8	0.0	0.0
				1) WITH WASTE USED as fuel (>3% of energy); relevant pollution abatement options		No filter	Simple particle control (ESP / PS / FF)	Optimized particle control (FF+SNCR / FF+WS / ESP+FGD / optimized FF)	Efficient air pollution control (FF+DS / ESP+DS / ESP+WS / ESP+SNCR)	Very efficient Hg pollution control (wetFGD+ACI / FF+scrubber +SNCR)	
				Enter per cent of total activity rate per type:		25	25				
			Error: Sum of entered % must not exceed 100	2) NO/LOW WASTE use as fuel; relevant pollution abatement options		No filter	Simple particle control (ESP / PS / FF)	Optimized particle control (FF+SNCR / FF+WS / ESP+FGD / optimized FF)	Efficient air pollution control (FF+DS / ESP+DS / ESP+WS / ESP+SNCR)	Very efficient Hg pollution control (wetFGD+ACI / FF+scrubber +SNCR)	
				Enter per cent of total activity rate per type:		25	25				
Pulp and paper production	N		Biomass used for production, t/y		-	-	-	-	-	-	-
				Relevant pollution abatement options (guide: click white cells)		No filters used	PM control with general ESP, or PS				
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		100.0					

Domestic production and processing with intentional use of mercury

Source category	Source present?	Activity rate		Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y					
Production of chemicals	**Y/N/?**	**Annual consumption /production**	**Unit**	**Standard estimate**	**Air**	**Water**	**Land**	**By-products and impurities**	**General waste**	**Sector specific waste treatment /disposal**
Chlor-alkali production with mercury-cells	N		Cl_2 produced, t/y	-	-	-	-	-	-	-
VCM production with mercury catalyst	N		VCM produced, t/y	-	-	-	-	-	-	-
Acetaldehyde production with mercury catalyst	N		Acetaldehyde produced, t/y	-	-	-	-	-	-	-
Production of products with mercury content										
Hg thermometers (medical, air, lab, industrial etc.)	?		Mercury used for production, kg/y	?	?	?	?	?	?	?
Electrical switches and relays with mercury	?		Mercury used for production, kg/y	?	?	?	?	?	?	?
Light sources with mercury (fluorescent, compact, others: see guideline)	?		Mercury used for production, kg/y	?	?	?	?	?	?	?
Batteries with mercury	?		Mercury used for production, kg/y	?	?	?	?	?	?	?
Manometers and gauges with mercury	?		Mercury used for production, kg/y	?	?	?	?	?	?	?
Biocides and pesticides with mercury	?		Mercury used for production, kg/y	?	?	?	?	?	?	?
Paints with mercury	?		Mercury used for production, kg/y	?	?	?	?	?	?	?

Skin lightening creams and soaps with mercury chemicals	?		Mercury used for production, kg/y	?	?	?	?	?	?	?

General waste management set up in the country

Source category	Source present?	Activity rate			Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y					
Production of recycled of metals	**Y/N/?**	**Annual production /waste disposal**	**Unit**	**Include Hg controls in estimation? (y/n)**	**Standard estimate**	**Air**	**Water**	**Land**	**By-products and impurities**	**General waste**	**Sector specific waste treatment /disposal**
Production of recycled mercury ("secondary production")	?		Mercury produced, kg/y		?	?	?	?	?	?	?
Production of recycled ferrous metals (iron and steel)	Y	1 440	Number of vehicles recycled/y		2	0.5	0.0	0.5	0.0	0.5	0.0
Waste incineration											
Incineration of municipal/general waste	?		Waste incinerated, t/y		?	?	?	?	?	?	?
				Relevant pollution abatement options (guide: click white cells)		No emission reduction devices	PM reduction, simple ESP, or similar	Acid gas control + high efficiency FF or ESP PM retention	Mercury specific absorbents + FF		
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		0	100				
Incineration of hazardous waste	?		Waste incinerated, t/y		?	?	?	?	?	?	?
				Relevant pollution abatement options (guide: click white		No emission reduction devices	PM reduction, simple ESP, or similar	Acid gas control + high efficiency FF or ESP	Mercury specific absorbents + FF		

				cells)				PM retention			
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		0	100				
Incineration / burning of medical waste	?		Waste incinerated, t/y		?	?	?	?	?	?	?
				Relevant pollution abatement options (guide: click white cells)		No emission reduction devices	PM reduction, simple ESP, or similar	Acid gas control + high efficiency FF or ESP PM retention	Mercury specific absorbents + FF		
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		100					
Sewage sludge incineration	?		Waste incinerated, t/y		?	?	?	?	?	?	?
Open fire waste burning (on landfills and informally)	Y	2 800 000	Waste burned, t/y		14 000	14 000.0	0.0	0.0	0.0	0.0	0.0
Waste deposition/landfilling and waste water treatment											
Controlled landfills/deposits	Y	530 000	Waste landfilled, t/y		2 650	26.5	0.3	0.0	-	-	-
Informal dumping of general waste *1	Y	1 400 000	Waste dumped, t/y		7 000	700.0	700.0	5 600.0	-	-	-
Waste water system/treatment	?		Waste		?	?	?	?	?	?	?

			water, m^3/y								
				Relevant pollution abatement options (guide: click white cells)		No treatment	Mechanical treatment only	Mechanical and biological treatment; no land application of sludge	Mechanical and biological treatment; with >40% of sludge used for land application		
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity rate per type:		0	100				

General consumption of mercury in products, as metal mercury and as mercury-containing products

Source category	Source present?	Activity rate			Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y					
	Y/N/?	Annual consumption /population	Unit	Include Hg controls in estimation ? (y/n)	Standard estimate	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal
					NOTE: Selection regarding waste management:	Less than 2/3 (two thirds; 67%) of the general waste is collected and deposited on lined landfills or incinerated with pollution abatement					
Use and disposal of products with mercury content						Less than 1/3 (one third = 33%) of the mercury-added products waste is safely collected and treated separately					
Dental amalgam fillings ("silver" fillings)	***Y***			N	229	***4.6***		***100.7***	***18.3***	***13.7***	***45.8***	***45.8***
Preparations of fillings at dentist clinics		23 154 000	Number of inhabitants			4.6		32.1	0.0	0.0	27.5	27.5
Use - from fillings already in the mouth		23 154 000	Number of inhabitants			0.0		4.6	0.0	0.0	0.0	0.0
Disposal (excavations, lost and extracted teeth)		23 154 000	Number of inhabitants			0.0		64.1	18.3	13.7	18.3	18.3
		0.041	Number of dental personnel per 1000 inhab.									
				Relevant pollution abatement options (guide: click white cells)		Clinics where only simple chair strainers/filters are used		Clinics where high efficiency amalgam separators are used				
			Error: Sum of entered % must not exceed 100	Enter per cent of total activity		100						

				rate per type:							
Thermometers	***Y***	***574 583***			575	***114.9***	***172.4***	***114.9***	***0.0***	***172.4***	***0.0***
Medical Hg thermometers	Y	574 583	Items sold/y		575						
Other glass Hg thermometers (air, laboratory, dairy, etc.)	?		Items sold/y		?						
Engine control Hg thermometers and other large industrial/speciality Hg thermometers	?		Items sold/y		?						
Electrical switches and relays with mercury	?	23 154 000	Number of inhabitants		?	?	?	?	?	?	?
		40	electricification rate, %								
Light sources with mercury	***Y***	*2 505 785*	Items sold/y		43	***13.0***	***0.0***	***13.0***	***0.0***	***17.3***	***0.0***
Fluorescent tubes (double end)	Y	583 882	Items sold/y		15						
Compact fluorescent lamp (CFL single end)	Y	1 167 763	Items sold/y		12						
Other Hg containing light sources (see guideline)	Y	754 140	Items sold/y		17						
Batteries with mercury	***Y***	***7 015***	***t batteries sold/y***		26 885	***6 721.3***	***0.0***	***6 721.3***	***0.0***	***13 442.7***	***0.0***
Mercury oxide (button cells and other sizes); also called mercury-zinc cells	Y	78	Batteries sold, t/y		24 970						
Other button cells (zinc-air, alkaline button cells, silver-oxide)	Y	27	Batteries sold, t/y		188						
Other batteries with mercury (plain cylindrical alkaline, permanganate, etc., see guideline)	Y	6 910	Batteries sold, t/y		1 727						

Polyurethane (PU, PUR) produced with mercury catalyst	y	23 154 000	Number of inhabitants		275	55.0	27.5	110.0	0.0	82.5	0.0
		40	Electrification rate, %								
Paints with mercury preservatives	?		Paint sold, t/y		?	?	?	?	?	?	?
Skin lightening creams and soaps with mercury chemicals	?		Cream or soap sold, t/y		?	?	?	?	?	?	?
Medical blood pressure gauges (mercury sphygmomanometers)	Y		Items sold/y		0	0.0	0.0	0.0	0.0	0.0	0.0
Other manometers and gauges with mercury	y	23 154 000	Number of inhabitants		46	9.2	13.8	9.2	0.0	13.8	0.0
		40	Electrification rate, %								
Laboratory chemicals	y	23 154 000	Number of inhabitants		92	0.0	30.3	0.0	0.0	30.3	31.2
		40	Electrification rate, %								
Other laboratory and medical equipment with mercury	y	23 154 000	Number of inhabitants		367	0.0	121.0	0.0	0.0	121.0	124.7
		40	Electrification rate, %								

Crematoria and cemeteries

Source category	Source present?	Activity rate		Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y					
Crematoria and cemeteries	Y/N/?	Annual numbers dead	Unit	Standard estimate	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal
Crematoria	N		Corpses cremated/ y	-	-	-	-	-	-	-
Cemeteries	Y	35 066	Corpses buried/y	88	0.0	0.0	87.7	-	0.0	0.0