Final Draft:Minimata Initial Assessment for Chad







Contents

Glossary 1
Foreword by Government Official 3
Executive Summary 3
I. Mercury Inventory 5
II. Legislative Gap Analysis 8
III. Institutional Gap Analysis 10
Introduction 11
I. Background of the Study 12
II. The Minamata Convention on Mercury 12
Chapter I: National Background Information 16
1.1 Bioclimatic Data 16
1.2 Population and Population Growth 18
1.3 Socio-economic Data 18
1.4 Energy Situation and Sources of the Energy Supply in Chad 22
1.5 Environmental Data 24
1.6 Analysis of the Institutional, Legislative Framework, Regulatory and Legal Framework on the Environment 25
1.7 Chad's Commitments in Relation to International Conventions 26
Chapter II: Mercury Inventory and Identification of Emissions and Resources 27
2.1 Identification and Selection of Categories and Subcategories of Major Sources of Mercury Releases 27
2.2 Preparatory Inventory Activities 36
2.2.1 Inventory Tools Design 36
2.2.2 Establishment of Inventory Teams 36
2.2.3 Training Inventory Teams 36
2.2.4 Conducting Inventory Operations 37
2.3 Results of the Mercury Release Inventory 39
2.3.1. Extraction and Use of Fuel/Energy Sources 39

2.3.2 Primary Production of Metal 46
2.3.4 Intentional Use of Mercury in Industrial Processes 52
2.3.5 Consumer Products Intentionally Containing Mercury....52
2.3.6 Waste Treatment and Recycling....67
2.3.7 Crematorium/Cemeteries....75
2.4 Sites Contaminated with Mercury 76
2.4.1 Geographical Location of Contaminated Sites 78
2.4.2 Evaluation of the Extent of the Contamination 79
2.5 Constraints and Difficulties 80
2.6 Mercury inventory conclusions....80
Chapter III: Policy, Regulatory and Institutional Framework Assessment 83
3.1 Legal Gap Analysis – Introduction 83
3.2 Chad Laws Relating to Chemicals and Wastes 83
3.3 Convention Obligations and Chad Legislations....93
3.4 Article 3. Mercury Supply Sources and Trade 93
3.5 Article 4. Mercury Added Products 96
3.6 Article 5. Manufacturing Processes in which Mercury or Mercury Compounds are Used....97
3.7 Article 7. Artisanal and Small-scale Gold Mining....99
3.8 Article 8. Emissions 101
3.8 Article 9. Releases 103
3.9 Article 10. Environmentally-sound Interim Storage of Mercury intended for use allowed under the Convention 104
3.10 Article 11. Mercury Wastes 106
3.11 Article 12. Contaminated Sites....108
3.12 Article 13. Financial Resources and Mechanisms....109
3.13 Article 16. Health Aspects....110
3.14 Article 17. Information Exchanges 111
3.15 Article 18. Public Information, Awareness and Education....113
3.16 Conclusion and Recommendations....113
3.17 Institutional Gap Analysis: Introduction 115

3.18 Legislation and institution conclusions 125

Chapter IV: Identification of Populations at Risks and Gender Dimensions 127

4.1 Preliminary review of potential populations at risk and potential health risks 127

4.2 Assessment of potential gender dimensions related to the management of mercury 129

4.2.1 Occupational Exposure 129

4.2.2 Mercury in fish 130

4.2.3 Mercury In households 131

4.2.4 Mercury in cosmetics 131

4.2.5 Artisanal Small-scale Gold Mining Activities 132

Chapter V: Awareness/Understanding of Workers and the Public; and Existing Training and Education Opportunities of Target Groups and Professionals 135

Chapter VI: Implementation Plan & Priorities for Action 137

Acknowledgments 141

Literature Cited 142

ANNEX I: Stakeholders 143

ANNEX II: Inventory details 144

ANNEX III: UNEP TOOLKIT Calculation Spreadsheet 150

Glossary

ANER	National Agency for Renewable Energies
ARSAT	Petroleum Sector Regulatory Authority in Chad
ASGM	Artisanal and Small-scale Gold Mining
BAT/BEP	Best Available Techniques/ Best Environmental Practices
BRI	Biodiversity Research Institute
CCNUCC	United Nations Framework Convention on Climate Change
CEMAC	Economic and Monetary Community of Central Africa
CHS	Health and safety committees in business and institutions
CNLCD	United Nations Convention on Biological Diversity
CNPCIC	Chinese Petroleum Company
COP	Conference of Parties
CTD	Decentralized Territorial Committee
DEELCPM	Environmental Assessment, and Pollution and Nuisances Elimination Directorate
DEELCCC	Department of Environmental Education and the Fight Against Climate Change
DEPS	The Department of Studies, Planning and Monitoring
DFCLD	The Forestry and Desertification Control Directorate
DPA	Department of Fishing and Aquaculture
ECOSIT	Surveys on Consumption and the Informal Sector in Chad
GEF	Global Environment Facility
GHS	Globally Harmonized System of Classification and Labeling of Chemicals
GPL	Liquefied Petroleum Gas
FEM	Global Environmental Funds
HCNE	High National Environmental Committee
IDH	Human Development Index
INC	Intergovernmental Negotiating Committee
INSEED	National Institute of Economic and Demographic Studies
IRB	Institute for Research on Biodiversity
MA	Ministry of Agriculture
MAP	Mercury-added Product
MCCAPS	Mercury-Cell Chlor-Alkali Plants
MEAS	Multilateral Environmental Agreements

MEEP	Ministry of Environment, and Fisheries
MEC	Ministry of Economy and Trade
MFB	Ministry of Finances and Budget
MHPV	Ministry of Pastoral and Rural Water
MIA	Minamata Initial Assessment
MSP	Ministry of Public Health
MP	Ministry of Oil
MPE	Ministry of Petroleum and Energy
MNE	Ministry of Mine and Energy
NAP	National Action Plan
NGOS	Non-Government Organizations
NIP	National Implementation Plan
NTC/POPS	National Technical Committee responsible for monitoring and evaluation of international conventions on organic pollutants, pesticides, chemicals and hazardous waste.
ODD	Sustainable Development Goals
ONUDI	United Nations Industrial Development Organization
PIB	Gross Domestic Product
PND	National Development Plan
PNUD	United Nations Development Program
PNUE	United Nations Environment Program
RGPH	General Census of Population and Housing
SDDR	Schema Director for the Development of Renewable Energies
SNE	National Electric Company
SNRP	National Strategy for Poverty Reduction
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
UTN	Technical Unit for Contro

Foreword

Mercury is a chemical element naturally found in trace concentrations in the environment. Currently, it is considered one of the most dangerous elements due to its use in several anthropogenic activities and the adverse health outcomes resulting from exposure. As a result, it is attracting increasing interest because of the contamination risk it poses at local, national and international scales. Mercury from anthropogenic activities is emitted and released into ecosystems where: (i) once emitted into the atmosphere, mercury can disperse over long distances and be deposited far from its original location; (ii) when released into aquatic ecosystems, mercury can be converted to methylmercury, one of its most toxic forms, which bioaccumulates in the food chain and can cause irreversible damage to human health depending on exposure. The negative effects include neurological damage (especially in fetuses and newborns) in the form of impaired brain function and developmental delays for children, as well as reduced muscle capacity resulting from cardiovascular disease,.

Given these adverse effects, the Minamata Convention was established as a binding instrument to regulate, reduce, and eliminate, where possible, the use and flow of mercury in order to protect human health and the environment from the impacts of mercury and mercury compounds.

The Minamata Convention on Mercury was formally adapted on 10 October, 2013. Chad, which has a variety of activities involving the use of mercury, became a signatory of the Minamata Convention on 25 September, 2014 in New York, promulgated LOI No.25/PR/2015 on 19 June, 2015, and signed the ratification instrument on 10 August, 2015.

The ratification instrument was deposited in New York on 24 September, 2015, by a team from the Ministry of Water and Fisheries Environment, of which Chad's National Minamata focal point was a member. This demonstrated Chad's interest in working to reduce the use of mercury and its compounds in order to protect

human health and preserve the environment. Thus, as a signatory state, Chad has benefited from the financial assistance of the Global Environment Fund (GEF) to establish a full inventory of mercury at the national level, identify priorities for action and propose plans for the implementation of the convention.

The Minamata Initial Assessment (MIA) - Chad project aims to carry out various assessments to establish the national situation with regard to the flows of mercury and its compounds, specifically the activities of various sectors, and the mercury emissions and releases that result from these activities.

This document is the final report of this project and it summarizes the results of the assessments conducted, establishes the national profile, identifies and quantifies the categories of mercury sources in the country in the form of a national inventory, and assesses the framework's existing politics, legislation, and institutions. It also presents the impacts on the environment and the population, particularly in terms of exposure and gender. It also outlines awareness-raising actions already carried out or to be undertaken. Finally, it outlines the priorities for actions chosen with their respective intervention plans.

Thus, the final MIA report is thought out and written on the basis of the individual reports of each evaluation. It aims to provide a realistic basis for guiding future actions and investigations for the effective and efficient implementation of the Minamata Convention.

Directorate of Environmental Assessment
Fighting Pollution and Nuisance

Executive Summary

Faced with this growing concern about the potential impacts of mercury use and pollution, the international community mobilized to adopt the Minamata Convention on Mercury on October 10, 2013. The objective of which is to ensure the protection of human health and the environment against emissions and anthropogenic releases of mercury and mercury compounds.

Chad signed the Minamata Convention on September 25, 2014 and ratified it on September 24, 2015. The Convention was enacted on August 16, 2017.

As a signatory to this global treaty, Chad has solicited and obtained funding from the GEF through UNIDO for the preparation of a Minamata Convention Initial Assessments (MIA) that includes national mercury release and mercury-contaminated site inventories. The Biodiversity Research Institute (BRI) and its Center for Mercury Studies acts as the MIA Executing Agency. The Ministry of Environment and Fisheries, represented by its National Minamata Focal Point, is the government structure responsible for overseeing, coordinating and monitoring all activities related to the implementation of the Minamata Convention in Chad.

I. Mercury Inventory

The main objective of the mercury inventory is to collect data on mercury use, emissions and releases, as well as mercury-contaminated sites to establish national policies and strategies to reduce and eliminate atmospheric releases of mercury, thereby ensuring human health and environmental protection from the indiscriminate effects of this chemical. The preparation of this inventory took place over four months (May to September 2018) domestically. The institutions surveyed are public, semi-public, households, customs stations, companies and businesses, economic operators, the Chamber of Commerce, hospitals and health centers,

town halls, laboratories and research institutes, teaching and research institutions, the National Institute for Economic and Demographic Studies (INSEED), the National Agency for Investments and Exports (ANIE), the Agency for Domestic Energy and the Environment (AEDE), the National Renewable Energies Agency (ANER), etc. Data collection cards were developed according to international standards. The collected data were compiled and processed using the dedicated Toolkit.

Findings estimate that the annual input of mercury to society in Chad is around **5,660 kg (Table 1).** Gold extraction with mercury amalgamation leads the way at 2,000 kg Hg/yr (35%), energy production (through charcoal) at 1,436 kg Hg/yr (25%), followed by use and disposal of mercury-containing products 784 kg Hg/yr (14%), waste deposition at 673 kg Hg/yr (12%), wastewater treatment at 394 kg Hg/yr (7%) and waste incineration at 169 kg Hg/yr (3%). In addition, the amount of mercury emitted during the production of other minerals such as cement totals 51 kg Hg/yr (<1%). Since cremation does not exist in Chad, only the number of bodies buried in the public cemeteries has been considered. For this purpose, mercury levels in cemetery soils are estimated at 493 kg Hg/yr (9%) (Table 1).

It is also important to mention that activities such as the intentional use of mercury in industrial processes and the production of other recycled metals (secondary metal production) were not identified during our investigations.

Based on these results, gaps/constraints have been identified and priorities identified for the development of an action plan that revolve around i) strengthening the technical and material capacities of stakeholders, ii) communication/raising awareness among the target populations; iii) promotion of dental restoration materials; iv) establishment of an appropriate legislative, regulatory and legal framework; vi) strengthening the current system of codification and control of products; instruments containing mercury, etc.

Table 1: Total estimated Hg input to Society (kg Hg/yr) and estimated releases (kg Hg/yr).

INVENTORY LEVEL 1 - EXECUTIVE SUMMARY									
Source category	Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y							Percent of total releases *3*4
		Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal	Total releases *3*4*5	
Coal combustion and other coal use	0.6	0.6	0.0	0.0	0.0	0.0	0.0	1	0%
Other fossil fuel and biomass combustion	1,435.7	1,435.7	0.0	0.0	0.0	0.0	0.0	1,436	17%
Oil and gas production	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Primary metal production (excl. gold production by amalgamation)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Gold extraction with mercury amalgamation	2,000.0	400.0	800.0	800.0	0.0	0.0	0.0	2,000	24%
Other materials production*6	50.9	38.2	0.0	0.0	12.7	0.0	0.0	51	1%
Chlor-alkali production with mercury-cells	-	-	-	-	-	-	-	0	0%
Other production of chemicals and polymers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Production of products with mercury content*1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Application, use and disposal of dental amalgam fillings	56.4	1.1	24.8	4.5	3.4	11.3	11.3	56	1%
Use and disposal of other products	783.9	187.4	84.4	193.8	0.0	310.1	8.2	784	10%
Production of recycled metals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Waste incineration and open waste burning*2	1,690.4	1,541.3	0.0	0.0	0.0	0.0	149.1	1,690	20%
Waste deposition*2	14.9	0.1	0.0	0.0	-	-	-	0	0%
Informal dumping of general waste *2*3	6,718.5	671.8	671.8	5,374.8	-	-	-	1,344	16%
Waste water system/treatment *4	3,940.8	0.0	3,546.7	0.0	0.0	394.1	0.0	394	5%
Crematoria and cemeteries	493.3	0.0	0.0	493.3	0.0	0.0	0.0	493	6%
TOTALS (rounded) *1*2*3*4*5*6	**5,660**	**4,280**	**1,580**	**1,490**	**20**	**720**	**170**	**8,250**	**100%**

*See Annex III for footnotes.

In addition, the following sub-categories were not identified during our preliminary inventories:

- coal combustion at large power plants;
- geothermal energy production;
- primary production of mercury;
- zinc extraction and process;
- copper extraction and processing;
- lead extraction and processing;
- gold mining and initial processing by processes other than mercury amalgamation;
- other non-ferrous metals - extraction and transduction;
- pulp and paper production;
- the production of chlorine and caustic soda by mercuric technique;
- the production of vinyl chloride manometer with mercury dichloride (HgCl);
- the production of acetaldehyde with mercuric sulfate (HgSO4);
- mercury metal used in religious rituals and traditional medicine;
- uses of miscellaneous products, mercury metal and other sources;
- the production of recycled ferrous metals (iron and steel);
- the production of recycled mercury (secondary production);
- the production of other recycled metals.

II. Legislative Gap Analysis

Chad faces similar challenges that are common to all new parties to the Minamata Convention, ensuring that the Minamata Convention is properly transposed into its domestic law and identifying gaps and inconsistencies between the Convention and national law. In the course of the legal review, the following conclusions were arrived at:

Within the context of Chad, some parts of the Convention are not immediately relevant and therefore need not be part of the country's priorities in addressing legal gaps. Issues related to supply/mining of mercury (part of Article 3), production of non-ferrous metals and other processes (Article 5), Article 8 (Emissions to air) and majority of activities listed in Annex D are not immediately relevant to Chad.

Two major mercury sources, by-product mercury from oil production and ASGM, however, are present in Chad. Articles 3, 7, 9, 10, and 11 of the Convention are very relevant and apply fully within the Chadian context. Further, Chad is a net importer of MAPs thus Article 3, 10 and 11 are critical obligations that need to be observed.

There is good foundational legislation in Chad to build on, notably:

- The Environment Code, which aims to establish the basic principles according to which the environment is sustainably managed and protected against any form of degradation. Particularly, provisions on the (1) protection of soil and subsoil, (2) waste management, (3) liquid and gaseous effluents and (4) protection against chemicals provides the foundation that will facilitate the implementation of the Convention. Moreover, norms on environmental quality and the establishment of a Special Fund for the Environment will ensure that mercury elimination activities can be realized.

- The Water Code enables the Chadian government to govern its water resources and protect them from any and all mercury releases, while the Mining Code regulates activities relating to the mineral and fossil resources within the territory of Chad. This covers any ASGM operations and the use of mercury in by small-scale gold miners. The Plant Protection Law is crucial in regulating pesticides, particularly mercury-containing pesticides should it enter Chadian territory.

- The implementation of GHS serves as an entry point for the regulation of the importation and export of mercury and mercury-added products.

An examination of the specific obligations under the Convention vis-à-vis Chadian legislations showed critical gaps and challenges that need to be addressed:

- The country does not have any law that directly addresses by-product mercury from oil production.

- As a net importer of MAPs, Chad needs to bolster its current laws in this area.

- ASGM can become a major mercury issue for Chad.

The absence of laws or regulations in Chad to cover Article 10 issues could leave it vulnerable to spillage and accidents due to improper storage of

commodity mercury, especially since Chad as an importer of mercury and MAPs. Moreover, the presence of ASGM in the country could pose as a major demand source for mercury requiring at the minimum strong Art. 10 provisions on storage.

- Environmentally sound management of mercury waste will be a pressing issue for Chad. It will need to update existing regulations as well as ensure that it is following Basel ESM guidelines on mercury waste.

- Preventing toxic waste dumping, including mercury waste is an important issue for Chad.

III. Institutional Gap Analysis

1. Chad is signatory and has ratified the Minamata Convention on Mercury and therefore is obliged to implement the provisions of the Conventions. Based on this Institutional Gap Analyses, the following is considered;

2. Within Chad, several parts of the Convention are not particularly relevant and therefore may not be part of the country's implementation plan. These are related, but not limited to, in-country chemical manufacturing processes such as production of non-ferrous metals and other processes (Article 5) and emissions to air (Article 8);

3. Other articles of the Convention are relevant and apply in Chad. It is likely that Chad is importing mercury-added products, and these would need to be halted by 2020 based on the Convention. In accordance to the Convention, there is a pressing need for a baseline assessment of mercury, called the Minamata Initial Assessment;

4. In terms of institutional and technical capacity, governmental staff who can oversee effective implementation of mercury assessment may be limited in the knowledge needed to meet the obligations of the Minamata Convention and therefore may need expert assistance;

5. Chad requires storage facilities for mercury or mercury containing waste products;

6. From past exercises, there is generally limited education and awareness among stakeholders and the public on chemical related issues. This is in part related to low awareness by stakeholders. Such limitations reduce the ability of national plans to be effectively executed. Therefore, an education and media plan is a key component of a future information communication.

Introduction

Mercury is a highly toxic substance with adverse effects to humans, ecosystem and wildlife. While initially seen as an acute, localized hazard, mercury pollution is now also established to pose chronic toxicity exposure diffused to the greater population in the global scale. The first Global Mercury Assessment conducted by the United Nations Environmental Programme (UNEP) in 2002[1] showed that environmental mercury levels have increased significantly since the industrial age due to anthropogenic emissions.[2] The most significant release of mercury is through the air, where it can be transported globally to regions far from the emission source. Once mercury is released to the environment, it persists and circulates among air, water, sediments, soil and biota in different forms.

Sufficient evidence of the significant and adverse impacts of mercury established in the Global Mercury Assessment led to a call for global action towards adopting mechanisms to reduce mercury emissions. In 2009, the UNEP Governing Council recognized that voluntary actions were not enough to address concerns caused by mercury. Thus, the UNEP Governing Council led the discussions on the formulation of a legally binding international agreement by establishing an Intergovernmental Negotiating Committee (INC) to determine interventions against mercury. The first INC meeting was held in 2010. It took five INC meetings to finally reach an agreement on January 19, 2013 in Geneva Switzerland. The final draft of the treaty was adopted on October 10, 2013—this document is known as the Minamata Convention on Mercury.

---

[1] UNEP, 2013. Global Mercury Assessment 2013: Sources, Emissions, Releases and Environmental Transport. UNEP Chemicals Branch, Geneva, Switzerland, available at: http://www.unep.org/PDF/PressReleases/GlobalMercuryAssessment2013.pdf.

[2] *Id*. at 31. Note, mercury is the only metal that exists in liquid form at low temperatures and has a boiling point of 356.6oC. It can be found in metal form such as mercury salts or as organic mercury compounds. Mercury rarely occurs free in nature and is usually found in cinnabar ores as HgS. Due to its unique properties, mercury has been heavily used in different industries. Elemental mercury is usually used in small-scale mining activities. It is also used in the manufacture of other chemicals, batteries, fluorescent lights, thermometers and barometers. Although mercury has its many uses, it is found to be highly toxic to the human health and persists in the environment, thus efforts to reduce and eventually eliminate its use are now being undertaken.

I. Background of the Study

This report is part of the UNIDO-GEF Project, entitled, "Minamata Convention Initial Assessment in Chad" (Project) with the Biodiversity Research Institute (BRI) as the Executing Agent. The Project is part of Chad's Minamata Initial Assessment (MIA) activity.

II. The Minamata Convention on Mercury

The Minamata Convention on Mercury (Convention) is a major international development in controlling the harmful effects of mercury pollution. It is the latest treaty on chemicals and wastes and is unique because of its scope and approach. 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*".[3] This reflects the results of UNEP's Global Mercury Assessment conducted in 2002 and later updated in 2013. The Convention presents a comprehensive approach on the management of mercury and covers the following stages of its life cycle:

1. Mercury supply sources and trade (Article 3);
2. Mercury-added products (Article 4);
3. Manufacturing process in which mercury or mercury compounds are used (Article 5);
4. Artisanal and small-scale gold mining (ASGM) (Article 7);
5. Emissions (to air) (Article 8);
6. Releases (to land and water) (Article 9);
7. Environmentally sound interim storage of mercury, other than mercury waste (Article 10);
8. Mercury wastes (Article 11);
9. Contaminated sites (Article 12);
10. Health aspects (Article 16).

The Convention also establishes certain mechanisms that will help countries comply with their obligations. These include:

11. Financial Resources and Mechanism (Article 13);

[3] Article 1, Minamata Convention on Mercury, October 10, 2013, available at: https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-17&chapter=27&lang=en.

12. Capacity-Building, Technical Assistance, and Technology Transfer (Article 14);
13. Implementation and Compliance Committee (Article 15);
14. Information Exchange (Article 17);
15. Public Information, Awareness, and Education (Article 18);
16. Research, Development, and Monitoring (Article 19);
17. Implementation Plans (Article 20).

The Republic of Chad signed the Convention on September 25, 2014 and ratified the Convention on September 24, 2015.

In Chad, various mercury-containing products and items are widely used, despite the toxic nature of this contaminant. In recent years, mercury-containing products such as thermostats, thermometers, fluorescent lamps, pressure measuring instruments and dental amalgam have been used for residential, commercial, industrial and institutional purposes. Mercury, in its elemental form, is currently used in artisanal and small-scale gold mining. The Moyo-Kebbi-West Region (Pala), located in the south-west of Chad, the Batha Region, in the Center of the country (Ati) and the regions of Borkou, Ennedi and Tibesti (BET) in the North of Chad, are the areas where the Orpallaige activities are more developed.

Mercury is the only metal that exists in nature in a liquid state. However, depending on the environmental conditions, it can be in three forms (elemental, inorganic and organic). Released into the atmosphere, mercury can travel long distances, be transported by air currents across borders before settling in soil, sediment and water, which it pollutes and contaminates. This is why it is a global problem.

After signing the Minamata Convention on September 25, 2014 and ratifying it on September 24, 2015, Chad conducted a Minamata Initial Assessment (MIA). Thanks to technical and financial support from the Global Environment Facility (GEF), through the United Nations Industrial Development Organization (UNIDO), Chad undertook the implementation of enabling activities, including mercury release and mercury contaminated site inventory. It is within the framework of

the Minamata Initial Assessments (MIA) that this inventory was carried out with the technical support from Biodiversity Research Institute (BRI) and its Center on Mercury Studies, as the Executing Agency of the MIA.

The MIA has four key outputs:

1. Development of a national mercury profile that includes key sectors identified for intervention and investment to reduce, and where possible eliminate, mercury use, release and emissions;

2. Review and identification of gaps in existing legislation related to mercury and identification of needed policy reforms for preparation of the implementation of the Minamata Convention;

3. Identification of institutional gaps and establishment of a national steering committee to coordinate activities related to the convention;

4. Development of communication tools and strategies for informing all relevant stakeholder groups, including governmental agencies, NGOs, academia, public and private sectors; on activities related to the Convention.

For the mercury inventory work, three national experts were mobilized in support of the Focal Point of the Minamata Convention on Mercury. They include the health and education expert, the trade and industry expert and the contaminated sites expert. Following their recruitment, these experts involved technical teams responsible for collecting data in the various activity sectors. Standard data collection sheets provided by UNEP and BRI, adapted to the national context, and were used for this purpose.

The methodology used consists of meetings with various institutions based in N'Djamena and in major urban centers in the interior of the country. A literature review (literature search) on the subject and field visits were conducted to gather information on how mercury and mercury-containing instruments are being used, but also, and above all, to identify poor practices and behaviors that are harmful to human health and the environment. Finally, the data collected were supplemented by interviews with local stakeholders, including gold washers, health care personnel, hygiene officers in town halls, laboratory

technicians, managers of industrial companies, etc. These meetings allowed for the hearing of expectations, suggestions, and concerns to collect additional data in case of need.

With note No. 176/PR/PM/MEEP/SG/PFMM/2018 of May 07, 2018 the General Secretariat of the Ministry in charge of the environment informed all the institutions concerned about the progress of the inventory operations and educate them about inventory operations.

After the preparatory phase, inventory teams traveled across the country to collect data from the structures involved. The data was compiled, analyzed and processed at the National Ozone Office. Inventory data show that the main sources of emissions and releases of mercury are (1) gold extraction with mercury amalgamation, (2) charcoal combustion, and (3) the consumer products sector that intentionally contain mercury. The inventory provided useful information for the development of a policy and action plan for the reduction and/or elimination of mercury releases.

As a result of this inventory work, a national mercury management action plan will be generated and will constitute the roadmap for a better resolution of the issue. This report is structured in five chapters: (1) general introduction of Chad, (2) a detailed inventory of mercury, (3) the legislative and institutional gap analyses, (4) opulations at risk and gender dimensions regarding mercury, (5) awareness raising of target populations of concern and (6) a national action plan.

Chapter I: National Background Information

This part presents, in a general way, the geographic situation of the country, the population and the growth demographics, as well as the socio-economic conditions in which Chad's population lives, highlighting access to electricity and sources of energy.

1.1 Bioclimatic Data

Chad is the fifth largest country in Africa with an area of 1,284,000 km^2. It borders the following countries: The Central African Republic, Cameroon, Nigeria, Niger, Libya and Sudan (Figure 1). It extends south to north over 1700 km and from west to east over 1200 km, marked by a very strong continental climate.

In terms of climate, it has three bioclimatic zones with varied rainfall. In the North lies the Saharan zone, which covers nearly 780,000 km2 and covers about 50% of the country's area. The Center is the Sahelian zone of the country, which covers an area of 374,000 km^2. The South is occupied by the Sudanian zone which occupies an area of approximately 130,000 km^2. The intensity of the global radiation varies on average from 4.5 to 6.5 kWh/m2/d. As for wind energy, the average wind speed varies from 2.5 m/s to 5 m/s from south to north.

Climate change over the past four decades has weakened natural ecosystems and compromised the country's economic development. The negative impacts of climatic disturbances are manifested by the drying up and narrowing of rivers such as Lake Chad, the area of which has considerably decreased, from 25,000 km^2 in the early 1960s to less than 2.5 km^2 now. Decreasing and poorly distributed rainfall has negatively impacted production and led to the loss of biodiversity. Across the country, people suffer from excessive heat waves and are exposed to the adverse effects of high winds.

In view of the disturbing deterioration of the living environment of the population, especially the population living in rural areas, the Government of the Republic of Chad has made environmental protection one of the priority areas for its development and welcomes any initiative aimed at the restoration of ecosystems to improve the living conditions of current and future generations.



Figure 1: Administrative Map of Chad

1.2 Population and Population Growth

The population is unevenly disbursed in this vast territory. The last General Census of the Population and Housing (RGPH 2), carried out in 2009, showed a total population of 11,039,873 people. The growth rate is 3.5%. The density of the population is 8.6 h/km^2. Thus, the Chadian population is estimated at about 13 million inhabitants (2015); the population number used for this inventory is 13,821,921. Women and men account for 50.7 percent and 49.3 percent of the total population (RGPH, 2009).

1.3 Socio-economic Data

The Government formulated and implemented, in the early 2000s, two National Poverty Reduction Strategies (NPRS 1 and 2) for 2003-2007 and 2008-2011. Then the National Development Plan (PND) (2013-2015) was developed to accelerate the improvement of living conditions of populations, as well as progress towards the achievement of the Millennium Development Goals (MDGs).

In social terms, the proportion of the Chadian population living below the poverty line decreased from 55% in 2003 to 46% in 2011 (ECOSIT 3, INSEED 2014). In addition, life expectancy at birth has increased from 49.6 to 51.4 years between 2010 and 2014 (HDR, 2015). Infant-juvenile mortality decreased from 191 to 123/1000 (EDS-MICS, 2014-2015). Despite an improvement in the net enrollment rate (63.6% between 2015 and 39% in 2000) and a completion rate for the primary cycle (50.8% in 2015 compared with 23% in 2000), the level of education of the population (illiteracy rate of 22.40%, 14% of which are women in 2009) remains one of the lowest in Africa.

The Human Development Index (HDI) has also risen over the last five years (Table 1). It was 0.392 in 2015, up 5.9% compared to 2012. In 2015, Chad is committed to achieving the Sustainable Development Goals (SDGs) during the 2016-2030 period as proposed by the United Nations.

Table 1: Evolution of the components of the HDI.

Life expectancy at birth	**Years**			
	2011	2012	2013	2014
	50.4	50.8	51.2	51.6
Expected duration of schooling	7.2	7.4	7.4	7.4
Average duration of enrollment	1.5	1.5	1.9	1.9
HDI	0.382	0.386	0.388	0.392

Source: World Bank 2008-2016

Economic progress has resulted in an average growth rate of 5% in 2010 and 2015 as well as a slight improvement in the business climate. Agriculture, the mainstay of the country's economy, remains subject to often erratic rain, which effects agricultural yields. The persistence of the drought has led to a strong migration of populations from the North to the South. These changes in production patterns also show how much successive climatic shocks have increased the vulnerability of the country's production systems.

More recently, Chad's economic environment has been marked by the fall in the price of a barrel of oil and the insecurity caused by terrorism in the Lake Chad Basin. Despite these two exogenous shocks that negatively impacted the management of public finances, economic growth was 6.4% in 2014, against 0.9% in 2013.The average GDP growth rate for the period from 2011-2013 (3.1%) was driven in part by increased public and private investment in line with the provisions of the 2013-2015 GDP. However, over the last three years, Chad has improved its Doing Business ranking, which rose to 183rd out of 189 countries in 2016 compared to 189th out of 189 countries in 2013 (Table 2).

Table 2: Doing Business Ranking of Chad (2008-2016)

Years	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Doing Business Ranking	173th /178	175th /181	183th /183	183th /183	183th /183	184th /189	189th /189	185th /189	183th /189

Source: World Bank (Doing Business Reports, World Bank 2008-2016).

Data on Gross Domestic Product (GDP) show that even though GDP has increased through oil exploitation, this rise in GDP is still unstable. Indeed, according to the National Strategy for Growth and Poverty Reduction document (SNCRP2), in 2008, on average, an 18.7% growth rate of oil GDP and a per capita growth rate of 15.6% were recorded. Non-oil GDP, on the other hand, grew at an accelerated pace of 6.4% for the same period. The decline in oil production also affected the growth of oil GDP, which is only 0.5%, as was the decline in non-oil GDP to 4.4% in 2006, which GDP will weaken in 2007 to stand at around 3.6%.

These macroeconomic data reveal that the population of Chad lives in conditions of extreme poverty. According to the National Development Program (**NDP**), Chad is living in a declining monetary poverty since the strong growth recorded in recent years has not been inclusive, that is it has not benefited the country in the same way in all economic sectors, in all regions, and in all categories of the population. This growth has not benefited many, especially young people who have remained unemployed or underemployed.

According to the results of the Third Survey of Consumption and the Informal Sector in Chad (ECOSIT 3) of 2011, just under half of the Chadian population (46.7%) lives in a state of extreme monetary poverty with a daily consumption expenditure equal to 652 CFA francs, compared to 55% in 2003 with a considerable difference between urban and rural areas: 25% compared to 59%. Between 2003 and 2011, poverty was at a little over 8 points.

Overall, poverty declined in most parts of Chad from 2003 to 2011, except for the region of Logone Occidental (poverty increased from 57.6% to 66.4%) and Tandjilé (from 62.1% to 65.3%). The capital N'Djamena recorded a sharp drop in poverty, where the rate went from 20.8% in 2003 to 11.0% in 2011.

Poverty also refers to the inability of an individual to find a decent job and to access basic social services. According to several sources (ECOSIT 2 in 2003, Ministry of Economy in 2000, etc.), the most widespread forms of poverty in Chad are related to the vulnerability of human existence, lack of infrastructure, lack of convenience and infrastructure, inadequate good governance, inaccessibility to health care, isolation of the country, lack of drinking water, under-nourishment, low levels of primary schooling, and the misallocation of resources. This form of poverty is more difficult to apprehend, and its evolution is often a source of comparison. In the absence of a powerful indicator of non-monetary poverty, the Human Development Index (HDI) of the United Nations Development Program (UNDP) is often used. Chad ranks among the top 10 countries in the world's lowest HDI rankings.

In terms of economic growth, the challenge is to raise the rate of change to at least 7% per annum over the 2013-2015 period in order to boost GDP per capita growth to over 3 % per year and put Chad on the trajectory of emergence and sustainable development (PND 2013-2015). This requires the mobilization of internal and external financial resources; skills and capabilities to diversify the economy; develop and modernize agriculture and livestock; develop SMEs, facilitate the development of the oil and mining sector. Efforts should be made to improve productivity, develop an offer of value-added goods and services, invest in research and development (R&D), promote traditional trades to young people, provide training trades and development, to support and encourage the agri-food processing industry, to continue efforts to build basic infrastructure (roads, energy, hydraulics, ICT, land-use planning, etc.) and to resolute policy to control demographic dynamics.

The will of the country's highest authorities is to make Chad "an emerging regional power by 2030, driven by diversified and sustainable sources of growth, creating added value and jobs and ensuring every Chadian has adequate access to basic social services, decent housing and adequate training." The in-depth reflection on this vision began in early 2013. It will involve adopting a

vision document capable of guiding the transformation of Chadian society in the medium and long term with clear programming.

1.4 Energy Situation and Sources of the Energy Supply in Chad

In general, 96.6% (RGPH.2, 2009) of households or 96.9% of the population use wood-related products for cooking, either in the form of firewood, charcoal, or plant materials. This strong demand for wood reflects the increasing pressure of the population on the vegetation. Other sources of cooking energy are: 1.8% petroleum and 0.6% gas. According to this census, the main mode of lighting is the kerosene lamp (50.7%). The flashlight and electricity network are in second place, used in 38.8% and 2.6% of households respectively. In 2009, other sources of lighting were introduced: battery-operated (38.8%), solar panel (0.1%), generator (1.0%) and gas lamp (0.5%). To alleviate this situation, the Government has drawn up an energy policy in Chad through the "Strategy Improvement Plan for Energy Management and Governance."

The overall objective is to develop a more economical and reliable system for producing, transporting and distributing electrical energy and to promote alternative clean energies to protect the environment her. The specific objectives are to:

- Make electricity accessible for most of the population;
- Facilitate access to butane gas and its equipment in all households to supplement wood and its derivatives;
- Promote renewable energies (solar and wind) by offering facilities of all kinds and facilitating access to these energies for all households;
- Open the energy sector.

The National Electricity Company (**SNE**) is the main public operator in this sector. Eta holds 81% of the capital and it ensures the production and distribution of electricity in large cities such as N'Djamena, Moundou, Abeche, Bongor, Doba,

Sarh, Faya, etc. The electric production fleet consists of plants fueled only by diesel.

From the legislative and regulatory point of view, Law No. 14/PR/99 of June 15, 1999 on the production, transmission, and distribution of electrical energy allows the management of this sector by independent producers in order to encourage private investment.

The Ministry of Petroleum and Energy is responsible for the energy sector and coordinates the country's energy policy. The Ministry of Finance sets the tax on energy products. The Ministry of Trade and Industry is involved in the control and pricing of petroleum products and electricity tariffs.

Indicators and targets for access to energy services are summarized in Table 3. The projected access rate for electricity in 2030 is 45%, while the gas rate is 30%. These two objectives will be achieved through the installation of the Djarmaya refinery which produces energy and enough gas of all kinds to supply the capital N'Djamena and some cities in the interior of the country.

Table 3: Indicators and Energy Access Rates (2011-2015) and Projections for 2030

Target Indicators	2011 Level	2015 Level	2030 Level
Electricity Access Rate	3.7 %	5.0 %	45 %
Gas Access Rate	2.0 %	3.5 %	30.0 %

Source: Chad's National Report on Access to Energy Services, 2013.

Sources of energy supply include the oil sector, hydrocarbons, renewable resources (biomass, wind and solar). Started in 2003, oil production, with its seven oil basins, provides significant amounts of hydrocarbons variously used in lighting cities, energy, air conditioning and refrigeration in households, public and private services, etc.

The use of petroleum resources has significantly improved the activities of public and private institutions, but also to many households. Thus, during the period from 2008 to 2011, consumption of petroleum products was around 878,049,500 liters (Table 4).

Table 4: Consumption of petroleum products between 2008 and 2011 (thousands of liters)

Years	Diesel	Super	Lamp Oil	Total
2008	101,090,915	29,725,889	1,699,641	**132,516,445**
2009	189,905761	34,599,265	1,536,019	**226,041,045**
2010	203,591,148	42,126,549	1,659,403	**247,377,100**
2011	223,950,263	46,339,304	1,825,343	**272,114,910**
Total	**718,538,087**	**152,791,007**	**6,720,406**	**878,049,500**

Source: Petroleum Sector Regulatory Authority, 2013.

It should be noted that all power production is 210 MW thermal, of which 120 MW is to supply the oil fields, 20 MW to supply the Djarmaya refinery and 70 MW for the rest of the country (including 64 MW in N'Djamena). A new 10 MW plant was installed to supply the Baouré Cement Plant for 200 Kt, inaugurated in 2012. A new 21 MW plant was commissioned in 2006 and an additional 40 MW was added in 2011, of which 20 MW to supply the new Djarmaya Refinery and 20 MW for the city of N'Djamena. Despite this new facility, power generation is progressing slowly due to inconsistent fuel supplies, high electrical losses due to outdated transmission facilities and the cost of distribution of the National Electricity Company (US $52)/KWh). The country has the lowest per capita energy consumption in the world (0.16 tep) and 9 kWh of electricity. This low energy consumption has a negative impact on other business sectors. The price of KWh, which varies between 84 and 120 FCFA, is one of the most expensive in the CEMAC sub-region.

1.5 Environmental Data

Potential

Despite the recurring droughts that occurred in the 1970s and 1980s, the consequences of which have been detrimental for the population and ecosystems, Chad has enormous natural resources potential, including:

- 23 million hectares of natural forests;
- 3 National Parks and 7 Wildlife Reserves (which occupy 10% of the national territory);
- 80 million hectares of natural pastures;
- 39 million heactares of cultivable lands;
- 19 million heactares of irrigated lands;
- Several fishing areas (with 80,000 to 120,000 tons of fish per year);
- 80,00 tons of Arabic gum picked annually.

In order to achieve sustainable management of these natural resources, the Government has developed a national environmental policy, which underpins laws no. 014 of 1998 and no. 014 of 2008.

1.6 Analysis of the Institutional, Legislative Framework, Regulatory and Legal Framework on the Environment

According to the Constitution of Chad of May 4, 2018, every citizen has the right to a healthy environment (Article 51) and the State and the Autonomous Communities must ensure the protection of the environment (Article 52). According to this Constitution, the conditions of storage, handling and disposal of toxic or polluting wastes from national activities are determined by the Law. Thus, the transit, import, storage, landfill, dumping on the national territory of toxic waste or foreign pollutants are prohibited.

Everyone is responsible for protecting the environment. The State and Autonomous Communities oversee the defense and protection of the environment. Any damage to the environment must be the subject of fair compensation (Article 57). Although environmental issues are shared among several institutions, responsibility for the environmental component has been given to a Ministry, which is responsible for leading the Government's environmental policy. Thus, the Ministry of Environment and Fisheries was created in the 90s in place of the Ministry of Water and Forests and Hunting. Outside of

this Ministry, there is also the High National Committee for the Environment (HCNE), which acts as the supreme body that can decide on all questions relating to the environment. In order to improve efficiency in actions, the Ministry in charge of the environment has created Technical Departments to make the government's environmental policy effective. This includes the:

- Environmental Assessments and Pollution and Nuisance Management Department (DEELCPN);
- Change (DEELCCC);
- Forestry and Desertification Control Directorate (DFLCD);
- Directorate of Fisheries (DPA);
- Department of National Parks and Wildlife Reserves (DPNRF);
- Department of Studies, Planning and Monitoring (DEPS).

Other environmental structures have also been put in place within the country.

1.7 Chad's Commitments in Relation to International Conventions

Concerned with ensuring the protection of its environment, Chad is the signatory of several environmental agreements, treaties, protocols and conventions – including:

- United Nations Framework Convention on Climate Change (UNFCCC);
- United Nations Convention on Biological Diversity (CNDB);
- United Nations Convention to Combat Desertfication (CNLCD);
- Stockholm Convention on Persistent Organic Pollutants (POPs);
- Basel Convention on Transboundary Movements of Hazardous Wastes;
- Rotterdam Convention on Prior Informed Consent;
- Convention of Vienna for the Protection of the Ozone Layer.

It also signed and ratified the Minamata Convention on Mercury on September 25, 2014 and September 24, 2015, respectively.

Chapter II: Mercury Inventory and Identification of Emissions and Resources

Findings estimate that the annual input of mercury to society in Chad is around 5,660 kg (Table 1). Gold extraction with mercury amalgamation leads the way at 2,000 kg Hg/yr (35%), energy production (through charcoal) at 1,436 kg Hg/yr (25%), followed by use and disposal of mercury-containing products 784 kg Hg/yr (14%), landfills at 673 kg Hg/yr (12%), wastewater treatment at 394 kg Hg/yr (7%) and waste incineration at 169 kg Hg/yr (3%). In addition, the amount of mercury emitted during the production of other minerals such as cement totals 51 kg Hg/yr (<1%). Since cremation does not exist in Chad, only the number of bodies buried in the public cemeteries has been considered. For this purpose, mercury levels in cemetery soils are estimated at 493 kg Hg/yr (9%) (Table 1).

2.1 Identification and Selection of Categories and Subcategories of Major Sources of Mercury Releases

Several multi-stakeholder meetings have identified the categories and subcategories in which mercury and its compounds are used and identified potential sources of emissions and releases of mercury and its compounds into the atmosphere. The following shows the possible categories and sub-categories (Table 2.1).

Table 2.1: Identification and selection of categories and subcategories

No	Categories	Subcategories	Situation in Chad	Observations
01	**Extraction and use of fuel/energy sources**	Use of coal combustion at large power plants;	No	This business does not exist in Chad.
		Use of biomass in energy and heat production	Yes	Bagasse and charcoal, cotton hull, peanut hull used in Chad
		Other carbon use	Yes	Coal used in furnaces, cement, cooking, etc.
		Use of other fossil fuels-extraction and use	No	Not known in the country. Chad does not produce and does not import peat and shale
		Extraction, refining and use of natural gas and liquefied gas	Yes	This is butane and liquefied petroleum gas (LPG) used for the generation of electricity and heat in Chad
		Extraction, refining and use of petroleum	Yes	Petroleum used for the production of energy and heat
		Production of geothermal energy	No	The Gauthio Falls are no longer used. No available data
02	**Primary production of metal (virgin)**	Primary production of mercury	No	Chad does not produce mercury.
		Extraction of copper and transformation.	No	This business does not exist in Chad.
		Extraction of gold and silver with the mercury amalgamation process	Yes	Artisanal and small-scale gold mining using mercury
		Extraction of zinc and transformation.	No	This business does not exist in Chad.
		Extraction and processing of gold by other processes	No	This business does not exist in Chad.
		Extraction and transformation of aluminium	No.	This business does not exist in Chad.
		Extraction and transformation with other non-ferrous materials.	No.	This business does not exist in Chad.
		Extraction of lead and transformation.	No.	This business does not exist in Chad.
03	**Production of other minerals and materials**	Production of lime	No.	Chad does not produce lime.
		Cement production	Yes	Chad has two cement plants in Baouré and Djermaya

	containing trace-amounts of mercury	Pulp and paper production	No	Chad does not produce pulp and paper.
04	**Intentional use of mercury as an auxiliary material in industry**	Alkali Chlorine Production with Mercury Technology	No	Chad does not have any industry for the production of chemicals
		Production of vinyl chloride manometer (VCM) with mercury dichloride ($HgcCl_2$) as a catalyst	No	Chad does not have any industry for this production
		Production of acetaldehyde with mercury sulphate ($HgSO_4$) as a catalyst	No	Chad has no industry to produce this chemical substance.
		Other productions of chemical substances and polymers with mercury compounds as catalysts	No	Chad does not have industries to produce various chemical substances
05	**Consumer products intentionally containing mercury**	Mercury thermometers	Yes	Thermometers are used in various ways to take the temperature
		Switches	Yes	These are the switches used to regulate the flow of electricity
		Mercury lamps (fluorescent tube lamps, fluorescent lamps, mercury-vapor lamps, etc.)	Yes	There is considerable variety in mercury light sources such as lamps used to illuminate different environments
		Electric batteries containing mercury	Yes	Some batteries used in Chad may contain mercury. Batteries contained in watches, bracelets, hearing aids, calculators, and in various laboratory instruments, hospitals and military installations contain mercury.
		Paints	Yes	Paints contain mercury to prevent painted surfaces from growing mold.
		Pharmaceutical products for human and veterinary use	No	Mercury is used in certain pharmaceutical products such as vaccines, eye drops, etc.
		Biocides and pesticides	Yes	In Chad, pesticides and disinfectants are used to control insects that destroy seeds and other products

		Cosmetics and related products	Yes	Mercury is present in creams, soaps and in other products. Chad imports these products from abroad.
06	**Other uses of products and/or processes with mercury**	Dental amalgamation and sealing	Yes	Several dentists' offices exist in the country and use an alloy of mercury, silver, lead and tin to fill cavities.
		Manometers and tensiometers	Yes	In Chad, these tools are used to measure blood pressure and tension. They may contain mercury.
		Chemicals and Laboratory Equipment	Yes	Laboratory instruments, reagents, preservatives and catalysts may contain mercury. However, the data is not available.
		Metallic mercury used in rituals and traditional medicine	No	In Chad, there is no use of mercury in cultural and religious activities. Therefore, there is no data.
		Other uses of miscellaneous products, mercury metal and other sources	No	In Chad, no information is available for this kind of mercury use contained in infrared semi-conductors.
07	**Production of recycled metals (secondary metal production)**	Production of recycled mercury (secondary production);	No	This business does not exist in Chad. Therefore, there is no information.
		Production of ferrous metals (iron and steel)	No	This activity does not exist in Chad. No information.
		Production of other recycled metals	No	Not applicable in Chad. No information.
08	**Waste incineration**	Incineration of household waste	Yes	Yes, open burning
		Incineration of medical waste	Yes	Open burning
		Incineration of hazardous industrial waste	Yes	All industrial plants do not have appropriate incinerators. For this reason, they use open burning
09	**Landfill and wastewater treatment**	Incineration of household waste	Yes	Burial of public waste
		Incineration of medical waste	Yes	There, there is waste generated by sanitary activities that are buried.
		Industrial hazardous waste landfills	Yes	All industrial plants do not have appropriate controlled incinerators. This is why the open burning is done.

				Incinerated industrial waste residues are buried in the soil
		Wastewater treatment	Yes	Considerable quantities of municipal wastewater are treated.
10	**Crematorium and cemeteries**	Cemeteries	Yes	Physical remains including teeth sealed with mercury amalgam are brought to the cemetery to be buried
		Crematorium	No	This practice does not exist in Chad. There is no incineration of human remains. Therefore, there is no information.

The categories of the main sources of mercury releases or Chad are summarized in Table 2.2.

Table 2.2: Categories of the main sources of emissions and releases of mercury

No.	Categories of the main sources	Situation in Chad
01	Extraction and use of fuel/energy sources	Yes
02	Primary Production of Metal (unprinted)	Yes
03	Production of other minerals and materials containing mercury impurities	Yes
04	Intentional use of mercury as an auxiliary material in industrial processes	No
05	Consumer products intentionally containing mercury	Yes
06	Other uses of products and/or processes with mercury	Yes
07	Production of recycled metals (secondary metal production)	No
08	Waste incineration	Yes
09	Burial of waste	Yes
10	Crematorium	No
11	Cemeteries	Yes

After identifying the main sources of the categories of waste, the following sub-categories have been selected for Chad (Tables 2.3-2.12).

Table 2.3: Category 1 Extraction and use of fuel/energy sources

No.	Subcategories	Situation in Chad	Observations

01	Use of coal combustion at large power plants;	No	This business does not exist in Chad.
02	Use of biomass in energy and heat production	Yes	Bagasse and charcoal, cotton hull, peanut hull used in Chad
03	Other carbon use	Yes	Coal used in furnaces, cement, cooking, etc.
04	Use of other fossil fuels-extraction and use	No	Not known in the country. Chad does not produce and does not import peat and shale
05	Extraction, refining and use of natural gas and liquefied gas	Yes	This is butane and liquefied petroleum gas (LPG) used for the generation of electricity and heat in Chad
06	Extraction, refining and use of petroleum	Yes	Petroleum used for the production of energy and heat
07	Geothermal energy production	No	The Gauthio Falls in Mayo-Kebbi are no longer used. No available data

Table 2.4: Category 2: Primary Production of Metal

No.	Subcategories	Situation in Chad	Observations
01	Primary production of mercury	No	Chad does not produce mercury.
02	Extraction of copper and transformation.	No	This business does not exist in Chad.
03	Extraction of gold and silver by mercury amalgamation process	Yes	Artisanal and small-scale gold mining using mercury
04	Extraction of zinc and transformation.	No	This business does not exist in Chad.
05	Extraction and processing of gold by other processes	No	This business does not exist in Chad.
06	Extraction and transformation of aluminum	No	This business does not exist in Chad.
07	Extraction and transformation with other non-ferrous materials.	No	This business does not exist in Chad.
08	Extraction of lead and transformation.	No	This business does not exist in Chad.

Table 2.5: Category 3: Production of other minerals and materials containing trace-amounts of mercury

No.	Subcategories	Situation in Chad	Observations
01	Production of lime	No	Chad does not produce lime.

02	Cement production	Yes	Chad has two cement plants in Baouré and Djermaya
03	Pulp and paper production	No	Chad does not produce pulp and paper.

Table 2.6: Category 4: Intentional use of mercury as an auxiliary material in industry

No.	Subcategories	Situation in Chad	Observations
01	Alkali Chlorine Production with Mercury Technology	No	Chad does not have any industry for the production of chemicals
02	Production of vinyl chloride manometer (VCM) with mercury dichloride (HgcCl2) as a catalyst	No	Chad does not have any industry for this production
03	Production of acetaldehyde with mercury sulphate (HgSO4) as a catalyst	No	Chad does not have any industry for this production
04	Other productions of chemical substances and polymers with mercury compounds as catalysts	No	Chad does not have industries to produce various chemical substances

Table 2.7: Category 5: Use of products intentionally containing mercury

No.	Subcategories	Situation in Chad	Observations
01	Mercury thermometers	Yes	Thermometers are used in various ways to take the temperature
02	Switches	Yes	These are the switches used to regulate the flow of electricity
03	Mercury lamps (fluorescent tube lamps, fluorescent lamps, mercury-vapor lamps, etc.)	Yes	There is considerable variety in mercury light sources such as lamps used to illuminate different environments
04	Electric batteries containing mercury	Yes	Some batteries used in Chad may contain mercury. Batteries contained in watches, bracelets, hearing aids, calculators, and in various laboratory instruments, hospitals and military installations contain mercury.
05	Paints	Yes	Paints contain mercury to prevent painted surfaces from growing mold and fungi.
06	Pharmaceutical products for human and veterinary use	Yes	Mercury is used in certain pharmaceutical products such as vaccines, eye drops, etc.
07	Biocides and pesticides	Yes	In Chad, pesticides and disinfectants are used to control insects that destroy seeds and other products

08	Cosmetics and related products	Yes	Mercury is present in creams, soaps and in other products. Chad imports these products from abroad.

Table 2.8: Category 6: Other uses of products and/or processes with mercury

No.	Subcategories	Situation in Chad	Observations
01	Dental amalgamation and sealing	Yes	Several dentists' offices exist in the country and use an alloy of mercury, silver, lead and tin to fil cavities.
02	Manometers and tensiometers	Yes	In Chad, these tools are used to measure blood pressure and tension. They contain mercury.
03	Chemicals and Laboratory Equipment	No	Laboratory instruments and equipment, reagents, preservatives and catalysts may contain mercury. However, the data is not available.
04	Metallic mercury used in rituals and traditional medicine	No	In Chad, there is no use of mercury in cultural and religious activities. There is no data for this point.
05	Other uses and sources	No	In Chad, no information is available for this kind of mercury use contained in infrared semi-conductors.

Table 2.9: Category 7: Production of recycled metals (secondary metal production)

No.	Subcategories	Situation in Chad	Observations
01	Production of recycled mercury (secondary production);	No	This business does not exist in Chad. There is no data for this point.
02	Production of ferrous metals (iron, steel)	No	This business does not exist in Chad. There is no data for this point.
03	Production of other recycled metals	No	This business does not exist in Chad. There is no data for this point.

Table 2.10: Category 8: Waste incineration

No.	Subcategories	Situation in Chad	Observations
01	Incineration of household waste (municipal waste)	Yes	Incinerate of waste outside cities
02	Incineration of medical waste	Yes	Incineration of waste in hospital furnaces
03	Incineration of hazardous industrial waste	Yes	All industrial plants do not have appropriate incinerators. For this reason, they use open burning of sludge and hydrocarbon waste

Table 2.11: Category 9: Landfill and wastewater treatment

No.	Subcategories	Situation in Chad	Observations
01	Burial of household waste (municipal waste)	Yes	Burial of public waste
02	Incineration of medical waste	Yes	There is waste generated by sanitary activities that are buried.
03	Industrial hazardous waste landfills	Yes	Incinerated industrial waste residues are buried in the soil
04	Wastewater treatment	Yes	Considerable quantities of municipal wastewater are treated.

Table 2.12: Category 10: Crematorium and cemeteries

No.	Subcategories	Situation in Chad	Observations
01	Crematorium	No	This practice does not exist in Chad. There is no incineration of human remains. No available data
02	Cemeteries	Yes	According to the MSP statistics, physical remains with teeth are sealed with mercury and are buried.

2.2 Preparatory Inventory Activities

2.2.1 Inventory Tools Design

Based on the Toolkit forms, the experts developed data sheets on the categories and sub-categories of the main sources of mercury releases. The sectors and sub-sectors affected by these inventories are the energy sector, the mining sector (traditional gold panning), public health (dental amalgamation and crematorium), waste, and equipment consumption, and articles containing mercury, industrial items, etc. The files have been designed to collect data for the last four years (2015, 2016, 2017 and 2018). All these sheets are attached to this report.

2.2.2 Establishment of Inventory Teams

After developing data sheets for the collection of atmospheric mercury release data, teams of investigators were used to carry out the inventory in question. Each team is led by a manager and includes five to six other members. These teams traveled across the country to cover all the business sectors.

2.2.3 Training Inventory Teams

The "National Inception Workshop and Mercury Inventory Toolkit Training" was held on 7-9 March 2016 in N'Djamena. During this session, the teams of investigators received training on data collection and completing datasheets in order to prepare them to better lead this activity. Each sheet was individually presented and explained to the investigators by the consultants. These datasheets, as well as questionnaires to be distributed for data gathering, were worked through by the investigators and consultants to ensure a though understanding as well as to tailor the data collection process to Chad. The inventory was then completed using the UN Environment's *Toolkit for the Identification and Quantification of Mercury Releases.* Specifically, the Level 1

toolkit was selected because of its straightforward nature and the ability to use default values to fill in data gaps.

2.2.4 Conducting Inventory Operations

The consultants and the teams of investigators targeted all the state and semi-public institutions, companies/businesses and NGOs concerned by mercury present in each site visited. Some artisanal gold mining sites have also been inventoried and even dentists' offices, as far as amalgams and dental fillings are concerned. Subsequently, the Secretariat General of the Ministry of Environment and Fisheries with note**. 176/PR/PM/MEEP/SG/PFMM/2018 of May 07, 2018** informed all institutions concerned about the Inventory workflow to prevent and raise awareness about inventory operations. These inventories occurred throughout the national territory, from May 4 to October 30, 2018. Appointments were made by these respondents through telephone contacts in order to gather all useful information.

After all these formalities, the four teams of investigators were sent to the interior of the country and to all public and semi-public institutions, companies and businesses, NGOs, etc. to collect the necessary information on sources of use and sources of mercury releases. For large agglomerations such as N'Djamena, Abéché, Moundou, Sarh, Doba and Koumra, data collection was carried out by district and neighborhood. Sub-teams of investigators were formed. According to the program developed, field missions were carried out to collect information on the use and releases of methane in the atmosphere, as well as on sites contaminated by this substance.

By mission order N° 058/PR/MEEP/SG/CMM/2018 of May 31, 2018, a team of data collectors visited the Pala gold zone and the Baouré Cement plant, located in the province of Mayo-Kebbi -Ouest of Chad, from June 03 to June 09, 2018. It has received information on the use of mercury in artisanal gold mining, mercury releases from various sources, and data on mercury-contaminated sites in the Pala gold panning area. For this work, groups of local collectors were formed

before taking training on the different data collection forms prepared for this purpose.

By Mission Order No. 13/PR/SG/BNO/2018 of June 10, 2018, another inventory team responsible for collecting data on the use and release of mercury in Chad carried out a mission from June 10-15, 2018 in the city of Abéché, Ouaddai Region, located north-east of Chad. This mission has received information from public and private institutions using mercury or instruments intentionally containing mercury or mercury compounds. The structures surveyed are:

- industrial companies;
- the regional departments of the Ministry of Mines and Petroleum;
- Customs districts;
- regional services of the Ministry of Energy;
- regional services of the Ministry of Health (Hospitals, health centers, dentists' offices);
- Town halls (waste management services);
- regional services of the Ministry of Commerce and Industry;
- Regional Delegations of the Environment;
- regional services of the Ministry of the Administration;
- schools, colleges, high schools and university institutes;
- regional offices of the Chamber of Commerce;
- economic operators (importers of mercury for dental filling);
- users of mercury;
- households

The data collected by the different teams were compiled and processed, then calculations were made using UNEP Toolkit Level 1 to determine the quantities of mercury released into the various compartments of the environment from the business sectors. Based on this inventory, national priorities for mercury management have been defined. These are the foundation upon which the National Action Plan will be built.

2.3 Results of the Mercury Release Inventory

2.3.1. Extraction and Use of Fuel/Energy Sources

Use of coal combustion at large power plants

According to the results of our inventories, Chad does not use coal in power plants. Power plants operate with diesel.

Use of biomass in energy and heat production

For this category, the data was collected from the Ministry of Energy, Mines and Petroleum, the Agency for Domestic Energy and the Environment (AEDE), the National Agency for Renewable Energies (ANER), the Master Plan of the Energy Sector in Chad (2011), the Master Plan for Renewable Energy Development (SDDER 2018), but also data from the National Institute for Economic and Demographic Studies (INSEED) and the National Development Plan (PND 2017-2021) and the 2030 vision of Chad.

Charcoal accounts for almost 90% of the country's total energy consumption and also covers 99% of total final energy consumed by rural households. However, on a national level, the state of wood resources seems satisfactory because the electricity sub-sector master plan in Chad estimates stumpage volume at 856 million tons with an annual output of 31 million tons. (1999 Energy Master Plan). However, the amount of wood consumed in Chad per year is 11,534,752 tons. Charcoal is produced from firewood. According to DFLCD data, 4 tons of fresh wood is needed to produce 1 ton of charcoal. Thus, the annual production of charcoal in Chad is 2,883,688 tons.

To this must be added the quantities of biomass burnt following bushfires. It consists of herbs and twigs. Table 2.13 gives the areas and quantity of biomass burned by type of vegetation during a year.

Table 2.13: Areas and quantities of calcined biomass.

Type of vegetation	Burned areas (ha)	Quantity of biomass burned (t/ha)	Total quantity
Savanna	434,128	0.60	**260,476.8**
Clear forest	13,651	0.90	**12,285.9**
Dense forest	6687	0.90	**6018.3**
Reforestation	1478	0.612	**867.8**
Total			**279,648.8**

Source: National Strategy for Bushfires, 2016.

It should also be noted that biomass is from crops and used as a source of energy for many households in rural areas (Table 2.14). The quantities of this biomass are estimated at 3,369,200 tons, according to the table below.

Table 2.14: Production of crop biomass in 2008.

Type of crops	Biomass production in tons
Sorghum	685,000
Pearl millet	523,200
Other cereals (wheat)	406,000
Yams	405,000
Peanuts	403,000
Sugar cane	390,000
Corn	226,000
Rice	170,000
Cassava	161,000
Total	**3,369,200**

Source: Chad National Report 2013.

According to statistics published by the Directorate of Agricultural Production and Statistics for the two consecutive years 2016 and 2017, the quantity of agricultural residues produced during this period is 6,146,933 tons (Table 2.15). The majority of these crop residues (78%), or 4,794,608 tons, are used as organic fertilizer for soil remediation. Only 22 % (1 352 325 tons) is used as a source of energy for rural households. The estimated mercury production factor (Table 2.16) combined with the amount of mercury emitted into the atmosphere through the use of biomass as a source of energy and forest fires (burning of forests) is therefore calculated at 1,433 kg Hg/year in Chad.

Table 2.15: Crop Type and Crop Residue Quantities Produced (2016-2017).

Type of crops	Quantity of product residues (tons)

Millet	2,394,734
Sorghum	2,477,613
Corn	88,756
Rice	51,540
Berber	1,134,290
Total biomass	**6,146,933**

Source: Directorate of Agricultural Production and Statistics (2016-2017).

Table 2.16: Total quantity and mercury content of biomass used annually as a source of energy.

Type of biomass	Quantity of biomass in tons per year	Mercury production factor (g of Hg/tonne of biomass used)
Wood and charcoal	11,534,752	0.0021
Herbs burned and crop residues	279,648.8 + 1,352,325	0.04

Table 2.17: Sources and quantities of mercury as an estimated input to Society kg Hg/yr) and released into the atmosphere.

Type of biomass	Quantity of biomass used (tons/year)	Mercury production factors (g of Hg/ton of biomass burned)	Distribution factor	Amount of mercury input to Society (kg Hg/yr)
Wood and charcoal	11,534,752	0.0021	1	49
Herbs burned and crop residues	1,631,974	0.04	1	1,384
Total	**13,166,725.8**		1	**1,433**

Other carbon use

Chad does not produce coal. It imports it. Coal is used in kilns, cement plants, etc. According to our investigations, the quantity of coal consumed in Chad in 2016 is 27.25 tons, according to Table 2.18. Based on default factors (Tables 2.19-2.21) the estimated amount of Hg input to Society from other coal uses is 1 kg Hg/yr.

Table 2.18: Types of coal imported to Chad in 2016.

Type of products	Quantities imported in tons
Coal, lignite, peat	810.5
Oil consumption	3,587.0
Total in tons	**4,397.5**

Source: INSEED 2016.

Because there is no mercury capture system, it is completely in the air. Thus, the main mercury receiving medium from coal combustion is ambient air.

Table 2.19: Default Distribution Factors for Mercury Releases

Life cycle phase	Air	Soil	Water	Products	Waste	Processing/use
Other carbon use	x					

Source: Toolkit

In order to determine the amount of mercury present in the coal, we used the default adsorption factor below.

Table 2.20: Default absorption factors for mercury in calcined coal

Material	Default absorption factors in g mercury per metric tonnes of coal consumed
Coal consumed in the production of energy	0.05 - 0.5

Source: Toolkit

Chad has no mercury reduction system, so all mercury is released into the atmosphere.

Table 2.21: Default Distribution Factors for Mercury in Environmental Areas

Emission Reduction System	Mercury Distribution Factors in Environmental Areas					
	Air	Soil	Water	Products	Waste	Processing
None	1					

Source: Toolkit

On this basis, we quantified mercury releases to the atmosphere, according to Table 2.22.

Table 2.22: Amount of mercury estimated as an input to Society (kg Hg/yr)

Activity rate	**Default absorption factors in g mercury per metric tonne of coal consumed**	**Distribution factor**	**Amount of mercury input to Society (kg Hg/yr)**

4,397.5	0.05 - 0.5	1	1

Source: Toolkit

The quantity of mercury annually emitted through the combustion of coal in Chad is 1 kg Hg/yr.

Use of other fossil fuels (extraction and use)

This practice is not known in Chad because our country does not produce and does not import peat and shale

Extraction, refining and use of natural gas and liquefied gas (LPG)

In Chad, butane has been used extensively in recent years as a substitute for firewood in households. The Liquified Petroleum Gas (LPG) is consumed for the production of electricity and heat.

Table 2.23: Consumption of Liquefied Petroleum Gas (LPG) in Chad, from 2007 to 2010

Years	2007	2008	2009	2010
Consumption of gas in tons in bottles in tons (t)	401	594	1702	4,258
Consumption of gas in tons in bottles in tons (t)	120	178	510	1,277
Total Consumption in tons (t)	**521**	**772**	**2,212**	**5,535**

Source: ARSAT 2010.

Table 2.24: Consumption of Liquefied Petroleum Gas (LPG) in Chad, from 2012 to 2013

Years	Quantities in liters or kg
2012	4,650,120
2013	8,329,729
Total	**12,979,849**

Source: ARSAT (Petroleum Sector Regulatory Authority) 2013.

Even if Chad joined the petroleum era in 2003, it continues to import certain petroleum products such as Liquefied Petroleum Gas (LPG) from neighboring countries such as Cameroon and Nigeria. Between 2012 and 2013, 12,979,849 kg were imported, an average of 6,489,925 kg.

The refinery in Djarmaya located about thirty km from N'Djamena produces butane, which is nowadays used to replace firewood in many households. This policy allows the vegetation cover to gradually recover.

During the combustion of butane gas, all the resulting mercury will be released almost completely into the air.
This gas may contain small amounts of mercury that are extracted from the subsoil during the exploitation of oil fields. These quantities can escape into nature during refining and combustion. Butane produced locally or imported from outside is packaged in bottles after liquefaction.

Because information on sources and mercury content of gases is not available in our country, we used default adsorption factors to estimate the amount of mercury released to the atmosphere. Based on default factors (Tables 2.26-2.28), the amount of mercury input to Society is <1 kg Hg/yr.

Table 2.26: Default absorption factors for mercury in natural gas

Type of gas	Default adsorption factors for ug of mercury/Nm^3
Butane in bottles	0.03 - 0.4

Default factors for the distribution of mercury emitted from the combustion of natural gas are in air. Knowing that the density of butane is 580 kg/m3, the volume of butane can be determined as follows: 6,489,925 kg/580, which is equal to 11,189.5 m3. The default mercury quantity and the default distribution factors for mercury releases can be determined on this basis.

Table 2.28: Absorption and Distribution Factors for Mercury Releases

Butane volume	Default absorption factors for mercury ug per m3 of gas	Default Distribution Factors for Mercury	Quantity of Mercury in the Waste Receiving Area in ug
11,189.5 m^3	0.03 - 0.4	1	335.69 – 4,475.8

Source: Based on the Toolkit

Extraction, refining and use of petroleum (mineral oil)

Although it is an oil country, the consumption of petroleum products in Chad represents only 3% of total consumption and electricity only 0.5%. National energy consumption is 96.5% dominated by firewood, the productivity of which is highly dependent on climate. The national consumption of hydrocarbons in Chad from 2008 to 2011 is found in Table 2.29.

Table 2.29: Consumption of petroleum products in Chad between 2008 and 2011 (thousands of liters)

Years	Diesel	Super	Lamp Oil	Total
2008	10,090,915	29,725,889	1,699,641	132,516,445
2009	189,905,761	34,599,265	1,536,019	226,041,045
2010	203,591,148	421,126,549	1,659,403	247,377,100
2011	223,950,263	46,339,304	1,825,343	272,114,810
Total	**525,306,058**	**152,791,007**	**6,690,406**	**1,926,536,431**

Source: Petroleum Taxation, 2011.

The following Table 2.30 presents the consumption of petroleum products (in liters or kg) from 2012 to 2013.

Table 2.30: Consumption of petroleum products in Chad between 2012 and 2013

Years	Diesel	Super	Jet A1	LPG	Super exp	Diesel ex
2012	166,432,611	139,491,130	25 882,005	4,650,130	4,709,330	5,539,084
2013	307,420,216	200,077,161	48,599,763	8,329,729	20,391,223	2,239,565
Total	**473,852,827**	**339,568,291**	**74,481,768**	**12,979,849**	**25,100,553**	**7,778,649**

Source: ARSAT 2013.

Thus, Chad annually produces 460,943,818.5 kg of mineral oils (kerosene, diesel, super, jet, etc.). Diesel is the most consumed of all petroleum products used.

The combustion of various petroleum products can cause mercury to be released in the atmosphere. The natural environment most affected by these releases will be air. Based on defaults and other parameters (Tables 2.32-2.34) the amount of mercury input to Society is 3 kg Hg/yr.

Note that parameters such as mercury content and amount of fuel consumed are the determining factors for quantitatively assess mercury released into the atmosphere.

Table 2.32: Parameters used to determine mercury releases in the combustion of mineral oils

Life cycle phase	Activity rate	Mercury input
Combustion	Fuel quantity	Mercury content in each type of mercury oil used

Source: Toolkit

At the present time, we have no reliable information on the mercury content in different petroleum products. Therefore, we have used the default factors presented in the table below.

Table 2.33: Default absorption factors for mercury in different petroleum products

Petroleum products	Default absorption factors in g mercury per metric tonne of coal consumed
Default Adsorption Factors per mg of mercury per metric ton of petroleum	1 - 100

Source: Toolkit

Based on this, and assuming that all mercury released will end up in the air, the following table provides estimates of the quantities of mercury emitted.

Table 2.34: Default absorption and distribution factors for mercury releases

Quantities of fuel consumed in tons (t)	Default adsorption factors (mg of mercury per metric ton of fuel)	Distribution factors of mercury releases in the air	Quantity of mercury released in grams (g)
460,943.82 T	1 - 100	1	460.94 – 46,094.38

Source: Based on the Toolkit

Geothermal energy production

According to our investigations, there are no official statistics concerning the production of geothermal energy. The few rudimentary tests are illustrated by the Gauthio Falls in southwestern Chad.

2.3.2 Primary Production of Metal

Extraction of gold and silver with the mercury amalgamation process

In Chad, artisanal and small-scale gold production has long been practiced in the north and south-west regions of the country. Since 2015, gold panning activities have spread to the Batha region, located in the center of the country. In these practices, miners use mercury to extract gold. Once commonplace, this activity has grown in recent years and is seen as a source of extra income for many households. Indeed, a gold miner can earn between 3000 and 4500 Fcfa daily. Annually, this activity injects about 17 billion CFA francs into the national economy and supports thousands of people. However, gold mining sites have become a medium of significant social injustice and chaos, as it has led to banditry, prostitution, STIs/AIDS, etc. Also, the use of mercury to amalgamate gold has resulted in the destruction of vegetation cover, soil contamination and water pollution.

Gold miners operating many sites reported that liquid mercury is imported from countries such as Sudan, the United Arab Emirates, Spain, China, and India. It is imported in cans and small 25 and 40-liter barrels. Some gold miners surveyed said they use 250 to 400 g of mercury a day to extract gold. It should be noted that only 140 gold sites throughout the national territory have their approval and are authorized to operate. The quantities of the declared gold are intended for domestic consumption and for export.

As part of this study, the inventory teams only traveled to the gold zones located in May-Kebbi Ouest Province (Pala). Due to prevailing insecurity in the central and northern parts of the country, the inventory teams did not have access to the gold zones in this part of the country. As a result, these inventory teams simply used the information available at the Ministry of Mines, Energy and Petroleum.

During the period from 2015 to 2018, artisanal and small-scale gold mining employed 40,280 gold miners in Mayo-West Kebbi province, in accordance with Tables 2.35-2.39.

Table 2.35: Number of Operators at Yapala 2 Gold Site in May-Kebbi Ouest Province of Chad

Yapala 2 Site	Years	Number of Operators	Men	Women	Youth
	2015	5000	200	800	4000
	2016	4200	424	500	3276
	2017	4000	430	450	3120
	2018	3000	320	340	2340
Total		**16200**	**1374**	**2090**	**12736**

Source: Inventory Acquisition

Table 2.36: Number of Operators at Hadjar Marfayine 1 Gold Site in the May-Kebbi Ouest Province of Chad

Hadjar Marfayine 1 Site	Years	Number of Operators	Men	Women	Youth
	2015	3000	1990	110	900
	2016	1000	300	100	600
	2017	600	130	70	400
	2018	400	50	50	300
Total		**5000**	**2470**	**330**	**2200**

Source: Inventory Data

Table 2.37: Number of Operators at Hadjar Marfayine 2 Gold Site in the May-Kebbi Ouest Province of Chad

Hadjar Marfayine 2 Site	Years	Number of Operators	Men	Women	Youth
	2015	3000	2595	105	300
	2016	2600	2170	135	295
	2017	280	0	85	195
	2018	200	83	17	100
Total		**6080**	**4848**	**342**	**890**

Source: Inventory Data

Table 2.38: Number of Operators at Gamboké Gold Site in Mayo-Kebbi West Province of Chad

Yapala 2 Site	Years	Number of Operators	Men	Women	Youth
	2015	6000	5350	200	450
	2016	4000	3460	160	380
	2017	2000	1560	140	300
	2018	1000	680	105	215
Total		**13000**	**11050**	**605**	**1345**

Source: Inventory Data

Table 2.39: Summary of the number of gold site operators in the Mayo-Kebbi Ouest Province of Chad

Sites	Number of Operators				
	2015	2016	2017	2018	Total
Yapala 2	5000	4200	4000	3000	**16200**
Hadjar Marfayine 1	3000	1000	600	400	**5000**
Hadjar Marfayine 2	3000	2600	280	200	**6080**
Gamboké	6000	4000	2000	1000	**13000**
Total	**17000**	**11800**	**6880**	**4600**	**40280**

Source: Inventory Data

According to toolkit, the amount of mercury used to extract a unit of gold (or silver) varies depending on the methods and equipment used, but also other physical factors. Thus, if mercury is used to extract gold from the deposits, and the recovery process is not used, the ratio of mercury used to gold extracted is greater than 3 (quantity of Hg used/amount of gold produced is greater than 3: 1). That is, more than 3 kg of mercury is used to extract 1 kg of gold. If the mercury is only used on the concentrated parts instead of the whole deposit, the ratio is 1: 1. If the concentrations and the retorts are used, then the amount of mercury used would be much lower (0.001) (UNIDO 2003).

For the purpose of this study, given the artisanal practices of gold mining in our country, we used the ratio of 2 kg of mercury used to extract 1 kg of gold. According to information available in the Ministry of Mines and Industrial Development, the **annual production of gold is 400 kg**. According to the toolkit, these amounts of mercury are distributed between air, water and soil, at a rate of 240 kg for air, 80 kg for water and 80 kg for soils. Thus, **the estimated input into Society is 2,000 kg Hg/yr (Table 40).**

Table 2.40: Amount of mercury released into the environment

Environmental departments (release route)	Total amount of mercury released into the environment (kg/year)	Distribution factor per department (%)	Estimated Hg input to Society kg Hg/yr
Air	400	20	
Water	800	40	
Soil	800	40	
Total			**2,000**

Source: Based on the Toolkit

According to statistics published by INSEED in 2016, Chad has taxed 11.12 tons of elemental mercury and 3812.41 tons of mercury oxide, or 3823.53 tons. This quantity is not just for gold mining businesses.

Production of other minerals and materials containing trace-amounts of mercury

Cement production

Chad has two cement plants in Baouré and Djermaya. The visits on June 6, 2018 by the teams responsible for inventorying the sources of emissions and releases of mercury indicate that these two industrial companies do not use mercury in the cement production process. According to the Head of the Exploitation Department of the National Cement Company, Mr Diguina Torbaye Ndilngar, the raw material used is composed of limestone, laterite, fine sand and clay. This material is obtained on site by rock crushing. The machine can crush up to 150 to 170 tons per hour. This machine has the ability to grind rocks for 8 hours in the day and work for five days in the week. Cement production was 237,000 tons in 2015, 166,904 tons in 2016 and 136,230 tons in 2017, an annual average of 180,044 tons. The gases escaping from Klinger do not contain mercury. They consist mainly of carbon dioxide (CO2) and carbon monoxide (CO). On the other hand, the raw material mentioned above for the production of cement could contain mercury contents.

The geographic coordinates of this Baouré cement plant are:

N 09°16.105 ' /33P0456467

E014°36.212 ' /UTM 1024546.

The cement plant in Djermaya is new. It just started operations last May. Thus, its global cement production cannot be tallied at the end of the current year. In addition, Chad imported 38,022 tons of Portland cement from countries such as Nigeria, Cameroon, etc. in 2016. This means that the amount of cement consumed in Chad in 2016 is 204,926 tons. We used the Toolkit approach to determine the amount of mercury released into the environment. The receiving

environments of this activity are the air, soil, products and waste (Table 2.41). On the basis of default factors and other information for cement as a source of mercury (Table 2.42-2.44), an estimated annual input to Society is 51 kg Hg/yr.

Table 2.41: Main sources of mercury-containing waste and locations

Stages	Air	Soil	Water	Products
Cement production	x			x
Cleaning cement construction waste	x	x		x

Source: Toolkit

Table 2.42: Quantity and mercury content of cement produced

Activities	Quantities of cement produced	Content of mercury in the cement produced
Cement production	Metric tonnes of cement produced per year	Grams of mercury per tonne of cement produced

Source: Toolkit

Table 2.43: Estimate of mercury in waste

Waste	Default factors (minimum-maximum)
Atmospheric emission factor	0.1-6 g of Hg per tonne of cement produced
Content of mercury in the cement produced	0.02-0.1 g of Hg per tonne of cement produced

Source: Toolkit

Table 2.44: Estimate of mercury released in cement production

Waste	Quantity of cement produced in tons	Default factor (minimum-maximum) g of mercury per tonne of cement produced	Estimate of mercury emitted in kg
Atmospheric emission factor	166,904	0.1 - 6	16.69 - 1001.42
Content of mercury in the cement produced	204,926	0.02 - 0.1	4.10 - 20.49
Total	371,830		**20.79 - 1021.91**

Source: Based on the Toolkit

Pulp and paper production

Chad does not have pulp and paper mills or paper recycling plants. All pulp and paper are imported. The pulp and paper used are either discarded or used as household fuels. Therefore, we have no information to provide concerning this activity.

Production of lime

Chad does not have lime production industries. This is imported to be converted into calcium hydroxide or slaked lime (Ca $(OH)_2$). In 2016, Chad imported approximately 245.8 tons of lime (INSEED 2016). There is no calcination. Therefore, it is difficult for us to determine the level of mercury released from imported lime.

2.3.4 Intentional Use of Mercury in Industrial Processes

According to our investigations, this category does not apply to Chad, since there are no industrial processes using mercury. Indeed, the field visits and interviews we had with officials at public and semi-public institutions, private institutions, associations, NGOs, etc. point out:

- There is no chlor-alkali production through mercury technology;
- There is no production of VCM by mercury dichloride ($HgCl_2$) technology as a catalyst in the industrial process;
- There is no production of acetaldehyde using technology using mercury sulphate ($HgSO_4$) as a catalyst;
- There is no production of chemicals and polymers in which the mercury compounds are used as catalysts.

In conclusion, this category cannot be considered as the case in Chad.

2.3.5 Consumer Products Intentionally Containing Mercury

Mercury thermometers

Thermometers are instruments for measuring temperature. Several types of thermometers exist in Chad. They are used in many different areas such as

homes, hospitals and health centers, training institutes, research and analysis laboratories, industries, etc. These thermometers contain liquid mercury present in the capillary tube. In large facilities, pyrometers are used to measure the temperature of materials and exhaust gases from large engines such as SNE and STE. Thermometers are used in the field of public health to measure body temperature (oral, rectal and axillary). Already very numerous, this type of thermometer is becoming obsolete and is being replaced by other models that do not contain mercury.

Inventory results show that 40,017 thermometers were imported in 2016 to Chad (Table 2.45-2.46). These instruments are mainly used in the medical field (92%), 5% in research and analysis laboratories and 4% in the industrial sector. These percentages correspond to 36,449, 1,931 and 1,638, respectively. They are imported from China, India, the United Arab Emirates, and France.

Table 2.45: Type of thermometers imported to Chad in 2016

Type of thermometer	Percentage (%)	Number of thermometers
Medical thermometers	91	36,449
Laboratory thermometers	5	1,931
Industrial Thermometers	4	1,638
Total	100	40,017

Source: Inventory Data

The mercury contained in the thermometers will be discarded when one breaks or cracks. Over the course of their use, more than 40% of thermometers break or crack. For example, mercury will be released to the environment (air, water, soil and trash) during use or disposal. We used the mercury default adsorption factors by type of thermometers (Table 2.47-2.48) and estimate the annual input to Society of 228 kg Hg/yr.

Table 2.46: Mercury default adsorption factors by thermometer type.

Type of thermometer	Amount of mercury (g of Hg per type of thermometer)
Medical thermometers	0.5 - 1.5
Laboratory thermometers	1 - 40
Industrial Thermometers	5 - 200

Source: Toolkit

The quantities of mercury in the thermometers to be removed as waste are calculated based on the information provided by the Toolkit.

Table 2.47: Estimate of quantities of mercury released into the environment.

Type and number of thermometers	Number of thermometers (activity rate)	Quantitative Mercury Factor	Quantity of Mercury (kg)
Medical thermometers	36,449	0.5 - 1.5	1.823 - 54.673
Laboratory thermometers	1,981	1 - 40	1.981 - 79.24
Industrial Thermometers	1,638	5 - 200	8.19 - 327.60
Total	**40,017**		11.994 - 461.513

Source: Based on the Toolkit.

The amount of mercury contained in the thermometers to be removed is between **11.99 and 461.51 kg.** This quantity of mercury released is distributed among the different areas of the environment as follows:

Table 2.48: Estimated quantity of mercury released.

Discharge routes (environmental areas)	Discharge distribution factor	Quantity of mercury released (kg)
Air	0.2	2.3988 - 92.3026
Soil	0.2	2.3988 - 92.3026
Water	0.3	3.5982 - 138.4539
Waste	0.3	3.5982 - 138.4539
Total		**11.994 - 461.513**

Source: Based on the Toolkit.

Switches

Mercury is present in a range of switches and electrical relays. They are used to adjust the flow of electricity according to pressure and temperature. There are a wide range of switches used in different areas of activity. According to our inventories, in 2016, Chad imported switches, relays and receivers, as well as circuit breakers. Table 2.49 gives the list of these instruments.

Table 2.49: Quantity of electrical materials and equipment imported to Chad in 2016

Type of material and equipment and materials	Quantities in tons
Multimeters	118.13
Accumulators	471.5
Electrical conductors for voltage	2,238.2

Switches	75.3
Voltage Breakers	148.0
Regulators	273.0
Electric Debtors, Regulators, Controllers	410.8
Manometers, manostats, pressure switches	138.1
Electricity meters	22.4
Voltage relay	14.4
Transformers	63.5
Electric amplifiers	175.0
Condensers	166.2
Total	**2076.33**

Chad is not a producing or exporting country for electrical switches and relays. It imports them from countries like China, India, France, and the United Arab Emirates. According to Table 2.49, the quantity of switches, receivers, electrical relays, multimeters, accumulators and electrical relays, manometers (pressure switches), etc. is 2076.3 metric tons. However, we do not have information on the mercury content in these instruments. It should be noted that mercury will be released into the atmosphere only when a switch is broken or cracked or with waste consisting of these instruments after their use. In most cases, these instruments will be disposed of only when the infrastructure in which they are used is demolished or rebuilt. Air, soil, water and waste are the receiving media for mercury emitted into the atmosphere (Table 2.50).

Table 2.50: Mercury Discharge Receiving Environments for Switches and Electronic/Electrical Relays (Switches)

Life cycle phase	Air	Soil	Water	Waste
Use	x	x	x	
Elimination	x	x		x

Source: Toolkit

Using the country's population in 2016 and the estimated electrification rate of 4%, we estimated the amount of mercury consumed, as shown in Tables 2.51-2.53 the estimated annual input of mercury to society from waste created by switches and electric relays is 68 kg Hg/yr.

Table 2.51: Estimate of mercury releases in electronic/electrical relay switches (switches)

Population in 2016	Electrification Rate	Mercury emission factors (g of mercury	Mercury consumed in 2016 in kg

		consumed per capita)	
13,821,921	4%	0.02 - 0.25	**11.058 - 138.219**

Source: Based on the Toolkit

Based on the information in the Toolkit, the distribution factors of the mercury emitted are given in the following table:

Table 2.52: Mercury Distribution Factors in the different environmental areas

Life cycle phase	**Default waste distribution factors**			
Quantity of mercury discarded	**Air**	**Soil**	**Water**	**Waste**
	0.1	0.1		0.8

Source: Toolkit

Table 2.53: Amount of mercury discarded into the environment

Type of Waste	**Distribution factors**	**Estimate of mercury discarded, kg**
Air	0.3	**20.3**
Land	0.4	**27.1**
General Waste	0.3	**20.3**
Total		**11.058 - 138.219**

Source: Based on the Toolkit

Mercury lamps

Mercury is used to manufacture various lamps (fluorescent lamps and compact fluorescent lamps, mercury vapor lamps, high-pressure sodium lamps, neon lamps, etc.). These are used for lighting households, industrial companies, administrative buildings, public roads, etc. Other types of lamps that contain mercury exist. These include special lamps for photographs, spectrometric lamps for atomic adsorption, sterilization lamps and lamps used in computers, photocopiers and televisions.

According to statistics published by INSEED, Chad imports 5,573,238 mercury fluorescent lamps for household purposes annually. However, it should be noted that these figures are in decline. Indeed, considering the development of informal trade in our country, thousands of these instruments enter Chad daily. Since these lamps consume less energy and are less expensive for users, their use

continues to increase. However, the use of these lamps raises concerns, because in case of breakage, they are thrown in garbage cans and landfills. They are never recovered and the mercury they contain is released into the atmosphere. This is therefore a source of air pollution and contamination of water and soil.

In contrast, several fluorescent lamps exist around the world. However, their mercury content also varies. In the United States, the fluorescent tubes used in recent years are the T12 tubes, which only contain 22 mg of mercury (NJ MTE 2002). The T8 lamps measuring 2.2 cm in diameter, which were manufactured to consume less energy, contain less mercury (14 mg). However, since 1995, the mercury content of T8 and T12 lamps has been reduced because of the introduction of ampoules with less mercury (less than 10 mg of mercury). In Canada and Europe, the mercury content of fluorescent lamps has dropped significantly to 15 mg or less mercury per tube (Environment Canada 1999).

Our surveys have revealed that 5,573,238 fluorescent lamps and 127 lamps ultraviolet were imported to Chad in 2016. The amount of mercury in these lamps is unknown but may be more elevated than lamps used in The United States, Canada and Europe. Based on default factors (Table 2.54-2.57) and a quantity of 5,573,365 units the estimated input to Society is 139 kg Hg/yr.

Table 2.54: Default mercury adsorption factors in fluorescent tube lamps

Types of instruments	Amount of mercury in mg/instrument
Fluorescent tube lamps	10-40
UV lamps	5-25

Toolkit: Source

The amount of mercury in lamps is **55.73 kg** in the following table based on the minimum end of the range accounting for the declining mercury content in these lamps discussed above:

Table 2.55: Amount of mercury in the various lamps used in Chad

Types of instruments	Number of ampoules	Quantity of mercury (mg) per instrument	Quantity of mercury in kg
Fluorescent tube lamps	5,573,238	10-40	55.73 - 222.93

UV lamps	127	5-25	0.0006 - 0.003
Total	**5,573,365**		**55.73 - 222.93**

For releases into the various areas of the environment, we used the following distribution ratio.

Table 2.56: Default Distribution Factors for Mercury in different environmental areas

Quantity of mercury discarded	**Mercury waste distribution factors**			
	Air	**Soil**	**Water**	**Waste**
	0.3	0.3		0.4

Source: Toolkit

By using the Toolkit, we determined the amount of mercury released to the environmental areas as shown in Table 2.57 below.

Table 57: Amount of mercury released into the environment

Waste sites	**Distribution factor per site**	**Quantity of mercury discarded in kg/year**	**Quantity of mercury discarded in kg/yr**
Air	0.3	16.72 - 66.88	41.8
Land	0.3	16.72 - 66.88	41.8
General Waste	0.4	22.29 - 89.17	55.7
Total		55.73 - 222.93	**139**

Source: Based on the Toolkit

The import of high-pressure steam lamps totaled **3,747 lamps**. There is no recovery system for these lamps.

Electric batteries containing mercury

There are various varieties of batteries on the international level. Among the most used batteries are mercury oxide batteries, silver oxide batteries and button cells. Button cells are found in wristbands, hearing aids, calculators and various applications in laboratories, hospitals and military camps.

Chad does not produce batteries. It imports them. According to these investigations, there are a large number of batteries and mercury batteries consumed in Chad. At the end of their life cycle, these batteries are released into the environment where they are burned in the open. According to the statistics available at INSEED, 875.6 kg of batteries were imported in Chad in

2016. These figures could be higher, because of the porous borders and the development of the informal sector in Chad.

Button batteries

These types of batteries are commonly used in our country. These batteries are used in watches, remotes and other goods. They are imported mainly from Asian countries informally. There is no official statistical data on this type of battery. It can be estimated at 4 million a year. Knowing that the average weight of these batteries is 5 grams, the total amount of batteries used in Chad is 895.2 kg per year or 0.98 tons per year (Table 2.58). Based on the default factors (Table 59-61) the estimated annual input of Hg to Society is 314 kg Hg/yr.

Thus, the total quantity of mercury emitted through waste batteries into the atmosphere is around 78.4 kg Hg/yr.

As Chad does not produce batteries, the adsorption factors can be summed up in the elimination of waste. The discard methods are release into the air, soil and waste.

Table 2.58: Estimate of mercury in batteries

Type of batteries	Activity rate (amount of battery per year (kg/yr)
Batteries	875.6
Button batteries	20
Total	895.2

Source: Toolkit

Table 2.59: Main mercury release areas

Quantity of mercury emitted (life cycle)	Air	Soil	Water	Waste
Elimination	X	x		x

Source: Toolkit

The distribution of mercury emitted is as follows, in accordance with the information provided in the Toolkit.

Table 2.60: Default Distribution Factors for Mercury Releases

Life cycle	Default Distribution Factors for Mercury			
	Air	Soil	Water	Waste
Quantity of mercury emitted	0.25	0.25		0.50

Source: Toolkit

The quantities of mercury released into the atmosphere are distributed among the environmental areas according to the table below.

Table 2.61: Quantity of mercury discarded into the environment.

Environmental areas (discard methods)	Distribution factor per site	Quantity of mercury discarded in kg/yr
Air	0.25	78.4
Soil	0.25	78.4
Waste	0.50	156.8
Total emissions/releases		**314**

Toolkit: Source

Paints

Different kinds of paint are in common use in Chad. Because Chad does not produce paints, they are imported from outside the country. As a result of this investigations, that Chad imported some 2900.1 tons in 2016. As a result, it is difficult to determine the materials used to manufacture paints and even less the amount of mercury used in their formulation. Therefore, we can only use the data published by INSEED in 2016. Indeed, the determining parameters to determine the repositories and receptors during the period of use for the paint are summarized in Table 2.62. The quantity of paint used was determined to be 290 kg or 0.32 tons/year and based on default factors (Table 2.63-2.66) has an estimated input to Society at approximately 1 kg Hg/yr.

Table 2.62: Emission mercury release areas

Life cycle phase	Air	Soil	Water	Waste
Paint use	X	x	x	

Source: Toolkit

In addition, it is important to note that in most cases, mercury contained in paints may be released into the air, starting with painted surfaces. For this reason, the

mercury levels in the paint suggested by the Toolkit are necessary to determine the amount of mercury contained in the paints.

Table 2.63: Default absorption factors for mercury in the paint.

Product	Default adsorption factors (g of mercury per metric ton of paint)
Quantity of paint containing mercury	300 - 5000

Source: Toolkit

Table 2.64: Estimate of mercury in the paint.

Quantity of paint used (t, activity rate)	**Default adsorption factors (kg of mercury/tonnes of paint)**	**Quantity of mercury released in the paints per gram (g)**
0.32	0.3 - 5	96 - 1,600

Source: Based on the Toolkit

Table 2.65: Default Distribution Factors for Mercury in Environmental Areas.

Life cycle phase	**Mercury Distribution Factors in Environmental Areas**			
	Air	**Soil**	**Water**	**Waste**
Paint use	0.92	0.05	0.03	

Source: Toolkit

Table 2.66: Mercury Distribution Factors in the different environmental areas.

Recovery channels (receiving areas)	**Distribution factor**	**Quantity of mercury released per area in kilograms (kg)**
Air	0.92	0.8
Land	0.03	0.1
Water	0.05	0.1
Total		**1.0**

Source: Based on the Toolkit

Pharmaceutical products for human and veterinary use

According to our surveys, Chad imported a quantity of 590.6 tons of medical products in 2016, mainly pharmaceutical products based on antibiotics. However, we do not have information on the mercury content in these products. Some literature argues that mercury was once used in vaccine production and in mercurochrome disinfectants and ophthalmic treatments. However, over time, all disinfectants containing mercury have been replaced.

In conclusion, it has been difficult to estimate the amount of mercury emitted using products used in pharmacies for human and animal care.

Biocides and pesticides

In Chad and throughout the Sahel, the use of pesticides for agricultural use is regulated and authorized by the Sahelian Committee of Pesticides (CSP). Unless otherwise indicated, there is no use to date on the use of biocides and pesticides containing ethyl mercury chloride or other mercurial organics. Chad, as a member of the CILSS, implements this regulatory provision. On the country level, there is also the National Committee for the Control of Pesticides (CNCP) which ensures the quality of new products before its introduction to the markets.

During the inventories, the teams reported quantities of 543.2 tons of imported pesticides and disinfectants in Chad in 2016, however there is no information on how much mercury be in these biocides and the UNEP Level I toolkit does not provide a default value for mercury content in biocides.

Cosmetic products and their byproducts

In this section, you will find perfumes, makeup products (mascara), ointments, soaps and detergents, as well as cream (cream milk) that is used to lighten the skin. Unfortunately, these contain mercury salts that are very toxic to human health and the environment. When used in high doses and repeatedly, these products cause dermatological discoloring, characterized by stripping the skin. During our inventories, we identified a range of cosmetic products in almost all local markets. According to the official statistical data published in 2016 by INSEED, quantities of 226 kgs of these products were imported into Chad (Table 2.67-2.68) The mercury concentration in these cosmetics is not known. According to some sources, mercury content in these products vary widely. Therefore, we used mercury absorption intervals in this source category, as indicated in the Toolkit.

Based on the default factors (Table 2.69-2.70), the total estimated annual input of Hg to Society is 8 kg Hg/yr. It should be noted that Chad is neither a producer nor an exporter of cosmetics. It mainly includes countries such as the United Arab Emirates, Nigeria, China, India, and so on. However, since there is no specific legislation in this area, the consumption of these products will continue to increase.

Table 2.67: Mercury adsorption factors in cosmetics

Products used	**Default adsorption factors g of mercury per metric ton of product**
Soaps, perfumes, creams, make-up products, detergents	10,000 - 50,000

Source: Toolkit

On this basis, the quantities of mercury present in cosmetic products were determined in accordance with the following table.

Table 2.68: Quantity of mercury in cosmetics

Quantities of cosmetics used, in kg	**Default adsorption factors (g of mercury per metric ton of product)**	**Quantity of mercury in the cosmetic products per gram (g)**
226 kg	10,000 - 50,000	2,262,610 – 11,313,050

Source: Based on the Toolkit

Thus, the default factors for the distribution of mercury emitted from cosmetic products are in the following table.

Table 2.69: Sources of releases and mercury-receiving locations in cosmetic products

Quantity of mercury issued (life cycle phase)	**Default waste distribution factors**			
	Air	**Soil**	**Water**	**Waste**
Use of cosmetic products		0.05	0.95	

Source: Toolkit

Based on previous tables, we have given estimates of the quantities of mercury released in t different areas.

Table 2.70: Quantities of mercury issued in different reception areas

Recovery channels (receiving areas)	Quantity of mercury discarded/year	Default Distribution Factor for Mercury	Quantity of mercury released in grams (g)
Soil	2,262,610 – 11,313,050	0.05	0.4
Water	2,262,610 – 11,313,050	0.95	7.1
Total			**8**

Other intentional use of products/processes

Dental amalgamation and sealing

Dental filling amalgam is composed of a mercury-based alloy, silver, lead and tin. This alloy is manufactured and used by dental clinics. It can occur either in the form of pure mercury (mercury metal) mixed with a powder composed of other metals, or in the form of mercury-containing capsules containing mercury and the primer of other products.

Mercury can be released into the air, water, soil and waste during the manufacture, use and disposal phase of the amalgam in question. Discharge can also occur as a result of the death of people who have had a dental filling.

At the dental clinic level, there is always a part of the dental amalgam after filling the dental cavity. This remaining part is thrown away. Thus, wastewater can always contain it, because during the renewal of the amalgam fillings, the amalgam user is buried or thrown in the sewage.

In Chad, filling decayed teeth with mercury is a very old and widespread practice. In fact, health centers and dental clinics use it frequently, without being concerned about the risks that this poses to human health and the environment. Preserved mercury capsules, which are often composed of a silver alloy and mercury, are also present today.

Statistics about the amounts of mercury used in dental amalgamation show that, annually, 8250 grams of bulk mercury is used to satisfy people's needs. For mercury-preloaded capsules, 432 packs of 50 capsules, or approximately 2160 capsules, are consumed. Knowing that a capsule contains an average of 440 mg of mercury, there is approximately 9,504.00 mg of mercury used at this level. Overall, 17,754 g of mercury is used annually in dental amalgamation.

Note that mercury in dental amalgam waste poses a serious problem of environmental pollution. To this end, it is advisable to put in place a national policy aimed at reducing dental amalgam waste discharges from dentists' offices by adopting the best management practices for these residues.

The main sources of waste and receiving environments of mercury-based dental amalgams are summarized in Table 2.71.

Table 2.71: Sources of releases and mercury-receiving locations in dental amalgams

Waste phase (life cycle phase)	**Air**	**Soil**	**Water**	**Products**	**Waste**	**Processing**
Supply of materials				x		
Preparation at the dental office	x		x		x	x
Use in the mouth			x			
Elimination			x		x	x

Source: Toolkit

Due to the fact that national statistics on dental filling are not available in Chad, we used the mercury adsorption factors as a default considering the urban population in 2012. Almost 25% of the urban population has lead teeth. According to the General Population and Housing Census, carried out in 2009, the population of Chad living in the city is 3,027,007 people (RPGH 2009), 25% of which have lead teeth, or 756,752 people. Based on the default and other factors (Table 2.72-2.75) the UNEP Level 1 toolkit estimated input to Society is 56 kg Hg/yr.

Table 2.72: Default absorption factors for mercury in dental amalgams

Life cycle phase	Default adsorption factors (g of mercury user per inhabitant)
Mercury in dental amalgam production	0.05 - 0.2

Source: Toolkit

Table 2.73: Estimate of the amount of mercury released annually into dental amalgam

Population	Dental personnel per 1,000 inhabitants	Default adsorption factors (g of mercury used per inhabitant)	Estimate of mercury used in the production of dental amalgam (g)
13,821,921	0.017	0.05 - 0.2	691,096.1 - 2,764,384.2

Source: Based on the Toolkit

The distribution factors for mercury releases in dental fillings are presented in the table below.

Table 2.74: Distribution factors for mercury in dental amalgams

Life cycle phase	Default Distribution Factors for waste in environmental areas					
	Air	Soil	Water	Products	Waste	Processing/ Elimination
Filling production	0.02		0.14	0.6	0.12	0.12
Use of filling in the mouth			0.02			
Equipment			0.3	0.06	0.12	0.12

Source: Toolkit

Table 2.75: Distribution of mercury waste emitted and releases into the environment.

Environmental Category	Distribution factor (%)	Quantity of mercury released in kilograms (kg)
Air	44	**1.13**
Water		**24.82**
By-products	6	**3.38**
General Waste and Sector Specific	40	**22.56**
Land	8	**4.51**
Total		**56**

Source: Based on the Toolkit

Thus, we have given estimates of the mercury released through the different receiving areas (Table 2.85).

Manometers and tensiometers

For this sub-category, data collected in hospitals and other services in the area show quantities of 1510 tensiometers and 248 manometers. These instruments are present in almost all health centers; however, the number of these tools will decrease due to the arrival of very powerful electronic sphygmomanometers.

We estimate the amount of mercury contained in tensiometers at 2 kg per year. No emission factor is available for this category. Likewise, there is no input value and emission factors for manometers.

Chemicals and laboratory equipment

According to our investigations, the laboratories set up do not use mercury or mercury compounds in their analytical work.

Metallic mercury used in rituals and traditional medicine

Formally, no statistics are available on the use of metallic mercury in rituals and traditional medicine. Nevertheless, in the informal sector we are witnessing the use of mercury by marabouts and the banknote forgers. Since the sector is informal, it is difficult to determine the quantities of mercury used in this area.

Other uses of miscellaneous products, mercury metal and other sources

No information is available for this purpose.

2.3.6 Waste Treatment and Recycling

Production of recycled metals (secondary metal production)

There is no use of mercury in the production of other recycled metals. Therefore, there is no data available for this sub-category.

Waste incineration

Incineration of household waste (municipal waste)

This is mainly household waste, peanut coke, etc. According to a study conducted by the BCEOM study group, the city of N'Djamena produces more than 1,000 tons of garbage per day. In 2016, it produced 1240 tons per day, or 452,600 tons. In 2016, the city of Abéché produced 27,520 tons of municipal solid

waste. Only 60% is collected with the bins distributed in the districts. The Town Hall carries out two types of collection, namely a door-to-door collection in the central districts and pre-collection connected to a post-transfer for the peripheral districts. This waste consists of 24.6% of decomposable materials (wood, leaves, straw, paper, cardboard, textiles, animal remains, etc.), which have a good energy potential for urban households.

Table 2.76: Quantities of household garbage produced daily in the city of N'Djamena from 2015, 2016, 2017 and 2018.

Years	**2015**	**2016**	**2017**	**2018 (January-June 2018)**
Garbage (t/d)	961	1025	915	920
Sand (t/d)	214	215	412	324
Mass	**1175**	**1240**	**1327**	**1044**

Source: DAES 2018.

All towns do not have municipal solid waste incinerators. However, there is outdoor incineration of household waste. Two tons are incinerated annually across the country. This is incineration of municipal waste/informal incineration of waste.

In the major urban centers of our country, at the level of production sources, municipal solid waste (MSW) is often stored on the ground in front of concessions to be incinerated and sometimes permanently abandoned. During the dry season, this waste is dispersed by the wind, while during rainy periods, it is dumped in hollow places to fill the streets or dumped directly in the gutters.

For garbage, bins are placed at intersections to collect waste from each house or concession. The services in question collect this waste for final disposal. However, most cities in Chad do not have landfill sites. As a result, waste is dumped, increasing the risk of water pollution and soil contamination.

According to these investigations, the annual production of municipal solid waste is 1,574,537.1 tons (Table 77). This quantity is determined based on 0.31 kg/equipment/day and the projection of the population in 2016 (13,821,921).

According to the Directorate of Roads, only 60% of municipal waste is collected (938,370.24 tons). The portion burned outdoors represents 24.6% of the total quantity disposed of in a dump, i.e. 230,839.08 tons (informal burning). The rest of the waste is buried in the soil. Based on the default and other factors (Table 2.78-2.80), the total estimated amount of input to Society is 10% of 1,154 kg Hg/yr or 115 kg Hg/yr (the 10% rule is used to avoid double-counting of mercury inputs from waste and products).

Table 2.77: Quantities of waste produced, incinerated and buried

Designation	Quantities of waste incinerated (t)	Quantities of waste buried (t)	Total (t)
Waste generated	230,839.08	1,343,698	**1,574,537.1**

The distribution factors for mercury releases in dental fillings are presented in the table below.

Table 2.78: Default distribution factors for mercury in the incineration of household waste

Life cycle phase	Air	Soil	Water	Products	Waste	Processing
Waste incineration	x					

Source: Toolkit

Default mercury absorption factors are found in the following table according to the Toolkit.

Table 2.79: Default absorption factors for mercury in incinerated waste

Life cycle phase	Default adsorption factors (g of mercury per tonne of incinerated waste)
Quantities of incinerated waste	1-10

Source: Toolkit

The quantity of mercury discharged to air is 1,038.78 kg, or **1.04 tons**, as shown in the table below.

Table 2.80: Mercury quantity released following incineration of household waste

Waste incinerated in tons	Default adsorption factors for mercury (g of mercury per tonne of incinerated waste)	Quantity of mercury discarded in kg
230,839.08	**1 - 10**	230.84 - 2308.40

Source: Based on the Toolkit

Incineration of medical waste

Medical waste is divided into two categories: Waste equivalent to household waste produced by health personnel or by accompanying persons, and waste produced in the special services of health establishments (anatomical waste, toxic waste, dressing residues, sharp and sharp tools). This waste is produced by sanitary structures such as hospitals, clinics, laboratories, veterinarians, etc. In 2016, the city of Abéché produced 399.8 tons of medical waste.

It is estimated that 11,297.5 tons of medical waste was produced in 2016, 8,309.6 tons of which was incinerated. With a default adsorption factor of 24 g of mercury per ton of waste, the quantity of mercury released is 199.43 kg.

Mercury releases from the incineration of medical waste can end up either in the air or in the soil and therefore the estimated medical waste incinerated was 199 kg Hg/yr and that medical waste buried was 15 kg Hg/yr based on amounts in Table 2.82 and default factors (Tables 83-84) Of these amount, 10% is used as an estimated input to Society – or 20 kg Hg/yr plus 1.5 kg Hg/yr, which equals 21.5 kg Hg/yr for both sources (Note: the 10% rule is used to avoid double-counting of mercury inputs from waste and products).

According to the statistics of the Ministry of Public Health, 74% of this waste is burned in an open pit or incinerator, while the remaining 26% is buried in the soil.

Table 2.82: Quantity of medical waste that are incinerated and buried

Designation	Quantities of open burned or incinerated medical waste (t)	Quantities of buried medical waste (t)	Total (t)
Medical waste produced in 2016	8,309.6	2987.9	11,297.5

The default adsorption factors for mercury releases through the incineration of medical waste are as follows.

Table 2.83: Default absorption factors for mercury in incinerated waste

Materials	Default absorption factors (g) for mercury in incinerated waste
Incinerated medical waste	8 - 40

Source: Toolkit

Table 2.84: Mercury quantity released following incineration of medical waste

Quantities of incinerated medical waste (t)	Absorption factors of mercury per tons of incinerated waste	Quantity of mercury (g) of mercury.
8,309.6	8 - 40	66,476.8 - 332,384

Source: Based on the Toolkit.

Industrial hazardous waste incineration

According to the Pollution and Nuisance Law No. 904, hazardous waste includes remnants of drugs, seized drugs, paints and varnishes, packaging containing pesticide, etc. Most of this waste is incinerated outdoors. Street drugs and seized drugs total 24,621.4 tons (Table 2.85). We could also add the used oils for a volume of 5,151,883m^3 These used oils are incinerated in boilers.

Industries likely to produce industrial hazardous waste are mostly located in southern Chad. This includes:

- the Compagnie Sucrière du Tchad;
- the Nouvelle Société Textile du Tchad,
- Coton Tchad,
- Oil refineries;
- les Brasseries du Tchad,
- Fish Processing Plants,
- the Manufacture de Cigarettes du Tchad (MCT),
- Soap producers;
- Slaughterhouses;
- Print shops;
- Oil companies

All these industrial companies produce large quantities of waste and wastewater that they incinerate or dump directly in the soil. Sometimes these companies directly discharge their toxic waste into rivers (Logone and Chari). This contaminates the surrounding soil and pollutes the waters. These become unfit for consumption. Industrial waste products contain various products such as

heavy metals, or ganic acids, organochlorines, sodium and potassium salts, detergents, dyes, surfactants, ketones, etc. There are also pesticides, oils, inorganic waste, textile waste, etc. The quantity of waste generated annually by industrial companies is estimated at 24,621.4 tons, which generates 337 kg Hg/yr or 34 kg Hg/yr as an estimated annual input to Society based on default factors (Table 2.86) (Note: the 10% rule is used to avoid double-counting of mercury inputs from waste and products).

Table 2.85: Quantity of industrial waste generated in 2016

Designation	**Quantity of waste generated in tons**	**Percentage (%)**
Incineration/outdoor burning of industrial waste	14,034.20	57
Industrial waste landfills	10,587.20	43
Total	**24,621.4**	**100.0**

Source: Inventory Data

On this basis, we used the mercury default adsorption factors as shown in the Toolkit, according to the table below.

Table 2.86: Quantity of mercury released from industrial waste incineration

Waste incinerated in metric tons (t)	Default adsorption factors (g) of mercury per tonne of waste	Quantity of mercury in g
14,034.20	**8 - 40**	**112,273.6 - 561,368**

Source: Based on the Toolkit

Landfill and wastewater treatment

Incineration of household waste (municipal waste)

In 2016, municipal waste generation totaled 1,563,950.4 tons, of which 230,839.08 tons were incinerated and 1,343,698 tons were buried in the soil (Table 2.87-2.88). Based on default factors for buried waste (as incinerated waste was covered previously) (Table 89-90), the estimated Hg output was 6,718 kg Hg/yr and after using the 10% Rule, an estimated annual input to Society was 672 kg Hg/yr (Note: the 10% rule is used to avoid double-counting of mercury inputs from waste and products).

Table 2.87: Main Sources and Receiving Environments of Mercury in the burial of household waste

Life cycle phase	**Air**	**Soil**	**Water**	**Products**	**Waste**

Burial of waste	x	x	x		x

Source: Toolkit

In order to determine the amount of mercury released into the area, we need to use the activity rates and mercury absorption factors for the waste produced, according to the table below.

Table 2.88: Factors Determining Mercury Releases in Household Waste

Activity rates	Mercury absorption factors
Quantities of waste buried in the soil.	Content of mercury in waste

Source: Toolkit

The default mercury generation factors are defined in the table below.

Table 2.89: Default absorption factors for mercury in buried household waste

Materials	**Default production factors for g of mercury per tonne of buried waste**
Quantity of buried waste in tons	1-10

Source: Toolkit

Table 2.90: Mercury units emitted by household waste landfill

Designation	**Default production factors for g of mercury per tonne of buried waste**	**Quantity of mercury emitted in kg**
1,343,698 tons of buried waste	1-10	1,343.7 - 13,437.0
Total		**671.9**

Source: Based on the Toolkit

Wastewater treatment

In Chad, the industry sector is poorly developed. However, some industrial companies exist in the country. This includes:

- the Compagnie Sucrière du Tchad (CST);
- Coton Tchad (CT),
- les Brasseries du Tchad,
- L'Abattoir de Farcha;
- La Manufacture Cigarette du Tchad ;
- La Centrale Pharmaceutique d'Achat (CPA);
- Les Boulangeries Hanana;
- Fish Processing Plants

All these industries produce phenomenal amounts of wastewater of all kinds. These waters are either thrown into streams or directly into the gutters, creating

health and environmental nuisances. Significant quantities of wastewater generated are discharged into the environment without prior treatment. It should also be noted that in most cases, Chadian households do not have adequate systems for the collection and storage of wastewater and excrement. Even if sometimes there are septic tanks, it is emptied manually, and the waters or fecal sludge are poured on the street or in the nearest recreation area.

In the big agglomerations like N'Djamena, Abéché, Sarh, Moundou and Doba, restaurants, hotels, hospitals, bars, military camps and shopping centers are another source of pollution, as they do not have waste water disposal sites. They dump the waste waters into nature. Dishwater with leftover food is also dumped into the gutters.

Latrines, septic tanks and water treatment plants produce large quantities of sludge. These are composed of substances that may contain mercury. These are batteries, neon lights, etc. At the national level, for an estimated population of 13,821,921 inhabitants in 2016, the statistics reported a quantity of 750,625,145.7 m3 of water used in Chad (Table 2.92). With a default factor of 10 g of mercury per liter of water the amount of mercury released into the water is 750,625,145 m^3/yr, which results in an estimated mercury output of 3,941 kg Hg/yr or using the 10% Rule an estimated 394 kg Hg/yr input to Society.

Sewage is also produced in tanneries such as those installed in the Diguel district. These waters are directly thrown in the Chari and Logone Rivers, without any appropriate treatment. The amount of wastewater produced annually is estimated at 750,625,146 m^3. These waters contain soaps that may have mercury-active substances. Therefore, their inappropriate management raises concerns as they pose a risk to human beings and the environment. To determine the amount of mercury released through wastewater, we used the default mercury production factors proposed in the Toolkit, see the Table below.

Table 2.92: Default Factors for Mercury in Wastewater

Activities in liters	Default mercury adsorption factors, mg per liter of wastewater	Quantity of mercury produced in kg
750,625,145.7	0.5 - 10	**375.31 - 7,506.25**

Source: Based on the Toolkit

2.3.7 Crematorium/Cemeteries

In Chad, there is no cremation, therefore, this category of sources does not exist in the country. However, bodies of people whose teeth have been sealed are buried. Based on the 2016 mortality rate of 197,324 provided by the Ministry of Public Health, the amount of mercury released into the soil can be estimated. In addition, we do not have exact information on the number of amalgam fillings prepared annually. We have therefore made estimates using the default production factors according to the following Tables (2.93, 2.95,2.96).

Table 2.93: Factors Determining Mercury Releases in human bodies

Activity rate	**Default mercury production factors (g of mercury per buried body)**
197,324	1-4 g of mercury per body

Source: Based on the Toolkit

The main receiving medium is soil (Table 2.118).

We used the default production factors (absorption) to determine the amount of this chemical element in cemeteries (Table 2.118).

Table 2.95: Production factors for mercury in buried bodies

Number of buried bodies	**Mercury Deficiency Factors (g)**	**Quantity of mercury in g**
197,324	1 - 4	**197,324 - 789,296**

Source: Toolkit

Thus, we estimated at **493 kg Hg/yr as an annual input to Society.**

Table 2.96: Amount of mercury released into cemetery soils

Activity rate	Absorption factor g of mercury per body	Distribution factor	Quantity of mercury discarded in the soil in kg
197,324	1 - 4	1	**197.3 - 789.3**

Source: based on the Toolkit

2.4 Sites Contaminated with Mercury

In Chad, artisanal and small-scale gold mining carries risks to human health, although this practice provides substantial additional income for many miners. The latter minimize these risks, arguing easy financial gains at lower costs.
The social consequences of the traditional exploitation of gold are multiple. As long as the mining sites are exploitable, countries abandon their crops, which earn less than the pittance the mine pays. But when they are closed, the miners are unemployed. In 2003, the Government has introduced a new mining code to regulate this industry and encourage it to consider the restoration of the sites: When a site is no longer exploitable because there is no more gold, it must be restored, filling holes and removing rubble. But this mining code is only rarely observed, and mines are often left unrestored.

Despite the presence of gold, the gold regions remain very poor. The profits from the exploitation go mainly to foreign companies that exploit the mines without any actual government objection. As for the small quantities provided by the artisanal extraction, they are used to produce jewelry and gold miners are not rich.

It should be noted that the exploitation of gold provides jobs for many local people, but also for foreigners from neighboring countries and Mali, Ivory Coast, Senegal, etc., with the hope of making a fortune in gold mines. They do not hesitate to handle toxic, sometimes deadly, products such as mercury.

Fights, settlements, risks of debacle with death, and clashes between indigenous and foreign gold miners are occurring. Clandestine gold panning sites are dangerous places. Illegal gold diggers handle toxic products such as mercury. They use explosives that degrade flora and fauna. An estimated 50,000 to 70,000 people work in this sector. Children have been exposed to highly toxic products such as mercury. It is an easy and cheap practice. Few people know that mercury can poison and cause serious health problems in the brain especially.

Mercury is imported from outside of Chad illegally. It is distributed nationwide by retailers for use in gold mining. The artisanal mining of gold is completely outside the control of the public administration. Many of the miners are clandestine workers who benefit from the complicity of local officials who take advantage of their work by collecting duties on their production. In this situation, the Government must formalize and legalize this activity to ensure regular control.

This first inventory of mercury contamination caused by artisanal gold mining in the Mayo-West Kebbi Region confirms threats to human health and the environment. The use of mercury in gold smelting has intensified in recent decades in Chad. It employs more than 50,000 to 70,000 people from surrounding villages in the gold zone, but also miners from other parts of the country. This resurgence of the gold mining related activities is due to the rise of the prices of the gold and the low costs of mining. Although traditional gold mining is widespread in the southwestern part of the country, there is no data available on this activity in the region. There have been no previous studies on the impacts of artisanal small-scale gold mining in this region and elsewhere in the country.

It should be noted that at the country level, there are three areas where the daily mining activities are concentrated. These are the Mayo-Kebbi-Ouest Region (Manager Lieu Pala), the Batha Region (Manager Lieu Ati) and the former BET Region (Borkou, Ennedi and Tibesti).

Due to the lack of accessibility, the inventory teams have unfortunately not been able to visit the Batha Region in the center of the country, as well as in those regions located in northern Chad. The contaminated sites described here belong to the gold zone of the Mayo-Kebbi-Ouest Region of Chad where field missions were conducted.

Given these challenges and issues, it is logical for Chad to have a national action plan to significantly reduce or even eliminate the use of mercury in the traditional gold panning sector.

2.4.1 Geographical Location of Contaminated Sites

During their stay in the locality, the inventory teams have surveyed the geographic coordinates of three sites using GPS for georeferences. These are as follows:

Yapala Gold Site:

N 08°52.848'/33P 0459 206
E 014°37.743' /UTM 0981 696
Altitude: 1309 m

This site is difficult to reach because the road is very degraded. The soil is sandy-clay supporting a dense forest. There is no sanitary or educational infrastructure.

Gamboké Gold Site:
N 09°27113' /33P 048 0123
E 014°49. 218' /UTM 1044787

Altitude: 1176 m

Hadjar Marfayine Gold Site1:
N 09°29930' /33P 0484 783
E 014° 51.681' /UTM 105 0005

Altitude: 1325 m

Hadjar Marfayine 2 Gold Site:
N 09° 29.752'

E 014°51.710 '
Altitude: 1361 m.

2.4.2 Evaluation of the Extent of the Contamination

In Chad, artisanal and small-scale gold mining has been a known activity for some time along with traditional gold panning. It employs several thousand people directly and tens of thousands of people indirectly through commercial activities. From an economic point of view, this activity is very profitable at the local level. It has changed many of the livelihoods of rural people because it has provided excellent opportunities to stimulate rural economies. However, ore processing techniques used by miners are at the root of health and environmental problems. This is the use of mercury to amalgamate gold.

In the area using traditional gold mining, the impact of mercury use on natural resources is visible. This impact is characterized by increased deforestation of areas subject to artisanal and small-scale gold mining. In fact, miners carry out the systematic falling of trees to install new gold sites. There is an irreversible change in the landscape and a considerable loss of biological diversity in which miners operate.

According to the local populations surveyed, the use of mercury has a real impact on the environment and human health. To this day, Chad does not have a legal framework for mercury use. Therefore, the use of this highly toxic substance is done without precautionary measures and without safety standards. The working conditions of gold miners are deplorable because they do not have the appropriate equipment to extract gold by amalgamation with mercury. Thus, significant quantities of mercury are released into the atmosphere by these mining extraction activities.

2.5 Constraints and Difficulties

During these inventory operations, the teams identified some constraints and gaps in data collection. The main difficulties are summarized as:

- The time spent collecting data was relatively short to completely cover the entire country given the large number of institutions to be investigated and challenging infrastructure;
- The absence in Chad of a laboratory with technical capacity required to control mercury releases into the atmosphere
- the informal sector has grown for most activities;
- the unavailability of data to be collected in certain activity sectors;
- social constraints prevent investigations from providing information (cases of cemeteries and crematoriums)
- ignorance about products containing mercury
- public unconsciousness, in general, and specifics about the negative effects of mercury on the human and human health environment
- inadequate legislation on the management of chemicals and hazardous waste, including a legal vacuum about mercury and its waste
- lack of knowledge of environmental laws and regulations.

To meet many challenges, some proposals have been formulated:

- adopt the customs nomenclature to allow the identification of products and articles containing mercury and its substances
- provide technical and financial assistance for the establishment of a national regulation specific to the use of mercury and mercury compounds
- conduct epidemiological studies to measure the effects of mercury on mercury exposed persons, including gold washers and dental technicians,
- develop and implement a plan for the management of waste generated by health activities, as well as dental amalgam waste. The implementation of these strategic documents would contribute to improving the health of the population and the quality of the environment;
- put in place information, training and awareness programs on the risks associated with the use mercury in gold panning sites (ASGM) as well as continue efforts to formalize the mining industry under the Mining Code;
- promote materials for mercury-free dental fillings, including educating health care professionals and clinics

2.6 Mercury inventory conclusions

The national inventory of mercury repositories and mercury contaminated sites were carried out during the period from May to August 2018. This inventory involved seventy-five (75) public and private institutions and enterprises, fifteen (15) customs posts, ten (10)) Economic operators importing liquid mercury who operating in the capital and the 22 Regional Heads, twenty-three (23) ministerial departments, oil sites, the Djarmaya refinery and the Baouré cement plant. It was conducted by teams of investigators, supervised, coordinated, supervised and monitored by three (03) national consultants recruited for this purpose. These teams of investigators were mainly composed of technicians in various fields. Each team of investigators was headed by a Chief, an Engineer with an appropriate background or a high-level Energy Engineer with many years of experience. The Chief ensures that inventory operations are normally conducted under good conditions and that the data collected is complete and reliable.

Before the start of inventory operations, the General Secretariat of the Environment (SGE), through the Minamata Focal Point, published a note No. Below, the General Secretariat of the Ministry of Environment and Fisheries with note ° 176/PR/PM/MEEP/SG/PFMM/2018 of May 7, 2018 informed all the institutions concerned of the progress of the inventory operations in order to prevent them and make them aware of the inventory operations. These inventories will take place throughout the national territory, from May 4 to October 30, 2018. Appointments were made by these respondents through telephone contacts in order to gather all useful information.

Also, in order to ensure the smooth execution of this inventory, the Minamata Focal Point organized several meetings in preparation of the investigators on the control of data sheets on the use of mercury and mercury releases. These technical meetings, which were facilitated by national consultants, were held at the National Ozone Office.

Other consultation and working meetings were held with stakeholders such as the General Directorate of Customs and Indirect Rights, the General Directorate of Trade, the General Directorate of Finance and Budget, the Energy Department, Directorate of Mines, the Directorate of Petroleum, the National Agency for Investments and Exports (ANIE), the Agency for Domestic Energy and the Environment (AEDE), the National Agency for Renewable Energies (ANER) etc.

Standard data sheets, developed based on the forms provided by the United Nations Environment Program (UNEP) and adapted to the national context, have been used for this purpose. After the surveys, the national experts performed the data collection, processing, analysis and compilation of data collected at the National Ozone Office (NOU). The Toolkit software and other computer tools were used to perform the calculations.

The inventory results, on one hand, and the different meetings and interviews with all the actors encountered, on the other, show that certain sub-categories of sources of mercury releases are not identified in our country. These are among the other intentional uses of mercury in industrial processes and the production of other recycled metals (secondary metal production) were not identified during our investigations.

The findings quantitatively demonstrate that of the annual input to Society of mercury in Chad is estimated at 5,660 kg Hg/yr. Gold extraction with mercury amalgamation was the leading contributor to mercury emissions/releases at 2,000 kg Hg/yr, with charcoal biomass burning the second leading contributor at 1,436 kg Hg/yr and the Consumption of mercury-containing products with 784 kg Hg/yr. Landfills, incinerators and wastewater treatment Locations also contributed to mercury releases (although note, that to avoid double-counting, only 10% of the calculated amounts are used for the final total).

Information gathered through the surveys shows that Chad imports mercury from China, India, Saudi Arabia, Kuwait, the United Arab Emirates, France and Nigeria. And, much of this mercury is used to the number on (and growing use) of gold extraction with mercury amalgamation. Ultimately, there is not an insignificant level of artisanal small-scale gold mining in Chad and a National Action Plan for this sector is recommended.

Chapter III: Policy, Regulatory and Institutional Framework Assessment

3.1 Legal Gap Analysis – Introduction

The sources of law in Chad include the Constitution, international treaties ratified by Chad, Acts of Parliament, regulations, ordinances, and customary law. The primary or supreme law of the land is the Constitution. All other laws must conform to its provisions. After the Constitution, secondary or domestic legal instruments are ranked in the following order of preference: laws, ordinances, decrees, ministerial orders and decisions.

3.2 Chad Laws Relating to Chemicals and Wastes

Law-making powers are shared concurrently between the Parliamentary and Executive branches of the Chad government. Article 21 of the Constitution defines the legislative domain. All other matters that have not been expressly identified to be within the ambit of the legislative jurisdiction fall squarely under the executive domain.[4]

[4] Chad Constitution, Articles 121-122.

International treaties are negotiated and ratified by the President of the Republic of Chad.[5] Once ratified, international treaties form part of local law and must conform to the Chadian Constitution.[6] Once a treaty is lawfully ratified and published, it has an authority that is superior to national legislation.[7]

LAWS

Chad has the following main environmental legislations that could be affected once the Minamata Convention enters into force.

Law 14/PR/98 of August 17, 1998 (Environment Code)

The Environment Code is the overarching law on environmental protection. Its main purpose is to establish the basic principles according to which the environment is sustainably managed and protected against any form of degradation, to safeguard and to enhance natural resources and to improve the living conditions of the population.

Provisions related to mercury may be covered under the following articles of the Environment Code:

a. Protection of soil and subsoil
   i. The Environment Code mandates that the resources contained in the soil and subsoil are limited or non-renewable resources, and as such should be managed rationally and protected against all forms of degradation.[8]

   ii. Forests should be protected against any form of degradation, pollution or destruction caused by over-exploitation, overgrazing, fires, burns, diseases or the introduction of inappropriate species.[9]

[5] Chad Constitution, Article 218.
[6] Chad Constitution, Article 221.
[7] International treaties are covered under Title XIV (Articles 217 to 221) of the Chadian Constitution.
[8] Defining the General Principles of Environmental Protection, Law 14 / PR / 98 of August 17, 1998, Article 20.
[9] Environment Code, Article. 29.

iii. The Administration shall take appropriate steps to ensure the systematic and periodic inventory and rational management of wetlands, as well as the prevention of all forms of pollution.[10]

iv. The atmosphere must be protected from various forms of pollution that contribute to the degradation of air quality, global warming and the depletion of the ozone layer. Article 38 of the Environment Code states that emission of any pollutants including smoke, dust or any toxic, corrosive or radioactive materials beyond the standards set by the implementing provisions of the Act are prohibited.[11]

b. Waste management

The classified installations for environmental protection (hereinafter referred to as classified facilities) are subject to authorization or declaration procedure or the nomenclature published by the competent authority.[12] According to Article 98, every owner or operator of classified facilities must take the necessary measures to prevent environmental pollution, in accordance with the norms and standards of quality of the environment.[13]

- The transportation, importation, storage, burial or dumping of foreign toxic or polluting waste in the national territory is prohibited.[14]
- Waste must first be reduced to the maximum extent possible at the source and adequate treatment must be done to eliminate or reduce their harmful or infectious damage to human health, resources natural, wildlife or the quality of the environment in general.[15]
- The transportation of hazardous waste in the territory of the Republic of Chad is subject to the issuance of a hazardous transportation permit as governed by the application of the Act.[16]
- The importation, export and transit of certain categories of waste, determined by implementing legislation, maybe prohibited or regulated by the administration responsible for the environment, or subject to the prior approval of competent authorities of the states concerned to prevent environmental damage.[17]

c. Liquid and gaseous effluents

[10] Environment Code, Article 31.
[11] Environment Code, Articles 37 and 38.
[12] Environment Code, Article 45.
[13] Environment Code, Article 47.
[14] Environment Code, Article 55.
[15] Environment Code, Article 56.
[16] Environment Code, Article 60.
[17] Environment Code, Article 61.

Discharge of liquid and gaseous effluents from various activities into the natural environment that are not in accordance with provisions of Article 68 of the Environment Code are prohibited or subject to prior authorization of the competent authority.[18] Decree 09-904 2009-08-06 PR/PM/M, which contains the implementing regulations of the Environment Code determines:

- The list of substances, including their composition and concentration, which will lead to either prohibition or prior administrative approval;
- The terms for the issuance of the authorization, as referred to in Article 59 of the Environment Code;
- The conditions which must be carried out during the collection, storage, treatment, reuse and recycling of effluents, as well as their final disposal; and
- The microbiological and virologic rejection quality.[19]

d. Protection against chemicals, hazardous or dangerous

Hazardous and noxious substances, which due to their toxicity, radioactivity or concentration may affect vital biological chains when discharged into the living environment, are subject to supervision and monitoring of the competent authority.[20] The regulations implementing this act shall develop:

- The list of harmful or dangerous substances whose discharge is prohibited or subject to prior authorization of the competent authorities;
- The list of harmful or dangerous substances whose circulation on national territory or across its borders is prohibited or subject to prior authorization of the administration; and
- The conditions, packaging, mode, route and transport timing of these substances.[21]

Establishments that produce, deliver, transfer, import, manage, store, use or destroy chemicals, harmful or dangerous, must receive permission to do so from the competent authorities in any activity previously in this field, and will be listed in the nomenclature of facilities classified for environmental protection. The authorities should systematically monitor the proper operation of these facilities in

[18] Environment Code, Article 65.
[19] Environment Code, Article 66.
[20] Environment Code, Article 68.
[21] Environment Code, Article 69.

accordance with the authorization given, including the elements that may contaminate the environment and all appropriate preventative measures that should be taken.[22] Institutions that produce or handle chemicals, harmful or dangerous substances must be equipped with filtration devices, purification, neutralization and storage in order to prevent environmental pollution.[23]

e. Norms and standards for environmental quality

According to the provisions of this Act and its implementing regulations, the administration responsible for the environment, after consulting the High National Committee for the Environment, will provide the necessary norms and standards to maintain the quality of the environment.[24] A system of financial and tax incentives encouraging investment on environmental clean-up and environmental preservation shall be implemented by the environmental administration in collaboration with the concerned departments and agencies.[25]

f. The Special Fund for the Environment

The Environment Code will establish a special fund for the environment. This fund takes the form of a special Treasury account. The modalities of implementation and operation of this fund are set by the Environment Code.[26]

The fund aims to contribute to the protection and enhancement of the environment. To reach this objective, the Fund will contribute particularly in:

- Fostering any action, research, study and training applied to the environment; and
- Funding of planned incentives under the Code and secondarily, in financing pilot operations.[27]

1. Law 016/PR of August 18, 1999 (Water Code)

[22] Environment Code, Article 72.
[23] Environment Code, Article 73.
[24] Environment Code, Article 96.
[25] Environment Code, Article 98.
[26] Environment Code, Article 99.
[27] Environment Code, Article 100.

The management of river water, lake or groundwater, and the exploitation of hydraulic structures are determined by the provisions of the Water Code, subject to compliance with international agreements. All water resources within the boundaries of Chad are considered as public good. As such, they are an integral part of the public domain of the State. Any operation on waters or water resources is subject to declaration or authorization under the laws and regulations in force, and in compliance with customary law.[28]

2. Act No. 011/PR/1995 of June 20, 1995 (Mining Code)

The Mining Code regulates the prospecting, exploration, exploitation, possession, transport, beneficiation and sale of mineral and fossil substances within the territory of Chad. Under the Mining Code, the State owns natural deposits and mineral substances contained in the nation's soil and subsoil. The Ministry of Mines and Geology is responsible for the implementation of the Mining Code.

i. Article 26 of the Mining Code requires that a mine operation permit be secured after a public survey has been conducted to assess the consequences of the proposed operation on the environment and local populations. The operating license holder is required to comply as much as possible with the studies, plans and programs. The Director of Mines must approve any material changes that may be made thereto.[29]

ii. Article 31 of the Mining Code defines gold washing or a small mine operation as exploitation of alluvial deposits or eluvial gold by artisanal means. The authorization of gold washing or operation of a small mine is granted to an individual or group of Chadian nationality.[30] The small-scale mining permit is issued by the Director of Mines which includes delimiting the area covered by the authorization and laying down, among others, operating conditions.[31]

iii. Activities governed by the Mining Code must be conducted in a way that minimizes their negative impact on the physical environment, local people and ancestral customs by containing pollution in all its forms within the acceptable standards under the Mining Code and other Environmental legislation. The mine owner or the beneficiary of a license under the Mining

[28] Water Code, Law 016 / PR of 18 August 1999, Article 1.
[29] Establishing the Mining Code in the Republic of Chad, Law No. 011/PR/95 of 20 June 1995, Art. 32.
[30] Mining Code, Article 32.
[31] Mining Code, Annex 1.

Code must use techniques to ensure effective protection and environmental management.[32]

3. Law 07-2006 from May 2, 2007 related to Oil (Oil Law)

This law defines the institutional framework governing all oil activities, including prospecting, exploration, exploitation, transportation via pipelines, processing, trade, storage, refinery and distribution. It also governs the obligations of legal entities involved in one or more of the aforementioned activities, including the rules on environmental protection as applicable to oil operations.

4. Law 14/PR/95 of July 13, 1995 or the Plant Protection Law

The Plant Protection Law aims to promote the development and security of the agricultural sector, including increasing crop yield and quality and farmers' income. It also ensures that agricultural development is achieved with respect to the environment, human and animal health. Under the law, importation, formulation, manufacturing, distribution and use of any pesticide, substance or biological material that may have an effect on crops and plants are regulated.[33] Moreover, the manufacturing, importation, distribution, marketing and use of any unapproved or unauthorized pesticide are strictly prohibited.[34]

ORDERS

1. Order 038/PR/PM/MEP/SG/ 06 on the Globally Harmonized System of Classification and Labeling of Chemicals application in Chad (GHS Order)

This Order relates to the implementation of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). The GHS was also subject to the application of Part V on pollution and nuisances from Law 14 / PR / 98 of August 17, 1998, which defines the general principles of the protection of the environment. GHS defines and classifies the hazards of chemical products and communicates health and safety information on labels and safety data sheets. The goal of the GHS system is to establish the same set of rules for classifying hazards, where the same format and content for labels and safety data sheets

[32] Mining Code, Article 66.
[33] Plant Protection Law, Law No. 14/PR/95 of 13 July 1995, Articles 22 and 24.
[34] Plant Protection, Article 23.

(SDS) will be adopted and used around the world. Mercury and mercury compounds are covered by the GHS.

The classification aims to identify all the physical, chemical, toxicological and ecotoxicological properties of substances and mixtures which can present a risk during their handling or normal use.[35]

Order 038/ PR/PM/MEP/SG/ 06 on GHS application in Chad makes the Focal Point on chemical substances responsible for the documents related to GHS dissemination to directly involve stakeholders for their application.[36] The Focal Point will also be responsible for the implementation of the whole GHS in Chad, in consultation with all concerned stakeholders.[37]

Through Article 8 of the same order, production, collection, storage and trade of chemicals and hazardous products on the national territory of Chad should be in compliance with the provisions of Law 14/PR/98, which defines the general principal of environmental protection. Also, the classification according to toxicological properties deals not only with short-term acute effects but also long-term effects due to one or repeated or long-term exposures to the substances and mixtures.[38]

The Ministry in charge of the Environment, in collaboration with the institutions involved in the implementation of the GHS, shall take the necessary measures to supply competent national structures with infrastructures to effectively implement the GHS. These measures may include, if necessary, the adoption of administrative measures, additional regulations, or their amendments, and also aim:

[35] Order 038/PR/PM/MEP/SG/06related to GHS application in Chad, Article 2.
[36] GHS Order, Article 3.
[37] GHS Order, Article 72.
[38] GHS Order, Article 42.

- To establish databases or registers containing information on GHS; and,
- To encourage initiatives from industrial sector and economical operators based in Chad to promote GHS.[39]

Order 036/MEE/DG/2000, from October 19, 2000, establishing the National Technical Committee responsible for monitoring and evaluation of international conventions on organic pollutants, pesticides, chemicals and hazardous waste (Order NTC/POPs)

This Order establishes the National Technical Committee for monitoring and evaluation of international conventions on organic pollutants, pesticides, chemicals and hazardous wastes (NTC/POPs). It was created in lieu of Article 69 of Law 14 / PR / 98 of August 17, 1998, which defines the general principles of the protection of the environment. The Decree establishing the NTC/POPS was signed by the Ministry of environment in 2000.

One of the goals of the Decree is to ensure the effective implementation of international agreements dealing with chemicals and hazardous waste, including: (1) the Stockholm Convention on Persistent Organic Pollutants, (2) the Rotterdam Convention on the Prior Informed Consent Procedure, (3) Basel Convention on the Prohibition of Transboundary Movements of Hazardous Wastes and Their Disposal and (4) the Bamako Convention on the Ban on Imports of Hazardous Waste and Control of Their Transboundary Movements in Africa.[40]

2. Order No. 0059/MSP/DG/187/DACS/96, regulating the importation, distribution and use of pesticides

This Order regulates the importation, distribution and use of pesticides used in public health. It prohibits all hazardous pesticides, especially organochlorine pesticides,[41] while allowing the use, after issuance of a license, of

[39] GHS Order, Article 74.
[40] Order 069/MEE/MDMEECERH/SG/PFSC/05 modifying the Order 036/MEE/DG/2000 from October 2000 on creation, composition and attribution of NTC/POPs, Article 2, paragraph 1.
[41] Order No. 0059/MSP/DG/187/DACS/96, Regulating the importation, distribution and use of pesticides, Article 5.

organophosphorus and carbamate pesticides. In case mercury-containing pesticides are defined for this regulation as a hazardous pesticide, this regulation will govern their use.

3. Order No. 0008/MFPTPEM/SE/DG/DTESS/99 of March 13, 1999 on the organization and functioning of health and safety committees (CHS) in business and institutions

4. Order on the regulation of Noxious and Hazardous Chemical Substances
The decree regulates Harmful or Dangerous Chemicals (SCND) listed on lists A and B in accordance with Decree No. 904 / PR / PM / MEERH / 2009 of August 6, 2009, regulating pollution and nuisances to the environment. List A mentions the harmful products wherein production, processing, storage, import, export, marketing, transport handling is strictly prohibited. On the other hand, list B enumerates the harmful products wherein production, processing, storage, import, export, marketing, transport handling is governed under Article 174 of the Order.

ORDINANCES AND DECREES

1. Ordinance No. 006/PR/12 of February 7, 2012, on the exportation and importation of petroleum products;

2. Ordinance No. 0186/PR/2011 of March 1, 2011, amending and supplementing Law No. 016/PR/99 of 18 August 1999 on the Water Code;

3. Decree 09-904 2009-08-06 PR/PM/MERH related to nuisances and environmental pollutions control. This Decree contains provisions determining the list of regulated substances and all activities allowed or prohibited in their management;

4. Decree No. 821/PR/MMEP/95 implementing the Mining Code;
5. Decree No. 010 / PR / MA / 99 of January 7, 1999 laying down the procedures for the application of Law No. 14 / PR / 95 of July 13, 1995 on Plant Protection;

6. Decree No. 364 / PR / MMSP / 01 of July 18, 2001 on the organization of community participation in health care costs. The provisions of this Decree lay down the rules of organization of community participation in health care costs;

7. Organizational decree of the Ministry of Environment. The provisions of this Decree establish the Organization of the Chart of Environment Department; and.

8. Decree No. 630 / PR / PM / MERH / 2010 of August 4, 2010, on the regulation of environmental impact studies (assessments). The provisions of this Decree relate to regulations on environmental impact studies.

CUSTOMARY LAW

Customary laws are among the sources of law in Chad. However, they are often oral sources. Articles 5 and 8 of the organic Law 013 / PR / 2010 of August 25, 2010, recognizes environmental protection, hygiene and safety, though these sources are not very definitive on these issues.

For instance, cutting trees in sacred forests are prohibited in Chadian tradition. However, these decisions are not recorded in written documents. It is found in practice and the attitudes of the village population.

3.3 Convention Obligations and Chad Legislations

The following section discusses the specific obligations under the Minamata Convention, as well as the counterpart domestic legislations in Chad. It also examines the consistency between the international and national laws.

3.4 Article 3. Mercury Supply Sources and Trade

The provisions under Article 3 limit the sources of mercury available for use and trade and specify procedures to follow where such trade is still allowed.[42] A major provision in Article 3 is the restriction of potential supplies from primary mercury mining and decommissioning chlor-alkali plants. It also seeks to identify any remaining large stocks of mercury. Primary mercury mining is the least favoured source of mercury supply under the Convention because it adds new mercury to the global mercury supply and is itself a significant source of mercury releases into the environment.

[42] Mercury supply comes from 5 main sources: a) primary mercury mining, b) by-product mercury from mining other metals and natural gas production, c) decommissioning chlor-alkali facilities; d) recovery of mercury from wastes and used products that contain mercury, and e) and government or private mercury stocks.

In the area of trade, Article 3 establishes a prior-informed consent requirement before any trade of mercury to occur between Parties. The relationship and obligations between Parties regarding mercury trade are elaborated, and rules governing Party to non-Party trade are also tackled in this article.

Article 3 - Supply and Trade	**Chad Domestic Law**	**Comments**
Not allow new primary mercury mining	No law covers this issue.	See discussion below.
Phase out existing primary mercury mining within 15 years	No law covers this issue.	
Prevent the import and use of mercury from primary mercury mining for artisanal and small-scale gold mining (ASGM)	No law covers this issue.	However, it can be regulated under the following laws: - Mining Code: Art 66 - Environment Code: Articles 35, 37, 38, and 55.
In accordance with Article 3.5(b), restrict the import and use of excess mercury from decommissioning chlor-alkali plants, and require environmentally sound disposal	No law covers this issue.	These gaps can be regulated under the Environment Code: Articles 55, 61, 68, and 69.
Obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons (MT), and mercury supply generating stocks exceeding 10 MT/yr	No law covers this issue.	
Not allow the export of mercury unless the importing country provides written consent, the mercury is for an allowed use or environmentally sound storage, and all other conditions of Article 3.6 are met.	No law covers this issue.	These gaps can be regulated under the Environment Code: Article 69
Not allow the import of mercury without government consent, ensuring both the mercury source and proposed use are allowed under the Convention (and applicable domestic law)	No law covers this issue.	

There are currently no primary mercury mines in Chad. Since Chad has ratified the Convention, it is obligated to prohibit future primary mining of mercury within its territory that is not existing when the country ratified the Convention. The

prohibition on future mercury mining can be reflected by specific amendment to the Mining Code.

The re-opening of Chad's oil fields, which has a sizeable reserve estimated at 1.5 million barrels in 2011,[43] can become a secondary source of mercury as a by-product of oil production. Mercury as a by-product of oil exploration is a major source of anthropogenic mercury and is thus covered by the Convention.

Currently, Chad does not have any law that directly addresses by-product mercury from oil production. The Oil Law will need to be amended to include this issue to address possible future supply of by-product mercury. At the same time, a joint Order from the Ministries in charge of Oil and Environment could further limit by-product mercury from oil extraction and processing.

Moreover, the Mining Code, through Article 66 calls for the mandatory minimization of the negative impacts of mining activities on the environment, local people, and customs through containing pollution in all its forms, etc. This provision is broad enough to include mercury, a known environmental pollutant, and form the basis for import or use prohibition in mining practices. Based on a similar rationale, Articles 35, 37, 38 and 55 of Law 14/PR/98 which defines the general principles of the Environment, could be used to govern the protection of wetlands surrounding mining sites from mercury pollution and reduce mercury emissions in mining and surrounding areas. Lastly, these articles could further serve as basis for specific regulations taken by the Ministries in charge of Mines, Environment, Trade and/or Public Health to limit or prevent mercury deviation from by-product mercury to prohibited uses in Chad.

[43] Online information from IBTimes. Viewed at: http://www.ibtimes.com/another-big-oil-producer-africa-chad-hopes-triple-crude-output-2015-1412108 [20 May 2016].

3.5 Article 4. Mercury Added Products

The Convention will reduce mercury demand in products through a combination of measures which phase out mercury uses in many key products, phase down mercury use in another, review remaining products for possible restrictions, and discourage the manufacture of new products using mercury.

A mercury-added product (MAP) is defined by the Convention as a "*product or product component that contains mercury or a mercury compound that was intentionally added*" (Article 2.f).[44] The definition of MAPs under the Convention is broad as it aims to cover all products containing mercury where the mercury was added in the manufacturing process. The definition does not aim to cover products where mercury was not intentionally added, e.g. where the mercury comes from a trace contaminant of natural origin in one of the manufacturing feed stocks.

The broad nature of this definition does not mean all MAPs are regulated under the Convention. Only those products listed in Annex A of the Convention are subject to immediate controls.

Article 4 - Mercury Added Products	**Chad Domestic Laws**	**Comments**
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 9	No specific text deals with mercury in products.	Some laws can regulate certain products listed in Annex A part 1: Plant Protection Law.
Phase down the use of dental amalgam through two or more measures listed in Part II of Annex A	No law covers this issue.	See discussion below.
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	No law covers this issue.	
Discourage the manufacture and distribution of new mercury product types	No law covers this issue.	

[44] Article 2.f, Minamata Convention.

Chad has no known sources of mercury nor do local industries appear to engage in the manufacture of products that contain mercury. Most of Chad's mercury comes from foreign sources through trade and importation of products that contain mercury.

As of this review, Chad does not appear to have a specific law addressing Article 4 obligations under the Convention covering MAPs. Only Article 5 of Decree 0059/MSP/DG 187/DACS/96 which regulates the importation, distribution and use of pesticides used in public health could be an entry point for regulation of mercury containing pesticides. The decree must be updated to include all mercury containing pesticides in the list of prohibited organochlorine pesticides.

Apart from pesticides, the phase down of dental amalgam, other mercury-added products and discouraging the manufacture and distribution of new mercury product types need to be addressed. The most direct route would be an enactment of new legislation that covers MAP. However, if this will be difficult to push or in the interim some specific Decrees or Orders for the implementation of the specific provisions of the Minamata Convention. This could be done in the form of a joint Order from the Ministries in charge of Environment, Trade, Customs, Public Health, Energy, or other relevant sectors.

3.6 Article 5. Manufacturing Processes in which Mercury or Mercury Compounds are Used

Certain manufacturing processes consume large quantities of mercury. For this reason, the Convention sought to install measures to prohibit or restrict mercury use in certain manufacturing processes as an important measure in reducing global mercury demand.

The Convention targets mercury that is used as a cathode to produce chlorine and caustic soda at mercury-cell chlor-alkali plants (MCCAPs). Another process which the Convention is closely looking at is mercury is used in a catalyst to produce vinyl chloride monomer (VCM), a precursor to PVC.

The Convention follows the Art. 4 approach in reducing mercury demand in the manufacturing sector. The Convention will phase out mercury uses in two manufacturing processes, phase down or restrict mercury use in three others, review remaining manufacturing processes for possible restrictions in five years, and discourage mercury use in new manufacturing processes.

Article 5 - Manufacturing Processes	**Chad Domestic Law**	**Comments**
Not allow the use of mercury or mercury compounds in the manufacturing processes listed in Part I of Annex B	No law covers this issue.	See discussion below.
Restrict (as specified in the Annex) the use of mercury in the processes listed in Part II of Annex B	No law covers this issue.	
Not allow new facilities from using mercury in the processes listed in Annex B, except facilities using mercury catalysts to produce polyurethane	No law covers this issue.	
For facilities with processes listed in Annex B, identify and obtain information on mercury or mercury compound use; and control mercury emissions to air, and releases to land and water	No law covers this issue.	
Discourage new uses of mercury in industrial processes	No law covers this issue.	

According to government data, there are currently no MCCAP and VCM production in Chad. Thus, now Article 5 does not appear to apply in the Chadian context.

It will be prudent for Chad to proactively address the issue and include a broad prohibition on the use of mercury in manufacturing processes. For instance, this effort can dovetail with proposed legislation on MAPs. By instituting a proactive approach, Chad will be able to guard its local manufacturing industry from the transfer of outdated and unwanted mercury reliant processing technologies.

3.7 Article 7. Artisanal and Small-scale Gold Mining

Artisanal and small-scale gold mining (ASGM) is defined in Article 2 of the Convention as "*gold mining conducted by individual miners or small enterprises with limited capital investment and production*." Article 7 applies to ASGM where mercury is used to extract gold.

ASGM is the major use of mercury in the world. Mercury emissions to air from ASGM are estimated by UNEP at 727 tonnes annually, making this the largest emitting sector, accounting for more than 35% of global man-made air emissions. ASGM is a complex development issue. While the practice frequently poses major environmental and social concerns, it also provides development opportunities in rural areas and for miners and rural communities.

Article 7 acknowledges the challenge of addressing mercury use in ASGM, especially for developing countries. The Convention provides these countries the flexibility to customize their approach to the conditions of the sector in their jurisdiction. The mechanism for providing this flexibility is the required National Action Plan (see Annex C of the Convention).

Article 7 - ASGM	**Chad Domestic Law**	**Comments**
For All Governments		
Take measures to reduce, and where feasible, eliminate mercury and mercury compound use, emissions (to air), and releases (to land and water) associated with ASGM	Mining Code	See Art. 3 discussion.
For governments where ASGM and mercury use is "more than insignificant"	Mining Code	The Mining Code covers small-scale mining. It will need an amendment to synchronize definitions.
Establish coordinating mechanism and delineate agency roles for development/implementation of an ASGM National Action Plan (NAP)	Mining Code	But it may be further regulated under: Decree 09-904 2009-08-06 PR / PM / MERH Decree on the regulation of pollution and nuisances to the environment: Articles 7; 8; 9; 10 and 13.

Define and formalize or regulate ASGM consistent with the Convention	Mining Code	The Mining Code covers small-scale mining. It will need an amendment to synchronize definitions.
Eliminate whole ore amalgamation, open burning of amalgam or processed amalgam, burning of amalgam in residential areas, and cyanide leaching of mercury-laden sediment, ore or tailings (the "worst practices")	Mining Code	Practice can be specifically banned by expanding, Act No. 011 / PR / 1995 of 20 June 1995 Mining Code: Article 66 Can be elaborated on in NAP.
Set mercury use reduction goals or targets consistent with the timely elimination of the worst practices and other use reduction efforts	Mining Code	Goal not specifically set. Chad can elaborate through its NAP.
Reduce mercury emissions, releases, and exposures associated with ASGM, and prevent mercury exposures of vulnerable populations (particularly women of child-bearing age and children)	Environment Code	It may be further regulated under: Act No. 011 / PR / 1995 of 20 June 1995 Mining Code: Article 66 Can be elaborated on in NAP.
Prevent the diversion of mercury and mercury compounds from other sectors to ASGM, and manage mercury trade consistent with the NAP	No law covers this issue.	This issue may be covered by Decree 09-904 2009-08-06 PR / PM / MERH Decree on the regulation of pollution and nuisances to the environment: Articles 172, 175
Implement a public health strategy to address mercury exposures to ASGM miners and communities	No law covers this issue.	Can be elaborated on in NAP.

In the past two-years, with the mounting challenges of ASGM the government took the decision to close ASGM sites as a step towards formalizing the gold mining sector. As of this writing, all ASGM sites, which are governed by the national Mining Code, without a permit are considered illegal in Chad. However, it is noted that artisanal mining is still operating in a clandestine way in Chad, including the use of mercury in some places.

The practical first step in managing Art. 7 obligations, is for the government of Chad to make a determination on whether ASGM in its territory is "more than insignificant". If there is a finding to this effect, Chad is bound to develop a National Action Plan under Annex C of the Convention. In such a case, Chad will

be eligible for support in its NAP development. The NAP will greatly aid Chad in aligning and developing appropriate policies and legislation on ASGM as well as coordinating efforts and addressing key areas covered under Annex C, e.g. public health policy, reduction targets and goals, information campaign, etc.

The NAP will be a critical tool in providing guidance to the government as it manages the ASGM issue, but also help in both implementing and inform its efforts.

In the interim, before a NAP is undertaken, the government of Chad can utilize:

- The NTC/POPS established under Decree 036/MEE/DG/2000 to serve as a national steering committee for the planning and implementation of NAP if ASGM is more than significant in the country.
- Through the implementation of Article 66 of the Mining Code related to environmental protection, a regulation could be developed in order to prevent the diversion of mercury for use in ASGM, if Chad deems to prohibit mercury use in ASGM, and to also prohibit unsound environmental practices in ASGM.

3.8 Article 8. Emissions

Article 8 - Air Emissions	**Chad Domestic Law**	**Comments**
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 ()	Environment Code BAT/BEP, ELV can be further integrated under: Law No. 014/ PR/98 defining the general principles of protection of the environment: Articles 38, 47, 68, 69, 72, 73	See discussion below.
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	Regulated under Law No. 014/ PR/98 defining the general principles of protection of the environment: 38, 39, 47, 65, 66, 68, 75, 96, 97	

Require monitoring/reporting and otherwise establish a mercury emissions inventory for sources listed in Annex D	Regulated under Law No. 014/ PR/98 defining the general principles of protection of the environment: 38, 39, 47, 65, 66, 68, 75, 96, 97	

Mercury is present in coal and other fossil fuels as a natural impurity. A significant amount of mercury is released into the atmosphere and environment from coal combusted in coal-burning power plants and industrial boilers. The purpose of Article 8 is to reduce mercury emissions to air the major source categories identified by the Convention: coal-fired power plants, coal-fired industrial boilers, non-ferrous metal smelting and roasting processes, waste incineration, and cement production.

Chad derives its energy demands from thermal power plants. These power plants located at N'Djamena provide most of the national output. These power plants are fueled by heavy fuel oil, which may contain mercury. Majority of the population rely on wood for fuel.

While the emission sources covered by the Convention do not specifically coincide with the current sources in Chad, nonetheless it would be prudent to measure and monitor mercury emissions from the two power plants. Once the appropriate data is generated and analyzed, Chad can proceed to evaluate next steps in addressing emissions from the two plants.

3.8 Article 9. Releases

Article 9 – Releases	Chad Domestic Law	Comments
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	Issue of Water Quality currently covered under Law No. 016 / PR / 99 covering the Water Code: Article 114 No specific text covers this point.	Need to specify approach and adopt future guidance from Convention.
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	Issue of Water Quality currently covered under: Law No. 016 / PR / 99 covering the Water Code: Articles 115, 116, 117, 118 and 138 - Law No. 014 / PR / 98 defining the general principles of protection of the environment: Articles 47, 97.	Need to specify approach and adopt future guidance from Convention.

The purpose of Article 9 is to reduce mercury releases to land and water from sources not addressed by other provisions of the Convention. Many of the provisions of Article 9 are patterned after Article 8, but there are some major differences.

Mercury releases to land and water from oil exploration may be covered under Article 9.

Article 37 of Law 14/PR/98 states that "Any owner or operator of a classified installation must take the necessary measures to prevent and fight against environmental pollution, in accordance with the norms and standards of

environmental quality referred to in Article 98 this Law. It has obligation to submit itself to any visit or possible inspection by the competent authorities". Hence, the government has the ability to control all industrial effluents directly released in water and land. Since effluents containing mercury are not excluded, these can be controlled by a specific governmental agency in charge of the same activity. At the same time, Article 97 expresses how the norms and standards for the environment shall be elaborated.

In addition to that, Law 016/PR/99 or the Water Code contains provisions to prevent water pollution from all chemicals, including mercury. Article 115 states that, "*The provisions (of the Water Code) apply to spills, flow discharges, releases, direct material of any kind deposit and, more generally, any fact likely to cause or increase water degradation by modifying their characteristics, whether of surface water or groundwater*". Article 117 further mentions that, "*[S]pills, flow discharges, direct or indirect deposits of water or material, and generally any circumstances which may affect the quality of surface water or groundwater are regulated and prior authorization pursuant with Articles 115 and 116. In all cases, the rights of third parties in respect of the pollution perpetrators are and remain reserved*". There will be a need however for Chad to further specify its approach to releases under the Convention and adopt future guidance on this issue from the Convention. The abovementioned laws provide basis for Chad to address land and water releases of mercury.

3.9 Article 10. Environmentally-sound Interim Storage of Mercury intended for use allowed under the Convention

Article 10 only covers the environmentally sound interim storage of mercury and mercury compounds. The scope of Article 10 is limited to "interim" or temporary storage since this is storage associated with mercury intended for use allowed under the Convention. The environmentally sound management of waste mercury and mercury compounds is covered in Article 11, as well as its long-term management or disposal.

The Convention acknowledges that in the collection, handling, transport and storage of mercury and mercury compounds emissions and releases can occur, especially if there is improper management during in any of the above stages. To prevent the possible adverse effects of mercury as it transfers in commerce or destinations, the Convention requires countries to take measures to ensure the environmentally sound storage of mercury under Article 10.

Article 10 – Interim Storage	**Chad Domestic Law**	**Comments**
Take measures to ensure interim mercury storage is conducted in an environmentally sound manner, taking into account guidelines to be developed by the Conference of the Parties (COP)	Environment Code – chemicals	Need to elaborate coverage of specific Minamata obligation.

Since Chad is a net importer of mercury and mercury added products, the absence of specific laws or regulations to cover Article 10 issues could leave it vulnerable to spillage and accidents due to improper storage of allowed use mercury. However, Article 66 of Law 14/PR/98 98 which defines the general principles for environmental protection, mentions that the "implementation texts" of the Law provide:

- The list of substances, including their composition and concentration, which will lead to either prohibition or prior administrative approval;
- The terms for the issuance of the authorization, as referred to in Article 59 of the Code;
- The conditions which must be carried out during the collection, storage, treatment, reuse and recycling of effluents, as well as their final disposal; and
- The Microbiological and virologic rejection quality.

Based on the 3rd paragraph of Article 66, there appears to be a basis to elaborate storage provisions for the environmentally sound storage of commodity mercury or those intended for an allowed use under the Convention. The government of Chad can look forward to the Convention Technical

Guidelines for environmentally sound storage of mercury and mercury compounds once this work has been finished.

3.10 Article 11. Mercury Wastes

Mercury wastes can come in a variety of forms, depending upon the source. Industrial processes using mercury will create wastes from both the manufacturing process and pollution control operations. Mercury-added products become wastes when discarded, either because it is or broken or when consumers decide to buy a new model, e.g. the case of electronic gadgets such as mobile phones and computers, where functioning devices are discarded and replaced with the latest models before the end of their useful life. The clean-up of contaminated sites may generate mercury wastes, such as treatment residuals and contaminated soil.

Article 11 is the provision of the Convention addressing these mercury wastes, and its implementation will eventually result in the final disposal of these hazardous wastes.

Article 11 – Mercury Waste Management	**Chad Domestic Law**	**Comments**
Use a definition of mercury waste consistent with Article 11.2	Currently regulated under Law No. 014 / PR / 98 defining the general principles of protection of the environment: Articles 2.12.	The Environment Code will need to be amended to reflect Minamata definitions.

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.	Currently regulated under Law No. 014 / PR / 98 defining the general principles of protection of the environment: Articles 55, 56,	Specific implementing rules may be needed that takes into consideration Basel Convention Technical Guidelines on the ESM of mercury waste
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	No specific text covers this point.	But it may be regulated either by expanding: Law No. 014 / PR / 98 defining the general principles of protection of the environment: Article 61 - OR, it's IRR.
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.	No specific text covers this point.	But it may be regulated under Law No. 014 / PR / 98 defining the general principles of protection of the environment: Article 60

Articles 55 and 56 of Law 14/PR/98 98 defining the general principles for environmental protection deal with wastes in general. Respectively, the provisions state that, "*[T]he transit, importation, storage, burying and dumping on the national territory of toxic wastes or foreign pollutants are prohibited*"; and that "*[W]aste must be subject to a reduction to the maximum possible volume at the source and to an appropriate treatment to eliminate or reduce their harmful or infectious effect to human health, natural resources, flora and fauna or the quality of the environment in general*." These articles can broadly cover mercury wastes and the need for their ESM. There is a major concern over toxic waste dumping and the provision of law bears this.

The provisions however are general, and more specific regulations are needed. Chad can look at the recently adopted Basel Convention Technical Guidelines for the ESM of waste consisting of, containing or contaminated with mercury or

mercury compounds for guidance in addressing mercury waste at the national level.[45]

It is also important to note that Chad also signed and ratified the Basel Convention on March 10, 2004. Thus, this international agreement is part of legal texts used to regulate the toxic wastes in Chad.
Articles 60 and 61 of Law 14/PR/98 98 defining the general principles for environmental protection, may be used to regulate the transport of mercury wastes across international boundaries.[46]

3.11 Article 12. Contaminated Sites

Contaminated sites are a difficult issue for all countries, whether developed or developing. These sites come in various forms: active sites, where existing processes or practices continue to contribute to the contamination; or historical sites, where such processes or practices have stopped but the pollution remains. The sources of the contamination can also vary. The source may be from waste management, manufacturing process, improper storage, etc. The risks to local communities and exposed populations are the principal concern over contaminated sites. To manage the complexity of the contaminated sites issue, the Convention sought to address the following factors under Art. 12: determining the nature and extent of contamination, the risks to exposed populations, remediation options, and the identity of entities or persons who should assume liability for some or all or the remediation costs.

---

[45] Available at: http://www.basel.int/TheConvention/ConferenceoftheParties/Meetings/COP12/tabid/4248/mctl/ViewDetails/EventModID/8051/EventID/542/xmid/13027/Default.aspx

[46] Article 60 mentions that "The transportation of special wastes in the territory of the Republic of Chad is subject to the issuance of a hazardous transportation permit as governed by the application texts of this Law". Article 62 further states that, "The importation, export and transit of certain categories of waste, determined by a statutory instrument, may be prohibited or regulated by the administration responsible for the environment or subject to the prior approval of competent authorities from the concerned Countries in order to prevent environmental damage".

Article 12 – Contaminated Sites	Chad Domestic Law	Comments
Develop strategies for identifying and assessing mercury/mercury compound contaminated sites	No text covers this point.	See discussion below.
If risk reduction activities are taken at contaminated sites, they are taken in an environmentally sound manner, incorporating risk assessment where appropriate	No text covers this point.	See discussion below.

Article 12 of the Convention calls for the creation and adoption of guidance in approaching contaminated sites. Note, that there are no mandatory obligations to push cleaning up contaminated sites. Chad has the option to create implementing legislation on the matter or wait for further initiatives from the Convention to take mandatory action. In the meantime, the Chad government can consider strategies for identifying and assessing mercury contaminated sites based on the Environment Code, and without need of developing new regulation on this action.

3.12 Article 13. Financial Resources and Mechanisms

Article 13 – Financial Resources	Chad Domestic Law
Access domestic resources as may be needed to implement Convention obligations	Partially covered by the annual law of finance, Special Fund
Access financial resources available under the Convention financial mechanism and other resources available from multilateral, regional, and bilateral funding sources	See discussion below.

Under Article 13, each Party will undertake to provide, within its capabilities, resources in respect of those national activities that are intended to implement

this Convention, in accordance with its national policies, priorities, plans and programmes. These resources may include domestic funding through relevant policies, development strategies and national budgets, and bilateral and multilateral funding, as well as private sector involvement.

Article 99 of Law 14/PR/98 defining the general principles for environmental protection, creates the Special Fund for the Environment which is in the form of a special account in the National Treasury. It will be used in accordance to the special provisions promulgated by an implementing text or regulation which the government of Chad will enact. In addition, Article 100 emphasizes the objectives of the Special Fund in terms of fostering and participating in any action, research, study and training applied to the environment, as well as the funding of planned incentives under Law 14/PR/98 and secondarily in financing pilot operations.

In spite of the existing mechanisms, based from the experiences of environmental authorities and local NGOs, the financial resources mobilized by the government for the management of chemicals in general are difficult to identify and collect. These resources remain very low. Given this particular challenge, Chad may need to look at other funding sources to help in the implementation of its Minamata Convention obligations.

3.13 Article 16. Health Aspects

Mercury impacts both human health and the environment. Article 16 pointedly focuses on the health ministries by providing guidance on activities the ministries can undertake to minimize exposure of their population to mercury.

Article 16 – Public Health	**Chad Domestic Law**	**Comments**
Promote the development and implementation of strategies to identify and protect **populations** at risk, such as developing fish consumption guidelines	No text covers this point.	See discussion below.
Promote occupational exposure educational and prevention programs	No text covers this point.	But it may be regulated under Labour Code Law 038 / PR / 96 from December 11, 1996: Article 226
Promote prevention, treatment, and care services for affected populations	No text covers this point.	See discussion below.

3.14 Article 17. Information Exchanges

Article 17 relates to information shared between parties, and it identifies key data or information.

The provisions of Article 16 are scarcely covered by Chad domestic laws. While decree 024/PR/MTEF/DG/DEP/85 amending the road tax on fresh, dried and

smoked fish identifies populations involved in fisheries activities, it only refers to taxes on fish and the penalties to be paid by violators. It does not cover fish consumption advisories. Regulations dealing with the promotion and implementation of strategies to identify and protect populations at risk were not found.

Article 17 – Information Exchanges	Chad Domestic Law	Comments
Collect and disseminate information on annual quantities of mercury and mercury compounds emitted, released, or disposed; and other information specified in Article 18	No text covers this point.	See discussion below.
Share information on the health and safety of humans and the environment as non-confidential, in accordance with Article 17.5	No text covers this point.	
Report to the COP on progress in implementing Convention obligations under Article 21	No text covers this point.	

Concerns on occupational exposure, educational and prevention programs can be regulated by Law # 038 / PR / 96 from December 11, 1996, Labour Code. Article 226 states that, "*To protect the life and health of employees, the employer is required to take all necessary measures that are appropriate to the company's operating conditions. This includes developing facilities and regulating labour functions in order to maintain the best possible situation for employees to work accidents and occupational disease*…" Thus, all activity sectors governed by the Labour code are required to take measures to avoid risks and hazards resulting from mercury exposure.
There is a need to elaborate on health-related regulation on mercury in Chad, especially on promoting prevention, treatment and care services for affected populations.

In the legal review, no legal provisions were found in domestic laws dealing with information exchange. To help comply with Art. 17 requirements, Chad will need to ensure that during its update of appropriate legislation and regulations on mercury that data on quantities of emissions, releases, disposal and other information required under Art. 18 are covered.

3.15 Article 18. Public Information, Awareness and Education

The available mechanisms to communicate to workers and share public information related to potential or actual risks related to production, importation, export, use and dumping of chemicals are more or less clear in Chadian context. Trade union confederations can organize training workshops related to the workers' health and the National Social Security Company (CNPS in French) regularly works to improve the health of the workers.

Also, Title III of the Law 14 / PR / 98 on the general principles relating to the environment protection, relates to environmental education. It is stated in Article 9 that, "education, information and training are set works at all levels in order to generate responsible behaviour vis-à-vis the preservation, restoration, and the value of the environment to sustainable development implementation service". Thus, regulatory basis exist in Chad to cover public information, awareness and education. However, this basis should be reinforced by other regulatory texts to emphasize chemicals hazards communication, including mercury.

3.16 Conclusion and Recommendations

Chad faces similar challenges that are common to all new parties to the Minamata Convention, ensuring that the Minamata Convention is properly transposed into its domestic law and identifying gaps and inconsistencies between the Convention and national law. In the course of the legal review, the following conclusions were arrived at:

Within the context of Chad, some parts of the Convention are not immediately relevant and therefore need not be part of the country's priorities in addressing legal gaps. In particular, issues related to supply/mining of mercury (part of Article 3), production of non-ferrous metals and other processes (Article 5), Article 8 (Emissions to air) and majority of activities listed in Annex D are not immediately relevant to Chad.

Two major mercury sources, by-product mercury from oil production and ASGM, however, are present in Chad. Articles 3, 7, 9, 10, and 11 of the Convention are very relevant and apply fully within the Chadian context. Further, Chad is a net importer of MAPs thus Article 3, 10 and 11 are critical obligations that need to be observed.

There is good foundational legislation in Chad to build on, notably:

- The Environment Code, which aims to establish the basic principles according to which the environment is sustainably managed and protected against any form of degradation. Particularly, provisions on the (1) protection of soil and subsoil, (2) waste management, (3) liquid and gaseous effluents and (4) protection against chemicals provides the foundation that will facilitate the implementation of the Convention. Moreover, norms on environmental quality and the establishment of a Special Fund for the Environment will ensure that mercury elimination activities can be realized.

- The Water Code enables the Chadian government to govern its water resources and protect them from any and all mercury releases, while the Mining Code regulates activities relating to the mineral and fossil resources within the territory of Chad. This covers any ASGM operations and the use of mercury in by small-scale gold miners. The Plant Protection Law is crucial in regulating pesticides, particularly mercury-containing pesticides should it enter Chadian territory.

- The implementation of GHS serves as an entry point for the regulation of the importation and export of mercury and mercury-added products.

An examination of the specific obligations under the Convention vis-à-vis Chadian legislations showed critical gaps and challenges that need to be addressed:

- The country does not have any law that directly addresses by-product mercury from oil production.
- As a net importer of MAPs, Chad needs to bolster its current laws in this area.
- ASGM can become a major mercury issue for Chad.

The absence of laws or regulations in Chad to cover Article 10 issues could leave it vulnerable to spillage and accidents due to improper storage of commodity mercury, especially since Chad as an importer of mercury and MAPs. Moreover,

the presence of ASGM in the country could pose as a major demand source for mercury requiring at the minimum strong Art. 10 provisions on storage.

- Environmentally sound management of mercury waste will be a pressing issue for Chad. It will need to update existing regulations as well as ensure that it is following Basel ESM guidelines on mercury waste.
- Preventing toxic waste dumping, including mercury waste is an important issue for Chad.

3.17 Institutional Gap Analysis: Introduction

In Chad, no one institution exists to monitor mercury import, use and disposal in the country. The Convention proposes regulating mercury sources and supplies, mercury added products, mercury wastes and also contaminated sites. It also proposes to undertake inventory and programs that inform population and monitors the release of the chemical. In order to thoroughly address these issues, the discussion of the Institutional Gap Analysis and Capacity Barriers for Chad is organized around each article in the Minamata Convention on Mercury. The Focal Point for the Ministry of Environment and Fisheries, representing the Chad government, identified the principal uses, stakeholders and priority level of the Article-specific problem associated with mercury in this Analyses (see each table under all Articles).

Institutional Gap Analysis: Article 3

Article 3 bans mercury mining for those sites not already mined and the phase-out over 15 years for sites that were running prior to entry into force of the convention. There are five main sources of mercury supply: (1) primary mercury mining, (2) by-product mercury from mining other metals, (3) decommissioning chlor-alkali facilities, (4) recovery of mercury from wastes and used products that contain mercury, and (5) government or private mercury stocks (Lennett and Gutierrez 2014). Chad is not conducting activities that involve any of these five main sources.

Article 3- Mercury supply sources and trade		
Principal Uses	Stakeholders (see page 2 for full names)	Priority level of this problem associated with mercury based on the Chad government evaluation:
There is a legislative, regulatory and legal framework in Chad, for the management of the pollution generated by mercury: - Law No. 014 / PR / 98 of August 17, 1998 defining the general principles of environmental protection; - Decree No. 904 / PR / PM / MERH / 2009 of August 6, 2009 on the regulation of pollution and nuisance to the environment. (See Annex A).	HCNE DPVC MHPV MSP MP MEP/ DEELCPN MMI ME CTD CTN UTC	HIGH

Institutional Gap Analysis: Article 4

This article bans the import and export of *products* listed in Annex A Part I and II of the Convention and regulates *processes* listed in Part II of Annex B. The ban is to be effective after the phase-out date, which is the year 2020. The Convention will reduce mercury demand in products through a combination of measures, which (1) phase out mercury uses in many key products, (2) phase down mercury use in others (3) require the review of some products for possible restrictions within five years, and (4) discourage the manufacture of new products using mercury (Lennett and Gutierrez 2014).

Mercury-added products includes batteries, switches and relays, compact fluorescent lamps (CFL), linear fluorescent lamps (LFL), high pressure mercury vapor lamps (HPMV), cold cathode lamps (CCFL) and electronic electrode fluorescent lamps (EEFL) and cosmetics with mercury content above 1.0 ppm, Pesticides, biocides and topical antiseptics and in non-electronic measuring

devices such as barometers, hygrometers, manometers, thermometers, and sphygmomanometers.

While Chad does not manufacture mercury-added products, it does import, use and throw away many of these products. The magnitude of the import, use, and waste of mercury-added products was identified in Chad through the MIA process.

In addition to the product phase-out, reductions, or alternative suggestions, Article 4 also covers measures to phase down the use of dental amalgams. Identifying the use and prevalence of mercury dental amalgams and setting national objectives in Chad will be determined after the MIA process.

The difficulties and constraints within this article is the fluidity of borders with neighboring countries, especially areas with few customs agents, where the control and monitoring of products with mercury will be challenging.

Article 4 - Mercury-added products		
Principal Uses	Stakeholders (see page 2 for full names)	Priority level of this problem associated with mercury based on the Chad government evaluation:
Chad does not manufacture mercury-added products but does import these products.	HCNE MEP/ DEELCPN M E C MSP MFB/DOUANE MMI OSC	HIGH

Institutional Gap Analysis: Article 5

This article exempts manufacturing processes that uses mercury added products, as well as processes for manufacturing such mercury added products or processes that handle mercury containing waste. The two primary anufacturing processes that consume a large quantity of mercury are (1) in the production of chlorine and caustic soda at mercury-cell chlor-alkali plants and (2) in the production of vinyl chloride monomers. Other uses include sodium or potassium

methylate or ethylate as catalysts in the manufacture of biodiesels and polyurethane elastomer applications that require a mercury catalyst. In Chad, there are no known existing industries that add mercury as part of the manufacturing process.

Article 5 - Manufacturing Processes in which mercury or mercury compounds are used		
Principal Uses	Stakeholders	Priority level of this problem associated with mercury based on the Chad government evaluation:
Not addressed by Chad regulations since there is no existing industry using mercury in manufacturing.	N/A	N/A

Institutional Gap Analysis: Article 7

Article 7 addresses artisanal and small-scale gold mining (ASGM) were mercury is used to extract gold. ASGM is defined as "gold mining conducted by individual miners or small enterprises with limited capital investment and production". ASGM is the largest use and emitter of mercury in the world (Lennett and Gutierrez 2014).

Article 7 - Artisanal and small-scale gold mining		
Principal Uses	Stakeholders (see page 2 for full names)	Priority level of this problem associated with mercury based on the Chad government evaluation:
There are insignificant regulations of ASGM activities.	HCNE MEP/ DEELCPN MMI MFB/DOUANE MSP MHV MA OSC	HIGH

Chad has indicated that ASGM activity is "more than insignificant" and has approached UNIDO about the development and implementation of an ASGM

National Action Plan (NAP). Chad may develop, with the support of UNIDO, the artisanal gold mining project. This project will establish a coordination mechanism and will determine the roles of all parties dependent on ASGM. Chad has already taken measures to limit and control exploration of ASGM sites, by formalizing the mining industry through a revised Mining Code and by considering unpermitted ASGM sites as illegal. This permitting process builds in oversight by allowing specification of operating conditions, limits on geographic extent, etc.

Institutional Gap Analysis: Article 8

Article 8 regulates the emission of mercury and mercury compounds to the atmosphere. Member states have to control and where feasible reduce emissions from processes listed in Annex D. The five primary source categories are: (1) coal fired power plants, (2) coal-fired industrial boilers, (3) smelting and roasting processes in the production of non-ferrous metals (e.g., lead, zinc, copper and industrial gold), (4) waste incineration facilities, and (5) cement production facilities. Waste incineration facilities include incinerators burning hazardous waste, municipal waste, medical waste, or sewage sludge; cement production sources cover the co-burning of wastes as well (Lennett and Gutierrez 2014).

In Chad, there are waste incinerators and a cement plant, and they are in strict compliance with current national legislation using best environmental technologies demanded by the authorities. The MIA process has further identified and defined the magnitude and source types of mercury in Chad.

For existing sources, a government may choose among five options to control mercury emissions. They are: (1) develop a quantified goal for controlling and reducing emissions from relevant sources, (2) identify emission limit values for controlling and reducing emissions from relevant sources, (3) use the best available techniques and best environmental practices to control emissions from relevant sources, (4) generate a multi-pollutant control strategy that would

deliver co-benefits for control of mercury emissions and (5) identify alternative measures to reduce emissions from relevant sources (Lennett and Gutierrez 2014).

Article 8 - Air Emissions		
Principal Uses	Stakeholders (see page 2 for full names)	Priority level of this problem associated with mercury based on the Chad government evaluation:
There is one cement plant which works in strict compliance with national legislation using best environmental practices requested by authorities There is also waste incineration. Other mercury emission sources do not exist in Chad (as defined in Article 8.2 (c)) listed in Annex D (coal power plants, industrial boilers using coal, smelting and non-ferrous metal mesh process. [6]	HCNE MEP/ DEELCPN MMI MP	HIGH

Institutional Gap Analysis: Article 9

This Article addresses identifying and, where feasible, reducing releases of mercury and mercury compounds to land and water from the relevant point sources not addressed in other provisions of this Convention. Parties must identify significant point sources of mercury releases. There are four control measures that must be taken for the release of mercury to land and water and they include: (1) define release limit values, (2) use BAT and BEP, (3) identify a multi-pollutant strategy that will deliver co-benefits for control of mercury releases and (40 identify alternative measures to reduce releases from relevant sources (Lennett and Gutierrez 2014).

In Chad, the release of mercury and mercury compounds to land and water is relatively unknown and undescribed. The MIA process facilitated the identification of sources of mercury released. In response, the government of Chad will decide to prepare an optional plan that would establish expected targets, goals, and outcomes.

Article 9 - Releases to Land and Water		
Principal Uses	Stakeholders (see page 2 for full names)	Priority level of this problem associated with mercury based on the Chad government evaluation:
The release of mercury and mercury compounds to land and water are relatively unknown and require assistance toward identification of potential source types and magnitude of releases.	HCNE MEP/ DEELCPN MMI MHPV	HIGH

Institutional Gap Analysis: Article 10

Article 10 addresses ensuring interim mercury storage is conducted in an environmentally sound manner, taking into account guidelines to be developed by the Conference of the Parties (COP). In Chad, there are no government-sanctioned facilities or storage of mercury and/or mercury containing products. A facility is urgently required to store hazardous materials including mercury and mercury added products.

Article 10 - Environmentally Sound interim storage of mercury		
Principal Uses	Stakeholders (see page 2 for full names)	Priority level of this problem associated with mercury based on the Chad government evaluation:
No interim storage of mercury is known; however, a facility is urgently needed.	HCNE MEP/ DEELCPN	HIGH

Institutional Gap Analysis: Article 11

This article addresses the definition of mercury wastes, as well as treatment of waste; including taking measures to manage mercury waste in an environmentally sound manner. The definition of mercury wastes is the substances or objects consisting, containing, or contaminated with mercury or mercury compounds in a quantity above the relevant thresholds that are: (1) disposed of, (2) intended to be disposed of, or (3) required to be disposed of by the provisions of national law or Article 11 (Lennett and Gutierrez 2014).

The Government of Chad, through laws and decrees, have taken measures to manage mercury waste in a manner respectful of the environment (e.g., reduce mercury by treatment or waste recycling), taking into account the guidelines developed in the Basel Convention and in accordance with the requirements to be developed by the COP of the Minamata Convention. Chad elaborated laws, decrees and measures also prevent the import and use of mercury from primary mercury mining for artisanal and small-scale gold mining. The Customs Services are required to conduct strict controls of cross-border transportation so that it conforms to the Basel Convention or with international rules, standards and guidelines.

Article 11- Mercury Waste Management		
Principal Uses	Stakeholders (see page 2 for full names)	Priority level of this problem associated with mercury based on the Chad government evaluation:
Artisanal Gold Mining and dentistry are using mercury or mercury compounds.	HCNE MEP/ DEELCPN MMI MFB/DOUANE	HIGH
Chad does not manufacture mercury-added products but does import these products.	HCNE MEP/ DEELCPN M E C MSP MFB/DOUANE MMI OSC	HIGH

Institutional Gap Analysis: Article 12

The Article recommends Parties to develop strategies for identifying and assessing sites contaminated by mercury or mercury compounds. The article specifies that the COP will issue guidance on managing contaminated sites and encourages Parties to cooperate in developing strategies and implementing activities with regards to identifying, managing and remediation of contaminated sites. However, there are no mandatory obligations in cleaning up contaminated sites or for assessing risk to human health.

Chad has taken measures to develop strategies for identifying and assessing contaminated sites with mercury and mercury compounds. The MIA process facilitated further identification and determination of the overall magnitude and risk that mercury-contaminated sites may pose.

Article 12 – Contaminated Sites		
Principal Uses	Stakeholders (see page 2 for full names)	Priority level of this problem associated with mercury based on the Chad government evaluation:
There has been the full closure of gold-mining sites.	HCNE MEP/ DEELCPN MMI MFB/Customs	HIGH

Institutional Gap Analysis: Article 13

This Article addresses financial resources available under the Convention financial mechanism and other resources available from multilateral, regional, and bilateral funding sources. Chad has identified the necessary resources to implement the obligations of the Convention.

Article 13 - Financial Resources		
Principal Activities	Stakeholders	Priority level of this problem associated with mercury

		based on the Chad government evaluation:
Chad will work with UNIDO to develop a NAP proposal	MP MFB	HIGH

Institutional Gap Analysis: Article 16

This article addresses promoting the development and implementation of strategies to identify and protect human populations at risk, such as developing fish consumption guidelines, which recognize activities will involve the World Health Organization and public health ministries. Article 16 provides guidance to health ministries, including (1) adopting science-based health guidelines, (2) setting targets for mercury exposure and reduction, and (3) public education (Lennett and Gutierrez 2014). Sensitization sessions and awareness campaigns of communities in terms of prevention, treatment and health care services for the population will be developed.

Article 16 - Public Health		
Principal Activities	Stakeholders (see page 2 for full names)	Priority level of this problem associated with mercury based on the Chad government evaluation:
Establishment of Center for Control of Consumption Products (CECOQDA). Sensitization sessions and population awareness for their protection and their preservation against the harmful effects of mercury and on environment and through their health will be developed.	HCNE MEP/ DEELCPN CECOQDA MMI MSP MEC MFB/Customs	HIGH

Institutional Gap Analysis: Article 18

The article addresses providing information to the public on mercury and mercury added products with regards to environmental and health impacts. Information to be made available includes: (1) the health and environmental effects of mercury and mercury compounds, (2) alternatives to mercury and

mercury compounds, (3) topics identified in Article 17 (Information Exchange), (4) results of research, development and monitoring activities identified in Article 19, and (5) activities to meet obligations under the Convention (Lennett and Gutierrez 2014).

Article 18 - Information Exchange/Awareness-raising		
Principal Activities	Stakeholders (see page 2 for full names)	Priority level of this problem associated with mercury based on the Chad government evaluation:
Chad is willing to share information on the health and safety of people and the environment, as non-confidential data, in accordance with Article 17.5 Chad, as a signing country of the Convention, will prevent the importation and use of mercury from primary mercury mining for artisanal and small-scale gold mining. Chad will submit its reports to the COP on the implementation of Convention's obligations progress in accordance with Article 21.	All government agencies are concerned	HIGH

3.18 Legislation and institution conclusions

Chad is signatory and has ratified the Minamata Convention on Mercury and therefore is obliged to implement the provisions of the Conventions. Based on this Institutional Gap Analyses, the following is considered:

- Within Chad, several parts of the Convention are not particularly relevant and therefore may not be part of the country's implementation plan. These are related, but not limited to, in-country chemical manufacturing processes such as production of non-ferrous metals and other processes (Article 5) and emissions to air (Article 8);

- Other articles of the Convention are relevant and apply in Chad. It is likely that Chad is importing mercury-added products, and these would need to be halted by 2020 based on the Convention. In accordance to the Convention, there is a pressing need for a baseline assessment of mercury, called the Minamata Initial Assessment.

- In terms of institutional and technical capacity, governmental staff who can oversee effective implementation of mercury assessment may be limited in the knowledge needed to meet the obligations of the Minamata Convention and therefore may need expert assistance.

- Chad requires storage facilities for mercury or mercury containing waste products.

- Chad has a Mining Code to formalize the gold mining sector, and should it determine that ASGM is "more than insignificant", it will be eligible for support in developing a NAP.
- From past exercises, there is generally limited education and awareness among stakeholders and the public on chemical related issues. This is in part related to low awareness by stakeholders. Such limitations reduce the ability of national plans to be effectively executed. Therefore, an education and media plan is a key component of a future information communication.

Chapter IV: Identification of Populations at Risks and Gender Dimensions

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

In general, there are groups of people susceptible to mercury, namely those who are more sensitive to the effects of mercury and those who are exposed to higher levels of mercury. As a targeted group, the fetus, newborns, and young children (<12 years of age) are especially susceptible to mercury exposure because of the sensitivity of the developing nervous system. Individuals with preconditions, such as diseases of the liver, kidney, nervous system, and lung are at higher risk of suffering from the toxic effects of mercury.

The other group consist of individuals exposed to higher levels of mercury, either through occupational, mercury-added products, or environmental exposure. This group includes those who regularly consume a regular diet of fish and aquatic organisms, particularly larger predatory animals. Pregnant women, and women who might become pregnant are generally the populations considered to be high risk groups because of the potential exposure to the fetus. Young children are also more highly impacted by the effects of mercury through dietary uptake of methylmercury. There are many studies on the impacts of methylmercury toxicity to the neurological, cardiovascular, and immune systems within humans. For example, neurological impacts are often measured and become evident through lowered IQ levels (Spadaro and Rabl 2008) and through various neuropsychological tests (Grandjean et al. 1998). Cardiovascular and immunological impacts are often related to chronic exposure to mercury (Sweet and Zelikoff 2010; Downer et al. 2017). However, the relative impacts from methylmercury's toxic effects can vary across human populations, whereas some groups may be more sensitive than others to the impacts of mercury exposure.

Methylmercury is known to affect neurological development in children and is also linked to cardiovascular disease in adults (Clarkson et al. 2003; Valera et al. 2011; Grandjean et al. 2012). Seafood mercury concentrations, best known in fish, are most studied in North America and Europe and least studied in Africa, Asia, and South America (Karimi et al. 2012). However, even in developed countries, monitoring of seafood mercury concentrations needs improvement to ensure accurate exposure estimates over time (Sunderland 2007).

Globally, mercury concentrations are lowest in smaller, short-lived fish. There are many regularly harvested fish from the region (e.g., Mediterranean Sea or Red Sea) that can be safely consumed on either a daily or weekly basis (i.e., they have average mercury concentrations under 0.22 ppm, ww), such as anchovies, sardines, flounder, cod, salmon, and surmullet. These species, and many others, are often harvested commercially and shipped through European markets (Appendix III). Mercury concentrations are highest in large, long-lived species, many of which are pelagic. Bluefin tuna, albacore tuna, bream, bonito, common sole, hake, bluefish and Atlantic horse mackerel have average total mercury concentrations over 0.22 ppm, ww and are riskier choices for human consumption, where only one meal per month is recommended (Table 4.1). Some swordfish and tuna individuals have average mercury body burdens that approach the "no consumption" guidance level of 0.95 ppm, ww (Table 4.1).

Table 4.1 Interpreting mercury concentrations and related risks of exposure.

Mercury in Seafood (ppm, ww)	Consumption Guidance
≤ 0.05	unrestricted
0.05-0.11	2 meals per week
0.11-0.22	1 meal per week
0.22-0.95	1 meal per month
> 0.95	no consumption

Fish mercury concentrations can be compared with consumption guidelines and linked with the number of seafood meals that could be eaten at various mercury

concentrations to stay within the U.S. EPA's health-based reference dose for methylmercury – with further interpretation by the Great Lakes Commission in the USA. For further reference, the World Health Organization (WHO) and the European Commission (EC) general guidance level for fish mercury concentrations is 0.5 ppm with an "exemption" for larger, predatory fish species (e.g., swordfish, shark, some tuna species) of up to 1.0 ppm, which is similar to the U.S. EPA "no consumption" level. Seafood mercury concentrations and associated meal frequency guidelines are based on the U.S. EPA reference dose of 1x104 mg of Hg/kg of body weight/day, a body weight of 132 pounds (60 kg) for an adult female person, and a fish meal size of about 6 ounces (170 gm). These guidelines are for muscle tissues in fish because >95% of Hg is in the methyl form. However, shellfish mercury concentrations greatly vary in percent methyl and therefore the consumption guidance provided here cannot be directly used with shellfish total mercury data.

4.2 Assessment of potential gender dimensions related to the management of mercury

This section presents the differing roles of gender with regards to the exposure and management of mercury. The objective is to ensure that gender considerations are effectively mainstreamed into the National Implementation Plan for mercury. While an extensive survey and assessment of gender issues related to mercury exposure in Chad is not yet defined, future plans could be designed to specifically identify at-risk populations. A descriptive summary could be developed to broadly apply across human populations relating to general exposure and gender risks within various sectors where mercury contamination is likely to occur.

4.2.1 Occupational Exposure

According to the exposure of mercury by known occupations within Chad, men are normally at a greater risk of mercury exposure than women. In the absence

of a national mercury-oriented industry, the main work groups and associated general patterns identified for occupational exposure may include:

- Waste collectors, medical waste incinerator workers and landfill workers: These groups are typically comprised of men who are at greater risk of exposure due to the handling of waste from mercury containing devices.

- Dental professionals: Within dental practices, there is often a higher population of male dentists as compared to females, and many are supported by female assistants. Therefore, male dentists would be more prone to be in contact with dental amalgams but assisting females may also be affected.

- Medical professionals: It is often the case that women may be more likely to be called upon for the clean-up of medical accidents involving mercury containing equipment, such as sphygmomanometers or thermometers. Therefore, women would be more likely to be exposed to mercury through the handling of medical waste.

- Gas station attendants: Service attendants in this profession are almost exclusively men, which would predispose men to a greater risk for environmental exposure.

- Environmental/enforcement officers: This group is called upon to investigate environmental pollution cases and are generally gender balanced (but this is a minor exposure route).

- Firemen and first responders to chemical accidents: This group is often primarily male.

It can be concluded for the professions outlined, there is a tendency for men to be at greater risk than women in relation to occupational mercury exposure (the one important exception may be within the medical professional community). A further study of the gender ratios for these professions in Chad would be required to accurately confirm and quantify patterns of exposure and at-risk populations, according to gender and occupation type.

4.2.2 Mercury in fish

With respect to mercury in fish, the issue is applicable across genders as both sexes generally eat similar quantities of fish. However, the adverse health impacts due to exposure of mercury are more significant in cases of children, pregnant women and women in child-bearing years. This is because the developing organ

systems (such as the fetal nervous system) are the most sensitive to the toxic effects of mercury. Recent studies also demonstrate that there may be increased risk for cardiovascular disease in adults (Downer et al. 2017), which may be particularly important for individuals either sensitive to methyl mercury or those with elevated levels. Men may be more prone to cardiovascular disease than women.

4.2.3 Mercury In households

Within households, women and children are more likely to be exposed to mercury from broken thermometers, since women may primarily use them during routine childcare or oversight of households.

4.2.4 Mercury in cosmetics

Women are more susceptible to exposure by mercury added cosmetics and personal products such as soaps, creams and shampoos. The use of skin lightening creams may also serve as an avenue for mercury exposure but was not investigated through this study. Nonetheless, local women may use skin lightening creams to remove blemishes due to excessive sun damage or to lighten skin and it is likely that the general public have limited knowledge of the use of harmful chemicals in cosmetics.

In summary, it is clear from the above considerations that men should be principally targeted for occupational exposure, especially in the field of waste management and first responders, such as firemen and disaster risk managers. However, in the medical profession, both genders are equally susceptible to mercury contamination. Women are a more important target group regarding dietary update of methylmercury and mercury in cosmetics. These trends are useful when considering training, education, and awareness-raising strategies regarding mercury exposure as they allow for more gender-sensitive communication strategies that can target the sexes differently to achieve maximum benefit.

4.2.5 Artisanal Small-scale Gold Mining Activities

In most of the gold-centric villages of Chad, artisanal and small-scale mining of gold seriously impacts the way of life of the populations in question. Indeed, the use of gold has replaced the agricultural activities in these gold villages of Southeastern Chad. This activity fascinates and attracts businessmen and companies from all over the country. But the ecological consequences of the traditional use of gold are alarming. Soil erosion is increasing, watercourse pollution is increasing, deforestation is increasing, and agriculture is declining. In addition to chemical pollution, the exploitation of gold is accompanied by an intense tree cutting activity. Several thousand trees are being cut down to expand the mining areas. After relegating agriculture to the background, mining and small-scale gold using mercury are destroying the environment in this part of the country.

Risks for human health

Mercury is toxic, even in low doses and in all its forms. However, it enters the food chains durably in its methylated form (methylmercury), the most toxic form, produced by bacteria under anoxic conditions (stagnant water, sediments, etc.). In fact, miners excavate along streams and amalgamate mineral particles, dust or miniscule pallets, using mercury, which is then extracted by heating and evaporation. These gold miners do not have the necessary equipment to recover the evaporated mercury, from which environmental pollution reaches the mercurial discharges. During the amalgamation of gold particles with mercury, some of this mercury is absorbed by organic matter and is found directly in the rivers. The contaminated waters of these rivers are consumed by the population, domestic animals and wildlife living in these environments. Thus, the former, poisoned by mercury, are miners who breathe in the vapors during distillation. The rest of the mercury pollutes the air, the soil and the food chain (fish and shellfish). The risks of exposure and contamination can be summarized as follows:

- In addition to indirect impacts due to the ingestion of food contaminated by mercury, people who breathe mercury vapor are exposed to acute or

chronic intoxication (hydragyrism). Mercury in the form of vapor moves easily through inhaled air into the blood;

- Derivatives/mercury compounds and other gold wash waste are also very toxic products for humans, animals and the environment;

- Gold washing activities as practiced in Chad are the cause of double mercury pollution: discarding the elemental form of the metal (Hg°) used as an amalgamation agent and by the erosion of soils that may naturally contain inorganic mercury (Hg II);

- Two exposure routes are observed at gold washing sites in Chad: occupational exposure by inhalation of mercury Hg ° (burning of amalgam, gold refining) and consumption of fish products (fish);

- The total amount of inorganic urinary mercury makes it possible to assess old exposure (more than 3 months) to inorganic mercury and is well correlated with the intensity of the exposure. This parameter is best correlated with health effects;

- The observed effects of severe mercury vapor poisoning are respiratory difficulties and fever (similar to influenza), accompanied by gastrointestinal and muscular pains. Chronic exposure to metallic mercury causes central and peripheral nervous system damage, and kidney damage, sometimes accompanied by gingivitis or stomatal disease.

According to the miners met by the inventory team in the gold mining sites of Hadjer Marfayine1 and 2, the Yapala 1 and 2 sites and the Gamboké site, the risks of exposure to mercury are disquieting. These gold miners reported that they suffer from stomach aches, headaches and nausea from the consumption of mercury-contaminated water in rivers near the gold panning area. Also, every year, more than fifty domestic animals die while drinking these waters from polluted rivers.

Risks to the environment

Artisanal and small-scale gold mining using mercury as practiced in Chad is a highly polluting and contaminating activity for the environment. Mercury is a major pollutant of the environment. It is one of those whose levels are increasing worryingly in all areas of the ecosystem. In fact, the data collected on artisanal gold mining sites in southwestern Chad show that rural populations are

abandoning cultivation work to engage in intensive gold mining and siltation activities, especially in the middle of the forest.

To meet many of the challenges posed using mercury to extract gold, Chad has enacted and ratified the Minamata Convention on Mercury. It aims to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. The Convention was adopted on October 10, 2013 at a Diplomatic Conference held in Kumato, Japan. Among the important points of this Convention is the prohibition of the establishment of new mercury mines, the elimination of existing ones, the abolition and progressive reduction of the use of mercury in a number of products and processes, control measures for air emissions and releases to land and water and the need for the development of national control systems for artisanal and small-scale gold mining.

Chapter V: Awareness/Understanding of Workers and the Public; and Existing Training and Education Opportunities of Target Groups and Professionals

The level of awareness in Chad about mercury exposure and its impacts on human health and the environment were evaluated in two ways:

1) Through a baseline assessment of stakeholder awareness taking into account past and on-going awareness raising and training activities, including an analysis of sustainability; and,

2) Through an analysis of the feedback received during the institutional and legislative review in order to determine next steps toward implementation of the Minamata Convention in Chad.

Article 3: Sources, supply and trade of mercury: The institutions involved and assessed demonstrate that even though there is no import or export of mercury to or from Chad reported by the relevant authorities, the level of knowledge of mercury is rather low and there is no monitoring system in place.

Article 4: Mercury- added products: The institutions involved and assessed suggest that given the absence of a robust legal framework and subsequent lack of enforcement and monitoring, there is a need for awareness raising among the regulatory bodies, the private sector and institutions involved in monitoring mercury-added products including customs, civil society and academia.

Article 5: Manufacturing processes where mercury or mercury compounds are used: The institutions involved and assessed note that the level of mercury knowledge is moderate but there is still a need for awareness raising about the potential impacts of mercury on human health and the environment for those in the industrial sector. In addition, there is a lack of capacity in this sector to

monitor mercury emissions and releases. Further, there is no separate information on mercury related industries provided by the national environment agency, and no monitoring in place.

Articles 8-Emissions, Article 9-Releases , and Article 11-Mercury wastes: The institutions involved and assessed suggest a low level of awareness and compliance from the regulatory bodies, as well as: private sector, e.g., industrial operators related to the control of mercury discharges; government agencies related to addressing mercury emissions to the air, water or land during environmental permitting process; and enforcement authorities for controlling the environmental permit conditions, i.e. reported emissions to waters and land. Given the low level of awareness it is clear that communities are not exercising the right to influence the decision makers and push for law enforcement.

Based on the above mentioned, there is a low level of awareness of mercury exposure to human health and the environment is among the public including communities living near industrial facilities, consumers, regulators, media, industry and government. There continues to be a need to enforce relevant legal and regulatory measures for current and future industrial development of the country to be in compliance with the Minamata Convention. In addition, it is worth highlighting that the latest government restructuring would require a reassessment of the situation related to awareness needs and the level of capacities at central and local levels.

In this context, a Communication, Education and Public Awareness Framework Plan is needed that identifies actions and activities to be taken by the government and its partners to tackle awareness and training needs. An integrated approach to awareness and training will enhance understanding and facilitate communication with the general public and relevant stakeholders and will raise awareness on issues related to Minamata Convention and its ratification.

Chapter VI: Implementation Plan & Priorities for Action

The assessment from the actions related to the Chad mercury proejcty recommends the following actions and next steps for the Chad government:

Updating terms and definitions between Minamata Convention and domestic laws. As discussed above, several legislations, e.g. Decree 09-904 2009-08-06 PR/PM/M will need to be updated in order to synchronize definitions used in the regulation and the Minamata Convention.

To facilitate activities relating to mercury, it would be necessary to create an oversight entity to monitor implementation and evaluate activities undertaken. In this regard, amending the mandate of the NTC/POPs by including the Minamata Convention in its jurisdiction can be a quick way to address this need.

Art. 3 (Supply and Trade): Although there is currently no primary mining of mercury in Chad, it would be prudent to transpose its Minamata obligation not to allow new primary mining of mercury into its national legislation and specifically prohibit this activity. In addition, it would be useful for Chad to clarify the provisions of the Mining Code to specifically state the prohibition of mercury use in mining practices. This would be necessary in case the Chad government decides to prohibit mercury use in ASGM.

Art. 4 (MAPs): As a net importer of MAPs, Chad needs to create new legislation for MAPs, particularly the need to cover MAPs beyond pesticides, addressing the applicable mandated phase outs, and manufacture of new MAPs. It also needs to incorporate provisions for reporting and inventory of mercury and mercury compounds as needed. In the new MAP legislation, Chad will need to elaborate on dental amalgam phase down measures as a minimum requirement under the Convention. Chad has the prerogative to undertake more stringent measures on MAPs that is not in contradiction with the Convention.

Art. 5 (Manufacturing Process). It would be prudent for Chad to enact a broad prohibition against the use of processes that use mercury or mercury compounds. This will be necessary to avoid transfers of unwanted mercury-based technologies into Chad.

Art. 7 (ASGM). ASGM can become a major mercury issue for Chad. Chad has made an effort to formalize the mining sector by closing ASGM sites and via a national Mining Code. This Code requires permits and licenses for operation of gold mining sites. However, the current provision of the Mining Code will need to be supplemented. However, before further legislative review and action is done, it is recommended that the government of Chad to make a determination if ASGM in its boundaries are more than insignificant for the country. If it is, the development of the National Action Plan, Annex C of the Convention, can be a critical tool in helping Chad address gaps in the Mining Code as well as in the creation of a more robust approach to ASGM. Chad can also tap the NTC/POPs for the planning and implementation of NAP if ASGM is more than significant in the country.

Art. 8 (Emissions) - While the emission sources covered by the Convention do not specifically coincide with the current sources in Chad, nonetheless it would be prudent for Chad to measure and monitor mercury emissions from the two power plants. The government can then proceed to assess, based on data collected and analyzed, appropriate next steps for it.

Art. 9 (Releases) - Chad will need to further specify its approach to releases under the Convention and adopt future guidance on this issue from the Convention. The current laws are too broad.

Art. 10 (Storage) - There appears to be a basis for elaborating on storage provisions for the environmentally sound storage of commodity mercury. The government of Chad can look forward to the Convention Technical Guidelines

for environmentally sound storage of mercury and mercury compounds once this work has been finished.

Art. 11 (ESM) - Environmentally sound management of mercury waste will be a pressing issue for Chad. It will need to update existing regulations as well as ensure that it is following Basel ESM guidelines on mercury waste. The waste management laws in Chad are too general; more specific regulations are needed. Chad can look at the recently adopted Basel Convention Technical Guidelines for the ESM of waste consisting of, containing or contaminated with mercury or mercury compounds for guidance in addressing mercury waste at the national level. Preventing toxic waste dumping, including mercury waste is an important issue for Chad. The government may wish to consider ratifying the Amendment to the Basel Convention that prohibits export of all toxic wastes from developed to developing countries, either for disposal or recycling, as an additional safeguard against toxic waste dumping.

Art. 12 (Contaminated Sites) - the Chad government can consider strategies for identifying and assessing mercury contaminated sites based on the Environment Code, and without need of developing new regulation on this action.

Art. 13 (Financial Resources) - Chad may need to look at other funding sources to help in the implementation of its Minamata Convention obligations given the challenge of generating local funds. The government can look at the GEF for possible support for mercury related projects to pilot in the country as an interim measure to address financial resource challenges.

Art. 16 (Health) - There is a need to elaborate on health-related regulation on mercury in Chad, especially on promoting prevention, treatment and care services for populations at risk from mercury exposure. Mercury advisories to critical or sensitive populations, e.g. women and children, will need to be operationalized. There is no clear regulation that mandates both regular advisories and access to information by the public.

Art. 17 (Information Exchange) - To help comply with Art. 17 requirements, Chad will need to ensure that during its update of appropriate legislation and regulations on mercury that data on quantities of emissions, releases, disposal and other information required under Art. 18 are covered. Lastly, information exchanges and public education and awareness-raising need to be intensified using existing platforms offered by other MEAs to which Chad is already part of.

Art. 18 (Public Information and Awareness) - regulatory basis exist in Chad to cover public information, awareness and education. However, this basis should be reinforced by more specific provisions allowing public access to information as well as results of studies conducted by the government. Moreover, public information should also extend to emphasize chemicals management and hazards communication, including mercury.

Acknowledgments

The Secretary General of the Ministry of Environment and Fisheries expresses his satisfaction and thanks to the various public and private administrators for their strong involvement and support that allowed for smooth calculation of mercury waste and mercury-contaminated sites nationally.

Customs Districts, Mayors, Ministerial Departments, the National Agency of Investments and Exports (ANIE), the Chamber of Commerce, the National Agency for Renewable Energies (ANER), the Agency for Domestic and Environmental Energy (AEDE), hospitals and health centers, dentists' offices, businesses involved in waste management, the National Institute of Statistics, Economic Studies and Demographic (INSEED), Laboratories of research and analysis, the Djermaya Refinery, the Baouré Cement Plant, etc. have greatly contributed to the success of these survey operations by providing information on imports and the use of mercury and virgin mercury, major sources of mercury releases and mercury-contaminated sites across the country. To this end, the General Secretariat of the Environment wishes to express his gratitude and hopes that these organizations can continue in this vein given the importance of health and the environment.

Noted is the assistance of gold miners at gold panning sites in Mayo-Kebbi-West (Pala) Province in data collection operations and for their support to ensure the success of this work.

This project has been in partnership with Biodiversity Research Institute, the management of which is handled by **Mr Abdallah Younous Adoum**, Point Focal of the Minamata Convention on Mercury and **Mr Abderaman Mahamat Abderaman**, Director of Environmental Evaluation and the Fight Against Pollution and Noise. Our deepest thanks to you.

Literature Cited

Chamber of Commerce. 2015. Index of Economic Operators in Chad. 400 pages.

Lennett, D. and R. Gutierrez. 2014. Minamata Convention on Mercury: Ratification and Implementation Manuel. Zero Mercury Group.

Ministry of Environment and Fisheries (MEF). 2015. Expected Contribution Determined at the National Level (INDC / INDC). 26 pages.
Ministry of Environment and Fisheries. 2016: National Strategy to Fight Bushfires. 56 pages.

Ministry of Petroleum and Energy May 2018. Schema Director for the Development of Renewable Energies 117 pages.

Ministry of the Economy and the Map: General Secretariat. 2010. External Commerce Statistics. National Institute of Statistics, Economic and Demographic Studies. INSEED. 117 pages.

United Nations Development Program (PNUD). 2015. Chad National Report on Access to Energy Resources Integrating Renewable Energy and Energy Efficiency. 54 pages.

ANNEX I: Stakeholders

MEF: Ministry in Charge of Environment and Fisheries;

ME: Ministry in Charge of Livestock;

MC: Ministry in Charge of Trade;

MF: Ministry in Charge of Finance;

MTP: Ministry in Charge of Public Works and Transport;

MATUH: Ministry in Charge of Land-use Planning, Urban Planning and Housing;

Mine: Ministry in Charge of Mines and Energy;

MEP: Ministry in Charge of Oil;

MFPT: Ministry in Charge of Public Service and Labour;

MES: Ministry in Charge of Higher Education;

UJT: Union of Chadian Journalists;

(C)/ONG: Collective of Nongovernmental Organizations;

CDA: Association of Chadian Consumers;

CERVALD: Centre of Study and Research for the Valorization of Waste;

CECOQDA: Control Centre, Qualities and Foodstuffs

ANNEX II: Inventory details

The inventory method used consists of the following steps:

- The review of the documentation;
- Interviews and meetings with the institutions concerned;
- The design of data sheets for mercury and mercury contaminated sites;
- The incorporation and training of the inventory teams;
- Field data collection missions;
- Analysis and processing of collected data;
- The determination of mercury quantities using the Toolkit tool;
- The drafting of the inventory report;
- The validation of the inventory report;
- The dissemination of the inventory report.

Table 121: Quantity of electrical materials and equipment imported to Chad in 2016

Type of material and equipment and materials	Quantities in tons
Thermometers, thermostats	59.8
Multimeters	118.13
Batteries	404.5
Mercury vapor lamps	3,634.9
Bulbs	4797.3
Accumulators	471.5
Electrical conductors for voltage	2,238.2
Switches	75.3
Voltage Breakers	148.0
Regulators	273.0
Electric Debtors, Regulators, Controllers	410.8
Manometers, manostats, pressure switches	138.1
Electricity meters	22.4
Household refrigerators	720.0
Voltage relay	14.4
Transformers	63.5
Electric amplifiers	175.0
Condensers	166.2

Source: INSEED 2016.

Table 122: Beauty products imported to Chad in 2016

Type of products	Quantities imported in tons
Soaps and detergents	22,176.3
Perfumes	35.5
Makeup	15.90
Cream	398.4
Total	**22,626.1**

Source: INSEED 2016.

Table 123: Construction products imported to Chad in 2016

Type of products	Quantities imported in tons
Paints	2,900.1
Lime (live)	245.8
Portland cement	38,022.0
Coal, lignite, peat	10.25
Clay	194.6
Oil consumption	17.0
Marble	0.6
Gypsum	16.0
Cement additives	631.3

Source: INSEED 2016.

Table 124: Various products imported to Chad in 2016

Type of products	Quantities imported in tons
Fertilizer, Urea	7027.5
Pesticides, disinfectants	543.2
Dyes	189.0
Antibiotic medications	590.6
Mercury and mercury oxide	3823.5
Calcium carbonate	7.4
Sodium carbonate	3.7
Organic solvents	138.8
Binders	480.7
Surface and preparation agents	289.1
Ceramic products	1155.6
Aluminum alloy	2369.4
Industrial furnace	306.1
Phosphoric acid	1.1
Silver oxide	1.0
Fluoride, bromide	132.5
Lithium	17.6
Polyurethane	37.2
Formic acid	21.3
Reagents for diagnostics	254.4
Insoluble silicates	287.1
Magnesium dioxide	3480.0
Natural barium sulfate	8019.0
Acrylic polymer	2134.5
Aluminum minerals	364.1
Ethylene polymers	168.1
Halogen mixes	677.1
Fatty acids	125.1
Lithium carbamate	211.8
Sodium hydroxide	7.5
Propylene polymer	2.0

Source: INSEED 2016.

Table 125: Petroleum products imported to Chad in 2016

Type of products	Quantities imported in tons
Super fuel	17,458.7
Butanone	8.3
Diesel	12.0
Petroleum bitumen	17.0
Diesel	3944.1
Petroleum oil	15.8
Other oils	3135.7
Lubricants	7840.7
Lamp Oil	4.3
Gas	31.0
Propane	2.0

Source: INSEED 2016.



Photo 1: Artisanal gold mining site in Hadjar Marfayine 2



Photo 2: Artisanal gold mining site in Hadjar Marfayine 2



Photo 3: Artisanal gold mining site in Hadjar Marfayine 2



Photo 4: Baouré Cemetery Visit on June 6, 2018



Photo 5: Presentation at the Baouré Cemetery on June 6, 2018



Photo 6: Meeting with the Baouré Cemetery Director on June 6, 2018

Table 126: List of People Met

No.	Surnames and Names	Location	Position	Contact Information
01	Diguina Torbaye Ndilgar	Baouré Cemetary (Pala)	Director	
02	Abdoulaye oil-ririma	Yapala 2	Village Chief	93 43 73 52
03	Adam Ali	Yapala 2	Miner	
04	Mahamat Ali	Yapala 2	Miner	
05	Haoissia Sekemma	Yapala 2	Miner	
06	Issakh Bakna	Yapala 2	Miner	
07	Djeratar Michel	Yapala 2	Miner	
08	Moussa Mahamat	Yapala 2	Miner	
09	Mahamat Gaba	Yapala 2	Miner	
10	Falsou David	Yapala 2	Miner	
11	Adoum Mahamat	Yapala 2	Site Manager	
12	Idriss Abdoulaye	Yapala 2	Miner	
13	Mahamat Abdelkerim	Hadjer Marfayine 1	Site Manager	63 89 77 51

14	Mahamat Issaka	Hadjer Marfayine 2	Site Manager	99 27 28 18
15	Adoum Djimet	Gamboké	Site Manager	60 22 64 74
16	Saleh Moussa Kelba	Ministry of Public Health	Liberté Hospital	66 40 44 32
17	Ramadan Barka	Ministry of Infrastructure		
18	Moussa Abakar Zezerti	Ministry of Mines and Petroleum		
19	Abdelkérim Dangaye	Ministry of Petroleum and Energy	Director of Energy	66 24 44 26
20	Djibia Mahamat	Farcha Laboratory	Cold Unit Manager	66 60 29 00

ANNEX III: UNEP TOOLKIT Calculation Spreadsheet

INVENTORY LEVEL 1 - EXECUTIVE SUMMARY									
Source category	Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y							Percent of total releases *3*4
		Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal	Total releases *3*4*5	
Coal combustion and other coal use	0.6	0.6	0.0	0.0	0.0	0.0	0.0	1	0%
Other fossil fuel and biomass combustion	1,435.7	1,435.7	0.0	0.0	0.0	0.0	0.0	1,436	17%
Oil and gas production	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Primary metal production (excl. gold production by amalgamation)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Gold extraction with mercury amalgamation	2,000.0	400.0	800.0	800.0	0.0	0.0	0.0	2,000	24%
Other materials production*6	50.9	38.2	0.0	0.0	12.7	0.0	0.0	51	1%
Chlor-alkali production with mercury-cells	-	-	-	-	-	-	-	0	0%
Other production of chemicals and polymers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Production of products with mercury content*1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Application, use and disposal of dental amalgam fillings	56.4	1.1	24.8	4.5	3.4	11.3	11.3	56	1%
Use and disposal of other products	783.9	187.4	84.4	193.8	0.0	310.1	8.2	784	10%
Production of recycled metals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Waste incineration and open waste burning*2	1,690.4	1,541.3	0.0	0.0	0.0	0.0	149.1	1,690	20%
Waste deposition*2	14.9	0.1	0.0	0.0	-	-	-	0	0%
Informal dumping of general waste *2*3	6,718.5	671.8	671.8	5,374.8	-	-	-	1,344	16%
Waste water system/treatment *4	3,940.8	0.0	3,546.7	0.0	0.0	394.1	0.0	394	5%
Crematoria and cemeteries	493.3	0.0	0.0	493.3	0.0	0.0	0.0	493	6%
TOTALS (rounded) *1*2*3*4*5*6	**5,660**	**4,280**	**1,580**	**1,490**	**20**	**720**	**170**	**8,250**	**100%**

*1: To avoid double counting of mercury inputs from waste and products in the input TOTAL, only 10% of the mercury input to waste incineration sources, waste deposition and informal dumping is included in the total for mercury inputs. These 10% represent approximately the mercury input to waste from materials which were not quantified individually in Inventory Level 1 of this Toolkit. See Appendix 1 to the Inventory Level1 Guideline for more explanation.
*2: The estimated quantities include mercury in products which has also been accounted for under each product category.
To avoid double counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS.
*3: 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, waste water system/treatment have been subtracted automatically in the TOTALS.
*4 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.
*5 To avoid double counting, fossil fuel mercury contributions to cement production was subtracted automatically in the TOTALS.