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INITIAL ASSESSMENT

REPORT 2019

PAKISTAN



Ministry of Climate Change
GOVERNMENT OF PAKISTAN

Development of Minamata Initial Assesment Report for Pakistan-2019

Ministry of Climate Change
GOVERNMENT OF PAKISTAN

Development of Mimamata Initial Assessment in Pakistan- 2019

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DISCLAIMER

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Acronyms

ASGM	Artisanal and Small-Scale Gold Mining
AED	Agricultural Extension Department
AEDB	Alternative Energy Development Board
CDM	Clean Development Mechanism
CPEC	China-Pakistan Economic Corridor
COP	Conference of the Parties
CPC	Chemical Protective Clothing
CFL	Compact Fluorescent Lamps
EPA	Environment Protection Agency
ELVs	Emission Limit Values
ESM	Environmentally Sound Management
ECO	Environment Consultancy Organization
FBR	Federal Board of Revenue
GEF	Global Environment Facility
GDP	Gross Domestic Product
GSP	Geological Survey of Pakistan
HDIP	Hydrocarbon Development Institute of Pakistan
HID	High Intensity Discharge
IEA	International Energy Agency
IRSA	Indus River System Authority),
LDA	Lahore Development Authority
LED	Light Emitting Diode
MIA	Minamata Initial Assessment
MT	Metric Tons
MoCC	Ministry of Climate Change
MoID	Ministry of Industrial Development
MoIP	Ministry of Industries & Production
MDA	Mercury Development Amalgam
NHSR&C	National Health Services Regulations and Coordination
NAP	National Action Plan

NEQS	National Environmental Quality Standards
NGOs	National Government Organizations
NCPC	National Cleaner Production Centre
NSSC	Neutral Sulphite Semi Chemical
OGDCL	Oil and Gas Development Company Limited
PMDC	Pakistan Mineral Development Corporation
PPD	Plant Protection Department
PCSIR	Pakistan Council for Scientific & Industrial Research
PEPA	Pakistan Environmental Protection Act
PCRWR	Pakistan Council of Research in Water Resources
PPIB	Private Power & Infrastructure Board
PSQCA	Pakistan Standards and Quality Control Authority
PMDC	Pakistan Medical and Dental Council
PPE	Personal Protective Equipment's
RDF	Refused Derived Fuel
RDP	Registered Dental Practitioner
SSM	Small Scale Manufacturing
SPC	Simple Particle Control
SWCs	Skin Whitening Creams
SDPI	Sustainable and Development Policy Institute
SCBA	Self-contained Breathing Apparatus
UNDP	United Nations Development Programme
UNIDO	United Nation Industrial Development Organization
UNEP	United Nations Environmental Program
UNITAR	United Nations Institute for Training and Research
USEPA	United States Environmental Protection Agency
WHO	World Health Organization
WASA	Water and Sanitation Authority

Foreword

The occurrence of Minamata disease in Japan in 1956 revealed the severity of toxic effects of mercury. Later, toxicity of elemental mercury and its different forms to human health has extensively been studied and now it has become an established fact that mercury is one of the most dangerous neurotoxic and ecotoxic element that adversely affect human health and the environment. Minamata Convention on Mercury has been developed as an instrument to provide legal basis for protection of human health and environment from mercury and its compounds globally. This convention provides a practical roadmap for reduction and elimination of adverse effects of mercury by controlling its anthropogenic releases throughout its life-cycle. The Minamata Convention contains a range of measures to meet its objectives, including control of emissions and releases of mercury to the environment from industrial sources, and the phasing out or phasing down of certain products or components of products that contain mercury or a mercury compound.

Pakistan became signatory to this Convention in 2013 and intends to ratify it after submission and validation of Minamata Initial Assessment (MIA) report, asit is linked to at least seven of the seventeen sustainable development goals adopted by Government of Pakistan as its national sustainable development agenda for 2030. UNEP in collaboration with GEF launched a project "Development of Minamata Initial Assessment in Asia", involving Cambodia, Pakistan and Philippines. Under this project, the Ministry of Climate Change, Government of Pakistan has taken certain initiatives like assessment of the institutional capacity and regulatory framework, research on mercury containing products, identification of people at risk and gender dimensions including level of awareness of workers and public, and inventorying the data regarding uses and releases of mercury. This MIA report is the output of successful implementation of that MIA project in Pakistan and indicates the serious efforts, Pakistan is making to achieve the objectives of Minamata Convention. Being a signatory to the convention, efforts are being made to pave the way towards ratification of Minamata Convention in coming days.

This report aims to assist in building a knowledge base that identifies the sources of mercury releases in the country and estimates or quantifies the releases. This information will also assist in decision-making with regard to possible policy measures to control mercury releases; in communicating with stakeholders; and in monitoring changes over time. This report is based on extensive baseline data on mercury sources. This will be very helpful in guiding the relevant stakeholders and regulators in taking measures for curbing the mercury toxicity in the country. It is hoped that this document will pave the way for achieving the targets of Minamata Convention of phasing down mercury containing products by 2020 and phasing out mercury use in industrial processes by 2025 ifunder the provisions of convention technical and financial assistance for implementation after joining convention will be available to Pakistan like other developing countries.

ZARTAJ GUL
Minister of State

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EXECUTIVE SUMMARY

Mercury is a toxic, naturally occurring heavy metal found in three forms, elemental mercury as liquid or vapour, as inorganic mercury compounds and organic mercury compounds in the form of methyl-mercury. Methyl-mercury is more harmful than elemental mercury because it impinges on central and peripheral nervous systems. It crosses the blood brain barrier and inhibits signals between the nerve cells and motors causing mental retardation and low IQ level in young people. Methylmercury is equally harmful for pregnant women and causes teratogenic effects on fetus. The inhalation of mercury vapor can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys and may be fatal. The inorganic salts of mercury are corrosive to the skin, eyes and gastrointestinal tract and may induce toxicityin kidneys if ingested.

In this wake, Minamata Convention on mercury was adopted in October 2013 at Kumamoto, Japan. The Government of Islamic Republic of Pakistan signed the Convention on 10thOctober, 2013 at Kumamoto, Japan but it has yet to be ratified by the parliament. To prepare the country for meeting the obligations under the Minamata Convention and reduce mercury releases and safeguarding its population and environment, the Government of Pakistan through its Ministry of Climate Change (MoCC) developed an inventory of mercury releases in the country under a project"Development of Minamata Initial Assessment in three Asian countries" implemented by UNEP and funded by Globlal Environment Facility (GEF), while the International Environmental Technology Center (IETC) of Osaka, Japan executed it.

The objective of this project was to facilitate the ratification and early implementation of the Minamata Convention by providing key national stakeholders in participating countries with the scientific and technical knowledge and tools needed for that purpose. The main outputs will be assessments of national institutional and regulatory capacity for the management of mercury, mercury release & emissions inventories and the identification of challenges, needs and opportunities to implement the Minamata Convention on Mercury. Through this project an effort has been made to analyse the situation of mercury in Pakistan and to assess mercury use and sources, mercury containing products, and identify, if any, vulnerable populations that require awareness raising about the mercury issue to protect human health and the environment.

The inventory mercury release has also been prepared using the Level II Toolkit for identification and quantification of mercury releases that was made available by the Chemicals Branch of the UNEP. It was observed during inventory development that some industries and hospitals have already minimized and phased out elemental and organic mercury from their processes because of new technological advancement and pressure from knowing the adverse effects of mercury. The quantity of dental amalgam filling is decreasing and dental filling with mercury amalgam is being replaced with composite material. Mercury is being phased out from laboratories doing pathological tests because of modern techniques and machines. In private hospitals now digital sphygmomanometer and thermometers are replacing mercury thermometer and sphygmomanometer. Mercury is also being phased out from cosmetics industries due to awareness about skin reactions and skin blacking in dark sun light.

Results of the national mercury Inventory

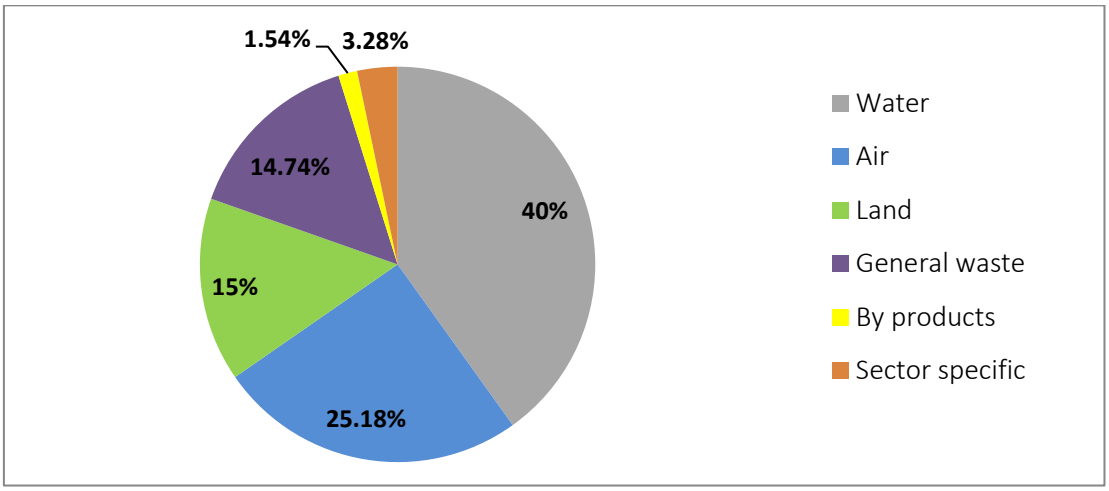
The results of inventory depicted that a total of 139,421 kg/y of mercury is released in the country. Most of the mercury identified in Pakistan comes from consumer products with intentional use of mercury (61%), such as mercury thermometers, electrical switches, lights and relays, batteries, polyurethane, cosmetics and related products. Among all these products, cosmetics (55%) have maximum contribution in release of mercury in the environment. Subcategories by other intentional products and processes (11%) include dental fillings, manometer and gauges with mercury and laboratory chemicals and equipment. Waste incineration and burning, gold extraction with mercury amalgamation process and extraction and use of energy sources all have significant contributions in mercury releases. A consolidated statement of annual quantities of mercury releases from each source category is presented in the table below.

Quantified summary of total annual mercury releases from each source category

Source category	Calculated Hg output, Kg/y						Total release	%age
	Air	Water	Land	Bypro -ducts	General waste	Sector specific		
Energy sources	4,719	817.8	-	2,034	-	920	8,492	6%
Primary (virgin) metal production	5,568	1,155.0	715.0	-	2,437.5	375	10,251	7%
Production of other minerals and materials with mercury impurities	374.4	-	-	118.1	-	118	611	0%
Intentional use of mercury in industrial processes	-	-	-	-	-	-	-	0%
Consumer products with intentional use of mercury (whole life cycle)	10,118	46,820	15,307.1	-	13,201.3	-	85,447	61%
Other intentional product/process use	1,334	4,948.3	1,218.6	-	4,832.5	3,074	15,408	11%
Production of recycled metals	1.7	2.1	-	-	-	0.1	4	0%
Waste incineration and burning	10,745	-	-	-	-	90	10,836	8%
Waste deposition	2,190	25,034	17,527.2	-	93.0	-	44,846	3%
Crematoria and cemeteries	63.8	-	3,833.4	-	-	-	3,897	3%
SUM OF QUANTIFIED RELEASES	**35,116**	**55,934**	**21,074**	**2,153**	**20,564**	**4,579**	**139,421**	**100%**

Releases of mercury in different pathways

The inventory of mercury releases in Pakistan indicates six different output pathways: 1.) emissions to air, 2.) direct releases to water, 3.) direct releases to land, and 4.) products, 5) general waste 6) sector specific waste treatment. Mercury releases major pathway is to water (40.1 percent), including marine and freshwater bodies and via waste water systems, followed by air (25.18 percent), land (15 percent), general waste (14.74 percent), sector specific (3.28 percent) and byproducts (1.54 percent), respectively, as shown in figure below.



Mercury output pathways

Mercury is released into water mainly from cosmetics and related products with mercury (45,386Kg/y), wastewater system and treatment (22,844Kg/y), laboratory chemicals and equipment (2,310Kg/y) and informal dumping of general waste (2,191 Kg/y). The major sources of mercury releases to air are informal waste burning (9,930 kg/y), electrical switches (5,880 kg/y), gold (and silver) extraction with mercury amalgamation processes (5,005 kg/y), biomass fired power and heat production (2,273 kg/y), informal dumping of general waste (2,191 kg/y), batteries with mercury (2,126 kg/y), manometer and gauges with mercury (1,219 kg/y) and other coal use (1,121 kg/y).

Whereas, source sub-categories responsible for release of mercury into land areinformal dumping of general waste (17,527 kg/y), electrical switches and relays with mercury (7,840 kg/y), cemeteries (3,833 kg/y), cosmetics and related products with mercury (2,389 kg/y), batteries with mercury (2,126 kg/y). The common contributing sub categories to general waste are electrical switches and relays with mercury (5,880 kg/y), batteries with mercury (4,253kg/y), aluminum extraction and initial processing (2,438 kg/y), laboratory chemicals and equipment with mercury (2,310 kg/y). However, subcategories have fewer shares for sector specific treatment/disposal and byproducts and impurities.

Policy, regulatory and institutional assessment

The governance analysis in terms of policy, regulatory and institutional framework for mercury management in the context of objectives of Minamata Convention performed duringprepration of MIA Report identified gaps that may impede effective implementation of the Minamata Convention and to achieve its objectives ata national level. The main gaps identified were as follows:

- A comprehensive, stand alone regulatory framework for mercury management in line with the objectives of Minamata Convention does not exist.
- The existing regulations that may be applicable to mercury management aresome broad base regulations which are inadequate as these do not meet the requirements to achieve the objectives of Minamata Convention;
- Although, provisions related to the import of mercury and mercury-added products are partially incorporated in Import Policy Order of 2016 and Pakistan Environmental Protection Act of 1997 but, policy measures related to mercury import for ASGM and phasing out of dental amalgam are not provided in national legislations;
- Obligation related to ban on use of mercury or mercury compounds in the manufacturing processes is not integrated into relevant laws effectively;
- There is no proper plan or regulations to formalize or regulate ASGM nor any measure/law available for the reduction or elimination of mercury use in ASGM. However, reduction in emissions, releases and exposures associated with ASGM in transport are provided to some extent in National Environmental Policy of 2005 and in draft *Handling, Manufacture, Storage;*
- However, the control and reduction in emissions of mercury and mercury compounds into the air and released into land and water is partialy covered in Pak-EPA's *National Environmental Quality Standards (Self-Monitoring And Reporting by Industry) Rules, 2001*, *Compounding of Offences and Payment of Administrative Penalty Rules, 2015*, *the Pollution Charge for Industry (Calculation and Collection) Rules, 2001* and other indirect regulations;
- Although not satisfactory provisions to achieve objectives of some articles of Minamata Conventions, such as interim mercury storage (Article 10) and mercury waste management (Article 11), have been transposed in national regulations;
- The objective of the mercury contaminated sites (Article 12) is partially covered through *Handling, Manufacture, Storage, and Import of Hazardous Substance Rules of 2016;*
- The obligations related to public health are partly transposed to relevant public health and environmental laws;
- The provisions of the Convention related to exchange of information, as well as information, awareness and education of the public are generally included in environmental protection and health protection laws;
- The obligation to develop mercury phasing out implementation plan does not exist in national legislation;
- There is a need for strengthening the legal framework to overcome these gaps with detailed analysis and incorporation of objectives of Minamata Convention in national legislation and regulations.

There is a long list of relevant stakeholders needed to be work with and communicate together towards efficient mercury phasing out and sustainable mercury management. The main players are Ministry of Climate Change, Environmental Protection Agencies, Ministry of National Health Services Regulations and Coordination, Ministry of Industries & Production, Ministry of Commerce and Federal Board of Revenue, Large importers, importing companies, Pakistan Mineral Development Corporation, Ministry of National Food Security& Research, Ministry of Water Resources, Ministry of Energy, Urban and rural municipalities and waste management companies, Ministry of Human Rights, Ministry of Information & Broadcasting and Media professionals, National Disaster Management Authority, Pakistan Council for Scientific & Industrial Research, NGOs and private sector organizations, medical professionals, and general public.

Recommmendations

It is very encouraging that all stakeholders actively participated in the process of MIA development and raised several problems linked with mercury management and elimination. The general steps and recommendations to be considered in future national actions for mercury management are as follows:

i. Mobilization and allocation of funds for further improvements towards reduction and elimination of mercury emissions and releases.

ii. Establishment of an efficient sustainable mercury inventory system and to develop a detailed inventory after the Minamata Convention ratification.

iii. For development of monitoring and reporting of mercury in different media; inter ministerial coordination is needed to control the use and import of mercury and mercury products through strengthening of institutional framework and mechanism of coordination.

iv. Capacity building and strengthen of institutions for phasing out mercury containing products which is the major source category according to the results of the mercury inventory.

v. Support to industry for incorporating BAT/BEP related to control of mercury emissions and good practice of mercury containing products management.

vi. Public awareness campaigns accompanied with mercury risk assessment study need to be launched with a comprehensive communication strategy for phasing out of mercury and mercury alternatives products and processes study.

vii. The future implementation plan should contain list of national priorities for mercury management and elimination to provide basis for preparation of action plan for mercury management and phase-out.

viii. Strengthening regulatory framework by changing or amending the existing regulations or even legislation to pave the gaps towards objectives of Minamata Convention will be needed.

This MIA Report may be used as a comprehensive information to be presented to the cabinet and parliament of the Pakistan in the course of ratification process. After ratification ofthe Minamata Convention (tentative period December 2019) the Ministry of Climate Change will continue to work on development of Implementation plan in accordance with the Article 20 of the Minamata Convention. It is planned to approach the Specific International Programmes with the proposals for development of the above mentioned actions in the implementation plan. The Minamata Secretariat will be approached for assistance in developing a National Action Plan for ASGM sector because it is the main source of release of mercury in the environment.

INTRODUCTION

Anthropogenic activities have disturbed the environment in several hazardous ways. Mercury contamination being one of them has tremendous toxic consequences to health of human and ecosystem. The emergence of mercury toxic effects in the form of Minamata disease in Japan in 1956 revealed the severity of this pollutant. The waves emerged through this heart-rendering consequence of mercury shook the whole world. The research community actively participated and proved that the primary targets for toxicity of mercury and mercury compounds are the nervous system, the kidneys, and the cardiovascular system. Other systems that may be affected include the respiratory, gastrointestinal, hematologic, immune, and reproductive systems.

After identification of sources, route of exposure and toxicity effects of mercury contamination, the world community realized to adopt a legal rule to minimize and eliminate its contamination. An arduous struggle resulted in emergence of Minamata Convention. Minamata Convention on mercury was adopted in October 2013 at Kumamoto, Japan and Pakistan signed the Convention on 10th October, 2013 at Kumamoto, Japan.Currently, 128 countries are the signatory and 28 countries have ratified the said Convention. Pakistan yet has to ratify the Convention. The protection of human health is at the core of the Minamata Convention. The Convention's main thrust is for countries to ban new mercury mines and carry out a systematic phase-out of existing ones. It also provides for the phase-out of mercury containing products and reducing mercury supply and trade, to make a significant reduction in mercury releases to air, water and land. The Convention also addresses: interim storage of mercury and its disposal once it becomes waste; sites contaminated by mercury; as well as human and environmental health issues related to exposure to mercury.

In this regard, UNEP has approved a project titled "Development of Minamata Initial Assessment in Asia", involving Cambodia, Pakistan and Philippines. United Nations Environment Programme (UNEP) was the Implementing Agency and International Environmental Technology Center, UNEP, Osaka, Japan was the Executing Agency for the project activities. The main components of the Project were:

i. Strengthening the baselines on mercury management.

ii. Development of national mercury inventories

iii. Piloting of sectoral action plans as a follow up of prioritization, including indicative sampling.

iv. Development of national mercury management plans and regional approach. Lessons learned, final report and national plans agreed

After the inception of Minamata convention, Pakistan has decided to tackle this issue as a part of national agenda. Under this project, UNEP and GEF in coordination with Ministry of Climate Change (MoCC) Pakistan have conducted following key activities:

1) Assessed the national infrastructure and capacity for mercury management, including national legislation and regulatory framework.
2) Compiled the national information/researches relevant to mercury

3) Assessed key national stakeholders, their roles in mercury management and institutional interest and capacities
4) Analysed the regulatory framework, identification of gaps and assessment of the regulatory reforms for the ratification and early implementation of the Minamata Convention
5) Devised a national coordination mechanism for mercury management
6) Conducted provincial mercury awareness workshops
7) Organized national training workshop on mercury inventory using UNEP's toolkit
8) Conducted mercury inventory through using Mercury Inventory Toolkit Level II by hiring national consultants
9) Developed national strategy to identify and assess mercury contaminated sites
10) Identified challenges, needs, opportunities and recommendations to implement the Minamata Convention on mercury
11) Conducted National researches on mercury containing products i.e., Cosmetic products, CFLs, Batteries, fish and soil, sediment and water samples collected from Artisanal and small- scale gold mining (ASGM) sites at Gilgit-Baltistan.

The Level 1 inventory was started in May 2008 and completed in August 2008. The results of the National Mercury Inventory were presented to stakeholders, together with the legal and institutional assessment in October 2008. Similarly, The Level 2 assessments were carried out in 2016 and together with a preliminary draft of the Minamata Initial Assessment, were presented to stakeholders at a final workshop on the 7th September 2018 (Annex I). The mercury profile was undertaken by a team of consultants.

This inventory of mercury releases and mercury containing products in Pakistan is prepared in accordance with the guidance provided in UNEP Toolkit for identification and quantification of mercury releases (the Toolkit-II) published in April 2013. Mercury Inventory Level 2 identified following potential sectors which are either contributing or may contribute towards release of mercury in the environment. Consumer products, dental amalgam, medical waste incineration, informal dumping and burning of general waste, artisanal and small scale gold mining, laboratories chemical, the extraction and use of fossil fuels, mining for minerals, ores and metals extraction and cement, paper and pulp production are the major sources of mercury release in the environment.

It is hoped that this MIA report will be useful for building a knowledge base that identifies the sources of mercury releases in the country and estimates or quantifies the releases. This information will also assist in: (1) decision-making with regard to possible policy measures to control mercury releases (2); in communicating with stakeholders, and (3) in monitoring changes over time. This report is based on extensive baseline data on mercury sources. This will be very helpful in guiding the relevant stakeholders and regulators in taking measures for curbing the mercury toxicity in the country.

CHAPTER 1: National Background Information

1. Country profile

The Islamic Republic of Pakistan has a variable climate and blessed with diverse natural resources. The Government of Pakistan aims to attain sustainable developments goals, ensuring water, food, energy and environment securities, without over-exploiting natural environment. The country has following background information:

1.1. Geographic profile

Pakistan is strategically located between the regions of South Asia, Central Asia, and the Middle East. This prime location – combined with varied natural resources, a diverse geography, and interesting environment – makes Pakistan a noteworthy country. Pakistan is the 36th largest nation by total area. The country has a total area of 796,095 sq km and is nearly four times the size of the United Kingdom. It lies between 23-35 to 37-05 north latitude and 60-50 to77-50 east longitude touching the Hindukush Mountains in the north and extending from the Pamirs to the Arabian Sea. Pakistan shares an eastern border with India (3,190 km) and a north-eastern border with China (438 km). Iran makes up the country's south-west border (959 km), and Afghanistan runs along its western and northern edge (2,670 km). The Arabian Sea is Pakistan's southern boundary with 1,064 km of coastline. Pakistan lies in the temperate zone (Fig 1.1).

The climate is generally arid, characterized by hot summers and cool or cold winters, and wide variations between extremes of temperature at given locations. There is little rainfall. Pakistan has are four seasons. Pakistan is divided into three major geographic areas: the northern highlands, the Indus River plain in the center and east, and the Baluchistan Plateau in the south and west. The lowest point of the country is Indian Ocean 0 m while highest point is K2 (Mt. Godwin-Austen). At 8,611 meters, it is the second highest peak in the world. Pakistan is currently working to develop areas for tourists and trekking sites.Pakistan is exposed to a variety of natural hazards. The most damaging are cyclones, droughts, earthquakes, floods, and landslides. In 2005, a high magnitude earthquake caused the greatest destruction and loss recorded in the country's history: 6,700 people died; indirect income losses totaled $576 million; and relief, recovery, and reconstruction cost $5.2 billion.



Figure1.1: Geographical map of Pakistan

1.2. Demographic profile

Pakistan is one of the largest and fastest growing countries in the world. In 2018, it ranked 5th most populous country and will stand at 4th in 2050. According to Pakistan's census 2017, population is comprises on 216 million inhabitants and it does not include the 1.7 million naturalized refugees from Afghanistan mainly found in Khyber Pakhtunkhwa (KPK). The share of urban population is 36% while rural population is 63%. Since the 1950; Pakistan has experienced a significant population growth rate ranging between two to four per cent per annum. Pakistan has remarkably young age structure. Nearly two-thirds of the Pakistani population is less than 30 years old with a median age of 23.8 years. The young age structure has been persistent in Pakistan for the last five decades. The share of School life expectancy (primary to tertiary education) is 8 years. The share of working-age population (15-65 years old) is 70%. Percentage of women employed outside the home is 9.16. Overall country unemployment rate is 5.8%. Several factors contributed significantly to the fertility decline during the last decade of 20th century in Pakistan such as overall socio-economic development, increased literacy and educational attainment particularly for female, and strengthening of family planning programs. However, current birth rate is 21.9 births/1,000 populations. Life expectancy at birth for both sexes has improved over the last five decades from 41.2 years in 1950-55 to 64.6 years in 2005-2010 and now it is 66.48 years in 2017.

Different languages are spoken for communication. Punjabi 48%, Sindhi 12%, Saraiki 10%, Pashto, 8%, Urdu (official) 8%, Baluchi 3%, Hindko 2%, Brahui 1%, English (official language of Pakistani elite and most government ministries), Burushaski, and other 8% . The educational achievement and literacy in Pakistan has not been impressive in the past. Existing literacy rate is 57.9% with male (69.5%) and female (45.8%).

Ethnic groups in Pakistan generally are categorized according to various combinations of religion, language, and sometimes tribe. Punjabis (44.2 percent of the population, divided into three occupational castes: Rajputs, Jats, and Arains), Pakhtuns (15.4 percent), Sindhis (14.1 percent), Balochis (3.6 percent) and other ethno linguistic groups include the Siraikis, Urdu-speaking Muhajirs and Brahuis are major ethnic groups in Pakistan (Fig 1.2).



Figure1.2: Map of major ethnic groups in Pakistan

1.3 Political profile

The Islamic Republic of Pakistan has a parliamentary democracy in which the prime minister is head of government and the president is head of state. A two-house parliament is comprised of a 342 members in National Assembly and 104 in Senate directly elected from each of the four provinces of the country; Balochistan, Khyber Pakhtunkhwa, Punjaband Sindh along with capital territory of Islamabad. There are two autonomous territories of Azad Jammu and Kashmir and Gilgit-Baltistan. Administratively, each province and territory is subdivided into divisions, which are further subdivided into districts and each district into tehsils or talukas, which are further subdivided into union councils. Within each province and territory, there are local governments mandated to make their own rules and regulations at local level responsible for implementation. District councils and metropolitan corporations are respectively the highest rural and urban tiers of local government in the provinces. Both urban and rural local governments have two or three tiers in all provinces except Khyber Pakhtunkhwa, where councils are not identified as either urban or rural. The legal system is derived from English common law and is based on the much-amended 1973 constitution and Islamic law (sharia). The Supreme Court, provincial high courts, and other courts have jurisdiction over criminal and civil issues.

1.4. Economic profile

The economy of Pakistan is the 24th largest in the world in terms of purchasing power parity (PPP), and 39th largest in terms of nominal gross domestic product. The economy is semi-industrialized, with centers of growth along the Indus River. Primary export commodities include textiles, leather goods, sports goods, chemicals, carpets/rugs and medical instruments. The future of Pakistan economy is brightened in the light of CPEC (China Pakistan Economic Corridor). CPEC is intended to rapidly modernize Pakistani infrastructure and strengthen its economy by the construction of modern transportation networks, numerous energy projects, and special economic zones.

1.5 Profiles of Economic Sectors

The economy of Pakistan is mainly dependent on agriculture but supported by textile, electronics, iron and steel products, automobile, nonmetallic mineral, cement, paper and board, coke and petroleum products engineering products, pharmaceutical, food beverages, surgical instruments, sports and leather products. Economically important natural resources include arable land, chromite, coal, copper, fire-clay, gypsum, iron, limestone, oil, natural gas, rock salt, and silica sand. The following key sectors (manufacturing processes and industries) were found in Pakistan which uses, trade, dispose and releases mercury into environment and likely to harm human health.Overall, major share of different sectors is showed in Fig 1.3.

1.5.1 Agriculture

Agriculture contributes 18.5 percent to country's Gross Domestic Product (GDP) and provides 38.5 percent employment to national labour force. The most important crops are wheat, sugarcane, cotton, and rice, which together account for more than 75% of the value of total crop output. Pakistan's largest food crop is wheat. Pakistan has also cut the use of dangerous pesticides dramatically. However, the quality of groundwater and surface water use for irrigation purposes is deteriorated with different heavy metals like arsenic, fluoride and mercury. The irrigation from mercury contaminated water is resulting in deposit of mercury in soil and crops which is threatening to consumers. Besides, fishery plays an important role in Pakistan's economy and is considered to be a source of livelihood for the coastal inhabitants. A part from marine fisheries, inland fisheries (based in rivers, lakes, ponds, dams etc.) is also very important activity throughout the country. The high concentration of mercury is also found in some fish species from coastal areas of Pakistan. Agriculture growth percentages of crops, livestock, forestry and fishing are given in Table 1.1.

Table1.1:- Agriculture Growth Percentages (Base=2005-06)

Sector	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Agriculture	2.68	2.50	2.13	0.15	2.18	3.94	0.85
Crops	1.53	2.64	0.16	-5.27	1.22	4.66	-4.43
i) Important Crops	0.17	7.22	-1.62	-5.86	2.60	3.56	-6.55
ii) Other Crops	5.58	-5.71	2.51	0.40	-2.51	6.15	1.95
iii) Cotton Ginning	-2.90	-1.33	7.24	-22.12	5.58	8.80	-12.74
Livestock	3.45	2.48	3.99	3.36	2.99	3.62	4.00
Forestry	6.58	1.88	-12.45	14.31	-2.33	2.58	6.47
Fishing	0.65	0.98	5.75	3.25	1.23	1.63	0.79
P: Provisional Source: Pakistan Bureau of Statistics							

1.5.2 Mining sector

The mineral potential of Pakistan is widely recognized to be excellent but this sector over the past inadequately developed. This is evident that its contribution to industry as a sub sector 13.5 percent and GDP remained 2.7 percent. This sector is lagging behind despite huge potential, due to interconnected and cross cutting issues like lack of infrastructure at mines sites, low level of technology installed and semi-skilled labor, low financial support and lack of marketing. However, this anthropogenic activity is contributing in release of mercury. Coal mining has a potential to release mercury into environment. The mercury fractions were extracted in Thar coal samples by using different extraction schemes in the country. However, currently no mining is observed for extraction of lead and mercury processing.

The global anthropogenic release of mercury to the environment comes from many sources, of which artisanal and small-scale gold mining (ASGM) is the biggest polluter, closely followed by the burning of coal. Although artisanal and small-scale gold mining (ASGM) is not happening in Pakistan at a large scale, however, according to international research studies almost 500,000 minors are associated with this profession which makes it “more than insignificant”. There is need to address this important concerns as it is one of the major source for release of mercury in the environment after fossil fuel consumption. Artisanal and small-scale gold mining (ASGM) industry is not only notorious because bulk of mercury is released in the environment through this method but it also immediately affects the workers exposed to it. In country like Pakistan where health and safety has yet not been implemented even in major industries, concerns of this local scale industry have never been addressed.

1.5.3 Industrial & manufacturing

Manufacturing plays a vital role in economic development. The contribution of manufacturing in GDP is hovering around 13.5-3.8 percent for almost decade. Major industries include textile, auto, cement, fertilizer, edible oil, sugar, steel, tobacco, chemicals, machinery, food and medical instruments primary surgical. Large Scale Manufacturing (LSM) has 78 percent share in manufacturing and 1.02 percent in GDP whereas Small Scale Manufacturing (SSM) accounts for 2.0 percent in GDP.

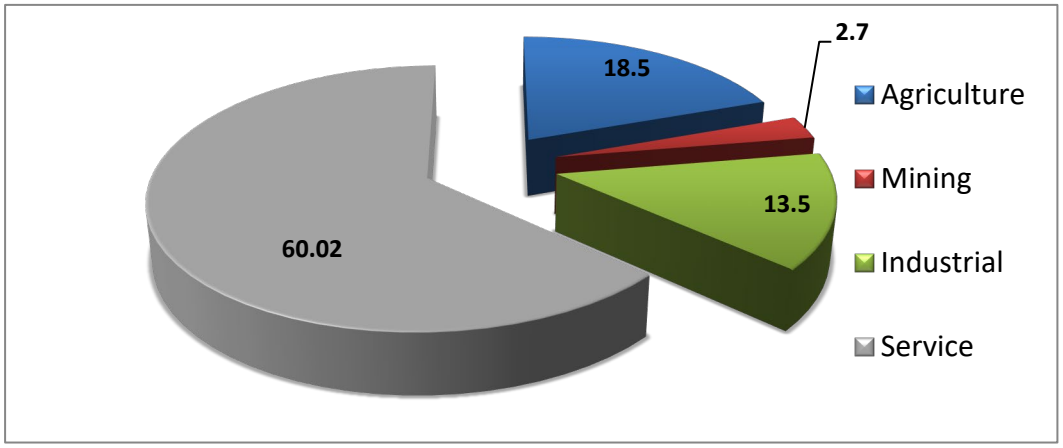


Figure 1.3 Share of major economic sectors in GDP of Pakistan

Besides mining and metals extractions, various other related industries such as cement production, paper and pulp industry as well as lime, caustic soda and gypsum production are also contributing in usage and subsequent release of mercury in Pakistan. However, there is no current estimate available about the quantity of mercury used ad released in the environment through these industries. Several researches showed presence of mercury in industrial effluents from textile, glass, paper, and cement industries. Table 1.2 provides a summary of the relative importance of the main economic sectors in the country including, inter alia: the manufacturing and industrial sector; agriculture, forestry and fishing sector; and mining and extraction sector.

1.5.4 Pakistan's service sector , remittances and tourism

Pakistan service sector accounts for about 60.2% of GDP. Similarly the remittances of Pakistanis living abroad has played important role in Pakistan's economy and foreign exchange reserves. The nine million-strong Pakistani diaspora, contributed US$19.3 billion to the economy in FY2017. Besides, tourism industry has also significant contribution in economy. Pakistan, with its diverse cultures, people and landscapes, has attracted 90 million tourists to the country, almost double to that of a decade ago.

1.5.5 Consumer products

There are various mercury containing consumers products which are either imported or manufactured in Pakistan. Few of these products are of medical use while others are used in household for domestic purposes. Mercury gauged thermometers and sphygmomanometers are commonly used in Pakistan. This equipment when expired is thrown either in medical waste or in municipal and domestic waste. Ultimately if this waste is incinerated or dumped it releases mercury contents in the environment. Dumping usually contaminate the soil and water through runoff while improper incineration release vapors of mercury in the air. In Pakistan, electrical switches with relay of mercury is also used which subsequently release mercury in the environment after their expiry. Mercury containing cosmetic products are frequently produced and used in Pakistan. Further, mercury is also used in paints, batteries, light sources, biocides and pesticides. These aforementioned products are either manufactured in Pakistan or imported from different countries.

1.5.6 Health sector

In Pakistan, dental amalgam filling in health sector is a source of mercury release into environment. It is restricted at federal and some provincial level. However, there is no strict regulation yet developed and implemented regarding the use of mercury in dental amalgam filling. In a current investigation campaign, mercury containing dental amalgam filling is found to be happening in almost all parts of the country. In dental clinics which use mercury in Dental Silver Amalgam, the

dentist and their assistants have been occupationally exposed to elemental mercury vapors (HgO) during manipulation of dental amalgam in their several routine occupational tasks, including preparation, restoration, and removal of dental amalgam.

Table1.2:- Summary of the relative importance of the main economic sectors in the country

Economic Sectors	Number of Employees (%)	Major Products in Each Sector	Contribution to GDP (%)	Growth Rate (%)
Manufacturing/ Industry Sector	16.05	Fertilizers, Vegetable Ghee, Sugar, Cement, Food &Tobacco, Jute, Textile, Motor tires, Motor tubes, Cycle tires, Cycle tube, Chemicals, Transport, Machinery & Electrical appliances, Paper & board, Steel Products	13.5-13.8	5.8
Mining and Extraction Sector	0.23	Antimony, Argonite/Marble, China Clay, Celestite, Chromite, Coal, Dolomite, Fire Clay, Fullers earth, Gypsum anhydrite, Lime Stone, Magnesite, Rock Salt, Silica Sand, Ochre, Sulphur, Soap stone, Baryte, Bauxite/Laterite, Iron Ore, Crude oil, Natural Gas.	13.5	3.04
Agriculture, Forestry and Fishing Sector	38.49	Wheat, Rice, Bajara, Jowar, Maize, Barley, Sugar Cane, Rapeseed &Mustard, Sesamum, Cotton, Tobacco, Fruits, Fish, Cuttlefish, Shrimp	18.5	3.81

1.6 Environmental Overview

In Pakistan, economic growth has generally been achieved at the cost of the environment, since most production and manufacturing processes exploit healthy but scarce ecosystems. The heavy dependence on natural resources and resulting environmental degradation has generated a cycle of "ecological poverty" with implications for the sustainability of economic growth. The country's large and growing population is sustained by, and critically dependent on, the Indus River and its tributaries. Irrigated agriculture accounts for more than 90% of food and fiber, and for most of fodder production. Population growth has reduced per capita water availability in Pakistan at present (2017) is around 865 cubic meters which is likely to reduce further to 850 cubic meters in 2025.

Pakistan's geographical location and socioeconomic fragility had made it at the top of the list of countries that are most vulnerable to the environmental, social and economic ramifications of climate change. Pakistan has set sight on the goals of sustainable development through vision 2025. Avoiding environmental degradation will ensure food, water and environmental securities in the future. Despite the integration of environmental consideration into development, the environment sector has not been given its due place in past. Studies conducted recently by the Government and donor agencies in Pakistan have highlighted a number of environmental issues. Broadly, the areas of concern identified include water, energy, pollution and waste management, irrigated agriculture, and biodiversity. Overall, these studies reveal deterioration in all these areas. The increasing pollution of water, air, and land continues to have an enormous impact on people's health, especially that of vulnerable groups such as children. The quality and quantity of renewable natural resources such as water, forests and other vegetation, and key biological habitats have declined.

1.6.1 Chemicals and mercury management

Poor management of chemicals and hazardous waste has potential threat to environment. Accurate and reliable data is essentially required for the systematic planning and safe and sound management of chemicals. Relevant ministries and organizations maintain their respective data; however, no central data exists for broader study and strategic planning. In fact, Pakistan lacks the expert capacity for data collection, analysis and dissemination to various stakeholders. Many industries neither maintain records of accidents, injuries, fatalities; not do they report to public authorities. The chemical industries do not maintain safety and security related data in a transparent manner. No data exists regarding areas heavily polluted by chemical waste and sites of obsolete chemicals. Moreover, national information system regarding chemicals and related safety and security aspects do not exists. Meanwhile, the absence of any regulation for mercury use in the country is the major cause of the free-wheeling use of the hazardous mercury in different forms, including cosmetic products such as whitening creams and soaps, dental filling, light bulbs, medical devices such as thermometers and blood pressure measuring apparatus, vaccines and batteries and other industrial products. Literature review revealed inadequate information on mercury and limited studies to establish the status of mercury sources, contamination in the environment and exposure risk factors. In 2007, United Nations Environmental Program (UNEP) approved financial support for Pakistan to study the mercury releases from all identified sources. In May, 2008, UNEP Chemicals expert provided the training to the inventory team from the Ministry of Environment, Government of Pakistan, by indicating a specific need data and information for gathering related to mercury releases after training, the inventory team initiated and identified hotspot areas of possibly mercury releases sources based on local knowledge and current activities. The inventory was conducted from May, 2008 to August, 2008 for data entry and analysis. Various sources of mercury release into the environment identified using this Tool Kit included; energy consumption, fuel refinery, primary metal production, cement production, use and disposal of mercury-containing products. Others were recycling of iron and steel, waste incineration, waste disposal, land filling, waste water treatment, crematoria and cemeteries.

Current inventory has been conducted to estimate the total mercury release into environment through different sources by using inventory Mercury Inventory Toolkit Level II and it is 139,421 Kg Hg/y. Mercury release per year in the country is assessed by analyzing the sectors: energy sources, primary metal production, production of other minerals and materials with mercury impurity, intentional use of mercury in industrial processes, consumer products with intentional use of mercury, other intentional product/process use, production of recycled metals, waste incineration and burning, waste deposition and waste water treatment and crematoria and cemeteries. The highest mercury contributing sector is consumer products with intentional use of mercury. However, the present mercury inventory revealed that overall among new sources of mercury are use of cosmetics products, ASGM activities, natural gas extraction refining and use, biomass fired power and heat production and coal uses. Further, informal dumping of waste and waste water treatment have also a major share in release of mercury into environment.

Still the lack of data on the extent of mercury use, awareness gap on its health and environmental impacts, the absence of environmental friendly alternative technology, a lack of political commitment and funding are the major roadblocks to rid the country of the mercury use. Pakistan is a signatory to the UN Minamata Convention on Mercury, a treaty to protect human health and the environment from the adverse effects of mercury. There is an urgent need to make a law that can help prevent the unchecked use of mercury and its handling in a scientific manner to protect the human health and environment.

CHAPTER 2: Institutional, Policy and Regulatory Assessment

2.1 Institutional assessment

In order to ensure effective implementation of the Minamata Convention through coordinated actions from institutions in the country, it is important to identify roles and responsibilities of Government ministries, agencies and institutions as well as non-government institutions, private sector partners and others, involved in the life-cycle management of mercury. It was recognized that the MOCC is the focal institution for the Convention, as well as being responsible for various implementing activities.

In order to provide the necessary information for this Chapter, Table 2.2 below is used as a starting point. The table is organized according to the provisions of the Minamata Convention. The table presents a summary assessment of existing national institutions, their roles and an analysis of possible gaps, such as capacities and institutions needed for the sound management of mercury, as deemed appropriate.

The approach methodology for the realization of this assessment of the institutional capacity to manage mercury is based on synthesis of documents on mercury, meetings with stakeholders, information and collected data, analysis of data and preparation of the draft report.

Table2.1-: Stakeholders' assessment matrix for mercury issues

Stakeholder	Relative importance rating	Relevant area
Ministry of Climate Change	High	Competent Authority for implementation of theMinamata Convention
Environmental Protection Agencies	High	Enforcement and monitoring agency for Minamata Convention obligations
Ministry of National Health Services Regulations and Coordination	High	Health Aspects, Research and monitoring.
Medical professionals	High	Importing and using dental amalgams, which is animportant source of mercury in Pakistan
Ministry of Industries & Production	High	Production of mercury containing products
Ministry of Commerce and Federal Board of Revenue	High	Port of entry for mercury and mercury containingdevices
Urban and rural municipalities and waste management companies	High	Interim storage and disposal of hazardous waste
Pakistan Mineral Development Corporation	High	Competent authority for mining licensing and regulation
Ministry of National Food Security & Research	High	Research and monitoring for mercury in fish andother seafood
Agricultural Extension Departments/ Plant Protection Departments	High	Authority for research and monitoring of pesticides and awareness of manufacturers
Ministry of Human Rights	Medium	Authority for the protection of labour health

Ministry of Water & Power	Medium	Authority for power generation from coal
Ministry of Information & Broadcasting and Media professionals	Medium	Education and Awareness of mercury issues
Largeimporters,importingcompanies	Medium	Awareness required to switch to Mercury freeproducts
National Disaster Management Authority	Medium	Important first responders for industrial accidents,chemical spills and fire
Pakistan Council for Scientific & Industrial Research	Low	In a position to undertake research and monitoring for mercury
Ministry of Federal Education & Professional Training	Low	In a position to create awareness through academic development
Higher Education Commission and autonomous universities	Low	In a position to undertake research and monitoring for mercury
NGOs and private sector organizations	Low	Undertaking inventory programme and reporting
General public	Low	Change of use of mercury containing devices

Table2.2:- Existing National Institutional Capacity and Remaining Gaps

Article 3 - Mercury supply sources and trade	
Article 3 contains control measures aimed at limiting the global supply of mercury, to complement and reinforce the demand reduction control measures in Articles 4-7. The Article 3 provisions limit the sources of mercury available for use and trade, and specify procedures to follow where such trade is still allowed. Article 3 restricts potential mercury supplies from primary mercury mining and decommissioning chlor-alkali plants, and seeks to identify any remaining large stocks of mercury. As for trade, Article 3 requires prior informed consent prior to any mercury trade. It specifies the relations and obligations between Parties in this regard and the rules governing tradebetween State Party and non-State Party.	
Succinct summary of provisions relevant to the country in question	▪ Not allow new primary mercury mining ▪ Prevent the import and use of mercury from primary mercury mining for artisanal and small-scale gold mining (ASGM) ▪ 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 ▪ Obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons (MT), and mercury supply generating stocks exceeding 10 MT/yr ▪ 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 ▪ 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)
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	Capacity in place:

Ministry of Climate Change (MOCC)	MOCC has a focal point for the Minamata Convention in its international cooperation wing that is obliged for the implementation of the relevant provisions in this article. MOCC has also a legal advisor as deputy director (legal) that works in collaboration with the Attorney General's (AG) office to update environmental laws, amongst other duties
Environmental Protection Agencies (EPAs)	EPAs (federal and all provincial environmental departments) have the relevant bodies/inspectors to enforce and implement the environmental laws and regulations.
Pakistan Mineral Development Corporation (PMDC)	Capacity is present for mining licensing and regulation through officer dealing legal matters however, sensitization is required regarding mercury mining and the Minamata Convention
Ministry of Industries & Production (MoIP)	Capacity is available to restrict the use of excess mercury in chlor-alkali plants and ASGM in future however, training and sensitization is required
Ministry of Commerce and Federal Board of Revenue (FBR)	Custom authorities and inspectors at the port of entry have been trained on key environmental conventions, most notably Basel, Montreal and Stockholm. A project has been submitted under the special programme trust fund, which will cover training of relevant custom authorities and inspectors with regards to mercury and Minamata Convention obligations. This project has been approved. Training of relevant custom authorties and inspectors will be conducted during project execution.

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

- Lack of effective coordination among above mentioned institutions to consult and implement the provision of article 3
- Sensitization required of the relevant stakeholders
- Sensitization and training required with regards to restriction on new mercury mines and import & export of mercury
- Training of custom authorities and inspectors
- Insufficientfinancial capacity for training and education
- Draft National Mercury Waste Management Plan of Pakistan 2010 quoted above is an old Bill which has not been further developed into law/Act. No steps have been taken to present it into the national legislation making process so that it could ultimately be enacted into law. There is dire need to take practical steps for promoting this bill into Act/law on urgent basis.

Article 4 – Mercury added products

Each Party shall ensure, by taking appropriate measures, thatno products content with mercury listed in Part I of Annex A aremanufactured, imported or exported after the date of definitiveabandonment fixed for those products, Except in the case of anexclusion specified in Annex A or pursuant to a derogationregistered for a Party in accordance with Article 6

Succinct summary of provisions relevant to the country in question	▪ Not allow the manufacture, import, and export ofproducts listed in Part I of Annex A, following thephase out date in Annex A ▪ Phase down the use of dental amalgam throughtwo or more measures listed in Part II of Annex A ▪ Prevent the incorporation of products listedin Part I of Annex A (i.e., switches and relays, batteries) into larger, assembled product

	▪ Discourage the manufacture and distributionof mercury-added products not covered by anyknown use before the Convention entered intoforce
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	Capacity in place:
Ministry of Climate Change	MOCC has a focal point for the Minamata Convention in its international cooperation wing that is obliged for the implementation of the relevant provisions in this article. MOCC has also a legal advisor as deputy director (legal) that works in collaboration with the Attorney General's (AG) office to update environmental laws, amongst other duties
Environmental Protection Agency	EPAs have the relevant bodies/inspectors to enforce and implement the environmental laws and regulations.
Ministry of National Health Services Regulations and Coordination (NHSR&C)	NHSR&C has an unannounced focal person that deals with dental amalgam issue. However, there is no capacity regarding thermometers and other medical products to be phased out. The capacity is insufficient and sensitization is needed
Ministry of Industries & Production	Capacity is present for notifying business members and manufacturers however, minimal training must be givenso that the right information is conveyed.
Ministry of Commerce	Capacity is present for notifying business members; however minimal training must be givenso that the right information is conveyed.
Federal Board of Revenue	Custom authorities and inspectors at the port of entry have been trained on key environmental conventions, most notably Basel, Stockholm and Montreal. A project has been submitted under the special programme trust fund, which will cover training of relevant custom authorities and inspectors with regards to mercury and Minamata Convention obligations. Current HS Codes are accurate but not sufficient for mercury added products. Hence, HS codes of mercury added products will be updated and will be communicated to custom authorities.
Agricultural Extension Departments (AEDs)	Capacity is present for notifying pesticides manufacturers however, sensitization and training is required regarding mercury effects and the Minamata convention
Plant Protection Departments (PPDs)	Capacity is present for notifying pesticides manufacturers however, sensitization and training is required regarding mercury effects and the Minamata convention
Largeimporters,importingcompanies	None
Pakistan Dental Association	Capacity is present for notifying mercury users in medical field howerver, sensitization and training is required regarding mercury effects on human health and the Minamata Convention
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	

- NHSR&C capacity building required for the phase down of thermometers listed in part 1 of Annex A and dental amalgam as provisioned by this article
- The dental amalgam phase down measures may also involve insurance and medical education
- And medical personnel are unaware of the adverse effects of mercury onhuman health.
- Lack of effective coordination among above mentioned institutions to consult and implement the provision of article 4
- The current customs tariff does not identify imported products containingmercury
- It is difficult to control trade in products containing mercury becausethe marketing system for these products has informal and formal channels
- There are no tools to detect mercury in the imported product, although the purchase of handheld analyzers, such as the XRF or Lumex, would be positive steps.
- Sensitization and training required of the relevant stakeholders from above listed ministries, private sector and large importers & importing companies
- Insufficient financial capacity for training and education

Article 5 - Manufacturing Processes

The Convention will reduce the demand for mercury in theindustrial sector through the same measures as for the productscovered by Article 4. The Convention will phase out the use ofmercury in manufacturing processes, eliminate or restrict the useof mercury, The revision of manufacturing processes with a viewto possible restrictions within five years of its entry into force andwill discourage the use of mercury in new manufacturingprocesses.

Succinct summary of provisions relevant to the country in question	▪ Not allow the use of mercury or mercurycompounds in the manufacturing processes listedin Part I of Annex B, following the Annex B phaseout date ▪ Restrict (as specified in the Annex) the useof mercury in the processes listed in Part II ofAnnex B ▪ Not allow new facilities to use mercury in theregulated processes under Article 5, as specifiedin Annex B ▪ For facilities with processes listed in Annex B,identify and obtain information on mercury ormercury compound use; and control mercuryemissions to air, and releases to land and water ▪ Discourage new uses of mercury in industrialprocesses
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC has a focal point for the Minamata Convention in its international cooperation wing that is obliged for the implementation of the relevant provisions in this article. MOCC has also a legal advisor as deputy director (legal) that works in collaboration with the AttorneyGeneral's (AG) office to update environmental laws, amongst other duties
Environmental Protection Agencies	EPAs have the relevant bodies/inspectors to enforce and implement the environmental laws and regulations.
Ministry of Industries & Production	Capacity is present for notifying manufacturers; however minimal training must be givenregarding mercury so that the right information is conveyed.
Ministry of Commerce	Capacity is present for notifying business members; however minimal training must be given regarding mercuryso that the right information is conveyed.
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	

▪ Lack of financial support to switch to mercury free technologies in industries. It can cause financial inflation due to products costs increase if new technologies adopted with current resources ▪ Inexistence of a collection mechanism, control structure and monitoring of mercury management in the industry sector ▪ Lack of involvement of research institutions in this field ▪ Lack of effective coordination among above mentioned institutions to consult and implement the provisions of article 5 ▪ Sensitization and training required of the relevant stakeholders ▪ Insufficientfinancial capacity for training and education ▪ The Convention does not define "discourage", but restrictions on new mercury processes would meet this Convention obligation.
Article 6 -Exemptions (Extensions of Time)
A Party seeking an extension of time for the definitive phase-out ofmercury use in products (Article 4) or industrial processes (Article 5)shall follow the procedure specified in Article 6. Article 6 establishes. Two different procedures, which theoretically allow a Party to extendthe deadline five years. Any derogation shall expire ten years afterthe time limit.

Succinct summary of provisions relevant to the country in question	None
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	Focal point for Minamata Convention in international cooperation wing of the MOCC can seek the extension if required
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	
▪ No current capacity gaps	

Article 7 –ASGM
Article 7 deals with artisanal and small-scale gold mining (ASGM), where mercury is used to extract gold. Article 7 recognizes thechallenge of addressing the use of mercury in the ASGM sector, especially in developing countries that depend on the economicbenefits of mining, providing them with the necessary flexibility toadapt to the conditions of the sector within its jurisdiction. Themechanism to bring about this flexibility is the national action plan

Succinct summary of provisions relevant to the country in question	▪ Reduce, and where feasible, eliminate mercuryand mercury compound use, emissions (to air), and releases (to land and water) associated with ASGM ▪ Establish a coordinating mechanism and delineate agency roles for development/implementation of an ASGM National Action Plan (NAP) ▪ Define and formalize or regulate ASGM consistent with the Convention ▪ 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") ▪ Set mercury use reduction goals or targets consistent with the timely elimination of the worst practices and other use reduction efforts

	▪ Reduce mercury emissions, releases, and exposures associated with ASGM, and preventmercury exposures of vulnerable populations (particularly women of child-bearing age andchildren) ▪ Prevent the diversion of mercury and mercury compounds from other sectors to ASGM, and manage mercury trade consistent with the NAP ▪ Implement a public health strategy to address mercury exposures to ASGM miners andcommunities
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	Capacity in place:
Ministry of Climate Change	MOCC has a focal point for the Minamata Convention in its international cooperation wing that is obliged for the implementation of the relevant provisions in this article. MOCC has also a legal advisor as deputy director (legal) that works in collaboration with the AttorneyGeneral's (AG) office to update environmental laws, amongst other duties
Environmental Protection Agencies	EPAs have the relevant bodies/inspectors to enforce and implement the environmental laws and regulations.
Ministry of Industries and Production	Capacity is present to formalize and regulate ASGM sector; however minimal training must be givenregarding mercury and the Minamata convention
Ministry of Commerce	Capacity is present to manage mercury trade; however minimal training must be given regarding mercuryso that the diversion of mercury and mercury compounds from other sectors can be prevented.
Pakistan Mineral Development Corporation	Capacity is present for mining licensing and regulation through officer dealing legal matters however, sensitization is required regarding mercury mining and the Minamata Convention
Ministry of National Health Services Regulations and Coordination (NHSR&C)	The capacity is insufficient and sensitization is needed to preventmercury exposures of vulnerable populations and to devise a public health strategy to address mercury exposures to ASGM miners andcommunities
Ministry of Human Rights	Capacity is present for the protection of the rights of labor, minors and communities that are involved in ASGM , however sensitization is required regarding this issue
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	
▪ The exact amount of the extract of gold and mercury used in the ASGM is unknown due to the informal sector of ASGM ▪ Lack of financial support for local minors to switch to mercury free technologies or adopt other livelihood sources because local minors live nomadic life and their livelihood source solely depends on ASGM ▪ Warrant a National Action Plan under Paragraph 2 of Article 7 ▪ A coordination mechanism is required where roles and responsibilities of the various ministries in developing and implementing the NAP are defined in anticipation. ▪ Sensitization and training of the relevant sectors/departments/ministries/stakeholders as listed above ▪ Insufficientfinancial capacity for training and education	
Article 8 - Air Emissions	

The purpose of Article 8 is to reduce mercury emissions to air from five of the most significant source categories identified during the Convention negotiations. The sources covered are listed in Annex D (coal-fired power plants, coal-fired industrial boilers, non-ferrous metal smelting and roasting processes, waste incineration, and cement production)	
Succinct summary of provisions relevant to the country in question	▪ Require best available techniques/best environmental practices (BAT/BEP) or associated emission limit values (ELVs) for new facilities (as defined in Article 8.2(c)) ▪ 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 ▪ Require monitoring/reporting and/or otherwise establish a mercury emissions inventory for sources listed in Annex D
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC has a focal point for the Minamata Convention in its international cooperation wing that is obliged for the implementation of the relevant provisions in this article. MOCC has also a legal advisor as deputy director (legal) that works in collaboration with the AttorneyGeneral's (AG) office to update environmental laws, amongst other duties
Environmental Protection Agencies	Capacity is available for monitoring of mercury emissions for medical/municipal waste incinerators, however it can be utilized after ratification of the Minamata convention by the country
Ministry of Industries & Production	Capacity is available to control/reduce mercury emissions from existing sources however, awareness and training is required regarding mercury emissions reduction and applying BAT/BEP techniques
Ministry of Health Services Regulations & Coordination	Limited capacity is available however, training shall be provided to apply BAT/BEP with regards to incineration of medical waste
Ministry of Water & Power	Some coal power plants have installed mercury specific filters however in general, the Ministry has no awareness regarding mercury and has no active capacity for such regulations or monitoring of the emissions and will depend on the BET/BEP standards developed by the Minamata Convention
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	
▪ Inexistence of the mercury emission standard, and regulations to manage emission sources in Pakistan ▪ Lack of national strategies for managing pollution from the industrial processes ▪ Training on BAT/BEP required for sources listed in Annex D and, more specifically, towards solid waste and medical waste incinerators ▪ Mechanism for BAT/BEP to be mainstreamed into the programmes for the relevant departments/ministries ▪ Lack of financial capacity for trainings	
Article 9 - Releases to Land and Water	
According to Article 9, each Party shall identify and then control significant pointsources of mercury releases to soil and water not considered inother provisions of the Convention. There is	

no list of sources tobe drawn up, as in Article 8, so that the sources controlled byArticle 9 may vary from one country to another.	
Succinct summary of provisions relevant to the country in question	▪ Require reporting and/or otherwise obtaininformation as needed to identify significantsources of mercury/mercury compound releasesto land or water, and to maintain an inventory ofreleases from the sources identified ▪ Require one or more measures specified in Article9.5 to control/reduce mercury and mercurycompound releases to land and water fromsignificant sources a country identifies
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC has a focal point for the Minamata Convention in its international cooperation wing that is obliged for the implementation of the relevant provisions in this article. MOCC has also a technical officer as deputy director (chemical) that works with the focal point of the Minamata Convention for the technical matters including identifying significant sources of mercury/mercury compound releases to land or water, and maintaining inventory of releases from the sources identified
Environmental Protection Agencies	Capacity is available for monitoring and reporting of mercury emissions to air and releases to land and water from industrial processes, and can be utilized after ratification of the Minamata convention by the country
Ministry of Industries & Production	Capacity is available to control/reduce mercury and mercury compound releases to land and water from significant sources however, awareness and training is required regarding mercury and the Minamata convention
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	
▪ Inexistence of the mercury release standards, and regulations to manage releasing sources in Pakistan ▪ Inexistence of strategies to identify and control mercury releases to the environment ▪ Staff and resources within the MOCC and EPAs are limited and that are already shared between various other conventions therefore, such activities would better be outsourced to private consultants. ▪ Lack of financial capacity for trainings	
Article 10 - Interim Mercury Storage	
The Article 10 scope is limited to “interim”or temporary storage of mercury destinedfor an allowed use under the Convention.	
Succinct summary of provisions relevant to the country in question	▪ Ensure interim mercury storage is conductedin an environmentally sound manner, taking into account guidelines to be developed by theConference of the Parties (COP)
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC has a focal point for the Minamata Convention in its international cooperation wing that is obliged for the implementation of the relevant provisions in this article.
Environmental Protection Agencies	Capacity is available for monitoring and reporting of mercury interim storage
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	

▪ Lack of proper infrastructure for temporary storage of mercury ▪ Inexistence of theinterim mercury storage standards, although once standards are developed within the Minamata Convention they will then be incorporated. ▪ Lack of awareness and training of the relevant stakeholders and insufficient financial capacity for these trainings	
Article 11 - Mercury Waste Management	
At the core of Article 11 is the focus on environmentally sound management (ESM) of mercury wastes and controls over its transboundary movement. The Convention provisions will preventboth improper management of the waste at thenational level and unwanted mercury waste dumping internationally. While both the Basel and Minamata Conventionsaddress mercury wastes, they bring different strengths to the global management of mercurywaste. The Minamata Convention may have astronger impact on national implementation of ESM, while the Basel Convention may be the primaryvehicle for regulating international mercury wastetransportation and management.	
Succinct summary of provisions relevant to the country in question	▪ Use a definition of mercury waste consistent with Article 11.2 ▪ Manage mercury wastes in an environmentally sound manner, taking into account guidelines developed under the Basel Convention andin accordance with COP requirements to bedeveloped ▪ Restrict mercury derived from the treatment orre-use of mercury waste to allowed uses under the Convention or environmentally sound disposal ▪ Require transport across international boundariesin accordance with the Basel Convention, or if the Basel Convention does not apply, consistent withinternational rules, standards, and guidelines
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC have previously carried out trans-boundary movement of hazardous waste in accordance with the Basel Convention. Therefore, institutional capacity does exist Additionally, MOCC has the jurisdiction to implement the restriction of mercury derived from the treatment or re-use of mercury waste to allowed uses under the Convention or environmentally sound disposal
Urban and rural municipalities and waste management companies	None
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	
▪ There is no structure in place, nor legal text for the management or monitoring and control of mercury wastes ▪ There is no specific management for products and wastes containing mercury in Pakistan. ▪ officers and management of the municipalities and other solid waste contractors to be trained on the environmentally sound management of mercury waste ▪ Lack of financial capacity for training	
Article 12 - Contaminated Sites	
Article 12 calls for the creation and adoption of COPguidance to Parties for approaching the evaluation and remediation of contaminated sites, but containsno mandatory obligations to establish liability orpropel progress in cleaning up contaminated sites.	

Article 12 allows governments to develop their ownlegal framework, within their financial and technicalcapability, to remediate mercury contaminated sites.	
Succinct summary of provisions relevant to the country in question	▪ Develop strategies for identifying and assessing mercury/mercury compound contaminated sites ▪ If risk reduction activities are taken atcontaminated sites, they are taken in anenvironmentally sound manner, incorporating riskassessment where appropriate
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC has the capacity to identify and assess contaminated sites
Urban and rural municipalities and waste management companies	None
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	
▪ Inexistence of the capacity for contaminated sites rehabilitation and riskassessment ▪ Funding for identification and awareness of the population around thecontaminated site does not exist. ▪ Officers and management of the municipalities and other solid waste contractors to be trained on the environmentally sound management of mercury waste ▪ Lack of financial capacity for training	
Article 13 - Financial Resources and Mechanism	
The first obligation under this Article is that a Party undertakes to provide resources for nationalimplementation activities within its capabilities (including through domestic funding, bilateral andmultilateral funding and private sector involvement). Notwithstanding, the Convention recognizes that providing financial assistance to developingcountries will improve the effective implementationof the Convention. As a formal mechanism toprovide this assistance, Article 13 establishes a Financial Mechanism with two components: (1) the Global Environment Facility Trust Fund, and (2) an International Programme to support capacity building and technical assistance.	
Succinct summary of provisions relevant to the country in question	▪ Access domestic resources as may be needed to implement Convention obligations ▪ Particularly for developing countries, access financial resources available under the Convention financial mechanism and other resources available from multilateral, regional, and bilateral funding sources
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC have the capacity to access financial resources available under the Convention financial mechanism and other resources available from multilateral, regional, and bilateral funding sources
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	
▪ Inexistence of the government budget for activities related to the Minamata Convention	
Article 14 - Capacity-Building, Technical Assistance and Transfer of Technology	
Under Article 14 of the Convention, Parties are required to cooperate to provide capacity building and technical assistance to developing countries, within their respective capabilities. A variety of mechanisms to deliver this assistance is anticipated.	

In addition, developed country Parties and other Parties, within their capabilities and supported by the private sector as appropriate, are required to facilitate and promote technology transfer to strengthen the capacity of developing countries to meet their obligations under the Convention.	
Succinct summary of provisions relevant to the country in question	None
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC have linkages with institutions from developed countries aswell as UN relevant bodies like UNITAR. However, mechanisms for cooperation on mercury is currentlylimited and will need to be developed
Universities in Pakistan	Some universities in Pakistan may have links with institutions from developed countries and relevant organizations. However, mechanisms for cooperation on mercury need to be developed.
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	
▪ Inexistence of the mechanism for seeking technical or financial cooperation from developed countries	
Article 16 - Public Health	
Article 16 promotes program development related to the health aspects of mercury, recognizing the activities will involve the World Health Organization (WHO), national public health ministries, and other organizations involved in the delivery of health services. Article 16 provides non-binding guidance to the health ministries and other actors on the activities they can undertake to minimize the mercury exposure of vulnerable populations, and the adverse consequences of such exposures.	
Succinct summary of provisions relevant to the country in question	▪ Promote the development and implementation of strategies to identify and protect populations at risk, such as developing fish consumption guidelines ▪ Promote occupational exposure educational and prevention programs ▪ Promote prevention, treatment, and care services for affected populations ▪ Strengthen institutional and professional capacities for addressing health risks associated with mercury exposure
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC has the focal point for Minamata convention in its international cooperation wing to implement the relevant provisions of this article.
Ministry of National Health Services Regulations and Coordination	The capacity is insufficient and sensitization is requiredon the relevant provisions of this article
Ministry of Human Rights	Capacity is present for the protection of the rights of affected populations however, sensitization is required regarding this issue
Ministry of National Food Security & Research	Capacity is present for the relevant provision under this article however, sensitization is required regarding the issue
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	
▪ Insufficientfinancial resources for the implementation of the provisions under article 16. ▪ Inexistence of a program or strategy developed in this area	

▪ Better information dissemination to the public by relevant ministries with regards to scientific information for mercury in fish and guidelines to reduce consumption of high risk species	
Article 17–21 – Information Exchange/Awareness-Raising	
TheConvention contains at least one Article dedicatedto each of these information pathways: Articles 17(Information exchange), 18 (Public information, awareness, and education), 19 (Research, development and monitoring), 20 (Implementation plans) and 21 (Reporting) contains obligations to report on measures eachParty has taken to implement the provisions of theConvention.	
Succinct summary of provisions relevant to the country in question	▪ Collect and disseminate information on annualquantities of mercury and mercury compounds emitted, released, or disposed; and otherinformation specified in Article 18 ▪ Share information on the health and safety ofhumans and the environment as non-confidential, in accordance with Article 17.5 ▪ Report to the COP on progress in implementingConvention's obligations under Article 21
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC has the focal point for Minamata convention in its international cooperation wing to implement the relevant provisions of these articles. However, expertise for annual inventory are limited and could be outsourced
Ministry of National Health Services Regulations and Coordination	None
Pakistan Council for Scientific & Industrial Research (PCSIR)	The research armin the field of mercury isstill in its infancy and would require strengthening
Ministry of Federal Education& Professional Training	None
Higher Education Commission and autonomous universities	Researches in the field of mercury is still in its infancy and would require strengthening
Ministry of Information & Broadcasting	Public awareness capacity is present however, sensitization is required regarding mercury and its adverse impacts on the human health and environment
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	
▪ Financial resources for annual data collection and dissemination as well as for training and awareness ▪ Limited research and monitoring in this field ▪ Non-existence of program and strategy developed ▪ Relevant stakeholders/ministries would require familiarization with the Minamata Convention on Mercury in order to disseminate mercury related information. ▪ PCSIR, NHSR&C and universities researchers would require training, not only to create the right information dissemination framework, butalso to conduct research and monitoring. ▪ Absence of laboratory directly related to mercury management research. ▪ Need to outsource inventory related activities since capacity is stretched within national institutions	
Articles 25–30 - Participation as Party/Administrative Matters	

Each government should ensure its representatives who can fully participate as a Party to the Convention. These functions include the power to:	
Succinct summary of provisions relevant to the country in question	▪ Participate in the COP, including voting, if and when required ▪ Participate in one of the dispute resolution processes specified if needed, under Article 25 of the Convention ▪ Determine how future Convention annex amendments will be ratified under Article 30.5 of the Convention
Institutional capacity in place to comply with the above listed provisions:	
Name of institution/entity or organization/business entity:	**Capacity in place:**
Ministry of Climate Change	MOCC has the focal point for Minamata convention in its international cooperation wing for the participation in COP and further administration matters
Remaining capacity gaps at national level that need to be addressed before provisions can be met:	

Conclusion

The implementation of Minamata Convention not only requires tools but also enabling institutional framework with defined role and responsibilities and mechanisms of coordination. This initial assessment provides insight into needs of Pakistan for implementation of the Minamata Convention.

Both, the lack of regulations and institutional capacities, are the hitch in implementing obligations of the Minamata Convention. Monitoring and control mechanisms are practically non-existent. Each actor of the administration works to fulfill the mission entrusted to it and to achieve the objectives set, without taking into account the others, which are complementary. The adoption of below measures is preferred and raises a priority:

- Stronger coordination among actors, greater involvement of the private sector is highly desirable.
- Actions must be taken to ensure that the private sector takes ownership of the importance of implementing the Convention before making them accountable.
- The actors who use a lot of products containing mercury will be the first to be sensitized: e.g. beauty products, electronics, dentists and industrial
- Capacity building for all actors, which can take several forms: tooling (identification of products containing mercury, control tools, etc.), setting up of a database, training of the staff involved must be implemented.
- Strengthening the partnership with research centers also provides a platform for research into mercury substitutes, best available techniques and best environmental practices

2.2: Policy and regulatory assessment

As ratification by a country of the Convention on Mercury legally binds the country to the Convention's obligations, the ratification process involves identifying existing relevant domestic legislation and identifying legal reform measures that may be needed.

To facilitate this policy and regulatory assessment, Table 2.3 below is used as a starting point. The table is organized according to the provisions of the Minamata Convention. This table presents a summary assessment of existing national policies and regulatory measures (in place and under

development), their scope and to what extent they already meet the requirements as stipulated in the provisions of the Minamata Convention. In addition, it also provides an analysis of existing gaps that would need to be addressed to ensure compliance with the Convention.

The methodology adopted follows a literature review, identifying the sources of legislative information and data on the mercury problem management and inventory of existing resources and collection. The methodology also focused on the descent to make the investigations, meeting with persons who held the information, visit to different institutions involved in the mercury problem in order to assess national legislation of mercury management and identify gaps and needs on this.

Table2.3:- Policy and Regulatory Measures in Place and Remaining Gaps

Article 3 - Mercury supply sources and trade	
Article 3 contains control measures aimed at limiting the global supply of mercury, to complement and reinforce the demand reduction control measures in Articles 4-7. The Article 3 provisions limit the sources of mercury available for use and trade, and specify procedures to follow where such trade is still allowed. Article 3 restricts potential mercury supplies from primary mercury mining and decommissioning chlor-alkali plants, and seeks to identify any remaining large stocks of mercury. As for trade, Article 3 requires prior informed consent prior to any mercury trade. It specifies the relations and obligations between Parties in this regard and the rules governing tradebetween State Party and non-State Party.	
Succinct summary of provisions relevant to the country in question	▪ Not allow new primary mercury mining ▪ Prevent the import and use of mercury from primary mercury mining for artisanal and small-scale gold mining (ASGM) ▪ 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 ▪ Obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons (MT), and mercury supply generating stocks exceeding 10 MT/yr ▪ 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 ▪ 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)
Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:
National Mineral Policy, 2013	Objectives of the Policy (Section 1) v) Mitigation of adverse environmental effects of mineral development Environment (Sub-section 7.3) With the increasing focus on the environment and international obligations, Pakistan, incommon with other countries, wishes to pursue an approach of sustainable developmentconsistent with environmental priorities. Companies will be expected to ensure that their miningoperations are carried out in an environmentally acceptable and safe manner and that suchoperations are properly monitored. To ensure that the mineral resources development activitiesare undertaken in an appropriate manner, environmental stewardship needs to be incorporatedthroughout the development process. This can be achieved through: ii. Compliance with the national environmental protection law and other appropriate national and international standards, codes, guidelines and policies

Pakistan Environmental Protection Act (PEPA), 1997	Prohibition of Import of Hazardous Waste (Section 13) No person will import hazardous waste into Pakistan and its territorial waters, Exclusive Economic Zone and historic waters. (xix) "hazardous waste" means waste which is or which contains a hazardous substance or which may be prescribed as hazardous waste, and includes hospital waste and nuclear waste. Handling of Hazardous Substances (Section 14) Subject to the provisions of this act, no person shall generate, collect, consigns, transport, treat, dispose off, store, handle or import any hazardous substance except __ a) Under a license issued by the Federal Agency and in such manner as may be prescribed; or b) In accordance with the provision of any other law for the time being in for or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Pakistan is a party.
Draft Handling, Manufacture, Storage, Import of hazardous waste and hazardous substances Rules, 2016	Import of Hazardous Chemicals (Section 17) In case the EPA of the province is of the opinion that the chemical should not be imported on safety or an environmental consideration, such Agency may direct stoppage of such import
Import Policy Order, 2016	Prohibition and restrictions (Section 5) Good specified in Appendix "A" are banned for import. Mercury is enlisted in Appendix A "under hazardous waste classified in the Basel Convention" Prohibition and restrictions imposed under the laws (Section 6) Notwithstanding anything contained in this order, the prohibitions, restrictions, conditions and requirements as prescribed under any other law, Act or Rules for the time being in force, shall be applicable, mutatis mutandis, on specified imports.
Export Policy Order, 2016	N/A
Import Export (Control) act, 1950	Powers to Prohibit or Restrict Imports and Exports (Section 3) 2) No goods of the specified description shall be imported or exported except in accordance with the conditions of a license to be issued by the Chief Controller or any other officer authorized in this behalf by the Federal Government.
National Environmental Policy, 2005	Trade and Environment (Sub-section 4.5) Develop strategies to deal with import of goods and technologies which could have detrimental effect on country's environment.

Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:

- Currently, primary minning is not occurring in Pakistan However there is need to amend National Mineral policy as well as Import policy order, 2016 to ban the import of mercury for future ASGM activities
- National planning and reporting requirements needed related to the management of the mercury at chlor-alkali plants upon closure or conversion
- Develop provisions relating to the export of Mercury to a country for disposal as per Convention requirements
- Reporting or licensing requirements needed for significant mercury supply sources within country's borders

▪ Government shall consider adoption of a mercury trade licensing system to meet the prior informed consent (PIC) requirements, the source/use restrictions, and the reporting obligations of Article 3.	
Article 4 – Mercury added products	
Each Party shall ensure, by taking appropriate measures, that no products content with mercury listed in Part I of Annex A are manufactured, imported or exported after the date of definitive abandonment fixed for those products, Except in the case of anexclusion specified in Annex A or pursuant to a derogation registered for a Party in accordance with Article 6	
Succinct summary of provisions relevant to the country in question	▪ Not allow the manufacture, import, and export of products listed in Part I of Annex A, following the phase out date in Annex A ▪ Phase down the use of dental amalgam through two or more measures listed in Part II of Annex A ▪ Prevent the incorporation of products listed in Part I of Annex A (i.e., switches and relays, batteries) into larger, assembled product ▪ Discourage the manufacture and distribution of mercury-added products not covered by any known use before the Convention entered into force
Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	**Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:**
Pakistan Environmental Protection Act, 1997	**Handling of Hazardous Substances (Section 14)** Subject to the provisions of this act, no person shall generate, collect, consigns, transport, treat, dispose off, store, handle or import any hazardous substance except __ a) Under a license issued by the Federal Agency and in such manner as may be prescribed; or b) In accordance with the provision of any other law for the time being in for or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Pakistan is a party.
Import Policy Order, 2016	**Prohibition and restrictions imposed under the laws (Section 6)** Notwithstanding anything contained in this order, the prohibitions, restrictions, conditions and requirements as prescribed under any other law, Act or Rules for the time being in force, shall be applicable, mutatis mutandis, on specified imports.
Export Policy Order, 2016	N/A
Import Export (Control) act, 1950	**Powers to Prohibit or Restrict Imports and Exports (Section 3)** 2) No goods of the specified description shall be imported or exported except in accordance with the conditions of a license to be issued by the Chief Controller or any other officer authorized in this behalf by the Federal Government.
Draft National Mercury Waste Management Plan 2010	▪ Replace mercury products with mercury alternatives in future. ▪ In order to regulate mercury at consumer level, all purchasers of mercury containing products should be registered and proper mercury/chemical regulation unit should be established in all provincial EPA's.

	▪ Simply ban mercury thermometers and introduce and make available alternative thermometers, forcing thermometers manufacturing industry to replace technology to manufacture alternatives.
Hazardous Substances Rules, 2003 (Draft)	Guidelines are found on: Defination of hazardous substances is mentioned in Section 3. Mercury and its compounds are enlisted as hazardous substances in Schedule I (143 number) ▪ Issue of license for hazardous substance (Article 7) ▪ Packing and labeling of hazardous substance (Article 9) ▪ Import of hazardous substance (Article 20) ▪ Transport of hazardous substance (Article 21)
Sectoral Guidelines for Major Chemical and Manufacturing Plants, 1997	Production Process (Sub-section 2.1.1) Information on major chemical substances and all dangerous goods used, stored, or produced on site must be provided
National Environmental Policy, 2005	Trade and Environment (Sub-ection4.5) Develop strategies to deal with import of goods and technologies which could have detrimental effect on country's environment.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ New legislation to ban the export of products listed in Part I of Annex A ▪ Pakistan Environment Proctection Act and Hazardous Substance Rule, 2003 should be amended to prohibit and/or restrict the manufacture and trade of mercury added products including creams, pharmaceutical and agricultural products on the Pakistani market, pharmaceutical preparations and sale of mercury-added -products. ▪ New legislation to phase down the use of dental amalgams in accordance to Part II of Annex A	
Article 5 - Manufacturing Processes	
The Convention will reduce the demand for mercury in the industrial sector through the same measures as for the products covered by Article 4. The Convention will phase out the use of mercury in manufacturing processes, eliminate or restrict the use of mercury, The revision of manufacturing processes with a view to possible restrictions within five years of its entry into force and will discourage the use of mercury in new manufacturing processes.	
Succinct summary of provisions relevant to the country in question	▪ Not allow the use of mercury or mercury compounds in the manufacturing processes listed in Part I of Annex B, following the Annex B phase out date ▪ Restrict (as specified in the Annex) the use of mercury in the processes listed in Part II of Annex B ▪ Not allow new facilities to use mercury in the regulated processes under Article 5, as specified in Annex B ▪ 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 ▪ Discourage new uses of mercury in industrial processes
Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	

Title and number of relevant Policy and Regulatory Measure, as well as date of approval	Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:
Pakistan Environmental Protection Act, 1997	Handling of Hazardous Substances (Section14) Subject to the provisions of this act, no person shell generate, collect, consigns, transport, treat, dispose off, store, handle or import any hazardous substance except __ a) Under a license issued by the Federal Agency and in such manner as may be prescribed; or b) In accordance with the provision of any other law for the time being in for or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Pakistan is a party.
Draft National Mercury Waste Management Plan, 2010	Promote cost effective and appropriate technological option for proper handling of mercury. Application of Basel convention technical guidelines on mercury uses sectors like Chlor-alkali industry, Health sector (especially dental amalgams) and light sources sector.
Sectoral Guidelines for Major Chemical and Manufacturing Plants, 1997	Production Process (Sub-section 2.1.1) Information on major chemical substances and all dangerous goods used, stored, or produced on site must be provided Clean Production Considerations (Sub-section 2.1.2) ▪ Air management systems to measure, collect, treat, and recycle gaseous emissions. ▪ Water management systems to provide water quality standards for any wastewater discharged from the site to sewer, storm water or natural drainage system ▪ Identify potential soil contaminants and mitigation measures
Guidelines for Processing and Using Refused Derived Fuel (RDF) in Cement Industry	▪ Combustion and Pollution control devices ▪ Anti-pollution devices should be installed. ▪ Mercury emission limits have been set ▪ Testing Facilities
Hazardous Substances Rules, 2003 (Draft)	EIA of Project or Industrial Activity An application for grant of license filed under Rule 4 shall be accompanied by an EIA of the project or industrial activity involving generation, collection, consignment, transport, treatment, disposal storage, handling or import of hazardous substance in respect of which the license is sought.
Sectoral Guidelines for Major Thermal Power Plants, 1997	5.2 Clean coal technologies 5.2.1 Integrated gasification and combined cycle 5.2.2 Atmospheric fluidized bed combustion 5.2.3 Pressurized fluidized bed combustion 6 Emission requirement 7 Monitoring and reporting
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
Hazardous Substance Rules,2003 should be updated and approved ban on use of mercury or mercury compounds in manufacturing processes	

Sectoral Guidelines for Major Chemical and Manufacturing Plants, 1997 could be amended to restrict (as specified in the Annex) the use of mercury in the processes listed in Part II of Annex B

- Prohibit the establishment of any facility using mercury or mercury compounds in its industrial processes and it could be introduced into Sectoral Guidelines for Major Chemical and Manufacturing Plants, 1997 through its amendment.

Article 6 -Exemptions (Extensions of Time)

A Party seeking an extension of time for the definitive phase-out of mercury use in products (Article 4) or industrial processes (Article 5) shall follow the procedure specified in Article 6. Article 6 establishes. Two different procedures, which theoretically allow a Party to extendthe deadline five years. Any derogation shall expire ten years afterthe time limit.

Succinct summary of provisions relevant to the country in question	None

Policy and regulatory measures in place that enable the country to comply with the above listed provisions:

Title and number of relevant Policy and Regulatory Measure, as well as date of approval	**Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:**
None	

Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:

- None

Article 7 – Artisanal and Small-Scale Gold Mining (ASGM)

Article 7 deals with ASGM, where mercury is used to extract gold. Article 7 recognizes the challenge of addressing the use of mercury in ASGM sector, especially in developing countries that depend on the economic benefits of mining, providing them with the necessary flexibility to adapt to the conditions of the sector within its jurisdiction. The mechanism to bring about this flexibility is the National Action Plan (NAP)

Succinct summary of provisions relevant to the country in question	▪ Reduce, and where feasible, eliminate mercury and mercury compound use, emissions (to air), and releases (to land and water) associated with ASGM ▪ Establish a coordinating mechanism and delineate agency roles for development/ implementation of an ASGM NAP ▪ Define and formalize or regulate ASGM consistent with the Convention ▪ 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") ▪ Set mercury use reduction goals or targets consistent with the timely elimination of the worst practices and other use reduction efforts ▪ Reduce mercury emissions, releases, and exposures associated with ASGM, and prevent mercury exposures of vulnerable populations (particularly women of child-bearing age and children)

	▪ Prevent the diversion of mercury and mercury compounds from other sectors to ASGM, and manage mercury trade consistent with the NAP ▪ Implement a public health strategy to address mercury exposures to ASGM miners and communities
Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	**Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:**
Pakistan Environmental Protection Act (PEPA), 1997	**Prohibition of certain Discharges or Emissions (Section 11)** Subject to the provisions of this Act and the rules and regulations made there under no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the National Environmental Quality Standards or, where applicable, the standards established under sub-clause (i) of clause (g) of sub-section (1) of section 6. **Handling of Hazardous Substances Section (Section 14)** Subject to the provisions of this act, no person shall generate, collect, consigns, transport, treat, dispose off, store, handle or import any hazardous substance except __ a) Under a license issued by the Federal Agency and in such manner as may be prescribed; or b) In accordance with the provision of any other law for the time being in for or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Pakistan is a party.
National Environmental Policy, 2005	**Air Quality (Sub-section3.2)** ▪ Establish and enforce standards for ambient and indoor air quality ▪ Ensure effective enforcement of the National Environment Quality Standards and Self-Monitoring Rules. ▪ Ensure reduction and control of harmful emissions through regulatory programs. ▪ Promote cleaner production technologies **Water Supply and Management (Sub-section 3.1)** ▪ Develop legal and policy framework for promotion of safe drinking water in water. ▪ Establish a water quality monitoring and surveillance ▪ Launched phased programs for cleanup and gradual up gradation of the quality of water bodies. **Health and Environment (Sub-ection 4.4)** To prevent, minimize, and mitigate detrimental health impacts associated with environmental hazards the government may: ▪ Develop and enforce occupational health and safety rules and regulation ▪ Promote dissemination of information on preventive healthcare at the grass root level.

Hazardous Substances Rules, 2003 (draft)	Safety precautions for workers (Section 12) ▪ No worker aged below 18 years or over 60 years shall be employed for any job involving physical handling of hazardous substances. ▪ All workers shall be thoroughly trained in safety precautions for handling hazardous substances and shall be supervised by qualified supervisors. ▪ Protective clothing and equipment should be available for all workers who may be exposed to any hazardous substance ▪ Medical checkup of all workers shall be carried out at the time of employment and at least once a year thereafter
National Operational Strategy CDM (Clean Development Mechanism), 2006	Criteria for CDM projects (Section 3) Pakistan shall allow unilateral, bilateral, multilateral CDM projects
Draft National Mercury Waste Management Plan of Pakistan	▪ Ensure protection and safety of all people working/using mercury for different purposes. ▪ Promote cost effective and appropriate technological option for proper handling of mercury. ▪ Increase public awareness about mercury releases, their toxicity and proper disposal through media and formal education.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ New regulations to eliminate mercury and mercury compound use, emissions (to air), and releases (to land and water) associated with ASGM ▪ This informal mining sector must be assigned the status of formal sector and mining license and regulation must be prepared particularly for this sector. ▪ The new and existing authorities ultimately relied upon to implement Article 7 should reflect the roles and responsibilities of the various ministries in developing and implementing the NAP. Accordingly, to the extent possible, the Article 7 legal assessment should take into account both the existence and the alignment of authorities, in anticipation of NAP preparation. ▪ New legislations to eliminate whole ore amalgamation, open burning of amalgam or processed amalgam and burning of amalgam in residential areas ▪ Set mercury use reduction goals or targets consistent with the timely elimination of the worst practices and other use reduction efforts ▪ Legislation to reduce mercury emissions, releases, and exposures associated with ASGM, and prevent mercury exposures of vulnerable populations (particularly women of child-bearing age and children) ▪ Implement a public health strategy to address mercury exposures to ASGM miners and communities	
Article 8 - Air Emissions	
The purpose of Article 8 is to reduce mercury emissions to air from five of the most significant source categories identified during the Convention negotiations. The sources covered are listed in Annex D (coal-fired power plants, coal-fired industrial boilers, non-ferrous metal smelting and roasting processes, waste incineration, and cement production)	
Succinct summary of provisions relevant to the country in question	▪ Require best available techniques/best environmental practices (BAT/BEP) or associated emission limit values (ELVs) for new facilities (as defined in Article 8.2(c)) ▪ 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

	▪ Require monitoring/reporting and/or otherwise establish a mercury emissions inventory for sources listed in Annex D
Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	**Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:**
National Environmental Policy, 2005	▪ Establish and enforce standards for ambient and indoor air quality ▪ Ensure effective enforcement of the National Environment Quality Standards and Self-Monitoring Rules. ▪ Ensure reduction and control of harmful emissions through regulatory programs. ▪ Promote cleaner production technologies
Pakistan Environmental Protection Act (PEPA), 1997	Subject to the provisions of this Act and the rules and regulations made thereunder no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the National Environmental Quality Standards or, where applicable, the standards established under sub-clause (i) of clause (g) of sub-section (1) of section 6.
Self-Monitoring and Reporting by the Industries Rules, 2001	An Industrial unit in Category 'A" & category "B" shall submit Environmental Monitoring Reports on monthly basis in respect of gaseous emissions, for priority parameters list in Table B of Schedule III and listed in Table B of schedule IV respectively. Relevant Industrial units to Minamata Convention are: Category A; cement, iron and steel, oil and gas production, pulp and paper, petroleum refining, thermal power plants (coal and oil based), boilers, furnaces, oven and Kilns (coal and oil fired), Brick kilns (firewood and bagasse based). Category B; Choloralkali plants
The Pollution Charge for Industry (Calculation and Collection) Rules, 2001	The Federal Government shall levy a pollution charge on any person who contravenes or fails to comply with the provisions of subsection (1), to be calculated at such rate, and collected in accordance with such procedures as may be prescribed.
National Environmental Quality Standards (NEQS)-Pakistan for Liquid Effluents and Gaseous Emissions, 2001	▪ National Environmental Quality Standards for Gaseous Emissions ▪ Environmental, Health, and Safety Guidelines for Thermal Power Plants
Guidelines for Processing and Using Refused Derived Fuel (RDF) in Cement Industry	▪ Cement unit using RDF should comply with the National Environmental Quality Standards (NEQS) (Permissible limit set for mercury emission 10 mg/Nm^3 and it is compulsory for Cement plants to submit their air emissions report to EPA biannually. ▪ All the anti-pollution devices should be kept in good operating condition.
Sectoral Guidelines for Major Chemical and	Some of the industries to which these guidelines apply include; petrochemical industries, Inorganic chemical industry,

Manufacturing Plants, 1997	pharmaceutical and fine chemicals industry and general manufacturing industries. The primary damage from air emissions includes adverse effects on human health and comfort, on vegetation, and on athletics. Air emissions may be controlled by use of incineration (Stack Flares), adsorption, gas scrubbing, membrane separation, cyclones, electrostatic precipitators, baghouse filters, catalytic reduction or oxidation, incineration, and absorption system.
Sectoral Guidelines for Major Thermal Power Plants, 1997	The environmental assessment should also address other project specific environmental concerns, such as emissions of cadmium, mercury and other heavy metals resulting from burning certain type of coal or heavy fuel oil. In such cases, the responsible authority will require specific measures to mitigate the impact of such emissions and set associated emission requirements.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ New standards required for emissions limits/standards for waste incinerators, including medical waste incinerators under the PEPA ▪ Application of best available techniques for medical waste incinerators ▪ Develop an inventory of mercury emissions (ideally in partnership with the Asian-Pacific Mercury Mointoring Network). ▪ Develop Best Available Techniques (BAT) and Best Environmental Practices (BEP) to control and reduce mercury emissions from new facilities (based on standards that are being developed through the Minamata Convention).	
Article 9 - Releases to Land and Water	
According to Article 9, each Party shall identify and then control significant pointsources of mercury releases to soil and water not considered inother provisions of the Convention. There is no list of sources tobe drawn up, as in Article 8, so that the sources controlled by Article 9 may vary from one country to another.	
Succinct summary of provisions relevant to the country in question	▪ Require reporting and/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 ▪ Require one or more measures specified in Article 9.5 to control/reduce mercury and mercury compound releases to land and water from significant sources a country identifies
Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	**Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:**
National Environmental Policy, 2005	**Water Supply and Management (Sub-section 3.1)** ▪ Develop legal and policy framework for promotion of safe drinking water in water. ▪ Establish a water quality monitoring and surveillance ▪ Launched phased programs for cleanup and gradual up gradation of the quality of water bodies. **Waste Management (Sub-section 3.3)** ▪ Strictly enforce the National Environmental Quality Standards and self-monitoring and reporting system.

	▪ Introduce discharge licensing system for industry. ▪ Make installation of wastewater treatment plant an integral part of all sewerage schemes. ▪ Establish cleaner production centers and promote cleaner production techniques and practices. ▪ Develop and enforce rules and regulations for proper management of municipal, industrial solid and liquid waste.
Pakistan Environmental Protection Act (PEPA), 1997	Prohibition of Certain Discharges or Emissions (Section 11) Subject to the provisions of this Act and the rules and regulations made thereunder no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the National Environmental Quality Standards or, where applicable, the standards established under sub-clause (i) of clause (g) of sub-section (1) of section 6. (2) Handling of Hazardous Substances (Section14) Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose of, store, handle or import any hazardous substance except under certain conditions.
Hazardous Substances Rules, 2003draft	Conditions for Premises (Section 10) The premises in which a hazardous substance is generated, collected, consigned, treated, disposed of, stored and handled shall comply with the conditions specified in Schedule IV. Entry, Inspection and Monitoring (Section 16) For purposes of verification of any matter relating to the conditions of the license, duly authorized staff of the Federal Agency/Provincial Agency as the case may be, shall be entitled to enter and inspect the premises in which the hazardous substance is being generated, collected, consigned, treated, disposed of , stored or handled.
Hospital Waste Management Rules, 2005	Waste disposal (Section 20) (1) Depending upon the type and nature of the waste material and the organism in the waste, risk waste shall be inactivated or rendered safe before final disposal by a suitable thermal, chemical, incineration, filtration, or other treatment method or by a combination of such methods involving proper validation and monitoring procedures. Effluent from the waste treatment shall also be periodically tested to verify that it conforms to the National Environmental Quality Standard before it is discharged into the sewerage system. (7) Landfill shall be located at sites with minimal risk of pollution of groundwater and rivers. Waste minimization and reuse (Section 22) (b) Waste recycling programmes, involving return of unused or waste chemicals in quantity to the supplier for reprocessing, return of pressurized gas cylinders to the suppliers for refilling and reuse, sale of materials such as mercury, cadmium, nickel and lead-acid to specialized recyclers.
The Pollution Charge for Industry (Calculation and Collection) Rules, 2001	The Federal Government shall levy a pollution charge on any person who contravenes or fails to comply with the provisions of

	subsection (1), to be calculated at such rate, and collected in accordance with such procedures as may be prescribed.
National Environmental Quality Standards (NEQS)-Pakistan for Liquid Effluents and Gaseous Emissions, 2001	National Environmental Quality Standards for Municipal and Liquid Industrial Effluents According to these standards, mercury release into inland water, into sewage treatment and into sea should be 0.01 mg/l.
Environmental Guidelines for Sound Disposal Management of Mercury in Compact Fluorescent Light Bulbs (CFLs), 2010	Handling of discarded CFLs (Section 3) The local area authorities carrying out municipal functions must install CFLs collection point so as to ensure that the CFLs are separated from the rest of household waste. These collections points should be installed in central locations such as local retail shops, post offices, bus stops etc so as to ensure that it is convenient for the consumers to return their expired CFLs.
Draft Guidelines for Solid Waste Management, 2005	Source reduction, reuse, recycling, collection, transportation, disposal and treatment of system of industrial, infectious hospital and other waste.
Sectoral Guidelines for Major Chemical and Manufacturing Plants, 1997	Water discharges (Section 3.2) Minimize the impact of pollutant discharge from industries on groundwater and surface water bodies by adopting runoff control measures and National Environmental Quality Standards. Solid waste (Sub-section 3.4) Landfills sited in areas of low permeability with deep ground water tables and lined disposal cells where ground water seepage is a potential concern.
Sectoral Guidelines for Major Thermal Power Plants, 1997	Solid waste (Sub-section 6.3) Dewatered ash and chemically stabilized FGD sludge's can be disposed of in: a) Landfills sited in areas of low permeability with deep ground water tables and b) Lined disposal cells where ground water seepage is a potential concern.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ In a new regulation and/or strategy for the management of mercury and other harmful chemicals and substances, mercury standards for land, and detailed best available techniques and alternatives for management of mercury releases on land should be specified. ▪ Require reporting or otherwise obtain information as needed to identify significant sources of mercury/mercury compound releases to land or water and to maintain periodic assessment as required for new sources and update to the inventory of releases.	
Article 10 - Interim Mercury Storage	
The Article 10 scope is limited to "interim"or temporary storage of mercury destined for an allowed use under the Convention.	
Succinct summary of provisions relevant to the country in question	▪ 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)
Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and	Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:

Regulatory Measure, as well as date of approval	
Hazardous Substance Rules, 2003 (draft)	**Conditions for Premises (Sub-section 10)** The premises in which a hazardous substance is generated, collected, consigned, treated, disposed of, stored or handled shall- ▪ Comply with conditions specified in Schedule IV; and ▪ Be fitted with a notice on the outer door or gate bearing the specific information. **Packaging and labeling (Section 9)** A container of hazardous substance shall be of such size, material and design as to ensure that ▪ It can be stored, transported and used without leakage and safely. The following information shall be printed conspicuously, legibly and indelibly on every container of a hazardous substance- ▪ Name of the hazardous substance ▪ Name, address and license number of the licensee ▪ Net contents (volume or weight) ▪ Date of manufacture and date of expire, if any; ▪ A warning statement ▪ Instructions regarding return or disposal of the empty containers.
Draft Handling, Manufacture, Storage, Import of hazardous waste and hazardous substances Rules, 2016	**General responsibility of the occupier during industrial activity (Article 3)** These rules shall apply to ▪ An industrial activity in which a hazardous chemical, which satisfies any of the criteria laid down in Part I of the Schedule I or listed in Column 2 of Part II of this Schedule is, or may be, involved; and ▪ Isolated storage of hazardous chemical listed in Schedule 2 in a quantity equal to or more than the threshold quantity specified in Column 3.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ Interim mercury storage standards may address areas such as location, quantity limits, duration, room temperature and humidity, containers, secondary containment and flooring, labeling, employee training, inspections and monitoring, release/spill response, security, financial responsibility (i.e., bonding, insurance) in the event of spills or facility abandonment, and reporting. ▪ Update the hazardous waste form to incorporate measures for mercury that are subsequently developed ▪ Prescribe standards for the management of hazardous waste under the PEPA ▪ Construction of hazardous waste storage facility that will include mercury wastes	
Article 11 - Mercury Waste Management	
At the core of Article 11 is the focus onenvironmentally sound management (ESM) ofmercury wastes and controls over its transboundary movement. The Convention provisions will prevent both improper management of the waste at thenational level and unwanted mercury waste dumping internationally. While both the Basel and Minamata Conventions address mercury wastes, they bring different strengths to the global management of mercury waste. The Minamata Convention may have	

astronger impact on national implementation of ESM, while the Basel Convention may be the primary vehicle for regulating international mercury waste transportation and management.	
Succinct summary of provisions relevant to the country in question	▪ Use a definition of mercury waste consistent with Article 11.2 ▪ Manage mercury wastes in an environmentally sound manner, taking into account guidelines developed under the Basel Convention andin accordance with COP requirements to be developed ▪ Restrict mercury derived from the treatment or re-use of mercury waste to allowed uses under the Convention or environmentally sound disposal ▪ 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
Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	**Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:**
Pakistan Environmental Protection Act, 1997	**Functions of Federal Agency (Section 6)** (n), Assist the local councils, local authorities, government agencies and other persons to implement schemes for the proper disposal of wastes so as to ensure compliance with the standards established by it
National Environmental Policy, 2005	**Waste management (Sub-section 3.3)** Pollution caused by liquid and solid waste in the country would be prevented and reduced through taking these measures by government: ▪ Enforce National Environment Quality Standards, self-monitoring and reporting system. ▪ Introduce discharge licensing system for industry ▪ Installation of wastewater treatment plants ▪ Establish cleaner production centers and techniques ▪ Encourage reduction, recycling and reuse of industrial and municipal waste ▪ Enforces rules and regulation for proper management of municipal, hazardous, hospital and industrial waste. ▪ Devise and implement guidelines for sustainable management of mining and oil exploration interventions as well for rehabilitation of expired mines/exploration sites.
Hazardous Substances Rules, 2003 (draft)	**Waste management plan (Section 19)** 1) The waste management plan if required to the submitted by an applicant under clause (b) of sub-rule (2) of Rule 5. a) Provide generation collection, transport, and disposal of hazardous waste b) Ensure that nonhazardous waste is not mix with hazardous waste 2) Review management plan every three years.
Hospital Waste Management Rules, 2005	**Waste management plan (Section 15)**

	A waste management plan should be prepared by the waste management officer for approval by the waste management team, and shall be based on internationally organized environment management standard such as the International Organization for Standardization 14000 series.
Draft Guidelines for Solid Waste Management	N/A
Draft National Mercury Waste Management Plan of Pakistan	The overall goal of the National Waste Management Plan for mercury is to improve the quality of life of people of Pakistan and to conserve aquatic resources by reducing mercury releases to environment through ensuring provision for mercury alternatives at all levels at an affordable cost and in an equitable, efficient and sustainable manner
Sectoral Guidelines for Major Chemical and Manufacturing Plants, 1997	Hazardous material management (Sub-section 4.2) Industrial and pharmaceuticals waste can contain hazardous waste materials. When dealing with disposal of such solid waste the following practices should be adopted: ▪ For hazardous there should be adequate treatment, storage and disposal treatment. ▪ Procedures to ensure waste are only disposed of at facilities which are operated in accordance with EPA standards.
Code of Conduct of Pakistan Mineral Development Corporation (Pvt) Limited	Promote resource conservations, waste minimization and the minimization of the release of obnoxious gases onto the environment during mining operations in coal and salt mines.
Environmental Guidelines for Sound Disposal Management of Mercury in Compact Fluorescent Light Bulbs (CFLs), 2010	Handling of discarded CFLs (Section 3) The local area authorities carrying out municipal functions must install CFLs collection point so as to ensure that the CFLs are separated from the rest of household waste. These collections points should be installed in central locations such as local retail shops, post offices, bus stops etc so as to ensure that it is convenient for the consumers to return their expired CFLs.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ Draft National Mercury Waste Management Plan of Pakistan 2010 quoted above is an old Bill which has not been further developed into law/Act. No steps have been taken to present it into the national legislation making process so that it could ultimately be enacted into law. ▪ Standards required under the EPA for transboundary movement of hazardous waste including mercury and mercury containing waste ▪ Developing Mercury Waste Regulations to come up with a provision for holistically addressing the issue of mercury wastes as stipulated in Article 11	
Article 12 - Contaminated Sites	
Article 12 calls for the creation and adoption of COP guidance to Parties for approaching the evaluation and remediation of contaminated sites, but containsno mandatory obligations to establish liability orpropel progress in cleaning up contaminated sites. Article 12 allows governments to develop their ownlegal framework, within their financial and technicalcapability, to remediate mercury contaminated sites.	
Succinct summary of provisions relevant to the country in question	▪ Develop strategies for identifying and assessing mercury/mercury compound contaminated sites

	▪ If risk reduction activities are taken at contaminated sites, they are taken in an environmentally sound manner, incorporating risk assessment where appropriate
Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	**Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:**
Hazardous Substance Rules, 2003 (draft)	**Safety Plan (Section17)** The safety plan to be submitted by an applicant under clause (a) of substance rule (2) of Rule 5 shall include- ▪ An analysis of major accidents hazards relating to the hazardous substance involved; ▪ An assessment of the nature and scope of the adverse environmental effects likely to be caused by major accidents; ▪ A description of the emergency measures proposed to be taken on and off the premises of the applicant to control major accidents, and to mitigate its adverse environmental effect.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ Develop strategies for identifying and assessing mercury/mercury compound contaminated sites ▪ Develop mercury specific risk reduction activities taken at contaminated sites in an environmentally sound manner, incorporating risk assessment	
Article 13 - Financial Resources and Mechanism	
The first obligation under this Article is that a Party undertakes to provide resources for national implementation activities within its capabilities (including through domestic funding, bilateral and multilateral funding and private sector involvement). Notwithstanding, the Convention recognizes that providing financial assistance to developing countries will improve the effective implementation of the Convention. As a formal mechanism to provide this assistance, Article 13 establishes a Financial Mechanism with two components: (1) the Global Environment Facility Trust Fund, and (2) an International Programme to support capacity building and technical assistance.	
Succinct summary of provisions relevant to the country in question	▪ Access domestic resources as may be needed to implement Convention obligations ▪ Particularly for developing countries, access financial resources available under the Convention financial mechanism and other resources available from multilateral, regional, and bilateral funding sources
Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	**Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:**
National Environmental Policy, 2005	**Capacity Development (Sub-section 5.3)** Capacity of the Ministry of Environment, Provincial Environment Departments, Environmental Protection Agencies, district and tehsil governments and other relevant government and non-government institutions and organizations at all levels would be

	strengthened by provision of adequate staff, equipment, infrastructure and financial resources to enable them effectively implement the policy. 5.4. Economic and Market Based Instruments Environmental fiscal reforms would be promoted. ▪ Trade barriers for the import of clean technologies, fuels, and pollution control equipment would be removed. ▪ Sustainable development funds would be operationalized at the federal and provincial levels. ▪ Industries would be encouraged to introduce environmental accounting systems in their financial management systems. ▪ Special credits/low interest loans/subsidies would be offered for the establishment of waste management system, introduction of clean technology and relocation of polluting industries. ▪ Opportunities for green business such as environmental engineering manufacturing and installation, environmentally-certified products and businesses, energy service and conservation companies and ecotourism would be promoted.
Pakistan Environmental Protection Act, 1997	Establishment of the Provincial Sustainable Fund (Section 5.3 09) (1) There shall be established in each Province a Sustainable Development Fund. (2) The Provincial Sustainable Development Fund shall be derived from the following sources, namely; a) Grants made or loans advance by the Federal Government or the Provincial Governments; b) Aid and assistance, grants, advances, donations and other non-obligatory fund received from foreign government, national and international agencies and non-governmental organizations; and c) Contributions from private organization and other persons.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ Inexistence of the government budget for activities related to the Minamata Convention ▪ National implementation plan for mercury must be mainstreamed in national budget planning processes ▪ Access domestic and international resources to implement Convention obligations	
Article 14 - Capacity-Building, Technical Assistance and Transfer of Technology	
Under Article 14 of the Convention, Parties are required to cooperate to provide capacity building and technical assistance to developing countries, within their respective capabilities. A variety of mechanisms to deliver this assistance is anticipated. In addition, developed country Parties and other Parties, within their capabilities and supported by the private sector as appropriate, are required to facilitate and promote technology transfer to strengthen the capacity of developing countries to meet their obligations under the Convention.	
Succinct summary of provisions relevant to the country in question	None

Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:
National Environmental Policy, 2005	5.3 Capacity Development ▪ Capacity of the Ministry of Environment, Provincial Environment Departments, Environmental Protection Agencies, district and tehsil governments and other relevant government and non-government institutions and organizations at all levels would be strengthened by provision of adequate staff, equipment, infrastructure and financial resources to enable them effectively implement the policy. ▪ Short, medium and long term programs would be designed and implemented after comprehensive training need assessment. ▪ Public sector training institutions would be encouraged to integrate environment in their curricula ▪ National research priorities in the environment sector would be identified and adequate funding would be made available to undertake need based research in priority areas. ▪ Relevant research and development institutions would be strengthened.
Clean Development Mechanism, National Operational strategy, 2006.	3. Criteria for CDM Projects Pakistan shall allow unilateral, bilateral and multilateral CDM projects preferably in the following areas (iv) Waste Management (e.g. landfills, solid waste management, recycling, animal/livestock wastes); (v) Transportation (e.g. alternative fuel vehicles, mass transit systems, cleaner engines, Compressed Natural Gas); and (vi) Industrial processes.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ Developed countries are required to cooperate to provide capacity building and technical assistance for mercury management to Pakistan.	
Article 16 - Public Health	
Article 16 promotes program development related to the health aspects of mercury, recognizing the activities will involve the World Health Organization (WHO), national public health ministries, and other organizations involved in the delivery of health services. Article 16 provides non-binding guidance to the health ministries and other actors on the activities they can undertake to minimize the mercury exposure of vulnerable populations, and the adverse consequences of such exposures.	
Succinct summary of provisions relevant to the country in question	▪ Promote the development and implementation of strategies to identify and protect populations at risk, such as developing fish consumption guidelines ▪ Promote occupational exposure educational and prevention programs ▪ Promote prevention, treatment, and care services for affected populations ▪ Strengthen institutional and professional capacities for addressing health risks associated with mercury exposure

Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:
National Environmental Policy, 2005	Health and Environment (Article 4.4) To prevent, minimize and mitigate detrimental health impacts associated with environmental hazards, the government may: ▪ Incorporate environmental health and healthcare waste management components into medical teaching and training programs. ▪ Develop and enforce health and safety rules and regulations. ▪ Introduce effective waste management system in all health care facilities. ▪ Promote dissemination of information on preventive health care at the grassroots level. Gender and Environment (Article 4.3) Address the environmental issues which impact women more adversely such as indoor air pollution and lack of access to water supply sources.
Hospital Waste Management Rules, 2005	Waste Collection (Article 17) (2) Sanitary staff and sweepers shall, when handling waste, wear protective clothing at all times including face mask, industrial aprons, leg protectors, industrial boots and disposable or heavy duty gloves
Draft National Mercury Waste Management Plan of Pakistan, 2010	3. Sectoral management plan for mercury 3.1. Plan for Chlor-alkali Sector 6. The Workers dealing with transport, storage, use and disposal of mercury containing chemicals must be fully and clearly informed about the possible hazards of mercury at any stage. 3.2. Plan for Health Sector 4. Workers should strictly follow practical steps in their work environment to manage mercury products carefully and dispose off it properly when broken. 30. The hospital may develop their procurement guidelines adjusted in respect of replacing mercury containing devices e.g. thermometers and sphygmomanometers, with electronic devices. 31. The curriculum for medical and health sciences may include syllabi on mercury usage and its hazards, including alternates. The same may also be addressed at school level curriculum for children. 35. The ministry of health should be made partner for the said project especially in research and planning in order to identify the possible health risk factors due to mercury among the population and to device policy.
Hazardous Substances Rules, 2003 (draft)	General safety precautions (Article 11) Safety precautions for workers (Article 12)
Sectoral Guidelines for EIA of Major Chemical and	Management and training (Article 7) The standard operating procedures must be enforced by management. Special training must be provided for toxic and

Manufacturing Plants, 1997	hazardous materials handling and their management should be further improved by detectors and alarms.
The Mines Act, 1923	Chapter V Provisions as to health and safety
Code of Conduct of Pakistan Mineral Development Corporation (PMDC)	**Health and Safety** Every staff member should take reasonable care to ensure the health and safety of him/her, who may be affected by his/her acts or omissions at work. Staff members should not tamper with or misuse any item provided by the Company to secure the safety, health and welfare of its staff and for the protection of the environment.
Environmental Guidelines for Sound Disposal Management of Mercury in Compact Fluorescent Light Bulbs (CFLs)	**Handling at Consumer Level (Article 4)** In case of breakage CFLs should be handled carefully, adopting precautionary measures. Detail is given in guidelines.
Sectoral Guidelines for Environmental Reports-Oil and Gas Exploration and Production, 1997	**Occupational Health and Safety (Article 3.18)** The material Safety Data Sheets provided by the manufacturers of chemicals will be strictly followed for the safe handling of chemicals and hazardous materials, which shall not be brought on site without the provisions of Data Sheet.
Sectoral Guidelines for Environmental Reports-Major Sewage Schemes, 1997	**Health and Safety (Article 4.5)** For health issues the mitigation strategy should consider the multiple measures.
The Factories act, 1934	**Health and Safety (Chapter III)** 13. Cleanliness, 14. Disposal of waste and effluents 15. Ventilation and temperature, 33L.Explosive or inflammable dust etc.
Outstanding regulatory aspects that would need to be addressed/ developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ Promote the development and implementation of strategies to identify and protect populations at risk, such as developing fish consumption guidelines ▪ Prepare and implement training programmes for relevant stakeholders and staff of relevant institutions. The training should be continual and sustainable. In a new regulation for mercury and other harmful chemicals and substances one may make reference to the relevant provisions of the Constitution and Other Acts.	
Article 17–21 – Information Exchange/Awareness-Raising	
The Convention contains at least one Article dedicatedto each of these information pathways: Articles 17 (Information Exchange), 18 (Public Information, Awareness, and Education) and 19 (Research, Development, and Monitoring). In addition, Article 21 contains obligations to report on measures each Party has taken to implement the provisions of the Convention.	
Succinct summary of provisions relevant to the country in question	▪ Collect and disseminate information on annual quantities of mercury and mercury compounds emitted, released, or disposed; and other information specified in Article 18 ▪ Share information on the health and safety of humans and the environment as non-confidential, in accordance with Article 17.5 ▪ Report to the COP on progress in implementing Convention obligations under Article 21
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	**Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:**

	The information sharing and gathering authoritiesmay be found in national environmental, hazardous substance control, pollution registry, and air/water pollution laws. Since these information and reporting requirements are often found ininternationalConventions, the authorities relied upon for other Convention information sharing andreporting may apply here as well, including but not limited to the other chemical Conventions (Basel,Rotterdam, Stockholm).
National Environmental Policy, 2005	Public Awareness and Education (Article 5.5) ▪ A national strategy would be developed and implemented for raising environmental awareness of the general public as well as selected target groups. ▪ Environmental education would be integrated into all levels of curricula and syllabi from primary to university levels. ▪ Establishment of environmental education and training institutions would be encouraged. ▪ Educational institutions throughout the country would be supported in establishment of environmental clubs. Capacity Development (Article 5.3) b) A national environmental information management system would be established to provide accurate and timely information for informed decision making as well as ensure public access to environmental information.
Draft Handling, Manufacture, Storage, Import of hazardous waste and hazardous substances Rules, 2016	Collection, Development and Dissemination of Information (Article 16) (3) The occupier while obtaining or developing a material safety data sheet as specified in Schedule 9 in respect of a hazardous chemical handled by him shall ensure that the information is recorded accurately and reflects the scientific evidence used in making the hazard determination. In case, any significant information regarding hazard of a chemical is available, it shall be added to the material safety data sheet as specified in Schedule 9 as soon as practicable. (4) Every container of a hazardous chemical shall be clearly labeled or marked to identify - (a) the contents of the container; (b) the name and address of manufacturer or importer of the hazardous chemical; (c) the physical, chemical and toxicological data as per the criteria given at Part I of Schedule 1.
Pollution Charge for Industry Rules, 2001.	Costs of Determination of Pollution Level (Article 8) The industrial unit shall provide all requisite assistance at the site for the visit of the Inspection Team and shall bear all costs relating to determination of the pollution level, including the prescribed fees specified in Schedule V, and costs of sampling, testing and reporting of results:
Guidelines for Self-Monitoring and Reporting by the Industry (SMART), 1998	Responsibility for reporting (Article 3) All industrial units shall be responsible for correct and timely submission of environmental monitoring reports to the Federal Agency. Environmental Monitoring Report (Article 9)

	An Environmental Monitoring Report shall comprise a Liquid Effluent Monitoring Report, A Gaseous Emissions Monitoring Report and cover sheet.
Draft Guidelines for Solid Waste Management, 2005	Part B: SWM Guidelines Public Education and Awareness Raising (Article 9).
National Mineral Policy, 2013	Research and Development Enhancement (Article 12) Efforts will be focused towards the development of new technologies for conversion of existing mineral resources into viable economic resources. Indigenous technology would be upgraded through research and adoption of technological innovations abroad.
Draft National Mercury Waste Management Plan, 2010	Promote cost effective and appropriate technological option for proper handling of mercury (Article 4). Increase public awareness about mercury releases, their toxicity and proper disposal through media and formal education (Article 5). To encourage NGOs and individual researchers to identify regional mercury hazards and entertains their suggestion (Article 9). 3.2. Plan for Health Sector Awareness regarding mercury and its toxicity must be raised at all levels. This also include that all those students who are currently studying in dental colleges must know about the toxicity of mercury and mercury alternatives (Article 2). Awareness regarding mercury and its toxicity in the hospitals and in clinics to use alternatives drugs, chemicals and its safely disposals should be adopted (Article 27). The curriculum for medical and health sciences may include syllabi on mercury usage and its hazards, including alternates. The same may also be addressed at school level curriculum for children (Article 31).
Code of Conduct of Pakistan Mineral Development Corporation	Environment Strive continuously to improve environment awareness and protection from hazardous mining operations in salt and coal mines.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ Provincial and local governments will develop programmes seeking advice and collaboration of media, especially TV and radio channels, to promote mercury related messages in their entertainment programmes. ▪ All above mentioned rules, policy and drafts' provisions on integration of education on the environment at all levels of education do not mention mercury issues education. Therefore all should be amended to incorporate issues of mercury and mercury compounds.	
Articles 25–30 - Participation as Party/Administrative Matters	
Each government should ensure its representatives can fully participate as a Party to the Convention. These functions include the power to:	
Succinct summary of provisions relevant to the country in question	▪ Participate in the COP, including voting, if and when required ▪ Participate in one of the dispute resolution processes specified if needed, under Article 25 of the Convention ▪ Determine how future Convention annex amendments will be ratified under Article 30.5 of the Convention

Policy and regulatory measures in place that enable the country to comply with the above listed provisions:	
Title and number of relevant Policy and Regulatory Measure, as well as date of approval	Explanation on what aspects of mercury management relevant to the provision in question (see above), are being addressed by policy/regulatory measure:
National Environmental Policy, 2005	Multilateral Environmental Agreements (Article 3.9) The government would continue to play a provocative role to ensure protection of regional and global environment and cooperate with the international community in promotion of sustainable development. In this context, the government may: ▪ Effectively participate in regional and international fora to foster cooperation for protection of environment and natural resources. ▪ Ensure effective implementation of bilateral, regional and international multilateral environmental agreements, protocols and conventions to which Pakistan is a party, in line with national policies and priorities. ▪ Develop and implement national strategies and actions plans for all multilateral environmental agreements, Johannesburg Plan of Implementation and Millennium Development Goals.
Outstanding regulatory aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions *(only in relation to binding provisions)*:	
▪ Participate in one of the dispute resolution processes specified if needed	

Conclusion

After analyzing the above mentioned table that serve as the main pillar to get an idea of the condition and reliability of national legislation on mercury management, it is noticed that there is a gap in regulatory framework for the mercury management in Pakistan. Therefore, the urgent adoption of normative acts to insert provisions making substantial contents of the effective implementation of the Minamata Convention in the national legislation is required. It is also crucial to tackle the advocacy sessions for the authorities and sensitization sessions for the masses on the implementation of the Minamata Convention and particularly on the administrative measures, the importance of the elaboration of regulatory framework to manage mercury in Pakistan. Thereafter, the adoption of normative acts of national level within the competence of all stakeholders is necessary. The adoption of normative legislations below is preferred and raises a priority:

- Definition of mercury discharge limits in the standards environment at all environmental components (air, water, soil) and implementation of control provisions of these discharges in the industrial process;
- Restriction or suppression progressive of the use of mercury-containing products or components in the area of Trade and Consumer Affairs, Health and Industry (as the same as the case of refrigerating equipment in the Montréal protocol of protection of ozone layer);
- Establishment of the guarantee for the customers to have right to the prior information and consent of the use of dental amalgam with its medical risks incurred. Further, when Pakistan will become the party, it will be mandatory to phase down dental amalgams
- Regulatory framework for adoption laying labeling of mercury-containing consumer products or mercury-based with mandatory indication of the volume of mercury in each product and theprecautions to take when using the products;

- Review or amendment of the legal provisions and /or regulations in force that may be the source of considerable mercury releases;
- Adoption of administrative or penal measures against the factories or institutions which do not apply legal provisions related to mercury management in Pakistan.
- Draft National Mercury Waste Management Plan of Pakistan 2010 is a critical step in achieving the requirments of Minamata Convention. It should be integrated into national legislation making process and also implement it after its enactment into law.

CHAPTER 3: Mercury Profile

3.1 Inventory planning, preparation and management

The inventory of mercury emissions and releases in Pakistan was undertaken using the UNEP's toolkit – level II for identification and quantification of mercury releases. The following preparatory activities were undertaken to ensure a successful inventory:

Six (06) data inventory consultants were hired from each province and territory by MOCC (Ministry of Climate Change) in June 2016 for conducting the inventory of mercury emission and releases in Pakistan. Data inventory consultants were attached to their local provincial Environmental Protection Agencies (EPAs) members. The members of the EPAs were part of the National Coordination Mechanism developed for this project. In addition, a three day mercury inventory training workshop was convened from 7-9 September, 2016at Hotel Margalla, Islamabad. The objective of the training workshop was to build the capacity of the stakeholders, EPAs members and data inventory consultants on the use of the UNEP's Toolkit for Identification and Quantification of mercury releases and emissions. This training workshop was attended by 44 stakeholders from relevant sectors and departments including MOCC (Ministry of Climate Change),ECO (Environment Consultancy Organization) Lahore, EPAs (Environment Protection Agency/Departments) of all provinces, Health Services Academy, WASA (Water and Sanitation authority), LDA (Lahore Development Authority), Ministry of Industry and Petroleum, Engineering Development Board, Metrology Department, COMSATS University, Islamabad, Margalla Institute of Health Sciences, Rawalpindi, SDPI (Sustainable Development Policy Institute), Textile Testing International,Etihad Chemicals Limited, Lahore, Chemical Engineering, Gujrat, Health Services Academy,ChakShahzad, Islamabad, PCRWR (Pakistan Council of Research in Water Resources) Islamabad, National Cleaner Production Centre (NCPC) and from academia and NGOs. The training was conducted by a UNEP consultant, Mr. DadanHasanuddinWardhana from Indonesia.

The collection, collation and verification of data for the inventory were commenced in Nov, 2016, after the completion of the mercury inventory training. The strategies applied for this inventory included the following:

- Desktop data gathering.
- Development and circulation of questionnaires to all relevant sectors/stakeholders with an indication of deadline for submission of completed questionnaires.
- Collection of data and information from stakeholders and relevant sources.
- Compilation and collation of data/information received.
- Documentation of sources and validation of the accuracy of data/information to resolve inconsistencies.
- Identification of issues, problems, or opportunities and determining if site visits are needed.
- Completion of data analyses and verifications.
- Input of data to Levels 2 of the UNEP Toolkit for the identification and quantification of mercury releases
- Interpretation of data and toolkit results, preparation of conclusions.

Site visits were conducted for priority sectors, selected on the basis of type, location and potential risks. The focus of the site visits was to conduct on-the-spot assessments and gathering of further relevant information. All mercury inventory data was gathered by national consultants from all provinces and compiled into final MIA report.

3.2 Summary of mercury inputs

3.2.2 Summary of mercury releases, stockpiles, and supply and trade.

The individual mercury release sub-categories contributing with the highest mercury releases to the atmosphere were informal waste burning (9,930 kg/y), electrical switches (5,880 kg/y), gold (and silver) extraction with mercury amalgamation processes (5,005 kg/y), biomass fired power and heat production (2,273 kg/y), informal dumping of general waste (2,191 kg/y), batteries with mercury (2,126 kg/y), manometer and gauges with mercury (1,219 kg/y) and other coal use (1,121 kg/y).

The individual mercury release sub-categories contributing with the highest inputs of new mercury werecosmetics and related products with mercury (47,775 kg/y), electrical switches and relays with mercury (19,600 kg/y), batteries with mercury (8,505 kg/y), laboratory chemicals and equipment with mercury (7,000 kg/y),gold (and silver) extraction with mercury amalgamation processes (6,500 kg/y),manometers and gauges with mercury (6,093 kg/y), polyurethane with mercury (4,200 kg/y), (natural gas - extraction, refining and use (4,078 kg/y),aluminum extraction and initial processing (3750 kg/y),thermometers with mercury (3,379 kg/y), Dental mercury amalgam fillings (2316 kg/y) and biomass fired power and heat production (2,273 kg/y).

The origin of mercury in waste and waste water produced in the country is mercury in-products. Waste fractions and waste water do therefore not represent original mercury inputs to society (except imported waste). Waste and waste water may however represent substantial flows of mercury through society. The following were found to be the major flows of mercury with waste water system/treatment (22,937 kg/y), informal waste burning (9930 kg/y) andinformal dumping of general waste (21,909 kg/y).

Detailed presentation of mercury inputs and releases for all mercury release source types present in the country are shown in the following report sections. The UNEP Toolkit spreadsheet used for the development of this inventory is annexed with this report. Major point sources of mercury releases identified are listed in each of the relevant source-sub category sections below.

Data gaps and recommendations for follow-up

The report is drawn on the basis of field surveys, questionnaires, answers of respondents, data from the available local sources, industries, government authorities, consulting international literature on mercury-containing materials and UNEP Toolkit. The information has been accepted as provided and has not been independently checked. In most of the cases there was lack of data availability on main and sub categories. The data has been utilized with the objective to calculate mercury inventory but it could contain errors because of inadequate information on different source categories. Availability of recent data from secondary sources was not accurate and showing variation from source to source. Field survey also reflects that in some sectors, there was no documentation and information about that specific sector. For instance dental doctors did not maintained record of last 15-20 years. Some respondents were also reluctant to provide information.

Artisanal and Small Scale Gold Mining (ASGM) is a source of mercury pollution in the North Region of the country. Activity level is “more than insignificant” in terms of health effects and number of minors. Different studies on health status of the people of this region have been carried out which manifest the mercury hazardous impacts on humans. The data of this subcategory was not well documented by the authorities concerned because this practice is informal in the country. Activity rate and number of associated people are high but it is not properly known so obtaining data was challenging. International documented data was used to assess the number of minors. Therefore,

there is need to document the data of this informal activity on sound basis and more research along the river and its tributaries and even in fish is necessary to conduct to save the humanity.

Another area which needs necessary attention is consumer products with intentional use of mercury. The production of light sources with mercury take place in the country however, no data of production could be mentioned in this report due to absence of recognized data of this activity. This industry is working on small level even it occurs in local shops. Hence, there is further need to collect information of this industry. Similar case is with the production of electrical switches and relays with mercury in the country. The production of this product occurs but further need is to document this data.

Batteries with mercury are not produced in the country. Data of this imported product is collected from government authorities. Import data is not clear. The HS codes do not distinguish among mercury containing batteries type. Data assessment contains uncertainties. Moreover, biocides and pesticides production, use and disposal all are going on in the country because Pakistan is an agricultural land. The data of activity rate of each could not be gathered. Industrial units of production of biocides and pesticides could not deliver the information that which products are manufactured with mercury. The labeling of products also does not contain such information. Due to these hurdles, this subcategory of mercury releases could not be added in this inventory report.

An area of key importance that needs detailed inventory, and lacks sufficient information, is the issue of mercury in paints (metallic paints might contain mercury while imported road paint certainly does). There are wide varieties of these products being imported and produce into the country, and it is not clear which brands contain mercury. Therefore, it is important to conduct specific analyses on these products. Similarly, production of cosmetics is unclear. The production of cosmetics is happening at household level in some areas of the country which is informal and not documented by the authorities concerned. This subcategory has highest share in mercury release in the country. Subsequently, there is a dire need to document this practice from large industrial units to household level.

Another area which needs further data collection is the production of other recycled metals. Pakistan is an industrialized country and several metals are recycled here. These recycled metals are used for different purposes. The activity rate is mentioned in Pakistan Bureau of Statistics but mercury input factor is not known by any source. Hence, mercury releases from this source is unknown. Additionally, lime production industry is well recognized in the country but data of mercury level use in it is missing. Due to unavailability of input factor this estimation remained unsolved. In terms of waste treatment and recycling, there is lot of unregulated waste disposal sites that were not accounted for during the inventory. This is as a result of the low waste collection rate by the municipal authorities that causes wide spread backyard dumping and open burning.

Default factors were mainly used in this report from the toolkit. Information sources during field visit and reviews of secondary data also lacking information about input factor. The objective of getting progress on mercury inventory need extended support and resources to conduct survey after a complete capacity building package of relevant stakeholder to achieve a full comprehensive inventory on mercury and its releases in order to avoid and fill the above mentioned gaps and having a true estimation for mercury releases in Pakistan.

It is recommended that a capacity building of relevant bodies in Pakistan should be enhanced to enable and bound them to collect data and information on mercury through regulatory measures. This will result in enhanced capacity of institutions to keep record of mercury its release, use/disposal, effects on society, its import, transport, storage, effect on pathways among others.

Table3.1:-Summary of mercury releases, stockpiles, and supply and trade.

Source category	Calculated Hg output, Kg/y							
	Air	Water	Land	By-pro-ducts and impurities	General waste	Sector specific treatment /disposal	Total releases by source category	Percent of total releases* 3*4
5.1: Extraction and use of fuels/energy sources	4,719.1	817.8	-	2,034.7	-	920.4	8,492	6%
5.2: Primary (virgin) metal production	5,568.2	1,155.0	715.0	-	2,437.5	375.0	10,251	7%
5.3: Production of other minerals and materials with mercury impurities	374.4	-	-	118.1	-	118.1	611	0%
5.4: Intentional use of mercury in industrial processes	-	-	-	-	-	-	-	0%
5.5: Consumer products with intentional use of mercury (whole life cycle)	10,118.3	46,820.1	15,307.1	-	13,201.3	-	85,447	61%
5.6: Other intentional product/process use*2	1,334.3	4,948.3	1,218.6	-	4,832.5	3,074.7	15,408	11%
5.7: Production of recycled metals	1.7	2.1	-	-	-	0.1	4	0%
5.8: Waste incineration and burning	10,745.7	-	-	-	-	90.6	10,836	8%
5.9: Waste deposition/landfilling and waste water treatment *3*4	2,190.9	25,034.9	17,527.2	-	93.0	-	44,846	3%
5.10: Crematoria and cemeteries	63.8	-	3,833.4	-	-	-	3,897	3%
SUM OF QUANTIFIED RELEASES*3*4	**35,116**	**55,934**	**21,074**	**2,153**	**20,564**	**4,579**	**139,421**	**100%**

Notes: *1 Includes production of cement, pulp and paper, lime and light weight aggregates. *2 Includes dental amalgam fillings, manometers and gauges, lab chemicals and equipment, Hg use in religious rituals and folklore medicine, and miscellaneous product uses. *3: The estimated quantities include mercury in products which has also been accounted for under each product category. To avoid double counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS. *4: The estimated input and release to water include mercury amounts which have also been accounted for under each source category. To avoid double counting, releases to water from waste water system/treatment have been subtracted automatically in the TOTALS.

3.2.1 Summary of mercury release source types present

A detailed inventory was conducted for finding the mercury release source types in the country. Table 3.2 shows which mercury release sources were identified as present, absent and possible but not positively identified in the country. Only source types positively identified as present are included in the quantitative assessment.

Table3.2:- Identified mercury release sources in the country

[sources present (y), absent (n), and possible but not positively identified (?)]

Toolkit Chapter	Source category	Source presence (Y/N/?)
5.1	**Source category: Extraction and use of fuels/energy sources**	
5.1.1	Coal combustion in power plants	Y
5.1.2.1	Coal combustion in coal fired industrial boilers	?
5.1.2.2	Other coal use	Y
5.1.3	Mineral oils - extraction, refining and use	Y
5.1.4	Natural gas - extraction, refining and use	Y
5.1.5	Other fossil fuels - extraction and use	N
5.1.6	Biomass fired power and heat production	Y
5.1.7	Geothermal power production	N
5.2	**Source category: Primary (virgin) metal production**	
5.2.1	Mercury (primary) extraction and initial processing (a	N
5.2.2	Gold (and silver) extraction with mercury amalgamation processes	Y
5.2.3	Zinc extraction and initial processing	N
5.2.4	Copper extraction and initial processing	N
5.2.5	Lead extraction and initial processing	N
5.2.6	Gold extraction and initial processing by methods other than mercury amalgamation	N
5.2.7	Aluminium extraction and initial processing	Y
5.2.8	Other non-ferrous metals - extraction and processing	N
5.2.9	Primary ferrous metal production	Y
5.3	**Source category: Production of other minerals and materials with mercury impurities**	
5.3.1	Cement production	Y
5.3.2	Pulp and paper production	Y
5.3.3	Production of lime and light weight aggregates	?
5.4	**Source category: Intentional use of mercury in industrial processes**	
5.4.1	Chlor-alkali production with mercury-technology	N

5.4.2	VCM production with mercury catalyst	N
5.4.3	Acetaldehyde production with mercury catalyst	N
5.4.4	Other production of chemicals and polymers with mercury	N
5.5	**Source category: Consumer products with intentional use of mercury**	
5.5.1	Thermometers with mercury	Y
5.5.2	Electrical switches and relays with mercury	Y
5.5.3	Light sources with mercury	Y
5.5.4	Batteries with mercury	Y
5.5.5	Polyurethane with mercury catalysts	Y
5.5.6	Biocides and pesticides with mercury	?
5.5.7	Paints with mercury	?
5.5.6	Pharmaceuticals for human and veterinary uses	?
5.5.9	Cosmetics and related products with mercury	Y
5.6	**Source category: Other intentional product/process use**	
5.6.1	Dental mercury-amalgam fillings (b	Y
5.6.2	Manometers and gauges with mercury	Y
5.6.3	Laboratory chemicals and equipment with mercury	Y
5.6.4	Mercury metal use in religious rituals and folklore medicine	N
5.6.5	Miscellaneous product uses, mercury metal uses, and other sources	N
5.7	**Source category: Production of recycled metals ("secondary" metal production)**	
5.7.1	Production of recycled mercury ("secondary production")	Y
5.7.2	Production of recycled ferrous metals (iron and steel)	N
5.7.3	Production of other recycled metals	Y
5.8	**Source category: Waste incineration*3**	
5.8.1	Incineration of municipal/general waste	N
5.8.2	Incineration of hazardous waste	Y
5.8.3	Incineration of medical waste	Y
5.8.4	Sewage sludge incineration	N
5.8.5	Informal waste burning	Y
5.9	**Source category: Waste deposition/landfilling and waste water treatment**	
5.9.1	Controlled landfills/deposits*3	?
5.9.2	Diffuse disposal under some control	N
5.9.3	Informal local disposal of industrial production waste	?
5.9.4	Informal dumping of general waste	Y
5.9.5	Waste water system/treatment	Y
5.10	**Source category: Crematoria and cemeteries**	
5.10.1	Crematoria/cremation	Y
5.10.2	Cemeteries	Y

3.2.2 Summary of mercury inputs to society

The total mercury inputs to society in the country for the year 2017 was about 139,421 Kg Hg/y. Table 3.3 the largest contribution of mercury releases include; consumer products with intentional use of mercury (61%) including thermometers with mercury, electrical and electronic switches, light

sources with mercury, batteries containing mercury and cosmetics and related products.Other intentional products/process use (11%) includesdental mercury-amalgam fillings, manometers and gauges and laboratory chemicals and equipment. The shareofprimary (virgin) metal production is 7%, the waste incineration and burning 8%, followed by extraction and use of fuels/energy sources 6%.

However other categories, i.e., aluminum extraction and initial processing, primary ferrous metal production, waste deposition/landfilling and waste water treatment (informal dumping of general waste, waste water system/treatment) andcremation and cemeteries (crematoria and cemeteries), each contributes less than 5% of the total mercury input to society.

Table3.3:- Summary of mercury inputs to society

C.No	Source category	Estimated Hg input, Kg Hg/y, by life cycle phase (as relevant)		
		Production phase*1	Use phase	Disposal phase
5.1	Main category - Extraction and use of fuels/energy sources			
5.1.1	Coal combustion in large power plants	-	666	-
5.1.2	Other coal combustion	-	1,121	-
5.1.3	Extraction, refining and use of mineral oil	354	-	-
5.1.4	Extraction, refining and use of natural gas	4,069	8	-
5.1.5	Extraction and use of other fossil fuels	-	-	-
5.1.6	Biomass fired power and heat production	-	2,273	-
5.1.7	Geothermal power production	-	-	-
5.2	Main category - Primary (virgin) metal production			
5.2.1	Primary extraction and processing of mercury	-	-	-
5.2.2	Gold and silver extraction with the mercury-amalgamation process	6,500	-	-
5.2.3	Zinc extraction and initial processing	-	-	-
5.2.4	Copper extraction and initial processing	-	-	-
5.2.5	Lead extraction and initial processing	-	-	-
5.2.6	Gold extraction and initial processing by other processes than mercury amalgamation	-	-	-
5.2.7	Aluminium extraction and initial processing	3,750	-	-
5.2.8	Extraction and processing of other non-ferrous metals	-	-	-
5.2.9	Primary ferrous metal production	1	-	-
5.3	Main category - Production of other minerals and materials with mercury impurities			
5.3.1	Cement production	591	-	-
5.3.2	Pulp and paper production	20	-	-

C.No	Source category	Estimated Hg input, Kg Hg/y, by life cycle phase (as relevant)		
5.3.3	Lime production and light weight aggregate kilns	-	-	-
5.3.4	Others minerals and materials	-	-	-
5.4	**Main category – Intentional use of mercury as an auxiliary material in industrial processes**			
5.4.1	Chlor-alkali production with mercury-technology	-	-	-
5.4.2	VCM (vinyl-chloride-monomer) production with mercury-dichloride ($HgCl_2$) as catalyst	-	-	-
5.4.3	Acetaldehyde production with mercury-sulphate ($HgSO_4$) as catalyst	-	-	-
5.4.4	Other production of chemicals and polymers with mercury compounds as catalysts	-	-	-
5.5	**Main category - Consumer products with intentional use of mercury**			
5.5.1	Thermometers with mercury	-	-	3,379
5.5.2	Electrical and electronic switches, contacts and relays with mercury	-	-	19,600
5.5.3	Light sources with mercury	-	-	1,987
5.5.4	Batteries containing mercury	-	-	8,505
5.5.5	Polyurethane with mercury catalysts	-	-	4,200
5.5.6	Biocides and pesticides	-	-	-
5.5.7	Paints	-	-	-
5.5.8	Pharmaceuticals for human and veterinary uses	-	-	-
5.5.8	Cosmetics and related products	-	-	47,775
5.6	**Main category - Other intentional products/process uses**			
5.6.1	Dental mercury-amalgam fillings	2,316	-	-
5.6.2	Manometers and gauges	-	-	6,093
5.6.3	Laboratory chemicals and equipment	-	-	7,000
5.6.4	Mercury metal use in religious rituals and folklore medicine	-	-	-
5.6.5	Miscellaneous product uses, mercury metal uses and other sources	-	-	-
5.7	**Main category - Production of recycled metals**			
5.7.1	Production of recycled mercury ("secondary production)	4	-	-
5.7.2	Production of recycled ferrous metals (iron and steel)	-	-	-
5.7.3	Production of other recycled metals	-	-	-
5.8	**Main category – Waste incineration**			
5.8.1	Incineration of municipal/ general waste	-	-	-
5.8.2	Incineration of hazardous waste	-	-	771
5.8.3	Incineration of medical waste	-	-	135
5.8.4	Sewage sludge incineration	-	-	-

C.No	Source category	Estimated Hg input, Kg Hg/y, by life cycle phase (as relevant)		
5.8.5	Informal waste burning	-	-	9,930
5.9	**Main category - Waste deposition/landfilling and waste water treatment**			
5.9.1	Controlled landfills/deposits	-	-	-
5.9.2	Diffuse deposition under some control	-	-	-
5.9.3	Informal local deposition of industrial production waste	-	-	-
5.9.4	Informal dumping of general waste	-	-	21,909
5.9.5	Waste water system/treatment	-	-	22,937
5.10	**Main category - Cremation and cemeteries**			
5.10.1	Crematoria	-	-	64
5.10.2	Cemeteries	-	-	3,833

Notes: *1: Production phase includes raw material production.

3.2.3 Summary of mercury releases

A summary of mercury releases from all source categories presented in Table 3.4.

Table3.4:- Summary of calculated Hg output in different environmental compartments

Toolkit Chapter		Source category	Exists (Y/N/?)	Calculated Hg output, Kg/y					
				Air	Water	Land	By-products and impurities	General waste	Sector specific treatment /disposal
5.1	**Source category: Extraction and use of fuels/energy sources**								
	5.1.1	Coal combustion in power plants	Y	167	0	0	0	0.0	500
	5.1.2.1	Coal combustion in coal fired industrial boilers	Y	0	0	0	0	0	0
	5.1.2.2	Other coal use	Y	1121	0	0	0	0	0
	5.1.3	Mineral oils - extraction, refining and use	Y	336	4	0	0	0	14
	5.1.4	Natural gas - extraction, refining and use	Y	822	814	0	2,035	0	407
	5.1.5	Other fossil fuels - extraction and use	N	0	0	0	0	0	0
	5.1.6	Biomass fired power and heat production	Y	2,273	0	0	0	0	0
	5.1.7	Geothermal power production	N	0	0	0	0	0	0
5.2	**Source category: Primary (virgin) metal production**								

	5.2.1	Mercury (primary) extraction and initial processing (a	N	0	0	0	0	0	0
	5.2.2	Gold (and silver) extraction with mercury amalgamation processes	Y	5,005	780	715	0	0	0
	5.2.3	Zinc extraction and initial processing	N	0	0	0	0	0	0
	5.2.4	Copper extraction and initial processing	N	0	0	0	0	0	0
	5.2.5	Lead extraction and initial processing	N	0	0	0	0	0	0
	5.2.6	Gold extraction and initial processing by methods other than mercury amalgamation	N	0	0	0	0	0	0
	5.2.7	Aluminium extraction and initial processing	Y	563	375	0	0	2,438	375
	5.2.8	Other non-ferrous metals - extraction and processing	N	0	0	0	0	0	0
	5.2.9	Primary ferrous metal production	Y	1	0	0	0	0	0
5.3	**Source category: Production of other minerals and materials with mercury impurities**								
	5.3.1	Cement production	Y	354	0	0	118	0	118
	5.3.2	Pulp and paper production	Y	20	0	0	0	0	0
	5.3.3	Production of lime and light weight aggregates	?	0	0	0	0	0	0
5.4	**Source category: Intentional use of mercury in industrial processes**								
	5.4.1	Chlor-alkali production with mercury-technology	N	0	0	0	0	0	0
	5.4.2	VCM production with mercury catalyst	N	0	0	0	0	0	0
	5.4.3	Acetaldehyde production with mercury catalyst	N	0	0	0	0	0	0
	5.4.4	Other production of chemicals and	N	0	0	0	0	0	0

		polymers with mercury							
5.5	Source category: Consumer products with intentional use of mercury								
	5.5.1	Thermometers with mercury	Y	676	1,014	676	-	1,014	0
	5.5.2	Electrical switches and relays with mercury	Y	5,880	0	7,840	-	5,880	0
	5.5.3	Light sources with mercury	Y	596	0	596	-	795	0
	5.5.4	Batteries with mercury	Y	2,126	0	2,126	-	4,253	0
	5.5.5	Polyurethane with mercury catalysts	Y	840	420	1,680	-	1,260	0
	5.5.6	Biocides and pesticides with mercury	?	0	0	0	-	0	0
	5.5.7	Paints with mercury	?	0	0	0	-	0	0
	5.5.6	Pharmaceuticals for human and veterinary uses	?	0	0	0	-	0	0
	5.5.9	Cosmetics and related products with mercury	Y	0	45,386	2,389	-	0	0
5.6	Source category: Other intentional product/process use								
	5.6.1	Dental mercury-amalgam fillings (b	Y	116	810	0	0	695	695
	5.6.2	Manometers and gauges with mercury	Y	1,219	1,828	1219	0	1,828	0
	5.6.3	Laboratory chemicals and equipment with mercury	Y	0	2,310	0	0	2,310	2,380
	5.6.4	Mercury metal use in religious rituals and folklore medicine	N	0	0	0	0	0	0
	5.6.5	Miscellaneous product uses, mercury metal uses, and other sources	N	0	0	0	0	0	0
5.7	Source category: Production of recycled metals ("secondary" metal production)								
	5.7.1	Production of recycled mercury ("secondary production”)	Y	2	2	0	0	0	0
	5.7.2	Production of recycled ferrous metals (iron and steel)	N	0	0	0	0	0	0

	5.7.3	Production of other recycled metals	?	0	0	0	0	0	0
5.8	Source category: Waste incineration*3								
	5.8.1	Incineration of municipal/general waste*1	N	0	0	0	0	0	0
	5.8.2	Incineration of hazardous waste*1	Y	694	0	0	0	0	77
	5.8.3	Incineration of medical waste*1	Y	122	0	0	0	0	14
	5.8.4	Sewage sludge incineration*1	N	0	0	0	0	0	0
	5.8.5	Informal waste burning*1	Y	9,930	0	0	0	0	0
5.9	Source category: Waste deposition/landfilling and waste water treatment								
	5.9.1	Controlled landfills/deposits* 1	?	0	0	0	0	0	0
	5.9.2	Diffuse disposal under some control	N	-	-	-	-	-	-
	5.9.3	Informal local disposal of industrial production waste	?	0	0	0	-	-	-
	5.9.4	Informal dumping of general waste*1*2	Y	2,191	2,191	17,527	-	-	-
	5.9.5	Waste water system/treatment *3	Y	0	22,844	0	0	93	0
5.10	Source category: Crematoria and cemeteries								
	5.10.1	Crematoria/crema tion	Y	64	0	0	-	0	0
	5.10.2	Cemeteries	Y	0	0	3,833	-	0	0
SUM OF QUANTIFIED INPUTS AND RELEASES				**35116**	**55934**	**21074**	**2152**	**20564**	**4579**

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

The key mercury releases here are releases to air (the atmosphere), to water (marine and freshwater bodies, including via waste water systems), to land, to general waste, and to sectors specific waste. An additional output pathway is "by-products and impurities" which designate mercury flows back into the market with by-products and products.

The major cotributors of release of Mercury to atmosphere in terms of sub-categories of source are informal waste burning (9,930 kg/y), electrical switches (5,880 kg/y), gold (and silver) extraction with mercury amalgamation processes (5,005 kg/y), biomass fired power and heat production

(2,273 kg/y), informal dumping of general waste (2,191 kg/y), batteries with mercury (2,126 kg/y), manometer and gauges with mercury (1,219 kg/y) and other coal use (1,121 kg/y).

Similarly, major cotributors of release of Mercury into water in terms of sub-categories of source are cosmetics and related products with mercury (45,386 kg/y), waste water system/treatment (22,844 kg/y), laboratory chemicals and equipment with mercury (2,310 kg/y), informal dumping of general waste (2,191 kg/y).

Wheras, major cotributors of release of Mercury in to land in terms of sub-categories of source are informal dumping of general waste (17,527 kg/y), electrical switches and relays with mercury (7,840 kg/y) > cemeteries (3,833 kg/y) > cosmetics and related products with mercury (2,389 kg/y) > batteries with mercury (2,126 kg/y). The largest contributing sub categories to general waste are electrical switches and relays with mercury (5,880 kg/y),> batteries with mercury (4,253kg/y)>aluminum extraction and initial processing (2,438 kg/y) > laboratory chemicals and equipment with mercury (2,310 kg/y). However, subcategories have fewer shares for sector specific treatment/disposal and by-pro-ducts and impurities.

However, the mercury release to water is high as compared to other releases pathways (Land and air), the source sub-categories that made contribution to water include; cosmetics and related products (81.14%) of the total national mercury releases and emissions; waste water system/treatment (40.84%); laboratory chemicals and equipment with mercury (4.12%) and informal dumping of general waste (3.91%). The contributions of the total mercury emission and releases to various output pathways include 25.18% to air, 15.11% to land and 40.11% to water.

An additional output pathway include; general waste (14.74%), sector specific treatment (3.28%) and byproducts and impurities (1.54%). The general descriptions and definitions of the output pathways is given in Table 3.5.

Table3.5:-Description of the types of results

Calculation result type	Description
Estimated Hg input Kg Hg/y	The standard estimate of the amount of mercury entering this source category with input materials, for example calculated mercury amount in the amount of coal used annually in the country for combustion in large power plants.
Air	Mercury emissions to the atmosphere from point sources and diffuse sources from which mercury may be spread locally or over long distances with air masses; for example from: • Point sources such as coal fired power plants, metal smelter, waste incineration; • Diffuse sources as small scale gold mining, informally burned waste with fluorescent lamps, batteries, thermometers..
Water	Mercury releases to aquatic environments and to waste water systems: Point sources and diffuse sources from which mercury will be spread to marine environments (oceans), and freshwaters (rivers, lakes, etc.). for example releases from: • Wet flue cleaning systems from coal fired power plants; • Industry, households, etc. to aquatic environments; • Surface run-off and leachate from mercury contaminated soil and waste dumps

Calculation result type	Description
Land	Mercury releases to soil, the terrestrial environment: General soil and ground water. For example, releases from: • Solid residues from flue gas cleaning on coal fired power plants used for gravel road construction; • Uncollected waste products dumped or buried informally • Local un-confined releases from industry such as on site hazardous waste storage/burial • Spreading of sewage sludge with mercury content on agricultural land (sludge used as fertilizer) • Application on land, seeds or seedlings of pesticides with mercury compounds
By-products and impurities	By-products that contain mercury, which are sent back into the market and cannot be directly allocated to environmental releases, for example: • Gypsum wallboard produced from solid residues from flue gas cleaning on coal fired power plants. • Sulphuric acid produced from desulphurization of flue gas (flue gas cleaning) in non-ferrous metal plants with mercury trace concentrations • Chlorine and sodium hydroxide produced with mercury-based chlor-alkali technology; with mercury trace concentrations • Metal mercury or calomel as by-product from non-ferrous metal mining (high mercury concentrations)
General waste	General waste: Also called municipal waste in some countries. Typically, household and institution waste where the waste undergoes a general treatment, such as incineration, landfilling or informal dumping or burning. The mercury sources to waste are consumer products with intentional mercury content (batteries, thermometers, fluorescent tubes, etc.) as well as high volume waste like printed paper, plastic, etc., with small trace concentrations of mercury.
Sector specific waste treatment /disposal	Waste from industry and consumers which is collected and treated in separate systems, and in some cases recycled; for example. • Confined deposition of solid residues from flue gas cleaning on coal fired power plants on dedicated sites. • Hazardous industrial waste with high mercury content which is deposited in dedicated, safe sites • Hazardous consumer waste with mercury content, mainly separately collected and safely treated batteries, thermometers, mercury switches, lost teeth with amalgam fillings etc. • Confined deposition of tailings and high volume rock/waste from extraction of non-ferrous metals The country-specific waste treatment/disposal method is described for each sub-category in the detailed report sections below.

3.3 Data and inventory on energy consumption and fuel production

3.3.1 Coal combustion in power plants

The Coal reserves of country is 185,175 million tonnes with province reservoirs shows that Sindh has capacity of 184,623, Baluchistan 217, Punjab 235, KPK 91 and AJK 9 Million tonnes. Pakistan's output of coal is 97% lignite and 3% subbituminous-to-bituminous coals. Coal can cater to the existing and future energy requirement of the country to a great extent.

Federal Government has been playing facilitation role for development of coal sector as per its mandate. Since its inception, Geological Survey of Pakistan (GSP) (attached department of Ministry of Petroleum & Natural Resources) has been working for exploration of mineral resources including coal as a routine job on regular basis. So far, nineteen coalfields have been discovered in the country with total coal resource potential estimated to exceed 186 billion tons; of which more than 185 billion tons are located in Sindh Province and over 175 billion tons in Thar coalfield alone.

All coal based power generation projects including those based on coal (indigenous or imported) are dealt by the Ministry of Water & Power and Private Power & Infrastructure Board (PPIB). As per PPIB six power generation projects based on indigenous coal with cumulative capacity of 4,290 MW are operational and seven power projects based on imported coal with cumulative capacity of 5,201 MW are presently under process at various stages to be completed by 2021. Sahiwal Coal Power Project (1320 MW) Qadarabad, Sahiwal, Port Qasim Coal Power Project (1320 MW) Karachi, Engro Thar Coal Power & Mine Project (660 MW) Thar, China Power Hub Generation Company (Private) Limited (1320 MW) Hub Balochistan, Engro Power Project (227 MW) at Qadirpur, Sindh, Orient Power Project (229 MW) at Balloki, Punjab, Saif Power Project (229 MW) at Sahiwal, Punjab, Sapphire Power Project (225 MW) at Muridke, Punjab are few examples among these coalpower projects.The data of coal consumption in power plants is 4,436,100 t/y provided in Economic Survey of Pakistan (2016-2017). Sub-bituminous (brown) coal (2,825,000t/y) and lignite (brown) coal (1,611,100t/y) are used in the country for power production.

In 2013, the major consumers of coal in the country were the cement sector, which accounted for 58 percent of total coal consumption, and brick kilns, which accounted for 41 percent of total coal consumption. The increase in consumption of coal by cement plants was attributed to transformation of cement plants to coal fuel operations. The exploration for new coal deposits in Pakistan is underway.

According to data of Economic Survey of Pakistan (2016-2017), the activity rate of coal combustion in this subcategory is 7,473,655.3t/y. Other coal combustion is done mostly in brick kilns and cement factories, whereas 10 percent is used in industries and household level. Annual domestic coal production is around 3.5 million tons. About 4-5 million tons of coal is imported per annum to meet the supply and demand gap of coal. Coal is imported mainly from Afghanistan, Australia, Canada, Indonesia, South Africa & U.S.A. and consumed in steel and cement manufacturing and power generation units. According to the information shared by Ministry of Petroleum Natural Resources (2016-2017), coal consumption in brick kilns is 305,800 MT while 2,019,000 MT is used for cement production.

Coal Combustion	Unit	Production	Use			Disposal	Sum of releases to pathway from assessed part of life-cycle
			In power plants (Coal types)		Other combustion		
			Sub-bituminous	Lignite			
Activity rate	t/y	-	2,825,000	1,611,100	7,473,655.3		-
Input factor for phase	g Hg/t	-	0.15	0.15	0.15	-	-
Calculated input to phase	kg Hg/y	-	424	242	1121		
Output distribution factors for phase:							-
- Air		-	0.25	0.25	1	-	-
- Water		-	-	-	-	-	-
- Land		-	-	-	-	-	-
- Products		-	-	-	-		-
- General waste treatment		-	-	-	-	-	-
- Sector specific waste treatment		-	0.75	0.75	-	-	-
Calculated outputs/releases to:							
- Air	kg/y	-	106	60.50	1,121	-	1,287.5
- Water		-	-	-	-	-	-
- Land		-	-	-	-	-	-
- Products		-	-	-	-	-	-
- General waste treatment		-	-	-	-	-	-
- Sector specific waste treatment	kg/y	-	318	181.50	-	-	499.5

3.3.2 Mineral oils - extraction, refining and use

Pakistan mainly depends upon oil and gas resources to fulfill energy requirements. The domestic production of crude oil remained 24.2 million barrels during July-March FY 2017 compared to 24.0 million tones during the corresponding period last year. Indigenous resources of oil are not enough to quench energy thirst of a growing economy. As a result Pakistan has to import large quantity of oil and oil based products from Middle East countries especially from Saudi Arabia. The quantity of crude oil imported remained 5.9 million tones. Transport and power are the two major users of oil. During July-March FY 2017, share of oil consumption in transport increased to 57 from 55 percent during the same period last year while share of oil consumption in power remained 33 percent during July 2017 which was 34 percent during the same period last year mainly because some of inefficient thermal plants remained closed due to overhauling during the period under discussion.

Severalreferences were used to reach to activity rate of all sub categories of this section are derived fromHydrocarbonDevelopment Institute of Pakistan (HDIP), Oil and Gas Development Company Limited (OGDCL) through field surveys and questionnaire approach, Ministry of Energy; Petroleum division and report of Pakistan Economic Survey (2016-2017). All sources have shown; 3,301,500 t/y mineral oil was extracted in year 2016-2017. Mercury Inventory Toolkit Level II was used to estimate the mercury release (11 kg/y) which is polluting the water compartment.

In Pakistan different oil refineries are functional i.e., Pak Arab Refinery, National Refinery Limited, Attock Refinery Ltd, Byco Petroleum Pakistan Limited, Pakistan Refinery Ltd. Khyber Refinery (Pvt)Ltd, Enar Petroleum Refining Facility. A few are under construction. All refineries are refining 27,350,000-ton oil per year. The mercury release from this sub category is 93 kg/y calculated through multiplication with factor 3.4 which is given in mercury Inventory Toolkit Level II.

Heavy oil consumption in Pakistan is occurring both in combustion facilities as well as in other than combustion facilities. Oil combustion facilities are working without any emission control system. There was no data on the actual mercury content of the heavy oil and petroleum coke imported into the country the UNPE's default factor has been considered to calculate the total mercury release from the two sources.

The demand for diesel, gasoil, petroleum, kerosene is high in Pakistan, as they are used majorly for the transport sector, energy generation, fuelling, cooking etc. Transport and power are the two major users of oil. During July-March FY 2017, share of oil consumption in transport increased to 57 from 55 percent during the same period last year while share of oil consumption in power remained 33 percent during July 2017 which was 34 percent during the same period last year mainly because some of inefficient thermal plants remained closed due to overhauling during the period under discussion. Activity rate and mercury input from these subcategories is mentioned in table below. Total mercury release from all subcategories is 417 Kg Hg/y. All subcategories are source of contamination to air (336.25 Kg/y) while extraction and refineries have potential to pollute water channels (0.93 Kg/y) and sector specific waste treatment (13.95 Kg/y).

Mineral oils - extraction, refining and use	Unit	Production		Use						DISPOSAL	Sum of releases to pathway from assessed part of life-cycle
				Heavy oil and petroleum coke		Gasoline, diesel, light fuel oil, kerosene, LPG and other light to medium distillates			Total Hg input form use		
		Extraction	Refining	Other than combustion facilities	Oil combustion facilities	Transport-ation	Residen-tial	Other oil combus-tion facilities			
Activity rate	t/y	3,301,500	27,350,000	7,529,626	5,536,618	14,962,554	77,169	10,522,923	-	-	-
Input factor for phase	mg Hg/t	3.4	3.4	20	20	2	2	2	-	-	-
Calculated input to phase	Kg Hg/y	11	93	151	111	30	0	21	417	-	-
Output distribution factors for phase:											
- Air		-	0.25	1	1	1	1	1	-	-	-
- Water		0.2	0.01	-	-	-	-	-	-	-	-
- Land		-	-	-	-	-	-	-	-	-	-
- Products		-	-	-	-	-	-	-	-	-	-
- General waste treatment		-	-	-	-	-	-	-	-	-	-
- Sector specific waste treatment		-	0.15	-	-	-	-	-	-	-	-
Calculated outputs/releases to:											
- Air	Kg/y	-	23.25	151	111	30	0	21	336.25	-	336.25
- Water	Kg/y	3	0.93	-	-	-	-	-	0.93	-	3.93
- Land		-	-	-	-	-	-	-	-	-	-
- Products		-	-	-	-	-	-	-	-		-
- General waste treatment		-	-	-	-	-	-	-	-	-	-
- Sector specific waste treatment	Kg/y	-	13.95	-	-	-	-	-	13.95	-	13.95

3.3.3 Natural gas - extraction, refining and use

Natural Gas is a clean, safe and efficient fuel source. It contributes about 48 percent of the total primary energy supply mix in the country. Pakistan has an extensive gas network of over 11,538 km transmission, 1,14,982 km distribution and 31,058 services gas pipelines to cater the requirement of more than 7.9 million consumers across the country by providing, about 4 billion cubic feet per day natural gas. The government is pursuing its policies to enhance gas production to meet the increasing demand of energy in the country. The average natural gas consumption in the country is about 3,387 million cubic feet per day, which are 35,006,843,183 per year.

Three references were used to reach to activity rate of gas extraction, refining, and consumption i.e. HDIP (Hydrocarbon Development Institute of Pakistan), OGDCL (Oil and Gas Development Company Limited), Ministry of Energy, Power division and reports of Pakistan Economic Survey 2016-2017. Gas extraction and refining in Pakistan is done without mercury removal. The activity rate of gas production is 40,693,819,392 Nm^3/y which is releasing 4069 Kg Hg/y into different environmental compartments i.e., air (813.88 Kg/y), water (813.88Kg/y), products (2034.69 kg/y) and sector specific treatment (406.94 Kg/y). The activity rate of use of pipeline gas is 38,079,783,936 Nm^3/y and calculated mercury input to phase is 8 Kg Hg/y calculated through using mercury Inventory Toolkit Level II. It is all released into air (3.38 kg/y).

Natural gas - extraction, refining and use	Unit	Production	Use of pipeline gas	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Nm^3/y	40693819392	38,079,783,936	-	-
Input factor for phase	µg Hg/Nm^3	100	0.22	-	-
Calculated input to phase	Kg Hg/y	4,069	8	-	-
Output distribution factors for phase:					-
- Air		0.2	1	-	-
- Water		0.2	-	-	-
- Land		-	-	-	-
- Products		0.5	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		0.1	-	-	-
Calculated outputs/releases to:					
- Air	Kg/y	813.88	8.38	-	822.26
- Water	Kg/y	813.88	-	-	813.88
- Land		-	-	-	-
- Products	Kg/y	2034.69	-	-	2,034.69
- General waste treatment		-	-	-	-
- Sector specific waste treatment	Kg/y	406.94	-	-	406.94

3.3.4 Biomass fired power and heat production

Pakistan's energy sector also derives energy from biomass (firewood, charcoal, crop residues and animal dung). The bulk of national energy consumption is met from biomass sources. As Pakistan

has not yet realized full electrification (only 70%) in the country, the rural areas are highly dependent on biomass for household use including cooking and lighting. In order to tap the potential of electricity generation from the sugar mills in Pakistan, the Government of Pakistan on recommendation of AEDB (Alternative Development Energy Board) announced the framework for power co-generation 2013 (Baggase/Biomass) in 2013. Twenty-Four (24) companies / sugar mills of 817.5 MW cumulative capacities have been issued letter of intent (LOI) from AEDB and are at different stages of project development and will be completed during 2018-19. Based on IEAstatistics, the residential sector was reported as main consumer of energy, predominantly relying on traditional biomass to meet its demand. The use of biomass in industry or power sector is very low yet. It is used at household consumption level. In Pakistan 64 % population rely on biomass. Charcoal is also imported in Pakistan. The data sources for these subcategories were Economic survey of Pakistan 2016-2017 and IEA statistics. 75,427,246 t (dry weight)/y biomass is used in Pakistan. This category has potential to release 2,262.82 Kg/y mercury in air. The calculated activity rate of charcoal combustion through similar sources is 2,262.82 t (dry weight)/y which are also releasing 10.23 kg/y mercury into air.

Biomass fired power and heat production	Unit	Production	Use		Disposal	Sum of releases to pathway from assessed part of life-cycle
			Use of biomass	Charcoal combustion		
Activity rate	t (dry weight)/y	-	75,427,246	85,279	-	-
Input factor for phase	g Hg/t(dry weight)	-	0.03	0.12	-	-
Calculated input to phase	Kg Hg/y	-	2263	10		-
Output distribution factors for phase:						
- Air		-	1	1	-	-
- Water		-	-	-	-	-
- Land		-	-	-		-
- Products		-	-	-	-	-
- General waste treatment		-	-	-	-	-
- Sector specific waste treatment		-			-	-
Calculated outputs/releases to:			-			
- Air	Kg/y	-	2,262.82	10.23	-	2,273.05
- Water		-	-	-	-	-
- Land			-	-	-	
- Products		-	-	-		-
- General waste treatment		-	-	-	-	-
- Sector specific waste treatment		-	-	-	-	-

3.4 Data and inventory on domestic production of metals and raw materials

3.4.1 Gold (and silver) extraction with mercury amalgamation processes

The global anthropogenic release of mercury to the environment comes from many sources, of which artisanal and small-scale gold mining (ASGM) is the biggest polluter, closely followed by the burning of coal. The gold washing / panning is a centuries-old profession in Indus and it's all tributary rivers and streams in Gilgit- Baltistan (GB) - area of Pakistan. The gold particles shed from mountains to basin with sand and soil erosion.

During an interview with the local gold washers in Diamer area of GB, MerajAlam told that gold is present in the rivers of GB as a natural treasure. He added that thousands of families are associated with this trade since many decades and these families roam the river banks in search of gold across the region when flow in the rivers decreased in winter season.

The gold washing is a tribal/ family profession of a community of gold washers locally known as "Soniwal." Whole families including children and women are involved in gold washing process from the months (October-June) when the flow of river is at low level. The gold washers collect panned concentrates from around big boulders and dry sites along the banks of rivers and river beds for gold extraction.

Families of the Soniwal tribe could be seen camped at river banks in different areas of GB, staying there through winter collecting gold and earn a livelihood by collecting gold specks from the sand accumulated along river banks and selling them to jewelers in Cities.The Gold washers are marginalized community with very low socio economic indicators. The poverty remains through generations as a vicious cycle. The nomadic life of the community does not allow them to access to education and health. The community possesses no assets like land and capital, nor do other skills, to shift their professions. These gold washers live in their huts along the river banks. The amalgamation process of gold concentrate with mercury and its open burning take place inside the huts on their cooking stoves. Mercury – generally being used for this panning - is easily available in the local markets to buy without any restrictions.



Figure 3.1: ASGM group in Rahimabad, District Gilgit (source: GB- EPA)

Previous researches, interviews and data collected from the field by GB Environmental Protection Agency and the Ministry of Climate Change, Pakistan shows that each family generate a minimum of 100g gold/ year and there are 1500 families reported on the bank of two rivers (Hunza and Gilgit) in GB only who are actively involved in this gold panning practice. Under MIA project, a data inventory consultant hired for GB collected the activity rate and Hg input factor for 12 accessible ASGM sites. A report (Table 3.6) presented bythe international institute for sustainable development "Global Trends in Artisanal and Small-Scale Mining (ASM): A review of key numbers and issues" have mentioned that in 2014, 450,000 miners were associated with this profession in Pakistan while another study (Stackling et al., 2017) claimed association of more than 500,000 people with this profession in 2017. Keeping in view the above representative data with a conservative approach, if a family of 10 people generates 100g of gold/ year then, 500,000 people are getting 5,000 kg of gold in a year through this practice in Pakistan.

Gold (and silver) extraction with mercury amalgamation processes (From Concentrate)	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Kg/y	5,000	-	-	-
Input factor for phase	kg Hg/kg	1.3	-	-	-
Calculated input to phase	Kg Hg/y	6,500	-	-	-
Output distribution factors for phase:					
- Air		0.77	-	-	-
- Water		0.12		-	-
- Land		0.11	-	-	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-

Gold (and silver) extraction with mercury amalgamation processes (From Concentrate)	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
- Sector specific waste treatment		-	-	-	-
Calculated outputs/releases to:					
- Air	Kg/y	5,005	-	-	5,005
- Water	Kg/y	780	-	-	780
- Land	Kg/y	715	-	-	715
- Products		-		-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		-	-	-	-

A report published by the international institute for sustainable development "Global Trends in Artisanal and Small-Scale Mining (ASM): A review of key numbers and issues" have mentioned countries where ASGM activity involved at least 200,000 miners in 2014 (Table 3.6). This study showed Pakistan is among the top of the list in the world where 450,000 minors are associated with ASGM sector.

Table 3.6: Countries with 200,000–500,000 ASGM operators, 2014

Brazil	467,500	Philippines	325,000
Ethipoia	450,000	Sierra Leone	300,000
Pakistan	450,000	Guinea	250,000
Madagascar	450,000	Mozambique	200,000
Zimbabwe	450,000	Uganda	200,000
Colombia	385,500	Angola	200,000
Niger	365,000		

Several researches have been conducted in Pakistan regarding health status of ASGM minors and other indirectly exposed population. Results had proved that the contamination of Hg occurred in biological samples of miners have caused several health problems in them (Fig 3.2). Further, GB EPA had conducted assessment of drinking water quality all across GB and found high mercury contamination (above permissible limits of 0.001mg/l) in drinking water of GB. Ministry of Climate Change - under MIA project – analyzed samples of river water and sediments from 25 ASGM sites. It was found that mercury contamination level was above the drinking water quality standards in water samples of 20 sites while 7 samples of sediments also contained high mercury level above Canadian guideline value of 160 ppb.

Complaints	%age
slow growth was observed in children of the occupational	67-71
chest pain	57-67
skin rashes	38-48
kidney diseases	30-56
sensory problems	28-31
individuals (both male and females workers) complained of tiredness and headache	23-67
cough and sputum	22-31
palpitation	21-28
cognitive impairment	20-45
disturbance in smell and taste	12-16
tremor	9-16



Figure 3.2 Occupational health hazards of mercury
Source: Ali Ahmad Jan Director, Sustainable Solutions 2013

Source: Ministry of Climate Change, Government of Pakistan

However, in Pakistan artisanal and small-scale gold mining (ASGM) is not happening at a larger scale. But above-mentioned reports and research data about number of minors and their poor health status manifest that Pakistan need to take pragmatic steps to save the human health from the hazardous impacts of mercury contamination from ASGM practices. Preparation and implementation of National action plan is necessary to address this chronic problem. However, currently NAP process has not been started by the country.

3.4.2 Alumina production from bauxite

High-Alumina bauxite deposits, categorized as “commercial bauxite” mainly occur in the following areas of Pakistan High-Alumina bauxite deposits, categorized as “commercial bauxite” mainly occur in the following areas of Pakistan.Aluminium is third most abundant element (after oxygen and silicon) and it is the most abundant metal in the Earth’s crust. It makes up about 8 percent by weight of the Earth’s solid surface. High-Alumina bauxite deposits, categorized as “commercial bauxite” mainly occur in the following areas of Pakistan (Fahad et al., 2009).

a) Katha-Pail Deposits (> 100 m.t) which contains 35.5-72.5% alumina, 8.68- 50% silica and 10-20% iron along with boehmite and kaolinite and trace amount of diaspore and gibbsite.
b) Chhoi-Akhori Deposits (46.5 m.t) which contains 32-76% Al2O3, 2.5-43% SiO2, 0.25-12% Fe2O3 and 2.2 - 4.2% TiO2.
c) Bauxite deposits have also been reported in Muzaffarabad-Kotli, BandiKapla-KhanpurHazara, Margalla Hills (0.86 m.t) and Attock Surge area (0.25 m.t).

The industry of Pakistan is considered to be rapidly emerging as a front runner in production level and consumption level of aluminum. Generally, aluminum is used for cooking equipment, aero planes, vehicles, power lines, etc. Pakistan is a developing country and the construction industry is slowly and steadily growing. The political scenario settling is also attracting higher levels of local and foreign investments. According to the information gathered from various industrial manufacturers through conducting survey and questionnaires, Economic Survey 2016-2017, Pakistan Bureau of Statistics revealed that the consumption of aluminum saw an average annual increase of 6.2% from year 2012-2017. Furthermore, this demand is growing up by 6.2% each year. Total bauxite used foraluminum production was7.5 mil t/y in 2016. This subcategory has a potential

to contaminate the air (562.50 kg/y), water (375 kg/y), general waste treatment (2,437 kg/y) and sector specific treatment (375 kg/y) which was calculated through using output distribution factors mentioned in UNEP Toolkit Inventory Level II.

Alumina production from bauxite	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Bauxite used, t/y	7,500,000	-		-
Input factor for phase	g Hg/t bauxite	0.5	-		-
Calculated input to phase	Kg Hg/y	3,750	-		-
Output distribution factors for phase:			-		-
- Air		0.15	-	-	-
- Water		0.1	-	-	-
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment		0.65	-	-	-
- Sector specific waste treatment		0.1	-	-	-
Calculated outputs/releases to:				-	
- Air	Kg/y	562.50	-	-	562.50
- Water	Kg/y	375.00	-	-	375.00
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment	Kg/y	2,437.50	-	-	2,437.50
- Sector specific waste treatment	Kg/y	375	-	-	375

3.4.3 Primary ferrous metal production

Pakistan's steel industry comprises a complete and a closely intertwined value chain – from pig iron furnaces to downstream sectors and end-user industries. However, steel production has not been very stable in the country. Part of the reason for this lack of dynamism is that the steel industry is extremely fragmented: there are at least 600 players in the industry, with no clear leaders that are able to provide vision and direction. Moreover, Pakistan's steel industry is characterized by small plants, most of which are utilizing obsolete technology. In particular, most melting, re-rolling and fabricating firms have small-size plants compared to their competitors in steel exporting countries. Similarly, the use of outdated (and energy inefficient) technology raises these firms' cost of production and results in output with low quality and varying standards. According to data of state bank of Pakistan and economic survey 2015-2016 the pig iron production activity rate was15000 t/y. The calculated mercury input to phase (1 Kg Hg/y) is going to air and sector specific waste treatment.

Primary ferrous metal production	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t/y	15,000	-	-	-
Input factor for phase	g Hg/t	0.05	-	-	-
Calculated input to phase	Kg Hg/y	1	-	-	-
Output distribution factors for phase:					
- Air		0.95	-	-	-
- Water		-	-	-	-
- Land		-	-	-	-
- Products		-	-		-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		0.05	-	-	-
Calculated outputs/releases to:					
- Air	Kg/y	0.71	-	-	0.71
- Water		-		-	-
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment	Kg/y	0.04	-	-	0.04

3.5 Data and inventory on production of other minerals and materials with mercury impurities

3.5.1 Cement production without co-incineration of waste

The country ranks amongst the top 5 exporters and 14th largest cement producer in the world. However, per capita cement consumption at 140kg is on the lower side as compared to most regional peers. Approximately 25 cement plants in Pakistan contribute billion of rupees to the national exchequer. Among them 12 in Punjab, 4 in Sindh, 7 in KPK and 2 in Baluchistan cement plants are working. All have installed filters with simple particle control (ESP / PS / FF) technology. Cement production is done without co-incineration of waste. Two types of fossil fuels are used for the cement production i.e. hard coal (anthracite, bituminous or coking coal) and natural gas. Data for inventory was collected through field visits to APCMA (All Pakistan Cement Manufacturer Association). An interview of vice chairman of the association revealed that99.7% of cement (36,910,934 ton) is produced by coal burning and remaining 111,066 ton of cement is produced by natural gas in year 2016. Output of mercury in air and product due to cement production through coal was found 591kgsby using mercury Inventory Toolkit Level II.

Cement production /without co-incineration of waste	Unit	Fossil fuels use in production		Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
		Hard coal	Natural gas			
Activity rate	t/y	36,910,934	111,066		-	-
Input factor for phase	g Hg/ t	0.016	0.00002		-	-
Calculated input to phase	Kg Hg/y	591	- 0		-	-
Output distribution factors for phase:						
- Air		0.6	0.7	-	-	-
- Water		-	-	-	-	-
- Land		-	-	-	-	-
- Products		0.2	0.3	-	-	-
- General waste treatment		-	-	-	-	-
- Sector specific waste treatment		0.2	0	-	-	-
Calculated outputs/releases to:					-	
- Air	Kg/y	354.34	0	-	-	354.34
- Water		-	-	-	-	-
- Land		-	-	-	-	-
- Products	Kg/y	118.11	0	-	-	118.11
- General waste treatment		-	-	-	-	-
- Sector specific waste treatment	Kg/y	118.11	0	-	-	118.11

3.5.2 Pulp and paper production

The production of paper is a very energy-intensive process, and requires a combination of electricity and steam. Energy is required to compress air, process pulp, and dry paper. Most of this energy is consumed in the drying process, which requires a steady flow of steam. In Pakistan, natural gas was the main fuel source for generating steam; its shortage has forced many manufacturers to shift to alternative sources recently. For instance, a large number of pulp manufacturers (e.g. Premiere Paper Mills), are using bio-mass run boilers (mainly wheat straw, kai grass and bagasse) to drain extra moisture from the paper , while Century Papers – one of the largest paper manufacturers in the country, has recently installed a coal/bio-mass run boiler. Pakistan forest area is only 2.2% of total country's land area , which indicates the limitation of forest resources for the use of raw material for the production of pulp, hence agricultural based raw materials i.e. wheat straw, rice straw, bagasse and cotton linter comprise the main raw materials (46%) along with waste paper (29%) and about 10% of imported pulp . Neutral SulphiteSemiChemical (NSSC) process is used for pulp production in Pakistan as it is considered as the most suitable method for agricultural raw materials. The contribution of different types of energy sources used in Pakistan's paper sector is natural gas 60%, biomass 25%, 13% electricity and 2% of other energy source.

Inventory team calculated the production data of this subcategory through two sources: by visited to Pakistan Pulp Paper and Board Mills Association and Economic Survey of Pakistan (2016-2017). The field visits to few paper plants were also conducted and all plants were working without any installed filters. Total 668500 t/y pulp and paper of all types is produced in year 2016-2017 in the country. This source subcategory is responsible for 20.055 Kg/y mercury release into air calculated through Inventory Toolkit Level II.

Pulp and Paper production	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Biomass, t/y	668,500	-	-	-
Input factor for phase	g Hg/t biomass	0.03	-	-	-
Calculated input to phase	Kg Hg/y	20.055	-	-	-
Output distribution factors for phase:				-	
- Air		1	-	-	-
- Water		-	-	-	-
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		-	-	-	-
Calculated outputs/releases to:				-	-
- Air	Kg/y	20.06	-	-	20.06
- Water		-	-	-	-
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		-	-	-	-

3.6 Data and inventory on consumer products with intentional use of mercury

3.6.1 Use and disposal of thermometers with mercury

In a mercury thermometer, a glass tube is filled with mercury and a standard temperature scale is marked on the tube. With changes in temperature, the mercury expands and contracts and the temperature can be read from the scale. Mercury thermometers can be used to determine body, liquid, and vapor temperature. Mercury thermometers are used in households, laboratory experiments, and industrial applications. In Pakistan, mercury thermometers are not produced but these are imported from other countries. Medical, ambient air and industrial all three types of mercury thermometers are used in Pakistan. Medical mercury thermometers are generally used at hospitals and clinics. Inventory team visited rural and urban areas of different provinces to assess the usage of medical thermometer in different hospitals and clinics. After visiting big private and public hospitals along with clinics in each province it was found that 80% were using manual mercury thermometer whereas 20% were using digital ones. The data of number of hospitals is given in economic survey (2016-2017) of Pakistan. Information from field visits and economic

survey was used to assess the total number of mercury medical thermometers use and their disposal in Pakistan. According to information obtained during field visit that mercury from broken thermometers spilled on the floor is simply washed out with water. The findings of inventory teams revealed that 1,394,148 medical thermometers were used in year 2016-2017. Through using Inventory Toolkit Level II, mercury release (1394 Kg/y) into air, water, land and general waste treatment from medical thermometers was derived.

Similarly, ambient air temperature thermometers, industrial and special application thermometers are also used in Pakistan. The industrial thermometers are used for different industrial purposes like in power plants and piping, chemical tanks, heating and cooling equipment, breweries, canneries, bakeries, candy making dairies, ships, wineries and distilleries and paint kettles. Exact data of number of imported industrial thermometers is not given. Mercury inventory team visited the relevant few industrial units and questionnaire conducted about the number of purchased industrial thermometers and their disposal method. Total number of industries (6,417) data was taken from Pakistan Bureau of Statistics. Data of industrial thermometers collected by inventory team through visiting 30 industries was then applied for all relevant industrial units in Pakistan. Almost 19,251 industrial thermometers were purchased by industries in year 2016.The mercury release from this subcategory 1983Kg/y was estimated through using the default factor given in Mercury Inventory Toolkit Level II.

Same methodology was applied for estimating the activity rate of ambient air thermometers. Inventory team visited the environment protection departments, metrological departments and institutions. Environment protection departments have air quality monitoring units which also measure the air temperature. They do not use ambient air thermometers. However, observatories and different regional metrological departments have ambient air thermometers. Metrological departments and environment departments at different universities also use these thermometers for research purpose. Inventory team calculatedthat total 697 ambient air thermometers were purchased in year 2016 by departments concerned. Comparatively to other thermometers, this source is releasing less mercury (2 kg/y) into environment. Thermometers of all categories were collected without any separate collection method and informal waste handling was observed in all places.

Thermometers with mercury	Unit	Production	Use +Disposal			Sum of releases to pathway from assessed part of life-cycle
			Medical	Ambient air	Industrial	
Activity rate	Items/y		1,394,148	697	19,251	-
Input factor for phase	g Hg/item		1	3.5	103	-
Calculated input to phase	Kg Hg/y		1,394	2	1,983	-
Output distribution factors for phase:						
- Air			0.2	0.2	0.2	-
- Water			0.3	0.3	0.3	-
- Land			0.2	0.2	0.2	-
- Products			-	-	-	-
- General waste treatment			0.3	0.3	0.3	-
- Sector specific waste treatment			-	-	-	-

Thermometers with mercury	Unit	Production	Use +Disposal			Sum of releases to pathway from assessed part of life-cycle
			Medical	Ambient air	Industrial	
Calculated outputs/releases to:						
- Air	Kg/y		278.80	0.40	396.60	675.8
- Water	Kg/y		418.20	0.60	594.90	1,013.7
- Land	Kg/y		278.80	0.40	396	675.2
- Products			-	-	-	-
- General waste treatment	Kg/y		418.20	0.60	594.90	1,013.7
- Sector specific waste treatment				-		-

3.6.2 Electrical switches and relays with mercury

Mercury is also part of many electric switches such as displacement/plunger. Electrical switches are produced in country and also imported from other countries like China and Japan. However, production data is not available. Only the use and disposal, activity rate data has been collected on the basis of identification of electricity users. The electrification rate in Pakistan is mentioned in Reference Guide of UNEP Mercury Inventory Toolkit Level II and it is 70 percent. The inhabitant households who are electrified use different kind of switches both in urban and rural areas of Pakistan. The mercury input and releases via switches was quantified using default factors in the Toolkit based on population. Default factor on emission pathways for most of the switches were available on toolkit which helped in calculation of release pathway data.

Around 200,000,000 million people use these kinds of switches and the subsequent hg input was found 19,600 kg/y, whereas the emission and release as output in air land and waste was found 5,880, 7,840 and 5,880 kg hg/y respectively. Informal waste handling of this product is common all over the country.

Electrical switches	Unit	Production	Use + Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Inhabitants	-	200,000,000	-
Input factor for phase	g Hg/(y*inhabitant)	-	0.14	-
Calculated input to phase	Kg Hg/y	-	19,600	-
Output distribution factors for phase:				
- Air		-	0.3	-
- Water		-	-	-
- Land		-	0.4	-
- Products		-	-	-
- General waste treatment		-	0.3	-
- Sector specific waste treatment		-	-	-

Electrical switches	Unit	Production	Use + Disposal	Sum of releases to pathway from assessed part of life-cycle
Calculated outputs/releases to:				
- Air	Kg/y	-	5,880	5,880
- Water		-	-	-
- Land	Kg/y	-	7,840	7,840
- Products		-	-	-
- General waste treatment	Kg/y	-	5,880	5,880
- Sector specific waste treatment		-	-	-

3.6.3 Light sources with mercury

Mercury containing lamps include linear fluorescent tubes, compact fluorescent, high pressure mercury vapour lamps, high pressure sodium lamps and metal halide camps are commonly used in country for indoor or outdoor purposes. The latter three types are grouped as high intensity discharge (HID) lamps. Since the taxes and bills are very heavy therefore people of the country gave priority to use the light saving bulbs. Compact fluorescent lamps are also produce in country but production data is not documented. Mostly this product is imported from China.The inventory team visited the ministry of commerce and FBR (Federal Board of Revenue) department to gather the data of all lights type shipped into country in year 2015-2016. According to the Inventory team findings, around 39,934,337 fluorescent tubes, 81,125,112compact fluorescent lamps, 4,333,022 high pressure mercury lamps, 2,294,000 high pressure sodium lamps and 63,000 mercury halide lamps were imported to the country in year 2015-2016. Since most of the input factor data was not available therefore the default figures guided to calculate input data for this subcategory. The average mercury concentrations were 25, 10, 30, 20, 15, 10 mg hg/item for fluorescent tube; compact fluorescent, high pressure mercury vapour lamps, high pressure sodium lamps and metal halide respectively given in Mercury Inventory Toolkit Level II. The total mercury input from all types of lamp was estimated at 1987 kg/y. There is no recycle facility for these light sources available in the country. All the lights lamps waste goes into open landfills or waste sewage channels of the country.

Light sources with mercury	Unit	Production	Use + Disposal					Sum of releases to pathway from assessed part of life-cycle
			FTs	CFLs	HPMLs	HPSLs	MHLs	
Activity rate	Items/y		39,934,337	81,125,112	4,333,022	2,294,000	63,000	-
Input factor for phase	mg Hg/item		25	10	30	20	25	-
Calculated input to phase	Kg Hg/y		998	811	130	46	2	-

Light sources with mercury	Unit	Production	Use + Disposal					Sum of releases to pathway from assessed part of life-cycle
			FTs	CFLs	HPMLs	HPSLs	MHLs	
Output distribution factors for phase:								
- Air			0.3	0.3	0.3	0.3	0.3	-
- Water			-		-			-
- Land			0.3	0.3	0.3	0.3	0.3	-
- Products			-		-			-
- General waste treatment			0.4	0.4	0.4	0.4	0.4	-
- Sector specific waste treatment			-		-			-
Calculated outputs/releases to:								
- Air	Kg/y		299.40	243.30	39	13.80	0.60	596.1
- Water			-		-			-
- Land	Kg/y		299.40	243.30	39	13.80	0.60	596.1
- Products			-		-			-
- General waste treatment	Kg/y		399.20	324.40	52	18.40	0.80	794.8
- Sector specific waste treatment			-			-	-	-

3.6.4 Batteries with mercury

Primary household batteries in municipal waste have a threat to environment due to presence of heavy metals like mercury. Leaching of mercury due to improper disposing of these batteries poses a serious risk to the human health and the environment, as it can pollute the soil, air and water. Primary batteries Watches, hearing aid devices, calculators, computers, smoke detectors, tape recorders, radiation detection meters, and scientific equipment's etc.are largely imported from China and other countries in Pakistan. After a specific period of time the used batteries are disposed of as waste material. The data of import of all categories of batteries was taken from the Federal Board of Revenue. Inventory undertaken by the inventory team indicates that a total of 2,607 tonnes of batteries were imported into the country in 2016. Mercury content in batteries was assessed through using the default factor of 320, 12, 5, 4, 0.25 (kg Hg/t batteries) mentioned in UNEP Mercury Inventory Toolkit Level II for mercury oxide cell, zinc air button cell, alkaline buttoncell, silver oxide button cell and alkaline other than button cell, the corresponding mercury input rates were 2,880 kg/y, 3,108 kg/y, 1,900 kg/y, 136 kg/yand481 kg/y respectively. The zinc air button cell batteries showed highest contribution of mercury release into environment. Whereas the emission and release of mercury as output in air land and general waste from all kind of batteries were found 2,126 kg/y, 1,698 kg/y and 4,252 kg /y respectively.

There is no treatment mechanism or facilities and dumping regulation for the waste batteries in the country. Bulk of household batteries becomes part of daily municipal waste. Due to toxic nature

and widespread use of batteries, the contamination of mercury has become a significantly environmental problem in the country.

Batteries with mercury	Unit	Production	Use +Disposal					Sum of releases to pathway from assessed part of life-cycle
			Mercury oxide	Zinc-air Button cell	Alkaline Button cell	Silver oxide Button Cell	Alkaline, other than Button cell	
Activity rate	Batteries t/y	-	9	259	380	34	1925	-
Input factor for phase	kg Hg/t batteries	-	320	12	5	4	0.25	-
Calculated input to phase	Kg Hg/y	-	2,880	3,108	1,900	136	481	-
Output distribution factors for phase:								
- Air		-	0.25	0.25	0.25	0.25	0.25	-
- Water		-						-
- Land		-	0.25	0.25	0.25	0.25	0.25	-
- Products		-						-
- General waste treatment		-						-
- Sector specific waste treatment		-	0.5	0.5	0.5	0.5	0.5	-
Calculated outputs/releases to:								
- Air	Kg/y	-	720	777	475	34	120.25	2,126.25
- Water		-	-	-	-	-	-	-
- Land	Kg/y	-	720	777	475	34	120.25	2,126.25
- Products		-	-	-	-	-	-	-
- General waste treatment	Kg/y	-	1,440	1,554	950	68	240.50	4,252.5
- Sector specific waste treatment		-	-	-	-	-	-	-

3.6.5 Polyurethane with mercury catalysts

Polyurethane is a synthetic material that is used in various applications in nearly every field imaginable. It is renowned for its durability and flexibility and can be produced in a number of different forms based on what it will be used for. Everything from airplane wings to tires can be made with polyurethane. In Pakistan case, the production of this product, the level of mercury content and amount in used were not well known. So, polyurethane data was also not available. The activity rate was estimated through using the current population of Pakistan, 200,000,000, in combination with the electrification rate (70 percent) from the Reference Report and Guideline for Inventory Level II. Toolkitis acting as a development indicator. Total activity rate was 20,000,000 inhabitants which was source of emission and release of mercury into air (840 kg/y), water (420 kg/y), land (1,640 kg/y) and general waste treatment (1,260 kg/y).

Polyurethane wih mercury catalyst	Unit	Production	Use+disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Inhabitants	-	200,000,000	-
Input factor for phase	g Hg/(y*inhabitant)		0.03	-
Calculated input to phase	Kg Hg/y	-	4,200	-
Output distribution factors for phase:				
- Air		-	0.2	-
- Water		-	0.1	-
- Land		-	0.4	-
- Products		-		-
- General waste treatment		-	0.3	-
- Sector specific waste treatment		-		-
Calculated outputs/releases to:				
- Air	Kg/y	-	840	840
- Water	Kg/y	-	420	420
- Land	Kg/y	-	1,680	1,620
- Products	-	-	-	-
- General waste treatment	Kg/y	-	1,260	1,260
- Sector specific waste treatment	-	-	-	-

3.6.6 Cosmetics and related products with mercury

This industry is growing in Pakistan unlike other developed countries of the world. In Pakistan, women use cosmetics to hide blemishes, discolored skin and scarring etc. Despite well-known hazards of mercury exposures, mercury contaminated skin whitening products are widely manufactured and available in pharmacies, and cosmetics shops of Pakistan like other regional states. Based on the information compiled through field visits to cosmetics shops and pharmacies of several cities of Pakistan, activity rate was derived. Skin whitening creams and soaps are widely used both in rural and urban areas. Further, the data was also gathered through visit to PCMA (Pakistan Cosmetics Manufacturing Association) and PSQCA (Pakistan Standards and Quality Control Authority. Further, the input factor 15 Kg Hg/t for cosmetics is derived through the research conducted under the project of "Initial Assessment of Minamata Convention in Pakistan", a research on national and international skin whitening creams in Pakistan. It was carried out by the joint efforts of MOCC and SDPI. Mercury analysis of 59 samples was found to be in the range of 0.74 ppm-44,292 ppm with mean value 15000 ppm. The results showed that among 59 samples of SWCs (Skin Whitening Creams) studied only 3 samples contain mercury content below the MCM permissible limit (1ppm) (Afzal et al., 2018). Mean value of the 59 samples was taken for input factor. The derived input factor (15 Kg/t) from country based research was used to calculate the activity rate 3,185 t/y by using Mercury Inventory Toolkit Level II. The mercury releases due to this subcategory goes into water (45,386.25kg/y) and land (2,388.75 kg). The share of this subcategory for mercury release in environment was highest among all sub categories.

Cosmetics and related products with mercury	Unit	Production	Use+ Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t/y	-	3,185	-
Input factor for phase	kg Hg/t	-	15	-
Calculated input to phase	Kg Hg/y	-	47,775	-
Output distribution factors for phase:				
- Air		-	-	-
- Water		-	0.95	-
- Land		-	0.05	-
- Products		-	-	-
- General waste treatment		-	-	-
- Sector specific waste treatment		-	-	-
Calculated outputs/releases to:				
- Air		-	-	-
- Water	Kg/y	-	45,386.25	45,386.25
- Land	Kg/y	-	2,388.75	2,388.75
- Products		-	-	-
- General waste treatment		-	-	-
- Sector specific waste treatment		-	-	-

3.7 Data and inventory on other intentional product/process use

3.7.1 Dental mercury-amalgam fillings, preparations of fillings at dentist clinics

Mercury may be released to air, water, and wastes during the use and disposal of amalgam fillings and the removal of fillings from teeth and releases after the death of a person with fillings in air from cremation and cemeteries. Most of dental clinics of Pakistan are operated by private sector and by public sector in hospitals with less care. According to PMDC (Pakistan Medical and Dental Council) that total RDPs (Registered Dental Practitioner Basic and Specialist) in Pakistan are (23,133+2,166 = 25,299).

Inventory team visited public and private dental clinics of capital cities of each province. These data include response from 50 dental clinics and 60 dental doctors from public and private hospitals. According to field survey by inventory team, most doctors were of the view thata single doctor treats two patients in a week of mercury dental amalgam. Materials used for tooth filling were mercury amalgam, composite and ceramic. Dentist, mostly at public clinics use pure mercury along with a powder mix of the other metals, which are weighed and mixed in the clinic. According to doctor of Punjab Dental Hospital, Lahore, longevity of amalgam teeth is from 6-8 years with failure rates of 5-15% during this period. Data obtained through these field visits could not provide the exact rate of mercury use for dental amalgam fillings all over the country. Further, there was no report or data available on mercury use by percentage, which could enable to calculate the total amount of neither mercury use for tooth fillings nor the emission by media. Nevertheless, to enable for calculation for the release of mercury into the environment, it is assumed that one amalgam filling contains an average amount of mercury with input factor of 0.2g based on UNEP Toolkit data, resulting in calculated mercury consumption equal to 5789 Kg Hg/year in maximum. Activity rate is derived through total number of inhabitants in the country. Dentists per 1000 inhabitants in Pakistan are 0.12 according to Reference Report of Mercury Inventory Toolkit Report. Regarding

mercury releases from dental clinics and dental amalgam use, there was no response from respondents on this challenge. Both solid and suspended amalgam drilling waste was most likely lost directly to the air (115.78 kg/y), water (810.43kg/y), general waste (694.65 kg/y) or sector specific waste treatment (649.65 kg/y) calculated through Mercury Inventory Toolkit Level II.

Dental mercury-amalgam fillings	Unit	Production	Use	Disposal -	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Inhabitants	200,000,000	-	-	-
Input factor for phase	g Hg/(y*inhabitant)	0.2	-	-	-
Calculated input to phase	Kg Hg/y	5,789	-	-	-
Output distribution factors for phase:					
- Air		0.02	-	-	-
- Water		0.14	-	-	-
- Land			-	-	-
- Products			-	-	-
- General waste treatment		0.12	-	-	-
- Sector specific waste treatment		0.12	-	-	-
Calculated outputs/releases to:					-
- Air	Kg/y	115.78	-	-	115.78
- Water	Kg/y	810.43	-	-	810.43
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment	Kg/y	694.65	-	-	694.65
- Sector specific waste treatment	Kg/y	694.65	-	-	694.65

3.7.2 Use and disposal of medical blood pressure gauges

Release of mercury from sphygmomanometers apparatus may take place by breakage or loss of mercury from gauges (to air, water/waste water, soil) during use and during disposal of the mercury after their use (directly to soil or landfill and subsequently to water and air).

Field visits of big and small hospitals in capital cities of each province of the country were conducted to estimate the use of blood pressure apparatus/y in hospitals. The questionnaires were conducted among hospital equipment procurement officials and nurses. In some hospitals, after breakage of apparatus, mercury is refilled by the officials by themselves. The leakage mercury destined without proper disposal. Further, health equipment data gathered through field visits were also verified throughdata given on PMDC (Pakistan Medical and Dental Council) website. Information from all sources reflects that total 76,160 blood pressure apparatuses have been purchased in year 2016 and average life of a blood pressure apparatus is 2-3 years. Among these, 15,000 BP apparatuses were used by private sector hospital and clinics. There was no proper disposal system after its use. Broken and damaged blood pressure apparatus were disposed in medical waste which eventually result in mercury release and emission in air, water, and solid waste. Since no information was

available on the mercury content in different pathways therefore an estimates were made by using the default input factors from the UNEP mercury Inventory Toolkit Level II.

According to this finding the out distribution in air, water, land and general waste was 1,218.56kg hg/y, 1,827.84kg hg/y, 1,218.56kg hg/y and 1,827.84kg hg/y respectively against input value of 80 Kg Hg/y. There was no record of disposal mechanism or data of damaged blood pressure apparatus in sampled facilities. Whereas the calculated HG input for blood pressureapparatus was found 6,093 kg Hg/y.

Manometers and gauges with mercury	Unit	Production	Use+ Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Items/y	-	76,160	-
Input factor for phase	g Hg/item	-	80	-
Calculated input to phase	Kg Hg/y	-	6,093	-
Output distribution factors for phase:				
- Air		-	0.2	-
- Water		-	0.3	-
- Land		-	0.2	-
- Products		-	-	-
- General waste treatment		-	0.3	-
- Sector specific waste treatment		-	-	-
Calculated outputs/releases to:				
- Air	Kg/y	-	1,218.56	1,218.56
- Water	Kg/y	-	1,827.84	1,827.84
- Land	Kg/y	-	1,218.56	1,218.56
- Products		-	-	
- General waste treatment	Kg/y	-	1,827.84	1,827.84
- Sector specific waste treatment		-	-	

3.7.3 Laboratory chemicals and equipment with mercury

Mercury is used in laboratories in instruments, chemicals, reagents, preservatives, and catalysts. Some of this mercury is released to air, primarily through lab vents. However, most of the mercury may be released in wastewater or disposed of as hazardous waste or municipal waste. There was no registered data on the consumption and management of laboratory chemicals and equipment in the country. These are imported into the country. The quantity of imported chemicals and equipment has been estimated using the current population of Pakistan, 200,000,000, in combination with the electrification rate from the Reference Report for Inventory Level II (70 percent) acting as a development indicator. The mercury input estimated for the inventory of chemicals was 1400 kg/y while for equipment 5600 kg/y through using mercury Inventory Level II. The distribution factors for water, general waste and sector specific for both of these sub categories are 0.33, 0.33 and 0.34 respectively. Laboratory chemicals are releasing 462 kg/y mercury into water, 462 Kg/y mercury into general waste and 476 kg/y mercury into sector specific. Similarly, laboratory equipment is discharging 1,848 kg/y mercury into water, 1,848 Kg/y mercury into general waste and 1,904 kg/y mercury into sector specific.

Laboratory chemicals and equipment with mercury	Unit	Production	Use+Disposal		Sum of releases to pathway from assessed part of life-cycle
			Chemical	Equipment	
Activity rate	Inhabitants	-	200,000,000	200,000,000	-
Input factor for phase	g Hg/y*inhabitant	-	0.01	0.04	-
Calculated input to phase	Kg Hg/y	-	1,400	5,600	-
Output distribution factors for phase:					
- Air		-	-	-	-
- Water		-	0.33	0.33	-
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment		-	0.33	0.33	-
- Sector specific waste treatment		-	0.34	0.34	-
Calculated outputs/releases to:					
- Air		-	-	-	
- Water	Kg/y	-	462	1848	2,310
- Land		-	-	-	
- Products		-	-	-	
- General waste treatment	Kg/y	-	462	1848	2,310
- Sector specific waste treatment	Kg/y	-	476	1904	2,380

3.8 Data and inventory on production of recycled metal

In Pakistan recycling of mercury and other metals take place. The activity rate of other recycle metal was noted from statistical year book 2017 and it is 5,475,000 Kg/y but input factor is unknown, so mercury input could not be calculated. Iron & steel are manufactured from scrap with the help of high temperature methods. According to UNEP mercury inventory toolkit mercury may be present in recycled metals due to natural mercury impurities in the original materials as well as presence of mercury contamination originating from anthropogenic use of mercury. Steel production is placed in the country, for example, ship breaking industry at Hub Baluchistan. Further, Pakistan's auto industry is rising sharply but sadly unlike India and other countries, there is no such system of car scrapping and recycling. There is no such law introduced by the government and ministry to scrap the old cars as these are the major source of pollutant in the environment.

3.8.1 Production of recycled mercury ("secondary production")

Many scrap markets for general waste, auto mobile parts scrape, ship furniture scrape, electronic panels scrapes, and scrape of power generators and electronics circuits, current diode, and AC DC connectors exist in the country. Mercury is found in electronic scrape parts including AC & DC contactors in UPS, electric panels, diodes, high energy blubs of industries use, computers circuitsand Merculief switches. Inventory team visited these scrap markets of the provincial capitals and conducted interviews of the persons concerned. Information revealed that mercury is precious in scrape market because the price of mercury 9,000 rupees/kg. Worker of Scrape market

said that the mercury quantity wasvery minute in scape market. 4 kg of mercury wasrecovering from electric scrapes per scrape shop. Mercury was collected by workers by puncturing the electronic scrapes of AC & DC contactors, diodes and high voltage blub. Approximately 4 to 5 kg mercury was collected from E-waste in per shop annually in different market. E-waste worker said, some doctors and dentists buy mercury from them for using it in different purposes.

From all these surveys, calculated total activity rate was 853 mercury recycled kg/y. The mercury releases from this subcategory was 856 Kg/y which is emitted into air (1.71 kg/y) and drain into water (2.06 kg/y) and sector specific waste treatment (0.10 kg/y) calculated through using mercury Inventory Toolkit Level II.

Production of recycled mercury ("secondary production")	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Mercury recycled, kg/y	853	-	-	-
Input factor for phase	kg Hg input/kg total Hg output	1.00452	-	-	-
Calculated input to phase	Kg Hg/y	856.85556	-	-	-
Output distribution factors for phase:			-		
- Air		0.002	-	-	-
- Water		0.0024	-	-	-
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		0.00012	-	-	-
Calculated outputs/releases to:					
- Air	Kg/y	1.71	-	-	1.71
- Water	Kg/y	2.06	-	-	2.06
- Land		-		-	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment	Kg/y	0.10	-	-	0.10

3.9 Data and inventory on incineration of waste

3.9.1 Incineration of hazardous waste

Most industrial processes produce waste, some of which can be hazardous and detrimental to public health and the environment if not managed properly. Hazardous wastes are generated in the production of cosmetics, detergents, pharmaceuticals, household paints and cleaning products, phones, televisions, garden pesticides, computers, gasoline, and even light bulbs. Hazardous wastes can be liquids, solids, contained gases, or sludge. In Pakistan, private and few public companies have made significant progress in recent years to reduce or recycle hazardous wastes from their processes. However, despite their best efforts, still million tons of hazardous waste is generated each year.

Inventory team visited several private and public companies who have installed and functional incinerators with PM reduce, simple ESP, or similar technology for incineration of hazardous waste. The list of the visited companies is:

1) Ali Trade Waste Management, Lahore
2) Alico Waste Expert, Karachi
3) Zephyr Waste Solutions, Karachi
4) Waste Busters, Lahore
5) Trash MASTI, Lahore
6) Environment Management Consultants Islamabad, Pakistan
7) Global Environment Laboratory, Kala Shah Kakoo, Lahore
8) Global Environment Laboratory, Karachi
9) Karachi Municipal Corporation
10) National Cleaner Production Unit

The data collected through the visits of all above mentioned companies showed that 32,120t/y hazardous waste is incinerated. The calculated potential of mercury release into air and sector specific waste treatment by using Inventory Toolkit Level IIwas 771Kg Hg/y.

Incineration of hazardous waste	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Waste incinerated, t/y	-	-	32,120	-
Input factor for phase	g Hg/t waste incinerated	-	-	24	-
Calculated input to phase	Kg Hg/y	-	-	771	-
Output distribution factors for phase:					
- Air		-	-	0.9	-
- Water		-	-	-	-
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		-	-	0.1	-
Calculated outputs/releases to:					
- Air	Kg/y	-	-	693.90	693.90
- Water		-	-	-	-
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-

Incineration of hazardous waste	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
- Sector specific waste treatment	Kg/y	-	-	77.10	77.10

3.9.2 Incineration of medical waste

Medical waste is composed of needles, syringes, glass bottles, glasses, surgical wastes, and other pharmaceutical wastes. Currently, the medical waste is generally reasonably managed in terms of waste classification, collection, storage, and disposal/burning in the country.

According to WHO (World Health Organization) report, hospitals in Pakistan cumulatively generate 250,000 tons of waste every year which is not only harmful to human health but to the environment, and the economy as well. Medical waste which is incinerated (with no control system) is very small; whereas medical waste like syringes plastic bottles glasses are also recycled. A large amount of medical waste is dumped into open landfill or thrown in open sewerages.

Inventory team surveyed 25 public sector hospitals of provincial capitals which have medical incinerators facility. Waste was segregated based on their specification and categorized into: general, bio-medical and hazardous wastes. All medical waste incinerators have PM reduce, simple ESPor similar emission control technology. Data of incinerated medical waste through survey of hospitals was further confirmed by EPA (Environment Protection Agency) Islamabad, medical waste of about 5,629tons/year is burned in incinerators. The input factor for mercury release is 24 g Hg/t mentioned in mercury Inventory Toolkit Level II. The total mercury release into air and sector specific waste treatment was 135 Kg Hg/y.

Incineration of medical waste	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Waste incinerated, t/y	-	-	5,629	-
Input factor for phase	g Hg/t waste		-	24	-
Calculated input to phase	Kg Hg/y	-	-	135	-
Output distribution factors for phase:					
- Air		-	-	0.9	-
- Water		-	-	-	-
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		-	-	0.1	-
Calculated outputs/releases to:					
- Air	Kg/y	-	-	121.50	121.50
- Water		-	-	-	-
- Land		-	-	-	-
- Products		-	-	-	-

Incineration of medical waste	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
- General waste treatment	Kg/y	-	-	-	-
- Sector specific waste treatment		-	-	13.50	13.50

3.9.3 Informal waste burning

Informal waste burning is defined here as waste burning undertaken at informal conditions, in barrels, containers, or on bare land, with no flue gas controls and diffuse spreading of incineration residues on land. If mercury is present in the waste, part of it will be released to air, and part of it will remain in incineration residues (including unburned and semi-degraded waste) with a potential for additional subsequent mercury releases to air, ground water and surface waters. Given the volatility of mercury, it is expected that most of the mercury is released into the air as a result of informal waste incineration. This waste disposal method may pose an immediate risk for the local community in which it takes place, because air emissions (of several potent pollutants) are not controlled and residues may cause contamination of the local ground water.

Pakistan generates about 48.5 million tons of solid waste a year, which has been increasing more than 2 percent annually. Like other developing countries, Pakistan lacks waste management infrastructure, creating serious environmental problems. Most municipal waste is either burned, dumped or buried on vacant lots, threatening the health and welfare of the general population. The Government of Pakistan (GOP) estimates that 87,000 tons of solid waste is generated per day, mostly from major metropolitan areas. Karachi, Pakistan's largest city generates more than 13,500 tons of municipal waste daily. Inventory team visited municipal authorities of provinces and gathered information regarding informal burning through conducted interviews with persons concerned. Based on the estimation made by experts, data showed that 1,986,050 t/y wastes areburned informally in Pakistan. Assessment from World Bank report "waste management; recent developments in Pakistan" in Pakistan and Ministry of Climate Change data also described the similar quantity of informal burning of waste in the country.

The toolkit provides 5 g Hg/t of waste burned for the calculation of the emission from informal burning of waste. In general, the waste management practice very low and the major portion of uncollected waste and the small amount of waste collected and transported in to dump sites are exposed of fire. Mercury released from this practice is 9,930 Kg/y and it becomes the source of air pollution.

Informal waste burning (open fire waste burning on landfills and informally)	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Waste burned, t/y	-	-	1,986,050	-
Input factor for phase	g Hg/t waste	-	-	5	-
Calculated input to phase	Kg Hg/y	-	-	9,930	-
Output distribution factors for phase:					
- Air		-	-	1	-
- Water		-	-	-	-
- Land		-	-	-	-

Informal waste burning (open fire waste burning on landfills and informally)	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		-	-	-	-
Calculated outputs/releases to:					
- Air	Kg/y	-	-	9,930	9,930
- Water		-	-	-	-
- Land		-	-	-	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		-	-	-	-

3.10 Data and inventory on waste deposition/landfilling and waste water treatment

3.10.1 Informal dumping of general waste

In developing countries, informal dumpsites are common, due to the low budget for waste disposal and non-availability of trained manpower. Informal dumping of MSW (Municipal Solid Waste) is a common practice in Pakistan. It also poses serious threat to groundwater resources and soil.Local and municipal governments are responsible for collecting waste throughout most of Pakistan's major cities. About 60-70 percent of solid waste in the cities is collected.

Inventory team visited the capital cities of provinces and recorded different information. They reported that Karachi, Pakistan's largest city, utilizes three sanitary landfill sites, while Lahore, the country's second-largest city, has two. Other major cities plan to build proper landfill sites. In many areas, solid waste is simply informally dumped outside the city limits. Solid waste management capabilities and systems vary by province. In Punjab, Lahore is the only city with a proper solid waste management, treatment, and disposal system, which was outsourced to Turkish companies Albayrak and OzPak. Similar systems are planned for other big Punjab cities. In Sindh, the Asian Development Bank's (ADB) Infrastructure and Service Delivery Reform Program has provided $400 million to the Sindh Cities Improvement Investment Program (SCIP), which aims to improve solid waste management services in 20 secondary cities. In Khyber Pakhtunkhwa, the WSSP (Water and Sanitation Services Peshawar) is planning to build a sanitary landfill. Baluchistan with a population of 6.9 million has no significant infrastructure for the waste management system. Overall informal dumping of waste data collected by all responsibleauthorities revealed that 4,381,794 t/ywaste was informally dumped which releases mercury into air (2,190 kg/y), water(2,190t/y) and land (17,527 kg/y).

Informal dumping of general waste	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Waste dumped, t/y	-	-	4,381,794	-

Informal dumping of general waste	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Input factor for phase	g Hg/t waste	-	-	5	-
Calculated input to phase	Kg Hg/y	-	-	21,909	-
Output distribution factors for phase:					
- Air		-	-	0.1	-
- Water		-	-	0.1	-
- Land		-	-	0.8	-
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		-	-	-	-
Calculated outputs/releases to:					
- Air	Kg/y	-	-	2,190.90	2,190.90
- Water	Kg/y	-	-	2,190.90	2,190.90
- Land	Kg/y	-	-	17,527.18	17,527.18
- Products		-	-	-	-
- General waste treatment		-	-	-	-
- Sector specific waste treatment		-	-	-	-

3.10.2 Waste water system/treatment

Pakistan, once a water-surplus country, is now a water deficit country. Per capita water availability in Pakistan at present is around 865 cubic meters which is likely to go down to 850 cubic meters in 2025.Waste water is produced from different sectors like industry, commercial, urban residential, rural residential and agriculture. In Pakistan, from all sectors, wastewater is either discharged directly to a sewer system, a natural drain or water body, a nearby field or an internal septic tank. Mostly, this wastewater is not treated and none of the cities have any biological treatment process except Islamabad and Karachi, and even these cities treat only a small proportion.

The data of treated and untreated waste water was collected through visiting different institutions PCRWR (Pakistan Council of Research and Water Resources), IRSA (Indus River System Authority), WASA (Water and Sanitation Authority) and waste water treatments plants in Lahore, Karachi and Islamabad. Out of 388 cities of Pakistan, only 8 have wastewater treatment facilities, that too up to primary level. According to the Chairman Pakistan Council of Research in Water Resources (PCRWR), Dr. Muhammad Ashraf, there are three wastewater treatment plants in Islamabad, of which only one is functional. Karachi has two trickling filters, where effluents generally receive screening and sedimentation. Sources in WASA told that the agency has planned a total of six waste water treatment plants for the Punjab provincial metropolis. In Faisalabad, there is a wastewater treatment plant, in which wastewater receives primary treatment. In rural areas, wastewater treatment is nonexistent, leading to pollution of surface and groundwater. Currently, only 4 percent of the domestic and industrial wastewater receives treatment. According to all these sources, 177,177,000m^3/y waste water wasmechanically treated while untreated waste water m^3/y 4,191,823,000 was directly discharged into water bodies.

Waste water system/treatment	Unit	Production	Use	Disposal		Sum of releases to pathway from assessed part of life-cycle
				Treated mechanically	Without treatment/ Released directly	
Activity rate	Waste water m^3/y	-	-	177,177,000	4,191,823,000	-
Input factor for phase	mg Hg/m^3 waste	-	-	5.25	5.25	-
Calculated input to phase	Kg Hg/y	-	-	930	22,007	-
Output distribution factors for phase:						
- Air	-	-	-	-	-	-
- Water	Kg/y	-	-	0.9	1	-
- Land	-	-	-	-	-	-
- Products	-	-	-	-	-	-
- General waste treatment	Kg/y	-	-	0.1	-	-
- Sector specific waste treatment	-	-	-	-	-	-
Calculated outputs/releases to:						
- Air	-	-	-	-	-	-
- Water	Kg/y	-	-	837	22,007	22,844
- Land	-	-	-	-	-	-
- Products	-	-	-	-	-	-
- General waste treatment	Kg/y	-	-	93	-	93
- Sector specific waste treatment	-	-	-	-	-	-

3.11 Data and inventory on crematoria and cemeteries

Pakistan being a Muslim country is a home of Muslims with a few proportions of minorities also. In Pakistan Hindu population is 7.2 percent. Cremation in Hinduism while buried the corpses is compulsory in Islam. Mercury in the human body, primarily from dental amalgam fillings, will be released to the soil at the cemetery or emitted into air after burning the corpse. Data and inventory on crematoria and cemeteries was derived through mortality rate in Pakistan. Mortality rate in Pakistan according to World Health Organization (WHO) report is 7.5. Number of the people buried per year and cremated per year was calculated through methods given below (Table 3.7).

Table 3.7:-Calculation method used to determine the number of buried and cremated per year

Total Muslim population	Death rate	(Total * Death rate) = Buried /year
204,450,128	7.5/1000	1,533,375
Total Hindu population	**Death rate**	**(Total * Death rate) = cremated /year**
3,403,882	7.5/1000	25,529

Input factor 2.5 g Hg/corpse was used to calculate the hg input from this sub category. The Mercury input release by crematoria was 63.8225Kg/y while through cemeteries was 3,833 Kg/y. The output distribution factor for air is 1 (crematoria) and distribution factor forwater is also 1 (cemeteries). Mercury releases to air due to crematories was 63.82 while cemeteries were source of mercury pollution to land (3,833 Kg/y) of the country.

Crematoria and cemeteries	Unit	Production	Use	Disposal		Sum of releases to pathway from assessed part of life-cycle
				Crematoria	Cemeteries	
Activity rate	Corpses cremated or buried/y	-	-	25,529	1,533,375	-
Input factor for phase	g Hg/corpse	-	-	2.5	2.5	-
Calculated input to phase	Kg Hg/y	-	-	63.8225	3,833.4375	-
Output distribution factors for phase:						
- Air		-	-	1	-	-
- Water		-	-	-	-	-
- Land		-	-	-	1	-
- Products		-	-	-	-	-
- General waste treatment		-	-	-	-	-
- Sector specific waste treatment		-	-	-	-	-
Calculated outputs/releases to:						
- Air	Kg/y	-	-	63.82	-	63.82
- Water		-	-	-	-	-
- Land	Kg/y	-	-	-	3,833.44	3,833.44
- Products		-	-	-	-	-
- General waste treatment		-	-	-	-	-
- Sector specific waste treatment		-	-	-	-	-

3.12 Impacts of mercury in human health and the environment

Mercury releases in the environment result mainly from human activity, particularly from coal-fired power stations, residential heating systems, and waste incinerators and as a result of mining for mercury, gold and other metals. Mercury exists in various forms: elemental (or metallic); inorganic (e.g. mercuric chloride); and organic (e.g., methyl- and ethyl mercury), which all have different toxic effects. Once in the environment, elemental mercury is naturally transformed into methylmercury that biomagnifies and bioaccumulates in shellfish, fish and other organisms. Human exposure occurs mainly through inhalation of elemental mercury vapors during industrial processes and through consumption of methylmercury contaminated fish and shellfish.

Mercury is toxic to human health, posing a particular threat to the development of the child in utero and early in life. Mercury vapors can cause damages to central nervous system, thyroid, kidneys, lungs, immune system, eyes, gums and skin. Neurological and behavior disorders include tremors, insomnia, memory and vision problem, neuromuscular effects and headache. Fetus and young children are more vulnerable to the mercury vapors.

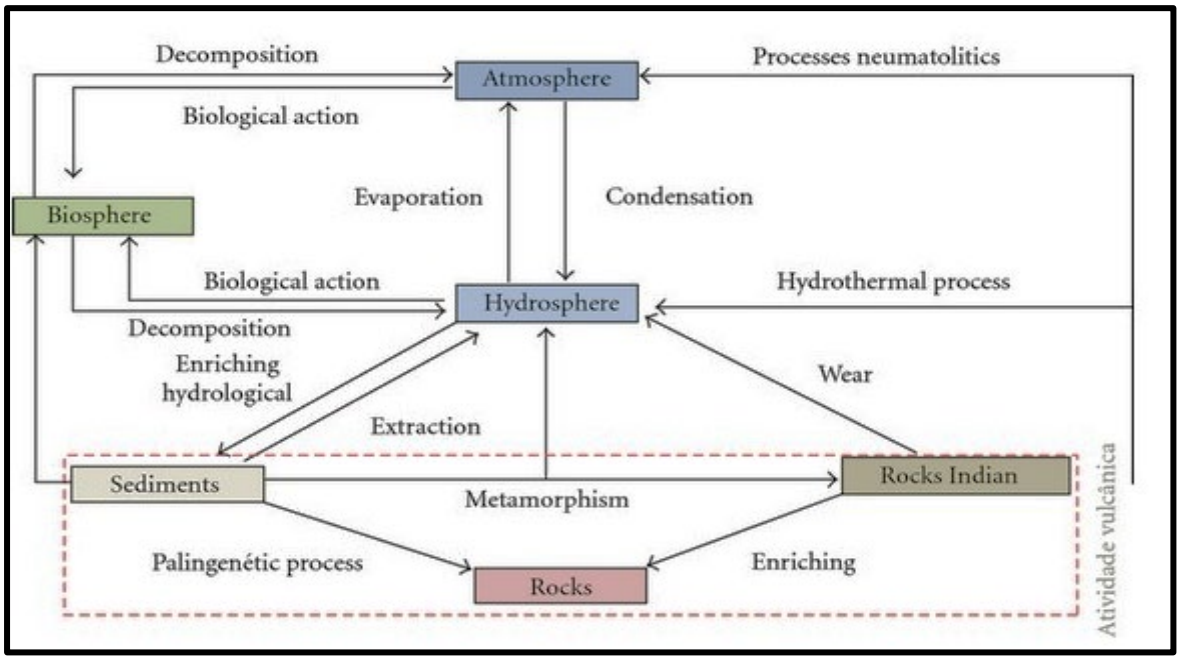


Figure 3.1: Mercury cycle in environment

People of Pakistan have mercury exposure and health impacts are documented through different researches. Mercury used in dental amalgam fillings, cosmetics, batteries, pesticides, lightening sources, medical equipment, thermometers, chemicals and its release into air from coal, oil combustion in different sectors, use of charcoal and ASGM activities, all these practices are occurring in the country. The total mercury release 139,421 kg/y from these subcategories is estimated through mercury Inventory Toolkit Level II. Mercury contamination in environment and several health impacts due to its exposure in Pakistan can also be demonstrated through following researches.

Mercury, the essential constituent of dental amalgam, is also known as quick silver, is a toxic substance of global concern. A persistent pollutant, mercury is not limited to its source but it travels, on time thousands of kilometers away from the source. Mercury poses risks to environment and human health, especially the health of children. Dental amalgam practices in Pakistan are a major source of mercury exposure to dental professional, patients and surrounded community. In dentistry, due to occupational exposure, high mercury concentration in bloods of dentist and dental assistants were analyzed. Moreover, the mercury concentration in all the studied dental wastewater samples, collected from twenty-two dental clinics, was found to be exceeding the recommended discharge limit of 0.01mg/L (Jamil et al., 2016).

Mercury is a toxic, persistent pollutant that bioaccumulates and biomagnifies through food webs. People are exposed to methylmercury mainly through their diet, especially through the consumption of freshwater and marine fish. A study reported mercury concentration in muscle tissues and contribution of the daily intake of Hg, based on the consumption of 250 g fresh fish muscles per day was found greater than WHO permissible limit (Shah et al., 2010). Another study on fish and water samples from Indus River showed higher mercury concentration in both water

and fish samples (Tariq et al., 2017). Hence, fish consumption could be a source of mercury toxicity to the people of Pakistan. Similarly, another food "Chicken" is consumed at massive scale. A research was conducted to measure the mercury level in this food. Mercury in chicken tissues were also found more than permissible limit in different parts i.e., liver, muscles and heart of chicken. The obtained data showed that mercury presence in chicken parts comes from their feed and manure (Shah et al., 2010).

People may be exposed to elemental or inorganic mercury through inhalation of ambient air. The human health risk of mercury exposure via dust particles as well as the proportion of human population that are potentially at risk from Hg contamination was calculated in another study. The results indicated higher concentration of mercury in dust particles and its bioaccumulation in the lower Indus-plain agricultural and industrial areas than the other areas of Pakistan. The highest mercury contamination of dust particles (3000 ppb) and its bioaccumulation (2480 ppb) were observed for the Lahore district, while the highest proportion (40%) of human population was identified to be potentially at risk from Hg contamination from these areas. In general, children were at higher risk of Hg exposure via dust (Eqani et al., 2016).

Occupational exposures in Pakistan can occur where mercury or mercury compounds are produced, used in processes, or incorporated in products. ASGM practice in Pakistan is also "more than insignificant". A study was conducted to investigate the negative impacts of Hg on the human beings involved in gold mining along the three rivers (Gilgit, Hunza and Indus) in the Northern Areas of Pakistan. Biological samples such as blood, urine, hair and nails were obtained from the gold miners including men and women. The results indicated that Hg in all (100%) samples exceeded the permissible limit set by US Environmental Protection Agency, (USEPA, 1997) and World Health Organization, (WHO, 2003). Being a highly toxic metal, Hg exposure has caused diseases in the workers such as inhalation problem, belly and neck pain, skin burn, stunted growth in children, teeth, heart, respiratory, kidney, joints and skin problems (Riaz et al., 2016).

Present inventory shows that maximum mercury releases occur in water bodies. This fact is supported by the research already conducted on surface and ground water quality of KPK, Pakistan. It revealed that there is an increase in the concentrations of heavy metals like mercury and trace elements in surface water and shallow water relative to deep water. This can be due to discharge of effluents from the existing industries and domestic areas into the stream water in the basin (Jabeen et al., 2014). Similarly, another study on country level proved mercury contamination in soils and waste water samples of Pakistan (Abbas et al., 2010). Moreover, a study of mercury contamination in water of industrial areas in KPK (Peshawar region) showed mercury level higher than permissible limit (Ishaq et al., 2013). Irrigation water in Pakistan is also mercury contaminated. It is a source to transfer mercury into irrigated soils and have a threat to plantation which lead to mercury toxicity in humans through bioaccumulation process. This fact in Pakistan is proved through a research study in Karachi area. Irrigated water samples and crops samples were analyzed. Heavy metal concentrations were found to be elevated ions in almost all samples of vegetables, fruits and fodders irrigated in the study area particularly concentrations of Mn, Pb, Hg and Zn, which are well beyond WHO prescribed standard prescribed limits (Farooq et al., 2010).

Exposures to elemental mercury or inorganic mercury forms can also occur due to use of some skin-lightening creams and soaps. Availability of mercury containing cosmetic is proved through different researches. Academia, NGOs (Khwaja et al., 2017) and Ministry of Climate Change (Afzal et al., 2018) had conducted researches to assess the mercury content in skin whitening creams and soaps. Higher mercury content was observed in maximum samples. Mercury presence shows a threat to human health. A total of 80 percent of the respondents had no idea about the presence of mercury in skin whitening creams. Interviews with dermatologist showed several skin problems have been observed among patients due to use of these skin whitening creams.

Environment and people of Pakistan are facing the challenge of mercury pollution. Current inventory data reveals that mercury is released and emitted into different environmental compartments (i.e., air, water and land of Pakistan). Different sectors and anthropogenic activities are responsible for this menace. The fact of mercury presence in human health and environment of Pakistan is also evident from the available national literature and researches on mercury and its impacts in Pakistan. Different research findings from wastewater, drinking water, soils, fish, dust particles, vegetables, and biological samples indicate that in Pakistan, human health and the environment are both under the threat of mercury toxicity.

CHAPTER 4: Identification of populations at risks and gender dimensions

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

Most people have some exposure to elemental, inorganic, or methyl mercury as a result of normal daily activities. Almost all people have at least trace amounts of mercury (that is, methyl mercury) in their tissues. Generally, these low exposures are not likely to cause adverse health effects. However, mercury can cause significant adverse effects on human health if exposure levels exceed established safe levels.

The primary targets for toxicity of mercury and mercury compounds are the nervous system, the kidneys and the cardiovascular system. It is generally accepted that developing organ systems (such as the fetal nervous system) are the most sensitive to toxic effects of mercury. Fetal brain methylmercury levels are higher than in maternal blood (SCAN, 2004), and the developing central nervous system of the fetus is currently regarded as the system of highest concern as it demonstrates the greatest sensitivity (WHO, 2004). It should be noted, however, that in humans the nervous system continues to develop through adolescence. Other systems that may be affected include the respiratory, gastrointestinal, hematologic, immune, and reproductive systems.

Potential population at risk

The major sources of mercury exposure to human population in Pakistan include cosmetics and related products with mercury, artisanal and small-scale gold mining; informal dumping of general waste, waste water system/treatment. Other significant contributing sectors are energy sources, dental amalgam and incineration of medical and hazardous waste. The available researches on mercury contamination in biotic and abiotic samples in the country are summarized in Table 4.1.

4.1.1 Cosmetics and related products with mercury

Exposures to elemental mercury or inorganic mercury forms can also occur due to use of some skin lightening creams and soaps. Mercury containing cosmetic products are frequently used in Pakistan. More than 90 percent of face whitening creams and related cosmetic products were found with mercury contamination in a recent investigation by Ministry of Climate Change (Afzal et al., 2018). Availability of mercury containing cosmetic is also proved through other researches by academia and NGOs (Khwaja et al., 2017). Higher mercury content (0.74 ppm-44,292 ppm) was observed in samples. Mercury presence shows a threat to human health. These face whitening creams and other related cosmetics is an immediate concern for human health. In view of the widespread use of mercury-containing cosmetics in the country it is estimated that about 40% of the population are at some risk to mercury exposure.

4.1.2 Artisanal and Small-scale Gold Mining (ASGM)

Small-scale or artisanal mining, using gold-mercury amalgamation to extract gold from ore is a significant source of exposure for the workers and nearby populations (UNEP, 2002). Miners burn the gold-mercury amalgam to vaporize the mercury and recover the gold; thus the miners and local populations can have high exposure to mercury vapors. For example, mercury concentrations in air as high as 60 mg/m3 have been associated with amalgam burning at a mining site. In addition, metallic mercury wastes are usually dumped into or near water courses. These discharges can lead to elevated methylmercury concentrations in the fish of these water bodies. Consumption of these contaminated fish by community residents can result in the intake of high levels of methylmercury (UNIDO, 2003a, 2003b).

Artisanal and small-scale gold mining (ASGM) industry is not only notorious because bulk of mercury is released in the environment through this method but it also immediately affects the workers exposed to it. Almost 500,000 minors are associated with this occupation in the country.

In country like Pakistan where health and safety has yet not been implemented even in major industries, concerns of this local scale industry have never been addressed. It has been found that workers involved with this occupation are not aware enough to use safety approaches to avoid mercury contamination. Neither those workers are well aware of adverse health effects of mercury.

4.1.3 Medical and hazardous waste incineration

Medical and hazardous waste incinerators are working without installed mercury controlling devices for the proper management of mercury. The target population groups at risk from mercury exposure related to medical and hazardous waste incineration include waste handlers and adjacent population in the country.

4.1.4. Dental amalgam

People may be exposed to elemental or inorganic mercury through inhalation of ambient air during occupational activities and from dental amalgams. Inhalation is the primary route of exposure for elemental mercury. In Pakistan, dental amalgam filling is restricted at federal and some provincial level. However, there is no strict regulation yet developed and implemented regarding the use of mercury in dental amalgam filling. It is a current investigation campaign, mercury containing dental amalgam filling is found to be happening in almost all parts of the country. It releases low levels of mercury in the form of a vapor that can be inhaled and absorbed by the lungs. High levels of mercury vapor exposure are associated with adverse effects in the brain and the kidneys.

Dental amalgam practices in Pakistan are a major source of mercury exposure to dental professional, patients and surrounded community. In dentistry, due to occupational exposure, high mercury concentration in bloods of dentist and dental assistants were analyzed. Moreover, the mercury concentration in all the studied dental wastewater samples, collected from twenty-two dental clinics, was found to be exceeding the recommended discharge limit of 0.01mg/L (Jamil et al., 2016).

4.1.5 Fish consumption

People are exposed to methylmercury mainly through their diet, especially through the consumption of freshwater and marine fish. In Pakistan, fish generally constitute the main diet of both urban and rural populations. A study reported mercury concentration in muscle tissues and contribution of the daily intake of Hg, based on the consumption of 250 g fresh fish muscles per day was found greater than WHO permissible limit (Shah et al., 2010). Another study on fish and water samples from Indus River showed higher mercury concentration in both water and fish samples (Tariq et al., 2017). Hence, fish consumption could be a source of mercury toxicity to the people of Pakistan.

4.1.6 Informal dumping of general waste and waste water system/treatment

Informal dumping of general waste contributes 15.71 percent and waste water system/treatment contributes 16.45 percent of mercury emissions in current mercury inventory in the country. People engaged in the waste sector such as waste scavengers, people who live near dumpsites or downstream dumpsites as they may be exposed to emissions as burning is a common practice in dumpsites or exposed to releases of leachate in the country.

4.1.7 Energy sources

Coal combustion, mineral oil and natural oil extraction, refining and use and biomass fired power and heat production have potential to cause several health impacts due to mercury exposure to

works and accompanying communities. Industry workers from industries that use coal for industrial boilers without scrubbers to mitigate emissions are at risk. Residents who use biomass especially burned it openly within homesteads in the rural areas without emissions stacks and therefore people directly inhaling the smoke in a confined environment.

4.1.8 Medical gauges

Significant exposures to mercury vapours can also occur due to mercury spills in the home (such as due to children playing with mercury, broken thermostats, leaky gas meters, etc.) and in hospitals. During conducting inventory of medical gauges in hospitals, workers told about a common practice of refilling of mercury in blood pressure apparatus after their breakage. Patients and medical occupational workers could be exposed of vaporized mercury through inhalation.

Table 4.1:- List of national studies of mercury assessment in different matrixes

Area	Matrix	Population at risk	Elevated or not	Concentration of total mercury	Reference
Hyderabad	Tissues of broiler chicken	Men, women, children	Yes	2.54–5.54 g/kg (liver), 1.27–3.86 ug/kg (muscles) and 2.13–3.27 ug/kg (heart).	Shah et al., 2010
Karachi, Lahore, Islamabad, Peshawar, Haripur	Skin whitening creams	Women	Yes	0.13-26,500 ppm	Khwaja et al., 2017
Lahore, Karachi, Islamabad, Peshawar	Skin whitening creams	Women	Yes	0.74 ppm-44,292 ppm	Afzal et al., 2018
Swat Valley and Gilgit-Baltistan, Kashmir valley, Lower Himalayan Mountains, Indus Plain-Agriculture, Indus Plain-Industrial	Dust particles & human hairs	Men, women and children at higher risk	Yes	Dust (10-6120 ppb) Hairs (116-5885 ppb)	Eqani et al., 2016
Gold mining along Gilgit, Hunza and Indus	Blood, urine, hairs & nails	Men, women	Yes	Total Hg concentrations in the blood (41 µg/L), plasma (30.8 µg/L,), urine (49.5 µg/L), hair (0.64 µg/kg) and nails (0.46 µg/kg) of male workers. Mercury content in female workers were blood (44.4 µg/L), plasma (36.8 µg/L), urine (41.5 µg/L), hair (1.1 µg/kg) and nails (0.97 µg/kg).	Riaz et al., 2016
Haripur Basin	Drinking water	Women, men, children	No	0.15-0.67 ppm	Jabeen et al., 2014
Karachi	Fish	Women, men, children	Yes	0.721-1.41 mg/kg	Shah et al., 2010

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

4.2.1 Factors justifying a gender-differentiated approach in sound chemicals management

Women, men and children vary in their physiological susceptibility to the effects of exposure to toxic chemicals like mercury. Women may have different susceptibility to the impacts of toxic chemical exposure, e.g. due to differences in physiology and in connection with their reproductive cycles. With generally a higher proportion of body fat, women are also more likely to store more environmental pollutants in their tissues. At particular stages of their lives, such as pregnancy, lactation, and menopause, women's bodies undergo rapid physiological changes that also may change their vulnerability to health damage from toxic chemicals.

In addition, a substantial portion of a woman's chemical burden can be passed on to the unborn child through the placenta, as well as during breast-feeding. For maternal and infant health protection, exposure of girls and women prior to and during childbearing years to chemicals poses risks to the future generations and thus must be minimized to the extent possible.

Children are generally at greater risk of health damage from toxic exposures because their rapid development and dynamic periods of growth (with which chemical exposure can interfere) increases their physiological sensitivity. Fetal exposure at critical times may have harmful effects that do not become evident until in school, at puberty or adulthood. Small children may absorb chemicals more efficiently and excrete them more slowly, resulting in greater body burdens of toxic contaminants. Moreover, children's intake of proportionally greater amounts of these environmental contaminants via water, air and food (relative to body size) further magnifies the risks.

4.2.2 Potential gender dimensions related to mercury management in Pakistan

The 2017 Census of Population and Housing, reported that Pakistan's population stood at 207,774,520 with females accounting for 50.7 percent of the total population and males accounting for 49.3 percent. The census also showed that more males are employed in the formal sector than females. Further, 63 percent of the total population resides in rural areas while 36 percent reside in urban areas. Most of population has mercury exposure through different sectors and mediums. Assessment of potential gender dimensions related to mercury management is necessary to save the people on sound basis.

It has been noted that efforts to ensure sound management of chemicals (SMC) within a context of sustainable development, have important gender dimensions. This is so because men, women, and children are exposed to different kinds of chemicals in varying concentrations. The level of exposure to toxic chemicals as well as the resulting impacts on human health is determined by social as well as biological factors. The source categories with their associated risk of mercury toxicity in context of gender dimension in the country are explained in Table 4.2.

Table 4.2: Assessment of source categories and potential mercury toxicity risk in gender dimensions

Source Category	Sub Category	Vulnerable Gender	Justification
Occupational Exposure	Waste collectors, medical waste incinerator workers and landfill workers	Males	Greater risk of mercury exposure due to waste mercury containing devices.

			Males are highly associated with this profession.
	Dental professionals	Male	Male dentists are more than females.
	Medical professionals	Females	Woman is more likely to be called upon to clean up accidents involving mercury containing equipment such as sphygmomanometers or thermometers.
	Environmental/enforcement officers:	Male & Females	This group is called upon to investigate environmental pollution cases and is generally gender balanced.
	Firemen and first responders to chemical accidents	Males	Mostly males adopt this profession in the country.
	Waste collectors	Males	People mostly male are engaged in the waste sector such as waste scavengers and workers of municipal authorities.
	ASGM workers	Male, Females & Children	Number of male's minors is high but their females and children are more susceptible to mercury contamination through ASGM activities in their living places due to their high physiological acceptance.
Mercury in fish		females & Children	With respect to mercury in fish, the issue is cross gender as both sexes generally eat the same quantities of fish, however the adverse health impacts due to exposure of mercury are more predominant in cases of children, pregnant women and women in child-bearing years.
Household level		, Females & Children	Within households, women and children are more likely to be exposed to mercury

			from broken thermometers, since women primarily use them, especially mothers.
Cosmetics products		Females	The use of skin lightening creams in Pakistan is quite relevant due to prevailing beauty perception, with particular preferences for lighter coloured, unblemished skin among females.
Poor communities/slum areas		Male, Females & Children	People who live near dumping sites or downstream dumpsites as they may be exposed to emissions as burning is a common practice in dumpsites or exposed to releases of leachate.

In summary of Table 4.2, it is clear from the above consideration 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. In the ASGM profession, males, females and children equally are vulnerable to mercury exposure. Inventory results showed that more men are associated with this profession. However, as this activity occurs within their living premises, so their women and children are equally at high risk. Even women and children have high threat due to their more sensitive physiology. Similarly, in the medical profession, both male and females are equally susceptible to mercury contamination. The highest mercury release source in present inventory is cosmetics. Women are a more important target group in regard to mercury in cosmetics. Besides 40 percent people in the country are living below poverty line. Most of people (males, females & children) are forced to live in slum areas. They are at high risk of mercury exposure, leaching from dumped waste in their surroundings. Assessments of these trends are useful when considering training and also education and awareness on safe handling of mercury as they allows for more gender-sensitive communication strategies that can target the sexes differently to achieve maximum benefit.

CHAPTER 5: Awareness/Understanding of Workers and the Public; and Existing Training and Education Opportunities of Target Groups and Professionals

5.1 Situational Analysis

Awareness among the workers and public regarding mercury toxicity can protect them from the harmful impacts of mercury. Exposure of mercury through different sources occurs on daily basis. A worker in coal combustion industries or a dentist at his clinic while doing amalgam fillings of his patient both has a chance to inhale mercury. Similarly, people involve in other occupations like ASGM, waste collection, waste incineration and treatment are at high risk of mercury contact. Ingestion of methyl mercury through fish is another common way of causing mercury toxicity to people. Besides the use of cosmetics products act as a double sword as on the one side they give a mentally satisfaction to their users but on the other side, they damage their health. Use of mercury containing SWCs (>1ppm) cuase several health issues among users. Hence, the use of mercury for its positive results ultimately leads to detrimental effects to environment and people. All this menace can be controlled through different legal and social instruments. Awareness is the most important tool to protect the people from this poison of mercury. The people at occupational and household places can protect themselves through different ways if they are fully aware about the toxic effects of mercury as well as about techniques to keep themselves away from this danger.

In the country, exposure to mercury from environmental sources, such as contaminated fish consumption, cosmetics and dental filling, pose potential health risks to the public. But many are unaware of it because of lack of awareness. National NGO, SDPI (Sustainable and Development Policy Institute) has conducted a detailed survey in different parts of Pakistan and has found through three parallel set that mercury level present in most of the private dental clinics are exceeded from a permissible limit from inside, outside the location and also at corridors of the structure. They told that the irony was that at most of the places even faculty was unaware about Minamata Convention. Another study of SDPI in Islamabad, Peshawar and Rawalpindi, showed that 93% of dentists are still using MDA (Mercury Development Amalgam) due to which a large number of people are at the health risk.

Similarly, awareness among other occupational workers and at household levels is insufficient. The status of lack of awareness is due to several causes. School, colleges, universities and mass media are not playing their constructive role about creating awareness. Role of curriculum of educational programs like in medicine, dentistry, environmental studies and other health and safety degree/diploma programs regarding awareness about mercury health impacts is not sufficient. Workers are not aware about the safety measures that should be taken for the protection of workers like use of personal protective equipment's (PPE), use of mercury in well ventilated areas, removal of all jewelry and watches during work condition, prohibit smoking and eating at work, clean all mercury-containing equipment, self-contained breathing apparatus (SCBA), chemical protective clothing (CPC) while dealing with heated vapor, decontaminate or dispose of clothing contacting liquid mercury. Hence, this kind of training to occupational workers is deficient in the country.

According to a national research team data the workers involved in gold mining and florescent lamp are exposed to Hg. High concentrations of Hg and its species (organic and inorganic) were observed in their biological samples (hair, nail, blood and urine) and in mostly samples it exceeded its permissible limits. The workers do not use any protective clothes and other measures, therefore, suffered with high risk and recorded numerous Hg associated health risk. According to other research study, Hg is present in all analyzed skin whitening creams including local, medicated, and

imported brands and exceeded the permissible limit set by US-EPA and WHO and the Minamata Convention limit of 1ppm. Moreover, Females use mercury for elongation, shining and thickening of hair which may cause skin rashes. Lack of proper awareness regarding this Hg application is a potentialhealth risk.

5.2 Role of Ministry of Climate Change in raising mercury awareness

The wave of robust mercury awareness in the country came in full swing with the execution of project "Minamata Initial Assessment in Pakistan". Under this project Ministry of Climate Change conducted the following activities to raise the awareness among several stakeholders and public.

i. National Inception Workshop
ii. National Training Workshop
iii. Visits to all Provincial Environmental Protection Departments
iv. Visits to industries using mercury in their products and process
v. Awareness workshops in all provinces
vi. Conducted painting, essay writing, speech and quiz competitions among the students of schools, colleges and universities.

Table 5.1:- Workshops and meetings at provincial level about the consequences of mercury usage in different products

Sr. No.	Activity Title	Date & Location	Convened by	Organized by
1	National Inception Workshop For The Project On Development Of Minamata Initial Assessment In Pakistan	19th May, 2016 at Hotel Margala, Islamabad	MoCC, GoP	MoCC, GoP
2	Meeting With The Secretary, Environment, Sports & Youth Affairs, Government Of Baluchistan	14th July, 2016 at Quetta	MoCC, GoP	MoCC, GoP
3	Meeting With The Medical Colleges	15th July, 2016 at Quetta	MoCC, GoP	MoCC, GoP
4	Meeting With The Secretary, Environment & Coastal Development Department, Government Of Sindh	18th July, 2016 at Sindh	MoCC, GoP	MoCC, GoP
5	Meeting With The Representatives Of Electronics Industry In Pakistan	19th July, 2016 at Quetta	MoCC, GoP	MoCC, GoP
6	Meeting with the Additional Secretary, Forest, Environment & Wildlife Department, Government of Khyber Paktunkhwa (KPK), Peshawar	4th August, 2016 at KPK	MoCC, GoP	MoCC, GoP

7	Meeting with the Secretary, Environmental Protection Department, Government of Punjab, Lahore	2nd August, 2016 at Punjab	MoCC, GoP	MoCC, GoP
8	National Training Workshop For The Project On Development Of Minamata Initial Assessment In Pakistan	7th-9th September, 2016 at Hotel Margala, Islamabad	MoCC, GoP	MoCC, GoP
9	Awareness Workshop On Minamata Initial Assessment & Training On Inventory Of Mercury And Mercury Compounds / In-Products In Pakistan Awareness Workshop On Minamata Initial Assessment & Training On Inventory Of Mercury And Mercury Compounds / In-Products In Pakistan	29th December 2016, Pearl Continental, Karachi	MoCC, GoP	Climate Change, Environment and Coastal Development Department, Government of Sindh
10	Awareness Workshop On Minamata Initial Assessment & Training On Inventory Of Mercury And Mercury Compounds / In-Products In Pakistan	19th January 2017, Serena Hotel, Quetta	MoCC, GoP	
11	Awareness Workshop On Minamata Initial Assessment & Training On Inventory Of Mercury And Mercury Compounds / In-Products In Pakistan	31st January 2017, PC Hotel, Muzaffarabad	MoCC, GoP	Environmental Protection Agency Muzaffarabad, Government of AJ&K
12	Awareness Workshop On Minamata Initial Assessment & Training On Inventory Of Mercury And Mercury Compounds / In-Products In Pakistan	2nd March 2017, Pearl Continental Hotel, Lahore	MoCC, GoP	Environmental Protection Department, Government of Punjab, Pakistan
13	Awareness Workshop On Minamata Initial Assessment & Training On	28th March 2017, PC Hotel, Peshawar	MoCC, GoP	Environmental Protection Agency

	Inventory Of Mercury And Mercury Compounds / In-Products In Pakistan			Peshawar, Government of Khyber Pakhtunkhwa,
14	First National Coordination Committee (NCC) Meeting On "Minamata Initial Assessment (MIA) In Pakistan"	9th June, 2017 at Committee Room, MOCC, Islamabad	MoCC, GoP	MoCC, GoP
15	Awareness Workshop On Minamata Initial Assessment & Training On Inventory Of Mercury And Mercury Compounds / In-Products In Pakistan	24th July 2017, Serena Hotel, Gilgit-Baltistan	MoCC, GoP	Environmental Protection Agency GilgitBaltistan, Government of GilgitBaltistan, Pakistan
16	First Meeting Of National Coordination Sub- Committee On Data Inventory Under The Project Titled "Development Of Minamata Initial Assessment In Pakistan"	21st June, 2018 at Grand Ambassador G-5/2, Islamabad	MoCC, GoP	MoCC, GoP
17	Second Meeting Of National Coordination Sub- Committee On Data Inventory Under The Project Titled" Development Of Minamata Initial Assessment In Pakistan"	30thAugust, 2018 at Grand Ambassador G-5/2, Islamabad	MoCC, GoP	MoCC, GoP
18	Mercury Awareness Seminar Under The Project Titled: Development Of Minamata Initial Assessment In Pakistan	5th September, 2018, Hotel Margala, Islamabad	MoCC, GoP	MoCC, GoP
19	Second National Coordination Committee (NCC) Meeting On "Minamata Initial Assessment (MIA) In Pakistan"	6th September, 2018, at Committee Room, MOCC, Islamabad	MoCC, GoP	MoCC, GoP
20	Final Workshop For The Project On The Development Of Minamata Initial Assessment In Pakistan	7th September, 2018, Hotel Margala, Islamabad	MoCC, GoP	MoCC, GoP
21	Final Workshop For The Project On The Development Of Minamata Initial Assessment In Pakistan	7th September, 2018, Hotel Margala, Islamabad	MoCC, GoP	MoCC, GoP

22	Meeting With Representatives From Associations And Industries On The Project Titled "Development Of Minamata Initial Assessment In Pakistan	29th October, 2018, at Committee Room, MoCC, Islamabad	MoCC, GoP	MoCC, GoP

5.2.1 Assessment of key national stakeholders, their roles in mercury management and institutional interest and capacities

In order to identify key national stakeholders and their roles in mercury management, the Ministry of Climate Change, Pakistan visited all the Provincial Environment Protection Departments (EPDs) as well as mercury using industries, hospitals and universities. In these visits of all the stakeholders from the relevant organization, awareness workshops were organized at all provinces to sensitize the public and stakeholders about the impacts of mercury on health and environment (Table 5.1). In this regard, Ministry of Climate Change, Pakistan convened awareness workshops at all provinces. After the workshops and field visits, potential national key stakeholders for mercury management were identified and the detail of consulted stakeholders is attached in Annex I.

As per project activities, the representatives of the Ministry of Climate Change visited Environment Protection Departments at all provinces as well as mercury using industries and hospitals to analyze the regulatory framework, identify gaps and assess the regulatory reforms needed for the ratification and early implementation of the Minamata Convention in Pakistan. In this regard, MoCC visited to province of Quetta-Balochistan, Karachi-Sindh, Lahore-Punjab, Peshawar (KPK), Gigit-Baltistan and AJK.

5.2.2 Meeting with the Secretary, Environment, Sports & Youth Affairs, Government of Balochistan

The measures under Minamata Convention on mercury include control of the supply and trade of mercury, including limitations on certain specific sources of mercury, such as from primary mining were considered keeping in the view the toxicity of mercury in products such as dental amalgam, skin whitening creams, light bulbs, health sector like thermometers, BP apparatus Etc. in the country. The objective of the Convention and mercury impacts on human health and environment from its emissions and releases from different compounds were discussed in Baluchistan. There was concern about substances producing significant neurological and other effects, with concerns expressed particularly about the effects on unborn children and infants. It was suggested that the Ministry should restrict the import of mercury and mercury compounds. Also emphasized was a need to create awareness in general public and to sensitize dentists about the use of mercury in dental filling. It was stressed for the national strategy on the phase down of the use of mercury and to introduce economical and environment friendly alternatives in health sector especially for dental filling, thermometers and BP apparatus.

5.2.3 Meeting with the Medical Colleges

The Ministry of Climate Change has already taken initiative to phase down the use of mercury in dental filling with the cooperation of Ministry of National Health Services, Regulations and Coordination. The MoCC has forced the dental surgeons as well as dentists to use mercury free alternatives like composites and ceramic in dental filling. In this context, the MoCC has conducted an awareness workshop at provincial level for dentists and other relevant stakeholders in their auditorium at Quetta.

5.2.4 Meeting with the Secretary, Environment & Coastal Development Department, Government of Sindh

The Ministry of Climate Change in collaboration with Environment & Coastal Development had attempted capacity building and awareness of all relevant stakeholders including industries, academia, NGOs etc., at Karachi about the health and environment impacts of mercury and mercury compounds under Minamata Convention on mercury.

5.2.5 Meeting with the representatives of electronics industry in Pakistan

The MOCC discussed about the Minamata Convention on mercury with electronic industry and Philips (one of the leading electronic Industry) and informed that mercury in products will be phased out by 2020 and mercury in processes by 2025 under the obligation of each ratified country. The Philips Pakistan has clarified that they have already closed the manufacturing of products containing since 2011 in Pakistan. Now they are importing CFL approximately one million per month from China. They are also importing LED and incandescent lamps from China. They informed that they are replacing 11-12 % CFL annually. They requested the Ministry for technology transfer regarding environmentally sound disposal of CFL. The electronic industry particularly Philips Pakistan was agreed to develop collection and disposal facility for used/obsolete CFL with the cooperation of Ministry of Climate Change in Pakistan in future.

5.2.6 Consultation with Artisanal and Small- Scale Gold Mining (ASGM) in Gilgit-Baltistan

The Ministry of Climate Change officials with the coordination of EPA, Gilgit visited Artisanal and small- scale gold mining (ASGM) sites at Gilgit-Baltistan and met with ASGM workers to know about the ASGM process and their health issues. The workers were briefed about Minamata Convention, its obligation and adverse health effects of mercury.

5.3 Achievements

- Environmental Protection Department Punjab, Government of KPK, Government of Gilgit-Baltistan, Environment Department, Government of Balochistan , Environment , Climate Change and Coastal Development Government of Sindh with the help of MoCC are working to sensitize the relevant stakeholders about the hazardous impacts of Mercury and its compounds in products in their provinces as it is an important to have a proper baseline, sectoral identification and development of National Mercury Management Plan to sensitize all stakeholders and particularly the masses about environmental and health hazardous of Hg exposure.

- Due to efforts of MoCC, now Pakistan chlor-alkali industry is considered by global industry experts among the most eco-friendly and advanced industries to phase out mercury and adopted the latest energy efficient technology. Pakistan had now become the third country after Japan and India in the world which has completely converted the process of chlor-alkali industry as “green” industry.

- Local manufacturing of CFLs (Khyber Lamps) will phase out mercury based CFL tube lights in their lamps manufacturing and moving towards LED tube lighting. Khyber Electric Lamps being the first manufacturer to introduce local LED lamps in Pakistan by the end of this year.

- The Government of Gilgit-Baltistan has taken varied initiatives to reduce the production and processing of mercury in the province. Moving ahead, the

Government is encouraging Gold Miners to discontinue the use of mercury for gold extraction in the country.

- Research conducted by MoCC to assess mercury content in almost all famous local and international skin whitening creams and highlighted it through media in front of general public and strict actions are taken against their manufactures.
- Raised awareness among the students of schools, colleges and universities through different activities.
- A few glimpses of literature and posters prepared by MoCC during the awareness campaign are revealed below.

AWARENESS WORKSHOP
28th March 2017, PC Hotel, Peshawar







MERCURY AWARENESS CAMPAIGN





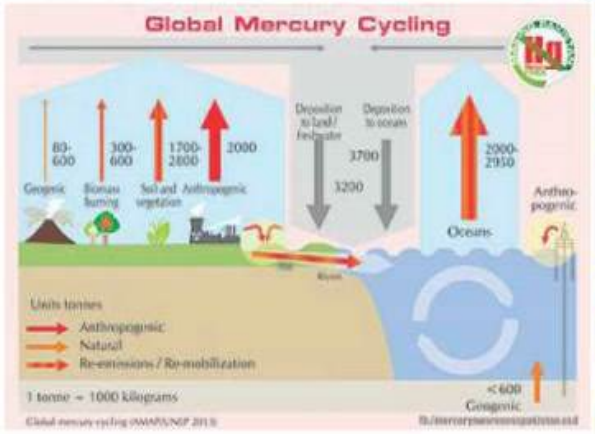








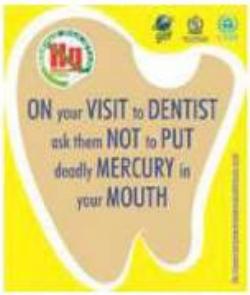


















MERCURY AWARENESS CAMPAIGN



Posters developed, printed and disseminated for public awareness



Information material developed for public awareness



پارہ ایک قدرتی عنصر ہے۔ پارہ اور اس کے مرکبات انسانی
اور جنگلی حیات کی صحت کیلئے انتہائی نقصان دہ ثابت
ہوسکتے ہیں۔ پارہ انتہائی زہریلا عنصر ہے اور یہ دماغ
گردوں اور پھیپھڑوں کو متاثر کرسکتا ہے۔ سب سے زیادہ
خطرہ نوزائیدہ یا چھوٹے بچوں کو ہوتا ہے کیونکہ ان کے
اعصابی نظام نامکمل ہوتے ہیں۔
پارے سے متاثرہ مچھلی کھانے کی وجہ سے بہت سے لوگ
پارے کے زہریلے اثرات کا شکار ہوچکے ہیں۔
ٹوٹے ہوئے تھرمامیٹر اور اسی طرح کی دیگر اشیاء سے
ماحول میں شامل ہونے والا پارہ بالآخر پانی میں شامل ہوکر
مچھلیوں اور جنگلی حیات کو آلودہ کررہا ہے۔

پارے کی حامل اشیاء کے عمومی متبادل

متبادل	تفصیل
دانتوں کا بھرنا	چاندی کا بھرنا
تھرمامیٹر	ڈیجیٹل یا الکحل والا تھرمامیٹر استعمال کریں
بلڈ پریشر کا آلہ	الکحل والا آلہ استعمال کریں
ٹیوبز	کم توانائی والے بلب (CFL) یا ایل ای ڈی بلب استعمال کریں
بیٹریوں میں پائے جانے والے کیمیکل سیسہ	خام لوہے یا سیسہ سے پاک بیٹریاں استعمال کریں
پارے سے چلنے والے پمپ	الکحل سے چلنے والے پمپ استعمال کریں
فلورسنٹ بلب	کم توانائی والے بلب استعمال کریں
کمپیوٹر مانیٹر	ایل سی ڈی یا ایل ای ڈی مانیٹر استعمال کریں
فلورسنٹ بلب (ٹیوبز)	کم توانائی والے بلب استعمال کریں
کمپیوٹر کی سرکٹ بورڈ	ایل ای ڈی یا کمپیوٹر کی سرکٹ بورڈ استعمال کریں
الکحل یا ڈیجیٹل تھرمامیٹر	ایل ای ڈی یا کمپیوٹر کی سرکٹ بورڈ استعمال کریں



5.4 Recommendations for awareness raising

There is a need of reducing public exposure to mercury by creating awareness among masses at all levels, particularly schools, colleges, universities and mass media. There should be an awareness campaign regarding all aspects of mercury to aware the local community as well as illiterate people giving and providing brief introduction , existence, uses, products, health and other hazardous effects caused by mercury and mercury related compounds. Awareness should be disseminating to general public, government officials and industrial stakeholders.

5.4.1 Role of educational institutions

Academic institutions provide an opportunity for several people to be reached and to instill knowledge to many generations. Syllabus of educational programs like in medicine, dentistry, environmental studies and other health and safety degree/diploma programs should have content of mercury and its hazardous impacts. Curriculum of dentistry and dermatology should be reviewed and revised.

5.4.2 Training of Human Resource

Training of human resource at all relevant occupational levels will help in capacity building, effective implementation and enforcement of MCM. Occupational safety and health rules should be applied on the workers to have minimum effects of Hg on their health. For instance, coal combustion is estimated to release almost 7.5 kg Hg/year so mass awareness is required on use of coal and their impacts to the workers.

5.4.3 Role of social media

It is a need of time to utilize media for launching mass awareness programmes on mercury issues. Both print and electronic media should launch the national awareness campaigns in the national and regional languages. Information regarding mercury/heavy metal should be printed or visible on social media/electronic media. Strengthen environmentalist forum of journalists is another dire requirement of time.

5.4.4 Product information

Awareness should be raised to ensure consumers knowledge to warn about health affect by using mercury containing products. Compulsory labeling of contents of mercury should be mentioned on products i.e., skin whitening creams. Similarly, monitoring of mercury and mercury containing products should be carried out in Hospitals/Clinics. The government should bound legally to the food manufacturing and preserving industries to explore, mention and label all the ingredients of food items especially in preserved food items which will recognize the mercury free products.

5.4.5 Role of NGOs

NGOs should play a constructive role in raising awareness among communities. Non-governmental organizations can be instrumental in influencing decision making and raising awareness at grassroots level. NGOs can influence decision makers through advocacy and lobbying hence they should be one of the main stakeholders involved in advocating for implementation of Article 18 of the Minamata Convention. The government through the Department of Environment shall therefore take steps to identify relevant NGOs and include them in the implementation of the Minamata Convention.

5.4.6 Conferences, seminars, workshops, symposium

Conferences, seminars, workshops and symposium should be organized on the hazardous effects of mercury and mercury containing compounds on health and wildlife. Whenever arranging a workshop or seminars give consideration to schools, colleges and educational sectors involvement and it is more effective to arrange these events at these localities so that maximum number of

population get benefit from knowledge and awareness.In the workshops and awareness campaigns there should be special consideration given to municipal and other departments which directly deals with the waste discharge and disposal to aware them about the mercury containing waste and its disposal.

5.4.7 Awareness regarding product disposal

There is a need to manage the “discharge system” or any “collection point “for the waste products like batteries in urban areas which will responsible for batteries discharge or collecting the expired batteries and send them for proper disposal. Proper disposal of waste products should be introduced and open air burning should be restricted. Training of workers and household people regarding such practices must be conducted.

5.4.8 Alternative products

There is an immense need to explore other metals, elements and compounds which have similar positive impact like mercury and can be used as alternative of mercury in products so that the mercury utilization can be minimized by alternatives. There should be an alternate material instead of Mercury amalgam in dental health hygiene. Almost 90% of the total population using mercury containing cosmetics, therefore a proper channel for import of Hg free cosmetics should be introduced.

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ANNEX I:*Stakeholders Engagment Process*

Glimpses of nation-wide awareness workshops



Pictorial glimpses of awareness workshop in Karachi





Pictorial glimpses of awareness workshop in Quetta







Pictorial Glimpses of awareness Workshop Muzaffarabad



Pictorial Glimpse of Awareness Workshop Lahore



Pictorial glimpses of awareness workshop Peshawar



Pictorial Glimpses of Awareness Workshop Gilgit Baltistan

ANNEX II: *Media Coverage of awareness workshops under MIA Project*



Moot calls for developing strategies for safe management of mercury

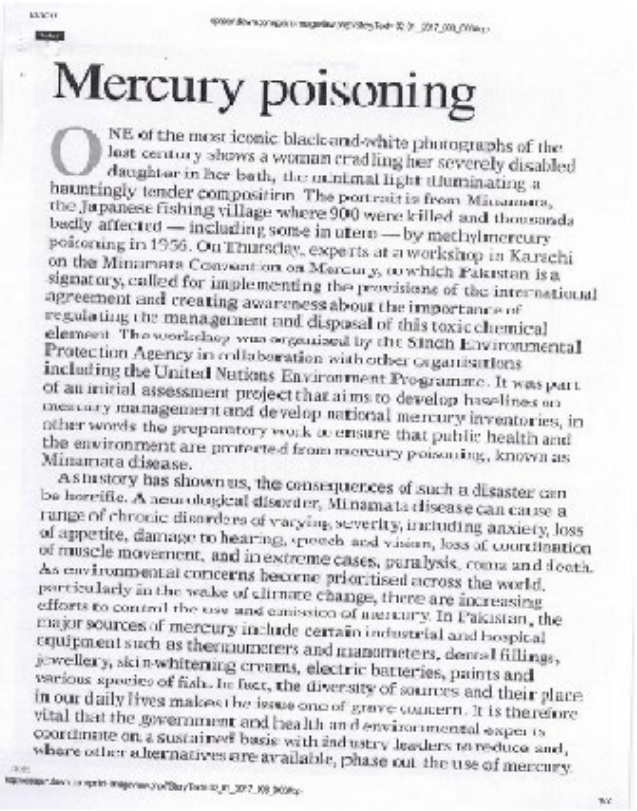
By Our Staff Reporter

KARACHI: Highlighting how mercury exposure can seriously affect humans and wildlife, experts at a workshop held on Thursday underlined the need for creating awareness on regulating the use of the highly toxic chemical element and developing strategies for safe management and disposal of mercury-bearing waste.

The workshop on Minamata Convention on Mercury, to which Pakistan is a signatory, was organised by the Sindh Environmental Protection Agency (Sepa) in detailing the mercury poisoning disaster that occurred in Japan 60 years ago when Minamata Bay got contaminated with mercury following disposal of mercury-bearing waste into the bay on a massive scale by a chemical plant.

The disaster took 1,700 lives and left 2,265 people badly affected who were certified as having directly suffered from mercury poisoning — now known as Minamata disease. The fora, wildlife was also seriously affected.

President of the International Society of Doctors for Environment, Dr Nadeem ul Haque gave a detailed presentation on



Mercury poisoning

ONE of the most iconic black-and-white photographs of the last century shows a woman cradling her severely disabled daughter in her bath, the minimal light illuminating a hauntingly tender composition. The portrait is from Minamata, the Japanese fishing village where 900 were killed and thousands badly affected — including some in utero — by methylmercury poisoning in 1956. On Thursday, experts at a workshop in Karachi on the Minamata Convention on Mercury, to which Pakistan is a signatory, called for implementing the provisions of the international agreement and creating awareness about the importance of regulating the management and disposal of this toxic chemical element. The workshop was organised by the Sindh Environmental Protection Agency in collaboration with other organisations including the United Nations Environment Programme. It was part of an initial assessment project that aims to develop baselines on mercury management and develop national mercury inventories, in other words the preparatory work to ensure that public health and the environment are protected from mercury poisoning, known as Minamata disease.

As history has shown us, the consequences of such a disaster can be horrific. A neurological disorder, Minamata disease can cause a range of chronic disorders of varying severity, including anxiety, loss of appetite, damage to hearing, speech and vision, loss of coordination of muscle movement, and in extreme cases, paralysis, coma and death. As environmental concerns become prioritised across the world, particularly in the wake of climate change, there are increasing efforts to control the use and emission of mercury. In Pakistan, the major sources of mercury include certain industrial and hospital equipment such as thermometers and manometers, dental fillings, jewellery, skin-whitening creams, electric batteries, paints and various species of fish. In fact, the diversity of sources and their place in our daily lives makes the issue one of grave concern. It is therefore vital that the government and health and environmental experts coordinate on a sustained basis with industry leaders to reduce and, where other alternatives are available, phase out the use of mercury.



NATIONAL

Mercury poses major environ and health risks threats: Experts

THE NEWS

Friday

Mercury poses major environmental, health risks

Daily Times

ISLAMABAD

Workshop held to sensitise people on hazardous effects of mercury

Daily Times



Daily Kashmir Times

کشمیر ٹائمز

راولپنڈی

ماحول کو بہتر بنانے کیلئے قانون سازی کی اشد ضرورت ہے، ماہرین

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Press clippings of Awareness workshop under MIA Project

ANNEX III: *Glimpses of field visits for collection of samples for research*

















Glimpses of ASGM Sites of Gilgit & Baltistan during Inventory



Visits towaste dumping sites and incineration facilities during Inventoryprepration



Pictures captured during inventory of mercury releases from Energy sources



Inventory of mercury releases from different source categories

ANNEX VI: *Inventory of Mercury releases*

Inventory of Mercury releases as per format of Toolkit provided is annexed as a separate file of MS Excel sheets.