Reviewed and Updated National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants in Sierra Leone

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Foreword

The Stockholm Convention is a global treaty to protect human health and the environment from a category of chemicals referred to as Persistent Organic Pollutants (POPs). The Convention requires that Parties adopt and introduce measures to reduce releases of POPs into the environment with the aim of minimising human, environment and wildlife exposure.

As a Signatory and Party to the Stockholm Convention on Persistent Organic Pollutants, Sierra Leone is required by Article 3 to prohibit and/or take legal and administrative measures necessary to eliminate the production and use of chemicals taking cognizance of the relevant provisos; the import or export of chemicals and restrict the production and use of chemicals listed in Annexes A and B respectively.

Sierra Leone is further required by Article 5 of the convention to take measures to reduce the total releases derived from anthropogenic sources of the chemicals listed in Annex C, which refers to chemicals present as impurities in conventional chemicals and released into the environment through unintended use.

Since 2008 when the first national implementation plan (NIP) of Sierra Leone was published based on the twelve (12) POPs listed in the annexes of the Stockholm Convention, several actions have been taken to increase its international portfolio and commitments within the chemicals and waste cluster. This is evident in the ratification of the *Basel Convention* on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, the *Rotterdam Convention* on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade and the *Minamata Convention* on Mercury in September, 2016 by the government of Sierra Leone**.** Further to this, has been the increased participation in the Strategic Approach to International Chemicals Management (SAICM) process due to the firm commitment of government's New Direction of Sierra Leone to the control and elimination of hazardous chemicals and waste. Government has made strides in the organization of awareness raising programs, promotion of Best Available Techniques (BAT) and Best Environmental Practices (BEP) within its populace, and participation in regional programs on sound management of chemicals countrywide. On the policy arm, the establishment of the Environment Protection Agency Sierra Leone through an Act of Parliament as a regulatory body for the effective protection of the environment and supervised by the Office of the President of the Republic of Sierra Leone further underscores the importance the Government attaches to environmental protection and management. The wind on improved environmental governance will continue to blow in the Government's New Direction.

One key obligation of a state party under the Stockholm Convention (SC) is to develop or as in this case review and update its National Implementation Plan (NIP). Following the listing of further chemicals within the annexes of the SC, Sierra Leone has reviewed and updated its NIP in line with the 23 POPs listed in the convention into three broad categories namely: pesticides, industrial chemicals and unintentional by-products of combustion and some industrial and non-industrial processes. In doing so, Sierra Leone is in compliance with Article 7 of the Stockholm Convention.

Notwithstanding the above, the risks to the country's environment and its natural resources are numerous. These risks include deforestation due to loss of flora and fauna species from illegal logging, slash and burn agriculture, land degradation due to unsustainable land management practices, landslides, fire disasters, storms, open burning and unregulated use of chemicals by industries and large-scale mining operations and agricultural entities.

The Government of Sierra Leone (GoSL) in its action plan of the reviewed and updated NIP to the SC has outlined a clear path to an environment free of POPs before 2035. In furtherance to the above, the GoSL through the Environment Protection Agency in its Mid-Term National Development Plan 2019-2023, identified as key targets, the establishment of a policy for the management of toxic chemicals and hazardous substances encompassing POPs and its precursors; the Control of land degradation and minimize pollution; put in place an environmental court to prosecute cases related to environmental crimes; educate and raise awareness about changing traditional and cultural practices that are harmful to the environment.

I wish to thank all those who have contributed to the preparation of this NIP and fervently hope that the expectation of the NIP will serve as an effective framework of engagement for all state and non-state actors including development actors around the common objective of promoting the transformation of Sierra Leone in the effective management of POPs. The NIP lays out a strong basis for the formulation of a focused Long-term Plan for the effective protection of the environment and human health in promoting sustainable development. The Government of Sierra Leone is determined to implement the NIP for sound and sustainable environmental management.

I therefore, on behalf of the Government of Sierra Leone endorse this reviewed and updated National Implementation Plan (NIP) for the effective protection of humans, wildlife and the environment from the negative impacts of POPs and other toxic substances. The Government of Sierra Leone wishes to seek partnerships with our development partners, non-state actors, and private sector investment, as well as the contributions of the public and general citizenry to translate the NIP into action. I expect the NIP to serve as a communication and resource mobilization strategy guide for the transformation of Sierra Leone in managing Persistent Organic Pollutants.

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Abbreviations and Acronyms

BFRs	Brominated Flame Retardants
CBOs	Community Based Organisations
CED	Customs and Excise Department
CSSL	Conservation Society of Sierra Leone
CHEC-SIL	Commonwealth Human Ecology Council
DDT	Dichlorodiphenyltrichloroethane
ED	Environment Department
EDSA	Electricity Distribution and Supply Authority
EEE	Electrical and Electronic Equipment
EGTC	Electricity Generation Transmission Commission
EFA	Environmental Foundation for Africa
EIA	Environmental Impact Assessment
EPA	Environment Protection Act
EPASL	Environment Protection Agency Sierra Leone
EPD	Environment Protection Division
FAO	Food and Agriculture Organisation
FBC	Fourah Bay College
GDP	Gross domestic product
GEF	Global Environment Facility
GHS	Globalized Harmonized System
GOSL	Government of Sierra Leone
HBCD	Hexabromocyclododecane
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HeptaBDE	Heptabromodiphenyl ether
HexaBDE	Hexabromodiphenyl ether
ILO	International Labour Organisation
IMBO	Institute of Marine Biology and Oceanography
INC	Initial National Communication
IPPC	International Plant Protection Convention
IPS	Institute for Population Studies
ODSs	Ozone Depleting Substances
ORIENT	Organisation for Research and Extension of Intermediate Technology
MAFFS	Ministry of Agriculture, Forestry and Food Security
MMMR	Ministry of Mines and Mineral Resources
MICS	Mortality Indicator Cluster Survey
MOHS	Ministry of Health and Sanitation
MEST	Ministry of Education, Science and Technology
MFMR	Ministry of Fisheries and Marine Resources

MLHCPE	Ministry of Lands, Housing, Country Planning and the Environment
MLIR	Ministry of Labour and Industrial Relations
MOE	Ministry of Energy
MTCA	Ministry of Tourism and Cultural Affairs
NaCEF	National Commission on Environment and Forestry
NAP	National Action Plan
NAPA	National Adaptation Plan of Action
NEAP	National Environmental Action Plan
NEP	National Environmental Policy
NEPB	National Environment Protection Board
NGOs	Non-Governmental Organisations
NIP	National Implementation Plan
NMA	National Mineral Agency
NMAGL	National Minerals Agency Geological Laboratory
NPA	National Power Authority
NPAA	National Protection Area Authority
NPK	Nitrogen, Phosphorus, Potassium
NRA	National Revenue Authority
OctaBDE	Octabromodiphenyl ether
OREINT	Organisation for Research and Extension of Intermediate Technology
PAHs	Polyaromatic Hydrocarbons
PBDEs	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated Biphenyls
PCDDs	Polychlorinated Dibenzo-p-dioxins
PCDFs	Polychlorinated Dibenzofurans
PCNs	Polychlorinated Naphthalenes
PeCB	Pentachlorobenzene
PentaBDE	Pentabromodiphenyl Ether
PFASs	Per- and Polyfluoroalkyl Substances
PFHxS	Perfluorohexanesulfonic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonic Acid
PIC	Prior Informed Consent
POPs	Persistent Organic Pollutants
SAICM	Strategic Approach of International Chemical Management
SALWACO	Sierra Leone Water Company
SCCPs	Short Chain Chlorinated Paraffins
SLMA	Sierra Leone Maritime Administration
SLSB	Sierra Leone Standards Bureau
SPS	Sanitary and Phytosanitary
TBT	Technical Barriers to Trade

TetraBDE	Tetrabromodiphenyl Ether
TDI	Tolerable Daily Intake
UNCBD	United Nations Conventions on Biological Diversity
UNCCD	United Nations Convention on Combating Desertification and/or Land Degradation
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environmental Programme
UNFCC	United Nations Framework Convention on Climate Change
UNITAR	United Nations Institute for Training and Research
WHO	World Health Organisation
WSD	Water Supply Division
WTO	World Trade Organisation

Executive Summary

The Stockholm Convention is a global treaty to protect human health and the environment from persistent organic pollutants (POPs). POPs are highly toxic chemicals of mostly anthropogenic origin that resist photolytic, chemical and biological degradation, causing an array of adverse effects, notably deaths (e.g. from cancer), diseases and birth defects among humans and animals. They concentrate in fatty tissues of living organisms through processes of bioaccumulation and bio-magnification. Concentrations are magnified up the food chain.

The Convention meanwhile covers a total of twenty-eight (28) POPs. This includes chemicals for restriction or elimination of the production and releases which include intentionally produced pesticides (i.e. aldrin, dieldrin, DDT, endrin, chlordane, hexachlorobenzene, mirex, toxaphene and heptachlor), industrial chemicals which are polychlorinated biphenyls (PCBs), brominated flame retardants including polybrominated diphenyl ethers (PBDEs) hexabromobiphenyl and hexabromocyclododecane (HBCD), Perfluorooctanesulfonic acid and hexachlorobenzene and unintentionally produced POPs (UPOPs) released from certain industrial and combustion processes, which include polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) and other UPOPs.

In fulfilling its requirement to the Convention, Sierra Leone developed a National Implementation Plan (NIP) document in 2008 for the 12 initial POPs, i.e.:

- Pesticides: aldrin, chlordane,1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane (DDT), dieldrin, endrin, heptachlor, hexachlorobenzene (HCB), mirex, toxaphene;
- Industrial chemicals: hexachlorobenzene (HCB), polychlorinated biphenyls (PCB);
- By-products: hexachlorobenzene (HCB), polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).

At the 4th Conference of the Parties in 2009, nine new POPs were listed in the Annexes A, B and C of the Convention, namely:

- Pesticides: chlordecone, alpha-hexachlorocyclohexane, beta-hexachlorocyclohexane, lindane, pentachlorobenzene (PeCB);
- Industrial chemicals: hexabromobiphenyl (HBB), hexabromodiphenyl ether (hexaBDE) and heptabromodiphenyl ether (HeptaBDE), PeCB, perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF), tetrabromodiphenyl ether (TetraBDE) and pentabromodiphenyl ether (PentaBDE);
- By-products: alpha-hexachlorocyclohexane, beta-hexachlorocyclohexane and PeCB.

The 5th Conference of the Parties in 2011 listed one pesticide, technical endosulfan and its related isomers in Annex A of the Convention, with specific exemptions for production and use for some crop-pest complexes as listed in accordance with the provisions of part VI of this Annex. Furthermore, the 6th Conference of the Parties in 2013 amended Annex A of the Convention by listing one more industrial chemical, hexabromocyclododecane (HBCD) with

time-limited exemptions for production and use in expanded polystyrene (EPS) and extruded polystyrene (XPS) insulation foams in buildings. At the 7th Conference of the Parties (COP) in 2015 hexachlorobutadiene (HCBD), pentachlorophenol (PCP) and polychlorinated naphthalenes (PCNs) were listed. And in 2017 decabromodiphenyl ether (DecaBDE) and short-chain chlorinated paraffins (SCCPs) were listed.

With the addition of these newly listed POPs chemicals, Sierra Leone is required to carry out a review and update of the National Implementation Plan (NIP). This document presents a review and update to the previous NIP by accommodating the newly listed POPs until COP 6 in the management of POPs in Sierra Leone.

Purpose of the National Implementation Plan (NIP)

The National Implementation Plan (NIP) for Sierra Leone is prepared to elaborate the current situation on POPs and commitments and actions that it intends to undertake in the management and control of POPs beginning 2019. Moreover, it should help Sierra Leone to meet its obligations under the Stockholm Convention on Persistent Organic Pollutants. Article 7 of the Convention requires Parties to the Convention to develop a national implementation plan to meet the requirements of the Convention and communicate such plan to the Conference of Parties (COP) within two years of the coming into force of the Convention for the Party. Sierra Leone will therefore integrate the NIP into its national sustainable development plans where necessary.

The main objective of the NIP is to prepare comprehensive and realistic action plans for effective management of POPs chemicals and to reduce and or eliminate the use and release of POPs.

The development of the NIP is intended to yield the following objectives:

a) To achieve the commitment of the Government to the objectives of the Stockholm Convention for effective management of POPs chemicals;

b) To provide the basis for monitoring the action plans and strategies that Sierra Leone has committed to undertake;

c) To build a basis for periodical reviewing and updating of the NIP as appropriate and in a manner to be specified by a decision of the Conference of Parties;

d) To utilise and, where necessary, establish the means to integrate appropriately the national implementation plan for POPs into the sustainable development strategies;

e) To cooperate directly or through global, regional and sub-regional organisations, and consult the national stakeholders, including women's groups and groups involved in the health of children, in order to facilitate the development, implementation and updating of the NIP;

f) To facilitate public awareness, education and participation in POPs management issues, and overall improvement in environmental and public health protection.

Status of POPs in Sierra Leone

The present status of POPs in Sierra Leone was assessed according to the Stockholm Convention assessment procedures under the various POPs chemical categories:

POPs pesticides

Sierra Leone is yet to officially ban individual POPs pesticides that are banned in the Convention. Illegal entry into the country is still common mainly through porous borders.

A wide range of pesticides are in use in the country. Approximately eight to ten thousand litres of obsolete pesticides and 4 kg Lindane was identified during the inventory whilst endosulfan is still in use illegally.

Pesticide contaminated sites exist at areas where pesticide were or are stored or where POPs pesticides have been applied in the past such as agricultural plots and agrochemical dealer shops.

Sierra Leone is an agrarian country with many women and children exposed to the dangers of POPs Pesticides. Exposure to POPs pesticides is mainly due to improper use of pesticide containers. This is further compounded by lack of awareness among the users and handling personnel. Farmers handle pesticides without personal protective equipment and hence expose various parts of their bodies to the harmful chemicals. Pesticide containers, after the products are used up, are given out to labourers and the surrounding communities for use to draw drinking water, thus putting the farming households at risk.

PCBs

PCBs are not produced in Sierra Leone and there is no existing law/regulation that specifically prohibits/controls the importation/use of goods containing PCBs. The inventory data on transformers containing PCB oil showed that 127 suspected PCB containing transformers, 94 redundant transformers and 74 tonnes of potentially PCB containing oils are in the country. No existing policy on waste oil handling exists in the country and retrieved oil from transformers is stored together with other waste oil. Oil contaminations are vividly seen at transformer sites. Up to now no PCB screening kit could be imported to confirm the presence of PCBs.

The Environment Protection Act 2000 broadly refers to the control of environmental pollutants but does not specifically mention PCBs or any POPs in relation to the provisions in the Stockholm Convention, which was signed later. The responses deduced from the survey affirm that the presence of PCBs in some goods and their effects on human health and the environment is new to some of the general public. In this regard, there is an urgent need for an intensive nationwide public awareness campaign on these issues.

PBDEs

Polybrominated diphenyl ethers (PBDEs) are a group of aromatic organo-bromine compounds widely used as additive flame retardants (i.e. Brominated flame retardants, BFRs) since the 1970s in consumer products. Sierra Leone like most other developing nations was not involved in the production of these chemicals or in the production of goods containing them.

The total amount of c-OctaBDE in CRTs based on the Stockholm Convention PBDEs inventory guidance emission factors for CRT monitors for TV and PC ranges between 955 – 2,787 kg for HexaBDE and 3,732 - 10,895 kg for HeptaBDE.

The estimated amount of WEEE/EEE plastic CRT (PC and TV) for 2015 is 10,083 tonnes.

The estimated amount of WEEE plastics from imported items in 2015 are 22.9 tonnes from CRT monitor and 90.5 tonnes from CRT TV. Estimated POP-PBDEs in stocks of EEE in households is 3752 kg.

The estimated amount of WEEE plastics stored/in-use at the household level in 2015 is151 tonnes from CRT monitor and 3871 tonnes from CRT TV

Based on domestic car sale data of 1975-2004 and that of second-hand imported car, the cumulative estimation of tetraBDE was at 19,697 kg, pentaBDE at 34,619 kg, hexaBDE at 4,775 kg and heptaBDE at 298.7 kg. The potential amount of POP-PBDEs in stockpiles of end-of life vehicles during the 2013 inventory was estimated at 15,185 kg for tetraBDE, 26,689 kg for pentaBDE, 3,681 kg for hexaBDE and 230 kg for heptaBDE.

HBCD

HBCD is used as flame retardant additive to reduce ignition. The total amount of HBCD or other flame retardants treated clothing (i.e. firefighting uniforms) ranged from 0.12 – 0.84 tonnes.

PFOS

PFOS is a fully fluorinated (perfluorinated) substance, which is commonly used as a salt in some applications. PFOS was not assessed in the first NIP. PFOS assessment during the inventory gave priority areas such as Sierra Leone Fire Force, the airport authority, petroleum companies, Sierra Leone Company to generate heat & power (EDSA&EGTC). The quantity of PFOS in stockpiles from these professional users range from Sierra Leone Fire Force (64.3 – 192.8Kg), airports (42.8 – 128.5 kg), petroleum companies (64.2 – 198.9 kg), Sierra Leone Company to generate heat & power (EDSA&EGTC) (214.7 – 644.1 kg).

Preliminary assessment of import data from customs using the specific Harmonized Commodity Description and Coding System or Harmonized System (HS) codes of imported and exported articles and products that possibly contain PFOS and its related substances was conducted to acquire information on PFOS. However, this information was not conclusive.

Unintentional POPs

The annual PCDD/PCDF releases calculated using UNEP Toolkit was estimated at 134.2 g TEQ for the year 2016 compared to 28.1 g TEQ for the 2007 inventory. The major contribution of PCDD/PCDF emission in Sierra Leone is from open waste burning and ferrous and non-ferrous metal production categories followed by heat and power generation sector. Open burning combustion contributed ~83% whilst combined release of gasoline and diesel powered generators as well as cement production accounted for ~4.8% and ~5.1 % of total UPOPs emission respectively. These emission sources would require attention for pollution control.

Until now, virtually no prevention and control mechanism of UPOP releases are available in the country and in particular the waste management sector needs urgent improvements.

POPs contaminated sites

Several POPs contaminated sites exists in Sierra Leone through the use and handling of articles that contain POPs chemicals. The dumpsites are a major contamination site for POPs in Sierra Leone, being the reservoir for many types of wastes and discarded products. Dumpsites around the country are in the vicinity of residential areas and they receive medical and other hazardous wastes in addition to normal domestic wastes. Most hospital does not have incinerators. Hence, open indiscriminate burning of wastes dump is common with tremendous followed by health and environmental impacts.

CRT TV repair shops are potential contaminated sites for PBDEs and heavy metals. PCB transformers and waste oils have not been properly managed over the years, consequently, a range of potentially PCB contaminated sites exist in Sierra Leone. Potential contaminated sites for PFOS and for PBDEs have also been recognised and need further assessment. However, no further analysis or assessment in these sites was done due to lack of capacity in the country. Also, there is no system in the country presently to remediate or secure contaminated sites.

Review of the 2008 NIP

Generally, virtually all of the action plans for the 2008 NIP have not been realized. This was largely due to lack of finance and poor coordination between related stakeholders. These needs to be addressed for the next NIP implementation.

Overview of national priorities and action plan of the NIP

Sierra Leone has developed action plans that intend to reduce or eliminate the chemicals described in Annexes A, B and C of the Stockholm Convention. The main priority issues identified are grouped into the following general major areas: strengthening the legal and institutional framework for management of POPs and other chemicals, develop capacity and establishing better environmental practices to manage POPs, and creating public information, awareness and education tools and mechanisms to manage POPs.

<u>Strengthening the legal and institutional framework for management of POPs</u>

- Enacting laws to govern POPs chemicals Management
- Legal institutional and regulatory strengthening measures
- Measures to reduce intentional use

<u>Develop capacity and establishing better environmental practices to manage POPs</u>

- Identify and prioritize sites contaminated with Annex A, B and C chemicals
- Developing effective methods of use, storage and disposal of POPs pesticides and their empty containers
- Reduced releases from open burning of wastes (private burning & landfill fires) and biomass

- Manage stockpiles in a safe and environmentally sound manner
- Safe handling, separation and sound disposal of stockpiles of chemical and articles in use
- Developing institutional, analytical and research capacity to manage POPs and other hazardous chemicals
- Developing appropriate analytical capacity approach for relevant POPs

Education and awareness for the public and stakeholders

- Raising public awareness on the Stockholm Convention on POPs
- Organising awareness-raising information materials
- Setting up a task team/awareness raising groups for development of materials for sensitisation
- Distribution of POPs information materials
- Implementation of awareness-raising programmes
- Development of skills, jingles, billboards
- Radio discussions
- Meeting with parliamentarians and policy makers and implementing institutions to promote POPs awareness in the country
- Conducting quizzes/essays (educational institutions and public),
- Prepare education and training materials on POPs & hazardous chemicals

Capacity requirements

Sierra Leone is severely challenged in its capacity to manage POPs and effective NIP implementation would require several resources criteria, such as: Active involvement and collaboration amongst stakeholders in the management of hazardous substances and wastes, especially those related to POPs; Effective law enforcement on POPs; Adequate financing from central and local governments and grants from donor agencies.

Table of Content

Foreword **2**

Abbreviations and Acronyms **4**

Executive Summary **7**

1.1 The Stockholm Convention on POPs 16

1.2 The National Implementation Plan 21

1.2.1 The purpose of the National Implementation Plan 21

1.2.2 Updating the National Implementation Plan 21

1.2.3 Preparation of the NIP 22

1.2.4 The lead agency in the preparation of the NIP 23

1.2.5 Assistance received in updating the NIP 23

1.3 Health and society problems and risks of POPs and hazardous chemicals 23

CHAPTER 2. COUNTRY BASELINE **27**

2.1 Country Profile 27

2.1.1 Physiographic and demographic setting 27

2.1.2 Macroeconomic environment 30

2.1.3 Environment 38

2.2 Institutional, Policy and Regulatory Framework 41

2.2.1 Environmental and sustainable development policy and general legislative framework 41

2.2.2 Institutional roles and responsibilities 45

2.2.3 Relevant international commitments and obligations 53

2.2.4 Description of existing legislation and regulations related to POPs 58

2.2.5 POPs Management capacity 60

2.3 Assessment of the POPs issue in the country 61

2.3.1 Assessment of POPs pesticides (Annex A, Part I) and DDT (Annex B) 61

2.3.2 Assessment of PCBs (Annex A, Part II) 72

2.3.3 Assessment of POP-PBDEs (Annex A, Part IV and Part V) 81

2.3.4 Assessment of HBCD (Annex A, Part I and Part VII) 99

2.3.5 Assessment of PFOS, its salts and PFOSF (Annex B, Part III) 102

2.3.6 Assessment of releases of unintentionally produced POPs (Annex C) 111

2.3.7 POPs contaminated sites 117

2.3.8 Summary of future production, use, and releases of POPs – requirements for exemptions 121

2.3.9 Existing programmes for monitoring releases and environmental and human health impacts, including findings 121

2.3.10 Current level of information, awareness, and education among target groups; existing systems to communicate such information to the various groups 122

2.3.11 Mechanism to report under Article 15 on measures taken to implement the provisions of the Convention and for information exchange with other Parties to the Convention 124

2.3.12 Relevant activities of non-governmental stakeholders 124

2.3.13 Overview of technical infrastructure for POPs assessment, measurement, analysis, alternatives and prevention measures, research and development – linkage to international programmes and projects. 125

2.3.14 Overview of technical infrastructure for POPs management and destruction 127

2.3.15 Identification of impacted populations or environments, estimated scale and magnitude of threats to public health and environmental quality, and social implications for workers and local communities 129

2.3.16 Details of any relevant system for the assessment and listing of new chemicals 129

2.3.17 Details of any relevant system for the assessment and regulation of chemicals already in the market 129

2.4 Implementation status of the first NIP 129

CHAPTER 3. STRATEGY AND ACTION PLAN ELEMENTS OF THE NATIONAL IMPLEMENTATION PLAN 133

3.1 Policy Statement 133

3.1.1 Background 133

3.1.2 Declaration of Intent 133

3.2 Implementation Strategy 134

3.3 Action plans, including respective activities and strategies 135

3.3.1 Activity: Institutional and regulatory strengthening measures 135

3.3.2 Activity: Measures to reduce or eliminate releases from intentional production and use 138

3.3.3 Activity: Production, Import and Export, Use, Stockpiles and Wastes of Annex A POPs Pesticides (Annex A, Part I Chemicals) 138

3.3.4 Activity: Production, import and export, use, identification, labelling, removal, storage, and disposal of PCBs and equipment containing PCBs (Annex A, Part II chemicals) 144

3.3.5 Activity: Production, import and export, use, stockpiles, and wastes of hexaBDE and heptaBDE (Annex A, Part IV chemicals) and tetraBDE and pentaBDE (Annex A, Part V chemicals) (and HBB, where applicable (Annex A, Part I chemicals)) 149

3.3.6 Activity: Production, import and export, use, stockpiles, and wastes of PFOS, its salts and PFOSF (Annex B, Part III chemicals) 154

3.3.7 Activity: Register for specific exemptions and the continuing need for exemptions (Article 4) 159

3.3.8 Action plan: Measures to reduce releases from unintentional production (Article 5) 160

3.3.9 Activity: Identification and management of stockpiles, waste and articles in use, including release reduction and appropriate measures for handling and disposal (Article 6) 164

3.3.10 Activity: Identification of contaminated sites (Annex A, B, and C Chemicals) and, where feasible, remediation in an environmentally sound manner 167

3.3.11 Activity: Facilitating or undertaking information exchange and stakeholder involvement 170

3.3.12 Activity: Public and stakeholder awareness, information and education (Article 10) 172

3.3.13 Activity: Effectiveness evaluation (Article 16) 175

3.3.14 Activity: Reporting (Article 15) 176

3.3.15 Activity: Research, development and monitoring (Article 11) 177

3.3.16 Activity: Technical and financial assistance (Articles 12 and 13) 180

3.5 Timetable for implementation strategy and measures of success 183

3.6 Resource Requirement and mobilization 183

ANNEX 1 – CONTACTS 186

CHAPTER 1. INTRODUCTION

1.1 The Stockholm Convention on POPs

The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty with the aim to protect humans and the environment from the adverse effects from POPs by eliminating or restricting the production and use of POPs. The Convention entered into force on 17 May 2004. Presently, there are 182 Parties to the Convention. Sierra Leone acceded to the Stockholm Convention on 26 September 2003 and entered into force on 17 May 2004.

Exposure to POPs can lead to serious health challenges. POPs are also persistent in the environment and do not respect boundaries. To address this global problem, the Convention requires Parties to take measures to eliminate or reduce the release of POPs into the environment.

The SC imposes a worldwide ban on the production and trade in pesticides (aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex, and toxaphene), two industrial chemicals (hexachloro-benzene and polychlorinated biphenyls (PCBs)) and two by-products of incineration processes (dioxins and furans) from 2004 onwards.

In 2009, the Conference of the Parties (COP), by decisions SC-4/10 to SC-4/18, adopted amendments to annexes A (elimination), B (restriction), and C (unintentional production) of the SC to list nine additional chemicals as persistent organic pollutants. The latter are namely the following pesticides: chlordecone, alpha hexachlorocyclohexane, beta hexachlorocyclohexane, lindane, pentachlorobenzene; industrial chemicals: hexabromobiphenyl, hexabromodiphenyl ether and heptabromodiphenyl ether, pentachlorobenzene, perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride, tetrabromodiphenyl ether and pentabromodiphenyl ether; and byproducts: alpha hexachlorocyclohexane, beta hexachlorocyclohexane and pentachlorobenzene.

In 2011, the Conference of the Parties (COP), through its decision SC-5/3, adopted an amendment to Annex A (elimination) listing technical endosulfan and its related isomers.

In 2013, the Conference of the Parties, in its decision SC-6/13, adopted an amendment to Annex A (elimination) by including hexabromocyclododecane (HBCD).

In 2015, through its decisions SC-7/12, SC-7/13 and SC-7/14, the Conference of the Parties adopted amendments to Annex A (elimination) and C (unintended production) listing hexachlorobutadiene, pentachlorophenol and its salts and esters and polychlorinated naphthalenes.

In 2017, through its decisions SC-8/10, SC-8/11 and SC-8/12, the Conference of the Parties adopted amendments to Annex A (elimination) and C (unintentional production) by adding

decabromodiphenyl ether (commercial mixture, c-decaBDE), short chain chlorinated paraffins (SCCPs) and hexachlorobutadiene (HCBD).

Table 1 presents an overview of the POPs listed in Annex A, B and C of the SC as of 2017.

Table 1. List of POPs in Annex A, B and C of the SC

Annex A (Elimination)	Annex B (Restriction)	Annex C (Unintentional Production)
Parties must take measures to eliminate the production and use of the chemicals listed under Annex A. Specific exemptions for use or production are listed in the Annex and apply only to Parties that register for them.	Parties must take measures to restrict the production and use of the chemicals listed under Annex B in light of any applicable acceptable purposes and/or specific exemptions listed in the Annex.	Parties must take measures to reduce the unintentional releases of chemicals listed under Annex C with the goal of continuing minimization and, where feasible, ultimate elimination.
POPs Pesticides: Aldrin Chlordane Chlordecone Dieldrin Endrin Heptachlor Hexachlorobenzene (HCB) Alpha hexachlorocyclohexane (HCH)* Beta hexachlorocyclohexane* Lindane (Mirex Toxaphene Technical endosulfan and its isomers Pentachlorophenol and its salts and esters (PCP, its salts and esters) **Industrial chemical:** Pentachlorobenzene (PeCBz) Polychlorinated biphenyls (PCBs) Tetrabromodiphenyl ether and pentabromodiphenyl ether Hexabromobiphenyl (HBB) Hexabromodiphenyl ether and heptabromodiphenyl ether Hexabromocyclododecane (HBCD) Hexachlorobutadiene (HCBD) Polychlorinated naphthalenes (PCNs) Decabromodiphenyl ether (commercial mixture, c-decaBDE), Short chain chlorinated paraffins (SCCPs)	DDT Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride (PFOS, its salts and PFOS-F)	Polychlorinated dibenzo-p-dioxins (PCDDs) Polychlorinated dibenzofurans (PCDFs) Hexachlorobenzene (HCB) Pentachlorobenzene (PeCBz) Polychlorinated biphenyls (PCBs) Polychlorinated naphthalenes (PCNs) Hexachlorobutadiene (HCBD)

*Alpha- and beta-HCH are by-product in the production of lindane (gamma-HCH)

In the case of some POPs listed in Annexes A and B, the COP has adopted acceptable purposes and/or specific exemptions as presented in Table 2 below.

Table 2. Acceptable purposes and/or specific exemptions for POPs listed in the SC

Chemical	Annex	Specific exemptions / Acceptable purposes	Related document (decision)
Decabromodiphenyl ether (commercial mixture, c-decaBDE)	A	**Production:** As allowed for the parties listed in the Register **Use:** Vehicles, aircraft, textile, additives in plastic housings etc., polyurethane foam for building insulation, in accordance with Part IX of Annex A	Not yet available
Hexabromocyclododecane	A	**Production:** As allowed by the parties listed in the Register of specific exemptions. **Use:** Expanded polystyrene and extruded polystyrene in buildings in accordance with the provisions of part VII of Annex A	SC-6/13
Hexabromodiphenyl ether and heptabromodiphenyl ether (commercial octabromodiphenyl ether)	A	**Production:** None **Use:** Articles in accordance with the provisions of Part IV of Annex A	SC-4/14
Lindane	A	**Production:** None **Use:** Human health pharmaceutical for control of head lice and scabies as second line treatment	SC-4/15
Pentachlorophenol and its salts and esters	A	**Production**: As allowed for the parties listed in the Register in accordance with the provisions of part VIII of Annex A **Use**: Pentachlorophenol for utility poles and cross-arms in accordance with the provisions of part VIII of Annex A	SC-7/13
Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride	B	**Production:** For the use below **Use:** Acceptable purposes and specific exemptions in accordance with Part III of Annex B	SC-4/17

Chemical	Annex	Specific exemptions / Acceptable purposes	Related document (decision)
Polychlorinated naphthalenes	A and C	**Production**: For the use below **Use**: Production of polyfluorinated naphthalenes, including octafluoronaphthalene	SC-7/14
Short-chain chlorinated paraffins (SCCPs)	A	**Production:** As allowed for the parties listed in the Register **Use:** Additives in transmission belts, rubber conveyor belts, leather, lubricant additives, tubes for outdoor decoration bulbs, paints, adhesives, metal processing, plasticizers	Not yet available
Technical endosulfan and its related isomers	A	**Production:** As allowed for the parties listed in the Register of specific exemptions **Use:** Crop-pest complexes as listed in accordance with the provisions of part VI of Annex A	SC-5/3
Tetrabromodiphenyl ether and pentabromodiphenyl ether (commercial pentabromodiphenyl ether)	A	**Production:** None **Use:** Articles in accordance with the provisions of Part V of Annex A	SC-4/18
DDT (1,1,1-trichloro-2,2-bis (4-chlorophenyl) ethane)		**Production:** Use of vector control against diseases in accordance with Part II of this Annex **Use:** Use of vector control against diseases in accordance with Part II of this Annex	

Source: Stockholm Convention website

These substances are designated as POPs and are toxic, persistent and can be transported over great distances through the air or water. POPs can cause adverse effects on the environment and health because they accumulate in organisms. This can result in cancer, sterility and disruption of the immune system. The SC imposes the obligation on the parties to develop, within two years of the ratification of the Convention, a NIP describing the national situation in respect of the substances covered by the SC and the strategies that have been developed to implement their obligations under the SC. The SC also requires all parties to develop an Action Plan. In this

National Action Plan (NAP) the Parties must specify what strategies they will be developing to meet the obligations of the SC.

1.2 The National Implementation Plan

1.2.1 The purpose of the National Implementation Plan

Article 7 of the Convention requires Parties to the Convention to develop a National Implementation Plan (NIP) to meet the requirements of the Convention and communicate such plan to the Conference of Parties (COP) within two years of the coming into force of the Convention for the Party. Sierra Leone developed its first National Implementation Plan in 2008 and transmitted to the Secretariat in 2009.

The purpose of the NIP is to elaborate the situation on POPs and formulate the commitment and actions that Sierra Leone intends to undertake in the management and control of POPs. Moreover, it should enable Sierra Leone to meet its obligations under the Stockholm Convention on Persistent Organic Pollutants. The main objective of the NIP is to prepare comprehensive and realistic action plans for effective management of POPs chemicals and to reduce and or eliminate the use and release of POPs.

The development of the NIP is intended to yield the following specific objectives:

a) To achieve the commitment of the Government to the objectives of the Stockholm Convention for effective management of POPs chemicals;

b) To provide the basis for monitoring the action plans and strategies that Sierra Leone has committed to undertake;

c) To build a basis for periodical reviewing and updating of the NIP as appropriate and in a manner to be specified by a decision of the Conference of Parties;

d) To utilise and, where necessary, establish the means to integrate appropriately the national implementation plan for persistent organic pollutants into the sustainable development strategies;

e) To cooperate directly or through global, regional and sub-regional organisations, and consult the national stakeholders, including women's groups and groups involved in the health of children, in order to facilitate the development, implementation and updating of the NIP;

f) To facilitate public awareness, education and participation in POPs management issues, and overall improvement in environmental and public health protection.

1.2.2 Updating the National Implementation Plan

It is mandatory that all Parties according to Article 7 of the Stockholm Convention shall review and update its NIP within two years of the date into force of the amendment adding a new chemical in Annex A, B or C of the Convention for that Party. The updated NIP should include on one side the revised action plans of initial POPs and on the other side the action plans to eliminate or restrict newly listed chemicals in accordance with the objective of the Convention.

Action plans should include the use/production, import/export and stockpile/waste of existing and new POPs within the country in the inventory. A socio-economic impact assessment as well as environmental and health implication should be part of the updated NIP. Sierra Leone will therefore integrate the NIP into the national sustainable development plans where necessary.

1.2.3 Preparation of the NIP

To formulate the NIP, activities have been grouped into components, each focused on a set of activities. These components are as follows:

Component 1: Initiation of the process of reviewing and updating national implementation plans

Activity 1.1: Conduct an initial assessment of institutional needs and strengths

Activity 1.2: Organize a National Inception Workshop to raise awareness and to define the scope and objective of the NIP updating process,

Component 2: Assessment of the national infrastructure and capacity for the management of all POPs, development of the New POPs inventories and updating for the initial POPs inventories and monitor effects of POPs in humans and the environment

Activity 2.1: Assess regulatory and institutional framework for POPs management and prepare report

Activity 2.2: Conduct inventory on new POPs and update existing inventories on the twelve initial POPs and prepare reports

Activity 2.3 Assess impacts of POPs to human health and the environment and prepare report

Component 3: Development of Action Plans for New POPs and updating of Action Plans for initial POPs including gaps analysis

Activity 3.1: Conduct a comprehensive review of the existing National Action Plans on POPs and actions taken after the first NIP

Activity 3.2: Develop, update and validate action plans on POPs Activity

Activity 3.3: Prepare gaps analysis and proposals to address them

Component 4: Formulation of revised and updated National Implementation Plan with its associated Action Plans for all 22 POPs

Activity 4.1: Organize a stakeholder's review of the National Objectives and Priorities of the NIP

Activity 4.2: Develop draft revised National Implementation Plan including validated Action Plans for all POPs for stakeholder thematic review

Component 5: Endorsement of National Implementation Plan

Activity 5.1: NIP outreach strategy developed and implemented to promote the NIP work and gain stakeholder support

Activity 5.2: Organization of a workshop to gain support for the NIP update and to endorse it

1.2.4 The lead agency in the preparation of the NIP

The Environment Protection Agency, Sierra Leone (EPA-SL) is the National Focal Point to the Stockholm Convention and is the National Lead Agency in the preparation of the NIP. EPA-SL was established by an Act of Parliament, the Environment Protection Agency (EPA) Act (2008), as a corporate body charged with responsibility for the effective protection of the environment. The agency acts as the focal point for all national and international environmental issues relating to Sierra Leone. The agency coordinates and monitors the implementation of all environmental policies, programmes, projects and activities. The updating exercise of the NIP is anchored in the Chemical Control and Management Department of EPA-SL, working in collaboration with the International Expert as well as a National Coordinator and a team of local experts from relevant ministries, government agencies, academia and research institutions and NGOs.

1.2.5 Assistance received in updating the NIP

Sierra Leone being a signatory to the Stockholm Convention received financial help from the Global Environment Facility (GEF) through the United Nations Environmental Programme to assist in the development of the National Implementation Plan (NIP). The amount provided was US $ 180,000 to cover the NIP preparation. UNEP prepared the project document entitled "Review and Update of the National Implementation Plan of the Stockholm Convention on Persistent Organic Pollutants in Sierra Leone". UNEP also provided training and the technical support for the preparation of the NIP. The Government of Sierra Leone provided in kind contribution in terms of personnel and office space.

1.3 Health and society problems and risks of POPs and hazardous chemicals

Along with POPs as POP-Pesticides, UPOPs, and industrial POPs have caused and are causing risks to human health, economy and society.

For the general population, there is a growing body of information and data on the links between pollution and health and this demonstrates more and more strongly the scale of the impacts of current chemical pollution and contaminants from air pollution and indoor exposure (including heating/cooking, chemicals used in buildings and consumer products) as well as exposure from contaminated sites. Death caused pollution is higher than that caused by major diseases like HIV, malaria or tuberculosis in developing countries[1,2]. The numbers of people affected worldwide by pollution are now estimated to be of the order of 200 million with estimated 8 million deaths per year.

POPs, POPs-like chemicals[1], other toxic chemicals (e.g. heavy metals, PAHs; other endocrine disrupting chemicals[2,3]) and fine particulate matter play a crucial role. This highlights that a more

[1]Scheringer, M., Strempel, S., Hukari, S., Ng, C.A., Blepp, M., Hungerbühler, K. (2012) How many Persistent Organic Pollutants should we expect? Atmospheric Pollution Research, 3, 383–391.
[2] UNEP & WHO (2013) State of the Science of Endocrine Disrupting Chemicals – 2012.

critical assessment of the social burdens of pollution from chemical production and use; industrial production and releases as well as chemical exposure is needed.

One challenge of socio-economic assessment is that for many processes, the assessment cannot be based on a single chemical but that the combined toxic release and effect of a process or an industry need to be included in the assessment to adequately address their health or environmental impact (e.g. recycling of electronic waste or release from an incinerator or secondary metal industry).

For Sierra Leone, the following health and socio-economic threats and concerns are highlighted as most relevant, with consideration of Sustainable Development Goals (SDGs):

A) Food and water safety (including exposure to POPs)

The basis for sustainable development is safe food (SDG 2) and safe drinking water (SDG 6) as well as clean and fertile soils (SDG 15). This environmental frame is the basis for the long term development of a healthy society. Within this frame, a sustainable economy (SDG 9) can develop which should serve society development, poverty eradication (SDG 1) and decent work (SDG 8); but need to ensure the protection and possible improvement of the environmental situation. At the same time, food is the major exposure pathway for most POPs while water soluble PFOS exposure via drinking water is also relevant[4,5].

B) Exposure of vulnerable groups and highly exposed groups

POPs have a particular impact on vulnerable groups. These include children which e.g. for new listed PBDE have in average a higher exposure compared to adults[6]. POPs are also a particular threat for woman in reproductive age with the risk of negatively influence the reproductive health[7,8], and on the health of the next generation by transfer of POPs and other pollutants during pregnancy to the fetus and via breast milk to the baby. POPs with related developmental and other adverse effects. E.g. from the new listed POPs PBDE correlates to reduced IQ in children[9].

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[3] Many POPs are at the same time endocrine disrupting chemicals.

[4] Brambilla G, D'Hollander W, Oliaei F, Stahl T, Weber R (2015) Pathways and factors for food safety and food security at PFOS contaminated sites within a problem based learning approach. Chemosphere 129, 192-202.

[5] Hu et al. (2016) Detection of poly- and perfluoroalkyl substances (PFASs) in U.S. drinking water linked to industrial Sites, Military Fire Training Areas, and Wastewater Treatment Plants. Environ. Sci. Technol. Lett. DOI: 10.1021/acs.estlett.6b00260.

[6] US EPA (2010) An Exposure Assessment of Polybrominated Diphenyl Ethers. EPA/600/R-08/086F, May 2010.

[7] CHE/Commonweal (2009) Hormone Disruptors and Women's Reproductive Health.

[8] Fei C, McLaughlin JK, Lipworth L, Olsen (2009) Maternal levels of perfluorinated chemicals and subfecundity. J Hum Reprod. 24, 1200-1205.

[9] Herbstman et al. (2010) Prenatal exposure to PBDE and neurodevelopment. Environ Health Perspect 118(5): 712-719. http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info%3Adoi%2F10.1289%2Fehp.0901340

However, also the reproductive health of men is impacted by some POPs and other endocrine disrupting chemicals. In industrial countries since 50 years, the sperm quality is decreasing[10,11]. Chemicals play an important role in the decline of sperm quality including POPs (e.g. PCBs, DDT, PFOS[12]) but also other toxic chemicals such as certain phthalates and organophosphates[10].

One major challenge of the assessment of the impact of POPs and POPs-like[13]chemicals in combination with the approx. 100,000 chemicals in use on health is the effect of chemical mixture. Various POPs have e.g. endocrine effects which have additive or synergistic effects with hundreds of other endocrine chemicals.[14]

Also, particular high occupational exposure risks exist. This includes farmer exposure to POPs and other hazardous pesticides. Other occupational exposures to POPs are e.g. fire fighters exposed to new listed POPs such as PFOS, PBDEs and unintentional POPs such as PCDD/PCDFs and related PBDD/PBDF[15] or workers in the textile or plating industry exposed with PFOS.

C) Challenge of end of life management and cost of destruction

The destruction of POPs stockpiles is very expensive. Export of POP-contaminated materials back to the original producers, normally industrial countries, for destruction is very expensive estimated at about US$1,000 to US$5,000/t.[16] The management costs for the disposal of the ca. 9 million tonnes of PCB-containing equipment alone can be estimated at between US$ 9 billion and US $45 billion[17].

Sierra Leone is still at the beginning of management and destruction and efforts and cost are a burden for industry, authorities and the society.

D) Cost of contaminate soil and site remediation

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[10] Sharpe R (2009) Male Reproductive Health Disorders and the Potential Role of Exposure to Environmental Chemicals http://www.chemtrust.org.uk/wp-content/uploads/ProfRSHARPE-MaleReproductiveHealth-CHEMTrust09-1.pdf

[11] Jurewicz J, Hanke W, Radwan M, Bonde JP (2009) Environmental factors and semen quality. Int J Occup Med Environ Health. 22, 305-329.

[12] Joensen , Bossi R, Leffers H, Jensen AA, Skakkebaek NE, Jørgensen N (2009) Do Perfluoroalkyl Compounds Impair Human Semen Quality? EHP 117:923–927. http://ehp03.niehs.nih.gov/article/info%3Adoi%2F10.1289%2Fehp.0800517

[13] Scheringer, M., Strempel, S., Hukari, S., Ng, C.A., Blepp, M., Hungerbühler, K. (2012) How many Persistent Organic Pollutants should we expect? Atmospheric Pollution Research, 3, 383–391.

[14] UNEP & WHO (2013) State of the Science of Endocrine Disrupting Chemicals – 2012.

[15] Not listed as POPs; Shaw SD, Berger ML, Harris JH, Yun SH, Wu Q, Liao C, Blum A, Stefani A, Kannan K. (2013) Persistent organic pollutants including polychlorinated and polybrominated dibenzo-p-dioxins and dibenzofurans in firefighters from Northern California. Chemosphere. 91, 1386-1394

[16] The final cost for the destruction of highly chlorinated wastes is less than US$1,000/tonne, but the cost of packing and shipping is more than the destruction itself.

[17] Stockholm Convention (2010) PCB Elimination Club (PEN) magazine. Issue 1 12/2010. http://chm.pops.int/Implementation/PCBs/PCBsEliminationNetworkPEN/PENmagazine/tabid/738/Default.aspx

The cost and the management challenge of contaminated sites (POPs, heavy metals, PAHs etc.) from more than a century industrialization are enormous and cannot adequately be managed even in industrial countries.[18,19] The experience highlight that after soils or ground water has been contaminated, it is costly and difficult to restore them that they might serve again food production or residential purposes. Therefore prevention has the highest priority. The experience of more than a decade Stockholm Convention implementation has shown that developing countries are not in the position to appropriately manage POPs and have not the technologies to adequately destroy POPs stockpiles.

Considering all above mentioned health and socio-economic burdens as well as risks including the high cost for their life cycle and wastes managing and the high cost of their destruction; the need to strongly take precautionary approaches not to generate more POPs and POPs-like wastes and contaminated sites and food, water and soil pollution and related human contamination is strongly emphasized.

Therefore, considering these socio-economic burdens, in the preparation of this NIP and for the implementation of the NIP the following approaches are considered:

- the precautionary approach as emphasized by the Stockholm Convention and Rio Declaration on Environment and Development.
- phase-out and substitution will be applied for POPs and POPs-like chemicals as fast as possible.
- the extended producer responsibility and the polluter pays principle will be applied to promote the internalization of environmental and social costs and the uses of economic instruments, taking into account that the polluter should bear the cost of pollution with due regard to the public interest considering Principle 16 of the Rio Declaration.

[18] European Environmental Agency (2014) Progress in management of contaminated sites (LSI003) - Assessment May 2014.
[19] Faber D (2008) Capitalizing on Environmental Injustice. The Rowman & Litlefield Publishing Group, Inc.

CHAPTER 2. COUNTRY BASELINE

2.1 Country Profile

2.1.1 Physiographic and demographic setting

Sierra Leone is located on the west coast of Africa and covers an area of 72,325 km^2. It lies between latitudes 6^{o}55N and 10^{o}00N and longitudes 10^{o}14W and 13^{o}17W. It has a north-south distance of 331 km and an east-west distance of 326 km. It is bounded in the north and north-east by the Republic of Guinea, on the south east by Liberia and on the south-west and west by the Atlantic Ocean (Figure 1).

The country is divided into four main physical regions. These are the Coastal Plains, the Interior Plains, and the Interior Plateaux and the Freetown Peninsula consisting mainly of mountains and hills; each of these physiographic regions can be subdivided into a number of ecosystems. The Coastal Plains are relatively gentle and consist of estuarine swamps, beach ridges, alluvial plains and coastal terraces. The Interior Plains rise gently from an elevation of 40 m in the west to 200 m. They extend from the coastal terraces in the west to the east of Sierra Leone and occupy approximately 43% of the land area. They are separated from the Interior Plateaux region by a distinct escarpment. They are made of flat treeless grasslands known as bolilands, undulating plains and isolated hills.

Figure 1. Map of Sierra Leone with administrative regions

The Plateaus region, which ranges in altitude from 200 m to 700 m, is found in the north-eastern and south-eastern part of the country and consists of undulating high relief and rolling plains and hills. The highest mountains are found in the north and north east of the country; the prominent ones being the Loma Mountains and the Tingi Hills. The highest peak in the Loma Mountains is the Bintumani, which rises to 1,945 m while the Sankan Biriwa on the Tingi Hills rises to 1,805 m. All the ecosystems of the Plateaux and Interior Plains account for 84% of the total land area of Sierra Leone, and have a flat to gently rolling topography.

West of the Loma Mountains and Tingi Hills, is the Freetown Peninsula, which consists of dissected mountainous peaks with Sugar Loaf and Picket Hills being the highest. They developed from basic and ultra-basic rocks, and hills of acid rock origin. Soils are moderately to well drained, and low in fertility. The Freetown Peninsula has ranges of hills, which make it unique in the sub-region and is reported to have contributed to giving Sierra Leone its original Spanish name "Sierra Loya", meaning "Lion Mountains".

Sierra Leone has a tropical humid climate with two distinct seasons, namely the wet season from May to October and the dry season from November to April. Diurnal temperatures vary from 25^{o} to 34^{o} Celsius, although they could be as low as 16^{o} Celsius at night during the Harmattan season when the north-east trade wind blowing from the Mediterranean Sea across the Sahara desert to the Atlantic Ocean arrives on the west coast depleted of most of its moisture. The average temperatures are around 26^{o} Celsius.

Rainfall varies both in space and time. The mean annual variability is about 20%. The average annual rainfall varies from about 2,500 mm in the drier areas of the north-west and north-east of the country to about 3,000 mm in the southeast and about 5,000 mm in the Freetown Peninsula. Often, heavy and continuous rainfall results in flooding during the months of July and August, being the wettest months in most parts of the country. For instance, sustained heavy downpour of rain from the 5th to the 6th of September 2015 burst river banks and caused destruction in eight communities in Bo; on the 16th September 2015, heavy flooding in Freetown killed at least 12 people, left many injured and displaced thousands; and quite recently in August 2017, a hillside in the Regent area in Freetown collapsed. Freetown often experience worse floods compared to other parts of the country. This is because of small drainage receiving high volume of runoffs from surrounding hills in excess of their transporting capacity, poor saturation of already waterlogged soil, waste illegally dumped into water ways by some residents which prevent the flow of water in drainages amongst others. Also, floods cause runoffs and leachates from dumpsites to pollute receiving streams, rivers and the environment with heavy metals, POPs chemicals and plastics.

The rainfall pattern is unimodal with most of the rainfall occurring from late April to early November. The heavy rains and maritime influence lead to high humidity. Relative humidity is usually about 90% in the wet seasons but drops to about 20% inland in the Harmattan season that occurs at the beginning of the dry season. Normal wind speed averages 8 knots throughout the year. There is plentiful of sunshine that varies substantially with amount of cloudiness averaging 6 - 8 hours per day during the dry season and 2 - 4 hours per day during the wet season.

The coastline is about 560 km long and the shelf covers an area of 30,000 km^2. The drainage system comprises many rivers running from north to south, which include the Great Scarcies, Little Scarcies, Rokel, Jong, Moa, Sewa and Mano.

Broadly speaking, Sierra Leone can be classified into seven vegetation types, and these include moist rainforest, semi-deciduous, montane, savannah, farmbush mangroves and swamp forests. At present, the country is covered with more of mosaic secondary forests and farmbush, which arise from the slash-and-burn agricultural practices. The moist and semi-deciduous forests are found in the protected areas especially on the tops of mountains and slopes. The woodland savannah is restricted to the northern part of the country and is increasingly subjected to frequent bushfires. Swamps are found in the coastal creeks' estuaries of the Scarcies, Sierra Leone, Sherbro and Malan Rivers. Mangroves extensively cover the Atlantic coastline. Based on this classification, the country has the following six major ecosystems: Forest, Montane, Savannah, Agricultural, Wetlands and Freshwater.

The population of Sierra Leone increased from ~2.2 million in 1963 to approx. 3.5 million in 1985. Population further increased to approx. 4.9 in 2004 and approx. 7.1 million in 2015 with a growth rate of 2.5% per annum (SSL 2010; Figure 2). 2016 population growth was estimated at 2.2%. Although Sierra Leone has been recording significant population growth over the years, it is comparatively low to that of 2.73 for the rest of Sub-Saharan Africa reported by the World Bank in 2015. Sierra Leone population is expected to 8.8 million in 2020 (The Statistical Digest, 2014 SSL).

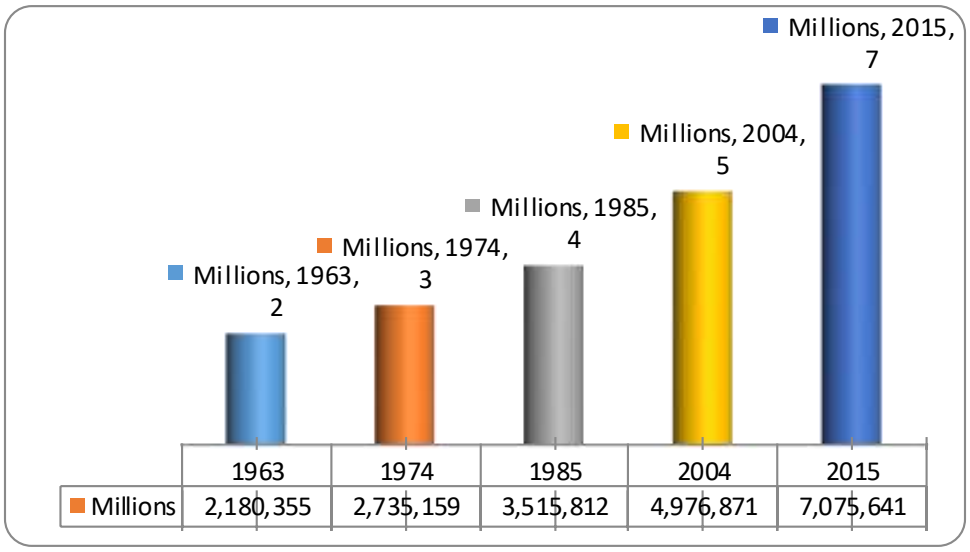

Figure 2. Population growth in Sierra Leone

In Sierra Leone, urban population is at 39.6%. Rural life is generally at a subsistence level and over two thirds of the population lives in absolute poverty. Life expectancy is very low, estimated at 46 years (WHO report 2015) giving a life expectancy ranking of 178 (http://www.worldlifeexpectancy.com/sierra-leone-life-expectancy, accessed on 20th August 2017); and the infant mortality rate is one of the highest in the world. Despite efforts to combat

this situation, the just concluded Ebola epidemic and almost annual flash floods continue to threaten health and living conditions in the country. This situation is further exacerbated in the Western Area by increasing urbanisation, population pressure on the available natural resources, inappropriate domestic policies and market failures. Illiteracy is very high and large sections of the population remain unemployed, especially youths. In consequence, Sierra Leone is classified as one of the poorest and least developed countries in the world, joint position of 179 with Eritrea out of 188 based on the United Nations Human Development Index (Human Development Report, 2016).

2.1.2 Macroeconomic environment

Sierra Leone economy was hit by the Ebola epidemic and the collapse of iron-ore prices in 2014-2015. However, some improvements have been recorded with Real Gross Domestic Growth (GDP) projected to recover from -20.6% in 2015 to 5.4% in 2017.The country's small open economy is predominantly agricultural and sustains about two thirds of the population at a bare subsistence level. Agriculture accounts for 71.1 percent of GDP (2016 estimate, World Factbook). However, in terms of export earning the mining sector is more significant than agriculture.

Diamond and iron-ore remain the chief export earners from the mining sector, with significant reserves of other minerals such as rutile and bauxite and to a much lesser extent gold and chromites. The trade in diamonds as the principal mineral resource is exposed to smuggling and other related illegal activities. Also, because mining is the primary industry and mineral exports generate most foreign exchange, Sierra Leone is vulnerable to fluctuations in commodity prices.

2.1.2.1 Economic recovery effort

Since the early 1980s the Government has made several efforts at redressing the pervasive economic decline and at restoring macroeconomic stability with support from bilateral and multilateral institutions. Earlier support efforts came from an IMF Extended Fund Facility (EFF) in 1981/82 and a stand-by arrangement in 1984/85. These programmes were, however, cancelled before the full utilisation of the credits because of Government's inability to meet agreed targets. In 1986 another IMF Support Reform Programme (SRP) focused on the adoption of a market-determined exchange rate, removal of price controls and the termination of government subsidies mainly on petroleum production. In early 1987, this programme was suspended due to political difficulties meeting targets.

Towards the latter part of 1987, the Government introduced a National Economic Emergence programme (NEEP), which imposed rigid controls on economic activity. These included exchange rate control and currency revaluation, rigid controls on currency holding, cross border trade, and controls on prices of staple products. These measures were, however by-passed. The private sector business was conducted on thriving illegal markets, thereby paving the way for smuggling of essential goods, national resources and capital flight. Faced with an increasing serious economic distress, the Government in collaboration with IMF and World Bank ushered in the Structural Adjustment Programme (SAP) for a reform of the economy in late 1989,

encompassing both stabilisation and structural reforms. Stabilisation includes exchange rate and trade liberalisation, deregulation of prices and indirect mechanisms of monetary control, and prudent fiscal management. On the other hand, structural reforms were focused on restructuring the civil service to enhance its ability to deliver public services, reform public enterprises, improve on their efficiency, and develop the private sector for propelling economic growth. Other reforms in sectoral policies and strategies resulted in new decrees/acts (by the then military government) to rationalise mining operations and in the formulation of new educational, health and environmental policies.

Unlike previous reform efforts, the Structural Adjustment Programme recorded initial gains and the economy began to stabilise during the first half of the 1990s with however mixed feelings about the social consequences of the programme. The escalation of the war by the close of 1994 and early 1995 hampered the economic recovery programme as the uncertainties of rebel attacks on productive areas of the economy undermined business confidence and general economic activity. Overall, economic performance has been affected by the worsening security situation. Still prevalent to date are the legacies of economic decline, weak institutional capacities, low domestic savings and investments, high unemployment particularly among youths, high debt burden, and weak fiscal and external sector positions. The overriding consequence has been abject poverty among the wider segment of the population, with the accompanying low standards of living.

In recent years economic growth has been driven by mining - particularly iron ore. The country's principal exports are iron ore, diamonds, and rutile, and the economy is vulnerable to fluctuations in international prices. Until 2014, the government had relied on external assistance to support its budget, but it was gradually becoming more independent. The Ebola outbreak of 2014 and 2015, combined with falling global commodities prices, caused a significant contraction of economic activity in all areas. While the World Health Organization declared an end to the Ebola outbreak in Sierra Leone in November 2015, low commodity prices in 2015-2016 contributed to the country's biggest fiscal shortfall since 2001. In 2017, increased iron ore exports are expected to support modest economic growth. Non-mining activities will remain constrained by inadequate infrastructure, such as power and roads, even though power sector projects may provide some additional electricity capacity in the near term. Continued economic growth will depend on rising commodities prices and increased efforts to diversify the sources of growth.

Trade is important to Sierra Leone's economy; the value of exports and imports taken together equals 59 percent of GDP. In general, foreign and domestic investors are treated equally under the law. State-owned enterprises distort the economy. The financial system was undermined by prolonged economic and political instability, and the recovery process has been sluggish. By mid-2017, Sierra Leone was ranked 136th in export economy of the world with an annual percentage trade value growth rate of 8% and total goods and services exported estimated at 20%.

2.1.2.2 Agriculture

Sierra Leone is an agricultural country accounting for up to 50% of the country's GDP. Agriculture is the largest sector in the economy, providing employment for over 60% of the labour force, nearly half of the working-age population engages in subsistence agriculture. Together with fisheries, forestry and hunting, it contributes 61.3% of GDP in 2013. In 2010, rice contributed 15% of agriculture GDP. Nearly 75% of the country's total land area (72,325 km^2) is arable. Upland and lowland ecologies make up 78% and 22% respectively of the arable land area. Most of the agriculture is carried out in the upland largely by slash-burn, shifting method of farming with rice cultivation making up the bulk of the subsistence activity. Despite the advantages of slash and burn to the farmers, its benefit is short lived in that it leave the land only fertile for a few years. In addition, slash and burn pose several environmental health concerns. For instance, in the dry season, particulate matter carbon black/soot releases is a nuisance on major roads. In general, various types of NPK fertilizers and pesticides for pest control are employed in farming. Farmers also make use of sheep and goat manure as organic fertilizer for the crops. Manure from chicken poultry farms are mainly used in village gardening together with fertilizers. Alternative practices of farming relying on composting and organic farming is low scale in Sierra Leone.

Rice grown by 80% of farmers, is the most important subsistence crop and, along with millet in the northeast, is the country's staple food. The Rice Research Institute located in the Northern Province breeds high-yielding varieties for seed. Other domestic food crops include cassava, yams, peanuts, corn, pineapples, coconuts, tomatoes, and pepper. In 2002, the most important staple food, rice, occupied nearly 402,200 ha. Apart from the upland ecosystem, rice is produced in 4 other distinct ecologies namely: inland valley swamps (IVS), mangrove, riverbank flood plains and bolilands. Upland rice is usually intercropped with up to 16 annual crops. Cash crops such as palm oil, cocoa, and coffee are still exported on small scale compared to countries like Cote d'Ivoire and Ghana, which have huge plantations and a large share of the world market. Domestic production of food crops, especially rice, the staple food, increased before the EVD crisis.

Livestock production is largely free range. It includes cattle, sheep, goats, pigs and chicken. Clean soil with low POPs and heavy metal contamination is crucial not to contaminate the grazing livestock with related exposure of the population[20]. However, pigs are often seen in the two major dumpsites and surrounding polluted places in Freetown. The number of livestock has increased significantly over the years rising from a total of under 500,000 head of cattle, sheep and goats in 1984 to over 2 million head in 2010. In 1984 the estimates of ruminants were 33,200 heads of cattle, 264,000 sheep and 145,000 goats. Similar increases in the number of chickens (1.3 to 9.4 million), ducks (128,000 to 800,000) and pigs (7,500 to 40,000) have occurred in the same timeframe (State of the Environment Report 2015). The main concentrations of livestock

[20]Weber R, Herold C, et al. (2018) Reviewing the relevance of dioxin and PCB sources for food from animal origin and the need for their inventory, control and management. Environ Sci Eur. 30:42. https://rdcu.be/bax79

are found in the northern region. By 2013, the estimates were 641,200 heads of cattle, 851,101 sheep and 990,120 goats. 2013 estimates for chicken, ducks and rabbits were 12, 567,380, 991,420 and 15,045 respectively. Currently there is no documented assessment of POPs pollutants in food animals and related food products in Sierra Leone.

2.1.2.3 Forestry

Sierra Leone was originally a forested country with over 60% of its land covered by closed high forest or moist evergreen and semi-deciduous types. However, less than 10% of the original primary forest cover remains today, as a result of deforestation attributed to the shifting cultivation practiced by more than 75% of the country's population, growing populations and shortening fallows. The forest is used for timber, firewood and food and tree crop production. Most dwelling houses in villages utilise building poles/sticks, canes, etc. in the construction of the mud buildings. In 2010, the forest sector contributed about 3% of the agricultural GDP (SSL, 2010).The contribution of forestry to national development in Sierra Leone especially in the energy sector, infrastructure development, biological research, food security, employment and welfare services, etc., is significant but generally underestimated. For instance, total forest area in Sierra Leone is estimated as 2,754,000 ha covering a land area of 38.5%. Forestry accounts for 0.4-2.3% employment in Sierra Leone. The country's main types of primary forest products are: round wood, sawn wood, wood-based panels, pulp, and paper and paperboard. Total annual round wood removals estimated by FAO in 2006 was 137,000 m^3 for industrial roundwood and 6,414,000 m^3 for wood fuel (https://rainforests.mongabay.com/20sierraleone.htm). It is estimated that 38.5% of the country is covered by tropical rainforest but it is estimated that deforestation rates have increased 7.3% since the end of the civil war. This is reflected in forestry contribution to the agricultural GDP between 2010 and 2014 given as 6.05 for 2010, 5.87 in 2011, 5.26 in 2012, 4.53 in 2013 and 4.39 in 2014 (Statistics Sierra Leone, 2013-2014). Continued deforestation is leading to large scale land degradation, loss of biodiversity and diminished land productivity in Sierra Leone. The EPA-SL is now leading the fight against deforestation in the country by encouraging tree planting exercises. Mining companies now have to submit an environmental management plan prior to application of license to operate.

Over 90 percent of Sierra Leone's domestic energy needs for heating and cooking are provided by fuel wood (Sannoh, 2011). Fuel wood and charcoal production provides a supplementary source of income for most farmers. However, uncontrolled logging practice has a negative impact on the remaining forest reserves. Efforts are currently underway to develop efficient local stoves which will use less amount of biomass in homes thereby reducing the heavy demand on fuel wood.

2.1.2.4 Fisheries

The Fishing industry is an important economic activity in Sierra Leone, providing employment for over 500,000 people, mainly in coastal communities. It is the principal source of livelihood for a large proportion of the population of the coastal villages, for example, coastal villages of

Bonthe, Shenge, Tombo etc, consist mostly of a fishing population, and about 25% of the male population of working age is in part-time or full-time fishing. Fish and other seafood are important sources of protein for people. Fisheries contribute about 20% of GDP.

Foreign fleets mainly do industrial fishing. Total catch is estimated at 65,000 metric tonnes with artisanal production accounting for up to 70 %. However, industrial fisheries are primarily in the private sector. Fishery development activities are concentrated on artisanal fishermen mainly in inland waters by assisting them to improve their techniques of production and processing (such as smoking and curing of fish) and by improvement of the infrastructures of credit, storage, transport and marketing. The fisheries division lacks the capability for effective patrolling of fishing in Sierra Leone territorial waters. As a result, the industry suffers from illegal fishing resulting in millions of dollars loss of revenue.

2.1.2.5 Tourism

Sierra Leone has exceptional advantages for the development of tourism: a dry season of 5 to 6 months, excellent beaches, a superb landscape of villages and hills along the coast and a hinterland with a great variety of landscapes and vibrant cultures. However, the tourism industry is still in its infancy.

The ten years civil conflict in the 90s destroyed the fragile tourism industry. Even when the war ended and the industry begin to breathe a sigh of relief, the Ebola epidemic in 2015 followed by the 2017 mudslide and repeated flooding continues to threaten the tourism industry. Notwithstanding, significant improvement are been recorded in the industry. Significant increase in tourist number has been recorded in recent years, with total registered tourist entering the country in 2007 at 32, 223 increasing to 59, 730 in 2017 (National Tourist Board). The UN World Tourism Organisation reported a significant increase in tourist numbers from 2015 to 2016. Tourist numbers recorded were 24,000 in 2015 and 74,400 in 2016 representing ~310% increase.

Despite the recorded gains, for Sierra Leone to experience major increase in tourism numbers compared to other tourist destinations in the sub-region will require large investments, public and private, in hotels, physical infrastructures and various tourism related services. Sand mining continues to be a problem on the beaches. Clearing of forests to construct large homes and charcoal for cooking, is also having an adverse effect on the country's landscape. A lack of sanitation infrastructure contributes to the polluting of the water along the most popular stretch of Lumley and Aberdeen Beaches in Freetown. The high air ticket cost to Sierra Leone is also another challenge for the tourism industry.

Already in place is the establishment of a hotel and tourism training school to address the need for trained manpower. The Freetown Peninsula Road and other major roads throughout the country that are under construction will improve access to the most scenic beaches in the Western Area and will also stimulate construction of hotels along the beaches. Ecotourism is

expected to rise albeit slowly in the coming years. Isolated beaches building eco-tourism community are Tokey, No 2 River Beach, Bureh Town, John Obey and Banana Islands. The Banana Islands lie southwest of the Freetown Peninsula in Sierra Leone. The Islands are about a 20 minutes boat ride from Kent, and offer good opportunities for snorkeling, fishing and a canoe trip around the Island.

2.1.2.6 Mining

Mining is the primary industry and mineral exports generate most foreign exchange. It provides about 2.7% of the country's GDP in 2016. Mining boasted GDP growth by 20% in 2013. The industry contributes more significantly to export earnings than does agriculture, accounting for up 79 percent of total export revenue with diamonds accounting for 46 percent of export revenue in 2008.The mining sector's great potential has not brought the needed benefits that the general populace expects, due to improper policies for exploiting, inefficiency of corruption and utilising the sector's resources and corruption. The recently formed Ministry of Mineral Resources is responsible for the management of the country's minerals sector and the Mines and Minerals Act 2009.

At independence the economy's prosperity was based on mining of diamonds and iron ore. While these exports initially grew, the economy began its seemingly irreversible decline, prosperity changed to stagnation, and then to continuous decline. The general inflation in primary product prices during the 1970s disguised the fall in the volume of mineral exports. In the same period, import prices rose significantly, leading to a decline in the net terms of trade. Overall, the stagnation of the mining sector generated a profoundly depressing effect on the economy.

2.1.2.7 Education

The decade-long war destroyed the infrastructure of the country's education system; the quality of teaching and of the learning environment reached the lowest levels in the world (World Bank and Ministry of Education, Science and Technology (MEST) 2006). However, the government introduced a new system of education in the 90s. The thrust of this new system is on vocational and middle-level manpower training, catering for early school leavers, weak students and dropouts. The system provides for pupils to spend 6, 3, 3, and 4 years respectively in primary school, junior secondary school, senior secondary school and university level. Emphasis is placed on basic and non-formal primary education, with the education of the girl-child as one of the key elements. Technical and vocational training for middle level manpower is being reinforced through restructuring of tertiary education, including the establishment of polytechnics. However, the realisation of the anticipated positive impact of these reforms has been hampered by resource constraints, poor delivery by low-equipped teachers, inadequate teachers and grossly oversized classed. This necessitated the government to amend the system to 6, 3, 4, 4, thereby allowing students to spend more time in the classroom. Despite this, teacher absenteeism in public schools is still a problem in Sierra Leone, a phenomenon which has exacerbated by the fact that teachers have to wait months to be paid by government.

Literacy rate for girls and boys are 50% and 69% respectively. In the recent years, there has been an increase in vocational institutes and colleges around the country. The 2012 Gender Inequality Index (GII) for population in Sierra Leone with at least secondary school education is 9.5% and 20.4% for male and female respectively compared to 23.7% and 35.1% for sub-Saharan Africa average. There is therefore an urgent need to pay serious attention to national education policy, capacity development of teachers and lecturers, quality and quantity of teachers, and teaching mode of delivery.

2.1.2.8 Health and sanitation

2.1.2.8.1 Health

The sector has suffered the same neglect as education, as reflected by the gloomy health indicators. The 2015, the UNDP Human Development Report recorded a life expectancy of 46 years. The Mortality Indicator Cluster Survey II (MICS 3) 2005 reported infant and child mortality rates of 170 and 286 per 1,000 respectively (Sierra Leone Basic Package Health 2005). Infant mortality rate for 2015 was 103 per 1000 whilst crude mortality for infant was 92 death per 1000 life birth. The government of Sierra Leone now provides free health care for pregnant and nursing mothers, and for under-fives. However, women face additional health problems arising mainly from their reproductive role. Poverty, inadequate access to poor reproductive health facilities and malnutrition are the major factors for high maternal mortality, a rate currently estimated at 18 per 1,000, three times higher than the average of 6 per 1,000 for sub-Saharan Africa. Largely as a result of sex and high illiteracy rate, family planning is not widespread as reflected in the contraceptive prevalent rate of only 6%.

2.1.2.8.2 Sanitation

The inadequate and appalling sanitary facilities largely explain the dismal health situation. WHO 2015 situational analysis report on health and sanitation revealed that half of Sierra Leone population lack access to safe drinking water, 13% of the population has access to improved non-shared sanitation facilities, 74% of urban dwellers have access to safe drinking water, 46% of rural people use safe water, 30% of residents have access to safe drinking water in the northern region and only 35% of rural residents have access to safe drinking water. Hardly any rural village has adequate pit latrines, which poses serious health and environmental problems for the communities. The prevailing scene in the rural communities is one in which women and children fetch pails of water from crude, unsanitary hand-dug wells or standing polls of water. Wells normally run dry during the dry season.

In the urban areas, sanitation problems arise mainly from inhabitable living conditions especially in slums areas and poor systems of solid waste disposal. It is common practice for most households without proper toilet system to dispose of refuse by dumping on the roadside, in drainages, or in backyards. The problem has been further compounded by the increasing rate or urbanisation, coupled with the inadequate infrastructure and services for solid waste disposal.

2.1.2.9 Transport

2.1.2.9.1 Road transport

The public road network constitutes the most important transport infrastructure, carrying roughly 80% of internal passenger and cargo traffic. The national road network totals about 11, 300 km, of which some 8,000 km were functionally classified in the national road system and the remaining 3,000 as local network and as unclassified roads and tracks. Following decades of poorly developed road infrastructure, the government embarked on massive road infrastructure development. The 164 Masiaka-Bo highway was completed in March 2010, a project jointly funded by the European Union and the Sierra Leone government. The 35km Matotoka highway commenced in March 2008 and completed in October 2009, funded by the World Bank and the government and many others. Presently, ~13% roads in all categories are in excellent condition whilst ~23, ~ 31 and ~32% of roads are in good, fair and poor states respectively, a significant development from previous years where less than 1,000 Km of the entire network was paved.

2.1.2.9.2 Air transport

Air transportation is similarly underdeveloped, with only one international airport. The international airport has been undergoing some modernization and upgrade to meet international standards. Sierra Leone no longer owns a national carrier. The then Sierra National Airlines, was grounded due to operational and financial constraints. There is a possibility of the construction of a new airport in the near future.

2.1.2.9.3 Water transport

River or maritime transportation is very important to the economy of Sierra Leone, given the long coastline and many navigable rivers and the high proportion of traded goods that are transported by sea and inland waterways. Even though the country has one of the best natural harbours in the world, the poor quality of port and jetty services and infrastructure limits activities and growth of the sector. River transportation is operated mainly by small boat owners, most of whose services are not only inefficient but also highly risky. Lack of adequate safety measures has exposed this system of transportation to a number of navigational hazards, and has accounted for several fatal accidents over the years. Currently, the main water transport in the capital Freetown is private companies ferrying passengers from Aberdeen, Murray Town and Government Wharf to Lungi airport.

2.1.2.10 Telecommunication

Despite the increasing demand for telecommunication services, the existing fixed/land telephone network is characterised by low penetration rates and poor quality of services. The telecommunication infrastructure has not kept pace with developments in the rest of the world. While the global trend has been an increase in the digital and satellite communication, Sierra Leone continues to use out-modeled equipment with low network penetration rates. However, efforts are currently being made to upgrade the existing fixed telephone networks. Presently,

several private sector service providers are operating locally by providing mobile telephone services in large parts of the country. Efforts are being made to cover the entire country with mobile telephone networks.

2.1.2.11 Energy and power

The provision of energy is vital for the realization of economic growth and human development. For years, energy and power supplies in the country have been consistently erratic and unsatisfactory. Energy consumption in Sierra Leone is dominated by biomass, which accounts for over 83% of energy used. The largest source of biomass energy is wood fuel followed by charcoal - the traditional form of energy and is used almost exclusively by households for cooking and craft activities. Imported Petroleum Products are the next largest source of power at approximately 15.8%. Grid-generated electricity accounts for the remainder of the power supplied to the country's citizens. Sierra Leone has a high potential for generating hydroelectric power. The long overdue Bumbuna Hydro Electricity Project inaugurated in the early 1970s was completed in 2007.

The electricity sector was operated by a state owned enterprise, the National Power Authority (NPA) that performs the four separate activities of generation, transmission, distribution and supply. It was characterized by old and inefficient, resulting in substantial losses of generated energy, estimated at 30-40%. Electricity generation, which stood at around a peak of 196 GW hours in 1984, declined drastically to around 25 - 30 GW hours in 2000. As a result, poor power supplies have increased the use of small petrol/diesel driven generators, with significant cost overheads for both individuals and private sector enterprises on the one hand and environmental pollution on the other hand.

In a bid to improve on efficiency, the former (NPA) was restructured into separate electricity generation transmission commission (EGTC) and electricity distribution and supply authority (EDSA). Nowadays, the capital Freetown is powered mainly through the newly constructed hydroelectric Bumbuna Dam, especially during the rainy season which has a 50MW generating capacity in the rainy season and 18MW in the dry. The Northern Provincial towns of Makeni, Magburaka, Lunsar benefit from the Bumbuna Hydro Electricity. Plans are underway by the government to develop mini-hydroelectric plant at Dodo in the Eastern Province that provides electricity to the provincial headquarters towns of Kenema and Bo as well as expand the existing facility and capacity of Bumbuna Hydro.

2.1.3 Environment

2.1.3.1 Physical/natural Environment

Sierra Leone is presently faced with the problem of environmental degradation arising mainly from demographic, economic and social pressures. Poor economic performance, rapid population increase, migration, and poverty have led to increasing demands on the physical environment with consequences of rapid deforestation and with degradation and uncontrolled exploitation of

natural resources. Deforestation accounts to a large extent for the environmental degradation in the country. The traditional farming practice of shifting cultivation, with declining fallow periods, has over the years left vast expanses of land deforested in much of the country. The problem is further exacerbated by the overwhelming dependence of the population on fuel as the main source of energy for cooking and baking and in cottage industry. About 4 million cubic meters of wood biomass is extracted annually to meet domestic energy needs. While uplands continues to be the principal source of fuel wood and construction materials, mangroves in the coastal areas are being increasingly exploited for fuel woods, boat construction, and rice cultivation. This has led to increasing exposures to storms and destruction of natural breeding grounds for marine and estuarine fish and other organisms.

In the northern region of Sierra Leone where 60% of the cattle and small ruminant population is concentrated, over 8,300 km^2 of land has been left bare due to overgrazing. There are no attempts at any form of range and pasture management. Bushfires continue to affect about 200,000 ha of savannah woodlands annually. Thus, overgrazing and annual bush fires have caused an apparent ecological change from savannah woodland to grassland in the cattle rearing areas.

Mining activities, particularly in the eastern and southern regions, have also left vast areas deforested and degraded. It is estimated that between 80,000 and 120,000 ha have been mined in different parts of the country with minimal efforts at reclamation. The uncontrolled exploitation of mineral resources, especially diamond and gold, coupled with the absence of mitigating policies and conservation programmes over the years, has resulted in devastating environmental consequences.

In the Western area, rapid urbanization threatens the natural beauty of the beaches along the coast. Round-the-clock sand-mining for new housing construction on beaches is having a devastating effect on the coastline, destroying properties, and damaging the beach's hopes of a tourism revival. Currently, coastal erosion is up to six meters in some beaches due to sand mining.

There are a range of sources for pollution of air, soil and water. Dumpsites around the country are a major source of atmospheric pollution as burning of waste is the only means at the sites to reduce the waste volume. Plastics are on the increase in waste fraction in the country (Frazer-Williams et al., 2011) and are major fuel sources. Open burning result in a range of pollutant release. Kargbo and Frazer-Williams (2017) reported values between 180 – 280 $\mu g/m^3$ for $PM_{2.5}$ and 300 – 520 $\mu g/m^3$ for PM_{10} from dumpsites in Freetown. Open burning of wastes in the dumpsites releases UPOPs such as PCDD/PCDFs and result in contaminated sites over time including contamination in the surrounding. The burning of polystyrene polymers - such as foam cups, yogurt and containers etc. -releases styrene. Styrene gas can readily be absorbed through the skin and lungs. These pollutants once in the human system have been documented to increase the risk of heart disease, aggravate respiratory ailments such as asthma and emphysema, cause

rashes, nausea or headaches, damages in the nervous system, kidney, liver, the reproductive and development system. The, lack of research capacity is preventing the country to determine the exact contribution of dumpsites in the release of POPs and other chemicals to the atmosphere.

There is no widespread soil pollution in Sierra Leone. However, significant small patch of soil pollution is evident around the country. These include areas where waste is burned, leakages from sites storing oils and chemicals, leachates containing heavy metals and dissolved organics from dumpsites, degradation products from dumpsites, spillages of used motor oils from garages, pesticides from runoffs in agricultural lands and gara-tie-dye wastewaters from cottage dye industries.

With regard water pollution, dumpsites are relevant emitters of pollutants to ground and surface water. Chemicals used in some industries might contaminate water. For instance, water soluble chemicals like perchloroethylene used in dry cleaning or per- and polyfluorinated alkylated substances (PFASs) used in firefighting foams or consumer goods can contaminate ground water. Also pesticides used in agriculture are likely contaminating ground and surface water. There has not been any assessment on chemicals used and resulting water pollution yet mainly due to lack of the appropriate technical capacity in the country. A major water pollution threat in the country include acid waters from mine sites which impact well water used by residents in nearby villages for domestic purposes.

In a bid to address this problem, the EPA-SL now do on and off site environmental monitoring across the country as well as mandate the submission of environmental data (soil, water and air as appropriate to the company) quarterly from all companies whose activities are likely to impact the environment.

2.1.3.2 Waste Management

There is no effective waste management in Sierra Leone. There is hardly any recycling activity in Sierra Leone. At present, only few private companies practice waste segregation. Wastes collected are mainly transported to dumpsites and another share is burned or disposed along road sites or on private level. Waste management at all dumpsites could be described as crude, uncontrolled and unacceptable according to modern method of handling of waste. At the dumpsites, scavengers scrambled over waste piles to retrieve recyclable metals and other materials which they sell for their livelihood.

Dumpsite leachates and runoff pollute nearby streams, ground water, estuarine waters and the Rokel river (Frazer-Williams *et al.,* 2011). Some residents around the Kingtom dumpsite that lack pipe water rely on well water for drinking water and other domestic purposes with potential exposure. Open burning with its consequent air pollution as well as rampant scavenging on waste heap for valuable recyclable materials is of public health concern (Frazer-Williams, 2015). Open burning is the only waste management practice employed on the dump site to reduce the waste and create room for incoming waste. Therefore these dumpsites also serve as contamination

sources for the release of polyaromatic hydrocarbons (PAHs), unintentional POPs (UPOPs) and carbon black during open burning.

2.1.3.3 Chemical Management

Chemical management is still a major challenge in the country as there is no waste segregation and no destruction capacity such as incineration with could destroy chemicals and chemicals in products at the end of life. Therefore all chemicals and chemicals in products imported to Sierra Leone are finally released to the environment or end up on dump sites with associated releases.

To date Sierra Leone has not done a chemical profile. However, the country has open discussion with UN agencies such as UNITAR to support in the development of the country's chemical profile.

2.2 Institutional, Policy and Regulatory Framework

2.2.1 Environmental and sustainable development policy and general legislative framework

2.2.1.1 Legislation formulation process

The process of formulating national laws is initiated by the relevant ministries or commissions which prepare draft legislation/policy. The draft legislation/policy is then normally circulated to various stakeholders who are invited to make inputs through regional and national workshops in order to achieve refinement and build consensus. The draft legislation is then submitted to the Cabinet via the relevant supervising ministry; it is then deliberated upon by the Cabinet and the approved decisions constitute a white paper which is then sent to the legal drafters employed by the Law Officers Department within the Office of the Attorney General and Ministry of Justice. The drafted legislation is then submitted to Parliament in the form of an act/bill for debating and adoption; the adopted act/bill, however, only becomes law when it receives Presidential accent/signature.

2.2.1.2 National environmental policy

There are a range of beneficial effects of chemicals to modern life. Different chemical groups and application including food preservatives, medicines, fertilisers, pesticides, detergents, refrigerants, cosmetics, have positive effects of modern society. However, there is also an unpleasant/harmful aspect to the use of chemicals. These unpleasant/harmful effects are frequently expressed as obnoxious health and environmental impacts, such as the increasing frequency of hitherto rare diseases like cancers, a range of endocrine effects, neuro-developmental effects including birth disorders, loss of biodiversity of certain types of fauna and flora, etc. It is against this background that Sierra Leone recognises the need for a strategic approach to the management of the use of chemicals, such that the beneficial effects far outweigh the inimical effects.

One group of chemicals that are highly relevant here are those referred to as "Persistent Organic Pollutants" (POPs). POPs share the following unique characteristics: persistence, toxicity, bio-accumulation, and the potential for long-range transport. Because of these unique properties (especially the fact that their unpleasant/deleterious effects can be expressed thousands of miles away from their places of production or use) coordinated global action is being employed in the frame of the Stockholm Convention to ensure that the production and use of POPs is banned or reduced and managed.

As a responsible member of the global community, Sierra Leone is aware of the need for global action in the protection of the environment and of human health. This awareness is manifested by the fact that Sierra Leone, during its relatively short contemporary period of its stable democracy, is signatory and party to a number of international environment and health-related conventions/protocols including the Stockholm Convention for controlling POP chemicals (refer to Table 3 for a more comprehensive list).

In 1990, the Government with the support of the World Bank prepared three national documents on the protection and management of the environment and natural resources, namely the National Environmental Policy (NEP), National Environmental Action Plan (NEAP) and the National Environment Protection Act, 2000 (NEPA).

The National Environmental Policy (NEP), which was approved by the Cabinet in1990 and revised in 1994 (GOSL, 1994), aimed at achieving sustainable development in Sierra Leone through sound environmental and natural resources management. The policy objectives are to:

- Secure for all Sierra Leoneans a quality of environment adequate for their health and well-being;
- Conserve and use the environment and natural resources for the benefit of the present and future generations;
- Restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere;
- Preserve biological diversity, and uphold the principle of optimum sustainable yield in the use of living natural resources and ecosystems;
- Raise public awareness and promote understanding of the essential linkages between the environment and development and encourage individual and community participation in environmental improvement efforts.

The NEP also contains sector policies on land tenure, land use and soil conservation; forests and wildlife; biological diversity and cultural heritage; mining and mineral resources; air quality and noise; sanitation and waste management; toxic and hazardous substances; coastal and marine resources; working environment; energy production and use; settlements, recreational space and

greenbelts and public participation. One of the major strategies which the Government is now pursuing to achieve the goals of the NEP is to make environmental impact assessment (EIA) of proposed activities, which may significantly affect the environment and the use of resources, a priority (GOSL, 1994).

The NEP also has a specific goal and policy for water resource management which ensures adequate quantity and acceptable water quality to meet domestic, industrial, transportation, agricultural and fisheries' needs by accelerating programmes for the utilisation of water for the various uses and expanding water quality management, monitoring and assessment programmes. Although laws prohibiting pollution of water bodies exist, they are hardly enforced.

2.2.1.3 Agriculture and food security sector policy

The Ministry of Agriculture and Food Security, in its drive to achieve Food Security by the year 2007, has prepared a policy intent document. This ministry deals with the protection of crops and animal diseases and therefore imports a lot of agrochemicals and likely POPs. This policy intent states thus:

(a) Fertilisers and agrochemicals

Intensified crop production normally requires the use of substantial quantities of fertilisers in order to exploit the potential of improved crop varieties, and to sustain the momentum of growth in production. There will also be a commensurate increase in requirement for agrochemicals such as pesticides, soil conditioners, etc. The government strategy entails the following:

- Encouraging the sustainable use of appropriate fertilisers and agrochemicals by farmers. To this end, the extension services will train and encourage farmers in the principles of integrated nutrient and pest management technologies;
- Transferring the responsibility for the procurement and distribution of fertilisers and agrochemicals to certified dealers in the private sector. The Government will, however, continue to monitor the sector in order to ensure that adequate quality, safety standards and fair prices are maintained;
- Encouraging the participation of entrepreneurs in the importation, marketing and distribution of fertilisers. Towards this end, the Government will waive duty for fertiliser importation, ensure that the road infrastructure is well maintained, and the entrepreneurs have credit guarantees to facilitate fertiliser imports and the purchase of delivery trucks;
- Since no private sector trade will develop if it has to compete with subsidised public importation and distribution, the Government will cease to subsidise the importation and distribution of fertilisers and agrochemicals.

(b) Crop protection

The objective of crop protection policy are to control and maintain surveillance of the major weeds, pests and plant diseases the incidence of which may cause large scale damage/loss to crop production.

(c) Soil health and organic farming.

The fertility of a soil is an important factor in crop productivity. In Sierra Leone, upland soils are generally ferralitic, shallow and infertile. Soil organic matter content is low (10.6 percent) and depth ranges from 3–9 cm, with low pH (4.0–5.0), and low nutrients (NPK), high aluminium content hence their inherent infertility. Although lowland soils are more fertile with Inland Valley Swamps (IVS), mangrove swamps and riverain grasslands all rich in organic matter, bolilands and some IVS have problems related to high iron and aluminium content. Further, water logging, inadequate drainage and poor water control are problems in IVS, seasonally flooded bolilands and the mangroves. Additional factors which influence soil health and fertility are pressure on land, especially upland soils, with the consequent reduction in fallow periods and low levels of fertilizer use among small holders. Sustainable soil fertility management with nitrogen fixing rotations, conservation agriculture/minimum tillage and targeted use of chemical inputs that are increasingly expensive are urgently needed to address soil infertility issues in the country.

Organic farming is not widespread in Sierra Leone. It is mostly practiced at low to medium scale agricultural activities especially in rural areas.

To realise these policy objectives, the Government will:

- Establish and maintain an early warning system that constantly monitors national crop pests, diseases and weeds and draws attention to emerging threats;
- Put in place a mechanism for emergency control measures for epidemics;
- Put in place effective quarantine facilities at strategic border crossing points;
- Mount educational programmes that will make farmers appreciate the need for early warning of pest and disease outbreaks and encourage them to adopt appropriate control measures;
- Assist farmers in identifying pest problems and assessing crop losses;
- Encourage research institutions to carry out investigations on the biology and ecology of pests in any geographical zone and determine the most appropriate methods of control;
- Seek the assistance or cooperation of neighbouring countries with the objective of controlling pests and diseases of economic importance without endangering national security.
- Support, encourage and increase the organic farming activities.

2.2.2 Institutional roles and responsibilities

2.2.2.1 Profile of the Government

Sierra Leone is a former British colony that is governed by a western style democracy that reflects largely the United States of America's system with a small blend of the British system. The constitution provides for 3 separate and independent organs of government, namely the Executive, the Parliament, and the Judiciary. Devolution of executive and parliamentary powers to the Local Government Councils on the basis of the Local Government Act 2004 is currently on-going. The aim is to give more power to the people at the grassroots level and enable them to competently participate in the planning and implementation of development programmes within their areas of jurisdiction.

(a) The Executive

The Executive is headed by the President who is elected by popular vote every 5 years. The President is assisted by the Vice President (also elected as running mate) and a group of ministers; these together constitute the Cabinet. The Cabinet Ministers are nominated by the President but must be vetted and approved by Parliament before they can serve in office.

(b) The Parliament

The Parliament is constituted of elected representatives of the various constituencies including Paramount Chiefs representing each of the 13 Districts and is the sole legislative organ; it is presided over by the Speaker and assisted by a Deputy Speaker both of whom are elected by Parliamentarians. In addition to the Plenary where bills are debated and laws enacted, Parliamentary Sub-Committees serve as oversight bodies for various ministries.

(c) The Judiciary

The judiciary is headed by the Chief Justice who is appointed by the President on the advice of the Attorney General who also doubles as Minister of Justice. The judiciary operates along the British system and consists of the following organs: the Supreme Court, the Court of Appeal, the High Court, and the Magistrate Courts. The judges and magistrates that preside over the various courts are appointed by the President on the advice of the Chief Justice and are vetted by the Parliament before they are qualified to serve. The Sierra Leone Law Reform Commission, an independent body of prominent Sierra Leoneans appointed by the President, is responsible for the review of the country's laws.

2.2.2.2 Government institutions involved with environmental and chemical management

Several institutions are charged with the responsibility of environmental and chemical management in the country.

2.2.2.2.1 National institutional arrangements related to chemical management

Numerous institutions in Sierra Leone are involved in the use or regulation of chemicals directly or indirectly in their daily operations. Major ones are:

i. The Environment Protection Agency (EPA-SL)
ii. National Protection Area Authority (NPPA)
iii. National Commission on Environment and Forestry (NaCEF)

There are no specific institutional arrangements and legislative framework for the use and management of chemicals. Nonetheless, these institutions have practices, policies and regulations with regard to the utilisation of chemicals and/or to natural resources management.

(i) Environmental Protection Agency – Sierra Leone

For a long time the administration of environmental issues in Sierra Leone was handled by a small department, the Environment Department (ED), appended to one of the major government ministries. The ED started as a unit in 1996 within the Ministry of Transport, Communication and the Environment; it was then transferred to and became a division within the Ministry of Agriculture, Forestry and the Environment in 1997 just before the interregnum. It was again transferred to the Ministry of Lands, Housing, Country Planning and the Environment (MLHCPE) in 1999 where on enactment of the Environment Protection Act 2000 it became a Department and is currently still based in this Ministry. The Department is headed by a Director of the Environment with a Board (the National Environment Protection Board - NEPB) that provides policy oversight. This further led to the development of a separate and an independent body - the Environment Protection Agency.

The Environment Protection Agency, Sierra Leone was established by an Act of Parliament, the Environment Protection Agency (EPA) Act (2008). It is now the leading institution in the country charged with the responsibility of protecting the environment. It is a corporate body charged with responsibility for the effective protection of the environment. The agency acts as the focal point for all national and international environmental issues relating to Sierra Leone. The agency coordinates and monitors the implementation of all environmental policies, programmes, projects and activities. The EPASL is the focal point for Stockholm, Minamata, Montreal and SAICM. The updating exercise of the NIP is anchored in the Chemical Control and Management Department of EPA-SL, working in collaboration with the International Expert as well as a National Coordinator and a team of local experts from relevant ministries, government agencies, academia and research institutions and NGOs. Presently, through the EPASL, Sierra Leone has opened discussion with UN agencies such as UNITAR to support in the development of the country's chemical profile.

In line with the National Environmental Policy of Sierra Leone, the EPA-SL ensures that Environmental Impact Assessment (EIA) is applied to all developments with potential impacts on the environment. EIA was introduced in 1999 by the then Department of Environment, under the Ministry of Lands, Country Planning and Environment. However, the EIA guidelines

developed in 1999 was not robust enough to address the many environmental issues during the development of projects. This necessitated the EPA-SL to revise the EIA procedure in 2015.

(ii) National Protection Area Authority

The National Protection Area Authority Act was passed in 2012. The Act provides for the establishment of the National Protected Area Authority (NPAA) and Conservation Trust Fund. The purpose of the Act is to promote biodiversity conservation, wildlife management, research, provide for the sale of ecosystems services in national protected areas, promotes co-management of natural resources for the NPAA within and outside national protected areas with local forest edge communities and exercise oversight and authority over National Parks and Protected Areas designated for conservation purposes and to promote sustainable land use practices and sustainable environmental management.

(iii) National Commission on Environment and Forestry (NaCEF)

This commission is intended to be the main authority for the management of the environment and forest resources in Sierra Leone. It is intended to carry out its mandate through two departments, namely the Environment Department and the Forestry Department. The Environment Department of the Commission is the lead agency for the implementation of the Stockholm Convention and the three Rio Conventions, i.e. the United Nations Conventions on Biological Diversity (UNCBD), the United Nations Framework Convention on Climate Change (UNFCCC), and the United Nations Convention on Combating Desertification and/or Land Degradation (UNCCD). The Department acts as the focal point for all national and international environmental issues relating to Sierra Leone and has the responsibility to coordinate and monitor the implementation of all environmental policies, programmes, projects and activities. It is empowered under the EPA to put in place all necessary mechanisms and environmental standards and legislation to protect and manage the environment and its natural resources.

It is proposed that the Commission be represented on the boards and committees of government line ministries and related institutions in order to promote effective collaboration and cooperation for proper environmental and natural resources management and thereby to ensure the mainstreaming of environmental sensitivity in natural resources management. It is also proposed that the Commission will have a board that will take over the functions of both the National Environmental Protection Board and the Forestry Board by providing policy and professional oversight (such as the review of Environmental Impact Assessments - EIA) and facilitating coordination, cooperation and collaboration among government ministries, local authorities and other government agencies in all matters relating to environmental protection and management.

The mandate of the Forestry Department is intended to be the collection of baseline data on forest reserves and forest biodiversity, monitoring and protection of improved forest trees, establishing a mechanism for harvesting and replenishing of forest resources on a sustainable yield basis, protecting watersheds, and developing wildlife sanctuaries, promoting agro-forestry

and community woodlots, promoting afforestation/reforestation and put in place measures that ensure the control of erosion and bushfires. The Wildlife Conservation Branch, which is under the Forestry Division and supervised by the Director of Forestry, has the mandate to manage all of the nation's protected areas and implement the provisions of the Wildlife Conservation Act and enforce the laws contained therein.

2.2.2.2.2 Ministry of Agriculture, Forestry and Food Security (MAFFS)

The mandate of the ministry spreads across crop and domesticated animals development and improvement policies, and related services. The ministry exercises mandate over the environment through such Departments as Agriculture, Land and Water Development, Planning, Evaluation, Monitoring and Statistics and the Livestock Unit. The crop protection section of the ministry is charge with the responsibility of control of pesticides.

2.2.2.2.3 Ministry of Mineral Resources (MMR)

This ministry controls all mining activities in the country. In recognition of the negative impact of mining on the environment and concerns expressed by the public, the Ministry has developed a new mining policy and legislation, which make provision for the rehabilitation of mined out areas and ensure "that prospecting, exploration, mining and processing of mineral resources proceed in an environmentally sound manner". The mining code stipulates that large and medium scale mines develop and submit an Environmental Impact Assessment (EIA) prior to the application for a mining license. The EIA must clearly state the appropriate steps/actions to be taken to mitigate damage caused by mining activities on the environment. The ministry contributes to the management of natural resources through provision of grants to local communities for the rehabilitation of mined out areas.

2.2.2.2.4 Ministry of Health and Sanitation (MoHS)

The Ministry of Health and Sanitation collaborates with various other ministries, department and agencies on matters relating to environmental health. Health officials often participate in meetings, projects and related activities relating to environmental management. The Department of Environmental Sanitation periodically sanitizes compounds although this is not effectively done to cover all households. Other-than this, the ministry is not actively involved in chemicals except drugs.

2.2.2.2.5 Ministry of Education, Science and Technology (MEST)

Through the academic institutions, the Ministry of Education, Science and Technology assists in the delivery of environmental education including climate change, environmental protection and preservation as well as the management of POPs. Nowadays, more tertiary institutions are offering courses that address environmental management.

2.2.2.2.6 Ministry of Fisheries and Marine Resources (MFMR)

This ministry manages, develops and conserves all fisheries and marine resources. The Fisheries Management and Development Act of 1988 (GOSL, 1988) and the Fisheries Regulation of 1990 prescribe the preparation of management and development plan, specific procedures for licenses, and measures for conservation, enforcement and surveillance.

The management of marine and coastal resources is shared between the Ministry of Fisheries and Marine Resources, the Institute of Marine Biology and Oceanography (IMBO) of the University

of Sierra Leone at Fourah Bay College, and the Maritime Authority of Sierra Leone and Maritime Protection Services of Sierra Leone (MPSSL). The performance of these institutions is very low due to the very low conviction rate of vessels charged with violating regulations and fixed fines at levels that make them ineffective as a deterrent (MPSSL, 1992).

2.2.2.2.7 Ministry of Energy (MoE)

The Water Supply Division (WSD) in the ministry, the Guma Valley Water Company and the Sierra Leone Water Company (SALWACO) has the responsibility to provide and conserve water and to control the water quality. The Department of Energy and Power (DEP) is responsible for the national energy policy, the development of energy resources and the promotion of energy conservation.

2.2.2.2.8 Ministry of Labour and Industrial Relations (MLIR)

The Factory Inspectorate of the Ministry of Labour and Industrial Relations is the unit charged with ensuring health and safety at the workplace. In the execution of its mandate, the Factory Inspectorate deals with matters related to the management of the use of chemicals including POPs. Through its membership of the International Labour Organisation (ILO) this unit is a party to a number of ILO conventions/protocols related to the management of chemicals. The Convention on Occupational Health and Safety at Work is perhaps the most relevant here.

2.2.2.2.9 Ministry of Tourism and Cultural Affairs (MTCA)

The MTCA supervises the National Tourist Board and the National Museum on tourist promotion and development. It also liaises with relevant ministries/departments regarding the preservation of ancient monuments and relics and environmental protection for tourism and eco-tourism.

2.2.2.3 Institutional infrastructure for chemicals

2.2.2.3.1 Customs and Excise Department (CED) of the National Revenue Authority (NRA)

At present no economically useful chemical is manufactured in Sierra Leone. All chemicals therefore have to be imported. The Customs and Excise Department (CED) of the National Revenue Authority (NRA) is the government organ responsible for overseeing and regulating the importation of chemicals into Sierra Leone. This department faces a number of challenges in the achievement of its ultimate goal of mobilising revenue for development. Some of these challenges include the employment of the right mix of personnel (including those with the requisite scientific background to support the chemical management efforts demanded by the Stockholm and other related Conventions) and requisite modern equipment and technology. The existence of a small number of customs posts, each covering hundreds of kilometers of porous borders connected by poor road and telephone network, is an added challenge for and effective control of the boarder. Currently, NRA is collaborating with the EPA on regulating importation of chemicals including ozone depleting substances into the country.

There is no life cycle control or management of chemicals currently in the country. Disposal of chemicals in the country is also a major challenge with no chemical treatment facility or destruction capacity available in the country. Although handling of chemicals is not a major activity in the country, no waste management company or the municipality is equipped in dealing with chemicals and products containing POPs or other problematic chemicals.

2.2.2.3.2 Ministry of Trade and Industry

One of the major assignments of the Ministry of Trade and Industry is the management of standards and quality in Sierra Leone. This ministry achieves its goal by supervising the Sierra Leone Standards Bureau (SLSB), which is an autonomous coordinating body responsible for all standards and quality issues in the country. The general mandate of the bureau is to ensure the safety of products consumed in Sierra Leone. The SLSB develops and adopts standards, is responsible for the inspection of goods and provides testing and quality control services. The bureau is currently financed from three sources: subventions from central government, a 0.03% levy on all imports and exports, and funds from international donors. The levy on imports and exports is fixed at a given level for all transactions. It is expected that as this bureau develops, this levy should be replaced by a fee directly related to the services provided.

Sierra Leone is a member of the World Trade Organisation (WTO) and needs to take further steps to meet the requirements of the Technical Barriers to Trade (TBT) and Sanitary and Phytosanitary (SPS) Agreement by making its technical regulations transparent to trading partners. The SLBS has been nominated as the enquiry point for both SPS and TBT issues. An effective notification and enquiry point requires trained staff and the resources to undertake inter-agency and inter-ministerial contacts and coordination and to manage the necessary flow of information.

2.2.2.4 Roles of private sector, academic and other non-governmental institutions

2.2.2.4.1 Local and private sector institutional arrangements

Sierra Leone at the moment cannot initiate natural resources management. This may be due to the poor resources available to government agencies and the pernicious degradation of the environment by rural and some communities.

However, the Government, NGOs and local communities have over the years initiated activities that are providing the nature of natural resources management interventions. Problems that are identified have been under scrutiny in these initiatives, including the poor level of resources available to the different sectors.

Various personalities and village level organisations throughout the country have a direct impact on the use and management of natural resources. The relative importance and effectiveness of these individuals/bodies vary greatly between one natural resource and the other. They are, however, all concerned with some aspect of natural resources management.

Individuals/organisations found in most villages and towns that are of direct relevance to the use of forest resources include:

- Traditional authorities, i.e. the chiefs and elders;
- Village development committees (which provide linkages between traditional authorities);
- Producer associations, farmers' associations, etc.;
- Market women's associations;
- Mutual support groups for farming activities;
- Fire volunteer squads.

While some villages are headed by a "headman" with little land resource holding responsibilities, there are other chiefs with vast land resource holding responsibilities. The importance of these authorities in natural resource issues vary widely, but generally the village or town chiefs play key roles in natural resources management. Chiefs have the responsibility to ensure that concession holders and developers in mining, timber production, palm wine production, sand extraction, etc. pay royalties. There is, however, little evidence that these chiefs carry out actions to ensure the conservation of the resources.

Village development committees operate in response to directives from the Government, NGOs and Community Based Organisations (CBOs). They generally organise communal labour initiatives often with plans for the management of natural resources. Farmers associations are widespread and assume responsibilities for a wide range of farming activities.

Fire volunteer squads are formed and operate in many communities. In the dry season, fire is the dominant causal factor in the changing use of land. As a result, fire is one of the issues that stimulate the highest degree of consensus and opinion.

The new dispensation to decentralise planning and administration to a local level will reinforce the local government council's role in:

- Ensuring the enforcement of bushfire laws;
- Initiating tree planting campaigns;
- Prompting payment of royalties and surface rents to land owners whose lands are mined out;
- Regulating chainsaw operators;
- Prohibiting clearing and cultivation of riversides;
- Prohibiting planting on marginal areas.

Formidable women organisations that have links with natural resources management also exist since they access a variety of forest products. They see the need for controlled harvesting of resources and have the ability to enforce rules about who could harvest how much and when.

2.2.2.4.2 Academic institutions

The Njala University, which evolved from the University of Sierra Leone in 2004, has a Faculty of Environmental Sciences with four academic departments that focus on teaching and research activities on the environment. Numerous other institutions within the University of Sierra Leone are involved in environmental and natural resources data gathering, monitoring, and evaluation. These include the Departments of Biological Sciences and of Chemistry, the Institute of Marine Biology and Oceanography (IMBO), the Institute for Population Studies (IPS) (all at Fourah Bay College) and the Division of Community Health at the College of Medicine and Allied Health Sciences. Besides the University of Sierra Leone and Njala University, none other academic institution has the capacity to manage POPs chemicals in the country

2.2.2.4.3 Non-governmental organisations

Non-governmental organisations (NGO's) in Sierra Leone have supported activities related to POPs management. There is a strong NGO sector in Sierra Leone creating public interest in environmental issues. The most active NGOs on the ground in areas related to environmental and natural resources management are The Conservation Society of Sierra Leone (CSSL), The Environmental Foundation for Africa (EFA),The Commonwealth Human Ecology Council (CHEC-SIL), The Organisation for Research and Extension of Intermediate Technology (OREINT) and Green Scenery and Friends of the Earth.

2.2.2.4.4 Media

The print and electronic media play a significant role in POPs management by disseminating information to the wider public. They serve as participants during workshop and often publish workshop communiqué and other proceedings. They also form part of tour teams in the provinces.

2.2.3 Relevant international commitments and obligations

Sierra Leone is a signatory to a number of international treaties and agreements relating to the management of the use of chemicals including Persistent Organic Pollutants (POPs). In a bid to foster international collaboration and cooperation in sound environmental management, the country signed and ratified a series of sub-regional, regional and global environmental conventions. Some of these treaties and conventions could be directly or indirectly related to chemicals or POPs management. Following the first NIP, Sierra Leone has increased number of conventions signed or ratified.

2.2.3.1 Stockholm Convention on Persistent Organic Pollutants

The Convention was adopted and opened for signature at a Conference of Plenipotentiaries held from 22 - 23 May 2001 in Stockholm, Sweden. Sierra Leone signed and acceded to the Stockholm Convention on Persistent Organic Pollutants (POPs) on 26th September 2003. Being a signatory to this convention, Sierra Leone is obliged to prepare her National Implementation Plan (NIP) to reduce or eliminate the use of PCB POPs.

Persistent Organic Pollutants possess toxic properties, resist degradation, lead to bioaccumulation and are transported through air, water and migratory species, across international boundaries and deposited far from their place of release, where they accumulate in terrestrial and aquatic ecosystems. They are of health concerns, particularly their impact on women and future generations. Thus, their production and use as pesticides and as dielectric in transformers and capacitors needs to be eliminated and the generation of unintentionally produced POPs ought to be reduced.

2.2.3.2 Bamako Convention on the Ban of the Importation into Africa and the Control of Transboundary Movement of Hazardous Waste within Africa

The goal of this Convention is:

1) To protect, by strict control, the human health of the African population against adverse effects which may result from hazardous wastes by reducing their generation to a minimum in terms of quantity and/or hazardous potential;

2) To adopt precautionary measures to ensure proper disposal of hazardous wastes and to prevent dumping of hazardous wastes in Africa.

Sierra Leone adopted this Convention in 1991 and signed it in 2003.

2.2.3.3 Rotterdam Convention on Prior Informed Consent (PIC) for Certain Hazardous Chemicals and Pesticides in International Trade

Sierra Leone ratified the Rotterdam Convention on Prior Informed Consent (PIC) for certain hazardous chemicals and pesticides in international trade on 1st November 2016.

2.2.3.4 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

Sierra Leone signed and ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal on 5th May 1992 and 1st November 2016 respectively.

2.2.3.5 Convention for the Prohibition of Chemical Weapons

Sierra Leone signed this Convention on 15 March 1993. It was later ratified on 30th September 2004.

2.2.3.6 International Plant Protection Convention (IPPC)

Sierra Leone became a party to the International Plant Protection Convention on 23 June 1981. This convention obliges the Government of Sierra Leone to protect plants that are within and those entering the country especially the invasion of alien species.

2.2.3.7 United Nations Convention on the Law of the Sea (UNCLOS)

Sierra Leone became a signatory to the United Nations Convention on the Law of the Sea (UNCLOS) on 12 January 1995. Under this convention, Sierra Leone is obliged to protect the sea from pollution from land and sea-based activities.

2.2.3.8 Convention for Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Abidjan Convention)

Sierra Leone signed the Abidjan Convention on 7 June 2005. The Abidjan Convention is a comprehensive umbrella agreement for the protection and management of the marine and coastal areas. It lists the sources of pollution which require control; pollution from ships, dumping, land-based sources, exploration and exploitation of the seabed, and pollution from or through the atmosphere. It also identifies environmental management issues for which cooperative efforts are to be made; coastal erosion, especially protected areas and combating pollution in case of emergencies.

2.2.3.9 United Nations Convention on Biological Diversity (UNCBD)

In 1994, Sierra Leone became signatory to the UNCBD and in 1995, GOSL ratified the CBD. In response to its obligations under the UNCBD, the then Ministry of Agriculture, Forestry and Marine Resources, Ministry of Lands, Country Planning and the Environment, with support provided by the United Nations Development Programme (UNDP), formulated the Biodiversity Strategy and Action Plan (BSAP) in 2003 and submitted its first draft report to the Conference of Parties (COP). This process was interrupted by the period of political instability, but restarted in 2000 - 2001. This formed the basis for the implementation of biodiversity country studies.

2.2.3.10 United Nations Convention on Combating Desertification (UNCCD)

GOSL signed and ratified the UNCCD on September 25, 1997. Since then, an elaboration of the National Action Plan (NAP) for the implementation of the CCD within the context of Sierra Leone's economic, social and environmental conditions has been undertaken. The then Ministry of Lands, Country Planning and the Environment was designated the lead agency for the implementation of UNCCD. The national focal point is within the Environment Protection Division (EPD) in the National Commission on Environment and Forestry. In 2002, the National Steering Committee for Desertification submitted Sierra Leone's first national report on the implementation of the CCD to the UNCCD Conference of Parties.

2.2.3.11 United Nations Framework Convention on Climate Change (UNFCCC)

Sierra Leone signed, ratified, and became a party to the UNFCCC, on June 25, 1995. With support from GEF Sierra Leone has undertaken a country study on the Initial National Communication (INC) for the UNFCCC and has submitted it to the COP, in compliance with the provisions outlined under Articles 4 and 12 of the Convention's guiding principles, namely:

- Considerations as a Non-Annex 1 developing country party with special circumstances;

- The extent of its capabilities;
- Regards for the common but yet differentiated responsibilities; and
- Partnership and sustainable development.

The country is in the process of developing the National Adaptation Plan of Action (NAPA). When completed, the policies and plans emanating from this document would be mainstreamed into the country's development programmes.

2.2.3.12 Nagoya Protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilization to the Convention on biodiversity

Sierra Leone ratified the Nagoya protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilization to the Convention on biodiversity.

2.2.3.13 Vienna Convention on Protecting the Ozone layer and Montreal Protocol

Sierra Leone signed and ratified the Vienna Convention on Protecting the Ozone layer on 21st August 2001 and 29th August 2001respectively.

Table 3. Sierra Leone status of international conventions/protocols related to the management of chemicals

Convention/Protocol	Signed	Ratified
Basel Convention on Control of Transboundary Movement of Hazardous Waste and their Disposal	5th May 1992	01 November, 2016
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade		01 November, 2016
Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits arising from their Utilization to the Convention on Biodiversity		01 November, 2016
Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Waste within Africa	9th December, 2003	
The Stockholm Convention on Persistent Organic Pollutants		Acceded 26 September 2003
The Vienna Convention on Protecting the Ozone Layer	21 August 2001	29th August 2001
The United Nations Convention on Biological Diversity (UNCBD)	1994	Acceded 12 December, 1994
The United Nations Convention to Combating Desertification (UNCCD)	11th November, 1994	25 September 1997
The United Nations Framework Convention on Climate Change (UNFCC)	11thFebruary, 1993	22 June 1995
Convention on the Prohibition of Chemical Weapons	15th January, 1993	30th September, 2004
Convention for Cooperation in the Protection and	7 June 2005	7 June 2005

Convention/Protocol	Signed	Ratified
Development of the Marine and Coastal Environment of the West and Central African Region (The Abidjan Convention)		
International Plant Protection Convention (IPPC)	23 June 1981	23 June 1981
United Nations Convention on the Law of the Sea (UNCLOS)	12 January 1995	12 January 1995
Ramsar Convention on the Conservation of Wetlands		13th December , 1999
Kyoto Protocol to the United Nations Framework Convention on Climate Change		10th November, 2006
The Paris Climate Agreement	26th September, 2016	1st November, 2016
Montreal Protocol on Substances that Deplete the Ozone Layer		29th August 2001
United Nations Convention on Biodiversity (UNCBD)	12thDecember, 1994	12th March 1995
Minamata Convention on Mercury	12th August, 2014	1st November, 2016
Stockholm Convention on Persistent Organic Pollutants	26th September, 2003	1st November, 2016
African Convention on the Conservation of Nature and Natural Resources	15th November, 1968	
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)		28thOctober, 1994
International Convention on Civil liability for Oil Pollution Damage		13th August 1993
Convention on Fishing and Conservation of Living Resources of the High seas		13th March 1962
International Convention on Plant protection		23rd June 1981
United Nations Convention on the Law of the Sea	27th August, 2001	12th December, 1994
International Convention on the Establishment of International Fund for Compensation for Oil Pollution Damage		13th August 1993
United Nations Convention on the carriage of Goods by Sea		7th October, 1988
Comprehensive Nuclear test Ban Treaty	8th September, 2000	17th September, 2001
Convention concerning the protection of the World Cultural and Natural Heritage	28th March 1962	
Amendment to the Montreal Protocol		29th August, 2001

2.2.3.14 SAICM

Sierra Leone is interested in the objectives of SAICM and participates in SAICM activities and the upcoming "beyond 2020" approach. Together with existing conventions, Sierra Leone will control and manage the import and use of chemicals. Therfore in the current SC NIP the to SAICM link is made for an integrated implementation in future where appropriate.

2.2.4 Description of existing legislation and regulations related to POPs

2.2.4.1 Environment Protection Act 2000

During the development of the first NIP, the ministry of lands, Country Planning and the Environment was solely in charge of environmental issues. Today, an autonomous body, EPA-SL, is the regulatory body that was established with the goal of creating and enforcing a strict regulatory framework for environmental regulation in Sierra Leone. It has the mandate to coordinate, monitor and evaluate the implementation of national environmental policies, programmes and projects, including issuing Environmental Impact Assessment (EIA) licences.

The Environment Protection Act (EPA) of 2000, which was enacted into law on 28. February 2000 established the Environment Protection Department (EPD) and authorised the Director of EPD and Minister of the Environment to administer and monitor the implementation of the act. The act makes provision for the sound management of chemicals in the environment including POPs as well as Environmental Impact Assessment (EIA) for certain types of projects to be undertaken within Sierra Leone, which include agriculture, mining, construction, waste disposal, and exploitation of hydraulic resources. In compliance with the Environment Protection Act, the EIA document to be submitted by the "Developer" must clearly give information on the project, its possible impacts on the ecosystem and its locality; social, economic, and cultural effects that the project is likely to have on the people and society; information on how the consultative process with the communities, interested parties, and government ministries is to be carried out; actions or measures taken or to be taken to avoid, prevent, change, mitigate, or remedy the likely effects on the natural resources, people and society of the project area; plans for decommissioning the project; and other information for proper review of the potential environmental impact of the project should also be provided in the EIA document.

Once an EIA document is submitted, the Environment Protection Agency will solicit comments on the EIA report from professional associations, governmental ministries, non-governmental organisation (NGOs) and the public. Following a two- week public comment period, the EIA document and the comments will be submitted to the EPA Board. The Board may provide recommendations to further assess the likely environmental impacts, and/or disapprove the EIA in cases where the proposed alternatives are expected to have significant adverse effects on the environment or natural resources, individuals, or society.

Upon approval of the EIA document, a license is issued for a twelve-month period or a time specified by the EPA. Once the license is issued, the EPA is to undertake effective monitoring of

the project's activities and its environmental impacts to verify compliance. The Minister of Environment may prescribe fees for the license if the terms and conditions of the license are not in compliance with the Environment Protection Act or if there is a substantial change in the project's operations resulting in an adverse effect on the environment. At the expiration of this period, the EPA has the authority to renew or revoke the license.

In issuing a license for a project based on an EIA, the Executive Chairperson of the EPA also has the authority to establish regulations for national environmental standards pertaining to the use of natural resources, water quality, effluent limitation, air quality, wastes, atmospheric and ozone protection, noise control, pesticide residues, and odours. Internationally banned chemicals are prohibited in Sierra Leone, as well as the discharge of any hazardous substances into air, land, and water.

The management of the use of chemicals is a cross-sectoral endeavour. The Environment Department of NaCEF is charged with the responsibility to coordinate the activities of related sectors/ministries with a view to achieve synergies in the overall effort to protect health and the environment.

2.2.4.2 Mines and Minerals Act, 1994

The Mines and Minerals Act of 1994, which came into operation on 4 March 1994, addresses mining leases and licenses requirements for artisanal and industrial mining. When a proponent/miner applies for a mining lease, he has to provide information on the period of time for which the lease is sought; estimated mineral deposits, reserves, and mining conditions; mining treatment options and those selected for use in the mining project; specific details of the mining operation such as the schedule, nature of production, potential environmental and social impacts, forecast of capital investment, operating costs and revenues, and the anticipated source of financing, proposed mitigation programs and marketing arrangements for the sale of the mineral production should be provided and forwarded to the Director of Mines in the Ministry of Mines and Mineral Resources.

Other requirements under the Mines and Minerals Act include the prohibition of illegal exploitation and disposal of any radioactive minerals.

2.2.4.3 New Forestry Act (NFA), 1988

The Act contains special protection provisions under which the Minister is empowered to declare any area to be a "protected area for the purpose of conservation of soil, water, flora and fauna". The legislation stipulates that no person may cut, burn, uproot or destroy trees that are in protected areas (PAs) or trees that have been declared as being protected. The section of the law states that any forest officer designated by the Chief Conservator/Director of Forest may issue a license authorising the holder to fell and extract a protected tree. The Wildlife Conservation Clause under this Act empowers the Minister to declare an area as a strict Nature Reserve,

Natural Park or Game Park. In such areas, activities specified in the act are prohibited "unless duly authorised".

The prohibition of burning of forest is related to the control of unintentional POPs.

2.2.4.4 Draft National Policy and Land Commission Act (NPLCA), 2004

Currently, a comprehensive Land Policy and Lands Commissions Act is being formulated by the Ministry of Lands, Country Planning and the Environment. The draft land policy document is intended to serve as a useful guide for the smooth administration and management of land. The policy provides the framework to ensure equity in access to land and to provide security to tenure in order to maintain a stable environment of the country's sustainable, socio-economic development.

The Land Commission Act is to establish a Commission with its composition and functions and for other purposes including the management of state lands, the execution of a comprehensive programme for the registration of title to land throughout Sierra Leone.

2.2.4.5 Shortcomings

In spite of this seemingly impressive array of environmental and related laws, the legislation has not fully provided a platform for the sustainable use of the country's natural resources and proper management of the environment. This can be attributed to the following reasons:

- Lack of implementation, enforcement and compliance;
- Potential conflicts of interest within sectors by not linking environmental and natural resources management responsibility with other development interests;
- Relatively poor effective mechanism that ensures the coordination of environmental and natural resources management issues in the sectoral ministries and line agencies;
- No regulatory framework on chemical management;
- No regulatory framework for waste management and no national waste management plan
- Slow response and reporting of information to the EPA to carry out effective monitoring of the implementation of environmental policies.

2.2.5 POPs Management capacity

2.2.5.1 National Infrastructure and capacity gaps to manage POPs

The ability of a country to manage POPs is dependent on her state of preparedness with respect to legislations, infrastructure, human resource and equipment.

2.2.5.1.1 Legislations

As can be seen in Table 4, Sierra Leone recently ratified some international conventions. However, the country is yet to domesticate many conventions and protocols.

At national level, few draft legislations:

- Pesticide Act, 1989;
- Plant Quarantine Regulations of Sierra Leone, 1989;
- Plant Quarantine Proposals, 1989;

were reported missing in the Crop Protection Unit of the Ministry of Agriculture, Forestry and Food Security during the rebel war thereby hampering the enactment of the laws.

There is also a lack of human capacity and infrastructure to assess or monitor POPs (see section 2.3).

2.2.5.2 Requirements for improving chemicals and specifically POPs management

It is clear from the foregoing that the capacity of Sierra Leone to successfully execute the National Implementation Plan for the elimination of POPs and overall chemical management is presently very weak. Sierra Leone has not developed a chemical profile yet. Also no activities on the implementation of the Globalized Harmonized System (GHS) have been initiated.

A key establishment, the EPA-SL is relatively young and would therefore rely heavily on relevant stakeholders to successfully execute manage POPs. The state of the requisite physical infrastructure (analytical chemistry laboratories and equipment) is very fragile especially with respect to the absence of equipment; the human capacity is grossly inadequate and also very weak especially in terms of numbers of adequately trained analytical chemists, laboratory technicians and equipment maintenance technicians as well as legal drafters. The other area of capacity constraints is the lack of local resources to fund the implementation of the NIP.

2.3 Assessment of the POPs issue in the country

2.3.1 Assessment of POPs pesticides (Annex A, Part I) and DDT (Annex B)

2.3.1.1 Introduction

Pesticides are toxic substances released intentionally into our environment to kill selected biota. This includes substances that kill weeds (herbicides), insects (insecticides), fungi (fungicides), rodents (rodenticides), and others. Pesticides are chemicals that are used by the farming and non – farming community all over the world. Herbicides are by far the most used pesticides, accounting for approximately 80% of pesticides in use worldwide.

Despite the usefulness of pesticides, some of these chemical have produce serious problems and threat to the environment because of their persistent nature. This had become a cause of concern to environmentalists and other scientists around the world. They discovered that the source of some of the environmental problems we are now facing was as a result of the direct effect of these compounds.

Meanwhile 15 POPs pesticides have been listed in the Stockholm Convention (See Table 1).

2.3.1.2 Current institutional and regulatory framework for POPs pesticide management in Sierra Leone

The institutional and regulatory arrangement for pesticide management since the first NIP remains unchanged. To date, there are no regulations regarding pesticides in Sierra Leone. However, there are consultations in the country with regards of formulating a pesticide policy.

There are two existing institutions that are supposed to take the lead with regards to monitor the distribution and use of pesticides and DDT in Sierra Leone. These are the Ministry of Health and Sanitation and the Ministry of Agriculture and Food Security. Under the Ministry of Health and Sanitation, the Entomology Department is the main division that handles pesticides, whilst in the Ministry of Agriculture and Food Security the Crop Protection Division is responsible. No existing regulatory mechanisms are in place on the importation/exportation, distribution and use of pesticides in Sierra Leone. Similarly, there is no regulation for banning and licensing of commercial rights for handling POPs pesticides.

2.3.1.3 Situational analysis on POPs pesticides in Sierra Leone

A gap in institutional and regulatory framework was identified in the last NIP document relating to pesticide. However, from the evaluation of the situation, it seems that the problem had compounded. There is a clear indication of this as you move around business centers and market areas (Loma) especially in big towns. Due to the dangerous nature of some of these chemicals, the expectation was that some form of regulatory body would have been in place. The quantity of pesticide available in market as of now, far exceed those in 2007. Vendors in Bo town claimed that they received training from Pest Control Services.

2.3.1.4 Objectives of the inventory

Since there is an overall lack of pesticide control in the country, the current inventory not only addressed POPs pesticides but also assessed other pesticides in current use and stockpiles.

The objectives of the pesticides inventory are as follows:

(i) Whether pesticides use and market have increased in the country;

(ii) To identify entry routes of pesticides into the country and if POPs pesticides might enter;

(iii) Quantity of POPs pesticides and other pesticides presently imported and used in the country if available;

(iv) Quantity of obsolete pesticides disposed/stored where possible;

(v) Identify potential POPs pesticides contaminated sites;

(vi) Identify the types of pesticides used in the country.

2.3.1.5 Scope of the inventory

Since there is a lack of pesticide assessment activities, this POPs pesticide inventory was designed to cover particularly POPs pesticide but also assessed other pesticides present in the country. Thus the three provinces and the Western Area were the target area for inventory collection. However, because of time and resource available, the main provincial towns were the point of call for investigation and data collection. Institutional and regulatory framework was assessed.

2.3.1.6 Banned POPs Pesticides in Sierra Leone and Exemptions

As a Party to the Convention, all POPs pesticides banned in the Convention are officially banned in Sierra Leone. Further, Sierra Leone is yet to officially ban individual pesticides through national legislation. Notwithstanding, illegal entry and use of POPs pesticides are common practices in Sierra Leone.

Application for exemption has never been made in the past from Sierra Leone to the Secretariat. Similarly, Sierra Leone is not requesting any exemption for the use of listed POPs pesticide presently.

2.3.1.7 Methodology

The approach employed to conduct the inventory of POPs and other pesticides in Sierra Leone utilizes two of the three principal types of inventory according to the FAO Pesticide Disposal Series guideline, volume 1, 2010:

i. Indicative inventory;

ii. Detailed inventory.

Indicative inventory refer to desktop review of data available in a country related to pesticide imports, government purchases, pesticide-management practices such as distribution, storage locations, etc., private sector sales data.

Detailed inventory involves a comprehensive (detailed) list of all pesticides in the country, their location and quantities as well as obsolete pesticides stockpiles.

Following the inventory exercise, additional information was obtained by a second inventory conducted between MAFFS and EPASL.

The following meetings were held to plan the inventory exercise:

- National Steering Committee;
- National Stakeholders Forum;
- Training Workshop of inventory team;
- Project Inventory Team consultative meetings.

The data for the inventory were collected from four regions: Western Area, Northern, Eastern and Southern Provinces respectively (Table 4).

Table 4. Places visited during the Pesticide inventory exercise

REGION/PROVINCES	CITIES
SOUTH	BO, MOYAMBA, PUJEHUN AND BONTHE DISTRICTS
EAST	KENEMA, KAILAHUN, KONO DISTRICTS
NORTH	PORT LOKO, BOMBALI, KAMBIA, KOINADUGU AND TONKOLILI DISTRICTS
WESTERN AREA	FREETOWN URBAN AND RURAL

The instrument used was well-structured opened and closed ended questionnaires designed by the World Health Organization of the United Nations. The questionnaire was divided into the following sections:

(a) Pesticide Information;

(b) Risk analysis;

(c) Empty containers;

(d) Contaminated soil;

(e) Contaminated equipment.

Information contained in the returned forms was used to prepare the inventory. Various stores and sites were visited and examined using the information on the inventory forms as a guide. Apart from using the forms face-to-face interviews were also conducted. This was done in situation were extra information may be helpful.

The categories of chemicals identified are grouped according to their use: (i) Domestic (ii) Agricultural (iii) Industrial.

2.3.1.8 Inventory results

In the inventory activities mainly pesticides not listed as POPs has been discovered during the assessment. The only POPs pesticide discovered during the inventory activity was approx. 4 kg Lindane.

Although Endosulfan was not reported as identified during the inventory exercise, a recent study conducted in 2016 reported that endosulfan is still in use illegally in Sierra Leone (Sankoh, 2016).

Table 5 below presents the results of pesticides inventory in 4 districts in the Northern Province of Sierra Leone.

The pesticides types range from insecticides, herbicides and fungicides. However, herbicides are more widely used than the insecticides and fungicides.

A challenge during the inventory was that some retailers refused to declare the quantity of pesticides in stock.

Table 5 presents types and quantities of various types of pesticides found around the country.

Table 5. Type and quantity of various types of pesticides found in the Country

Organization and address	Western Area	Pesticide name	Amount
Govt. Hospital –Macauley St.	Western Area	Wastox	8 kg
TushFaw Ent. No. 85 Mountain Cut	Western Area	Fatala	Undisclosed
Amadu Barry Pharmaceutical – No.59 Fourah Bay Rd.	Western Area	Arrow insecticide	8 kg
Ola During Children Hospital PCMH	Western Area	sprite	16 kg
Mohamed Barry Ent. No. 5 kissy Rd.	Western Area	Premium mosquito coil	0.5 kg
Inter Food Limited- No.24 Wilberforce St.	Western Area	Spritex and Sprigone	20 feet container every three months
Choithram Super market – No.3 Kroo town Road.	Western Area	Super choice black mosquito coil	0.4 kg
Hawker Wilber force St.	Western Area	Energer	0.4kg
Monoprix Super market- Wilkinson Rd.	Western Area	Super killtox	20 feet container
Ndereh Ent.- 2Sani Abacha St.	Western Area	Hewelon	0.4 g
Ali and Hassan Ent.-No. 7 Upper East St.	Western Area	Sweet dream insecticide (coil)	20 feet container every three months
T.Jal Ent.- No.2 Kingtom Bridge	Western Area	Chloropyrifos Cythane **Lindane** Fipane Carbofan	4 kg 4 kg **4 kg** 4 kg 4 kg
Animal Welfare Society. No. 26a Main Motor Rd. Congo Cross	Western Area	Kepromecpour-con Norotraz SeroinDududud	4 kg 4 kg 4 kg
J.J. Enterprise	Eastern Province	Bay-Bay	Not specified
Mr. Foday Samai –No. 21 Kingsway St. Kenema	Eastern Province	5555	Not specified
Kanduleppiama Drug Store – Kenema	Eastern Province	Yuki maton	Not specified
Sierra Diamond Tonguma	Eastern Province	Piri mon	Few cartoons
Waw enterprises	Eastern Province	Befine	Few cartoons
Kenema Super market- No.62 Hanga Rd.	Eastern Province	Vape	Few cartoons
Mohamed Shaw Ent. No. 2 Lambayama Avenue.	Eastern Province	Djimba	Not specified
BramaBawo No. 47d Maxwell Kobe St.	Eastern Province	Cobra coil	Not specified
Munar.No. 11 Hanga Rd.	Eastern Province	Baygon	Not specified

Organization and address	Western Area	Pesticide name	Amount
Choithram Super Market – kemema	Eastern Province	Attack	Not specified
Gold Tree Daru	Eastern Province	Plan D	20 feet container annually
Musa Ent.No.71 Main KaikorduRd	Eastern Province	Glyphosate	20 feet container
K and E Ent.and Agriculture	Eastern Province	Spray tox	Not specified
M.M.Pawopawo Ent. No.40 Main KaikorduKono	Eastern Province	Energer	Not specified
Unique Super Market. No.44 Main Kaikordu Rd.	Eastern Province	Asmaco	Not specified
Niagara Ent. No. 29 Main Kaikordu Rd.	Eastern Province	Aobao	Not specified
SOCFIN	Pujehun	Glyphosate(finish360SL) Chloropyrifos(Pyriga) Turf (Savana SAS) Deltamethrine(tamega25 EC)	20 feet container 20 feet container 20 feet container 20 feet container Nine 20 feet containers in all, 450 twenty (20) litres containers in each, i.e. 9000litres/ 20feet container
Sierra Rutile Limited	Moyamba District	Sulphosuccinate dester Drimax Soda Ash Denser Flottec F.100 (Frother) Potassium Amyl Xanthate(PAX)	0.8kg 0.8kg 0.2kg 0.2kg 0.2kg
Gulf Gold Mining Company		Cypermethrin (Cobra)	12 kg
Alpha Jalloh- Fataba St.	Bo	Diazinon	2kg
Gbassay	Samu	Propanil	6 kg
Njala	Moyamba District	Paraeforce Diazinon Glyphosate Butachlor Carbaryl 50 WP Double Force Glycot	5kg 5kg 1kg 1 kg 1 kg 1kg 1kg
MAFFS	Bo	Atrazine 500 EC Lamda Super Carinifo 500 Rigold (Propanil)360 Round- all (Butachlor 50% EC) Diazinion 60 EC Propanil Chlorpane 480 EC Paraquat 200 SL	21 cartoons expired 1 kg 1 kg 1 kg 1 kg 1 kg 1 kg 1 kg 1 kg

Organization and address	Western Area	Pesticide name	Amount
		Malik (Haloxyfop-R-Methyl)	1 kg

*Estimated

2.3.1.9 Estimated quantity of pesticide in the country

Any quantification of pesticides in Sierra Leone will be grossly underestimated. This is because, whilst some traders in the pesticide business are unwilling to disclose the quantity they bring into the country, some even distance themselves from the enquiry during the inventory process. However, the Ministry of Agriculture Forestry and Food Security are still putting some modalities to identify the amount of pesticide imported into the country.

2.3.1.10 Entry route of pesticides into Sierra Leone

Pesticides enter Sierra Leone through many routes: legally and illegally. The illegal means is by smuggling while the legal route is through procurement by commercial dealers or Government. By smuggling of pesticides also POPs pesticides currently produced/used such as endosulfan might enter the country as it is impossible to identify undercover practices and sales of illegal pesticides trade. The main route of smuggling pesticide into the country is through Guinea. The inventory exercise revealed smuggled pesticides originate from countries like China, Indonesia, France and UAE. Various suppliers are involved in pesticide trade in Sierra Leone. Some of them are ALM international, Yagala Enterprises (23,Wilkinson Rd.), AG- Farm, Sodimex, Wadi and Sons Ltd., Monoprix, T.jal Enterprises, Animal Welfare, Tashco Enterprise, Sierra Diamonds, WAW enterprise, Kenema Super Market, Ishwari and Sons, Gold Tree, K and E Enterprises, Unique Super market, C.A.J.(24, Kaikordu Rd.-Kono), A.O. Grand Group. Apart from these, Government also procures large consignment of pesticides and agricultural equipment. For the mining companies, they have their overseas procurement agents.

2.3.1.11 Past and present uses of pesticides in Sierra Leone

The uses of pesticide fall into three categories: (i) Agriculture (ii) Domestic and (iii) Industrial.

In the past till the development of the first NIP, POPs pesticides have been widely used in the control of various pests. For example, DDT was used to protect soldiers and civilians from mosquitoes. Dieldrin, HCB, phosphine, methyl bromide, bidrin, and lindane were used as soil fumigants in the production of tobacco in the provinces especially in the Bombali, Kambia, Tonkolili, Bo and Moyamba districts. Gammalin 20 (lindane), cocotine, and bidrin were used for fishing in the past. HCB was and is still used in local fishing practices, preservation of kola nuts and treatment of head lice.Aldrin and azodrin were used in the control of beetles in cashew nut production. Stam F-34, Gammalin 20 (lindane), gammazone, cocotine, tennate, and klerate were widely used in the past for the control of a variety of pests across the country. At present, malathion and furadan are used as broad spectrum pesticides. In the Northern Province of the country, ash from rice husk is added to malathion to produce a substance which local farmers referred to as B.H.C. Kocide 101 was used as fungicide and bactericide in cocoa production.

Permithrin is used as insect powder against a wide range of insect pests. Endosulfan is also used in the control of insect pests. With the present drive of food security nationwide, there is the likelihood of an increased use of pesticides in the future, since it is viewed as a means to reduce pre and post-harvest losses. DDT was used in the control of insect vectors that cause malaria and onchocerciasis, especially along the Rokel River in the Tonkolili district, Scarcies River in the Kambia district and the Taia River in the Moyamba district. It was reported during the inventory for the development of the first NIP that DDT was no longer in use in Sierra Leone.

During the inventory for the development of the second (review) NIP, it was discovered that agricultural herbicides are the most widely used in Sierra Leone especially in large commercial farms like SOCFIN. Insecticides and fungicides are used only when there are serious insect or disease outbreak. Some farmers do apply a particular pesticide as bait to kill rodent and birds in their farms. Domestically, the most common insecticide used in majority of homes is those referred to as sheltox. These are in different brand names but almost the same chemical composition. They are used against mosquitoes, cockroaches and house-fly. Other types of pesticide used domestically are those used against bed bugs and rats. Industrially pesticides have very little use in industries as they have industrial chemicals used in their operations.

2.3.1.12 POPs Pesticide stockpiles

Obsolete pesticide stockpile in any country is a serious problem due to its health, environmental and disposal challenges it poses. Exposure to these chemicals can cause allergies, cancer, damage the nervous system etc. A least developed country like Sierra Leone with virtually no facility to deal with stockpiles is even more vulnerable to stockpile challenges. Already banned pesticides in Stockholm Convention are banned in Sierra Leone. However, Sierra Leone imports pesticides to increase agricultural production and control vector-borne diseases. Over time, unused pesticides accumulate especially in government stores (Figure 3 and 4; Table 6).

Figure 3. MAFFS Store Kissy Freetown

Poor storage and stock management have also contributed to the problem (Figure 4).

Figure 4. Bombali District store

Consequently, theses accumulated and unused stocks become obsolete over time. The table below gives a summary of obsolete pesticide recently documented in the country on district level (Table 6) (data from National Inventory on Obsolete Pesticides and Associated wastes project in Sierra Leone Report, 2017).

Only a small fraction of obsolete pesticides identified were POPs pesticide. Many of the pesticides used in farming areas are not POPs pesticide. Only at one store Lindane (POP pesticide) was discovered. No endosulfan was discovered during the current inventory activities. The overall share of POPs pesticides is difficult to estimate since some of the pesticide stocks were not labelled. Nevertheless, visual appearance of some of the pesticide stock showing no labelling and damaged packaging/container suggests that at least 10% of these could be obsolete.

Table 6. Summary of obsolete pesticide stockpiles at district level

District	**Quantity of Obsolete Pesticide**	
	Solid pesticides (KG)	**Liquid pesticides (L)**
Port Loko	207	1,014
Kambia	0	0
Bombali	165	775
Koinadugu	61	751
Tonkolili	135	1,760
Kono	2	1,625
Kenema	26	583
Kailahun	200	340
Bo	100	372
Pujehun	235	1060
TOTAL	**1,131**	**8,280**

Atrazine was found in all the provinces in the country. A larger stock of 21 cartons of expired atrazine 500 EC was found in the South of Sierra Leone at MAFFS Bo store. Atrazine is not

listed as POPs but also this stockpile needs to be managed in future. Officially, there is no accepted DDT use in Sierra Leone, although its illegal use cannot be confirmed.

Also highly hazardous pesticide (HHP)[21] use was discovered such as paraquat, atrazine or chlorpyrifos.

2.3.1.14 Impact on human health and the environment

Whatever form pesticides are used for, they could be dangerous to the health of human and the environment. Pesticides use could lead to many health problems such as skin problems, nausea, seizure, respiratory disorder, blurred vision, loss of appetite, lacrimation, nervous disorder, head ache and stomach ache and more (EPA, 2014). In Sierra Leone, effects from pesticides use such as skin problems, nausea, seizure, respiratory disorders, blurred vision, loss of appetite, lacrimation and nervous disorder were significantly higher among farmers who use pesticides (Sankoh, 2016). Reports of deaths were reported in the first NIP resulting from pesticide use.

There are several ways (direct or indirectly) human beings can come in contact with pesticides. One encouraging part in relation to risk of pesticide, are the precautionary measures some of the large agricultural companies or institution in Sierra Leone adopt. Most of them tried to maintain some form of environmental health standards such as: (i) good store condition (ii) location of store away from residence (iii) Security and (iv) Protective gears for store keepers. Notwithstanding the above practices are not found among all especially mining companies.

Another important area of concern with regard pesticide impact on health and the environment is empty pesticide containers. Empty pesticide containers are sold to recyclers and sometimes some of the containers are used to store food items without proper cleaning of the containers. There are reported cases of empty containers being dumped with domestic garbage in the street.

Handling of pesticides is another area of concern. Farmers handle pesticides without personal protective equipment and hence expose various parts of their bodies to the harmful chemicals. Farmers use their hands to eat following application of pesticides with unprotected hands. Pesticides are often stored in farmers homes which pose serious risk to inmates of the house. Some pesticide vendors smoke while handling pesticide whilst. Pesticides are sometimes stored with other goods in store clumped together. This poses serious risk especially because spillage of liquid pesticides may endanger the lives others in the store. In the outside store of the Crop Protection Services, there are large collection of empty pesticide containers and damaged equipment. The store is dilapidated, when it rains, water enters and pesticides are washed out with the water. The polluted water goes out to the surrounding which is a busy business area.

Misuses of pesticides have also been reported by farmers in Sierra Leone (Sankoh, 2016). This have not only resulted in death of animals and organisms but also runoffs into nearby water bodies, some of which is transported along the food chain.

[21] PAN International List of Highly Hazardous Pesticides (PAN List of HHPs). December 2016

2.3.1.15 Challenges encountered during the inventory exercise

The challenges encountered cut across among the groups despite the location are different. These constraints could be highlighted as follows:

(i) Traders involved in pesticide trade are reluctant, and in some cases refused to release information,

(ii) The proliferation of the pesticides all over the country and in unconventional way poses severe challenges in their identification,

(iii) The languages on the product is often in Chinese or French makes it difficult to determine the type of pesticide,

(iv) The terrain at the time of inventory taking was not friendly, making the exercise very challenging, The transport facility provided limited the scope of the inventory exercise. There is no monitoring capacity in the country and therefore no assessment of non-labelled pesticides or potentially contaminated areas could be conducted

2.3.1.16 CONCLUSION

There seems to be an increase in the:

(i) Number of people currently involved in the pesticide trade in Sierra Leone relative to the last inventory exercise done for the first NIP,

(ii) Quantity imported into the country,

(iii) Types of pesticides in the market.

(iv) From the POPs pesticides, only lindane was discovered during the inventory. Although endosulfan was not reported identified during the inventory exercise, a recent study reported endosulfan is still in use illegally in Sierra Leone (Sankoh, 2016).

(v) Only preliminary considerations on POPs pesticide contaminated sites could be made due to the lack of monitoring capacity.

This shows clearly that there are no regulatory policies in place, if any, not very effective. Therefore, the environmental risk is evident especially in highly populated areas. One of the most striking observations was that the majority of those in the pesticide business do not have any knowledge on pesticides. Handling seems to be a problem by those involved in the business.

2.3.2 Assessment of PCBs (Annex A, Part II)

2.3.2.1 Introduction

In an effort to update the 2008 National Implementation Plan (NIP) for the phase out, minimization and control of Persistent Organic Pollutants (POPs) comprising among others, the PCBs, the EPA-SL conducted a nation-wide inventory on PCB oils and PCB-containing equipment in a bid to assess the current status of the use, handling and environmental contamination of this category of POPs in the country. The inventory sought to identify PCB containing equipment and estimate amounts of PCB oil currently in use in line with UNEP's guidelines. The inventory also identified possible contaminated sites, assessed levels of contamination and recommends possible clean-up actions.

2.3.2.2 Objectives and scope of inventory

The key objective is to capture information relevant for updating the existing. The inventory targeted both public and private sectors known or suspected for operating PCB-containing equipment including the energy sector (electricity generation and distribution companies), mining sector (mining companies with electricity generation facilities, lighting ballasts and heavy duty machines using lubricating oils), the auto-mechanic sector (vehicle fleets operators and garages) and road construction companies. The inventory identified possible uses of PCB containing oils/equipment and estimated quantities in current use or stored wastes in all targeted institutions/businesses. The inventory also noted cases of the use of alternatives to PCB containing oils as means of assessing the effectiveness of compliance to existing global regulatory frame work for the eradication of PCB containing equipment, oils and products. Dumpsites and garages were assessed to identify possible contaminated sites and personnel quizzed on the handling and disposal of oil wastes and the level of awareness on the environmental pollution and health hazards associated with the improper disposal of waste oil. Due to the weak control of PCB containing oils, PCBs might enter the waste oil and waste oil recycling sector with associated recycling and release.

Also PCNs have been used in similar applications as PCBs including capacitors, transformers and open PCB applications like sealants, paints and coating.

Furthermore also short-chain chlorinated paraffins (SCCPs) listed as POPs in the Stockholm Convention is used in a range of industrial oils (hydraulic oils, metal working fluids, cutting oils, drilling oils, and lubricants) and likely contaminate waste oils and the recycling of oils. Mineral oil has a potential to contaminated soil and ground water and need to be controlled and managed.

2.3.2.3 Existing institutional and regulatory framework for PCBs

Sierra Leone is a Party to the Stockholm Convention on POPs. As a Party, it is required of the country with the support of UNEP/UN Environment, GEF and other UN agencies to periodically update the existing National Implementation Plan (NIP) with the aim of eliminating or restricting the production and use of POPs. The Environment Protection Agency Sierra Leone (EPA-SL)

established by an act of Parliament in 2008 (amended in 2010) has the mandate among others to coordinate the country's obligations to international treaties. The existing NIP that was launched in 2008 was more or less dormant and its provisions or recommendations have largely not been implemented. There is currently no regulation(s) specifically addressing the use, handling or disposal of PCB waste oil or containing equipment. Thus the current update is intended to capture information that should be relevant in initiating the implementation of a National Plan that regulates the use, handling and safe disposal of PCB oil or containing equipment.

2.3.2.4 Stakeholder (Workers, public, industry) awareness/knowledge with regard to PCBs

Although the EPA-SL has engaged the public through radio and TV discussions on PCBs information sharing, a lot more needs to be done in trickling the information down to the less literate segment of the population. The labor force in direct contact with potential PCB containing products has little or no information about their harmful effects on public health and the environment. There are reported incidences of members of the public using PCB containing oils as dermal lotion for the treatment of certain skin conditions and the use of waste oil as insecticides for roofing boards or a broad spectrum domestic herbicide. Therefore, there is need for an intensified public and industry awareness campaign through additional radio & TV jingles and discussions, local government involvement, postal with wordings in local languages etc. There is also need to organize workshops on the safe handling and occupational hazards of PCB containing chemicals/equipment for low-to-medium level workers in both the energy and mining sectors.

2.3.2.5 Methodology

The inventory covered the following:

- energy generation and distribution companies;
- all mining companies;
- industrial facilities; and
- and other companies that might use PCB containing chemicals/equipment in the country.

Inventory was carried out through visitations of facilities owned by target institution/companies and where necessary, follow-up contacts made with the appropriate competent authority. Mining companies that generate energy on their own were of particular interest including Sierra Rutile Limited, Vimetco (Bauxite mining company) and Shandong Steel and Iron Ore, Diamond mining companies (Octea), etc. In the energy sector, both public and private power generation and distribution companies were targeted including all District and Regional Power Stations, Addax Bio-Energy (a bio-energy power generation company) and Bumbuna Hydroelectric Dam.

Other sectors of interest included construction companies, quarries and garages. A structured questionnaire developed by the PCB inventory group (see appendix I) was administered alongside on-site inspection of transformers, circuit breakers and other equipment known to

contain PCB containing chemicals with the aim of obtaining information relevant to the inventory and identifying possible contaminated sites.

2.3.2.6 Identification and inventory procedures

Possible PCBs containing equipment (transformers, capacitors, etc.) were located and information on name plates obtained. Further information on the brand of oil, equipment maintenance, and record of decommissioned equipment/waste parts are obtained from the personnel in charge of suspecting PCB containing equipment/objects. Product information on used/waste objects like capacitors was obtained in order to ascertain compliance to PCB regulations.

There was no testing of oils due to the lack of analytical capacity and equipment.

Also testing environmental samples from contaminated sites was not done since such activities were outside the scope of the inventory and no monitoring capacity is available in the country.

2.3.2.7 Inventory results

a) Transformers

i) Public Operators

The main operators of public transformers in the country are the regional offices of the electricity generation and distribution agencies (EDSA and EGTC). Table 7 gives a summary of the distribution of public transformers in the four regions of the country and Figure 5 gives a summary of the distribution of suspected PCB-containing transformers in the four regions. The Western Area with a rather aging energy generation and distribution infrastructure has the largest number of public transformers in operation totalling 341, out of which 70 (21 percent) are suspected of containing PCB transformer oil due to the age of the transformers, i.e. manufactured before 1970. Sixty-three redundant transformers comprising mainly those that are burnt or decommissioned were found either located at the premises of EDSA/EGTC or merely abandoned at installation sites. Figure 6 (a) and (b) shows abandoned burnt transformers at two installation site within the Western Area. Burnt transformers generate PCDF contaminated sites if the transformer contained PCBs.

Table 7 shows the regional distribution of suspected and redundant PCB containing transformers and an estimated suspecting PCB-containing oil in Sierra Leone. Figure 3 gives a distribution of suspecting PCB-containing transformers in the four regions of Sierra Leone**.** These two illustrations indicate Western Area Southern and Eastern Provinces have more suspected PCB containing transformers. The total suspecting PCB-containing oil is estimated at 74 metric tonnes, with the largest volume in the Western Area. The Northern Province with a recently developed electricity distribution infrastructure has little or virtually no problems with PCB-containing transformer oil.

Table 7. Regional Distribution of Transformers in Sierra Leone

Public Institution	Region	No. of Transformers in Operation	No. of Suspecting PCB containing Transformers	No. of Redundant Transformers	Estimated PCB Containing Oil (tonnes)
EDSA/EGTC	Western Area	341	70	63	56
EDSA/EGTC	Northern Province	112	2	2	-
EDSA/BKPS	Southern Province	82	36	18	11
EDSA/BKPS	Eastern Province	56	19	11	7
Total		**591**	**127**	**94**	**74**

Suspecting PCB Containing transformers are counted as those with manufacturing dates 1970 and below. Redundant transformers are counted as burnt or decommissioned transformers not currently in operations.

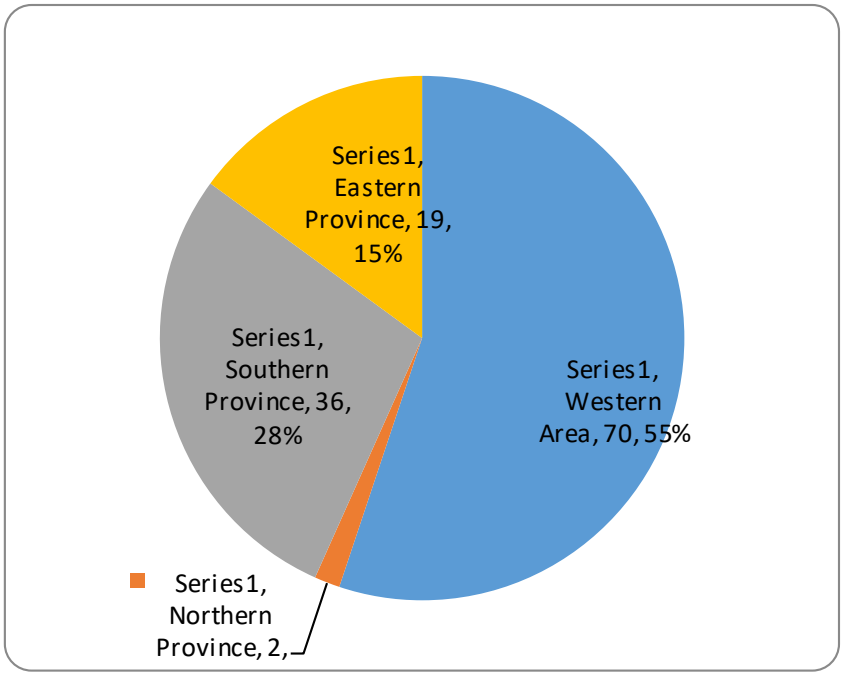

Figure 5. Distribution of suspected PCB containing transformers in the four regions of Sierra Leone

(a)

(b)

Figure 6. (a) and (b) Burnt transformers abandoned at two transformer sites within the Western Area, Sierra Leone.

Generally, there is no existing policy on waste oil handling in the country. It is reported that retrieved oil from transformers are stored together with other waste oil but no information regarding disposal is mentioned by contact persons of these institutions. The inventory team however noted the possibility that waste oil is mostly given/sold to the public for use in various ways (as lubricating oil for timber sawing machines, insecticide in the timber industry and sometimes smeared over the skin by some people for cure of certain skin rashes). Evidences of

environmental oil contamination are vividly seen at transformer sites but levels of potential PCB contamination were not determined.

ii) Private Sector Operators

The two major electricity generation companies are the Bumbuna Hydroelectric Company-Bumbuna and ADDAX Bio-energy Makeni both operating in the Northern Province. The two companies have recently installed transformers, which are free of PCB-containing oils. Both companies are in full compliant with the non-use of PCB containing equipment. Addax Bio-energy uses Castrol Oil BS148 and capacitors bearing the inscription "*PCB-Free"*. Bumbuna Hydroelectric Company uses Oil Natural Air Natural cooling system (ONAN) transformers and "*PCB-Free"* transformer oil (Gulf transformer meeting BSI, IEC and AS specifications).

Mining companies including Shandong Steel, Sierra Rutile, Sierra Mineral Holding Ltd (VIMETCO) etc. that generate energy for them are all in complaint with the use of *"PCB-Free"* transformer oil and capacitors.

The following Figures 7 to 9 show typical transformers installed by energy generation and distributors in the Northern Province.

Figure 7. (a) A pole-mounted transformer in Lunsar; (b) A standing transformer in Makeni; (c) A standing transformer in Lungi; (d) Relics of a decommissioned transformer in Port Loko

b) Circuit Breakers

Circuit breakers found installed also used transformer oils but almost all circuit breakers were recently installed and no records of old ones were reported. Generally, the officers-in-charge at the power stations reported that after the breaking up of the former National Power Authority (NPA) into EDSA and EGTC, both institutions recruited their own employees afresh giving the impression that the emerging institutions do not have records of the operations of NPA. Nonetheless, the team discovered one old circuit breaker that may have used PCB-containing transformer oil but this assumption could not be ascertained since information on the name plate of the equipment was blurred. However, this state of affairs may not be the case in other regions in the country that had had long existing power stations.

Figure 8. A decommissioned Circuit Breaker at the EDSA/EGTC Power Station in Lungi

c) Capacitors

Light Ballast capacitors were mostly found in use at operation facilities/sites of Quarries, mining companies and power stations. About fifty (50) capacitors in total were checked. However, up to now, labels on all capacitors in use or scrap piles carry the label "Non-PCB" (Figure 9).

Figure 9. Capacitors bearing Non-PCB labels in compliance with provisions of the Stockholm Convention

2.3.2.8 Challenges Encountered

Although the inventory process was largely a success, the team however encountered a couple of challenges:

- The time and resources allocation were limited in accomplishing a comprehensive inventory.
- No test kits were available for the assessment of PCBs. The team tried to purchase test kits from Switzerland but did finally not succeed in the purchase.
- Also the team tried to make the GC-ECD at the Department of Chemistry, Fourah Bay College, University of Sierra Leone operational. The option to receive used GC-columns from Japan was explored and would be possible. However to get gas for the operation of the GC-ECD is complicated.
- A few companies presented some bureaucratic hold-ups in cooperating with inventory team. This led to some unexpected delays in the exercise.
- Equipment needed to do on-the-spot analysis of contaminated sites for PCBs were not available.

2.3.3 Assessment of POP-PBDEs (Annex A, Part IV and Part V)

2.3.3.1. Introduction

Polybrominated diphenyl ethers (PBDEs) are a group of aromatic organo-bromine compounds widely used as additive flame retardants (i.e. brominated flame retardants, BFRs) since the 1970s in consumer products. Flame retardants are intended to slow the rate of ignition and fire growth, allowing more time for people to escape from a fire or extinguish it.

Two groups of PBDEs, commercial PentaBDE (c-PentaBDE) and c-OctaBDE (used in Electrical and Electronic Equipment - EEE) general referred to as POP-PBDEs are listed since 2009 to be eliminated under the Stockholm Convention because of their associated human health and environmental problems. Furthermore, the third commercial PBDE mixture used in articles (c-DecaBDE) has been listed as POP-PBDE in May 2017.

An estimated 100,000 tonnes of c-OctaBDE was used worldwide from an estimated production of between 1.3 – 1.5 million tonnes total PBDEs from the 1970s to 2004 when production was ended in the United State (UNEP/POPs/COP.7/INF/27, 2015). There was no information of PBDEs being produced in developing countries after 2004 which is however unlikely. The main former use of c-OctaBDE is in acrylonitrile-butadiene-styrene (ABS) mainly used for casings of EEE, especially for cathode ray tube housings in televisions and computers and other office equipment such as copying machines and printers.

Sierra Leone like most other developing nations was not involved in the production of these chemicals or in the production of goods containing them. However, consumer items such as casings for CRT monitors of computers and television contain these chemicals were imported to

Sierra Leone the last 40 years. Sierra Leone as a signatory to the Stockholm Convention on Persistent Organic Pollutants has an obligation to ensure the elimination of the listed POP-PBDEs from its boundaries. A key step in achieving such goal is to determine the presence and the quantity of these items containing the POP-PBDEs within the country and how they are being managed onto the end-of-life stages.

Objectives of the inventory

The main objective of the inventory is to obtain information about the situation of POP-PBDEs in the electrical and electronic sector in the country as listed below:

- To get a general overview of POP-PBDE impacted articles and waste and the amount of PBDEs contained in these materials.
- To evaluate whether the current management system for PBDEs containing items meets the requirement of the convention and identify areas where there do not.
- To provide the basis for development of a strategy in the NIP i.e. identify areas and the economic sectors where there is a need to develop and prioritize effective strategies and action plans for managing POP-PBDEs containing articles and materials;
- To identify areas where financial or technical support are needed to fill the gaps in the inventory and in the management of PBDE containing materials.

Scope of the inventory

The inventory focused mainly on capturing the following information:

- Types and quantity of articles containing POP-PBDEs imported, in use/store and end-of-life (CRT monitors for TVs and PCs).
- Types and quantity of articles stocked at household, public and private entities.
- Identification of potentially contaminated sites with POP-PBDEs (storage areas at EEE repairs shop and landfill/dumpsites etc.).

2.3.3.2. METHODOLOGY

Table 8 indicates the different stakeholders and their various roles required in the inventory exercise.

Table 8. Stakeholders and their various roles required in the inventory exercise.

No	Institution/Sector	Responsibility
1	Customs (National Revenue Authority)	Provision of importation data on number and type of new and second-hand Electrical and Electronics Equipment (EEE) imported in 2015 and the previous years.
2	Sierra Leone Road Safety Authority (SLRSA)	• National statistics on number of imported vehicles (cars, buses and trucks) in 2015 and earlier. • Number of registered cars, busses and trucks for 2015 and earlier. • Life expectancy of vehicle and end-of-life vehicle due to accident in the country.
3	Importers and retailers of electrical and electronic equipment	Information on type and quantity of electrical and electronic equipment
4	Household, corporate and institutional consumers.	Information on type and quantity of electrical and electronic equipment
5	EEE repairs workshop and scrapyards	Head count of CRT monitor (PCs and TV) and vehicles in their possession

Secondary Data
Use of available data at state institutions such as Customs (National Revenue Authority) and the Sierra Leone Road Safety Authority (SLRSA) about past and present importation of articles containing POP-PBDEs and vehicle registration data respectively were used to estimate for key parameters as described in the guidance.

Site Visit
Site visit and interviews at end-of-life vehicles treatment facilities/scrape yard and electrical and electronic repair workshops were conducted. Information obtained from owners included head count of the number of scrape cars or CRT television or computers and general way in which the operations are conducted and management of the resulting waste.

Administering of Questionnaires
Questionnaire with explanatory note using the format described in the PBDE inventory guidance were administered by team members at households and also sent to institutions and private companies. These questionnaires assess the knowledge and attitude/behaviour of these different stakeholders towards the management of EEE/WEEE and also obtained in formation of the different types and quantity of EEE in use/stored at the different areas.

2.3.3.3. INVENTORY RESULTS/FINDINGS

Electrical and Electronic Equipment (EEE) and related waste (WEEE)
The major fraction of POP-PBDE (c-OctaBDE) is in plastic casing from CRT computer and TV monitors produced before 2005 (since the production of c-OctaBDE stopped in 2004). The flat screen computer and TV monitors are not expected to contain c-OctaBDE since production of the chemical has stopped at the time of production of these items. Therefore, the inventory on the POP-PBDEs in the EEE/WEEE sector addresses the following areas:

- Second hand EEE imported in 2015 and earlier years (2013 – 2014) was used as the base for estimating stocks.
- EEE stocks (in use and/or stored in possession of consumers)
- EEE entering the waste stream (from EEE repairs workshop).

Initial Assessment
Table 9 gives a rundown of the different census conducted in Sierra Leone since independence.

Table 9. Population of Sierra Leone between 1963 to 2015 (SSL, 2016)

	1963	1974	1985	2004	2015
Population	2,180,355	2,735,159	3,515,812	4,976,871	**7,075,641**
Distribution of population by region for the 2015 census					
Region		Eastern Province	Northern Province	Southern Province	Western Area
Population		1,641,012	2,502,805	1,438,572	1,493,252

An initial estimate prior to the start of the inventory for the minimum amount of POP-PBDEs in the country was conducted using the following parameters:

- Population of the country in 2015 (7,075,641 persons).
- Average weight of CRT monitors for TV and PC is estimated at 25 Kg
- Polymer fraction of CRT casing is estimated at 30%
- A range of c-OctaBDE content of 0.87 – 2.54 tonnes/kg, for these polymers used in CRT casing.
- A penetration factor of 0.19 from Ghana (a country in the same region) was utilized.

The range of c-OctaBDE (Kg) in CRT devices was calculated as follows:
M_{PBDE} = [no. of CRTs/capita] × population × 25 kg × 0.3 × [0.00087 to 0.00254]

Therefore, for the year 2015
M_{PBDE} = 0.19 × 7,075,641 × 25 × 0.3 × 0.00087 to 0.19 × 7,075,641 × 25 × 0.3 × 0.00254
M_{PBDE} = 8,772.03 to 25,610.28

Therefore the range of c-OctaBDE in CRT devices is between 8,678 kg to 25,337 kg.

The POP-PBDEs (HexaBDE and HeptaBDE) in the c-OctaBDE calculated is presented in Table 10 below:

Table 10. Composition of the homologue of c-OctaBDE that are POP-PBDEs

Homologue	Distribution of the Homologue of c-OctaBDE	Minimum (kg)	Maximum (kg)
HexaBDE	11% × [8,678.25 to 25,336.5]	955	2,787
HeptaBDE	43% × [8,678.25 to 25,336.5]	3,732	10,895

The amount of WEEE plastic corresponding to the initial estimate using a penetration factor of 0.19 for the population of 7,075,641 (for 2015) is calculated as follows:

Amount of CRT unit = 0.19 × 7,075,641 = 1,344,372 units

Using a polymer content of 30% and assuming mass of 25 Kg per unit,

$$Estimate\ of\ WEEE\ plastic = \frac{1344372 \times 25 \times 0.3}{1000} = 10{,}083\ tonnes$$

Hence the estimated amount of WEEE/EEE plastic CRT (PC and TV) for 2015 is 10,083 tonnes.

Importation of new and second-hand EEE

Data for importation of computers and televisions were obtained from the customs service (National Revenue Authority) for the period 2013 – 2015 (tables 11 and 12). The items were identified as new or used and in some cases further identification as flat screen/LCD/LED/Plasma done for the televisions. However, the data does not clearly indicate which of the TV and PC contain CRT monitors. An average weight of 25 kg for CRT monitors for PCs and TVs is assumed.

Table 11. Number of imported PCs (old and new) between 2013 - 2015

Computer monitor			
	2013	2014	2015
Used	3898	3184	4669
New	2336	2194	2409
Total (unit/ year)	**6234**	**5378**	**7078**
% used	**62.5**	**59.2**	**66.0**

Table 12. Number of imported TVs (old and new) between 2013 - 2015

Television						
	Flat screen/LCD/LED/Plasma			General		
	2013	2014	2015	2013	2014	2015
Used	118	534	965	5593	5163	8092
New	2008	3496	4681	4072	9159	14256
Total	**2160**	**4030**	**5646**	**9665**	**14322**	**22348**
	2013		**2014**		**2015**	
Total (unit/year)	**11825**		**18352**		**27994**	
% used	**48.3**		**31.0**		**32.4**	

To estimate the number of CRT monitors in the lot, a further survey was conducted at retail shops (mostly for second-hand items) to determine the percentage of CRT monitors present at the retail outlet at the time of the survey as. It was difficult to obtain reliable information on historical data (which would have improved the reliability of the information collected) as no evidence of inventory was done by the owners.

Table 13. Survey of flat screen and CRT monitors in 23 retail outlets

Item	Amount of unit	Percentage
Flat Screen monitor	439	56.9
CRT Monitor	332	43.1
Total	**771**	**100**

Using the result of the survey in Table 13, the estimate of the number of CRT monitors for the imported PCs and TVs is as shown in Table 14 below.

Table 14. Estimated amount of CRT monitors for imported EEE

	2013	**2014**	**2015**
Computer (Total)	6234	5378	7078
CRT Monitor	2687	2318	3051
TV (Total)	11825	18352	27994
CRT-TV	**5097**	**7910**	**12065**

The estimated amount of POP-PBDEs in imported computers and televisions can be calculated as: $M_{c\text{-}OctaBDE;imported\ EEE} = M_{EEE;imported} \times f_{Polymer} \times f_{EEE;second\text{-}hand} \times C_{OctaBDE;Polymer}$

Where
$M_{c\text{-}OctaBDE;imported\ EEE}$ = the amount of OctaBDE in imported second-hand EEE in kg
$M_{EEE;imported}$ = the amount of imported (new + second-hand) EEE per year in tonnes
$f_{Polymer}$ =the total polymer fraction in EEE in weight-%
$f_{EEE;second\text{-}hand}$ = the share of second-hand EEE among the import in weight-%
$C_{OctaBDE;Polymer}$= the content of c-OctaBDE in the total polymer fraction of EEE in kg/tonne

Table 15. Estimate POP-PBDEs in imported computers and television for 2013 - 2015

Year	Product	$M_{EEE;imported}$ (tonne)	$f_{Polymer}$ (weight-%)	$f_{EEE;second\text{-}hand}$ (%)	$C_{OctaBDE;Polymer}$ (kg/tonne)	$M_{c\text{-}OctaBDE;imported\ EEE}$ (kg)	Total (kg)
2013	PCs	67.17	30	62.5	2.54	31.99	**48.05**
	TVs	127.41	30	48.3	0.87	16.06	
2014	PCs	57.95	30	59.2	2.54	26.14	**42.14**
	TVs	197.74	30	31.0	0.87	16.00	
2015	PCs	76.27	30	66.0	2.54	38.36	**63.86**
	TVs	301.64	30	32.4	0.87	25.50	

The estimated amount of WEEE plastics from imported items in 2015 are 22.9 tonnes from CRT monitor and 90.5 tonnes from CRT TV.

The POP-PBDEs (HexaBDE and HeptaBDE) in the c-OctaBDE for the imported EEE is calculated based on the distribution given in the guidance as shown in Table 16:

Table 16. HexaBDE and HeptaBDE present in imported EEE (CRT PCs and TVs)

Homologues	Distribution homologues in c-OctaBDE	Homologues in import for 2013 (kg)	Homologues in import for 2014 (kg)	Homologues in import for 2015 (kg)
HexaBDE	11%	**5.3**	**4.6**	**7.0**
HeptaBDE	43%	**20.7**	**18.1**	**27.5**

EEE in use or stored at the consumer level

Stocks of EEE at this level are divided into the following groups:

i. Private consumers (households)

ii. Institutional consumers (educational, governments, parastatals etc)

iii. Corporate consumers (Banks, mining companies etc)

Private consumers (households)

As a first estimation, EEE in use or stored at household is calculated using penetration data adopted from similar study conducted in Ghana for different appliances (UNEP/POPs/COP.7/INF/27, 2015). The total weight of appliances is then calculated by multiplying the penetration factors by the average weight of the appliance and the population of the country based on the 2015 population and housing census (Table 17).

Table 17. Estimation of the tonnage of EEE at households

Equipment	Penetration factor	Average weight (kg)	Population	Total weight (tonne)
Fridge	0.26	90*	7,075,641	165570.00
Air conditioner	0.09	40*	7,075,641	25472.31
Mobile phone	0.72	0.1	7,075,641	509.45
Radio	0.28	2	7,075,641	3962.36
Iron	0.19	2.5*	7,075,641	3360.93
Kettle	0.12	3.5*	7,075,641	2971.77
PC (CRT monitor)	0.08**	14.1	7,075,641	7981.32
PC (LCD monitor)	0.08**	4.7	7,075,641	2660.44
TV (CRT)	0.2**	31.6	7,075,641	44718.05
TV (Flat screen)	0.2**	15	7,075,641	21226.92

*Rough estimate

**deduced from values in the guidance

For an in depth inventory, a questionnaire survey of 175 households was conducted, in which the number and type of EEE at the household were identified and the knowledge and attitude of the public is assessed. Table 18 illustrates the data from the survey.

Table 18. Summary of EEE stocked in 175 households

Product	Quantity	No. of units per household	Estimated weight (kg)	Total weight per household	Total number of households	Total wt in households (tonne)
Cat 1						
Fridge	203	1.16	90			
Air Con.	70	0.40	40			
Freezer	176	1.00	90			
Gas stove	90	0.51	25			
Cat 2						
Iron	93	0.53	2.5			
Kettle	64	0.37	3.5			
Fan	168	0.96	10			
Cat 3						
PC	16	0.09	9.9			
CRT monitor	24	0.14	14.1	1.974	**255220***	503.80
LCD monitor	21	0.12	4.7			
Laptop	143	0.82				
Mobile phone	478	2.73	0.1			
Phone	35	0.20				
Printer	26	0.15				
Copy machine	27	0.15				
Scanner	15	0.09				
Fax machine	24	0.14				
Modem	64	0.37	0.05			
Cat 4						
TV (CRT)	280	1.60	31.6	50.56	255220*	12903.92
TV (flat panel)	128	0.73	15			
Radio	120	0.69	2			
Stereo	130	0.74	10			
DVD player	307	1.75				
VCR player	12	0.07				
MP3	17	0.10				
Camera	15	0.09				
Game console	6	0.03				
					255220*	**13407.72**

*estimated from the number of household from the 2004 survey (164,198 household with an household size of 6 person)

The amount of POP-PBDEs in the household is estimated using the number of CRT monitors and TV CRT using the formula

$$M_{OctaBDE;EEE} = M_{EEE;household} \times f_{Polymer} \times C_{c\text{-}OctaBDE;Polymer}$$

Where,

$M_{OctaBDE;EEE}$ = the amount of c-OctaBDEin household EEE (kg)

$M_{EEE;household}$ = amount of household CRT containing EEE (metric tonne)

$f_{Polymer}$ = total polymer fraction in EEE (weight-%)

$C_{c\text{-}OctaBDE;Polymer}$ = the content of the c-OctaBDE in the total polymer fraction of EEE (kg/metric ton)

Table 19. Estimated POP-PBDEs in stocks of EEE in households

Product	Amount of household EEE (tonne)	Total polymer fraction in EEE (% wt)	Content of c-OctaBDE in total polymer fraction of EEE	Amount of c-OctaBDE in household EEE (kg)
CRT monitors	503.80	30	2.54	383.90
TV (CRT)	12904	30	0.87	3367.92
TOTAL				**3752**

The estimated amount of WEEE plastics stored/in-use at the household level in 2015 is 151 tonnes from CRT monitor and 3871 tonnes from CRT TV.

The POP-PBDEs (HexaBDE and HeptaBDE) in the c-OctaBDE for the EEE at the households is calculated thus;

Table 20. HexaBDE and HeptaBDE present in household EEE (CRT PCs and TVs)

Homologues	Distribution homologues in c-OctaBDE	Homologues in household EEE
HexaBDE	11%	**416.45**
HeptaBDE	42%	**1575.76**

Institutional consumers

The growth of IT in the country have seen huge amount of such equipment imported into the country. This sector accounts for a large proportion of the use of IT equipment in the country. The institutional consumers included the universities, IT institutions/ computer centres, government MDA and parastatals etc. Table 21 gives total amount of electrical and electronic equipment recorded during the questionnaire survey from eight IT institutions/computer centres.

Table 21. Stocked EEE at Educational institutions (8 IT institution/computer centres)

Product	Total unit	Estimated weight (kg)	Number of employees	Unit per employee	Estimated number of employer in sector	Total unit of stocked EEE	Total weight of stocked EEE (t)
Large household appliances(category 1)							
Fridge	7	90					
Freezer	5	90					
Electric heater	3						
Electric/gas stove	2	25					
Air conditioner	22	40					
Oven	2						
Small household appliances(category 2)							
Iron	3	2.5					
Kettle	8	3.5					
Microwave	2						
Fan	43	10					
Water dispenser	3						
Carpet sweeper	3						
IT and telecom equipment(category 3)							
PC (central)	209	9.9					
CRT monitor	4	14.1		0.04		47	0.6627
LCD monitor	288	4.9					
Laptop	53						
Mobile phone	11	0.1					
Phone	7						
Printer							
Copy machine	12						
Scanner							
Fax machine							
Modem	10	0.05					
Consumer equipment (category 4)							
TV (CRT)	1	31.6		0.01		11.75	0.3713
TV (flat panel)	15	15					
Video projector	12						
Camera	18						
DVD player	2						
Radio	5	2					
Lighting Equipment (category 5)							
Light bulb	18						
Fluorescent bulb	53						
Energy saving bulb	77						
Rechargeable lamp	2						
TOTAL			**94**		**1175**		**1.034**

Corporate consumers

Questionnaire survey was also conducted at two of the largest banks in the country. The banking industry is one of the fastest growing industries in the country since the return of democracy. Table 22 gives an estimate of the number of electrical and electronic equipment for banks.

Table 22. Stocked EEE at Corporate institutions (Two Bank)

Product	Total unit	Estimated weight (kg)	Number of employees	Unit per employee	Estimated number of employer in sector	Total unit of stocked EEE	Total weight of stocked EEE (t)
Large household appliances (category 1)							
Fridge	64	90		0.14			
Freezer	21	90		0.05			
Electric heater	15			0.03			
Electric/gas stove	15	25		0.03			
Air conditioner	130	40		0.29			
Electric hotplate	9	10		0.02			
Small household appliances(category 2)							
Iron	10	2.5		0.02			
Kettle	52	3.5		0.12			
Microwave	20	15		0.09			
Fan	58	10		0.13			
Water dispenser	52	25		0.16			
Vacuum cleaner	18	15		0.04			
IT and telecom equipment(category 3)							
PC (central)	0	9.9		0.00			
CRT monitor	0	14.1		0.00			
LCD monitor	350	4.9		0.78			
Laptop	125	3		0.28			
Mobile phone	300	0.1		0.67			
Phone	300	0.5		0.67			
Printer	150	25		0.33			
Copy machine	36	25		0.08			
Scanner	25	20		0.06			
Fax machine	3	25		0.007			
Modem	125	0.05		0.28			
Consumer equipment (category 4)							
TV (CRT)	0	31.6		0			
TV (flat panel)	40	15		0.09			
Video projector	8			0.02			
Camera	18			0.04			
Lighting Equipment (category 5)							
Light bulb	410			0.91			
Fluorescent bulb	410			0.91			
Energy saving bulb	120			0.27			
Rechargeable lamp	32			0.07			
TOTAL			**450**				

The estimated amount of POP-PBDEs for the institution considered are summarised in Table 23 below.

Table 23. Estimated POP-PBDEs in stocks of EEE in institutions

Product	Amount of household EEE (tonne)	Total polymer fraction in EEE (% wt)	Content of c-OctaBDE in total polymer fraction of EEE	Amount of c-OctaBDE in household EEE (kg)
CRT monitors	0.6627	30	2.54	0.505
TV (CRT)	0.3713	30	0.87	0.097
TOTAL				**0.602**

The estimate amount of WEEE plastics from items institutions in 2015 are 199 Kg (0.199 tonnes) from CRT monitor and 111 Kg (0.111 tonnes) from CRT TV.

EEE repairs shops

EEE repairs shops accumulate huge stock of faulty CRT TV as most of these items from the household ended up with them. Generally, they serve as reservoir of spare part and ultimately dispose of when they have been exhausted. Disposal of the unwanted waste is on average done twice per year according to the owners of the shops. A survey of about 20 EEE repairs shop in Freetown indicated an estimated 650 CRT TVs stocked in these shops. In order to estimate the c-OctaBDE potentially entering the waste stream the following expression was used:

$$M_{OctaBDE;WEEE} = M_{WEEE} \times f_{Polymer} \times C_{c\text{-}OctaBDE;Polymer}$$

Where,
$M_{OctaBDE;EEE}$ = the amount of c-OctaBDE in waste EEE (kg)
M_{WEEE} = amount of waste CRT containing EEE (tonne); 650 × 25 = 16.25 ton
$f_{Polymer}$ = total polymer fraction in EEE (weight-%); 30%
$C_{c\text{-}OctaBDE;Polymer}$ = the content of the c-OctaBDE in the total polymer fraction of EEE (kg/metric ton); 0.87

$M_{OctaBDE;EEE} = 16.25 \times 0.3 \times 0.87 = 4.24$ kg

The POP-PBDEs (HexaBDE and HeptaBDE) in the c-OctaBDE stocked in this sector is estimated as :

Table 24. HexaBDE and HeptaBDE present in EEE (CRT TVs)

Homologues	Distribution homologues in c-OctaBDE	Homologues in household EEE (kg)
HexaBDE	11%	**0.4664**
HeptaBDE	42%	**1.7808**

The amount of WEEE plastics from repair shops is estimated as 4.9 tonnes from CRT TV.

EEE Entering the Waste Stream

WEEE entering the waste streams can emanate from household, companies, institutions and EEE repair shops. Two key inputs for calculating EEE articles entering the waste stream area are:

i. The amount of EEE stockpiled.
ii. The average life span.

The WEEE generated can be calculated using the formula

WEEE generated per year = $M_{EEE;stockpiled} \times Is_{EEE}$

$M_{EEE;stockpiled}$ = is the amount of EEE stockpiled (in tonnes)

Is_{EEE} = is the average life span of the specific appliance (in years)

Table 25. Data and assumption used in estimating WEEE generated

Data description	Household	Institution (corporate/education)	EEE Repairs shop
Stocked CRT computer monitors (tonnes)	503.80	47	
Average life span of CRT computer monitors (years)	10	4	1
Estimated WEEE entering the waste stream from CRT computer monitors (tonnes)	50.38	11.75	
Stocked CRT TVs (tonnes)	12903.92	11.75	10.3648
Average life span of CRT TVs (years)	10	4	1
Estimated WEEE entering the waste stream from CRT TVs (tonnes)	1290.392	2.9375	10.3648

Total WEEE generated from CRT computer monitors = 62.1 tonne

Total WEEE generated from CRT TVs = 1304 tonne

The total amount c-OctaBDE in EEE entering the waste stream is then estimated as indicated in table 26 below.

Table 26. Amount of c-OctaBDE of EEE entering the waste stream

Product	Amount of WEEE generated (tonnes)	Total polymer fraction in WEEE (wt-%)	Content of c-OctaBDE in total polymer fraction (kg/tonne)	Amount of c-OctaBDE (kg)
CRT monitors	62.13	30%	2.54	46.97
CRT-TVs	1303.6943	30%	0.87	340.26
Total amount of c-OctaBDE in EEE entering the waste stream				**387.23**

The estimate amount of WEEE plastics entering the waste stream from the different sources are 18.64 tonnes from CRT monitor and 391.10 tonnes from CRT TV.

Table 27 gives a summary of POP-PBDEs recalculated from the total c-OctaBDE using the percentage distribution of the homologues as indicated in the guide from the area considered.

Table 27. Inventory of POP-PBDEs for 2015 (in kg)

Homologues	Distribution of homologues of c-OctaBDE	POP-PBDEs in import for 2015	POP-PBDEs in stock for 2015	POP-PBDEs entering the waste stream for 2015	Total (kg)
Inventoried c-OctaBDE		**63.86**	**3752.42**	**387.23**	**4203.51**
HexaBDE	11%	7.0246	412.7662	42.5953	462.4
HeptaBDE	43%	27.4598	1613.5406	166.5089	1807.5
OctaBDE	35%	22.3510	1313.347	135.5305	1471.2
NonaBDE	10%	6.3860	375.242	38.723	420.4
DecaBDE	1%	0.6386	37.5242	3.8723	42.0
Estimated WEEE plastics (tonnes)		TV = 90.5 PC = 22.9	TV = 3871.11 PC = 151.20	TV = 391.1 PC = 18.64	

Potential PBDE Contaminated Site

The CRT TV in these repair shops were mostly stored in the open where they came in direct contact with sunlight and rain, thereby leading to deterioration of these plastic materials leaching out the chemical. These locations can therefore be potential contaminated sites. At the dumpsites, scavengers do collect the casings which are usually mixed with other wastes and are used as trash can, flower vase and as place to sit on. The damage casings are burnt together with the solid wastes in the dumpsite.

2.3.3.4. PBDE in transport sector

Introduction

An estimated 100,000 tonnes of commercial PentaBDE (c-PentaBDE) was produced worldwide- Approx. 90% has been used in polyurethane used in vehicles and furniture mainly in the United States. c-PentaBDE was used largely in the transport sector in the treatment of flexible PUR foams used for automotive seating, head rests, car ceilings, acoustic management systems, etc. Minor uses include: back-coating of textiles used on car seats.

Cars and other vehicles (trucks and buses) making up the major portion of the transport sector containing the largest volume of POP-PBDEs (Secretariat of the Stockholm Convention 2015). Therefore the focus and methodology for the inventory are centred on these vehicles. Since POP-PBDEs listed in 2009 were produced and used in the period from approximately 1975 to 2004 and only vehicles produced during this period need currently be inventoried for POP-PBDEs (Secretariat of the Stockholm Convention 2015).

Furthermore DecaBDE have been listed in May 2017 in the Stockholm Convention as POP and it was and is still used in vehicles (Kajiwara et al. 2014) as one of the specific exemptions of DecaBDE when in the listing (UNEP 2017).

Objectives of the inventory

The main objective of the inventory is to obtain information about the situation of POP-PBDEs in the transport sector with the main focus on cars, vehicles and buses in Sierra Leone. This can be achieved through the following steps:

- To get a general overview of POP-PBDE impacted articles and waste and the amount of POP-PBDEs contained in these materials;
- To evaluate whether the current management system for POP-PBDE containing items meets the requirement of the Stockholm Convention and identify areas where they do not;
- To provide the basis for development of a strategy in the NIP i.e. identify areas and the economic sectors where there is a need to develop and prioritize effective strategies and action plans for managing POP-PBDE containing articles and materials;
- To identify areas where financial or technical support are needed to fill the gaps in the inventory and in the management of POP-PBDE containing materials;
- To develop the basis to manage plastics and polymers in vehicles.

Scope of the inventory

The inventory focuses mainly on capturing the following information:

- Number and types of imported vehicles (second hand) with country of origin and year of manufacturing;
- Number of vehicle in use (obtained from vehicle licencing register of the country);

- End-of-life vehicle in the inventory year (i.e. 2015);
- Life expectancy of vehicle (cars, buses and trucks) in Sierra Leone.

Methodology

Data were generally collected from institutional data base and interviews conducted during site visit.

Secondary Data

Import data for new and used vehicles (for 2013 – 2015) was collected from the National Revenue Authority. Additional data on vehicle registration etc. will be obtained from the Sierra Leone Road Safety Authority (SLRSA).

Site Visit

Site visit and interviews at four end-of-life vehicle treatment facilities/scrap yards were conducted to take a head count of scrapped vehicles and assess how waste is managed generally at these facilities.

Inventory results/findings

a) Calculation of POP-PBDEs in Imported Vehicles

Import of used cars, vans, trucks and other forms of transport is significant especially for a low income country like Sierra Leone. Table 28 gives the amount of vehicle imported to the country between 2013 and 2015 with an average of 96.4% of them being used vehicles and a similar percentage of these used vehicles are older than ten years i.e. they were manufactured before 2005.

Table 28. Distribution of vehicles imported between 2013 – 2015 (National Revenue Authority)

	2013	2014	2015
Used	9008	6715	8623
New	259	305	334
Total	9267	7020	8957
% used	97.2	95.6	96.3

The levels of c-PentaBDE used in vehicles depend on the national/regional legislation where production occurs. For the United State where an approximately 90% of c-PentaBDE was used, a factor of 0.5 (50% of vehicle produced between 1975 and 2004 impacted) was selected for adjustment of vehicles imported from that country whereas, a factor of 0.05 is considered for other region (Europe and Asia) where a relatively smaller amount of the chemical was used in the transport sector. Table 29 gives the amount of vehicles (cars, vans and trucks) imported from the US and the total amount of vehicles imported from other regions (Europe and Asia) for the period 2013 - 2015.

Table 29. Importation of used vehicles (cars, bus, trucks) from the US and other regions

	2013	2014	2015

United State	2533	2666	3098
Other regions	6475	4049	5525
Total	9008	6715	8623

The amount of c-PentaBDE in imported vehicles can be calculated as follows:

$M_{c\text{-}PentaBDE;imported\ vehicles} = M_{vehicles;imported} \times f_{reginal\ factor} \times C_{PentaBDE;content}$
$M_{c\text{-}PentaBDE;imported\ vehicles}$ = Quantity of c-PentaBDE in kg
$M_{vehicles;imported}$ = number of imported cars/trucks per year (unit/year)
$C_{PentaBDE;content}$ (kg) = Quantity of c-PentaBDE per truck/car; 0.16 kg
$f_{reginal\ factor}$ = regional factor; 0.5 for the US and 0.05 for all other regions

The total estimated amount of PUR foam in imported vehicles during 2013-2015 was approx. 390 tonnes containing 0.8 tonnes of POP-PBDEs.

The total polymeric fraction amount in imported cars/trucks during 2013-2015 was estimated, as this need to be managed at the end-of-life. Considering that 1 car/truck contain approx. 200 kg polymers: 24346 cars/trucks x 0.2 t polymer = 4869t polymer within the three years

Table 30. Amount of c-PentaBDE (kg) in PUR foam of imported vehicles in 2013 - 2015

Number of imported cars/trucks(manufactured in US before 2005)	Amount of c-PentaBDE per car/truck	Regional factor	Total amount of POP-PBDEs in cars/trucks imported from US 2015 (kg)
3098	0.16	0.5	**247.84**
Number of imported cars/trucks (manufactured in other regions before 2005)	Amount of c-PentaBDE per car/truck	Regional factor	Total amount of POP-PBDEs in cars/trucks imported in 2015 from regions other than US
5525	0.16	0.05	**44.20**
Number of imported cars/trucks (manufactured in US before 2005)	Amount of c-PentaBDE per car/truck	Regional factor	Total amount of POP-PBDEs in cars/trucks imported from US in 2014
2666	0.16	0.5	**213.28**
Number of imported cars/trucks (manufactured in other regions before 2005)	Amount of c-PentaBDE per car/truck	Regional factor	Total amount of POP-PBDEs in cars/trucks imported in 2014 from regions other than US
4049	0.16	0.05	**32.392**
Number of imported cars/trucks (manufactured in US before 2005)	Amount of c-PentaBDE per car/truck	Regional factor	Total amount of POP-PBDEs in cars/trucks imported from US in 2013
2533	0.16	0.5	**202.64**
Number of imported cars/trucks (manufactured in other regions before 2005)	Amount of c-PentaBDE per car/truck	Regional factor	Total amount of POP-PBDEs in cars/trucks imported in 2013 from regions other than US
6475	0.16	0.05	**51.80**

Total: 24346			**793.15**

b) Calculation of POP-PBDEs in current use/registered vehicles

In 2013, a total of 18,200 vehicles are registered (excluding motorcycles) of which an estimated 1,024 vehicles are newly registered (Statistics Sierra Leone, 2014). With over 90% of the vehicles being older than ten years, an estimated amount of 16,380 of registered vehicles were manufactured before 2005. The amount of c-PentaBDE in this number of vehicles is calculated thus, Amount of c-PentaBDE (kg) = 16380 × 0.16 × 0.275 = 720.72 Kg

Where 0.275 (i.e. {0.5 + 0.05}/2) as the regional factor since the origin of vehicles is not known.

The polymer fraction in the vehicles is given as 16,380 × 0.2 = 3276 tonnes.

c) Calculation of POP-PBDEs in End-of-Life Vehicles

National data on number of vehicles being scrapped are not available as inventory on such has not being conducted in the past by the relevant authorities. Interviews were conducted at the four main vehicle scrap yards in Freetown and a head count of the number of vehicle present/being scrapped at the different locations was obtained as indicated in Table 31.

Table 31. Estimate of vehicle been scrapped quarterly (at four scrape yards)

Location	Coordinate	Quantity of scrapped vehicles
Upgun (Kissy)	N 08° 29.057′ W 13° 12.676′	40
Halen Town (Kiorsk)	N 08° 24.791′ W 13° 08.220′	25
Halen Town (1 Pole)	N 08° 24.413′ W 13° 08.532′	60
Hill Cut Road (G Gate)	N 08° 27.931′ W 13° 15.007′	58
Total		**183**

The aforementioned scrape yards are the main facilities available in the capital (Freetown) and may represent only a fraction of those available in the country. Vehicles are also been dismantled in areas such as garages and abandoned locations.

There was no information on the region of origin of the scrapped vehicles, so a regional factor of 0.275 (i.e. {0.5 + 0.05}/2) is used for the estimation. It was estimated during the survey that on average, a total amount of 183 vehicles are being scraped in these four scrap yards on a quarterly basis, therefore, a total of 732 vehicles is being scrapped per annum.

Quantity of c-PentaBDE in scrapped vehicles (kg) in 2016= 732 × 0.16 × 0.275 = **32.2 kg**

The estimated total amount of PUR foam is 12 tonnes containing 0.032 tonnes of POP-PBDEs.

The PBDEs are contained in polyurethane, synthetic textiles and for the recently listed DecaBDE also in a range of plastic parts. For the management of PBDEs in vehicles, the plastic and polymer parts need to be adequately managed. The management of plastic and polymers is also relevant to reduce the overall plastic pollution in Sierra Leone including the fuel of open burning on dumpsites and the impact on marine litter.

The average polymers (plastic, foams and synthetics) in cars are approximately 15 %[22] considering an average weight of a car (1.333 t). This means that approx. 200 kg polymers (plastic, foams and synthetics) are in one car. Therefore the 732 cars contain approx. 146 tonnes of polymers which should be managed in an environmentally sound manner.

Table 32. Summary of the estimated amounts of POP-PBDEs, PUR foam and polymeric fraction

	Imported vehicles 2013-2013 (tonnes)	**In use/registered vehicles 2003-2013 (tonnes)**	**End-of-life vehicles 2015 (tonnes)**	**Total estimated amount (tonnes)**
Estimated total amount of POP-PBDEs content	0.8	3.2	0.032	4.032
Estimated total amount of PUR foam	390	2220	12	2622
Estimated total amount of polymeric fraction	3652	20922	146	24720

2.3.4 Assessment of HBCD (Annex A, Part I and Part VII)

2.3.4.1 Introduction

Hexabromocyclododecane (HBCD) was listed in Annex A of the Stockholm Convention in 2013. Like all POPs, it is toxic, resists degradation, bioaccumulates and can be transported through air, water and migratory species. HBCD is used as flame retardant additive to reduce ignition and has been in use as early as the 1960s. The main application has been in polystyrene foam, in insulation boards widely used in building and construction. These polystyrene foams exist in two forms, as expanded polystyrene (EPS) and extruded polystyrene (XPS) foam, with HBCD concentrations ranging from 0.7% to 3%. The second most important application (though as minor) is in textiles as back-coating and can be present at concentrations ranging from 2.2 – 4.3%. A further smaller application has also been reported in high impact polystyrene (HIPS) which is used in electrical and electronics equipment and appliances at levels ranging from 1 – 7%.The use of HBCD differs from one region to another. The use in the EU was mainly in XPS and EPS with the uses in HIPS and textile estimated at 2% each. In Japan, 80% of the consumption of HBCD was in insulation boards and 20% in textile.

[22] Please note: The polymer content and the weight of vehicles changes over time with increasing contribution of polymers.

In Sierra Leone, HBCD can be present in imported articles containing these chemical as there is no evidence of production or being used in articles produced within the country. In- fact, there is no flammability standards requiring the addition of flame retardant in the production of goods in the country.

2.3.4.2 Objectives of the inventory

The main objective of the inventory is to obtain information needed for the implementation of the provisions of the convention, mainly:

- Provide the basis for development of a strategy in the NIP (i.e. identify the economic sectors that shou1d be prioritized and the type of actions required for those sectors);
- Identify areas where financial or technical supports are needed.

2.3.4.3 Scope of the inventory

The inventory focuses mainly on capturing the following information:

- Types and quantity of articles containing HBCD imported, in use/store and end-of-life;
- Disposal practices for product and articles containing HBCD;
- Identification of potentially contaminated sites.

2.3.4.4 Methodology

The inventory was developed considering the HBCD inventory guidance[23]. Questionnaires was sent out to different construction companies to investigate, if present, the types and quantity of insulating materials in use/store and how they manage waste generated from these material during construction or demolition of buildings containing insulation materials.
Site visit was conducted at the head office of the National Fire Force during which interviews was conducted to collect information on the quantity and type of fire protecting suits in-use/store used by the fire fighters to culled fire incidents.

2.3.4.5 Inventory results

a) HBCD Use in Textile Clothing (fire fighters uniform)

Common use of HBCD or other flame retardants in specialized clothing is in suit worn by fire fighters to fight fire outbreaks. Furthermore there are some textiles which do not need flame retardants and can be used for such uniforms. The National Fire Force (NFF) is the regulatory body with the mandate to address fire related issues in the country. Table 33 presents data on the type and number of firefighting suits in-use/store used by the NFF all over the country.

Table 33. Statistics of Protective Clothing in-use/store (National Fire Force)

Country of origin	Total Quantity	Amount in-use	Amount in store

[23] UNEP, 2015. Guidance for the inventory, identification and substitution of Hexabromocyclododecane (HBCD).

United States	156	96	60
Germany	255	128	127
China	150	100	50
TOTAL	**561**	**324**	**237**

Amount in-use represents the number of suits distributed to different units throughout the country and the amount in store represents suits that are kept in the head office. Damaged suit are collected and stored at the head office.

To calculate the potential amount of HBCD or other that may be contained in these suits, the following relationship was used:

$$Qty\ of HBCD\ treated\ in\ clothing\ (kg) = amount\ of\ Treated\ clothing \times 2.2\%\ to\ 15\%$$

With 2% to 15% representing the minimum and maximum HBCD content in textiles respectively as indicated in the UNEP, 2015, Guidance for inventory for conducting an inventory for this chemical:

Assuming that each suit (coat + trousers) weighs 10 Kg,
Total amount of HBCD treated clothing = (561 × 10)/1000 = 5.61 tonnes
It needs to be stressed that different flame retardants are used in textiles and therefore this calculation is an upper estimate. Another flame retardant used is DecaBDE listed as POPs in the Stockholm Convention at COP 8 in May 2017. A share of the estimated 5.6 tonnes could therefore be DecaBDE. Furthermore other flame retardants such as phosphorus organic flame retardants are used or textiles which does not need flame retardants.
Since 2013 after listing of HBCD in the Convention, the chemical is most likely not use anymore in textile production. Therefore uniforms produced after 2013 most likely do not contain HBCD. However also these newer uniforms could contain DecaBDE which has been listed with exemption for the use as flame retardant in textile production. For clarification monitoring studies or detailed information from the original producers are needed.

Textiles used as window curtains etc. in hotels, hospitals, offices and some homes which are normally imported from countries with flammability standards may be potential sources of HBCD contamination.

Table 34. Estimation of the amount of HBCD or other flame retardant in textile clothing

Total amount of HBCD or other FRs treated clothing (in-use/store) in tonnes	HBCD/FR Content in textiles	Total amount of HBCD/FR in clothing (tonnes)
5.61	2.2% × 5.61	**0.123**
	15% × 5.61	**0.8415**

Similarly, interviews conducted with some construction companies say enough data is not available to conclusively indicate the use of insulating foams containing these pollutants; however, it is possible that such materials may have been used in buildings constructed over decades.

c) Other uses

Interviews and investigations conducted at local outlets (importers) where materials for upholstery are sold did not show the presence of HBCD in the materials (based on the material information provided by the importers). The materials are mainly imported from the Middle East and Asia.

2.3.5 Assessment of PFOS, its salts and PFOSF (Annex B, Part III)

2.3.5.1 Introduction

PFOS is a fully fluorinated (perfluorinated) substance, which is commonly used as a salt in some applications. While PFOS can exist in anionic, acid and salt forms, the PFOS anion is the most common form in the environment and in the human body (Environment Canada, 2006). The aim of listing PFOS, its salts and PFOSF in the Stockholm Convention is to restrict the use and production of PFOS and its related substances.

PFOS and related substances are all regulated under the Convention. PFOS-related substances refer to a larger group of substances containing perfluorinatedsulfonyl with eight-carbon chain length, which may be simple salts of PFOS (e.g. potassium, lithium, ammonium, diethanolamine) or polymers that contain PFOS. Figure 10 illustrates the structural formula of PFOS shown as its potassium salt (UNEP, 2006b).

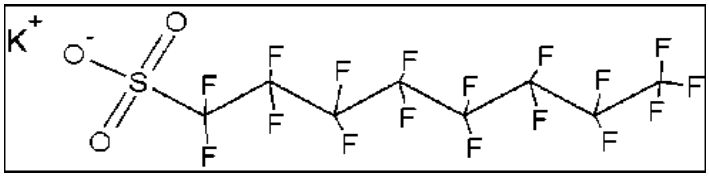

Figure 10. Structural formula of PFOS shown as its potassium salt

PFOS can be formed by environmental microbial degradation or by metabolism in larger organisms from PFOS-related substances (UNEP, 2006b).

2.3.5.2 Objectives of the PFOS inventory

The main objective of the inventory is to obtain the information needed for several important decisions related to the management of PFOS and its related substances and implementation of the obligations in the Stockholm Convention for Sierra Leone. More specifically, the objectives are to:

- Provide the basis for development of a strategy in the NIP (i.e. identify the economic sectors that should be prioritized and the type of actions required for those sectors);

- Provide a basis for the evaluation whether the current national use, production, chemical and waste management meet the requirements of the Convention and identify areas where they do not;

- Provide a basis and information to support the report to the COP of the Convention on progress made to eliminate PFOS, its salts, and PFOSF;

- Identify areas where financial or technical support are needed (when resources are limited, to fill the gaps in the inventory/fulfill the obligations of the Convention).

2.3.5.3 Data collection and methodologies

A number of different methodologies have been used for gathering information about hazardous substances such as PFOS.

The methodologies for data collection employed can be divided into three main groups:

Indicative method: This includes desk study of existing information, workshops, and interviews. questionnaires to obtain more specific data

Quantitative method: Information obtained from the customs service, national bureau of statistics, and national central bank; published literature in scientific journals, technical reports or notes, commissioned research reports, development assistance study reports; phone books and Internet searches.

Questionnaires can be administered through various outreach mechanisms, including postal distribution; supply chain distribution; distribution via trade unions, NGOs, local governments and community leaders; and hand delivery in one-on-one interviews, etc.

In cases where the sheets of declarations on health and safety attached to the products do not contain information about the content of PFOS and its related substances, professional users are encouraged to consult the suppliers of products to provide this information. Suppliers are encouraged to consult with the manufacturers to obtain this information if it is missing.

- Site inspection, sampling and analysis: Samples of products and articles can be gathered in site inspections of relevant installations and facilities, as well as at local retailers. Also for potentially contaminated sites the locations would be inspected and samples of e.g. ground water, soils or fishes would be selected.

Identification of stakeholders in key sectors during the inventory

The following tools were used to identify and get contact details to stakeholders of relevance in the country:

- Email/Web-based information sourcing;

- Phone books;
- National registers;
- Consulting with other stakeholders.

The contact was made by using:

- Face-to-face interviews;
- Telephone interviews.

Tiered approach

Collecting inventory-related data is a multi-step process that can be based on a tiered approach. An initial assessment (tier I) is carried out to get an overview of the relevant stakeholders to be contacted in the key sector under investigation. This can be followed by a (preliminary) inventory (tier II) to generate data and identify missing and incomplete data sets. If needed and resources are available, a more in-depth inventory (tier III) can be initiated after evaluation of the data gathered in the preliminary inventory.

Collecting and compiling data from sectors

For data collection from key areas, the PFOS inventory team investigated the following in the country:

- Production of PFOS, its salts and PFOSF; PFOS-related substances; and chemical preparations containing PFOS;
- Industries using chemicals containing PFOS and its related substances;
- Products and articles containing PFOS and its related substances on the national consumer market;
- Professional users of articles or products containing PFOS and its related substances;
- Waste fractions containing PFOS and its related substances, and how they are managed;
- Stockpiles containing PFOS and its related substances, and how they are managed;
- Contaminated sites with PFOS and its related substances.

The following types of numerical data needed to be collected and compiled in the inventory were based on the following:

- Information about the types and quantities of relevant PFOS in each identified category is obtained through questionnaire by hand delivery and using face-to-face interview.
- Records from certain government departments (Custom, Civil Defense) is obtained for data completion and verification
- Data evaluation: Data is evaluated for its reliability mainly by further contact with the identified stakeholders.

- Emission factor: Emission factor from UNEP Guidance document for each Category is used to calculate the PFOS in cases where no information about the actual concentration is declared.

The inventory of PFOS is undertaken by using the Guidance for the inventory of Perfluorooctane Sulfonic Acid (PFOS) and related chemicals listed under the Stockholm Convention on Persistent Organic Pollutants, (Secretariat of the Stockholm Convention 2012). The key sectors that were investigated fall under four main inventory areas:

- Firefighting foams, aviation hydraulic fluids and insecticides containing PFOS and its related substances;
- Production and use of PFOS and its related substances in the industrial sectors;
- Products and articles containing PFOS and its related substances on the consumer market;
- Waste, stockpiles and contaminated sites containing PFOS and its related substances.

Initial information waste obtained from the following:

- Fire Force;
- Retail outlet (Private Sectors);
- Chemical Industry;
- Custom Department(NRA);
- Civil Defence Department;
- Aviation Authority;
- Freetown City Council & MASADA(Waste management authority);
- Petroleum Regulatory Commission;
- Mining company.

2.3.5.4 Inventory results

(Major) retailers of commercial products possibly containing PFOS.

In the assessment of AFFF and other suspected foams, it could not be clarified if PFOS or other PFAS chemicals were used. The labels on containers of AFFF did not specify whether the foams contained PFOS-based related substances or other fluorinated compounds. This information was not known/provided. For a conservative estimate, it is assumed that the AFFF and related foams contained PFOS

Firefighting foams containing PFOS and its related substances

Below is Table 35 showing Information (obtained through questionnaire by hand delivery and using face-to-face interview) about the types and quantities of relevant firefighting foams (PFOS) in each identified category.

Table 35. Types and quantities of relevant firefighting foams (PFOS) in each identified category

Professional user /Stakeholders	Type of PFOS	Quantity for 2016	Stockpiles	Site Location
Sierra Leone Fire Force	ARFFFP and AFFP	29000	12600	Freetown
Airport	AFFP[Carbondioxide(CO_2)]	2260	8400	Lungi International Airport
Petroleum Companies NP (SL) Limited	3% Espandol Synthetic(expansion foam) and AFFP Carbondioxide(CO_2) and ABC Dry powder]	21000	4200	Kissy Terminal
Total (SL) Limited	PROFLON-FP 3, PROFLON-FP 6, EMULSOR, Firefighting foam Suppressant and AFFP	10000	8800	Kissy Terminal
Sierra Leone Company to generate heat & power(EDSA&EGTC)	AFFP [Carbondioxide(CO2) and ABC Dry powder]	44500	42100	Falcon Bridge, Freetown.
Civil Defence	Not applicable	None	None	Freetown

The obtained data from stakeholders on stockpiles of PFOS are compiled in Table 36 and on emitted PFOS in Table 37.

Table 36.Quantity of PFOS[24] in stockpiles in 2016

Professional user	Stockpiles of PFOS-based foam, litres (Kg)	Quantity of PFOS in stockpiles, Kg
Sierra Leone Fire Force	12600 (12852)	Low 64.26 High 192.78
Airports	8400(8568)	Low 42.84 High 128.52
Petroleum Companies NP (sl) Limited Total (SL) Limited	 4200(4284) 8800(8976)	 Low 21.42 High 64.26 Low 44.88 High 134.64
Sierra Leone Company to generate heat & power(EDSA&EGTC)	42100(42942)	Low 214.71 High 644.13
Civil Defence	Nil	Nil

[24]In the assessment of AFFF and other suspected foams, it could not be clarified if PFOS or other PFAS chemicals were used. For a conservative estimate, it is assumed that the AFFF and related foams contained PFOS.

B. Quantity of PFOS-related substances[24] emitted in 2016 from firefighting foams.

The amount of used firefighting foam potentially containing PFOS[24] has been inventoried and is listed compiled in Table 37 and Table 38. Further assessment is needed to which extent these foams contained PFOS or other PFAS such as perfluorooctanoic acid (PFOA) which has been listed in 2019 as POPs in the convention or perfluorohexanesulfonic acid (PFHxS) which is currently assessed in the POPs Review Committee.

Table 37. Quantity of PFOS[24] used and released into the environment in 2016

Professional user	PFOS-based foam used in 2016, litres (Kg)	Quantity (Kg) of PFOS emitted in 2016
Sierra Leone Fire Force	29000 (29988)	Low 149.94 High 449.82
Airports	2260(2305.2)	Low 11.526 High 34.578
Petroleum Companies NP (SL) Limited Total (SL) Limited	 21000(21420) 10000(10200)	Low 107.10 High 321.30 Low 51.00 High 15.30
Sierra Leone Company to generate heat & power (EDSA&EGTC)	44500(45390)	Low 226.95 High 680.85
Civil Defence	Nil	Nil

Table 38. Cities/quantity of PFOS[24] based foam used for training in 2016

City (Fire Stations/training location)	Quantity of PFOS[24] base-foam used in 2016 (litres)	Type of Foams
Seima Town Rokel Training School	25	AFFP and ARFFFP
Airports	55	AFFF
Petroleum Companies NP (SL) Limited Total (SL) Limited	 20 800	3% Espandol Synthetic (expansion foam) and AFFP. PROFLON-FP 3 PROFLON-FP 6, EMULSOR, Firefighting foam Suppressant
Sierra Leone Company to generate heat & power(EDSA&EGTC)	Nil	Nil

Table 39 shows the locations and amount of firefighting foam used in actual fire events (for the past 20 years).The labels on containers of AFFF did not specify whether the foams contained PFOS-based related substances or other PFAS compounds.

Table 39. Locations and amount of firefighting foam used in major fire events (for past 20 years)

Professional users	Location of large fire event	Date	Type of firefighting foam	Estimated amount Kg
National Fire Force	Shell/Total Filling Station Tanker Fire at Pademba Road	2015/16	ARFFFP ARFFFP	25 15
Petroleum Companies NP(SL) Limited Total (SL) Limited	Nil Nil	Nil Nil	Nil Nil	Nil Nil
Sierra Leone Airport Authority	FNA Aerodrome- Runway 30 Northern Apron FNA Aerodrome	2008 2012	AFFF AFFF	 55

Step 4: Evaluation of received data

Private traders do not give out information about their sales and they don't have large stockpiles of PFOS because the users purchase them through retail markets.

Tables 36 shows Stockpiles of possibly PFOS-containing foams held by different stakeholders. Table 37 to 39 show PFOS-based foam used in 2016 and training sites and the quantity used by different categories for training or fire events. Private companies involved in petroleum operations have large quantity of stockpiles of PFOS-based foams. Annual consumption varies among user categories with figures ranging from 60 to 4000 litres.

There were no existed plans for management of waste resulted from spills or expired products. All of them reported that they do not hold any expired foams. **The labels on containers of AFFF did not specify whether the foams contained PFOS-based related substances or other fluorinated compounds.** The countries from which the foams are imported are UK, USA, Germany, France and China.

The record on the Quantity of PFOS-related substances in stockpiles for different categories, emission of them and Quantity of PFOS-related substances emitted in the year of 2016 shows that the Sierra Leone Company that generate heat & power (EDSA&EGTC) has the largest stock of PFOS than other stakeholders or Institutions.

The stockpiles of foam at the airports is relatively high and their explanation for it is that it is kept for emergency and that it also can be used by Airport authorities for any emergency inside or outside the airport premises if needed. Also, the records about the stockpiles are considered to be reliable. However there are no records about historical use. Most of users keep some of their stockpiles for more than two years and this mainly due to low frequency of use.

No information on the amount and stockpiles of firefighting foam was given by the Armed Forces or Defence Authorities. Also there were no data on PFOS used during training exercise for Sierra Leone Company to generate heat & power (EDSA&EGTC) and no record of incident on fire disaster from Total (SL) Limited for 2016. Data on the training sites showed greater amount of foam used or as compare to the actual fire incidents for the various Institution. These training sites are mostly on the western part of the country.

In observation of PFOS released during training exercises, the worst-case scenario is taken by considering that all the foams used in training at these sites are PFOS-containing foams and after training their decomposition was done naturally (biodegradable) or by adding water through evaporation and volatalization especially for the petroleum sector which is environmentally not friendly (Figure 11).

Figure 11: Participants undergoing firefighting training

Information obtained from Customs did not specify the type of firefighting foams entering the country (all types of firefighting foams are classified under one code), which make the distinction of AFFF and other foams and content of PFOS or other surfactants impossible.

Inventory of aviation hydraulic fluids

Aviation hydraulic oils containing PFOS are used in civil and military airplanes to prevent corrosion and improved performance.

The professional users of aviation hydraulic oils are:

- Arm force;
- Airports;

- Private companies.

Table 40 below shows information received from professional users.

Information on the aviation hydraulic oil was only received from the Sierra Leone Airport Authority through Total SL Limited that is sub-contracted to supply Aviation fuel. There was no record on historical release of PFOS from the custom department and the quantity of hydraulic aviation fluids imported in the last ten years.

Table 40. Identified professional users of PFOS and the quantity used

Professional user	Type of Aviation hydraulic oil	Amount of Aviation hydraulic oil (litres) for 2016.	Stockpiles of Aviation hydraulic oil	Country of Origin
Arm force	None	None	None	None
Air ports	Jet A1	4,903,900	4,895,084	Cote D'Ivoire
Private companies	None	None	None	None

Inventory of waste, stockpiles and contaminated sites containing PFOS and its related substances

A Questionnaire was administered to the Freetown City Council with regards to waste, stockpiles and contaminated sites containing PFOS and its related substances.

The content of the questionnaire was based on the following:

- Identifying waste fractions that contain PFOS and its related salts and how they are managed;
- Identification of stockpiles and their storage conditions in different locations;
- Identification of sites which are potentially contaminated with PFOS and its related salts;
- Waste of articles and products.

According to the information provided by the custom, 189852 tonnes of carpets entered the country in 2016. According to information obtained from the users of firefighting foams, the waste water is released to the environment at the application site due to natural occurrence or open burning. There is no regulation in the country governing collection and management of such hazardous waste. According to information from airport authorities, some of their aviation hydraulic fluids waste is disposed of in the drainage system and finally end up in sewage water or sludge.

For the aviation hydraulic fluid, the area in which replacement or addition to complete filling of the equipment may contain waste which needs to be managed, i.e. especial pre-treatment prior final disposal should be operated.

2.3.6 Assessment of releases of unintentionally produced POPs (Annex C)

2.3.6.1 Introduction

For unintentionally generated POPs (UPOPs), such as polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), measures should be taken to ‘‘reduce the total releases derived from anthropogenic sources’; the final goal is ultimate elimination, where feasible (Stockholm Convention, Article5 and Annex C). Besides PCDD/PCDFs, the Stockholm Convention also includes unintentionally produced polychlorinated biphenyls (PCBs), polychlorinated naphthalenes (PCNs), hexachlorobenzene (HCB) and pentachlorobenzene (PeCB) and hexachlorobutadiene (HCBD) in Annex C. For unintentional PCBs, HCB and PeCB that are not from intentional production and use the same obligations apply as to PCDD/PCDF.

Under the Convention, Parties have to establish and maintain release inventories of unintentionally generated POPs to prove the reduction. Release reduction or minimization of PCDD/PCDFs would be achieved by application of best environmental practice (BEP) or through best available techniques (BAT).

The first UPOPs inventory for Sierra Leone was compiled in 2008 based on Toolkit 2005.

Since many countries including Sierra Leone do not have the technical and financial capacity to measure all releases from all potential PCDD/PCDF sources, UNEP has developed the ‘Standardized Toolkit for the Identification of Quantification of Dioxin and Furan Releases’ (“Toolkit” for short). In 2013 the update “Toolkit for Identification and Quantification of Releases of Dioxins, Furans and Other Unintentional POPs under Article 5 of the Stockholm Convention on Persistent Organic Pollutants” was published as an online tool (http://toolkit.pops.int/) which has been used for the calculation of this inventory (UNEP, 2013).

With this methodology, annual releases can be estimated by multiplying process-specific default emission factors provided in the Toolkit with national activity data. This inventory report summarizes the results of the national release inventories undertaken with the Toolkit.

2.3.6.2 Objectives

The objectives targeted for this updated UPOPs inventory for Sierra Leone are:

- To identify all potential sources and update the current body of knowledge of PCDD/PCDF in Sierra Leone;
- To update the release estimate from the different source groups and categories in line with the standard operating procedures of the updated UNEP toolkit (2013);
- To assess and update the baseline inventory (2007) with the updated toolkit and refinement of data.

2.3.6.3 Methodology and sources of information

This Toolkit contained several source groups such as; Waste Incineration, Metal production, Heat and Power Generation, Production of Mineral Products, Transport, Open Burning, Chemicals and Consumer Goods, Miscellaneous, Disposal and Hot Spots.

A well-structured field based questionnaire containing tools for eight (8) source groups according to the Toolkit considered applicable in Sierra Leone was developed. For each source group, several source categories were considered to quantify emissions as contained in the

standard unit reporting format. The data were mainly from 2016 and therefore this updated inventory is considered as 2016 inventory.

Information for the inventory was obtained from personal field observation, focus group discussion, one-on-one discussion, photo snap shot, site visitations and desk review, and online published sources. . In some scenarios, estimates were made based on assumptions in the field and response from stakeholders.

2.3.6.4 Inventory results

Table 41 summarizes the different emissions of UPOPs. Details of the various source groups and categories have been described below. They include:

Table 41. Summary of Annual releases of UPOPs for various source groups in 2016

Group	Source Groups	Annual Releases (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	0.011	0.000	0.00	0.000	0.001
2	Ferrous and Non-Ferrous Metal Production	0.000	0.000	0.00	0.000	0.000
3	Heat and Power Generation	6.472	0.000	0.00	0.000	0.000
4	Production of Mineral Products	6.844	0.000	0.00	0.000	0.000
5	Transportation	0.708	0.000	0.00	0.000	0.000
6	Open Burning Processes	110.98	0.000	4.02	0.000	0.000
7	Production of Chemicals and Consumer Goods	0.000	0.000	0.00	0.000	0.000
8	Miscellaneous	0.648	0.000	0.00	0.000	0.648
9	Disposal	0.000	0.139	0.00	0.036	3.678
10	Identification of Potential Hot-Spots				0.000	0.000
1-10	**Total**	**125.7**	**0.139**	**4.02**	**0.036**	**4.327**
	Grand Total	**134.185**				

Category 1: Waste incineration

Of the various sources, only medical waste is currently incinerated in Sierra Leone. Potential release for uncontrolled batch combustion to the air calculated from waste incinerator in Sierra Leone is **0.16 g TEQ/a.**

Category 2 Ferrous and Non-Ferrous Metal Production

Sierra Leone does not produce metal neither do have any metal plant. All metals are imported. Currently, E-waste fraction reaching the dumpsites has dropped significantly. Estimated e-waste is about 0.011 tonnes/annum (Frazer-Williams, Completed). This amount generated zero emission when imputed into the toolkit.

Category 3: Heat and power generation

The various sources applicable to Sierra Leone that contribute emission to this category include fossil fuel power plants, household heating and cooking and domestic heating – fossil fuel.

Emissions calculated from the various sub-categories:

Combined release of gasoline and diesel powered generators is **0.009 g TEQ/a.** The annual release of virgin wood/biomass stoves is estimated at 6.472 g TEQ/a whilst annual release fossil fuel power plants estimated at 0.002 g TEQ/a

Category 4: Production of mineral products

The only source in Sierra Leone in this category is cement production. The annual release of PCDD/PCDFs in air from cement production is **6.844 gTEQ/a.** Asphalt mixing which is a category of this source group was considered to be a minor source of release of PCDD/PCDFs. Asphalt used in Sierra Leone is 100% imported.

Category 5: Transportation

In this category, total annual releases in the various sector are: 0.065 **g TEQ/a** and 0.008 **g TEQ/a** for petrol and diesel for four stoke engines respectively and 0.052 **g TEQ/a** for 2 stoke petrol engines.

Category 6: Open burning processes

(a) Biomass burning

Open burning is considered a major source of release of PCDD/PCDFs. It was estimated that around 45,000 ha of biomass is burnt annually depending on the severity of dry season and 40,000 - 50,000 t/a burned annually.

(b) Waste burning and accidental fires

Waste burning is the most significant contribution to this category. The total release of PCDD/PCDFs from open burning process is **111.0 g TEQ/a** in air and **4.02 g TEQ/a** on land. It needs to be stressed that the PCDD/PCDFs in air are largely on particles which deposits on land.

Category 7: Production and use of chemicals and consumer goods

Sierra Leone does not have a chemical or other relevant industry and therefore cannot calculate any PCDD/F in this sub category. Sierra Leone is importing chemicals (certain pesticides) or chemicals in products (certain colour pigments)) which might contain unintentional POPs.

Category 8: Miscellaneous

The bulk of the categories in this source group (e.g. crematoria) are not normally practiced in Sierra Leone except for other sources groups such as production and smoking of cigarettes. Total emission from this category is 0.001 g TEQ/a..

Category 9: Disposal/landfill

Landfills, Waste Dumps and Landfill Mining

The release of PCDD/PCDF in developing countries is also associated with waste dumpsites. Open dumpsites in Sierra Leone involve indiscriminate disposal of various forms of waste, such as hazardous wastes, domestic wastes and mixed wastes. Emission from this sub-category results in 0.02 g TEQ/a in water and 1.56 g TEQ/a residue.

(c) Open water dumping

There are few industrial processes in the country but continuous discharge of wastewater into streams goes on. Major industrial activities include brewing and beverage production, mining activities, as well as small to medium enterprises such as gara tie-dying, soap making, etc.

Wastewater discharge from dumpsites and homes may account for most of the UPOPs release to water (dish waters, soap water, wash water, direct dumping of sewage sludge and other waste types).

Assume 10 L of is released per person per day.

It means 10 L × 365 days × 7,200,000 persons = 26,280,000,000 L/a = 26, 280, 000 **m^3/a**

d) Composting

Composting is a rare activity by few households mainly because waste sorting and segregation is not practiced in Sierra Leone. Only few companies now practice waste segregation at source. As such, clean compost from waste is uncommon. However, compost production from isolated industrial organic waste such as from Palm Karnel Cake, chicken manure etc produces about 60,000kg per month (720,000 kg per annum) amounting to 0.036 g TEQ annual release of product per annum.

(e) Waste oil deposit

Oil spill is a common scene across power station and auto garages. This practice may be a major source of PCDD/PCDF emissions. The total residual release of PCDD/PCDF of this category was 1.568 g TEQ/a residual, 0.02 water and 0.036 product.

Comparison of the updated inventories of 2017 with the baseline inventory in 2007

Estimated dioxins releases in 2007 were 28 g TEQ while in 2016, the estimate was 107 g TEQ according this updated inventory (Tables 41 and 42, Figure 12).

Table 42. Summary of Annual releases of UPOPs for various source groups in 2007

Group	Source Groups	Annual Releases (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	0.012	0.000	0.000	0.000	0.000
2	Ferrous and Non-Ferrous Metal Production	0.000	0.000	0.000	0.000	0.000
3	Heat and Power Generation	2.990	0.000	0.000	0.000	0.000
4	Production of Mineral Products	2.281	0.000	0.000	0.000	0.000
5	Transportation	0.603	0.000	0.000	0.000	0.000
6	Open Burning Processes	18.791	0.000	0.473	0.000	0.000
7	Production of Chemicals and Consumer Goods	0.000	0.000	0.000	0.000	0.000
8	Miscellaneous	0.490	0.000	0.000	0.000	0.490
9	Disposal	0.000	0.070	0.000	0.000	1.858
10	Identification of Potential Hot-Spots				0.000	0.000
1-10	**Total**	**25.167**	**0.070**	**0.473**	**0.000**	**2.348**
	Grand Total	**28.059**				

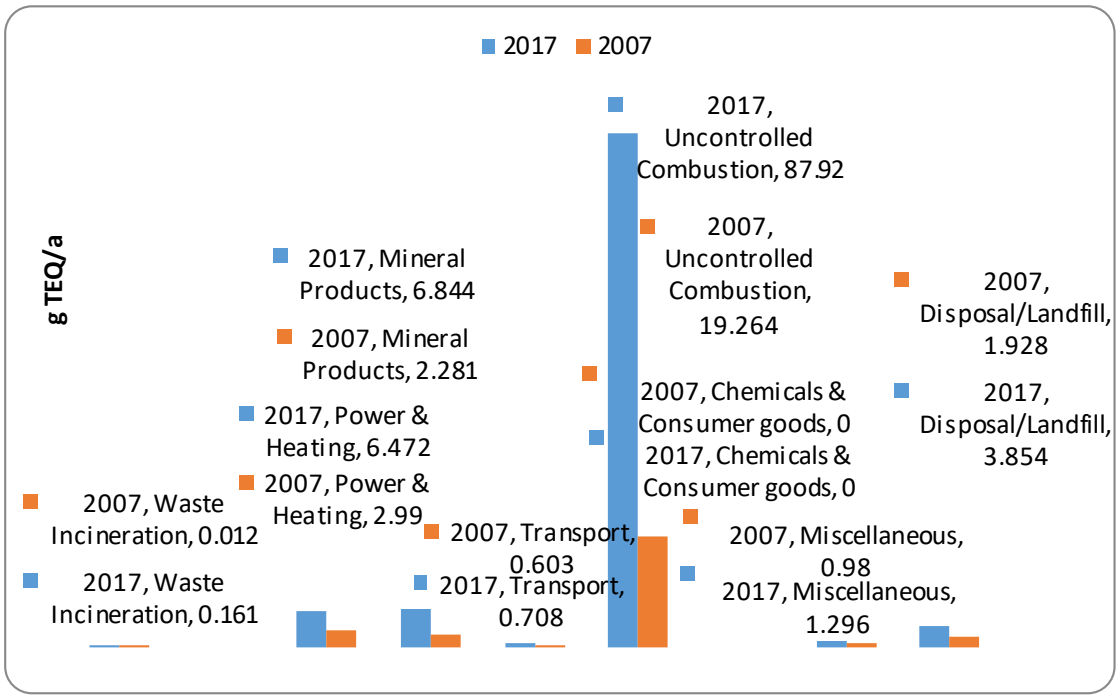

Figure 12. Comparison of 2017 UPOPs emission with 2007 UPOPs emissions

Annual release of UPOPs in 2007 was recalculated using the 2013 toolkit. There is an increase in mission from 2007 to 2016. The main reason for this sharp and significant increase in 2016 compared to 2007 is mainly due to uncontrolled burning. Emissions from open burning sources increase by a factor of four from 2007 to 2016. Within this category, the increase emanated mainly from the burning of waste. Waste burning is the primary waste management option employed to reduce waste in the dumpsite as well as residents in their backyards. Between 2007 and 2016, population in urban areas increases significantly as well as the change in lifestyle for inhabitants who once lived in rural settings. Studies have shown that residents in cities have more non-biodegradable wastes such as plastics compared to residents in rural settings. With a lack of waste management practices in the cities, the common waste reduction strategy is open burning. Open burning has even increased in waste transfer stations over the years in the capital.

Other areas were increase emission occurred are:

Power: Within this category, the increase use of wood for household heating and cooking over the years is evident. The population using biomass for heating and cooking remains high and continue to be on the increase.

Mineral: This category recorded only cement production. Production and use of cement has been on a continuous increase.

Disposal/landfill: The increase in waste volume increased in increased emissions.

2.3.7 POPs contaminated sites

2.3.7.1 POPs pesticide contaminated sites

Pesticide contaminated sites exist at areas where pesticide were or are stored or where POPs pesticides have been applied in the past such as agricultural plots, agrochemical dealer shops etc. Soils at agrochemical sites are often contaminated as a result of accidental spillage with mixtures of pesticides at concentrations higher than field-application rates. During the current inventory activities, several contaminated sites were identified. These include:

- places where pesticides were stored including sales agent and where leakages have occurred
- agricultural areas where POPs pesticides have been applied in the past and areas where DDT have been sprayed for vector control or other purposes

One of the challenges in identifying a contaminated site is that illegal vendor are hardly identified and hence the area where the store pesticides or mix pesticides cannot be assessed.

For sites identified, no assessment of contaminated soils or contamination level at the respective pesticide stores was made due to lack of capacity (i.e. appropriate equipment) in the country to conduct such analysis. These areas are considered potentially pesticide contaminated. Since in the past POPs might have been stored at these sites, the areas are potentially POPs pesticide contaminated sites. There is no system in place in the country to remediate contaminated sites, not even assessment, securing/isolation of such places.

2.3.7.2 Potential PCB contaminated sites

PCB transformers and waste oils have not been properly managed in the past in Sierra Leone and there are concerns that this still exist in some areas. Therefore a range of potentially PCB contaminated sites likely exist in Sierra Leone.

a) Areas where PCBs are and have been used

Sites were transformers are and have been used can be contaminated. During inventory development in some cases, leaks were evident on the floor.

c) Storage sites of transformers and other PCB equipment

There is no former storage for old transformer sites because they were stolen during and after decommissioning.

c) Sites of transformers maintenance

Also sites of transformer maintenance might be contaminated sites due to spillages.

d) Sites where Waste Oil is stored

At a range of sites where oil is stored or used, pollution to soil and underground occurred (Figure 13). Copious amounts of assorted oil waste were found at the facilities of mining and energy companies. PCBs have been used in the mining sector in transformers but also hydraulic oils. Shandong Steel and Addax Bio-energy hold over hundreds of drums of waste oil each at their

facilities. Unfortunately, there are no hazardous waste handling vendors in the country and the Basel Convention constrains the transfer of such hazardous wastes to other countries for handling. This calls for the EPASL to encourage private investment in hazardous waste management sector. There was a company that recycles waste and sold to selected drivers for use as fuel in vehicles as well as for use as insect repellent in the timber industry. This was not widespread or at a large scale and they are also ill-equipped. The EPA-SL closed this company in 2016. The site is likely contaminated with PCBs, mineral oil and other pollutants.

Furthermore, artisan garages spill oil waste in their surroundings without any restrictions. The proliferation of such garages in major towns and cities should be a public health concern. Potential PCB oils but also mineral oils are pollutants for soil and ground water. The EPASL should endeavor to sanitize this sector by introducing regulations that will control environmental contamination. Figure 8 shows evidences of waste oil storage and environmental contamination.

Figure 13. (a) Contaminated soil (with waste oil) at Addax Bio-energy facility; (b) Drums of waste oil at Addax Bio-energy waste collection site; (c) Oil spill at the Flash Vehicle maintenance garage in Makeni; (d) Heavy Oil waste collection ditch at the EDSA power station in Lungi

Reuse and recycling of waste oil is common in Sierra Leone even though it is not properly done. The use and recycling of oils and waste oils can result in POPs and UPOPs contaminated sites. In addition to PCBs and PCDF, such waste oil can possibly contain PCNs and HCBD from former use of PCNs and HCBD in different types of industrial oils (e.g. transformers, hydraulic oil, and lubricants) which might still be partly present.

2.3.7.3 Potential PBDE Contaminated Sites

PBDE contamination in particularly are generated from end of life management of PBDE containing waste with open burning. The main wastes in Sierra Leone containing PBDEs are plastic from e-waste/WEEE and polymers and textiles from vehicles.

Therefore sites where WEEE is openly burned or polymers from vehicles are openly burned can become contaminated with PBDEs and unintentional POPs like PCDD/F over time.

All four scrap yards are potential contaminated sites as wastes from the scrapped vehicles are visible in the various location with evidence of burning of waste and dumping of waste along water ways also conducted at the sites.

These sites have also other pollutants like heavy metals or PCBs.

2.3.7.4 PFOS Contaminated sites

PFOS have high chemical stability and low volatility and by these properties are persistent in the environment. As a result, they can be found in soil and groundwater as contaminants decades after use.

The inventory results indicated that the main route of PFOS entering the country are either through import of firefighting foams or aviation hydraulic fluids. The suspected areas contaminated with PFOS-base foam are the training and equipment testing sites, fire drill areas, stockpiles storage area and accidental spill or leakage areas. For aviation hydraulic fluids, the suspected contaminated areas are the maintenance sites, stockpiles storage area and accidental spill or leakage areas.

Furthermore PFOS and other PFAS are leaching from dumpsites containing e.g. PFOS/PFAS treated consumer products. The main contaminated site from dumping identified during this inventory is the two legal dumping sites at Kingtom dumpsite in the west and Granville Brook dumpsite located in the city town situated at eastern part of Freetown. In addition, there are over thirty-three (33) illegal mini dumpsites within the western part of Freetown. These are potential sites for contaminations of PFOS and other hazardous wastes. The two dumpsites in Freetown are the most contaminated sites since they contain mixed wastes and there is no means of segregating the waste at the source to the final point. Waste treatment is by natural decomposition and burning which causes a lot of health hazards (see photos in annex). These dumpsites contain high leachates concentrations and heavy metals, thus serious underground pollutions of PFOS substances and other toxic chemicals may occur.

2.3.7.5 Potential PCDD/F and other UPOPs contaminated sites and hotspots

The following potential PCDD/F contaminated sites were found to be present in Sierra Leone:

Application sites of PCDD/PCDF containing pesticides and chemicals: Various types of pesticides have been applied either in agriculture or other applications such as for head lice, household pests control etc. It is possible that dioxin-containing herbicides/pesticides such as 2,4,5-T, 2,4-D, PCP or others are amongst those that have been in use in the country. The Crop Division of the Ministry of Agriculture, Forestry and Food Security together with the security forces are unable to deal with illegal importation through our borders and trade of pesticides. The inventory exercise revealed several outlets of prohibited/obsolete pesticides sales. Several government and private pesticide stores were identified with damaged pesticide containers and leaks that have soiled the immediate vicinity of the stores. Where these pesticides have been stored are potentially PCDD/PCDF contaminated sites

Timber manufacture and treatment sites: Timber trade is a major activity in the country. Forestry accounts for up to 2.3% of the national economy. Besides logging of trees for timber sale abroad, several furniture companies operates in the country with some applying various forms of treatment to the logged trees or different types of varnish polish on board for house hold and office furniture decorations. In this inventory it was not assessed if PCP listed 2015 have been used in timber treatment which is the main driver for PCDD/F contaminated sites from wood treatment.

Textile and leather factories: Textile and leather factories in Sierra Leone are limited to tanning practices and minor activities. No primary manufacture of textile exists. All leather materials are imported into Sierra Leone. The textile dyeing industry is still low key and scattered countrywide. The gara-tie dye process is characterized by the use of chlorinated chemicals and caustic soda for bleaching purposes and organic dyes for staining the fabric. This batch type mode of processing is extremely concentrated. The effluents from gara-tie-dye industries often find their way into water bodies and sometimes percolate into the subsoil at the location of the dyeing activities.

Use of PCBs: Unintentional PCDFs and PCNs are present in technical PCB formulations. Therefore PCB contaminated sits have PCDF and PCNs as co-contaminant..The electricity generated company in Sierra Leone and some other mining companies have made use of PCB containing transformers and capacitors in the past. Area of former use and storage sites of transformers with PCB containing oil might be contaminated.

Waste incinerators: Several locally made incinerators are in operation in some hospitals. The uncontrolled spread of ashes might have resulted in hot spots.

Metal industries: The metal industries in Sierra Leone engage in cutting and shaping of metals. The tiny waste metals pieces and scraps are sometimes collected and transferred to dumpsites. Since collection is never efficient, contaminated soil often remain in and around the vicinity of metal workshops.

Fire Accidents: Fires can produce soot and residues with elevated concentrations of PCDD/PCDF. The Western often accounted for most of the fire incidents in the country. For instance between 1st January and 27th February 2017, the National Fire Force reported that Freetown accounted for 36 out of 60 fire incident countrywide.

In addition to accidental fires in homes and offices, widespread agricultural burning take places in the provinces; some of which is for the slash and burn agricultural practice. Bush fire does not only emit smoke but also ashes are blown about by wind.

Dredging of sediments and contaminated flood plains: All mining sites are hotspots. Sierra Rutile Limited and Vemetco that mined rutile and bauxite respectively have utilized dredging over the years. Sierra Rutile Limited operated two dredges that remove sediments thereby creating ponds with its environmental consequences. Dredged sediments are often piled up at mine sites. However, the Sierra Rutile Limited is currently working to replace old dredges. The iron ore mining companies do not use wet mining. Excavated earth is separated from the ore, and the latter is shipped out of the country. Other mining site which is also a potential contaminated site is the Marampa Iron Ore Mines. These companies in the past have used hydraulic oil and transformers which was possibly contaminated with PCB and PCDF.

Dumps of waste and residues: Sierra Leone only operates dumpsites. Dumpsites with frequent open burning are reservoir of PCDD/F containing products or residues. At these dumpsites all types of wastes, including various forms of plastics, plastic-coated copper cables, foams, leathers etc are being deliberately burned to reduce the waste and make room for incoming waste. During burning, noxious smoke is emitted into the atmosphere. In addition to the official dumpsite, several illegal sites where open burning took place almost daily. These sites where such open burning is practiced are contaminated by PCDD/F, other UPOPs and heavy metals. Heavy metals may leach into ground water and surrounding water bodies.

2.3.8 Summary of future production, use, and releases of POPs – requirements for exemptions

In the assessment of individual POPs with exemption of use (PFOS, Lindane, DDT, PBDE recycling), no need of use has been discovered. Therefore PFOS, Lindane and DDT do not need an exemption and can be banned. However, there are still PFOS containing firefighting foams in use. It needs to be decided if these foams can further be used or if they need to be destroyed (action plan).

In 2017, two new POPs have been listed - short chain chlorinated paraffins (SCCPs) and DecaBDE - with a range of exemptions. In 2015 pentachlorophenol (PCP) have been listed with exemption of wood treatment for utility poles. These very recent listed POPs have not been assessed in the current NIP if any of these exemptions are needed in Sierra Leone. Therefore some of these resent listed POPs might be used in future in the country. This assessment is therefore included as an activity in the action plan.

2.3.9 Existing programmes for monitoring releases and environmental and human health impacts, including findings

Currently there is no monitoring program of POPs in Sierra Leone. There are even no scientific studies dedicated on POPs in the country. Furthermore Sierra Leone has not participated in the human milk study or the Global Monitoring Plan. However there are a range of scientist in the country trained in chemical analysis and there is a potential plan to develop certain POPs analysis in the country or develop research cooperation with other countries to generate POPs data in Sierra Leone. This is however dependent on the availability of funds and the necessary laboratory facilities.

2.3.10 Current level of information, awareness, and education among target groups; existing systems to communicate such information to the various groups

2.3.10.1 Awareness-raising, education and access to information

Until now, POPs issue is relatively new to the people of Sierra Leone, despite awareness of other environmental topics. With this in mind, the National Sensitisation and Awareness-raising Team during and after the first NIP was charged with the responsibility of disseminating information on POPs, thus raising awareness in especially vulnerable groups such as women and children as well as those directly dealing with pesticides and PCBs about the harmful effects of POPs on both the environment and human beings.

Overview of environment related public information policies and practices

There have been several interventions by the Government and interested development partners (NGOs) in salvaging the degenerating environmental conditions. The Government has made policies and legislations that are geared towards public information on the environment. These policies have been used by environmentally minded NGOs and individuals to embark on sensitisation programmes, though not addressing POPs in many cases.

Beyond information is public involvement in environmental management. To this extent, one of the government policies has created the National Commission on the Environment and Forestry (NaCEF). This Commission is pushing the Stockholm Convention's agenda through public involvement and contribution to the National Implementation Plan (NIP) on POPs. There is also the Association of Environmental Journalists which publishes articles in newspapers on matters relating to the environment. The Sierra Leone Broadcasting Station Television (SLBCTV) aired environmental and other current affairs programmes that showed the level of degradation of the environment and possible corrective measures. Programmes on POPs and harzadous chemicals are aired during special programmes organized by the EPASL. Furthermore, certain days in respect of the environment, such as the National Tree Planting Day, are set aside for public activities nationwide.

The Environment Protection Act 2000 makes provision for public participation in environmental impact assessment.

In addition to the above, there is a whole portion in the National Environmental Policy, revised edition (October 1994), on public participation whose goal is to raise public awareness and

promote the understanding of essential linkages between environment, population and development, and to encourage individual and community participation in environmental efforts to improve the quality of life. It will ensure among others:

a) Broad public participation towards defining quality environmental objectives

Promotion, support and adoption of community based approaches to public education and enlightenment through culturally relevant social and religious groups, NGOs and other voluntary organizations.

b) Organising intensive campaigns

- Inclusion of environmental programmes in curricula of educational institutions
- Education of management and workers on dangers posed by industrial emissions and other forms of pollution
- Environment Impact Assessment as a Public Priority

Like in most other countries, the people of Sierra Leone are informed and involved in other environmental issues but POPs. Except indirectly, relevant laws and general environmental issues do not specifically mention and emphasise public awareness on POPs. Environmental issues are the concerns of every one, meaning that the general public should be aware about every aspect of it from policy formulation to implementation of environmental action plans.

2.3.10.2 Public information tool

The following public information tools have been used to ensure information flow on POPs to the people of Sierra Leone.

- Handbook on the Stockholm Convention
- Newspaper articles
- Radio interviews and television discussions
- Radio and television

Radio and television

Also SLBCTV, though having a relatively small coverage compared to radio was used to present a pictural view of the threats and levels of devastation by POPs. Pictures of identified contaminated sites were televised for people to see and appreciate the degree of the threat and to begin to think about alternatives and controls.

Newspapers/handbills/posters

Despite the low literacy level, still an appreciable number of people read newspapers and other documents on a daily basis. Thus, the Association of Environmental Journalists (AEJ) and other

journalists were invited to meetings so that they could be adequately informed and encouraged to publish the information on POPs. Furthermore, spot interviews were conducted which were also given wide publicity in the newspapers. These newspapers are distributed at least at the regional level.

Handbills and posters with eye-catching messages and pictures were pasted on public notice boards in schools/colleges and local councils in Bo, Makeni and Kenema for public viewing.

Others

To maximise the impact of this exercise on POPs, discussions, visits and meetings formed part of the process. Of unique importance was the membership of a pastor on the Team who ensured that messages on POPs/PCBs were included in his Sunday sermons and the church meetings. Other members of the Team also used various opportunities to spread the message in different fora.

2.3.10.3 Assessment of existing public information and awareness

The EPASL have been engaged in awareness raising in the radio and TV as well as have been encouraging schools nature clubs across the country. Other awareness programmes in existence in the country are the "Enviroscope" programme on SLBC-TV and Environmental Journalists. Despite these, POPs is yet to be singled out and given the prominence it deserves as far as public awareness is concerned. Public knowledge about POPs is still low.

Challenges are the low level of public knowledge about POPs, the lack of sufficient information material, the insufficiency of POPs specific awareness programmes, the lack of data on POPs containing pollutants and the limitations on use of information outlets.

2.3.11 Mechanism to report under Article 15 on measures taken to implement the provisions of the Convention and for information exchange with other Parties to the Convention

Parties are obligated to report to the secretariat every four years and in accordance with a format as established by the COP at its first meeting (decision SC-1/22). Up to now Sierra Leone has not submitted any report under Article 15.

2.3.12 Relevant activities of non-governmental stakeholders

There are a number of non-governmental organisations (NGOs) in Sierra Leone that have supported communities to address sustainable use of natural resources. They have done this through encouraging communities to maintain forest reserve areas, promoting community biodiversity, supporting livestock production and management, capacity building, park management and public awareness.

There is a strong NGO sector in Sierra Leone creating public interest in environmental issues though not specifically addressing POPs or hazardous chemicals possibly because of limited

knowledge of POPs. The most active NGOs on the ground in areas related to environmental and natural resources management are:

- The Conservation Society of Sierra Leone (CSSL), which promotes the conservation and sustainable use of Sierra Leone's natural resources through research, education, advocacy and support to site management groups. CSSL also undertakes campaigns for the protection of wildlife, parks and sanctuaries.
- The Environmental Foundation for Africa (EFA), whose mission in Sierra Leone is to restore and protect the environment and its natural resources. It has acquired experience in terms of operation in conflict zones, humanitarian and refugee operations, post-conflict reconstruction and rehabilitation.
- The Commonwealth Human Ecology Council (CHEC-SIL) promotes conservation of the ecology through education and disseminates environmental information through the mass media. It also supports the Government of Sierra Leone (GOSL) in promoting, through education, policy implementation and project execution.
- The Organisation for Research and Extension of Intermediate Technology (OREINT) promotes self-sustaining rural development through the promotion of agriculture and appropriate technology to enhance and improve the socio-economic status of the people in rural areas.
- Green Scenery and Friends of the Earth are other local NGOs that are actively involved in tree planting and awareness raising campaigns on the protection and management of the environment and natural resources.
- Association of Environmental Journalists (ASJ): This organization does not exist in Sierra Leone. Notwithstanding, journalists in the country do report on environmental issues.

There are other bodies such as industrial associations. However, these are not active in addressing POPs or hazardous chemicals in the country. Also, chemical society in the country is currently dormant.

2.3.13 Overview of technical infrastructure for POPs assessment, measurement, analysis, alternatives and prevention measures, research and development – linkage to international programmes and projects.

Since the development of the first NIP in 2008, few analytical laboratories have come into existing in principle. These include National Minerals Agency Geological Laboratory (NMAGL), SGS Laboratories and The Bumbuna Watershed management Authority Laboratory. While Bumbuna Watershed management Authority Laboratory is operational, the National Minerals Agency Geological Laboratory (NMAGL), and SGS Laboratory are yet to become operational.

Of the various laboratories present in the country, most private laboratories lack the required space to conduct full-scale analytical work. These laboratories can mainly boast of field test kit.

The two main public institutions; University of Sierra Leone and Njala University have adequate space but since the decade long war between 1991- 2001 that caused massive destruction to existing facilities, these laboratories are yet to be refurbished completely and be capacitated to be a fully functional laboratory. Furthermore, there are some institutions with virtually no capacity of infrastructure, human resource and equipment e.g. National Minerals Agency (NMA) Laboratory. This means, compared to the first NIP, the country's infrastructural capacity to assess and manage POPs remains low.

A) Human Resource

No laboratory in Sierra Leone is properly staffed. For instance, all laboratories in Sierra Leone are plagued with the scarcity of trained and qualified laboratory technicians. Most of the technicians are mainly laboratory assistants and low-skilled. Hence they are unable to operate high-tech equipment. Technician training within the country is limited to under-graduate certificate level. Fellowships for short course technicians training are unavailable to improve their ability in new and modern equipment. The lack of training opportunities over the years for technical staff to go overseas on fellowship has been a major concern. In some institutions (especially the universities), senior academic supervise or conduct analytical work. Hence, there is an urgent need for training of laboratory staff in the areas of documentation, equipment handling and operation, methodology, sampling, etc.

B) Equipment

A major challenge for all public laboratories in Sierra Leone is the lack of adequate and in some case functional equipment for analytical work. Public laboratories are a bit better in functional laboratories albeit most of them operate filed test kits which are limited in performing detailed analytical work. Whilst some public institutions have little functional equipment, others do not have any. Table 43 below shows the type of equipment available in laboratories of institutions with some capacity to conduct some work on environmental analysis in Sierra Leone.

Table 43. Capacities for the analytical determination/assessment of POPs

Institution	Equipment status	Remarks
Chemistry Department, FBC, USL	Flame Photometer, GC installed, FTIR installation incomplete, no UV/Vis spectrophotometer, AAS faulty, black carbon reflectometer and air sampler ($PM_{2.5}$ and PM_{10}) for air pollution studies, basic wet chemistry facilities	Partly equipped for POPs analysis. Low in technical staff strength and expertise
Physics Department, FBC, USL	Hand held XRF	Other than the XRF that can be utilized for some POPs screening, the department is poorly equipped for POPs.
IEMQC, Njala University	$PM_{2.5}$ and PM_{10} analyser	Poorly equipped for POPs analysis
Chemistry Department, Njala University	AAS & HPLC (uninstalled), Flame photometer, Double beam spectrometer	Poorly equipped for POPs analysis
SL Standards Bureau	AAS and HPLC (to be installed)	Currently not equipped for POPs

Institution	Equipment status	Remarks
Laboratory		analysis
Pharmacy Board SL, National Quality Control Laboratory	3 HPLC's, UV visible, Hach multi parameter test kit	Not equipped for POPs analysis but can analyse heavy metals and nutrients in water samples as well as cosmetics. Adequate staff
Water Division of MWR	Mainly field test kits available	Not equipped for POPs analysis but can analyse heavy metals and nutrients in water samples
RAMSY Laboratories	Test kits for water and soil	Not equipped for POPs analysis but can analyse heavy metals and nutrients in water samples Staff strength adequate
Bumbuna Watershed Management Authority Laboratory	Water test kit available	Not equipped for POPs analysis but can analyse heavy metals and nutrients in water samples
National Minerals Agency (NMA)	bench XRF Spectrometer	Not equipped for POPs analysis but can analyse liquids and solid powders (pressed and fused beads)

Additional problems relating to equipment in Sierra Leone are maintenance/repairs and calibration of equipment. Since the few technicians are not trained in equipment maintenance, once equipment becomes malfunctioned, it is very difficult to get them functional again. All of the laboratories have equipment bought or donated from different manufacturers. Each laboratory has equipment of the same function from two or more different manufacturers and different laboratories also have equipment from different manufacturers. Since the cost of calibration is exorbitant due to the fact that expatriates need to fly in, it is very difficult to keep certain equipment functioning. Consequently, this equipment can become derelict with time. Hence, with the acquisition of field test kits, private laboratories are able to conduct limited environmental/analytical tests on water and soil samples all year round.

2.3.14 Overview of technical infrastructure for POPs management and destruction

At present, no facility of international standard exists for the destruction of POPs chemical. Disposal of chemical hardly go through official channels or through the knowledge of the EPASL. Almost all institutions lack any proper means of destroying waste materials including chemicals. These are transported to the official dumpsites where they are subjected to open burning as this is the only means of destruction available in the country.

Nowadays, most government hospitals in the country made use of locally made incinerators (please refer to UPOPs inventory for details) which are partly inefficient emitting incomplete combustion products and PCDD/Fs and other UPOPs.

2.3.14.1 Waste management including POPs management

All over the world and most especially many countries in sub-Saharan Africa like Sierra Leone, waste management has become one of the biggest challenges. There is an overall lack of capacity to manage waste including hazardous waste such as POPs. Currently most of the waste in Sierra Leone is not sorted, recycled or recovered. They are either left in the vicinity of transit collection points or disposed to dumpsites. Only a tiny percentage of valuables such as electronics, metals etc, are recovered from the waste. However plastic and polymers containing POP-BFRs or synthetic carpets partly containing PFOS related substances are dumped with build-up of stocks in the dumpsites and associated releases facilitated by open burning.

Few proposals are now being developed by private investors to improve on waste management in the country. Some have proposed improving the current dumpsites whilst others have proposed constructing a new sanitary landfill. Whichever proposal is accepted, the EPASL is confident will address POPs management as they will be part of the development and implementation phases.

2.3.14.2 POPs destruction capacity and export

There is no capacity for the destruction of POPs in the country. There is no cement kiln either in the country.

To date, Sierra Leone has not exported POPs chemical to any country. However, in the future, this can be a possibility under the application of Basel Convention procedures or through the FAO in the management of obsolete Pesticides or PCBs.

2.3.14.3 Capacity and Infrastructure for Contaminated Sites Assessment, Securing and Remediation

Currently, no specific legislation on contaminated site exists in Sierra Leone. Several sites (e.g. fire drill areas, pesticide/PCB storage sites) , principally contaminated with POPs pesticides as well as PCBs have been identified during the NIP review preparation and as the field surveys progresses during future follow-up activities, more sites contaminated with POP chemicals will likely be coming to light. The urgency to address these known sites stems not only from the non-containment and lack of management of these sites in the past, but the fact that local communities continue to settle in and around these areas, making them susceptible to health risk. Also run-off and groundwater contamination is of concern.

There is currently no capacity for assessment, securing and remediation of contaminated sites (human capacity and monitoring capacity).

Therefore contaminated sites identification and management including related capacity development is one of the priority areas for NIP implementation. Contaminated sites should be managed in an environmentally sound manner.

2.3.15 Identification of impacted populations or environments, estimated scale and magnitude of threats to public health and environmental quality, and social implications for workers and local communities

Up to now no comprehensive assessment of POPs impacted population has been conducted other than investigations made during POPs inventory in the country.

2.3.16 Details of any relevant system for the assessment and listing of new chemicals

Sierra Leone at the moment do not have any system for the assessment and listing of new chemicals entering into the market and the country as a whole.

2.3.17 Details of any relevant system for the assessment and regulation of chemicals already in the market

As in 2.3.17 above, there is no system for the assessment and regulation of chemicals already in the market in the country. The EPASL will need to look into this as a matter of urgency.

2.4 Implementation status of the first NIP

Within the framework of the implementation of the Stockholm Convention (overview in Table 44), a range of activities were listed to have been done in the first NIP action plan; some within in the frame of the regional POPs project with a focus on the following main tasks:

- Establishing policies and regulations for the sound management of POPs;
- Environmentally Sound Management (ESM) of pesticide stockpiles and wastes;
- Environmentally Sound Management (ESM) of PCBs stockpiles and wastes;
- Promoting research and applying science, technological and innovative solutions in the sound management, reduction, destruction and elimination of POPs;
- Expanding and improving the efficiency of international cooperation.
- Improving awareness raising amongst stakeholders and the populace at large

Of the above main tasks, only the establishment of EPA-SL was successfully achieved. Additionally, some level of awareness raising on POPs management was conducted. It is envisaged that since currently the measures for reduction with the aim of final elimination of the new listed POPs have not started, the compliance with the SC provision in respect to new listed industrial POPs will be carried out and presented in the future NIP updates. The action plans for the new listed POPs and the updated action plans for the initial POPs are presented in Chapter 3.

Table 44. Sierra Leone level of NIP implementation status (compliance with the SC requirements) in respect to initial POPs listed in the Convention Annexes

Convention Article	Level of compliance	Comments (if any)
ARTICLE 3 Measures to reduce or eliminate releases from intentional production and use	For POPs pesticides see ***section 2.3.1.***	-
	For PCBs see ***section 2.3.2.***	-
ARTICLE 4 Register of exemptions	Sierra Leone is not registered for any specific exemptions, as listed in SC Annexes	-
ARTICLE 5 Measures to reduce or eliminate releases from unintentional production	See **section *2.3.6.***	-
ARTICLE 6 Measures to reduce or eliminate releases from stockpiles and wastes	For POPs pesticides see **section *2.3.1.***	-
	For PCBs see ***section 2.3.2***	-
ARTICLE 7 Implementation plans	Sierra Leone submitted its first NIP on 03/11/2009.	Some aspects of institutional and legislative framework addressed.
ARTICLE 8 Listing of chemicals in Annexes A, B and C	Up to now Sierra Leone has not submitted a proposal on the listing of new chemicals in Annexes A, B and C to the COP.	-
ARTICLE 9 Information exchange	See ***section 2.3.10.***	Sierra Leone has participated and will continue to participate in COP meetings, regional meetings and workshops relating to POPs issue. The participation in such meetings facilitates the information exchange and support the implementation by getting updated information and approaches from other countries. Sierra Leone did also participate in a Regional project on Chemical Information Exchange Network (CIEN)
ARTICLE 10 Public information, awareness and education	See ***section 2.3.10.***	Sierra Leone has conducted some information and awareness programmes for enforcement agencies and local authorities.
ARTICLE 11 Research,	See ***section 2.3.9.***	Virtually little or none was

Convention Article	Level of compliance	Comments (if any)
development and monitoring		done in research and monitoring relating to pops due to lack of facilities. However the urge for research for doctoral degrees on POPs is increasing
ARTICLE 12 Technical assistance	Sierra Leone is a recipient developing country Party. Since the first NIP, Sierra Leone have received technical assistance from the following developed countries/international organizations to undertake the following:: UNIDO – organize workshops on "cleaner waste management", raise awareness on BAT and BEP in the informal sector, conduct a survey on existing concepts for plastic waste management, raise awareness on health risk that may result from the exposure to POPs contaminated sites. UNEP – national training workshops on environmentally sound management of POPs, national legislative and regulatory framework for chemicals in Sierra Leone, training on the SC and other chemical Convention for the Judiciary and Law Officers in Sierra Leone UNEP/FAO – undertake a national inventory of obsolete pesticides; training of national experts in Mali and Sierra Leone. UNEP/SAICM – undertake awareness raising workshop for policy makers and other operatives on overall sound management of chemicals	-
ARTICLE 13 Financial resources and mechanisms	As of 31May 2018, according to the Status of Contribution compiled by the SC Secretariat, Sierra Leone has 1967 USD unpaid pledges for prior years, 2017& 2018.	Co-financing from the GoSL is increasing and several obligations within the SC are now mainstreamed within governments policies, plans and programs

Convention Article	Level of compliance	Comments (if any)
ARTICLE 15 Reporting	Sierra Leone has not sent any report pursuant to Article 15 of the Convention.	The country's Focal Point of the Stockholm Convention was the Ministry of Foreign Affairs and International Cooperation (MFAIC). It is expected that the EPASL with the statutory responsibility as focal institution for all environmental matters will address this in the next cycle of reporting
ARTICLE 16 Effectiveness evaluation	Sierra Leone did not participate in the WHO human milk study for the basic POPs (POPs pesticides, PCB, PCDD/F and HCB)	-
ARTICLE 17 Non-compliance	As the procedures and institutional mechanisms for determining non-compliance are not yet approved and developed, the countries compliance cannot yet be verified	-
ARTICLE 19 Conference of the Parties	Sierra Leone has attended to all Stockholm Convention COPs since it became a party	-
ARTICLE 21 Amendments to the Convention	Sierra Leone has accepted all the Stockholm Convention amendments	-
ARTICLE 22 Adoption and amendment of annexes		-
ARTICLE 24 Signature	Not the case.	-
ARTICLE 25 Ratification, acceptance, approval or accession	Sierra Leone acceded to the Convention on 26/09/2003.	-
ARTICLE 26 Entry into force	The Stockholm Convention entered into force for Sierra Leone on 17/05/2004.	-

CHAPTER 3. STRATEGY AND ACTION PLAN ELEMENTS OF THE NATIONAL IMPLEMENTATION PLAN

3.1 Policy Statement

3.1.1 Background

Sierra Leone participated in the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil in 1992. At this Conference, Heads of States or Governments adopted "Agenda 21" - a document that seeks, among other things, to enhance sound management of chemicals. The document, outlined responsibilities of every nation towards the collective achievement of sustainable development. Of special relevance for chemicals management is the chapter 19 of "Agenda 21" which deals with environmentally sound management of chemicals, including illegal international traffic in toxic and dangerous products.

In response to this global concern, the Government of Sierra Leone has taken concrete steps and measures to meet its obligations in achieving sustainable environmental protection and economic development. This led to the development of Local Agenda 21, National Environmental Action Plan (NEAP), and the National Environmental Policy (NEP) for Sierra Leone. The ultimate aim of the overall National Environment Policy (NEP) of Sierra Leone is to achieve sustainable development in Sierra Leone through sound environmental management. The policy, specifically, seeks to:

- Secure for all persons resident in Sierra Leone now and yet unborn an environment suitable for their health and well-being;
- Promote efficient utilization and management of the country's natural resources and encourage, where appropriate, long term self-sufficiency in food, fuel wood and other energy requirements;
- Facilitate the restoration, maintenance and enhancement of the ecosystems and ecological processes essential for the functioning of the biosphere and prudent use of renewable resources;
- Enhance public awareness of the importance of sound environmental understanding of various environmental issues and participating in addressing them; and
- Enhance co-operation with Governments and relevant international/ regional organizations, local communities, non-governmental organizations and the private sector in the management and protection of the environment.

3.1.2 Declaration of Intent

In line with the National Environmental Action Plan (NEAP), the National Environmental Policy (NEP) and the EPA Act 2010, the Government seeks among other things to "take appropriate measures, irrespective of the existing levels of environmental pollution and extent of degradation, to control pollution and the importation and use of potentially toxic chemicals".

This commitment has led to the development of the ozone depleting substances phase-out plan and also the promulgation of law to control the importation and use of harmful/hazard chemicals (including POPs).

Moreover, notwithstanding the role POPs have been playing in global and national development strives, the Government saw it necessary to accede to the Stockholm Convention on POPs. The Environment Protection Agency being the host of the designated focal point is playing the leading role in promoting safe management and use of chemicals (including POPs) for industrial, agricultural and public health in ensuring sustainable development.

Consequently, the EPA-SL in collaboration with UN agencies (UNEP, etc.) have been undertaking a series of capacity building activities to ensure the strengthening of national capacity and capability that leads to effective and efficient chemical management. The efforts have enabled Sierra Leone to acquire skills in comprehensive chemical assessment and legislations/regulations and plans in the management/control of toxic chemicals. There is also a provision in the national legislation for environmental impact assessment. This has led to the reduction of activities that emit POPs chemicals. Furthermore, the NIP has created a framework on which to build on. In a dynamic world, emerging policies needs are to be easily related with the framework in national chemical management initiatives to ensure maximum efficiency and reduce duplication of efforts.

The NIP has therefore been developed to create an enabling environment for the reduction and ultimate elimination of POPs based on voluntary and non-voluntary approaches. The mechanism includes the adoption and application of alternatives to POPs at industrial and enterprise levels to ensure sustained recourse. The draft bill for chemical waste management is apt to support the NIP, hence enactment of the draft bill is of essence.

3.2 Implementation Strategy

Parties to the Stockholm Convention are required to develop National Implementation Plans (NIP) to demonstrate how their obligations will be implemented. The implementation plan include updated action plans to reflect progress made in the implementation of the first NIP (2008) and to include additional newly listed POPs where relevant, and new additional action plans, objectives and priorities for newly listed POPs as necessary. The action plans outline a framework mechanism to coordinate discrete NIP activities which include future reviews, reporting and evaluating. As Sierra Leone does not produce POPs, the strategies developed focused mainly on the following:

- Control of importation , use and disposal;
- Raising awareness of decision makers and the public;
- Private and NGO stakeholders participation;
- Equipping institutions involved in monitoring and reporting of implementation activities;
- Priority areas that will be continuously identified by stakeholders;
- Adherence to and use of BAT and BEP for the reduction of POPs releases.

3.3 Action plans, including respective activities and strategies

3.3.1 Activity: Institutional and regulatory strengthening measures

The issue of hazardous chemicals and wastes (including POPs) is of great concern and a priority in Sierra Leone. However, there is no comprehensive and streamlined legislation for chemicals management and waste management in the country. The POPs action plan aims at improving the existing institutional and regulatory framework in Sierra Leone and facilitating chemical and waste management.

A successful implementation of the Convention in Sierra Leone would therefore attempt an integrated approach of the BRS Convention and SAICM and integration of some related provisions into the current institutional and regulatory framework for managing chemicals in the country. A readily available tool to ensure adequate flow of information on hazards and safe use, handling and transport of chemicals on the market is the national adoption of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Another objective is to prevent the production and use of pesticides and industrial chemicals that are potential POPs or highly hazardous pesticides (SAICM issue of concern) or hazardous chemicals in products (CiP).

Table 45. Institutional and Regulatory Strengthening Measures

Objectives	Activities	performance indicators	Time Frame	Implementers	Resources / Needs($)
To assess, harmonize existing legal/policy framework on POPs hazardous chemicals	• Compile and assess existing legal instruments for the life cycle management of POPs (and other hazardous chemicals) in the country. • Review existing legislations on management of all POPs and other hazardous chemicals in selected neighbouring and other countries. • Draft and promulgate regulations to prevent production and prohibit/eliminate the use, import and export of listed POPs (considering exemptions). • Improve or develop an overall chemical	Compiled and updated inventory. Proposals for legislative and policy review. Draft regulation.	5 years	Law Reform Commission, EPASL	20,000

Objectives	Activities	performance indicators	Time Frame	Implementers	Resources / Needs($)
	regulatory frame including the assessment of chemicals in use and chemicals for registration for their POPs (and other hazardous properties).	An overall draft chemicals law			
Assessment of responsibilities of ministries and other authorities for the life cycle management of POPs (and other hazardous chemicals; SAICM synergy)	• Compile and assess responsibilities of institutions for life cycle management of POPs (and other hazardous chemicals) and related gaps and needs assessment. • Addressing gaps and improving capacity(including technical) for the life cycle management of POPs (and other hazardous chemicals). • Developing materials for education and conduct trainings and workshops. • Assess if the responsible institutions can implement the respective legislation, further gap assessment and improvement	Needs assessment conducted Modalities for upgrading physical capacities put in place and documented	6months 1 year	EPASL, National expert EPASL, Universities, Research institutions and other stakeholders	3,000 100,000 15,000 5,000
To inform, sensitize and capacitate institutions and stakeholders on regulations and on enforcement and compliance of regulations on POPs and other hazardous chemicals (SAICM)	• Development of information materials on regulatory requirements for the respective POPs tailored for institutions and industrial and other stakeholders. • Organize information and sensitisation workshops on regulatory issues for stakeholder groups for individual POPs	Workshops organised	2 years	EPA, Police, Civil Society Organisation, Awareness raising Organisations,Other Relevant Stakeholders	Finance, Logistics, Resource Personnel
To assist relevant institutions to implement compliance and	• Assign institutions with specific responsibilities to control POPs and hazardous chemicals in	MOU in place	2 years	EPA, Universities and Researc	Finance, Legal & Technical Experts,

Objectives	Activities	performance indicators	Time Frame	Implementers	Resources / Needs($)
enforcement for POPs ((i) POPs Pesticides (ii) PCBs (iii) new industrial POPs (iii) UPOPs.) and other hazardous chemicals (SAICM)	the life cycle • Form a compliance and enforcement network on managing POPs and hazardous chemicals in the life cycle. • Continued capacity building of personnel from institutions. e.g. recruitment and training of staff. • Develop monitoring plan of activities for relevant institutions.	Compliance and enforcement network operational. Well-equipped institutions Operational monitoring plans		h Institutions, Police, ONS, MAFFS, other Relevant Stakeholders, Police,	
(4) To assist relevant institutions implement compliance and enforcement for (i) POPs Pesticides (ii) PCBs (iii) new industrial POPs (iii) Dioxins/Furans etc. and other hazardous chemicals (SAICM)	• Prepare Memorandum of Understanding (MOUs) with relevant institutions and assign them with specific responsibilities towards the implementation of the Convention. • Form a Compliance and Enforcement Network on managing POPs and hazardous chemicals in the life cycle. • Build capacity of personnel from all relevant institutions. e.g. recruitment and training of staff. • Develop monitoring plan of activities for relevant institutions.	MOU in place Compliance and enforcement network established and operational. Well-equipped institutions Operational monitoring plans	2 years	EPASL, Police, ONS and other Relevant Stakeholders,	Finance, Legal Experts

3.3.2 Activity: Measures to reduce or eliminate releases from intentional production and use

Sierra Leone does not have intentional production of POPs chemicals facility. However, there are several POPs in use including POP-PBDEs in articles or PFOS in stocks such as products and articles. Furthermore, recently listed POPs such as SCCPs and DecaBDE have a range of exemptions, which have not yet been assessed for Sierra Leone in the current NIP update. These are likely used in some processes and are certainly present and used in articles and products.

Article 3 of the Convention summarises activities that need to be put in-place to reduce and eliminate releases from intentional production. These activities include legal and administrative measures. This action plan presented below (Table 46) identifies measures to reduce or eliminate releases from intentional production and use of POPs.

Table 46. Measures to reduce or eliminate releases from intentional use

Objectives	Activities	Performance indicators	Time frame	Implementer	Resources ($)
Assessment of current use of POPs and reducing and eliminating releases and use of POPs	Update inventory of annex A and B chemicals imported and used considering the recent listed SCCP and DecaBDE and possibly PCP.	Database of Annex A & B Chemicals currently in use in Sierra Leone	5 years	CM HI&T Relevant Sector	4,000
	Analyse pattern of usage of annex A and B chemicals	Use pattern and processes of POPs identified			3,000
	Control and reduce release				2,000
	Phase out of current use of identified POPs and substitution (PFOS and likely SCCPs)	Substitution by more sustainable chemicals and non-chemical alternatives			4,000
Restricting or prohibit import of Annex A & B chemicals	Evaluate the need for any exemption Develop regulatory framework to restrict or prohibit	Prohibition regulation	3 year	CM Relevant sector Hi&T	1,000

3.3.3 Activity: Production, Import and Export, Use, Stockpiles and Wastes of Annex A POPs Pesticides (Annex A, Part I Chemicals)

There has not been any previous production of the listed POP pesticides (initial POPs pesticides and pesticides listed in 2009 and 2011) in Sierra Leone and the country does not envisage any

possibility of producing any of these POP pesticides in the future. There is also no approved current use of these POP pesticides in Sierra Leone. As a signatory to the Convention, all POPs pesticides listed until 2015 are also banned in Sierra Leone.

The following draft action plan for POPs pesticides contain options of activities to manage the listed initial POPs pesticides and pesticides listed in 2009 and 2011 (Endolsulfan). PCP listed in 2015 has not been assessed in this NIP update and therefore need to be assessed and controlled in future. Initial activities required are included in this action plan.

The legislative and regulatory framework on pesticides management (illegal trading, smuggling, use, import, registration, distribution, storage, waste management (obsolete stockpiles and empty containers)) need to be strengthened. Listed POPs pesticides need to banned after assessment if any exemption is needed. If any of the permitted exemptions is needed then these would be registered at the secretariat of the Stockholm Convention.

Within the synergy of the Stockholm Convention and the Strategic Approach of International Chemical Management (SAICM), an option is to include highly hazardous pesticides (HHPs)[25,26,27]which is an "Issue of Concern" under SAICM[28]in the action plan to avoid duplication of work for addressing HHPs.

The action plan (Table 47) should be harmonized with the activities of the Ministry of Agriculture Forestry and Food Security (normally responsible for controlling pesticide use) and best be developed in cooperation.

Table 47. Objectives, activities and indicators for the Action Plan: Production, import and export, use, stockpiles, and wastes of Annex A POPs pesticides (Annex A, Part I chemicals) and DDT and highly hazardous pesticides (HHPs).

Objective	Activities	Indicator	Responsible/ Implementers	Time (years)	Budget/ Needs
Development of an adequate legislative frame and policy	Updating the existent regulations to restrict/address all listed pesticides by banning and regulating of new/all listed POPs pesticides	Updated legislation, regulation and list of banned pesticides	EPASL(Lead), MAFFS(Co-lead), Relevant Institutions	Short term 2018-2020	15,000
	Assessing of the need and possibly listing of	Pesticides needing an exemption	EPA, University and Research Institutions,	Short term 2018-	15,000

[25] FAO http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/hhp/en/
[26]WHO http://www.who.int/ipcs/assessment/public_health/pesticides/en/
[27] FAO, WHO (2016) Guidelines on Highly Hazardous Pesticides. International Code of Conduct on Pesticide Management.
[28] SAICM issues of concern http://www.saicm.org/Implementation/EmergingPolicyIssues/tabid/5524/language/en-US/Default.aspx

Objective	Activities	Indicator	Responsible/ Implementers	Time (years)	Budget/ Needs
	exemptions (DDT, Endosulfan, PCP, Lindane, PFOS)	reported to Secretariat	MAFFS	2020	
	Implementation of GHS and related labelling	GHS implemented	EPASL, MAFFS	Medium term 2020-2023	20,000
	Develop regulatory measures to combat illegal traffic of banned pesticides and counterfeit pesticides	Regulatory measures in place	EPA, MAFFS	Short term 2018-2020	15,000
	Regulatory frame for good agricultural practice, IPM and organic farming	Regulatory measures in place	EPA, MAFFS	Short term 2018-2020	15,000
	Regulatory frame for wood treatment and for management of PCP (and hazardous chemical) treated waste wood	Legislation for wood treatment and management of wood established	EPA, MAFFS	2018-2020	15,000
Develop/update POPs pesticides inventory	Improvement of POPs Pesticide inventory possibly considering FAO PSMS (overall stockpiles; avoiding reoccurrence of obsolete pesticides stocks)	Updated inventory	Tertiary and Research Institutions	Medium term 2020 - 2023	20,000
	Inventory of PCP treated wood and PCP wood treatment sites (link to Dioxin/UPOP)	Validated Inventory	Tertiary and Research Institutions (Lead), practitioners in the field	Medium term 2020 - 2023	20,000
	Inventory of former PCP use and treated materials (leather, textile, paper, agriculture)	Validated inventory	Tertiary and Research Institutions (Lead), practitioners in the field	Medium term 2020 - 2023	15,000
Life cycle management of POPs Pesticides including handling, storage, transfer and disposal of POPs pesticides and POPs pesticides wastes	General improvement of POPs pesticides and general pesticide management	Life cycle management of pesticides established considering FAO guidance documents	Tertiary and Research Institutions (Lead/Consultant),	Medium term 2020 - 2023	30,000
	Establishing of an empty containers collecting and	Report on empty container	EPASL, MAFFS, Industry	Short term 2018 -	15000

Objective	Activities	Indicator	Responsible/ Implementers	Time (years)	Budget/ Needs
	management system, with specific attention to address the use of pesticides empty containers	program	representative(s)	2021	
	Establishing of proper POPs and waste pesticide storages and securing them	Sufficient pesticide storage built	EPASL, MAFFS	Medium term 2020 - 2023	35,000
	Establishing capacity to address emergencies and disasters relative to POPs pesticides and HHPs (poisoning, spillage, fires contamination)	Poisoning centre established and operative	EPASL, MAFFS	Medium term 2020 - 2023	45,000
	Assessing the country's capacity for disposing of obsolete POPs pesticides stockpiles and/or considering the export for environmental sound disposal	Capacity assessed and options of disposal documented (report)	EPASL, Universities and research institutions, MAFFS	Medium term 2020 - 2023	55,000
	Disposal of POPs pesticide and other obsolete pesticides	POPs pesticides are disposed in an environmental sound manner	EPASL, Universities and research institutions, MAFFS	Medium-long term 2020 - 2030	60,000
Education and awareness of stakeholders (customs, farmers NGOs and the public)	Strengthen the inspection on pesticides for custom and for competent authority (market survey, sales, storage, usage and disposal including counterfeit and illegal pesticides).	Number of educated customs and competent authority	EPASL, Customs	Short Term 2018-2020	35,000
	Education of policy makers on health hazards of POPs pesticides and HHPs and the benefits of IPM and organic farming	Policy makers in relevant ministries understood relevance	EPASL	Short Term 2018-2020	15,000
	Education of	Number and	EPASL	Short	15,000

Objective	Activities	Indicator	Responsible/ Implementers	Time (years)	Budget/ Needs
	farmers on POPs pesticides, HHPs, counterfeit pesticides and the use of IPM and organic farming	share of educated farmers		Term 2018-2020	
	Education of citizens and NGOs on POPs pesticides, HHPs, counterfeit pesticides and organic farming and organic products	Number of educated citizens and NGOs	EPASL	Short Term 2018-2020	15,000
Assessment of POPs pesticides and HHPs (SAICM Synergy) **and alternatives used and implementation of substitution and IPM and organic farming.**	Compilation of information on alternatives to POPs pesticides and HHPs (SAICM Synergy) including a risk assessment for POPs pesticides and HHPs and their alternatives using existing and possibly generating new data, including the risk to humans and biota and ecosystem indicators	Report on assessment on alternatives to POPs and HHPs.	EPASL, Universities & research institutions MAFFS	Short Term 2018-2020	30,000
	Supporting implementation and research on IPM/IVM, including the use of alternatives as a measure for reducing POPs pesticides and HHP use	Shift to IPM/IVM (report)	Universities, research institutions	Medium term 2020-2023	80,000
	Selection of the most sustainable alternative chemicals and non-chemical solutions in the different applications and including promotion of organic farming.	Report on alternatives Target for organic farming	MAFFS, Universities, research institutions	Medium term 2020-2023	80,000
	Education and capacity building on alternatives and	Number of farmers educated Share of	EPASL, MAFFS, Universities and research	Short term 2018-	15,000

Objective	Activities	Indicator	Responsible/ Implementers	Time (years)	Budget/ Needs
	organic farming and implementation	alternatives and organic farming	institutions	2020	
Established analysis and monitoring of POPs pesticides and HHPs (SAICM synergy)(products, environment, food, exposure)	Strengthening and developing laboratory capacity to analyse pesticides (including POPs and Highly Hazardous Pesticides)	Laboratory capacity established and accredited	EPASL, MAFFS, Universities and research institutions	Medium to long term 2021 – 2031	800,000
	Assessment of occupational exposure to POPs pesticides and HHPs	Report on occupational risk	EPASL	Short term, 2018 - 2020	15,000
	Monitoring and establishing a pesticide monitoring programme (food, soils, water, consumer)	Report on POPs pesticide and HHP pollution situation and risk for human, environment and Ecosystem indicators	EPASL, MAFFS, Universities and research institutions	Short term, 2018 - 2020	15,000
Established capacity of risk and socio-economic assessment	Development of knowledge, capacity, tools and indicators to better assess the risks and socio-economic impact of POPs/HHPs	Experts or institution with capacity in risk and socio-economic assessment	EPASL, MAFFS, Universities and research institutions	Medium term 2021-2023	35,000
Identification and securing and potential remediation of POPs pesticides contaminated sites	Identification of all (former) POPs pesticides use and storage/disposal locations	Inventory report of potentially contaminated sites	EPASL, MAFFS, Universities and research institutions	Short term 2018-2020	15,000
	Identify the level of contamination of soil and ground water and potential receptors and exposure risk	Assessment report of potentially contaminated sites	EPASL, MAFFS, Universities and research institutions	Medium term 2021-2023	15,000
	Secure and monitor contaminated sites and possibly remediate contaminated sites	Sites secured and/or remediated (report)	EPASL, MAFFS, Universities and research institutions	Short to medium term 2018-2021	120,000
	Database and conceptual site models of potentially contaminated sites	Database established (one database for all POPs or all contaminated sites)	EPASL, MAFFS, Universities and research institutions	Long term 2023-2033	20,000

Objective	Activities	Indicator	Responsible/ Implementers	Time (years)	Budget/ Needs
	Prioritization of sites (risks) for further assessment and securing	Sites prioritized	EPASL, MAFFS, Universities and research institutions	Medium term 2021-2023	20,000
Undertake research and develop alternatives to POPs pesticides and HHPs	Undertake BAT and BEP demonstrations in key agricultural programmes including integrated pest management (IPM) and integrated vector management (IVM) at household and agro-industry level	BAT and BEP demonstrations Regional cooperatation	EPASL, MAFFS, Universities and research institutions	Long term 2023-2033	500,000

3.3.4 Activity: Production, import and export, use, identification, labelling, removal, storage, and disposal of PCBs and equipment containing PCBs (Annex A, Part II chemicals)

There is no and has never been any production of PCBs in the country. However, importation and use of closed, semi-closed and open application equipment have entered into the country the last 60 years but are not properly monitored and documented.

The proposed activities define specific actions in respect of managing PCBs, both in the short and the long term in a manner that is consistent with the obligations of the Stockholm Convention (Table 48). The overall objective is a reduction and ultimate elimination of PCBs use, the prevention of releases of the chemical into the environment, and to provide for environmentally sound disposal or final elimination of PCBs waste.

While the major focus of this action plan is on management of PCBs, also PCNs are addressed by this action plan. PCNs have been listed in the Convention in Annnex A and C in 2015. PCNs have been used in the same application as PCBs but mainly in the 1930s to 1960s: In closed application mainly in capacitors and less in transformers and hydraulic oils (UNEP 2017)[29]. PCNs have also been used in the same open applications as PCBs (additives in paints, sealants, rubber, cable sheets, as metal working fluids). The total production was approx. 150,000 tonnes (10% of global PCB production). Due to the lower use volume and the earlier production/use, industrial PCNs have much lower overall relevance compared to PCBs and it is unknown if any relevant amount of PCNs are present in the former uses. PCNs can be managed within the frame

[29]. UNEP (2017) Draft guidance on preparing inventories of polychlorinated naphthalenes. UNEP/POPS/COP.8/INF/19.

of PCB management. They are detected by the chlorine test kits for screening of PCBs in transformers and would be integrated in the instrumental screening for chlorine positive samples.

Furthermore, Short Chain Chlorinated Paraffins (SCCPs) have been listed recently at COP8 (05/2017) as POPs with a range of exemptions. SCCPs have substituted PCB and PCN in a wide range of open applications (e.g. paints, coatings, sealants, plastic additive/flame retardant, rubber, lubricants, metal working fluids). Since SCCP will need to be addressed in the next NIP update and since the use is in these applications, an inventory of open applications would address all three POPs.

Table 48. Objectives, activities and indicators for PCB Action Plan

Objective	Activities	Indicator	Implementers	Time (years)	Budget/ Needs
Development and implementations of legislative frame, policy and measures for control and management of PCBs and PCNs in closed and open applications (equipment, materials and wastes).	Assessment of the performance of regulations in managing and eliminating PCBs/PCNs in use and out of use, ban the importation and strengthening the current legislative package	Legislative frame, policy and measures developed Implementation report of legislatve framework	EPASL, Law Officers Department, Universities, Research Institutions, Customs Department	Short Term (1-2 Years)	20,000
	Establishing penalties/fines for the improper management of PCB/PCN containing equipment	Penalties/fines drafted	EPASL, Law Officers Department, Universities, Research Institutions, Police	Short Term (1-2 Years)	10,000
	Developing and implementing incentives for electric utilities to comply with the phase-out of PCBs/PCNs,	Incentives developed and documented	EPASL, Universities, Research Institutions, EDSA &EGTC	Short Term (1-2 Years)	10,000
	Defining a National PCBs/PCNs Elimination Plan, best within a National Hazardous Waste Management Plan and, define the responsibilities for institutions and companies for PCB/PCN containing wastes management and disposal	National PCBs/PCNs Elimination Plan developed	EPASL, Universities, Research Institutions, Waste Companies	Short to Medium term (2 - 5 Years)	15,000
	Strengthening the control/inspection for PCB/PCN containing equipment still in use, and for interim storages	Inspectors trained and equipment replaced	EPASL, Universities, Research Institutions, Customs	Short to Medium term (2 - 5 Years)	15,000

Objective	Activities	Indicator	Implementers	Time (years)	Budget/ Needs
	and disposal facilities.		Department, Police, Waste Companies		
Development/update of a PCB/PCN inventory in closed and PCB/PCN and SCCP inventory in open applications where relevant	Completing inventory of PCB/PCN containing equipment (in use and out of use).	Inventory of transformers, capacitors and other equipment conducted	Medium Term (3-5 Years)	Short Term (2 Years)	15,000
	Assessment of the past use of PCBs/PCNs and current/past use of SCCP in open applications (e.g. sealants, paints, rubber, chloroprene, plastic additive, industrial oils) in the country and, where relevant, developing inventory of PCBs/PCNs and SCCPs in open applications.	Assessment report	EPASL, Universities, Research Institutions,	Short to Medium term (2 - 5 Years)	15,000
	Assessment of waste oil management and use and inventory of potentially PCB/PCN and SCCP contaminated waste oils. Assessment of risk of (waste) oils for food, feed and	Assessment Report	EPASL, Universities, Research Institutions, Waste companies	Medium term (3 years)	15,000
	Developing and regularly updating a database for PCB/PCN containing equipment (in use and storage) and open applications (e.g. buildings/constructions)	Database developed	Medium term (3 years)	EPASI, Universities, EDSA & EGTC	20,000
Life cycle management of closed and open applications containing PCBs/PCNs and SCCP					
Life cycle management (handling, storage, transport and disposal) of PCBs/PCNs, PCB/PCN-containing equipment, open applications and PCB/PCN containing and contaminated wastes	Establishing ESM procedures for PCBs/PCNs equipment and wastes considering existing technical guidelines.	Authorities and staff trained	EPASL, Universities, Research Institutions, Waste companies	Medium Term (1 year)	30,000
	Establishing storage, inspection/control on the handling, transfer and disposal of PCB/PCN containing equipment and PCB/PCN containing wastes	Inspectors trained Inspections conducted (reports)	EPASL, Universities, Research Institutions, Waste companies, Police	Short Term (1-2 years)	20,000
	Phase-out PCB/PCN in closed and open applications and	Phase out of equipment by 2025.	EPASL, Universities, Research	Medium– Long Term (6 years)	30,000

Objective	Activities	Indicator	Implementers	Time (years)	Budget/ Needs
	monitoring of the progress	Documented management and export	Institutions		
	Environmentally sound management and disposal of PCB/PCN containing equipment and waste	Disposal of equipment by 2027	EPASL, Universities, Research Institutions, Waste companies	Medium – Long Term (9 years)	100,000
	Procure packaging equipment and export or technology for disposal	Disposal equipment procured and purchased	EPASL, MOHS, Universities, Research Institutions, Rep of Waste Management Company	Medium to long tern (5 - 9 years)	200,000
Awareness, education and training of stakeholders (policy makers; customs, related industries, NGOs and the public) on PCBs/PCNs in closed and open applications (linked to the awareness on chemicals in products (SAICM synergy))	Awareness/education of policy makers and other stakeholders on health hazards of PCBs, PCNs and SCCP and the related risk for humans, environment and food.	Number of awareness activities conducted	EPASL, Universities, Research Institutions, Waste companies, Police, 50:50 Group, NGOs, Civil Society	Continuous (1- 10 years)	50,000
	Strengthen the inspection capacity for customs and other competent authority (in use; mark/sales, storage, disposal).	Customs and inspectors trained (number of trainings; participants)	EPASL, Universities, Research Institutions, Customs Department, Police	Short Term (2 years)	30,000
	Education of utility sector, maintenance workers and industry owing transformers, capacitors and other PCB/PCN containing closed equipment and open applications on PCBs, PCNs and alternatives. Education of citizens and NGOs on PCBs and PCNs including open applications relevant for consumers (paints and sealants)	Workers and stakeholders trained (number of trainings; participants)	EPASL, Universities, Research Institutions, Consumer Protection, Awareness Raising groups	Short Term (1 year)	20,000
Established monitoring and analysis of PCBs and PCNs (closed and	Monitoring and analysis of PCBs and PCNs for closed and open	PCB/PCN inventory in closed	EPASL, Universities, Research	Medium Term (3 years)	100,000

Objective	Activities	Indicator	Implementers	Time (years)	Budget/ Needs
open applications, environment, food, exposure)	applications (see above)	application	Institutions		
	Monitoring of occupational exposure (maintenance and management/remediation staff)	Monitoring data of potentially exposed staff	EPASL, Universities, Research Institutions, Ministry of Labour	Medium Term (5 years)	20,000
	Monitoring of PCB/PCNs and SCCP (human, environment biota, imports, food) by own capacity or regional/international collaboration	Monitoring data	EPASL, Universities, Research Institutions	Medium Term (3 years)	50,000
Assessment and promotion of sustainable alternatives used for PCBs and PCNs in closed and open applications	Compilation of information on alternatives in closed and open applications of PCBs/PCNs and SCCPs and assessment of alternatives used	Reports (compiling available information from e.g. POPRC)	EPASL, Universities, Research Institutions	2 years	5,000
	Education on alternatives of PCBs/PCNs and SCCP in closed and open applications	Trainings conducted (numbers of participants)	EPASL, Universities, Research Institutions, Representatives from stakeholder institutions	Medium Term (3 years)	25,000
	Promotion of most sustainable alternatives in closed applications considering chemical and energy aspects	Selected alternative equipment (e.g. ecolabel; Green public procurement)	EPASL, Consultant	Medium Term (5 years)	10,000
	Promotion of the most sustainable alternatives in (former) open applications of PCBs/PCNs and SCCP	Selected alternatives (e.g. ecolabel)	EPASL, Consultant	Medium Term (5 years)	10,000

3.3.5 Activity: Production, import and export, use, stockpiles, and wastes of hexaBDE and heptaBDE (AnnexA, Part IV chemicals) and tetraBDE and pentaBDE (Annex A, Part V chemicals) (and HBB, where applicable (Annex A, Part I chemicals))

According to the PBDE inventory POP-PBDEs listed in 2009 have been imported via electrical and electronic equipment and related waste (EEE/WEEE) in vehicles and possibly other goods and is present in stocks at consumer levels or as wastes. Furthermore, in May 2017 DecaBDE has been listed as POPs which had by far the highest use volume of all PBDEs. Therefore, the total amount of POP-PBDE in products and waste is considerably higher compared to the current first PBDE inventory considering only POP-PBDEs listed in 2009.

The action plan (Table 49) focus on setting objectives and actions need to lead to managing and controlling POPs-PBDEs and HBCD (POP-BFR) containing products still in use, currently recycled, stockpiled, or landfilled. The implementation can only be successful if the overall management of EEE/WEEE, end of life vehicles and construction & demolition waste is appropriately developed. This is considered and addressed in this action plan but need to be addressed in and linked to the larger frame of the national waste management action plan.

For managing PBDEs, the life cycle management (import, export, use, recycling, destruction) of POPs containing articles/products and waste needs to be developed, in particular for EEE/WEEE and vehicles and end of life vehicles. In addition, HBCD, DecaBDE and to a less extent PBDE listed in 2009 are used in insulation (polyurethane and polystyrene) and other plastic and polymer applications in buildings.

For these three large material and waste flows also resource recovery and recycling need to be considered, following the waste management hierarchy for the recovery of resources and to move to a (more) circular economy. At the same time pollutants such as PBDE, HBCD and other POPs/PTS need to be phased out of the recycling.

Furthermore, the three waste categories WEEE, end-of-life vehicles and construction & demolition waste contain a large share of the total plastic/polymer volume which needs to be managed considering the impact on plastic/polymers on marine litter and on the role as fuel for open burning. Here the Stockholm Convention COP 8 gave the mandate to the regional Stockholm/Basel Centers to address plastic waste and marine plastic litter in future which also need to be considered for the national implementation plan.

The action plan also considers where appropriate the synergy of Stockholm Convention and the Strategic Approach of International Chemical Management (SAICM). POP-BFRs are prime examples of Hazardous Chemicals in Products (SAICM emerging policy issue) and are closely linked with the SAICM policy issues “Hazardous substance within the life cycle of electrical and electronic products” and “Endocrine-disrupting chemicals”.

Table 49. Action plan activities for elimination and management of POP-BFRs (PBDEs, HBCD and PBB[30])

Objectives	Activities	Performance indicators	Time Frame	Responsible/ Stakeholders	Resource $
Established regulatory frame for management of POP-BFRs (hazardous chemicals) and related articles and waste categories	• Inclusion of PBDEs, PBB and HBCD in list of banned or restricted substances.	▪ PBDE, PBB and HBCD restricted	Short Term (1 year)	EPASL, Law Officers Department, Universities	5,000
	• Assessment of regulatory frameworks for these substances and the products and wastes containing these substances.	▪ Overview of international regulations compiled	Short Term (1 year)		10,000
	• Development of regulatory frame for EEE/WEEE management[31]	▪ Regulatory frames for EEE/WEEE developed	Medium Term (3 Years)		10,000
	• Development of a regulatory frame for vehicles management (importation, end of life management; see e.g. EU ELV directive).	▪ Regulatory frames for vehicles developed	Medium Term (3 Years)		10,000
	• Development of a regulatory frame for HBCD in insulation. • Assessment/listing if exemption needed for HBCD in insulation? (frame)	▪ Regulatory frame for HBCD insulation foams developed	Medium Term (3 Years)		10,000
Updated and refined inventory of PBDEs (including DecaBDE) and HBCD containing articles and wastes/resources and developed/updated appropriate databases for information management	▪ Update PBDE inventories considering DecaBDE (and other update if necessary)	▪ Updated inventory report	Short Term (1 - 2 years)	EPASL, Universities, Research institutions	70,000
	▪ Develop dynamic MFA/SFA inventory for POPs/PTS (and resources) in EEE/WEEE ▪ Develop dynamic MFA/SFA inventory for POPs/PTS (and resources) in vehicles, ▪ Develop dynamic MFA/SFA inventory for HBCD containing EPS/XPS in construction.	▪ Dynamic substance flow analysis of POP-BFR containing products and waste (report)	Short Term (2 years)	EPASL, Universities, Research, Institutions, Stakeholders /Retailers NGOs	50,000
	▪ Data management system for product and waste categories containing BFRs (for general waste management)	▪ Databank for EEE/WEEE, vehicles, established	Short Term (2 years)	EPASL, Universities, Research, Waste Companies institutions, NGOs	60,000

[30]HBB have been produced and used in minor amounts (approx. 5000 t) in the 1970s mainly in the ÚS and are not considered relevant today. HBB is included in the monitoring action plan to verify this.

[31] see e.g. EU WEEE directive & EU POP regulation; but also developing countries like Nigeria or Ghana have developed a regulatory frame for WEEE

Objectives	Activities	Performance indicators	Time Frame	Responsible/ Stakeholders	Resource $
Sound Life Cycle Management of PBDE and HBCD containing product and waste categories (EEE/WEEE, end of life vehicle, insulation foam)	• Compilation of information of management for POP-BFR containing products and waste including fate of other pollutants. • Assessment of management and destruction option of waste categories containing POP-BFR (WEEE; ELV, insulation foam, furniture). • Assessment of recycling options and limitations of product/waste categories containing POP-BFR. • Compile guidelines and guidance on safe handling of POP-BFR polymers in EEE, ELV etc. and develop national guidance for management of POP-BFRs containing insulation foam from construction.	▪ Database of POP-BFR products developed ▪ Management of POP-BFR report	Medium Term (5 years)	EPASL, Universities, Research, Waste Companies institutions, NGOs	25,000
	• Development of sound management (financing, collection, storage, treatment according to waste hierarchy) of POP-BFR containing plastic and other polymer in EEE/WEEE within the frame of hazardous substance management in EEE life cycle. • Development of sound management of POP-BFR containing plastic and other polymer in end of life vehicles within the frame of hazardous substance management in the life cycle of EoL vehicles. • Development of sound management of POP-BFR containing plastic and other polymer in buildings and construction within the frame of POPs (PCBs, PCP, POP-pesticide in wood, SCCP) and hazardous substance management in buildings and construction. • Development of sound management of POP-BFR containing plastic and other polymer in other uses found relevant • Including POP-BFRs and other hazardous substances in a larger frame of plastic management (link to marine litter etc)	▪ EEE plastic and related PBDE management in WEEE addressed ▪ MOU in place ▪ Compliance and enforcement network operational. ▪ Institutions have appropriate capacity ▪ Operational monitoring plans in place	Short Term (2 years)	EPASL, Universities, Research Institutions, Waste Companies, NGOs	500,000 (tentative)

Objectives	Activities	Performance indicators	Time Frame	Responsible/ Stakeholders	Resource $
	▪ Identify destruction and energy recovery options for POP-BFR containing waste. ▪ Develop phase out/destruction options for identified PBDEs sources.	▪ Phase out/ destruction options identified. ▪ Phase out/destruction programmes in place	Medium term (5 years)	EPASL, Universities, Research Institutions, Waste Companies	10,000
To assess and select the most sustainable alternatives to POP-BFRs (HBCDand DecaBDE) in used/exempted applications.	▪ Compilation of information on alternatives to HBCD containing EPS/XPS insulation (see SC HBCD BAT/BEP guidance; POPRC). ▪ Compilation of information on alternatives to DecaBDE (considering activities of POPRC; UNEP BAT/BEP group). ▪ Education and capacity building on alternatives assessment. ▪ Selection of the most sustainable alternative chemicals and non-chemical solutions in the different applications. ▪ Phase in of sustainable chemicals and non-chemical alternatives.	▪ Alternatives to HBCD compiled ▪ Alternatives to DecaBDE compiled ▪ Assessment report on education and capacity building ▪ Most sustainable alternative chemicals and non-chemical solutions selected ▪ Sustainable chemicals and non-chemical	Medium Term (3 years)	EPASL, Universities, Research Institutions, Waste Companies , NGOs	20,000
To apply BAT/BEP if HBCD(or DecaBDE) as much as feasible to ensure the controlled use and ESM along the life cycle.	▪ BAT/BEP in production, use and ESM of HBCD EPS/XPS in construction. ▪ BAT/BEP in recycling of POP-PBDEs containing plastic/polymers (please note that DecaBDE does not have a recycling exemption) ▪ BAT/BEP if DecaBDE in exempted uses ▪ DecaBDE in plastic in EEE & vehicles ▪ DecaBDE in textile (comment: unclear how to control life cycle) ▪ DecaBDE in other exempted uses. ▪ Labelling of products containing HBCD and DecaBDE	▪ BAT/BEP guidelines including timelines on use of HBCD (including DecaBDE) developed	Short – Medium (1 – 5 years)	EPASL, Universities, Research, Waste Companies institutions, NGOs	10,000
Awareness of major stakeholders on POP-BFR containing products and	▪ Develop awareness creation strategy on impact (health, recycling, environment) of POP-BFRs (PBDEs, HBCD) and other hazardous chemicals in the life cycle of EEE, vehicles, buildings,	▪ Development of awareness creation materials	Short to Medium Term (1 - 5 years)	EPASL, Universities, NGOs, Media	50,000

Objectives	Activities	Performance indicators	Time Frame	Responsible/ Stakeholders	Resource $
waste created (integrated in the overarching frame on awareness of "Chemicals in Products" and "Management of hazardous chemicals in the life cycle of EEE" (SAICM synergy)	textiles and other impacted product categories. ▪ Developing awareness raising materials on POP-BFRs and other hazardous substances in EEE, ELVs, buildings etc. ▪ Awareness raising campaigns for stakeholders (policy makers, authorities, industry, recyclers, research and public) on POP-BFRs within a larger awareness campaign on chemicals in products. ▪ Awareness of the public on POP-BFR impacted plastic within a general awareness on plastic and marine litter and sustainable consumption ▪ (Conducting awareness creation campaigns to reduce/eliminate the practice of open burning of EEE/WEEE and ELV polymer scrap.)				
Built knowledge and capacity for management of POP-BFR impacted materials and waste categories within the life cycle management of hazardous substances in EEE, vehicles, buildings, furniture, textiles	▪ Carry out policy and regulatory needs assessment and develop recommendations. ▪ Capacity building of authorities and institution for developing the regulatory frame for life cycle management of EEE, ELVs, construction sector and others ▪ Develop training materials and programmes .to monitor the enforcement of the regulatory frame for WEEE. ELV, insulation in buildings and other impacted waste management and related polymer and POP-PBDEs management ▪ Capacity building for implementation of the regulatory frames for managing WEEE, ELVs and other impacted wastes ▪ Develop procedures on inspections and maintenance of stockpiles and waste of plastic and other polymers in EEE. ▪ Training/education of customs authorities on control of import of import control of WEEE, ELVs and other relevant products.	▪ policy and regulatory Needs assessment report ▪ Resource persons identified ▪ Training materials developed Procedures on inspections and maintenance of stockpiles and waste developed.	Short Term (2 years)	EPASL, Universities, Waste Companies, Customs,	70,000
	▪ Development of education and training materials for life cycle management of POP-BFRs	▪ Education training materials	Short to Medium Term (1 -	EPASL, Universities, Research	25,000

Objectives	Activities	Performance indicators	Time Frame	Responsible/ Stakeholders	Resource $
	(considering already available materials) and training of related recyclers and waste management sector for relevant sectors within the life cycle management of hazardous substances in EEE, vehicles, buildings, furniture, textiles ▪ Capacity building of life cycle management for POP-BFRs (considering available materials) and training of recyclers and waste management sector for relevant sectors within the life cycle management of hazardous substances in EEE, vehicles, buildings, furniture, textiles.	developed/produced ▪ Training and capacity building workshop report	5 years)	Institutions,	
Established monitoring of POP-BFRs and pollutants in the technosphere and other priority areas	▪ Assessment of options for monitoring of POP-BFRs (international collaboration or development of own/regional capacity) ▪ Establish of monitoring approach for POP-BFRs (PBDEs, HBCD, PBB). ▪ Monitoring of major product categories and related wastes/recycling. ▪ Improvement of inventory by monitoring approach where knowledge gaps have been identified. ▪ Monitoring of humans, biota and environment for POP-BFR for effectiveness evaluation and in priority areas (e.g. contaminated site).	▪ Report of assessment, monitoring and analysis of POP-BFRs	Short to Medium Term (1 - 5 years)	EPASL, Universities, Research Institutions, Waste Companies	120,000

3.3.6 Activity: Production, import and export, use, stockpiles, and wastes of PFOS, its salts and PFOSF (Annex B, Part III chemicals)

Due to the risk to ground water and drinking water combined with the very high persistence, PFOS are an issue of high concern and threat for Sierra Leone.

Since per- and polyfluorinated[32] substances (PFASs) are an issue of concern under the Strategic Approach to Chemical Management (SAICM)[33,34], the action plan (Table 50) have been extended to other PFAS where appropriate, to promote the synergy of SC and SAICM.

[32] Polyfluoroalkyl substances are considered under SAICM and have perfluorinated degradation products.

Table 50. Action plan with objectives, activities and indicators for measures to reduce or eliminate PFOS and control PFAS (SAICM Synergy)

Objectives	Activities/tasks	Indicators	Timeline	Responsible institutions	Budget/ needs ($)
To establish policy and regulatory framework for management of PFOS and related substances and other PFAS (SAICM synergy)	Assessment of regulatory frameworks of other countries for controlling PFOS and related substances and other PFAS	Assessment report	Short Term (1-2 years)	EPASL, Universities, National Fire Force, Law Officers Deptartment	15,000
	1.2 Amend existing laws, or develop new laws related to the control and management of PFOS and other PFAS. Banning of PFOS with exemption for aviation hydraulic fluids and fire-fighting foams	Law and policy in place	Short Term (1-2 years)	EPASL, Universities, Law Officers Department	15,000
	1.3 Custom control and improvement of the traceability of PFOS and other PFAS in imports (including chemicals in products. including GHS)	GHS and customs trained	Short Term (1-2 years)	EPASL, Customs Department, Private Sector	25,000
	1.4 Extended producer/user responsibility for management of PFOS and other PFAS throughout product life cycle (including disposal)	EPR in place	Short Term	EPASL	25,000
Updated and refined inventory of PFOS and other PFAS (SAICM synergy) use and containing articles and wastes and developed/updated databases for information management	Refining inventory of PFOS and other PFAS in firefighting foams Refining of inventory of PFOS and other PFAS in consumer and other products and applications Refining of inventory of PFOS and PFAS in industrial use Refining of inventory of stocks and waste of PFOS and other PFAS (including landfills) Refining inventory of historic use and release of PFOS and PFAS (see contaminated site action plan) (Option) Material and substance flow analysis of	Updated inventory with robust data and list of data gaps	Short to Medium Term (1 – 5 years)	EPASL, Universities, National Fire Force	35,000

[33]SAICMhttp://www.saicm.org/Implementation/EmergingPolicyIssues/tabid/5524/language/en-US/Default.aspx

[34] Perfluorooctanoic acid (PFOA) and perfluorohexanesulfonic acid (PFHxS) are currently assessed as POPs in the POP Review Committee under the Stockholm Convention

Objectives	Activities/tasks	Indicators	Timeline	Responsible institutions	Budget/ needs ($)
	PFOS and other PFAS				
Life cycle management of PFOS/PFAS containing products, stockpiles and waste.	Compilation of information of management situation of PFOS and PFAS containing products in the country	Report	Short Term (1 – 2 years)	EPASL, Universities	15,000
	Assessment of management and destruction option of PFOS and other PFAS containing stocks and wastes	Management and destruction options assessed (report)	Short – Medium Term (1-5 years)	EPASL, Universities, research institutions, National Fire Force	25,000
	Policy and strategy for control and management of PFOS and other PFAS-containing products and wastes	Strategy incorporated in National Chemical and Waste Management Plan	Short – Medium term (1-5 years)	EPASL, Universities, research institutions, National Fire Force	15,000
	Environmental safe storage of PFOS-containing materials	PFOS containing waste stored	Medium Term (3-5 years)	EPASL, Universities, research institutions, National Fire Force	40,000
	Stop recycling of PFOS containing products or extract/remove PFOS before recycling	Recycled and reused products free of PFOS	Short – Medium Term (1 – 2 years)	EPASL, Universities, research institutions, National Fire Force, Law Officers, Police	20,000
	ESM of PFAS containing products; destruction or export of PFOS containing waste considering Basel synergy and extended producer responsibility;	PFOS stocks and waste disposed; Compliance and enforcement of the SC	Long Term (5 – 10 years)	EPASL, Universities, research institutions, National Fire Force	60,000
PFOS alternatives in use/exempted uses are assessed and PFOS is substituted by the most sustainable chemical and non-chemical solution	Compilation of information on alternatives to PFOS and related substances (considering available information of e.g. POPRC)	Information materials developed (report) and disseminated.	Short Term (1 – 2 years)	EPASL, Universities, research institutions, National Fire Force	15,000
	Education and capacity building on alternatives and alternative assessment	Alternatives assessment guidance document	Short-Medium Term (1 – 5 years)	EPASL, Universities, research institutions, National Fire Force	25,000

Objectives	Activities/tasks	Indicators	Timeline	Responsible institutions	Budget/ needs ($)
	Selection of the most sustainable alternative chemicals and non- chemical solutions in the different applications	Phase in and use of alternatives	Short Term (1 – 2 years)	EPASL, Universities, research institutions, National Fire Force	15,000
Training and awareness raising for stakeholder groups on PFOS and other PFAS and establishing approach for information exchange	Development of related education and awareness materials for stakeholder groups (considering already available materials)	Education materials developed Awareness created	Short Term (1 – 2 years)	EPASL, Universities, research institutions, Reps of various awareness groups	15,000
	Inform and educate stakeholders including users (e.g. fire fighters; paper/leather/furniture/aviation industry), policy makers and public on the environmental and health impact, environmentally sound management and on alternatives of PFOS and related substances.	Number of workshops/seminar conducted	Short Term (1 – 2 years)	EPASL, Universities, research institutions,	15,000
	Training/education of customs authorities on PFOS (and other POPs and other hazardous substances) in articles and products.	Number of trained personnel Education/awareness of	Short Term (1 – 2 years)	EPASL, Universities, research institutions,	15,000
6BAT/BEP application in exempted uses	Using BAT/BEP in case PFOS and related chemicals are used in industrial applications, including closed-loop systems.	BAT/BEP applied Minimum/zero emission achieved.	Medium Term (3 – 5 years)	EPASL, Universities, research institutions, National Fire Force	30,000
Established monitoring of PFOS and other PFAS in priority areas	Assessment of options for monitoring of PFOS and PFAS (international collaboration or development of own capacity) Monitoring of major drinking water supplies Improvement of inventory by monitoring approach where knowledge gaps have been found. Monitoring of chemicals and chemicals in products/articles known to contain PFOS and its related substances. Monitoring biota and soil samples for PFOS especially	Monitoring approach for PFOS and related substances has been established. Monitoring of Priority areas including major drinking water reservoirs	Medium to Long Term (3-5 years)	Universities, research institutions,	350,000

Objectives	Activities/tasks	Indicators	Timeline	Responsible institutions	Budget/ needs ($)
	in vicinity of suspected contaminated sites (see contaminated site action plan).	conducted			
8. Established assessment, management, database of potentially PFOS and other PFAS contaminated sites and securing /remediation	Develop/update legislation to set criteria for determining contaminated sites. Legislation on liability related to contamination and clean-up procedures. (general activity on contaminated site framework)	Contaminated site criteria defined and legislation developed	Short Term (1 – 2 years)	EPASL, Law Officers Department, Universities, research institutions,	20,000
	Develop/adopt guidelines for identification, assessment and priorization of PFOS/PFAS contaminated sites[35]	Guidelines on identification developed	Short Term (1 – 2 years)	EPASL, Universities, Research institutions, National Fire Force	15,000
	Training in identification and management of contaminated sites	Workshops conducted, staff trained	Short Term (1 – 2 years)	EPASL, Universities, Research institutions, National Fire Force	25,000
	Database and maps of potentially contaminated sites and prioritization of the sites (risks) for further assessment and clean-up	Database developed Priority sites determined	Short Term (1 – 2 years)	EPASL, Universities, Research institutions, National Fire Force	20,000
	Analytical confirmation of POPs contamination for the identified locations (according a prioritization list	Pollution assessed	Short to long Term (1 – 10 years)	Universities, Research institutions	100,000
	Develop strategies for the environmentally sound management of POPs contaminated sites	Strategies for addressing sites developed	Short Term (1 – 2 years)	EPASL, Universities, Research institutions, National Fire Force	25,000
	Take measures to secure the contaminated sites to stop human exposure and environmental releases	Measures to secure sites implemented	Short Term (1 – 2 years)	EPASL, Police, Consumer Protection Agency	20,000
	Identification of clean-up measures and initiate clean-up procedures for high priority sites considering polluter pays	High priority sites with exposure remediated	Short to Medium Term (1 – 5	EPASL, Universities, Research institutions,	35,000

[35] A handbook on PFOS/PFAS contaminated sites has been developed by the German federal state working group

Objectives	Activities/tasks	Indicators	Timeline	Responsible institutions	Budget/ needs ($)
	principle.		years)	Consumer Protection Agency	

3.3.7 Activity: Register for specific exemptions and the continuing need for exemptions (Article 4)

Article 4 of the Stockholm Convention on POPs requires the establishment of POPs register for the purpose of identifying parties that have specific exemptions listed in Annex A or B. All registrations of specific exemptions are subject to periodic review.

The listed POPs with specific exemptions and acceptable purposes have increased and meanwhile 9 POPs have been listed with exemptions (HBCD, DecaBDE, SCCP, PFOS, DDT, Lindane, PCP and recycling of PBDEs). To decide if an exemption is needed an informed decision need to be made considering alternative chemicals and non-chemical solutions. Such an assessment is made by appropriate research institutions and committees (see 3.3.15 Activity: Research, development and monitoring (Article 11)). If after such a scientific assessment an exemption is needed, then the Secretariat of the Stockholm Convention/COP would be informed and the exemption registered. Therefore in this action plan an activity is included to establish an appropriate systematic methodology of an exemption is needed to appropriately meet the obligations under Article 4 in future.

Table 51. Register for specific exemptions and continuing need for exemptions (Article 4)

Objectives	Activities	Key performance indicators	Time Frame	Implementers	Budget/Needs ($)
To establish an informed registration process for needed exemptions of individual POPs.	(a) Organize stakeholder consultation to establish criteria for assessment and selection of exemptions for chemicals listed under Annex A or B (b) Assess for PFOS, PFOA, HBCD, PCP, DDT, DecaBDE, and SCCP future listed POPs with exemptions. (c) Notification of Convention Secretariat on specific exemptions if needed (d) Periodic review to assess whether there is need for continued exemptions and alternatives and stop exemption and use more sustainable alternatives as soon as feasible	Stakeholder consultation on criteria for assessment held and outcomes documented Country assessment of current listed POPs with exemptions if any Notification submitted and exemption listed if applicable Review exemption needs report	Annually	EPASL, Universities and Research Institutions, Relevant Stakeholders	10,000, Expert
If a certain POPs exemption is needed it would be described in this activity	Inform Secretariat of the Stockholm Convention/COP on the needed of exemption after thorough assessment of the need and alternative options	Secretariat of the Stockholm Convention/COP is informed on the needed exemption and exemption is registered	Annually	EPASL, Universities and Research Institutions, Relevant Stakeholders	Financial assistance, Expert

3.3.8 Action plan: Measures to reduce releases from unintentional production (Article 5)

In this section activities are proposed for the action plan to reduce the release from unintentionally produced POPs (PCDD/PCDF and unintentional PCB, PCN, HCB and PeCBz) (Table 52). In the action plan the activities have been set by considering the listing of the priority sources in Annex C of the SC, the contemporary releases as an outcome of the inventory process and considering point sources with potential risk to humans.

PCDD/PCDF and PCB levels are globally still above the Tolerable Daily Intake (TDI) for breast fed children.[36] Therefore further reduction of PCDD/PCDF release is a relevant task. PCDD/PCDF and other unintentional POPs (PCBs, PCNs) are endocrine disrupting chemicals

[36] Since human milk is the best nutrition for a baby and the benefits of breastfeeding far outweighs the presence of POPs human milk is exclusively recommended for at least 6 month by WHO http://www.who.int/nutrition/topics/exclusive_breastfeeding/en/).

(EDCs) and contribute to overall exposure of humans to EDCs. Also the overall exposure to EDCs need to be reduced considering the high external cost of EDCs to society.[37,38]

For an adequate assessment of UPOP emissions and emission sources and related impact of reduction, the total impact of release reduction from addressed individual industrial emissions, open burning, indoor cooking/heating and transport including other major pollutants need to be considered for an appropriate risk assessment and priority setting on air and soil pollution prevention.

Other pollutants to consider include:

- other releases from open burning, cooking/heating, transport (e.g. particulate matter (PM), carbon black, PAHs, heavy metals)
- other releases from industrial processes (e.g. particulate matter (PM), carbon black, PAHs, heavy metals).

Since these releases are one of the main sources for ambient air pollution causing between 9 to 12.6 million deaths including 2.2 million in the African region (WHO 2016[39], Lancet Commission on Pollution and Health[40]), the reduction of the release of these pollution as a whole (Dioxins/UPOPs, particulate matter, heavy metals, PAHs, black carbon) should be a priority for many countries. Integrated actions to address the different sources and the multiple pollutants need to be implemented if the exposure of the population is to be adequately decreased. The proposal therefore is an action plan for reducing the unintentional releases of POPs as well as other relevant co-pollutants (particulate matter (PM), black carbon, PAHs, heavy metals) from these sources in an integrated manner towards an integrated pollution prevention and control approach.

Table 52. Objectives/aims and action plan activities for reduction and elimination of Dioxins/UPOPs including timelines, responsible authorities and stakeholders and associated cost

Objectives/ aims	Activities	Time frame	Implementing/ institutions*	Resource needs
To establish policy and legal framework for reduction and minimization of unintentional POPs	• Undertake law and policy assessment on PCDD/F and other UPOPs and possibly co-pollutants. • Amend existing laws, or develop new laws where needed, related to the management of UPOPs possibly within an integrated pollution prevention and control approach. • Develop emission standards or limits	Short - Medium Term (5 year)	EPASL, Ministry of Justice & Law Reform Commission, Law Officers Department, Awareness Raising	50,000

[37] Attina TM, Hauser R, et al. (2016) Exposure to endocrine-disrupting chemicals in the USA: a population-based disease burden and cost analysis. Lancet Diabetes Endocrinol. 4(12), 996-1003.

[38] Trasande L, Zoeller T et al. (2015) Estimating Burden and Disease Costs of Exposure to Endocrine-Disrupting Chemicals in the European Union. J ClinEndocrinolMetab. 100(4), 1245–1255.

[39] WHO (2015) http://www.who.int/mediacentre/news/releases/2016/deaths-attributable-to-unhealthy-environments/en/

[40] The Lancet Commission on pollution and health. http://www.thelancet.com/commissions/pollution-and-health

Objectives/ aims	Activities	Time frame	Implementing/ institutions*	Resource needs
	for UPOPs for sources and in environmental media or food considered relevant. • Conduct awareness and training for stakeholders on legal issues of UPOPs and integrated pollution prevention and control.		Organisation	
Updated sources inventories for PCDD/F and possibly other listed UPOPs with data management and harmonization with related release inventories.	▪ Refine/update Dioxin/UPOP inventory ▪ Incorporate new listed unintentional POPs where useful ▪ Regularly update of the UPOP inventory and reporting as appropriate ▪ Quantify other co-pollutants (e.g. PAHs; carbon black)	Short - Medium Term (5 year)	EPASL, Universities, Research Institutions	60,000
	▪ Development of a mechanism ensuring appropriate storage and management of data ▪ Development of an integrated database of pollutant releases (e.g. Dioxin/UPOPs, mercury, GHG; carbon black) ▪ Development of a PRTR	Short - Medium Term (5 year)	EPASL, Universities, Research Institutions	30,000
Reduced releases from open burning of wastes (private burning& landfill fires) and biomass burning by improvement of waste management (waste hierarchy; circular economy).	• Regulatory frame for waste hierarchy and circular economy • Regulatory frame for control of open burning • Development of waste catalogue and related management options considering waste hierarchy • Implementation of sound management of waste with increased reuse, recycling and recovery (3/Multi R concept towards a more circular economy). • Energy recovery in cement plants and boilers/incinerators • Construct engineered landfills for remaining waste disposal	Short Term (2 years)	EPASL, Ministry of Justice & Law Reform Commission, Law Officers Department, Universities, Research Institutions, Waste Management Companies	35,000
	• Develop a guidance and awareness materials for detection, extinguishing and prevention of landfill/dumpsite fires. • Closure of dump sites and stop illegal dumping of wastes (fines) or upgrade all existing dumpsites into environmentally friendly landfill sites. • Develop an awareness for landfill	Short to - Medium Term (2 – 5 years)	EPASL, Awareness Rasing Organisation, Police, Waste Management Companies, Municipalities	120,000

Objectives/ aims	Activities	Time frame	Implementing/ institutions*	Resource needs
	operators on the impacts of open waste burning and implement education program for control • Awareness raising program and fines for open waste burning on private level			
Reduce and minimize release of UPOPs from waste incinerators	• Education of operators and competent authorities on the need to minimize Dioxin/UPOPs release and emission control • Implementation of regulatory frame including BEP and/or BAT for meeting regulation limits (appropriate time frame). • Install cleaner technology/equipment	Medium Term (5 years)	EPASL, Ministry of Justice & Law Reform Commission, Law Officers Department, Universities, Research Institutions, Awareness Raising Organizations	80,000
	• Implement BEP and where required BAT in existing medical waste incinerators • Assessment of technologies to treat medical waste • Selection and implementation of sound treatment of medical waste including also non-incineration technologies • Develop guidelines for sound management of medical waste (WHO "Safe management of wastes from health-care activities") • Strengthen institution and human resource capabilities to implement environmentally sound medical waste management	Medium Term (5 years)	EPASL, Law Officers Department, Universities, Research Institutions, Ministry of Health	25,000
To conduct awareness raising and establishing network	• Develop of education and awareness materials on the health and environmental impact of Dioxins and other UPOPs • Sensitize the public and stakeholders on the environmental and health impact of UPOPs • Develop awareness creation strategy on impact UPOPs and releases of other hazardous pollutants • Awareness raising on Dioxins and UPOPs and other pollutants of concern for relevant stakeholders and sources (open burning, industrial sources,	Short – Long Term (Continuous)	EPASL, Universities, Research Institutions, Awareness Raising Organizations, Ministry of Health	15,000

Objectives/ aims	Activities	Time frame	Implementing/ institutions*	Resource needs
	industries, waste wood).			
Established monitoring of PCDD/F and other UPOPs and relevant pollutants from Annex II and III sources and human exposure	• Assessment of the need and the options for monitoring Dioxins and other UPOPs from priority sources and for human exposure (food, feed, soils). • Establish and strengthen the national capacity for UPOPs monitoring considering instrumental analysis, bio-assay and international co-operations. • Emission monitoring of relevant sources of PCDD/F and other UPOPs. • Monitor priority environmental and foods samples for Dioxins and possibly other UPOPs (e.g. samples with potential human exposure for residents around suspected contaminated sites). • Monitoring of chemicals and chemicals in products/articles known to potentially contain PCDD/F and other UPOPs.	Medium Term (3 years)	EPASL, Universities, Research Institutions,	120,000

3.3.9 Activity: Identification and management of stockpiles, waste and articles in use, including release reduction and appropriate measures for handling and disposal (Article 6)

Toxic releases from stockpiles and waste constitute serious threat to human health and the environment. This calls for their safe, efficient and environmentally sound management. Activities geared towards the development of appropriate strategies and measures to stem releases through actions such as proper handling, collection and transport and disposal of such stockpiles and waste are outlined in the action plans (Table 53) for the individual POPs above.

In addition to remaining PCB and pesticides, large volumes of POP-BFR containing wastes and stocks have been generated (WEEE plastic; plastic/polymers of end of life vehicles; insulation foam from construction). A similar situation exists with PFOS and related substances (PFOS precursors) and SCCP and related containing stockpile (carpets and possibly others). PFOA has been listed as POP in COP9 and PFHxS is evaluated by POPRC as POPs and SAICM has all perfluorinated alkylated substances as an issue of concern and related wastes will need to be managed/destroyed in future. Wastes containing these POPs and PBT chemicals need to be managed. Activities for the management of POPs specific waste are listed in the individual action plans and would be considered/linked to the activities listed in this generic action plan.

Safe, efficient and environmentally sound management of stockpiles as well as proper handling and disposal of articles in use, which contain POPs, and other hazardous chemicals are important for the achievement of the country obligations under the Stockholm Convention (Article 6) and

the Strategic Approach of Chemical Management (SAICM synergy). E.g. also related stockpiles and wastes containing perfluorinated alkylated substances (SAICM issue of concern) or hazardous chemicals in electronics (SAICM emerging policy issue) need to be managed that these and other hazardous chemicals do not enter the environment and impact human health and the environment including wildlife. Therefore, appropriate end of life management of impacted waste categories is important to achieve such goals.

At the same time only a part of these waste categories are impacted. Furthermore, they contain valuable resources to be recovered considering the need to move to a (more) circular economy. Therefore, an appropriate approach on material recovery, energy recovery and destruction of pollutants need to be developed. Within these activities the synergies with Basel Convention and related activities need to be considered.

Table 53. Action plan to reduce releases from stockpiles and wastes (Article 6)

Objectives	Activities	Performance indicators	Time Frame	Implementers	Resource /Needs
Please note: The management of the stockpiles of the individual POPs (PCBs, pesticides, PFOS, PBDEs, HBCD) is in the action plans of individual POPs above					
To manage stockpiles in a safe and environmentally sound manner	▪ Identify appropriate storage facilities for interim storage of stockpiles ▪ Upgrade existing information for safe management of stockpiles	▪ Meetings to develop guidelines for safe storage ▪ Facilities to handle stockpiles in place ▪ Workshops to train personnel in management of stockpiles	3 years	EPASL, Universities and Research Institutions, Waste Management Companies, Other Relevant Stakeholders	Financial assistance, Expert
To know option and limitations for the destruction of POPs and hazardous chemicals in the country and the current and future capacity needs and options	▪ Evaluation the option and limitation of facilities for destruction or other ESM measures for chemicals and chemicals in products (CiP) in country ▪ Need assessment for improvement of destruction capacity	▪ Documentation of destruction or otherwise ESM options in the country ▪ Need assessment report	3 years	EPASL, Universities and Research Institutions, Other Relevant Stakeholders	Financial assistance, Expert

Objectives	Activities	Performance indicators	Time Frame	Implementers	Resource /Needs
To develop measures for safe handling, separation and sound disposal of stockpiles of chemical and articles in use and to appropriately recover resources and energy to move to more circular economy.	▪ Develop manuals for safe handling and disposal. ▪ Develop guidelines for the transport of articles in use to safe locations. ▪ Establish collection scheme for POPs containing articles in use. ▪ Establish appropriate separation, recycling and energy recovery schemes for impacted waste categories.	▪ Meetings to develop manuals for safe handling and disposal ▪ Guidelines on transport developed ▪ Collections points/scheme for articles in use established	5 Years	EPASL, Universities and Research Institutions, Other Relevant Stakeholders	Financial assistance, Expert
Destruction, disposal or export of POPs and other hazardous chemicals and waste in an ESM	▪ Destruction of POPs containing waste and other hazardous chemicals containing waste in an ESM ▪ Export of POPs and other hazardous chemical waste which cannot be treated or disposed in the country ▪ Disposal of selected hazardous waste	▪ POPs and other hazardous chemical waste (including hazardous chemicals in products) managed in ESM	5 – 10 years	EPASL, Universities and Research Institutions, Relevant Stakeholders	Financial assistance, Expert

3.3.10 Activity: Identification of contaminated sites (Annex A, B, and C Chemicals) and, where feasible, remediation in an environmentally sound manner

Article 6 of the Stockholm Convention requires that Parties develop appropriate strategies for the identification of sites contaminated with chemicals listed in Annex A, B or C and if remediation of such sites is carried out to do it in an environmentally sound manner. The country strategy is as outlined below in the action plan (Table 54).

Table 54. Identification of Contaminated Sites (Annex A, B and C Chemicals) and Securing and Remediation in an Environmentally Sound Manner

Objectives	Activities	Key performance indicators	Time Frame	Implementers	Resource / Needs
Regulatory frame for contaminated sites	▪ Develop/update legislation to set criteria for determining contaminated sites for relevant POPs. ▪ Establish guidelines for soil and ground water assessment ▪ Legislation on liability (Polluter Pays Principle (PPP) related to contamination and clean-up procedures.	Draft regulation developed on contaminated sites and soils. Draft Legislation on liability (Polluter Pays Principle (PPP) related to contamination and clean-up	3 years	EPASL, Law Reform Commission	Finance, Legal and Technical experts
Methodology to identify and prioritize sites contaminated with Annex A, B and C chemicals	▪ Develop methodology to systematically identify and prioritize POPs contaminated sites considering available guidance documents[41] ▪ Establish methodology for ground water and soil assessment ▪ Develop list of potential contaminated sites (see individual POPs below) ▪ (Preliminary) prioritization of POPs contaminated sites ▪ To participate in or to follow the UNEP working group on POPs contaminated sites	General procedures for investigations developed Expert nominated for contact/ participation UNEP BAT/BEP group	3-4 years	EPASL, Universities and Research Institutions, Relevant Stakeholders	Finance, Legal and Technical experts

[41] See e.g. UNIDO POPs contaminated site Toolkit http://chm.pops.int/Implementation/BATandBEP/AdditionalResources/tabid/1493/Default.aspx or UNEP Toolkit Category 10 (http://toolkit.pops.int/Publish/Main/II_10_HotSpots.html).

Objectives	Activities	Key performance indicators	Time Frame	Implementers	Resource / Needs
Secure POPs contaminated sites, and were feasible conduct remediation of contaminated sites	▪ Standard procedures for securing and labelling contaminated sites ▪ Identify potential remediation technologies available. Develop strategies for the environmentally sound management of POPs contaminated sites ▪ Train and upgrade skills of personnel in the assessment, securing and remediation of contaminated sites	▪ Procedures for securing contaminated sites identified and isolated. ▪ Compilation and selection of available environmentally sound remediation methods (report) ▪ Draft guidelines on clean up procedures ▪ Training of stuff on contaminated sites; contaminated site expert in EPASL	5-10 years	EPASL, Universities and Research Institutions	Finance, Legal and Technical experts
Countrywide database for POPs contaminated sites considering relevant co-pollutants	▪ Assessment of database systems for contaminated sites in other countries ▪ Selection of database approach and establishing POPs contaminated site data base considering co-pollutants integrated in a general contaminated site database	▪ Report on database with recommendation ▪ Database selected and established	3 years	EPASL, Universities and Research Institutions	Finance, Legal and Technical experts
Identification, assessment, securing and possibly remediation of POPs pesticides contaminated sites	▪ Assessing of potentially POPs pesticides contaminated sites (sites of formulation, storage, use and disposal) ▪ Overall risk assessment of the sites (toxicity of mixture present)[42] and prioritizing sites ▪ Securing of sites and remediation of sites as appropriate	Potential POPs pesticide contaminated sites are assessed, ranked for priority and secured	5 years	EPASL, Universities and Research Institutions	Finance, Legal and Technical experts

[42] See for example: Pieterse B, Rijk IJC, Simon E, van Vugt-Lussenburg BMA, Fokke BFH, van der Wijk M, Besselink H, Weber R, van der Burg B (2015) Effect-based assessment of persistent organic pollutant- and pesticide dumpsite using mammalian CALUX reporter cell lines. Environ SciPollut Res Int. 22:14442-14454.

Objectives	Activities	Key performance indicators	Time Frame	Implementers	Resource / Needs
Identification, assessment, securing and possibly remediation of PCB contaminated sites	• Assessing of potentially PCB contaminated sites (storage, use and disposal PCB equipment) ▪ Securing of sites and remediation of sites as appropriate	Potential POPs pesticide contaminated sites are assessed, ranked for priority and secured	5 years	EPASL, Universities and Research Institutions, EGTC & EDSA, Police, Municipalities	
Identification, assessment, securing and possibly remediation of POP-PBDE contaminated sites.[43]	▪ Develop method for risk assessment of sites where WEEE, EoLV or other have been treated ▪ Train and upgrade skills of personnel in the application of identified remedial measures and safe handling ▪ Assessment and securing and possibly remediation of contaminated sites	Method for risk assessment developed Best securing and remediation measures identified and personnel trained	5 years	EPASL, Universities and Research Institutions, National Fire Force, other Relevant stakeholders	Finance, Legal experts
Identification, assessment, management, of potentially PFOS and PFAS contaminated sites and securing /remediation needs	▪ Use guidelines for identification and assessment of PFOS/PFAS contaminated sites ▪ Database and maps of potentially contaminated sites and prioritization of the sites (risks) for further assessment and clean-up ▪ Analytical confirmation of POPs contamination for the identified locations (according to prioritization list) ▪ Take measures to secure the contaminated sites to stop human exposure and environmental releases ▪ Identification of clean-up measures and initiate clean-up procedures considering priority sites.	Contaminated site criteria defined and legislation developed Guidelines on identification developed Workshops conducted, staff trained Priority sites determine Pollution assessed Strategies for addressing sites developed ▪ Measures to secure sites implemented	3 years	EPASL, Universities and Research Institutions, National Fire Force, other Relevant stakeholders	Finance, Legal and Technical experts

[43]At sites where WEEE and end of life vehicle and other PBDE containing waste is treated the final pollution is a mixture of many pollutants (Wong et al. 2007). Wong MH, Wu SC, Deng WJ, Yu XZ, Luo Q, Leung AO, Wong CS, Luksemburg W J, Wong AS (2007) Export of toxic chemicals - a review of the case of uncontrolled electronic-waste recycling. Environ Pollut. 149(2):131-140.

Objectives	Activities	Key performance indicators	Time Frame	Implementers	Resource / Needs
Assessment, management, database of potentially PCDD/PCDF and other UPOPs contaminated sites and securing /remediation needs	▪ Use guidelines[44] for identification and assessment of UPOPs contaminated sites ▪ Training in identification and management of contaminated sites ▪ Database and maps of potentially contaminated sites and prioritization of the sites (risks) for further assessment and clean-up ▪ Analytical confirmation of UPOPs contamination for the identified locations (considering prioritization) ▪ Develop strategies for the environmentally sound management of POPs contaminated sites ▪ Take measures to secure the contaminated sites to stop human exposure and environmental releases ▪ Identification of clean-up measures and initiate clean-up procedures considering the prioritization.	Contaminated site criteria defined and legislation developed Guidelines on identification developed Workshops conducted, staff trained Priority sites determined UPOPs Pollution assessed Strategies for addressing sites developed Measures to secure sites implemented	3 years	EPASL, Universities and Research Institutions, Municipality, Waste Management Companies, Other Relevant stakeholders	Finance, Legal and Technical experts

3.3.11 Activity: Facilitating or undertaking information exchange and stakeholder involvement

This action plan (Table 55) is supporting and establishing a system for exchanging information on POPs at national, regional and international scale. Referring to Articles 9 and 10 of the Convention, the Parties provide the access to information to the community and constantly update the information on POPs.

[44] See e.g. UNEP Toolkit Category 10 (http://toolkit.pops.int/Publish/Main/II_10_HotSpots.html) or UNIDO POPs contaminated site Toolkit
http://chm.pops.int/Implementation/BATandBEP/AdditionalResources/tabid/1493/Default.aspx

The information exchange between the Parties of the Stockholm Convention is performed via the National Focal Points and with the support of the Secretariat of the Stockholm Convention.
Regarding the content of the information exchange, the Parties to the Convention exchange information on the activities directed to reduce or eliminate POPs and on the risk imposed by POPs to humans and environment, including information of involved socio-economic costs.
Information exchange and stakeholder involvement are activities to be elaborated for the implementation of the NIP. The development of a comprehensive strategic information exchange and communication plan will be one-step to take in order to achieve successful implementation of the NIP. The communication plan must also ensure that POPs-management issues will be addressed through various media - a website and other means of communication, in order to raise public awareness and to receive full collaboration. This activity is closely linked with the action plan on awareness raising in chapter 3.3.13 below. A national activity for institutional information exchange will be developed through regular workshops to ensure full stakeholder engagement.
Due to the complexity of the increasing numbers of POPs and POPs like chemicals close information exchange on regional and international level is needed to take place.

Table 55. Activities for facilitating information exchange and stakeholder participation

Objectives	Activities	Performance indicator	Time frame	Implementers	Resource / Needs
Information exchange on POPs in the region and internationally	Development of a mechanism that information generated in the Stockholm, Basel and Rotterdam Secretariat and SAICM Secretariat reach the country and the stakeholders. Mechanism that information on POPs from the country with regional or international relevance are communicated to the regional Basel and/or Stockholm centres and to the BRS secretariat	Mechanism of information exchange on POPs in the region and internationally ensured	3 years	EPASL to lead, Other Relevant Stakeholders, Regional stakeholders	Finance
Access of information and documents for national stakeholders	Establish mechanism and possibly website that key documents, information and news on POPs and hazardous chemicals can be found by stakeholders.	Set up website. Key documents and information accessible to stakeholders	3 years	EPASL to lead, Other Relevant Stakeholders	Finance
Improved information exchange on national level between stakeholders	Facilitate the dialogue between industry, research and policy makers Establish or improve dialogue between science community and policy makers for improved science-policy dialogue.	Information exchange on national level between stakeholders take place	2 years	EPASL, relevant national stakeholders	Finance

3.3.12 Activity: Public and stakeholder awareness, information and education (Article 10)

Article 10 of the Stockholm Convention on public awareness, information and education, requires parties to promote and facilitate awareness among policy and decision makers with regard to POPs. Parties should ensure that all available information on POPs is made available to the public and the information is kept up to date. In pursuance of this article, parties should ensure that appropriate education programmes are put in place for groups such as women, children and the least educated, as well as for workers, scientists, educators and technical and managerial personnel.

The successful implementation of the Stockholm Convention on POPs in the country will only be achieved when the relevant stakeholders (policy makers, industry, science community, civil society and general population) are sensitised on the nature of POPs, other hazardous chemicals and their effects on human health and the environment. By an appropriate awareness of stakeholders, the needed commitment is reached for the achievement of the Convention objective. It is therefore important for action to be directed at promoting the continuous and detailed awareness, information and training programmes on POPs and hazardous chemicals in the life cycle (SAICM synergy). Information need to be individually developed and targeted for specific stakeholder groups including policy and decision makers, industry as well as the general public. The individual stakeholders should be trained to be appropriately informed to play their respective roles.

The awareness activities will be linked to general awareness activities on chemical safety, awareness programmes on public health, and on green economic development, as well as awareness programs on sustainable consumption and production - all aimed at broad awareness raising strategies for sustainable development.

It has been acknowledged that awareness-raising campaign through appropriate films and accompanying discussions can have excellent results and make a serious input and can be communicated in schools, academia, as well as mass media. A comprehensive approach on using films for awareness on national level has been developed in Switzerland (Films for the Earth)[45]. Here more than 200 films on sustainability and environmental topics including some POPs related films such as "Story of Stuff"[46] or "Silent Snow"[47] (on contamination of the Arctic by the global use of POPs) have been compiling and are communicated by festivals, the website (https://filmsfortheearth.org/en) and video on demand.

A range of suggested awareness activities have been included in the individual action plans of this NIP for pesticides, PCBs, UPOPs, and new industrial POPs (POP-BFRs and PFOS). These activities will be coordinated and addressed collectively where appropriate. In this section general activities on awareness of POPs and hazardous chemicals are compiled.

[45] https://filmefuerdieerde.org/en
[46] www.storyofstuff.org
[47] http://www.silentsnow.org

Table 56. Activities for stakeholder awareness, information and education activities

Objectives	Activities	Performance indicators	Time Frame	Implementers	Resource / Needs
General Awareness on POPs and on POPs-related SAICM issues and general hazardous chemicals as appropriate (For specific awareness activities for individual POPs see the respective action plans of individual POPs and coordinate)	Compile available state of art awareness and education materials on POPs and other hazardous chemicals and GHS	Awareness and education materials on POPs and other hazardous chemicals and GHS compiled	1 year	EPASL, Universities and Research Institutions	Finance
	Adopt education and training materials on POPs & hazardous chemicals tailor made for target groups (policy makers, industry, public, curricula) considering available materials and translate selected materials into the country languages	Education and training materials on POPs & hazardous chemicals tailored to target groups	2 years	EPASL, Universities and Research Institutions, Civil society groups	Finance
	Implement trainings and programs for teachers and lecturers about toxicology, environment and ecology issues related to POPs and hazardous chemicals	Trainings and workshops conducted (number & participants)	3 years	EPASL, Universities and Research Institutions	Finance & expert
	Providing training and guidance for stakeholder groups that are directly exposed, treating equipment and waste containing POP (see individual POPs action plans)	Training and guidance for stakeholder groups that are directly exposed, treating equipment and waste containing POP (see individual POPs action plans) provided	3 years	EPASL, Universities and Research Institutions	Finance
	Implement communication activities, raise awareness on POPs and POP-like chemicals; exchange and dissemination of information on these chemicals in media outlets targeted to stakeholder groups and the public.	Number of communication activities and number of stakeholders reached	2 years	EPASL, Universities and Research Institutions, Awareness raising group	Finance
	Implement the activities to raise awareness and training for inspectors; customs, environmental police, on the contents related to POPs management	Awareness Trainings workshops conducted	2 years	EPASL, Universities and Research Institutions, Awareness raising group	Finance, Training materials

Objectives	Activities	Performance indicators	Time Frame	Implementers	Resource / Needs
	Integrating POPs and hazardous chemicals in the environmental education syllabus of basic and secondary schools	Updated syllabus of basic and secondary schools			
Raising awareness on POPs & alternatives to POPs and introduction of green and sustainable chemistry approach	Compile information materials available on alternatives to POPs and Green and Sustainable Chemistry	Materials compiled (place on POPs website)	1 year	EPASL, National IT experts, Universities	Finance, website
	Develop education modules on Green and Sustainable Chemistry versus POPs/POPs-like chemicals for curricula of secondary and tertiary education	Modules for curricula developed and used in secondary and tertiary education	3 years	National Consultant/expert, Universities	Finance
	Develop information materials on Green and Sustainable Chemistry for selected industries	Training on alternatives to POPs considering green and sustainable chemistry (numbers; participants)	5 years	EPASL, National Expert/consultant, Universities	Finance

3.3.13 Activity: Effectiveness evaluation (Article 16)

Article 16 of the Convention requires parties to establish mechanisms for providing comparable monitoring data on the presence of Annex A, B and C chemicals. According to Article 16 (paraphrased): Parties, in accordance with their technical and financial capabilities and using existing monitoring programmes and mechanisms (where possible), are to co-operate on a regional basis, when appropriate, and contribute to a global monitoring programme for the SC. This evaluation shall be conducted on the basis of available scientific, environmental, technical and economic information including national reports. As main matrices selected for assessment of the effectiveness of the implementation, human milk and air have been chosen. These activities are coordinated. E.g. UNEP together with WHO and the Stockholm Convention Secretariat are conducting and supporting human milk surveys in developing countries.[48]

[48]http://www.who.int/foodsafety/areas_work/chemical-risks/pops/en/index1.html

Table 57. Activities for effectiveness evaluation (Article 16)

Objectives	Activities	Performance indicator	Time frame	Implementers	Resource / Needs
Conduct a monitoring of POPs in human milk or human blood	Monitoring of POPs in human milk	Data on POPs in human milk/blood	3 years	EPASL, Universities & Research Institutions	Finance, Lab equipments
Evaluating the effectiveness of the implementation of the Convention by other approach	Develop further national performance evaluation criteria. Assessment of the implementation and progress performance	Criteria Developed. Assessment report	1 year 3 years	EPASL, Relevant National Stakeholders	Finance

3.3.14 Activity: Reporting (Article 15)

According to Article 15: Parties are required to report periodically on the measures taken, and on their effectiveness in meeting the objectives of the SC. Article 15 of the Stockholm Convention on POPs mandates parties to report to the Conference of Parties (COP) on measures taken to implement the provisions of the Convention as well as the effectiveness of the measures taken. In addition, each party is to provide to the Secretariat, statistical data on its total quantities of production, import and export of each of the chemicals listed in Annex A and B as well as a list of states from/to which it has imported/exported each of such substances. The Article 15 reports provide a substantial input to the effectiveness evaluation of the Convention (Article 16), and are submitted every four years. This Action Plan (Table 58) therefore aims at collecting/collating all information relevant to the provisions of the Convention and packaging them in a suitable manner for reporting to the secretariat and the COP

Table 58. Activities for reporting under Article 15 of the Stockholm Convention

Objectives	Activities	Performance indicator	Time frame	Implementers	Resource / Needs
Setting up mechanism for article 15 reporting	Develop a mechanism for complying with the reporting requirements by submission of reports within the given deadlines	Mechanism established	1 year	EPASL	Finance
	Setting up responsibilities for data compilation and filling the reporting form	Data compiled	1 year	EPASL, Data expert	Finance

Complying with article 15 reporting	Compile information for reporting (updated inventory and other information) Submit report to the secretariat (website)	Reporting submitted deadlines met	Report in 2018; then every 4 year cycles	Stockholm Focal Point	Finance

3.3.15 Activity: Research, development and monitoring (Article 11)

Article 11 of the Stockholm Convention mandates parties to undertake appropriate research, development, monitoring and cooperation pertaining to POPs and where relevant to their alternatives and candidate POPs. Considering the large amount of POPs-like chemicals identified in international research and considering the synergies with SAICM emerging policy issues and issues of concern, a wider frame of research and monitoring capacity is needed to address these hazardous chemicals and to select appropriate alternatives to POPs and other chemicals of concern.

Science–policy interfaces are critical in shaping environmental governance and sustainable development. Science has delivered many assessments, syntheses and reviews to inform on chemical pollution and health effects which could facilitate the conventions' implementation. However, science and other forms of knowledge are not used effectively in policymaking; and policymakers do not always effectively inform scientists about their needs for scientific knowledge. Here an effective science-policy interface is needed and robust institutes or working groups which can generate and compile the necessary science based information and communicate it in a way that the information can be used for policy making.

This section therefore identifies various activities in addressing the science-policy, research, development and monitoring needs (Table 59).

Table 59. Research, development and monitoring (Article 11)

Objectives	Activities	Performance indicator	Time frame	Implementer/ stakeholders	Resource /Needs
Developing institutional and research capacity to manage POPs and other hazardous chemicals (SAICM synergy)	Identify institutions with the potential to undertake research into POPs and other hazardous chemicals (SAICM Syn.)	Institutions identified, contacted and agreement (MOU) for cooperation	1 year	EPASL, Universities and Research Institutions	Finance, Equipments and software
	Strengthen national scientific and technical research capacity and infrastructure to gather, evaluate and exchange information on chemicals	Needs of national scientific and technical research capabilities in relation to POPs and other hazardous chemicals established	3 years	EPASL, Universities and Research Institutions	Finance, Equipments and software
	Develop networks among identified research institutions on national and international level	Networks established Researchers participated in international conferences	3 years	EPASL, Universities and Research Institutions	Finance
	Establish capacity on health, exposure and risk assessment to POPs and other hazardous chemicals	Report on exposure and risk assessment	3 years	EPASL, Universities and Research Institutions, Ministry of Health & Sanitation	Finance
	Establish outlets for communicating research and development findings to the public	Number science articles in newspapers and reports on chemicals & waste in TV and radio	5 years	EPASL, Universities and Research	Finance
Establishing improved and operative science-policy interface and contributing to decision making	Assessment of current science-policy interface in decision making. gaps and improvement need	Gap assessment of science-policy interface report	1 year	EPASL, Universities and Research, Technical expert, Relevant stakeholders	Finance
	Establish/improve science policy interface for chemicals and waste/resources for assessing the impact of POPs and hazardous chemicals to the SDGs and indicators, ecosystem services[49] and other policy drivers.	Compilation of impact of hazardous chemicals to SDGs and related indicators Science-policy assessment report on chemicals and waste/resources	3 years	EPASL, Universities and Research, Technical expert, Relevant stakeholders	Finance

[49] See

Objectives	Activities	Performance indicator	Time frame	Implementer/ stakeholders	Resource /Needs
Conducting socio economic assessment, life cycle costing and external cost for policy making	Compile information and develop capacity on life cycle cost, external cost and socio-economic analysis of POPs and other hazardous chemicals	Institute or working group with expertise on external costing and socio-economic established.	3 years	EPASL, Universities and Research, Technical expert, Relevant stakeholders	Finance
	Contribute information on life cycle cost, external cost and socio economic assessment to the science-policy dialogue	Reports and policy documents for key areas Information reached policy makers and are referenced in decisions and policy and legislation background documents	3 years	EPASL, Universities and Research Institutions	Finance
Developing appropriate analytical capacity approach for relevant POPs	Assessment on analytical capacity need (see individual POPs action plans)	Needs assessment	1 year	EPASL, Universities and Research Institutions	Finance
	Develop laboratory capacity for POPs considered relevant for the country	Laboratories established Staff trained Laboratories accredited for all relevant	5 years	EPASL, Universities and Research Institutions, Expert	Finance
	Identify cooperation partners for POPs and PBT research on regional and international level	Regional or international cooperation established	1 year	EPASL, Universities and Research Institutions	Finance
Monitoring POPs and other relevant PBTs needed for the implementation (see individual action plans)	Support the monitoring needs of the action plans of the individual POPs groups (see individual POPs groups)	Sample matrices identified Sampling methods selected Samples collected Analysis results	5 years	EPASL, Universities and Research Institutions, Awareness raising group	Finance
Ensure proper generation and management of data	Establish procedures for the management of analysis results and other data Consider recognized guidelines for data generation and interpreting monitoring results and presenting monitoring reports	Procedure for management of analysis results established Good Laboratory Practice used, International standards accredited	2 years	EPASL, Universities and Research Institutions, Awareness raising group	Finance
Establishing a mechanism for quality assurance and control of	Establish effective quality assurance and quality control system	Protocol for ensuring QA/QC in place	2 years	EPASL, Universities and Research Institutions	Finance

Objectives	Activities	Performance indicator	Time frame	Implementer/ stakeholders	Resource /Needs
monitoring activities		Procedure for data evaluation developed			
Research on alternatives to POPs considering Green and Sustainable Chemistry	Compilation of information on alternative assessment and research on alternatives	Research project into alternatives to POPs	5 years	EPASL, Universities and Research Institutions	Finance
	Develop research into Green and Sustainable Chemistry (G&SC))	Workshops on G&SC Research project on G&SC	5 years	EPASL, Universities and Research Institution	Finance

3.3.16 Activity: Technical and financial assistance (Articles 12 and 13)

The ability of the country to fulfil its obligations under the POPs Convention depends partly on the provision of adequate financial and technical assistance. The following actions would be required to enable the country obtain the needed financial and technical support required for the successful implementation of activities and actions to be carried out to achieve the POPs overall objectives (Table 60).

Table 60. Technical and financial assistance (Articles 12 and 13)

Objectives	Activities	Key performance indicator	Time frame	Key implementers	Resource/ Needs
To source for technical assistance towards the successful implementation of the Convention (Article 12)	▪ Assess technical needs ▪ Identify sources of technical assistance	▪ Documentation of needs ▪ List of sources of technical assistance ▪ Number of proposals prepared and submitted and acceptance	2 - 5 years	EPASL, Universities and Research Institutions	Finance, Experts
To source for financial assistance towards the successful implementation of the Convention	▪ Financial needs assessment ▪ Identify sources of Financial assistance ▪ Requisition for financial assistance through proposal writing	▪ Studies evaluating and demonstrating financial needs ▪ List of potential donors identified ▪ Number of proposals prepared and submitted	3 year	EPASL	Finance

3.4 Development and capacity-building proposals and priorities

During the review and update of the NIP, several priorities including development and capacity-building needs were identified. These would spread over a decade for most to be achieved. Where possible and appropriate, the implementation of the SC should seek synergies with the implementation of other Conventions. The SC activities should also be linked and harmonized with national priorities and support Sustainable Development goals (SDGs).

The priority areas of development and capacity-building identified are listed below:

I. Strengthening the coordination between institutions and stakeholders

All the listed priorities need the support and cooperation of all stakeholders such as ministries, departments, agencies as well as institutions and NGOs for the effectiveness of the implementation of the action plan. The effectiveness of these various stakeholders working together depends on how coordinated their activities are. Therefore, there is need for the strengthening of cooperation between stakeholders for an effective implementation of the Stockholm Convention NIP. The EPASL has been identified as the most suitable body to coordinate all stakeholders.

II. Institutional and regulatory strengthening measures

Improvement and harmonisation of legislation regulating chemical management in Sierra Leone is needed. Where appropriate, legislations should be merged, and duplication or conflicts of the law avoided. Where gaps have been identified, legislation should be amended. Furthermore, legislation on waste management need to be improved. A range of waste fractions containing POPs need particular waste management regulatory frames (e.g. PCB equipment; e-waste; end-of-life vehicles, waste oils, PFOS articles etc).

III. Awareness raising, information and education

Article 9 of the Stockholm Convention emphasises on information exchange, public access to information and building of educational programmes for public participation and awareness. To date, public

Knowledge of POPs in the Country is relatively rare. Since some of the new industrial POPs are present in consumer products (e.g. electronics, vehicles, synthetic carpets, flame retarded or surface treated textiles, furniture, mattresses, etc.), the establishment of awareness raising materials and awareness communication should include also the new-POPs. The awareness on POPs should integrate and give impulse to general education and awareness raising on chemicals exposure and health. This also should include awareness and education on waste management for relevant stakeholders. For sustained awareness, education on POPs should be included in mainstream school curriculum.

IV. Improvement of waste management for reduction of unintentionally-formed POPs and management of new industrial POPs (POP-PBDEs, HBCD, SCCP, PFOS and related substances) potentially present in all waste streams.

Like many other third world countries, open waste burning is the single most important source of PCDD/PCDF release into the environment in Sierra Leone. Sierra Leone presently lacks proper waste management system. There is no environmentally sound waste destruction facility. Therefore, in future, exporting POPs containing (PCBs; pesticide stocks) could be considered although this comes at a high cost.

New industrial POPs (in particular POP-PBDEs, HBCD, PFOS and SCCP) can be present in several waste streams such as electronic waste, car residues, synthetic carpets, flame retarded or surface treated textiles, furniture, mattresses, rubber, PVC etc. These wastes are currently all disposed in dumpsites and waste transit points in Sierra Leone and with the lack of proper waste management practices in the country; this presents a serious threat to soil, ground water, and the environment as a whole.

V. Managing POPs stockpiles (PCB, pesticide containers; POP-PBDES, HBCD and PFOS)

There still exist possible old PCB stockpiles in some parts of the country. Future assessment will be required to obtain a clearer location map of these POPs chemical. Details of these have been planned out in the action plan. The EPASL will need to lead monitoring activities of sites and coordinate removal, possibly export and clean-up activities.

VI. Implementation of BAT/BEP for management of POPs in exempted used (POP-PBDEs, HBCD, PFOS and related substances)

To date, Sierra Leone lacks BAT in majority of her public facilities. Through the intervention of the EPASL, mainly because of requirement for renewal of EIA license, private companies are embarking on BAT/BEP. Sierra Leone is not presently requesting any exemption of specific POPs chemical.

VII. Implementation of BAT/BEP for PCDD/PCDF release reduction

For Annex C on facilities relevant for PCDD/PCDF release (medical waste incinerator). Where facilities exist, emission standards are lacking in the country. Hence as a whole, institutions generally do not comply to BAT. There is therefore need for EPASL to enforce BAT within EIA when renewing license to existing institutions..

VIII. Monitoring of POPs, effectiveness evaluation and initiate research and collaborations

Monitoring, evaluation and research activities

The objectives of POPs monitoring is to increase monitoring activities as well as initiate action for the monitoring of the new POPs. This will involve monitoring all POPs levels in the soil,

water, air and sediment; monitoring the POPs levels along the food chain and contaminated sites as well as its remediation measures. The Convention in Article 11 provides indications of topics that Parties should address in defining research, development and monitoring objectives. During the development of the NIP, Sierra Leone's existing capabilities to address these objectives were reviewed.

There is virtually no monitoring data on POPs in Sierra Leone mainly because of virtual lack of analytical facilities. In order to support policy and management activities, Sierra Leone need to engage actively in research and development activities.

IX. Contaminated site assessment and management

For all POPs groups (Pesticides, PCB, Dioxin/UPOPs, PFOS and PBDEs) there are a range of sites identified to be potentially contaminated. These include fire drill sites, waste dumps, scrap yards, public and private stores for chemicals, pesticides etc. The inventory exercise was not completely exhaustive; hence, future inventory exercise should conduct detail assessment and mapping of POPs-contaminated sites across the country including sites with potential contamination of ground and drinking water with PFOS.

Management of all contaminated sites within the country is appalling. Lack of proper management poses serious risk to leakage and thereby contamination of the environment, ground water and ground water.

A range of activities in the different action plans for the various POPs chemicals is linked to these priority areas and are therefore not repeated here. They are listed in the action plan tables above (see chapter 3.3).

3.5 Timetable for implementation strategy and measures of success

The individual action plans and activities developed and compiled in chapter 3.3 contain individual time frames suggested for implementation of the individual activities. Timeframes are categorized into short term (2 years and less), medium term (3 to 5 years) and long term (10 years).

3.6 Resource Requirement and mobilization

An initial estimate of resource requirements of the respective activities is included in the action plan tables presented in chapter 3.3. Sierra Leone is aware that the financial resources from GEF and other UN funding bodies do not sufficiently cover the full implementation costs; hence, co-funding will be considered including contribution from the Government of Sierra Leone.

Therefore, additional potential sources of funding will be identified. Details on co-funding will be elaborated during the respective project developments.

The government shall contribute appropriate resources, while mobilizing the contributions of international financing sources for the NIP implementation. The Government should create a legal basis and favourable conditions to encourage and attract the participation of all related economic sectors, domestic and foreign organizations, as well as investors for the implementation of the National Plan.

General resource needs for individual activity are listed in the action plans. A detailed budget for an activity will be calculated during development of individual projects prior to implementation. This will take into consideration specific human resources identified, stakeholder contributions, requirements for possible Global Environment Facility (GEF) incremental cost and funding by development/donor partners.

Considering the large percentage of external funding needs for the action plans, the National Implementation Plan should be coordinated and integrated where appropriate with other related activities and programs on waste management, resources management, sustainable development, climate change, or programs or projects on science and technology, in order to ensure cost effective approach, sustainability and wise use of resources. Smaller activities that require much less cost could be incorporated into national budgets or linked to small scale nationally funded projects.

For the management of POPs contaminated wastes like e-waste plastic, extended producer responsibility contributions should contribute to the environmental sound management of related waste fractions. An important source for financing the management of wastes and stockpiles is the extended producer responsibility (EPR) approach. For several waste fractions related to POPs, the extended producer responsibility can be applied and need to be set up by policy and regulation. Following (partly) POPs contaminated wastes can be covered under the extended producer responsibility frame:

- E-waste including e-waste plastic
- End of life vehicle (including the polymers)
- Empty pesticides containers and stockpiles
- Synthetic carpets

The establishment of recycling and recovery schemes also can contribute to financing of waste management including POPs management. Nowadays, reuse and recycling can contribute to national and global economy. In Sierra Leone, scavengers collect huge piles of scrap metals, plastics, electronics and other e-waste components. Appropriate policy can be formulated in line

with sound waste management which will allow certain amount of money to be collected that could contribute towards funding e-waste management and the end-of life vehicle management.

In Advanced countries, the polluter pays principle (PPP) has been a success. Sierra Leone would be required to develop the necessary legislative framework before the PPP can be used as co-funding source.

Establishing and strengthening international bilateral cooperation could also be an important source of co-funding for Sierra Leone. This can pave the way for technical cooperation, grant aid for project development, improve capacity for institutions that carry out analytical determinations, institutional improvement/support through projects etc.

In addition to the foregoing, mobilisation of adequate financial resources at national and international levels is crucial to the timely and sustainable implementation of the Convention. The following are possible areas worth looking at:

- Technical assistance provisions under the various MEAs to be carefully examined with a view to aggressively developing associated projects with benefits mutual to chemicals management;
- Promoting non-chemical alternatives to current uses of chemicals (e.g., pyrethrum production) at agricultural and industrial exhibitions;
- Adoption of environmentally sound technologies through the introduction of BAT/BEP;
- Development of chemical management systems - to include a national chemicals profile, national emergency preparedness and response plans;
- Technology access transfer and diffusion;
- Information dissemination.

ANNEX 1 – CONTACTS

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