Government of Pakistan

Ministry of Climate Change

UPDATED NATIONAL IMPLEMENTATION PLAN (NIP) FOR PHASING OUT AND ELIMINATION OF POPS FROM PAKISTAN UNDER STOCKHOLM CONVENTION ARTICLE 7 (a)

Islamabad 12 February 2020

Executive Summary

The Stockholm Convention (SC) on Persistent Organic Pollutants (POPs) was adopted on 22 May 2001 in Stockholm, Sweden. The Convention entered into force on 17 May 2004. The objective of the SC is the protection of human health and the environment from these hazardous substances. The SC imposes a worldwide ban or control on the production and trade of POPs pesticides and POPs used in industrial processes and consumer goods, and requires the reduction and minimization of the unintentional production and release of POPs formed as unintentional by-products in industrial and combustion processes.

Pakistan has signed the Stockholm Convention on Persistent Organic Pollutants (POPs) on 06 December 2001, ratified the Convention on 17 April 2008 which entered into force in July 2008.

Article 7 of the SC requires each Party to develop, and endeavour to put into practice, a plan setting out how it will implement its obligations under the Convention. Therefore, Pakistan has developed and updated its National Implementation Plan (NIP) to meet the country's obligations to the Stockholm Convention. The NIP is transmitted to the Conference of the Parties through the Secretariat of the Stockholm Convention.

The NIP describes how Pakistan will fulfil its obligations under the SC to eliminate or reduce POPs releases and carry out environmentally sound management of stockpiles of POPs containing wastes and contaminated sites that pose high risks to human health and the environment. The NIP supports the implementation of the SDGs[1] by linking priority actions to SDGs (Chapter 3.4) and support the National Action Plan on Sustainable Consumption and Production[2] and Pakistan's Vision 2025[3]. The action plans described in the NIP should be mainstreamed into the related goals/strategies of these national plans where appropriate.

The current NIP has addressed the POPs listed up to 2013 (COP6). The action plan also included initial activities to address the POPs listed in 2015 (COP 7) and 2017 (COP8).

The goals of the NIP are:

- To describe the actions that Pakistan has undertaken regarding the inventory, management and reduction of the presence of POPs;
- To propose actions that Pakistan will undertake in order to manage and eliminate POPs, as well as for preventing these chemicals from entering the environment;
- To inform the Conference of the Parties and Pakistan's stakeholders about the national initiatives and projects designed to meet the requirements of the SC.

[1] Government of Pakistan (2018) SUMMARY FOR THE NATIONAL ECONOMIC COUNCIL (NEC) SUSTAINABLE DEVELOPMENT GOALS (SDGS) NATIONAL FRAMEWORK PLANNING COMMISSION, Ministry of Planning, Development and Reform, March 2018.

[2] Government of Pakistan (2017) Pakistan National Action Plan on SDG 12 Sustainable Consumption and Production. Ministry of Climate Change, May 2017.

[3]Government of Pakistan (2014) Pakistan2025 One Nation – One Vision..Ministry of Planning, Development and Reform.

The NIP comprises of three chapters:

Chapter 1 provides an overview of the aims and goals of the NIP, as well as the process for the development of the NIP;

Chapter 2 outlines Pakistan's demographic, political and economic status and it gives basic information on Pakistan's status regarding the management of POPs;

Chapter 3 presents an overview of recommended activities, strategies, action plans, and presents priorities, capacity-building needs, time frame for implementation strategy and estimated resource requirements.

During the NIP formulation the situation of the POPs has been assessed and inventories have been developed. The following are the main assessments conducted:

POPs pesticides: POPs pesticides are not used in Pakistan anymore. POPs pesticides are banned or not registered except of dicofol only recently added to the Convention (05/2019) and registered for the use in cotton. There is no plan of future use of POPs pesticides in Pakistan and since India announced to close the last dicofol production in 2019 also the dicofol use will be stopped. However some pesticides are illegally smuggled into the country and some counterfeit pesticides might be sold in the country and it cannot be excluded that some POP pesticides might enter the country via these two routes.

The current estimate of remaining POPs pesticides in stockpiles is around 275 tonnes (t) out of total 6033 t reported in the previous NIP. Out of this 275 t, 134 t are now remaining in Sindh, followed by 65.8 t in Punjab, 60 t in Balochistan and 15 t in KPK. The amount present in AJ&K and GB is not estimated in this updated NIP document. The rest is either destroyed through POPs elimination projects and government development projects, deteriorated, or spread into the environment through floods or disposal. It has been reported that a large but unknown quantity of POPs was buried in Yazman area of Cholistan desert and in Malir, Karachi. While the total obsolete pesticide stock has significantly decreased, there is still a high risk from old stores, the pesticides which have been distributed by flash floods or which have been unsoundly disposed off. There is an ongoing UNDP POPs project addressing remaining obsolete pesticides.

Dichlorodiphenyltrichloroethane (DDT): In Pakistan DDT was prohibited in 1994 and no exemption is taken for the use of DDT for malaria control. Hence there is no current legal use of DDT in Pakistan. However, it is found that DDT is illegally imported into Pakistan and used in agriculture. Also some stock of DDT is remaining in stores of obsolete POPs pesticides stockpiles.

Polychlorinated biphenyls (PCB) and polychlorinated naphthalenes (PCNs): PCB-containing equipment and materials, such as transformers, capacitors, hydraulic oils, and

PCB-containing materials for open applications (e.g. paints, cables etc.) have been imported in the past.

Most PCB-containing or contaminated equipment can be found in the electricity generation sector, which is owned by government enterprises. Pakistan has developed with UNDP a POPs elimination project under GEF including assessment and elimination of PCB. First capacity building workshops were conducted in 2018 and assessment and monitoring of closed applications are planned for 2019 and 2020.

The production and use of PCBs is not specifically regulated in Pakistan. Therefore the regulatory and registration frameworks for PCBs need to be established.

Within the NIP update some site visits, inception workshops, and interviews were conducted and data on transformers has been collected from distribution companies from multiple provinces of Pakistan. The main assessment and monitoring of PCBs is currently planned within the UNDP- POPs project.

PCNs have been used in the same application as PCBs but in much lower quantities. Therefore, stocks and waste of PCNs can be addressed within the management of PCBs.

Polybrominated diphenyl ethers (PBDEs): The major PBDEs stocks in Pakistan are in plastic in electronics and e-waste, and in plastic and polymers in the transport sector and related end of life vehicles (ELVs). Some PBDEs are likely in polyurethane foams and textiles. Also some stocks of flame retardants might exist in industry.

Out of the total estimated volume of CRTs in use/stock in households the polymer fraction is ca. 261,673 t containing 227 t to 665 t of c-OctaBDE including 123 to 358 t of PBDEs listed 2009. Overall this can be considered a lower estimate since decaBDE was listed in 2017 in the Stockholm Convention as POP and has not been considered in this inventory but is the POP-PBDE with the highest former production and use. Furthermore Pakistan is one of the largest e-waste importers with 94,500 t e-waste import per year which is a continuously increasing PBDEs stocks.

The currently registered 2,955,000 vehicles contain approx. 591,000 t plastic and other polymers which need appropriate management. The amount of PBDEs listed 2009 in the PUR foam of vehicles is estimated to 282 t within approx. 71,210 t of PUR foam. Since the levels of decaBDE listed as POP in 2017 (not covered in the current inventory) is higher than the PBDE listed 2009, the total PBDE content in vehicles is considerably higher than this initial estimate.

Hexabromocyclododecane (HBCD): There is no HBCD production in Pakistan. However, EPS/XPS containing HBCD is produced in Pakistan since more than 10 years. Only one company has provided information on usage of HBCD in the production of insulation boards for the years 2015 to 2018 with a total use of 56 t in approx. 5600 t of EPS. Furthermore

798 t of EPS and 7 t of XPS foam board sheets with approx. 6 t HBCD were imported to Pakistan in 2018.

For other minor uses of HBCD (textiles and electronics) no quantitative assessment was made.

Perfluorooctane sulfonic acid (PFOS): The import data indicate that total imports of product categories possibly containing PFOS were 554 t of firefighting foams and 62 t of PFAS containing insecticides. Further assessments are needed to clarify the share of products actually containing PFOS or PFOA and related substances. The main stocks of PFOS and related substances are likely firefighting foams. Current uses might also include plating industries. However neither the plating industry nor the firefighting foam users provided information.

Also synthetic carpets imported to Pakistan in particular before 2002 might contain PFOS.

Unintentionally-produced POPs (UPOPs): The inventory of polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) was compiled for inventory year 2016. The total emission from inventoried sources were 4491.6 g TEQ/a. The highest share of PCDD/F released stem from open burning with an estimated release of 2049 g TEQ/a (45.6% of total release) with major release from open waste burning (1359 g TEQ/a; 30.3% of total) and second major release from open burning of agricultural residues (690 g TEQ/a; 15.3% of total). The second most relevant source group was waste incineration with 1136 g TEQ/a release (25.3% of total release) all from hospital/medical waste incineration. These was followed by releases from metal industries (436.8 g; 9.7% of total) mainly from secondary iron production (236 g TEQ/a; 5.3% of total) and secondary zinc production (131 g TEQ/a; 2.9% of total) and secondary aluminium production (43.2 g TEQ/a; 1% of total). The forth most relevant source group was the production of mineral products (386 g TEQ/a; 8.6%) mainly from brick production (178 g TEQ/a; 4% of total) and cement industry (136 g TEQ/a; 3% of total). The fifth relevant source is the release from chemical production and use with 328.6 g TEQ/a (7.3%) with releases from leather production (210.5 g TEQ/a; 4.7% of total) and EDC/PVC production (92.2 g TEQ/a; 2.3%). Domestic cooking with fires are also a source of UPOPs and other pollutants (particulates and PAHs) affecting health. Further assessment of releases and refining of the inventory is included in the action plan.

An initial assessment of **POPs-contaminated sites** was conducted. For all POPs categories, contaminated sites likely exist in Pakistan. However, there is limited assessment and analytical capacity in the country to ascertain these premises. Major POPs contaminated sites have resulted from the stockpiles of POPs pesticides and related disposal. Also PCB contaminated sites were likely generated at storage places and during use of PCB transformers and capacitors. POP-PBDE contaminated soils were likely generated by e-waste management and related open burning of plastic and cables. Also the use of PFOS containing firefighting foams and PFOS in plating industries have most probably resulted in the

contamination of soils and ground water. PCDD/F contaminated soils were likely generated from frequent open burning of waste and releases from waste incinerators and metal industries. Also, the production of chlorine, EDC and chlorinated organics has likely generated PCDD/F contaminated wastes and due to the lack of destruction capacity these wastes might have generated contaminated sites. For a range of potentially POPs pesticide and PCB contaminated sites, soil samples were taken during site visits for further assessment (action plan).

Laboratory capacity was assessed in the country and this revealed that very limited instrumental capacity exists. However knowledge capacity has been developed by cooperation with experienced research groups in Australia, China, Germany, and UK. By these international cooperation also POPs monitoring data have been generated for PCBs, pesticides, PBDEs and dioxins. Also currently further research cooperation is being developed for future POPs research.

POPs management and destruction capacity were also evaluated. A part of the POPs pesticides were destroyed in a cement kiln and in a small waste incinerator. Unfortunately the destruction efficiencies were not documented and also PCDD/F emissions were not measured. Therefore, no final conclusion on the appropriateness of the facilities could be made. Future POPs destruction process needs to be assessed by an appropriate monitoring frame including e.g. stack emission monitoring of cement kilns and incinerators.

An assessment scheme exists in the country for evaluating pesticides and all POPs pesticides have been restricted. However, there is currently no particular assessment scheme for industrial chemicals used in Pakistan. Also GHS has not been established in Pakistan.

Chapter 3 comprises the **Policy Statement (3.1), and strategies for NIP implementation (3.2)** including:

- Strengthening the coordination between institutions and stakeholders and development of capacity and knowledge in the relevant committees;
- Adequate legal, institutional, administrative and technical infrastructure;
- Synergies among related Multilateral Environmental Agreements (MEAs);
- Addressing POPs substitution and Clean Material Cycles within implementation of sustainable consumption and production (SDG12).

Section 3.3 of this NIP outlines the action plans, including respective objectives, activities and strategies for POPs management in Pakistan with suggested time frames for implementation and responsible implementing authorities and participating implementers and stakeholders. Individual action plans have been developed which can support the overall management of POPs and waste fractions impacted by hazardous chemicals. The action plans

can support the development of BAT/BEP and improve research in environmental monitoring, in recycling and industrial releases as well as contributing to:

- Institutional and regulatory strengthening measures including development of legislation;
- Measures to reduce or eliminate releases from intentional production and use POPs pesticides and highly hazardous pesticides (SAICM synergy) - import and export, use, stockpiles/waste and disposal as well as implementation of IPM and organic farming;
- PCBs – inventory, storage, management, import and export, use, and disposal;
- POP-BFRs (PBDEs, HBCD and HBB) - regulation and life cycle management;
- PFOS and related substances – life cycle management and synergies, use, stockpiles, and wastes. To promote the synergy of the Stockholm Convention and SAICM, the action plan is extended where appropriate to other PFAS which are issues of concern in SAICM;
- Need for exemptions and register for specific exemptions and acceptable purposes(Article 4);
- Measures to reduce releases from unintentional production (PCDD/Fs and other UPOPs) including integrated pollution prevention and control;
- Identification and management of stockpiles, waste and articles in use, including release reduction and appropriate measures for handling and disposal (Article 6);
- Identification of contaminated sites of Annex A, B, and C Chemicals and, where feasible, remediation in an environmentally sound manner;
- Facilitating or undertaking information exchange and stakeholder participation;
- Public/stakeholder information, awareness and education (Article 10);
- Research, development and monitoring/analytical capacity (Article 11);
- Technical and financial assistance (Article 12 and 13);
- Reporting (Article 15);
- Effectiveness evaluation (Article 16).

In Chapter 3.4, priority activities and capacity building needs are compiled. The main priority action areas include:

- Strengthening coordination between institutions and stakeholders and development of capacity and knowledge in the relevant working committees of the National Environmental Conservation and Climate Change Central Committee;
- Strengthening of Environmental Agency in terms of update knowledge and implementation;
- Development of legislation and related implementation;
- Education, information and awareness raising;

- Management of POPs stockpiles (PCBs/PCNs, pesticides; POP-PBDEs, HBCD and PFOS);
- Improvement of waste management and introduction of waste hierarchy for reduction of unintentionally formed POPs from open burning;
- BAT/BEP for dioxin/UPOPs reduction and integrated pollutant prevention and control;
- Monitoring of POPs, effectiveness evaluation and initiate research and collaborations;
- Substitution of POPs in use and selection of green and sustainable alternatives;
- Contaminated sites assessment and management.

In Chapter 3.5 strategies for financing of the NIP are shortly compiled. Financial resources needed for implementation of priority activities are roughly estimated.

The ability of the country to fulfil its obligations under the POPs Convention depends on adequate financial and technical assistance. Pakistan needs technical and financial assistance from international donors and will seek this assistance when implementing its NIP. By mainstreaming of the NIP into Pakistan's SDG implementation and the NAP implementation of SDG 12 with the close link and support of Pakistan Vision2025, the NIP can support these national efforts in respect to pollution reduction, support for a cleaner circular economy and protection of human health and the environment.

For the priority areas, tentative budget requirements have been estimated. For a range of activities information needed for estimating the cost can only be generated during the implementation of the NIP. Considering the larger share of co-funding needed for GEF projects, appropriate and robust co-funding sources and approaches are needed. Therefore, approaches and strategies for funding and co-funding are compiled in Section 3.5

Action plans on technical and financial assistance (Articles 12 and 13) have been developed (in Section 3.3) to enable the country to obtain the needed financial and technical support required for the successful implementation of activities and actions to be carried out to achieve the overall objectives of the POPs Convention.

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List of Abbreviations and Acronyms

AFFF	Aqueous film forming foams
BAT	Best available techniques
BC	Basel Convention
BEP	Best environmental practices
BFRs	Brominated flame retardants
BHC	Benzene hexachloride (hexachlorocyclohexane)
BRI	Belt & Road Initiative
CAD	Current account deficit
CFY	Current Fiscal Year
CNG	Compressed natural gas
COP	Conference of the Parties
CPEC	China-Pakistan Economic Corridor
CPI	Consumer Price Index
CRT	Cathode Ray Tube
DDE	Dichlorodiphenyldichloroethylene
DDT	1,1,1-trichloro-2,2-bis (4-chlorophenyl)ethane
EDC	Endocrine Disrupting Chemicals
EEE	Electrical and electronic equipment
EIA	Environmental Impact Assessment
ELV	End of life vehicle
EPA	Environmental Protection Agency
EPD	Environment Protection Department
EPR	Extended Producer Responsibility
ESM	Environmentally sound management
EU	European Union
E-waste	Electronic waste
FAO	Food and Agriculture Organization
FATA	Federally administered tribal areas
FBR	Federal Board of Revenue
FPCCI	The Federation of Pakistan Chamber of Commerce & Industry
FY	Fiscal Year
GAIA	Global alliance for incineration alternatives
GC-MS	Gas chromatography–mass spectrometry
GDP	Gross domestic product
GEF	Global Environment Facility
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
GMP	Global Monitoring Plan
GOP	Government of Pakistan
G&SC	Green and Sustainable Chemistry
HBB	Hexabromobiphenyl

HBCD	Hexabromocyclododecane
HCB	Hexachlorobenzene
HCH	Hexachlorocyclohexane
HCBD	Hexachlorobutadiene
HEC	Higher Education Commission
HHPs	Highly Hazardous Pesticides
HIPS	High Impact Polystyrene
IMF	International Monetary Fund
IPM	Integrated Pest Management
IUCN	The world conservation union
IPPC	Integrated Pollution Prevention and Control
KPK	Khyber Pakhtunkhwa province
L	Liters
LNG	Liquefied natural gas
LSM	Large-scale manufacturing
MNFSR	Ministry of National Food Security and Research
MoCC	Ministry of Climate Change
MoC	Ministry of Commerce
MoENT	Ministry of Federal Education and Professional Training
MoF	Ministry of Finance
MoI&P	Ministry of Industries & Production
MoNHSR&C	Ministry of National Health Services, Regulations and Coordination
MoST	Ministry of Science and Technology
MoWR	Ministry of Water Resources
NAP	National Action Plan
NEAP	National Environmental Action Plan
NEP	National Environmental Policy
NEPRA	National Electrical Power Regulatory Authority
NEQS	National environmental quality standards
NFA	Net Foreign Assets
NGOs	Non-Governmental Organizations
NIP	National Implementation Plan
OCP	Organochlorine pesticides
ODS	Ozone Depleting Substances
OECD	Organisation for Economic Co-operation and Development
PAHs	Polycyclic aromatic hydrocarbons
Pak-EPA	Pakistan (Federal) Environmental Protection Agency
PBC	Pakistan Banao Certificates
PBDEs	Polybrominated diphenyl ethers
PBM	Pakistan Baitul Mal
PBT	Persistent, bioaccumulative and toxic (chemical)
PCBs	Polychlorinated biphenyls

PCDDs	Polychlorinated dibenzo-p-dioxins
PCDFs	Polychlorinated dibenzofurans
PCP	Pentachlorophenol
PCRWR	Pakistan Council of Research in Water Resources
PeCB	Pentachlorobenzene
PEPA	Pakistan Environmental Protection Act
PEPC	Pakistan Environmental Protection Council,
PFASs	Per- and polyfluoroalkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic acid
PFOSF	Perfluorooctane sulfonyl fluoride
pg	Picogram
PIA	Pakistan International Airlines
PKR	Pakistani Rupee
POPs	Persistent Organic Pollutants
POPRC	POPs Review Committee
PPAF	Pakistan Poverty Alleviation Fund
PPD	Plant Protection Directorate
PPE	Personal protective equipment
ppm	Parts per million
PPP	Polluter pays principle
PRSP	Pakistan rural support program
PSDP	Public Sector Development Program
PSMS	Pesticide stockpile management system
PSQCA	Pakistan Standards and Quality Control Authority
PSX	Pakistan Stock Exchange
PTA	Pakistan Telecommunication Authority
PTS	Persistent Toxic Substances
PUR	Polyurethane
PVC	Polyvinyl Chloride
SAICM	Strategic Approach to International Chemicals Management
SBP	State Bank of Pakistan
SC	Stockholm Convention
SCP	Sustainable Consumption and Production
SDPI	Sustainable Development Policy Institute
SECP	Security and exchange commission of Pakistan
SEA	Socio-Economic Assessment
SMEs	Small and medium enterprises
SSP	Sehat Sahulat Program
t	Tonnes; metric tons
TEQ	Toxic equivalent
TVs	Televisions

UNEP	United Nation Environment Programme
UNIDO	United Nation Industrial Development Organization
UPOPs	Unintentionally produced POPs
WAPDA	Water and Power Development Authority
WEEE	Electric and electronic equipment waste
WHO	World Health Organization
WPI	Wholesale Price Index
WWF	Workers Welfare Fund
XRF	X-ray fluorescence

1 Introduction

Chapter 1 outlines the purpose and structure of the National Implementation Plan (NIP), including a summary of the Stockholm Convention (SC), its aims and its obligations. It also describes the mechanism used to develop the NIP and the stakeholder consultation process.

1.1 Stockholm Convention

The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty to protect human health and the environment from POPs that remain intact in the environment for long periods, become widely distributed geographically, accumulate in humans and wildlife, and have harmful impacts on human health or on the environment. Exposure to POPs can lead to serious health effects including certain cancers, birth defects, dysfunctional immune and reproductive systems, greater susceptibility to disease and damages to the central and peripheral nervous systems.

In response to this global problem, the Stockholm Convention, which was adopted in 2001 and entered into force in 2004, requires its Parties to take measures to eliminate or reduce the release of POPs into the environment.

Pakistan has signed the Stockholm Convention on 06 December 2001, ratified the Convention on 17 April 2008, which entered into force in July 2008.

1.2 Provision of the Stockholm Convention

Among others, the provisions of the Convention require each party to:

- Prohibit and/or eliminate the production and use, as well as the import and export, of the intentionally produced POPs that are listed in Annex A to the Convention (Article 3). Annex A allows for the registration of specific exemptions for the production or use of listed POPs, in accordance with that Annex and Article 4, bearing in mind that special rules apply to PCBs. The import and export of chemicals listed in Annex A can take place under specific restrictive conditions, as set out in paragraph 2 of Article 3.
- Restrict the production and use, as well as the import and export, of the intentionally produced POPs that are listed in Annex B to the Convention (Article 3). Annex B allows for the registration of acceptable purposes for the production and use of the listed POPs, in accordance with that Annex, and for the registration of specific exemptions for the production and use of the listed POPs, in accordance with that Annex and Article 4. The import and export of chemicals listed in Annex B can take place under specific restrictive conditions, as set out in paragraph 2 of Article 3.

- Reduce or eliminate releases from unintentionally produced POPs that are listed in Annex C to the Convention (Article 5).
- Promote the use of best available techniques and best environmental practices (BAT/BEP) for preventing releases of POPs into the environment.
- Ensure that stockpiles and wastes consisting of, containing or contaminated with POPs are managed safely and in an environmentally sound manner (Article 6).
- Identify and managestockpiles and wastes to reduce or eliminate POPs releases from these sources.
- Wastes containing POPs are transported across international boundaries taking into account relevant international rules, standards and guidelines.
- To target additional POPs (Article 8).

The Convention provides for detailed procedures for the listing of new POPs in Annexes A, B and/or C. A Committee composed of experts in chemical assessment or management - the Persistent Organic Pollutants Review Committee, is established to examine proposals for the listing of chemicals, in accordance with the process set out in Article 8 and the information requirements specified in Annexes D, E and F of the Convention.

Other provisions of the Convention relate to the development of implementation plans (Article 7), information exchange (Article 9), public information, awareness and education (Article 10), research, development and monitoring (Article 11), technical assistance (Article 12), financial resources and mechanisms (Article 13), reporting (Article 15), effectiveness evaluation (Article 16) and non-compliance (Article 17).

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

The POPs recently listed in 2015 (PCNs, HCBD, PCP) and 2017 (DecaBDE, SCCPs) are not assessed in this updated NIP. However, activities are proposed in the action plan to address these POPs in future.

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

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.
• Aldrin • Chlordane • Chlordecone • Decabromodiphenyl ether • Dieldrin • Dicofol • Endrin • Heptachlor • Hexabromobiphenyl (HBB) • Hexabromodiphenyl ether and heptabromodiphenyl ether • Hexabromocyclododecane (HBCD) • Hexachlorobenzene (HCB) • Hexachlorobutadiene (HCBD) • Alpha-hexachlorocyclohexane (HCH) • Beta-hexachlorocyclohexane (HCH) • Lindane (Gamma-HCH) • Mirex • Pentachlorobenzene (PeCB) • Pentachlorophenol and its salts and esters (PCP, its salts and esters) • Perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds • Polychlorinated biphenyls (PCBs) • Polychlorinated naphthalenes (PCNs) • Short-chain chlorinated paraffins (SCCPs) • Tetrabromodiphenyl ether and pentabromodiphenyl ether • Toxaphene • Technical endosulfan and its related isomers	• DDT • Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride (PFOS, its salts and PFOS-F)	• Polychlorinated dibenzo-p-dioxins (PCDD) • Polychlorinated dibenzofurans (PCDF) • Hexachlorobenzene (HCB) • Pentachlorobenzene (PeCB) • Polychlorinated biphenyls (PCBs) • Polychlorinated naphthalenes (PCNs) • Hexachlorobutadiene (HCBD)

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

Chemical	Annex	Specific exemptions / Acceptable purposes	Related (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 , polyurethane foam for building insulation, in accordance with Part IX of Annex A	SC-8/10
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 (c-OctaBDE)	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/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
Polychlorinated naphthalenes	A and C	Production and use of polyfluorinated naphthalenes	SC-7/14
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 (c-PentaBDE)	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)	B	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

1.3 National Implementation Plan

Article 7 of the SC requires that each Party must develop, and endeavour to put into practice, a plan setting out how it will implement its obligations under the SC. 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 and to transmit the NIP to the Conference of the Parties (COP).

The goals of the current NIP of Pakistan are:

- To set out the actions that Pakistan has undertaken regarding the reduction of the presence of POPs;
- To propose actions that Pakistan will undertake in order to manage and eliminate POPs from entering the environment considering the Convention;
- To inform the Conference of the Parties and Pakistan's community about national initiatives and projects designed to meet the requirements of the SC.

The NIP describes how Pakistan will fulfil its obligations under the SC to eliminate or reduce POPs-releases to the environment and carries out environmentally-sound management of stockpiles of POPs contaminated wastes and contaminated sites that pose high risks for human health and the environment, with a regional perspective.

The outcomes from the implementation of the NIP will include:

- The protection of public health from the effects of POPs;
- Meeting the obligations under the SC;
- A structured POPs management;
- Capacity building to maintain and monitor the quality of the environment;
- The coordination with related national plans;
- Awareness raising of all stakeholders with an emphasize on the industrial sector and local communities about the hazardous effect of POPs and countermeasures.

The NIP will be updated as necessary to reflect decisions made by the Government and by the COP - such as amendments to the SC or its annexes, including the addition of chemicals to annexes A, B or C, or adoption of guidance or guidelines

1.4 NIP Development Methodology

The NIP is consistent with the GEF initial guidelines for enabling activities for the SC on POPs, and the guidance for developing a NIP (UNEP and The World Bank Group), including strategies required under Articles 5 and 6 of the Convention. The process of developing the NIP was supported financially by the GEF with UNEP as implementing agency.

Activities that have been conducted for developing the NIP were:

1. *Establishing a coordinating mechanism* through the SC Focal Person and the Project Working Committee to guide the process leading to the formulation and approval of the NIP.
2. *Training*. The task teams participated in different workshops and activities on national level that were aimed at raising awareness on the obligations to the SC and help build or strengthen human capacity to implement the Convention at a national level. A national training workshop on NIP development and inventory development has been conducted concerning the different areas covered by the SC such as the basic POPs and newly listed POPs (until COP6 in 2013), control and effects of unintentional POPs releases, PCBs, pesticides, legislation related to controlled substances, contaminated sites, etc. International expertise is engaged to conduct training to improve the local staff's capacity;
3. *Establishment of basic and new listed POPs inventories and assessment of national, legal, infrastructure and institutional capacity to manage new POPs* have been executed. In order to assure a valid NIP, the development of the inventories of all POPs listed until 2013 was conducted within this NIP development. Staff got acquainted with the Stockholm Convention inventory guidance documents and the updated UNEP toolkit to elaborate inventories.
4. *An initial assessment of potentially impacted population* in particular workers and related families have been conducted
5. *Monitoring and POPs management capacity.* A review of the capacity and capacity needs to monitor POPs and other chemical pollution and potential POPs destruction capacity has been conducted;
6. *National Priority assessment and objective setting to accelerate reduction and elimination of new POPs* to support the implementation of the SC;

7. *Development of action plans for implementation of the developed NIPs.*

1.5 NIP structure

The NIP comprises of the following three chapters:

- Chapter 1 gives an introduction about the SC and its goals and provisions. It describes the development and the structure of the NIP. Overall, chapter 1 provides an overview of the aims and goals of the NIP, as well as the process for the development of the NIP;
- Chapter 2 outlines Pakistan's demographic, political and economic status. It elaborates on the environmental situation and the current status of the institutional, policy and regulatory framework. This chapter also presents the results of the assessment of POPs, focusing on the import and export, production, current and future use, registration, release, storage, disposal, and the potential impact. The POPs mentioned in this chapter are: POPs pesticides, PCBs, DDT, new POPs (POP-PBDEs, HBCD, HBB, PFOS and related substances), and unintentional produced POPs. The existing monitoring programmes, and the information exchange and awareness are also described in this chapter. Overall, it gives basic information on Pakistan's status regarding the management of POPs;
- Chapter 3 presents an overview of recommended activities, strategies, and action plans. In addition, there is a budget related to the activities of the action plan; and
- The appendices contain information on stakeholders and other information relevant to NIP.

1.6 Further considerations

1.6.1 Socio-Economic Assessment

A growing body of data on the links between pollution and health demonstrates the negative impacts, including contaminants from indoor exposure (e.g. heating/cooking, chemicals used indoor and chemicals in consumer products), outdoor air pollution, pesticide use and contaminated sites with highest impact on health in developing countries with an estimated 12 to 14 million deaths per year[4,5,6]. Open waste burning[7,8] and open biomass burning[9]

[4] Prüss-Ustün A, Wolf A, Corvalán C, Bos R, Neira M (2016) Preventing disease through healthy environments: a global assessment of the burden of disease from environmental risks. WHO report. ISBN 978 92 4 156519 6

[5] The Lancet Commission on pollution and health. http://www.thelancet.com/commissions/pollution-and-health

[6] Other studies see these diseases as the major reason for death (Institute for Health Metrix & Evaluation; http://www.healthdata.org/gbd/publications)

contribute to the overall air pollution including particulate matter (PM10; PM2.5), dioxins/UPOPs, PAHs, and heavy metals with plastic as a relevant contribution to open burning in urban area as fuel source. POPs, POPs-like chemicals[10] and other toxic chemicals including e.g. heavy metals. Endocrine disrupting chemicals including POPs and their effects are main contributor to health associated costs also in industrial countries[11,12,13]. A recent assessment suggests that environmental chemical exposures contribute costs that may exceed 10% of the global domestic product.[14] Therefore, a more critical assessment of the burden of pollution from chemicals, industrial and other releases is needed.

References to socio-economic assessment can be found throughout the text of the Stockholm Convention.[15] These references indicate the importance of a socio-economic assessment when implementing the obligations under the Convention and when developing the updated NIP. GEF 2020 strategy suggests aligning global environmental objectives with priorities of national and global socioeconomic development.

Annex F Information of the SC on socio-economic considerations provides an indicative list of items to be taken into consideration by Parties when undertaking an evaluation regarding possible control measures for chemicals being considered for inclusion into the Convention. The preamble to Annex F states that: "An evaluation should be undertaken regarding possible control measures for chemicals under consideration for inclusion in this Convention, encompassing the full range of options, including management and elimination. For this purpose, relevant information should be provided relating to socio-economic considerations associated with possible control measures to enable a decision to be taken by the Conference of the Parties".

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[7]Wiedinmyer C, Yokelson RJ, Gullett BK (2014) Global emissions of trace gases, particulate matter, and hazardous air pollutants from open burning of domestic waste. Environ Sci Technol. 48(16), 9523-9530.

[8] Kumar S, Aggarwal SG, Gupta PK, Kawamura K (2015) Investigation of the tracers for plastic-enriched waste burning aerosols. Atmospheric Environment 108, 49-58.

[9] Yadav IC, Linthoingambi Devi N, Li J, Syed JH, Zhang G, Watanabe H. (2017) Biomass burning in Indo-China peninsula and its impacts on regional air quality and global climate change-a review Environ Pollut. 227, 414-427.

[10] 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..

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

[12] 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.

[13] Trasande L, Zoeller T et al. (2015) Estimating Burden and Disease Costs of Exposure to Endocrine-Disrupting Chemicals in the European Union. J Clin Endocrinol Metab. 100(4), 1245–1255.

[14] Grandjean P., Bellanger M (2017) Calculation of the disease burden associated with environmental chemical exposures: application of toxicological information in health economic estimation. Environmental Health. 16:123

[15]UNEP (2007) Draft guidance on socio-economic assessment for national implementation plan development and implementation under the Stockholm Convention. UNEP/POPS/COP.3/INF/8.

The Conference of the Parties (COP), in its decision SC-1/12 requested the Secretariat of SC, in collaboration with other relevant organizations and subject to resource availability, to develop among others, additional guidance on social and economic assessment, and in doing so to take into consideration the particular circumstances of developing countries and countries with economies in transition. In response to that request, the Secretariat developed the draft guidance on socio-economic assessment for national implementation plan development and implementation under the Convention. According to the guidance, the Socio-Economic Assessment (SEA) is a systematic appraisal of the potential social impacts of economic or other activities such as the management of POPs in all sectors of society (including local communities and groups, civil society, private sector and government). It is a means of analysing and managing the intended and unintended social impacts, both positive and negative, of planned interventions (policies, programs, plans and projects) and any social change processes invoked by those interventions. Social impacts are the changes to individuals and communities that come about due to actions that alter the day-to-day way in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society.

In the context of managing POPs, social and economic impacts might include:

- contamination of air, water and soil and threat to food safety and drinking water safety;
- degradation of ecosystem services[16]
- vulnerability arising from exposure to POPs;
- deterioration or improvement in health[8];
- loss or improvement in livelihoods;
- changes in cost of living;
- cost of contaminated site management and remediation;
- changes in employment, income and workplace protection;
- changes in levels of equity of wealth distribution;
- opportunities for enterprise development (including Small and Medium Enterprises);
- changes in demand for public services, such as health and education.

[16] Millenium-Ecosystem Assessment (2005) Ecosystems and Human Well-being: General Synthesis. http://www.maweb.org/documents/document.356.aspx.pdf

The Socio-Economic Assessment assisted and will assist in taking actions that are appropriate and effective. Socio-Economic Assessment provides a basis for minimising the negative impact on the population and improving equitable outcomes for the most vulnerable groups. However, the socio-economic assessment lacks information on external costs. The unknown external costs can bias decisions and need to be compensated by taking precautionary approaches.

The human resource capacity on socio-economic assessment in Pakistan is rather limited and needs to be improved throughout the implementation of updated NIP.

Socio-Economic Assessment can help at any phase of development of the national implementation plan and during its implementation. If priorities have already been set in Phase I-III of the national implementation plan, then a socio-economic assessment can be used in order to gain insight into the impacts of mitigation measures already decided. In this case, a brief investigation may be conducted for Phase IV. The results will assist in developing NIP communication strategies and rule out the worst excesses of inequitable impact.

For Pakistan the following socio-economic considerations and cost benefit analysis are highlighted as relevant. These key areas are considered as a frame for implementation without trying to apply usual socio-economic calculations requiring sophisticated single stakeholder assessments and often not leading to a practical outcome for developing countries where such information is not available.

a) Food and water safety (including POPs exposure of population);
b) Exposure of vulnerable and highly exposed groups;
c) Management of chemicals and waste;
d) Cost of destruction and end of life management and treatment of POPs and other hazardous waste;
e) Cost of contaminated soil and site remediation.

The socio-economic considerations mentioned above are highlighted as most relevant. Improper chemical and waste management play a relevant role.

At the same time these areas are partly related to Sustainable Development Goals.

1.6.2 Gender policy in NIP development and implementation

Efforts to ensure sound management of chemicals, including POPs have important gender dimensions, because in daily life, men, women, and children are exposed to different kinds of chemicals in varying concentrations. Biological factors, notably size and physiological differences between women and men and between adults and children, influence susceptibility to health damage from exposure to toxic chemicals. Social factors, primarily gender-determined occupational roles, also have an impact on the level and frequency of exposure to toxic chemicals, the kinds of chemicals encountered, and the resulting impacts on human health.[17.]

It is important that these gender dimensions be reflected at both site and policy level interventions for sound chemical management. The gender analysis is used to identify, understand, and describe gender differences and the impact of gender inequalities in a sector or program at the country level. Gender analysis is a required element of strategic planning and is the basic foundation on which gender integration is built. Gender analysis examines the different but interdependent roles of men and women and the relations between the sexes. It also involves an examination of the rights and opportunities of men and women, power relations, and access to and control over resources. Gender analysis identifies disparities, investigates why such disparities exist, determines whether they are detrimental, and if so, looks at how they can be remedied[18].

[17]United Nation Development Programme, Gender Mainstreaming. A Key Driver of Development in Environment and Energy, Energy and Environment Practice. Gender Mainstreaming Guidance Series;

[18] United States Agency for International Development (2011), Tips for Conducting a Gender Analysis at the Activity and Project Level. Additional Help for ADS Chapter 201;

2 Country baseline

Section 2 provides basic background information relevant to the NIP. It describes the current situation and state of knowledge in the country about POPs and the status of institutional and other capacity to address the problem.

Pakistan country profile, institutional, policy/regulatory framework and an assessment of the persistent organic pollutants (POPs) issues in Pakistan are briefly described in the following pages.

2.1 Country Profile

Pakistan displays some of Asia's most magnificent landscapes as it stretches from the Arabian Sea, its southern border, to some of the world's most spectacular mountain ranges in the north. Pakistan is also home to sites that date back to world's earliest settlements matching those of ancient Egypt and Mesopotamia. The economy of Pakistan is the 24th largest in the world in terms of purchasing power parity, and 42nd largest in terms of nominal gross domestic product. Pakistan's industrial sector accounts for about 18% of GDP. Cotton textile production and apparel manufacturing are Pakistan's largest industries, accounting for about 65% of the merchandise exports and almost 40% of the employed labour force.

2.1.1 Location, Geography and Climate

Located in South Asia, Pakistan shares an eastern border with India and a north-eastern border with China. Iran makes up the country's south-west border, and Afghanistan runs along its western and northern edge. The Arabian Sea is Pakistan's southern boundary with 1,064 km of coastline. The country has a total area of 796,095 sq km and is nearly four times the size of the United Kingdom. From Gwadar Bay in it's south-eastern corner, the country extends more than 1,800 km to the Khunjerab Pass on China's border*****.

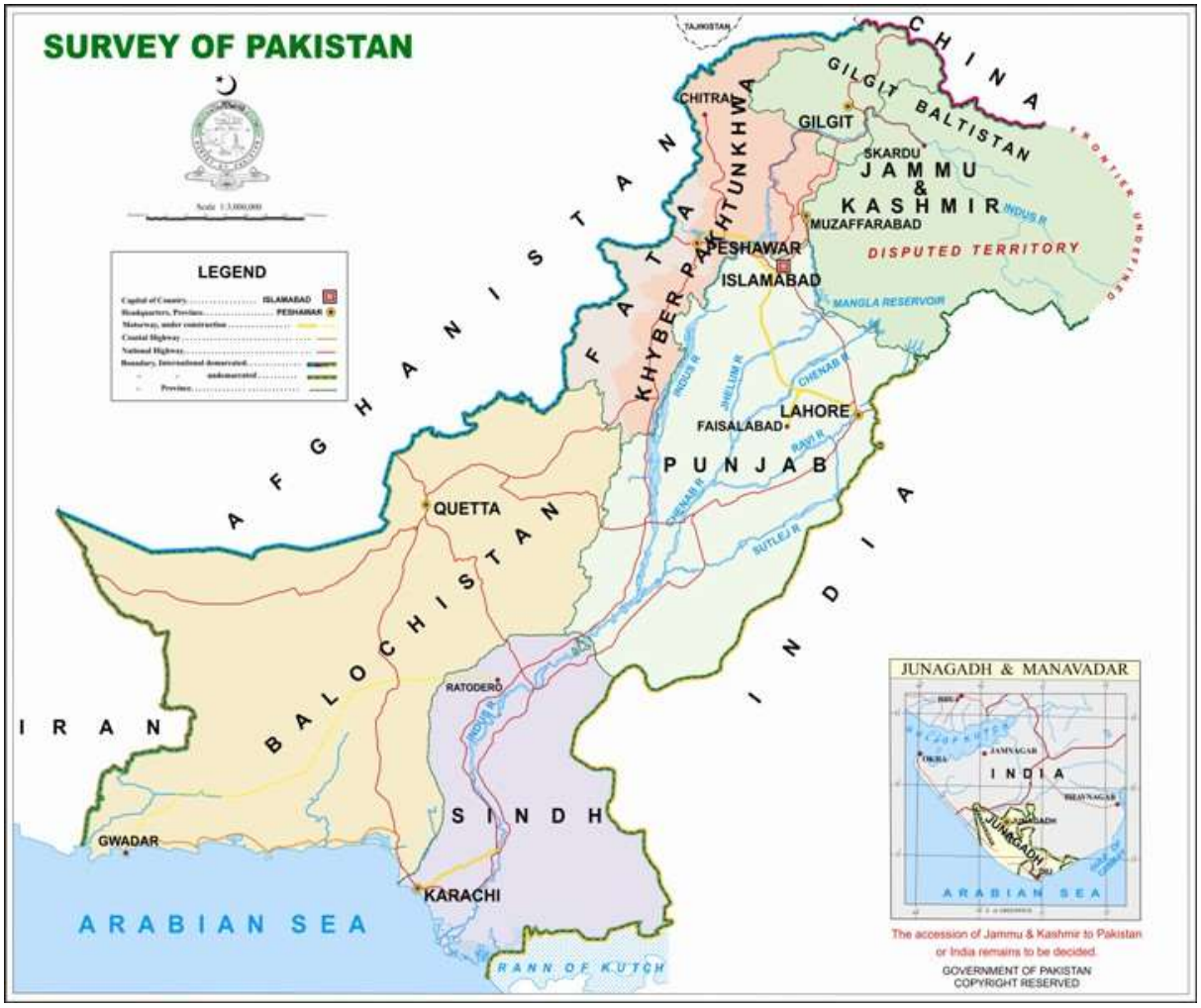

Figure 1. Location of Pakistan

Pakistan is a land of many splendours. The scenery changes northward from coastal beaches, lagoons and mangrove swamps in the south to sandy deserts, desolate plateaus, fertile plains, dissected upland in the middle and high mountains with beautiful valleys, snow-covered peaks and eternal glaciers in the north. The variety of landscape divides Pakistan into six major regions: the North High Mountainous Region, the Western Low Mountainous Region, the Balochistan Plateau, the Potohar Uplands, the Punjab and the Sindh Plains.

High Mountain Region: Stretching in the North, from east to west, are a series of high mountain ranges which separate Pakistan from China, Russia and Afghanistan. They include the Himalayas, the Karakoram and the Hindukush. The Himalayas spread in the north-east and the Karakoram rises on the north-west of the Himalayas and extends eastward up to Gilgit. The Hindu Kush Mountains lie to the north-west of the Karakoram, but extend eastward into Afghanistan. With the assemblage of 35 giant peaks over 7,315m high, the

region is the climbers' paradise. Five summits (of worldwide 14) are even higher than 8,000 m and the highest K-2 (Mt.Godwin Austin) is exceeded only by Mt. Everest.

The passes are rarely lower than the summit of Mt. Blanc and several are over 5,500 m. The Karakoram Highway that passes through the mountains, is the highest trade route in the world. Besides, the region abounds in vast glaciers, large lakes and green valleys which have combined at places to produce holiday resorts such as Gilgit, Hunza and Yasin in the west and the valleys of Chitral, Dir, Kaghan and Swat drained by rivers Chitral, Pankkora, Kunhar and Swat respectively in the east. Dotted profusely with scenic spots having numerous streams and rivulets, thick forests of pine and junipers and a vast variety of fauna and flora, the Chitral, Kaghan and Swat valleys have particularly earned the reputation of being the most enchanting tourist resorts of Pakistan.

South of the high mountains, the ranges lose their height gradually and settle down finally in the Margalla hills (2,000-3,000 ft.) in the vicinity of Islamabad, the Capital of Pakistan, and Swat and Chitral hills, north of river Kabul. Although the climate of the region is extremely diverse, according to aspect and elevation, yet as a whole it remains under the grip of severe cold from November to April. May, June and July are pleasant months. The southern slopes receive heavy rainfall and consequently are covered with forest of deodar, pine, poplar and willow trees. The more northerly ranges and north-facing slopes receive practically no rains and are, therefore, without trees.

Pakistan boasts of the largest share of the highest mountain peaks in the world. Three of the mightiest mountain systems - the Hindukush, the Karakorams and the Himalayas - adorn the forehead of Pakistan. Pakistan has seven of the 16 tallest peaks in Asia. The statistics are simply baffling: 40 of the world's 50 highest mountains are in Pakistan; in Baltistan over 45 peaks touch or cross the 20,000 foot mark; in Gilgit within a radius of 65 miles, there are over two dozens peaks ranging in height between 18,000 to 26,000 feet. There are a total of 14 main peaks soaring above 8000 metres in the world. Out of these, 8 are located in Nepal, 5 in Pakistan and 1 in China. K-2 (8611m) is the second highest mountain in the world.

There is a considerable human movement from the mountains to the plains in winter and from plains to the mountains in summer. The permanent settlers grow corn, maize, barley, wheat and rice on the terraced fields and also raise orchards of apples, apricots, peaches and grapes.

In the far-north of Pakistan are valleys which are closed within the silent, brooding forts of these mountains and are almost as high as the mountains themselves. Here dwell, from times immemorial, various tribes differing in race and culture. If one tribe has Mongol features, its

neighbour is obviously Aryan. Separated by insurmountable obstacles, these tribes very often live a totally land-locked existence blissfully unaware of the world beyond. But a traveller is simply wonderstruck by one common element - Islam.

Pakistan has more glaciers than any other land outside the North and South Poles. Pakistan's glacial area covers some 13,680 sq.km which represents an average of 13 per cent of mountain regions of the upper Indus Basin. Pakistan's glaciers can rightly claim to possess the greatest mass and collection of glaciated space on the face of earth. In fact, in the lap of the Karakoram of Pakistan alone there are glaciers whose total length would add up to above 6,160 sq. km. To put it more precisely, as high as 37% of the Karakoram area is under its glaciers against Himalayas' 17% and European Alps 22%. The Karakorams have one more claim to proclaim; its souther flank (east and west of the enormous Biafo glacier) has a concentration of glaciers which works out to 59% of its area. The Siachin glacier is 75 kms. The Hispar (53 kms) joins the Biafo at the Hispar La (5154.16 metres (16,910 ft) to form an ice corridor 116.87 kms long. The Batura, too is 58 kms in length. But, the most outstanding of these rivers of ice is the 62 kms Baltoro. This mighty glacier fed by some 30 tributaries constitutes a surface of 1291.39 sq. kms.

These western low mountains spread from the Swat and Chitral hills in a north-south direction (along which Alexander the Great led his army in 327 B.C) and cover a large portion of the North-West Frontier Province. North of the river Kabul their altitude ranges from 5,000 to 6,000 ft. in Mohamand and Malakand hills. South of the river Kabul spreads the Koh-e-Sofed Range with a general height of 10,000 ft. Its highest peak, Skaram, being 15,620 ft. South of Kohe-Sofed are the Kohat and Waziristan hills (5,000 ft) which are traversed by the Kurram and Tochi rivers, and are bounded on south by Gomal River.

The whole area is a tangle of arid hills composed of limestone and sandstone. South of the Gomal River, the Sulaiman Mountains run for a distance of about 483 kilomaters in a north-south direction, Takht-e-Sulaiman (11,295 ft.) being its highest peak. At the southern end lie the low Marri and Bugti hills. The area shows an extraordinary landscape of innumerable scarps, small plateaus and steep craggy out-crops with terraced slopes and patches of alluvial basins which afford little cultivation.

Kirthar Range South of the Sulaiman Mountains is the Kirthar Range which forms a boundary between the Sindh plain and the Balochistan plateau. It consists of a series of ascending ridges running generally north to south with broad flat valleys in-between. The highest peak named Kutte ji Kabar (dog's grace is 6,878 ft. above sea level. Bleak, rugged

and barren as these hills are, they afford some pasturage for flocks of sheep and goats. The valleys are green with grass and admit cultivation up to a hight of 4,000 ft.

Although the country is in the monsoon region, it is arid, except for the southern slopes of the Himalayas and the sub-mountainous tracts which have a rainfall from 76 to 127 cm. Balochistan is the driest part of the country with an average rainfall of 21 cm. On the southern ranges of the Himalayas, 127 cm. of precipitation takes place, while under the lee of these mountains (Gilgit and Baltistan) rainfall is hardly 16 cm. Rainfall also occurs from western cyclonic disturbances originating in the Mediterranean. It is appreciable in the western mountains and the immediate fore lying area; the rainfall average ranges from 27 to 76 cm. The contribution of these western disturbances to rainfall over the plains is about 4 cm. A large part of the precipitation in the northern mountain system is in the form of snow which feeds the rivers. The all-pervasive aridity over most of Pakistan, the predominant influence on the life and habitat of the people, coupled with the climatic rhythm, characteristic of a monsoon climate, are conducive to homogeneity of the land.

Seasons: The four well-marked seasons in Pakistan are:-

i. Cold season (December to March).

ii. Hot season (April to June).

iii. Monsoon season (July to September).

iv. Post-Monsoon season (October and November).

The cold season sets in by the middle of December. This period is characterised by fine weather, bracing air-low humidity and large diurnal range of temperature. Winter disturbances in this season accordingly cause fairly widespread rain. Average minimum and maximum temperatures are 4 °C and 18 °C, though on occasions the mercury falls well below freezing point. The winter sun is glorious. The hot season is usually dry. Relative humidity in May and June varies from 50 per cent in the morning to 25 per cent or less in the afternoon. The temperature soars to 40 °C and beyond. The highest recorded temperature at Jacobabad in June is 53 °C. While the interior is blazing hot, the temperature along the sea coastal ranges between 25°C to 35 °C, but the humidity persists around 70 to 80 percent.

The south-west monsoon reaches Pakistan towards the beginning of July and establishes itself by the middle of the month. The strength of the monsoon current increases from June to July; it then remains steady, and starts retreating towards the end of August,

though occasionally, it continues to be active even in September when some of the highest floods of the Indus Basin have been recorded. From the middle of September to the middle of November is the transitory period which may be called the post-monsoon season.

In October, the maximum temperature is of the order of 34°C to 37°C all over Pakistan, while the nights are fairly cool with the minimum temperature around 16 °C. In the month of November, both the maximum and the minimum temperatures fall by about 6 °C and the weather becomes pleasant. October and November are by far the driest months all over the plains of Pakistan.

2.1.2 Population, education, health and employment

Pakistan's latest estimated population is 212,742,631 according to the 2017 Census of Pakistan. This makes Pakistan the world's sixth-most-populous country, just behind Indonesia and slightly ahead of Brazil. Density per square kilometre is 201 persons. Literacy rate is estimated to be 60 per cent.

Of the four provinces, with 25.8 per cent of land area of the country, Punjab has 56.5 per cent of the total population; Sindh, with 17.7 per cent of land area, has 22.6 per cent: Khyber Pakhtunkhwa (KPK) province, (including FATA) with 12.8 per cent of land area, has 15.7 per cent; Balochistan, with 43.6 per cent of land area, has 5.1 per cent.

Sindh is the province with 43 per cent of the people living in urban areas including Karachi City. The urban population of Punjab is 28 per cent followed by KPK, 21 per cent, and Balochistan 16 per cent. About 67 per cent of the total urban population of the country lives in 28 cities with population of 100,000 and above, while 57 per cent of the total urban population lives in 12 cities with population of 200,000 and above. Age Composition According to the Labour Force Survey, 1990-91, 46.93 per cent of the population is under 15 years of age; 49.66 per cent is between the age groups of 15 and 64 years, while 3.41 per cent comprises persons 65 years old and above.

To achieve the Goal 4 of SDGs, the federal government is committed to work with provinces for allocation of more resources for education, decrease the number of out of school children (OOSC), reduce the dropout rates, bring uniformity in education standards and enhance access to vocational and skills training. The country wide school enrolments during 2017-18 were recorded at 50.616 million compared to 48.062 million during 2016-17. It improved by

5.31 percent and it is estimated to further increase by 4.8 percent to 53.032 million during 2018-19. The total numbers of the educational institutes were recorded at 260.6 thousand during 2017-18 as compared to 260.1 thousand during 2016-17. This number is estimated to increase by 1.60 percent to 264.7 thousand during 2018-19. The total numbers of teachers during 2017-18 were 1.753 million compared to 1.726 million during 2016-17 showing an increase of 1.6 percent. This number is estimated to increase by 2.85 percent to 1.803 million during the year 2018-19.

According to Labour Force Survey 2017-18, literacy rate was estimated at 62.3 percent in 2017-18 as compared to 60.7 percent estimated in 2014-15. For males it increased from 71.6 percent to 72.5 percent and for females it increased from 49.6 percent to 51.8 percent. Area wise analysis suggests that literacy rate increased in both rural areas (51.9 percent to 53.3 percent) and urban areas (76.0 percent to 76.6 percent). Literacy rate increased in three provinces; Khyber Pakhtunkhwa from 54.1 percent to 55.3 percent, Punjab from 61.9 percent to 64.7 percent and Balochistan from 54.3 percent to 55.5 percent while Sindh it decreased marginally from 63.0 percent to 62.2 percent.

Public Expenditure on education as a percentage of GDP is estimated at 2.4 percent in FY2018 as compared to 2.2 percent in FY2017. The education related expenditure increased by 18.6 percent to Rs 829.2 billion in FY2018 from Rs 699.2 billion in FY2017. The provincial governments are also spending sizeable amount of their Annual Development Plans (ADPs) on education. Punjab increased its expenditure in FY2018 to Rs 340.8 billion from Rs 260.6 billion in FY2017 showing an increase of 30.8 percent. Sindh increased its expenditure from Rs 146.7 billion in FY2017 to Rs 166.0 billion in FY2018 showing an increase of 13.16 percent. Similarly, Khyber Pakhtunkhwa and Balochistan also increased their expenditure on education from Rs 136.1 billion to Rs 142.6 billion and from Rs 47.7 billion to Rs 52.8 billion respectively during the corresponding period.

Under the Public Sector Development Program (PSDP) 2018-19, the government had initially allocated PKR 35.829 billion to Higher Education Commission (HEC) for implementing 178 development projects (133 ongoing & 45 un-approved projects) of Public Sector universities. However, with rationalization of PSDP by Ministry of Planning, Development & Reform (PD&R), the size of the PSDP allocation was revised to PKR 30.961 billion for only 136 ongoing development projects of Universities. These projects are; Construction of new

academic buildings, Strengthening of ICT Infrastructure, Faculty Development, Procurement of Laboratory Equipment and other approved components.

In addition to PSDP budget, a Technical Supplementary Grant of PKR 0.503 billion for the project titled "Award of 3000 Scholarships to students from Afghanistan under the Prime Minister's Directive" has also been released to HEC. Under this scheme, the Government of Pakistan offers scholarships to 3000 Afghan students in various field including Medicine, Engineering, Agriculture, Management and Computer Sciences to create Pakistan's goodwill among the people of Afghanistan, to promote Human Resource Development for reconstruction of Afghanistan, to develop people to people contact between two neighbouring countries and to create excellent leadership qualities among Afghan Youth.

Ministry of National Health Services, Regulations and Coordination in collaboration with provincial governments, started a landmark and flagship health care and social protection initiative, the Sehat Sahulat Program (SSP). In the first phase, the program is being implemented in 38 districts of Pakistan covering 3.2 million families. Initially, In Sehat Sahulat Program each enrolled family will be insured upto PKR 50,000/- per year for secondary care treatment and upto PKR 250,000/- per year for 7 priority care treatment. Patients who have consumed their limits will be provided with additional limits by Pakistan Bait-ul-Mal. In phase-II of the Sehat Sahulat Program, benefit package of each enrolled family has been raised to PKR 120,000/- per year for secondary care treatment and up to PKR 600,000/- per year for 8 priority diseases/illnesses related treatment. Furthermore, SSP is a cashless scheme in which no cash assistance or cash transfers will be provided to the beneficiary except indoor health care services and a traveling allowance. Traveling allowance of PKR 350/- per discharge, for a total of 3 discharges per year, from residence to hospital and back is provided to the beneficiaries. In Phase-II of SSP, enhanced transportation cost of PKR 1,000 is being provided to beneficiaries upon discharge. As of 9th February 2019, a total of 3,237,660 families have been enrolled in the Sehat Sahulat Program and more than 117,726 families have been treated for various illnesses from 157 empanelled hospitals across Pakistan.

Sehat Sahulat Program is being implemented through State Life Insurance Corporation of Pakistan, hired through an open and transparent bidding process. Services are delivered to the beneficiaries by empaneling secondary and tertiary level health care facilities, both at public and private sector, in all focused districts and metropolitan cities of the country. The hospital

is being empanelled through the insurance company based on hospital empanelment criteria set forth in the program documents.

Ministry of National Health Services Regulations & Coordination has initiated a strategy in January, 2019 to enhance efforts to reduce the prevalence of tobacco use in any form in the country by urging all tobacco manufacturers to print new Pictorial Health Warning (PHW) on cigarette packs and outers. Cumulative health expenditures by federal and provincial governments during 2018-19 (July-March) increased to Rs 203.74 billion which is 3.29 percent higher than PKR 197.25 spent during the corresponding period of previous year. The current expenditure increased by 19.84 percent from PKR 149.97 billion to PKR 179.72 billion while development expenditure decreased by 49.19 percent from PKR 47.28 billion to PKR 24.03 billion.

However, the break-up of expenditures among federal government and provincial governments demonstrates that during July-March FY2019, Federal and Punjab health expenditures decreased by 10.0 and 8.2 percent, respectively, as compared to the corresponding period of the last year. On the other hand, health expenditures of Sindh, Baluchistan and Khyber Pakhtunkhwa increased by 22.2, 18.4 and 10.5 percent respectively, during the same period. As percentage of GDP, health expenditure has improved from 0.91 percent in 2016-17 to 0.97 percent in 2017-18. During FY 2018-19 (July-March) it has increased by 0.53 percent compared to 0.49 percent increase recorded during the corresponding period of last year. By the year 2018, the number of public sector hospitals has increased to 1,279. The number of Basic Health Units (BHUs) has increased to 5,527, that of Rural Health Centres (RHCs) to 686 and that of dispensaries to 5,671. The total number of registered doctors is 220,829, of registered dentists is 22,595 and that of registered nurses is 108,474.

Employment growth is a challenge for any developing, labour abundant economy. In the past the plans were designed to promote growth but less priority was given to employment generation. The present government has taken special initiatives to fulfil its commitment to create 10 million jobs during its term of five years. Private sector will play a key role in creation of jobs supported by the government. Naya Pakistan Housing Program, which is government's initiative to provide affordable housing to low income groups targeting most vulnerable segment of our economy by constructing 10 million houses, has a potential to generate massive employment opportunities during next five years. Similarly, National

Financial inclusion Strategy to promote SMEs and digitization of financial services will also create substantial employment opportunities. It is also estimated that investments in tourism will generate over half a million new direct and induced jobs over the next five years. For the youth, the government has launched a new program – the Kamyab Jawan Program. Over the next 5 years, it is estimated that 138 thousand youth will benefit from KamyabJawan program, with banks disbursing a cumulative credit of Rs 200 billion.

2.1.3 Overview of the economy

The macroeconomic stability is a fundamental pre-requisite for sustained economic growth. Pakistan's economy has experienced frequent boom and bust cycles. Typically, each cycle comprised of 3-4 years of relatively higher growth followed by a macroeconomic crisis which necessitated the stabilization programs. The inability to achieve sustained and rapid economic growth is due to structural issues which require effective monetary and fiscal measures to achieve macroeconomic stability.

The outgoing five-year plan has seen an average growth of 4.7 percent against the target of 5.4 percent. This growth can be characterized as a consumption led growth. The unplanned borrowing from different sources increased both private and public consumption resulting in higher debt repayment liabilities, which created severe macroeconomic imbalances. The investment did not pick up as higher demand was met primarily through imports leading to enormous rise in external imbalances. Due to low growth in revenues and the unplanned and unproductive expenditures, the fiscal deficit widened. The persistence of large fiscal and current account deficits and associated build up of public and external debt became the major source of macroeconomic imbalance. The new elected government faces formidable macroeconomic challenges. The foremost challenge to the economy is the rising aggregate demand without corresponding resources to support it, leading to rising fiscal and external account deficits. To address the issue of severe macroeconomic instability and to put the economy on the path of sustained growth and stability, the government has introduced a comprehensive set of economic and structural reform measures.

As a short-term measure to get a breathing space, the government secured $ 9.2 billion from friendly countries to build up buffers and to ensure timely repayment of previous loans. The government has also taken some overdue tough decisions i.e. increase in energy tariffs to stop further accumulation of circular debt, reduction in imports through regulatory duties and

withdrawal of some of the tax relaxations given in the last budget in order to arrest the deterioration in primary balance. These painful decisions were tough for the new elected government, but at the same time were necessary for economic stabilization. Recently, staff level agreement has been negotiated with the International Monetary Fund (IMF) to avail Extended Fund Facility for achieving macroeconomic stability. The staff level agreement will now be placed before the IMF Board for its approval. The impact of macroeconomic adjustment policies, such as monetary tightening, exchange rate adjustment, expenditure control and enhancement of regulatory duties on non-essential imports, started to become visible this year. These steps have served to bring some degree of stability and have also helped in reducing economic uncertainty. However, the situation calls for sustained efforts.

The outgoing fiscal year 2018-19 witnessed a muted growth of 3.29 percent against the ambitious target of 6.2 percent. The target was based upon sectoral growth projections for agriculture, industry, and services at 3.8 percent, 7.6 percent and 6.5 percent respectively. The actual sectoral growth turned out to be 0.85 percent for agriculture, 1.4 percent for industry and 4.7 percent for services. Some of the major crops witnessed negative growth as production of cotton, rice and sugarcane declined by 17.5 percent, 3.3 percent and 19.4 percent respectively. The crops showing positive growth include wheat and maize which grew at the rate of 0.5 percent and 6.9 percent respectively. Other crops have shown growth of 1.95 percent mainly due to increase in production of pulses and Livestock sector has shown a growth of 4.0 percent. The growth recorded for the forestry is 6.47 percent which was mainly due to increase in production of timber in Khyber Pakhtunkhwa ranging from 26.7 to 36.1 thousand cubic meters.

The growth in industrial sector has been estimated at 1.40 percent. The mining and quarrying sector has witnessed a negative growth of 1.96 percent mainly due to reduction in production of natural gas (-1.98 percent) and coal (-25.4 percent). The large-scale manufacturing sector as per QIM data (from July 2017 to February 2018) shows a decline of 2.06 percent. Major decline has been observed in Textile (-0.27 percent), Food, Beverage & Tobacco (-1.55 percent), Coke & Petroleum Products (-5.50 percent), Pharmaceuticals (-8.67 percent), Chemicals (-3.92 percent), Non-Metallic Mineral Products (-3.87 percent), Automobiles (-6.11 percent) and Iron & Steel products (-10.26). On the other hand, the substantial growth in large-scale manufacturing (LSM) has been observed in Electronics (34.63 percent), Engineering Products (8.63 percent) and Wood Products (17.84 percent). Electricity and gas

sub sector has grown by 40.54 percent, whereas the construction activity has declined by 7.57 percent.

The services sector has shown an overall growth of 4.71 percent. Wholesale and Retail Trade grew by 3.11 percent, while the Transport, Storage and Communication sector registered a growth of 3.34 percent mainly due to positive contribution by railways (38.93 percent), air transport (3.38 percent) and road transport (3.85 percent). Finance and insurance sector showed an overall growth of 5.14 percent. While the central banking has declined by 12.5 percent, a positive growth has been observed in scheduled banks (5.3 percent), non-scheduled banks (24.6 percent) and insurance activities (12.8 percent). The Housing Services has grown at 4.0 percent. The growth recorded in General Government Services is 7.99 percent which is mainly on account of increase in salaries of employees of federal, provincial and district governments. Other private services, comprising of various distinct activities such as computer related activities, education, health & social work, NGOs etc recorded a growth of 7.05 percent.

The total investments as a percentage of GDP was recorded at 15.4 percent against the target of 17.2 percent. The fixed investment as percentage of GDP remained 13.8 percent against the target of 15.6 percent, while public and private investments remained at 4.0 and 9.8 percent against the target of 4.8 and 10.8 percent respectively. The National Savings remained at 10.7 percent of GDP against the target of 13.1 percent. The consumption growth was recorded at 11.9 percent compared to 10.2 percent growth recorded last year. As percentage of GDP, it increased to 94.8 percent compared to last year's figure of 94.2 percent.

On the demand side, the exports declined by 1.9 percent despite exchange rate depreciation, while imports declined by 4.9 percent. This helped in reducing the trade deficit by 7.3 percent during July- April FY 2019 while it had shown an expansion of 24.3 percent during the corresponding period of last year. The workers' remittances played a major role in containing current account deficit to 4.03 percent of GDP. The current account deficit (CAD) showed a contraction of 27 percent during July-April of the current year while it had expanded by 70 percent during the corresponding period of last year. The State Bank is following a contractionary policy to anchor the aggregate demand and address rising inflation on the back of high fiscal and current account deficits.

The next year, agriculture sector is likely to rebound under Prime Minister's Agriculture Emergency Program. The water availability is expected to be better as compared to current year. There is substantial increase in Agriculture Credit disbursement which is recorded at PKR 805 billion during July-April FY2019 compared to PKR 666.2 billion during the corresponding period of last year, posting a growth of 20.8 percent. The import of agriculture machinery has recorded a growth of 10.95 during July-April FY2019 which is a good indicator. The base effect will also support growth in agriculture. On the back of expected growth in agriculture sector along with government initiatives in the construction sector, SMEs sector and tourism and automobile sector. Both, agriculture and LSM sector growth is likely to have a good impact on services sector on account of goods transport services linked to agriculture and wholesale trade.

The fiscal tightening and the rising inflation on account of increasing utility prices, rationalization of taxes, measures to reduce the primary balance, and any further exchange rate adjustments, alongwith higher oil prices, protectionists tendencies in some of the economies and tightening monetary conditions in the developed countries leading to lower capital inflows will remain downside risk.

2.1.3.1 Poverty and Income Distribution

The government dissects pro-poor expenditure in different sectors through the Medium-Term Expenditure Framework (MTEF) under PRSP-II program. Expenditure on these pro-poor sectors has shown an increasing trend in absolute terms as well as percentage of GDP. Expenditure on these sectors increased from PKR 1,934.2 billion in FY 2014 which was 7.7 percent of GDP to PKR 3,167.92 billion in FY 2018 which is 9.2 percent of GDP.

The social safety nets are major initiatives to reinforce the government's efforts to reduce the adverse effects of poverty on the poor. Benazir Income Support Program (BISP), a flagship program of the government has made a remarkable progress by providing cash transfers to over 5.8 million beneficiaries. The quarterly cash grant has gradually been enhanced by the successive governments which currently stands at PKR 5000/- per quarter per eligible beneficiary. Since inception, BISP has disbursed Rs 691.5 billion as cash transfers. BISP is following the path of automation and 98.5 percent of beneficiaries are being paid through technology-based payment mechanisms. Under Waseela-e-Taleem program, 3.1 million children have been enrolled so far and an amount of PKR 9.8 billion has been disbursed.

Pakistan Poverty Alleviation Fund (PPAF) also helps in micro-credit, water, health, education, livelihood. Since its inception in April 2000 uptill March 2019, PPAF has disbursed an amount of approximately PKR 222.037 billion to its Partner Organizations (POs) in 137 districts across the country. The overall disbursements for core operations during July 2018 to March, 2019 amounted to Rs 756 million. Pakistan Baitul Mal (PBM) is also making a significant contribution towards poverty reduction by providing financial assistance to destitute, widows, orphans, invalid, infirm and other needy persons irrespective of their gender, cast, creed and religion through its establishments at the district level. During July to March FY2019, PBM has disbursed an amount of Rs 2.562 billion through its core projects.

Workers Welfare Fund (WWF) is providing various services in the areas of housing, health and education to the industrial workers and financial assistance is also being extended in the form of death grant, marriage grant and scholarships. During July-March, FY2019 expenditures amounting to Rs 468.273 million have been incurred on 3,992 scholarships while Rs 1,985.38 million has been disbursed as Marriage Grant (@100,000/-) which benefitted 19,854 workers' families. WWF has also disbursed Rs 1,597.55 million as Death Grant (@500,000/-) to 3,195 families all over the country. Employees Old-Age Benefits Institution (EOBI) provides monetary benefits to the old age workers through various programs such as the Old-Age Pension, Invalidity Pension, Survivors Pension and Old-Age Grants. During July-March 2018-19, PKR 23.30 billion has been disbursed to 401,940 beneficiaries.

2.1.3.2 Fiscal Development

In Pakistan, fiscal sector has faced multifaceted challenges over the years due to excessive and unproductive expenditures on one hand and lower tax revenues on the other. Generally, higher current expenditures and lower tax revenues left limited fiscal space for public investment and social safety net. Furthermore, high interest payments, untargeted subsidies, loss making PSEs, energy subsidies and security related issues all weighed on expanding fiscal deficit. During the last five years, total revenue as percent of GDP on average reached to 14.9 percent, whereas it stood at 15.1 percent in FY2018. The total expenditures as percent of GDP on average reached to 20.5 percent, while during the preceding year FY2018, it was the highest at 21.6 percent. Resultantly, fiscal deficit on average stood at 5.5 percent, while during the last year it was recorded at 6.5 percent.

During first nine months (July- March) Current Fiscal Year (CFY) 2019, consolidated fiscal indicators suggest that total revenue registered zero growth, while growth in total expenditures was 8.7 percent. Therefore, fiscal deficit as percent of GDP was 5.0 percent as compared 4.3 percent during the corresponding period of last year. Total revenue increased to Rs 3,583.7 billion (9.3 percent of GDP) from Rs 3,582.4 billion (10.3 percent of GDP) during the comparable period of last year, showing almost zero growth in comparison of growth of 13.9 percent during the same period last year. Decelerated performance of total revenues primarily was due to marginal growth of 1.8 percent in tax revenues and negative growth of 16.7 percent in non-tax revenues.

During the period Jul-Apr, CFY2019 Federal Board of Revenue (FBR) tax receipts remained at Rs 2,976.0 billion against Rs 2,922.5 billion during the same period of FY2018, registering a growth of 1.8 percent. Actual tax collection during first ten months of CFY remained at 67.7 percent of revised target of Rs 4,398 billion. Total expenditures increased to Rs 5,506.2 billion (14.3 percent of GDP) during first nine months of CFY compared with Rs 5,063.3 billion (14.6 percent of GDP) during the comparable period of last year, registering a growth of 8.7 percent during Jul-Mar, FY2019 against the growth of 15.5 percent in the same period last year. Within total expenditures, current expenditures posted a growth of 17.7 percent to Rs 4,798.4 billion (12.4 percent of GDP) during Jul-Mar, FY2019 compared to Rs 4,075.4 billion (11.8 percent of GDP) in the same period last year. Federal and provincial governments' current expenditures grew by 19.9 and 13.7 percent, respectively during the period under review.

In contrast, development expenditures (excluding net lending) decreased to Rs 655.9 billion during Jul-Mar FY2019 compared to Rs 993.3 billion last year, posting a negative growth of 34.0 percent compared with positive growth of 23.6 percent recorded last year. PSDP share in total development expenditure stood at 88 percent during first nine months of CFY amounting to Rs 578.5 billion compared with Rs 931.4 billion expenditure during the same period last year, witnessing a decline of 37.9 percent compared with growth of 24.7 percent recorded last year. Within PSDP, federal and provincial PSDP's decreased by 14.5 and 52.2 percent respectively during Jul-Mar, FY2019 over the same period of last year. Total expenditures declined by 5.2 percent. As a result, overall provincial surplus increased to Rs 291.6 billion as compared to Rs 191.05 billion during the same period last year. For FY2019, provincial surplus target is budgeted at Rs 285.6 billion.

2.1.3.3 Money and Credit

Pakistan has posed challenges for the economy towards the end of FY2018. Resultantly, the State Bank of Pakistan (SBP) reversed its policy stance since January 2018 from accommodative to contractionary monetary policy to curb excessive aggregate demand and ensure near term stability. Policy rate has gradually increased by cumulative 650 bps. The policy rate stands at 12.25 percent effective from 21st May, 2019. During the period 01 July-26 April, FY2019 money supply (M2) increased by Rs 625.3 billion (growth of 3.9 percent) compared with Rs 601.8 billion (growth of 4.1 percent) in comparable period last year. Within Broad Money, Net Foreign Assets (NFA) of the banking sector further contracted to Rs 882.4 billion during 01 July-26 April, FY2019 against contraction of Rs 475.4 billion during the comparable period last year. Therefore, both SBA and scheduled bank's NFA remained negative during the period under review. During the period 01 July-26 April, FY2019 NDA of the banking sector registered an expansion of Rs 1,507.7 billion (growth of 9.3 percent) compared with Rs 1,077.2 billion (7.7 percent) during the same period last year.

On the other hand, reserve money posted an expansion of Rs 488.0 billion (growth of 8.9 percent) during 01 July-26 April, FY2019 against Rs 260.5 billion (growth of 5.4 percent) last year. Credit to Public Sector Enterprises (PSEs) increased to Rs 312.1 billion during the period 01 July-26 April, FY2019 against Rs 153.2 billion during the same period last year. During 01 July-26 April, FY2019 government borrowed Rs 1,073.0 billion for budgetary support compared to Rs 850.0 billion in the same period last year, of which, government has borrowed Rs 3,204.7 billion from SBP as compared to Rs 1,316.1 billion last year. On the other hand, government retired Rs 2,131.7 billion to scheduled banks against retirement of Rs 466.1 billion during the same period last year. Net government sector borrowing thus remained at Rs 908.0 billion during the period under review compared with Rs 813.6 billion during the corresponding period last year.

During the period 01 July-26 April, FY2019, flows of private sector credit has been recorded at Rs 580.9 billion compared with Rs 498.5 billion during the same period last year, witnessing Year on Year (YoY) growth of 15.1 percent against a growth of 14.7 percent during the same period last year. During July-March, FY2019 working capital credit demand increased to Rs 369.0 billion against Rs 215.3 billion in the same period last year. Credit demand for fixed investment decelerated to Rs 83.1 billion during July-March FY2019

compared to Rs 148.1 billion during the same period last year. Prudent risk-based regulations have also helped the banking sector to maintain a strong solvency profile. Capital Adequacy Ratio (CAR) improved to 16.2 percent as of end December-2018; well above the minimum required level of 11.90 percent and global benchmark of 10.5 percent.

2.1.3.4 Capital Market

Capital market in Pakistan plays a crucial role in mobilizing domestic resources and channeling them to productive uses; however, its performance remained volatile during the period under discussion. Many factors contributed to its volatility. The Pakistan Stock Exchange (PSX) index has increased from 33,229 points as on January 1, 2016, to 38,649 as on March 31, 2019, a rise of 16 percent. At the start of FY2019, the market gained some momentum, reaching 43,557 points on July 30, 2018, after which it started moving down, reaching period's lowest index at 36,663 points on October 16, 2018.

The financial measures introduced through Finance Bill in January 2019 gave some respite to the market and the index saw rising trend for some period. However, it has remained volatile during the period under review and closed at 38,649 points on March 31, 2019, while the market capitalization was PKR 7,868.6 billion. The average daily value traded (T+2) during the first nine months of FY 2019 was PKR 7.2 billion and the average daily turnover was 170 million shares. The average daily trade value in futures was PKR 2.9 billion and the trading volume was 71 million shares during the period. The foreign investors offloaded securities worth US$ 373 million which was absorbed by domestic investors, Banks/DFIs, companies and insurance companies. The strong buying by local investors has shown the confidence of the investors in Pakistan equity market. Going forward it is expected that the market will move in upward trajectory.

In order to provide short-term stimulus to the stock market and arrest its downward trend, the Economic Coordination Committee of the Cabinet Division authorized the government to issue sovereign guarantee amounting to PKR 20 billion for investment in National Investment Trust (NIT)-State Enterprise Fund. This step would increase liquidity in the PSX and would woo investors to divert more investment in the market. As of March 31, 2019, 120 corporate debt securities were outstanding with an amount of PKR888.24 billion. These nine months saw 10,865 new companies getting registered with the SECP, a growth of 30 percent from the corresponding period of last financial year.

Assets under management of the mutual funds stood at PKR 635.90 billion. Equity Funds dominated the industry with the largest share i.e. 37.75 percent of the mutual fund industry. Money Market held the second largest industry share i.e. 36.93 percent, followed by Income Funds with industry share of 17.50 percent as of March 31, 2019, The SECP has taken additional measures in this fiscal year to address potential threat of money laundering and terrorist financing within its regulated entities and maintained integrity of the financial markets, including framing of SECP Anti-Money Laundering/Counter Financing of Terrorism (AML/CFT) Regulations 2018, amendment in Securities Brokers (Licensing and Operations) Regulations 2016 by introducing pre-condition that ultimate beneficial owners of securities broker should not have been convicted in any predicate offences provided under Anti- Money Laundering Act 2010 or the Anti- Terrorist Act 1997, and organizing fifteen awareness sessions on AML/CFT regulatory framework.

2.1.3.5 Inflation

The Consumer Price Index (CPI) has witnessed a rising trend during the current financial year. It increased to 5.8 percent in July 2018 and after remaining sticky at 5 percent during following two months increased to 6.8 percent in October 2018. The spike witnessed in October 2018 was due to increase in gas prices. The Oil and Gas Regulatory Authority revised the retail prices of natural gas for various consumers after keeping them unchanged for about two years. The substantial increase of 9.4 percent was witnessed in March 2019 while in April 2019 it was recorded at 8.8 percent. During July-April FY2019 headline inflation measured by CPI averaged at 7.00 percent against 3.77 percent during corresponding period of last year on the back of the prevalence of some underlying demand in the economy as well as continued pass through of exchange rate depreciation and higher fuel prices.

The other inflationary indicators like Sensitive Price Indicator (SPI) remained at 4.0 percent during Jul-April FY 2019 against the 0.8 percent during the corresponding period last year. Wholesale Price Index (WPI) was recorded at 11.7 percent in July-April FY 2019 compared to 2.8 percent in corresponding period of FY 2018. Core inflation which is Non Food and Non Energy is recorded at 8.1 percent compared to 5.6 percent of corresponding period of FY 2018. The rising input costs on the back of high utility prices and the lagged impact of exchange rate depreciation is likely to maintain upward pressure on inflation during the remaining period of current fiscal year. The impact will be more visible on non food prices

while the food prices are likely to remain stable due to effective monitoring of prices and smooth supply of essential commodities by the federal and provincial governments.

2.1.3.6 Trade and Payment

The export target for FY2019 was set at US$ 28 billion. Exports registered a decline of 1.9 percent growth during July-April FY2019. Exports during July-April FY2019 reached to US$ 20.09 billion as compared to US$ 20.48 in July-April FY2018. Import target for FY2019 was set to US$ 56.5 billion. Imports stood at US$ 44.03 billion in July-April FY2019 as compared to US$ 46.30 billion in the same period last year showing a decline of 4.9 percent. The reduction in imports is due to decrease in imports of furnace oil, machinery & electric equipment, palm oil, colza seeds and textiles. Trade account especially services trade presented a positive picture in FY2019. Goods Trade balance contracted by 7.3 percent during Jul-Apr FY2019 to US$ 23.93 billion as compared to US$ 25.81 billion in the corresponding period last year. On the other hand, services sector remained on positive trajectory throughout FY2019. Major shift in current account balance also came from services sector which shrunk by 36.18 percent to US$ 3.217 billion during Jul-Apr FY2019 as compared US$ 5.04 billion in the same period last year.

Pakistan's current account deficit outlook remains positive throughout FY2019. Current account deficit reached to US$ 11.586 billion in Jul-April FY2019 as compared to US$ 15.864 billion in the same period last year and showed a contraction of 26.9 percent. While last year during the same period it widened by 69.6 percent during July-April FY2018. However, month on month it increased to US$ 1241 million in April FY2019 as compared to US$ 871 million in March FY2019. Decreasing exports and low remittances, specifically from EU and UAE, pushed up CAB in the month of April FY2019. The remittances registered a significant growth of 8.45 percent during July-April FY 2019 as compared to 5.36 percent last year, and reached to US$ 17.875 billion during first ten months of current fiscal year against US$ 16.482 billion during the same period last year. On the back of initiatives taken by the government and the trend observed, it is expected that target of US$ 21.2 billion for FY 2019 is likely to be achieved.

Foreign investment remained low during Jul-Apr FY2019. It dropped by 51.7 percent in July-April FY2019 to US $ 1.376 billion as compared to US $ 2.849 billion in July-April FY2018. FDI from China remained at 31.2 percent of overall inflows as compare to 60.5 percent in the

preceding year. However, China continued to dominate direct investment followed by UK and Hongkong. A considerable decline in investment from Malaysia has been observed in this period. Foreign portfolio investment account witnessed an outflow of US$ 1.27 billion in July-April FY2019 as compared to US$ 2.352 billion inflows in the same period last year. Eurobond and Sukuk bonds in December 2017 worth of US$ 2.5 billion were the main reason of the hump in FPI last year. However, amid decline in foreign investment, external financing from bilateral sources were quite helpful.

Meanwhile, Pakistan has also improved its position on ease of doing business index and jumped to 136th position as compared to 147th position last year out of total 190 economies. This will surely attract foreign investors and will boost FDI. Although the higher import bills and debt repayments led to depletion of FR reserves. Yet it was stabilized with the help of monetary inflows from friendly countries. Pakistan had received US$ 9.2 billion as a financial support from China, Saudi Arabia and UAE between July 1, 2018 and end-March 2019. Foreign exchange reserves stood at US$ 15.722 billion till end-April FY2019. This was below than the total reserves of US$ 17.519 billion of the same period last year. Out of this SBP reserves were US$ 8.781 billion, where reserves held with commercial banks were US$ 6.941 billion. The PKR also remained under pressure during the year, as despite the decline in the current account gap, it stayed at a high level. Responding to the resulting payment pressures, the PKR depreciated by 14.1 percent against the US Dollar between July 1, 2018 and April 22, 2019.

2.1.3.7 External Debt and Liabilities

Total public debt stood at PKR 28,607 billion at end of March 2019, recording an increase of PKR 3,655 billion during the first nine months of current fiscal year. The bifurcation of this increase is as follows:

The cumulative increase in debt stock cannot be entirely attributed to the borrowing of the government. External loans are contracted in various currencies; however, disbursements are effectively converted into PKR. Thus, devaluation of PKR against international currencies can increase the value of external public debt portfolio when converted into PKR for reporting purposes. This is evident from the fact that increase in external public debt contributed PKR 1,900 billion to the public debt during first nine months of ongoing fiscal year while government borrowing for financing of fiscal deficit from external sources was

PKR 524 billion during the said period. This differential was mainly on account of depreciation of PKR against US Dollar. It is worth noting that depreciation of PKR increases the rupee value of external public debt, however, any such negative impact is spread over many years depending on the life of any given loan and immediate cash flow impact is not significant. The domestic debt registered an increase of PKR 1,754 billion while government borrowing for financing of fiscal deficit from domestic sources was PKR 1,398 billion. This differential is mainly attributed to an increase in credit balances of the government with the banking system.

Pakistan's public debt dynamics witnessed various developments during the ongoing fiscal year, some of them are highlighted below:

Government introduced Pakistan Banao Certificates (PBC) which is a US Dollar denominated retail level instrument, for Pakistanis having bank accounts overseas. PBC is the first sovereign retail instrument being offered by Government of Pakistan that allows overseas Pakistanis to contribute towards their country's development while providing attractive investment opportunity. Borrowing from commercial sources have relatively increased during the last few years, however, external public debt still largely comprises multilateral and bilateral sources which cumulatively constituted 78 percent of external public debt portfolio at end March 2019. These multilateral and bilateral loans are contracted at concessional terms.

Government has taken various measures to transform Central Directorate of National Savings from merely a retail debt raising arm of the government to an effective vehicle for financial inclusion. Initiatives are being taken to introduce Sharia Products, Overseas Pakistanis Savings Certificates, PKR 100,000 Premium Prize Bonds, Scrip-less Issuances, Registered Prize Bonds, Debit Cards & Membership of 1-Link System.

In accordance with the Medium Term Debt Management Strategy (2015/16-2018/19), at end June 2018, three of the nine thresholds were breached by a range varying from 0.5 percent to 1.6 percent. The upper range for the risk indicator "Domestic Debt Maturing within a Year" was 65 percent while this indicator at end June 2018 was recorded at 66.3 percent. The banks opted to tilt their portfolio towards short term market treasury bills as expectation of a further rise in policy rate discouraged them to invest in long-term debt instruments, largely to manage market risk. The upper range for "Domestic Debt Re-Fixing in 1 Year" and "Public

Debt Re-Fixing in 1 Year" was envisaged at 65 percent and 55 percent respectively, while these indicators stood at 66.6 percent and 55.5 percent respectively at end June 2018. Short term external public debt maturities were 80.6 percent of official liquid reserves at end June 2018 compared with 68.5 percent at end June 2013.

During first nine month of current fiscal year, EDL recorded an increase of US$ 10.6 billion to stand at US$ 105.8 billion at end March 2019 out of which public debt was US$ 74.2 billion. External public debt increased by around US$ 3.9 billion during first nine months of current fiscal year compared with the increase of US$ 6.7 billion witnessed during the same period last year. Government is committed to achieve the targets outlined in Fiscal Responsibility and Debt Limitation Act, 2005. Over the medium term, Government's objective is to bring and maintain its Public Debt-to-GDP and Debt Service-to-Revenue ratios to sustainable levels through a combination of greater revenue mobilization, rationalization of current expenditure and efficient and productive utilization of debt.

2.1.3.8 Energy

The energy side bottlenecks have hampered the economic growth of the country in the past. In order to address the energy shortage, massive projects were incorporated in between years 2013-18, adding a cumulative capacity of 12,230 MW. However, the transmission and distribution side congestion. and inefficiencies has hampered the sustained delivery of energy services. Additionally, the higher energy prices are also a by-product of such aggressive capacity additions during 2013-18.

In term of energy-mix, in FY2018, Pakistan's reliance on oil has been reduced to 31.2 percent while reliance on gas has been reduced to 34.6 percent, while the share of hydel energy stood at 7.7 percent. Though the declining share of oil is a welcoming sign, the diminishing share of hydro represents the shortsightedness of policy as well as the inability of successive governments to undertake large capital-intensive projects in a timely manner. The reduction of natural gas share is somewhat attributed to declining natural gas reserves as well as restricted consumption of gas in the transport industry and the induction of liquefied natural gas (LNG) since 2015. The share of imported LNG has increased from 0.7 percent in FY2015 to 8.7 percent in FY2018. The share of renewable was at 1.1 percent in FY2018 while the share of nuclear has increased to 2.7 percent in FY2018.

Such historical variability for each energy source in the energy mix of the country has been used to formulate the Integrated Energy Plan which will not only help in estimating the energy demands and respective supply paths for the future but also in formulating the evidence based long term policy options. The immediate focus of the government is to reduce the losses and increase the effectiveness of the whole value chain. Power Division, Ministry of Energy has given a target to DISCOs to recover Pakistani Rupee (PKR) 80 billion from old receivables and to ensure that the receivable figures do not increase from the level recorded on 31st October 2018. Further, DISCOs have been given a target to recover another PKR 60 billion by controlling theft and improving governance and efficiency. As of end March 2019, total installed capacity of electricity reached 34,282 MW which was at 33,433 MW at end of March 2018, thus, posting a growth of 2.5 percent. Although electricity generation varies due to availability of inputs and other constraints, the generation increased from 82,011 GWh to 84,680 GWh, posting a growth of 2.1 percent during the period under discussion.

As far as the share of different sources of electricity generation is concerned, it can be observed that the share of hydro in electricity generation has decreased over the last few decades. Availability of water is one of the main reason for reduced generation from hydel power plants. Currently, thermal has the largest share in electricity generation. Share of RLNG has shown a tremendous growth in energy mix as it served the demand of various power plants (Bhikki, Haveli Bahadur Shah, Balloki, Halmore, Orient, Rousch, KAPCO, Saif and Sapphire) as well as that of fertilizer plants and industrial and transport sector. The government has also shown its commitment for electricity generation through renewable energy sources. During July 2018 - March 2019, there was an increase of 1 percent in share of renewables in electricity generation, and it is expected that the share will further increase in coming years.

2.1.4 Economic sectors

Agriculture is the mainstay of Pakistan’s economy. The performance of Agriculture during 2018-19 remained subdued. It grew by only 0.85 percent against the target of 3.8 percent. The under-performance of agriculture sector hinged upon reduction in the area of cultivation, lower water availability and drop in fertilizer off take. The crops sector has witnessed negative growth of 4.43 percent against the target 3.6 percent on the back of decline in growth of important crops by (-6.55) percent. Sugarcane production declined by (-19.4) percent to 67.174 million t, Cotton (-17.5 percent) to 9.861 million bales and Rice (-3.3

percent) to 7.202 million tonnes while production of Maize crop increased by 6.9 percent to 6.309 million tonnes and production of wheat crop marginally increased by 0.5 percent to 25.195 million tonnes. Other crops having share of 11.21 percent in agriculture value addition and 2.08 percent in GDP, showed growth of 1.95 mainly due to increase in production of pulses and oilseeds. Cotton ginning declined by 12.74 percent due to decrease in production of cotton crop.

Livestock having share of 60.54 percent in agriculture and 11.22 percent in GDP, recorded the growth at 4.0 percent against the target of 3.8 percent. The Fishing and Forestry sector having share of 2.10 percent each in agriculture value addition grew by 0.79 and 6.47 percent, respectively. The strong growth in forestry is due to increase in timber production in Khyber Pakhtunkhwa in the range of 26.7 to 36.1 thousand cubic meters.

The gram production increased by 35.6 percent on account of higher yield due to favourable weather condition prevalent at the time of sowing. The production of Bajra increased by 3.2 percent. The production of Barley, Rapeseed & Mustard and Tobacco remained constant while the production of Jowar witnessed a decline of 2.6 percent. The production of Onion and Chillies witnessed increase of 2.0 percent to 2.12 thousand tonnes and 0.4 percent to 148.7 thousand tonnes respectively, as compared to production of last year. However, the production of pulse Mash (Lentil), Moong and Potato decreased by 5.5 percent, 3.4 percent and 0.3 percent, respectively compared to last year's production. While the production of Masoor pulse remained the same as last year's production.

The total availability of water for the Kharif crops 2018 recorded 59.6 Million Acre Feet (MAF), which means it remained short by 11.2 percent against the average system usage of 67.1 MAF and by 14.9 percent as compared to Kharif 2017. During Rabi season 2018-19, the total water availability was recorded at 24.8 MAF showing an increase of 2.5 percent over Rabi 2017-18 and a decline of 31.9 percent from the normal availability of 36.4 MAF.

The domestic production of fertilizers during 2018-19 (July-March) increased by 2.6 per cent over the same period of previous year. This increase is due to functioning of two urea manufacturing plants (Agritech& Fatima Fertilizer) as supply of LNG was available on subsidized rates. The imported fertilizer increased by 4.8 percent. Therefore, total availability of fertilizer increased by 3.2 percent during current fiscal year. Total off take of fertilizer nutrients decreased by 7.3 percent. Nitrogen off take decreased by 2.89 percent and

phosphate by 18.2 percent. Potash off take recorded an increase of 4.55 percent during 2018-19 (July-March). Reduction in fertilizers off take was due to its high prices.

In line with government's priority for agriculture sector development, Agricultural Credit Advisory Committee (ACAC) has set the indicative agricultural credit disbursement targets at Rs 1,250 billion for FY 2018-19 to 50 agriculture lending institutions including 19 commercial banks, 2 specialized banks, 5 Islamic banks, 11 microfinance banks and 13 microfinance institutions/rural support programs (MFIs/RSPs).

During FY 2018-19 (July- March), the agriculture lending institutions have disbursed PKR 805 billion which is 64.4 percent of the overall annual target of PKR 1,250 billion and 20.8 percent higher than the disbursement of PKR 666.2 billion made during corresponding period of last year. The outstanding portfolio of agriculture loans has increased by 15.5 percent to PKR 70.7 billion by end March, 2019. Further, the agriculture outreach in terms of total borrowers has increased to 4.0 million, showing a rise of 8.2 percent over 3.72 million borrowers as of end June, 2018.

The Large-Scale Manufacturing (LSM) declined by 2.93 percent during July-March FY 2019 in contrast to growth of 6.33 percent during the same period last year. The target for this year was 8.1 percent. The present trend suggests that full year LSM growth will remain below the target by a wide margin. Year on Year (YoY), LSM growth witnessed sharp decline of 10.63 percent in March 2019 as compared to increase of 4.70 percent in March 2018.

There are a number of factors which have contributed to the negative growth in LSM. These include lower PSDP expenditures compared to last year, muted private sector construction activities and lower consumer spending on durable goods amongst others. This was more noticeable in construction-allied industries. Demand for housing moderated as the price of building materials and cost of financing increased. Moreover, additional tax measures further restricted the real estate market. Certain sector-specific issues also contributed to the decline in LSM. Automobile prices witnessed multiple upward revisions due to PKR depreciation which made the potential buyers refrain from making booking and purchases. Certain restrictions on non-filers with respect to purchase of cars further dampened the automobile demand. Pharmaceuticals also suffered due to a considerable lag in regulatory adjustments in prices. This pricing issue was in addition to weakening of the local currency, which added to the distress of an import dependent sector.

The industry specific data shows that electronics recorded highest growth of 23.70 percent, wood products 15.21 percent, rubber products 3.47 percent, engineering products 9.54 percent, leather products 0.97 percent and fertilizers 4.50 percent. The industries which recorded negative growth during the period are; Iron & Steel 11.00 percent, Pharmaceuticals 8.40 percent, Automobile 7.58 percent, Coke & Petroleum products 6.00 percent, Food Beverages & Tobacco 4.69 percent, Chemicals 3.94 percent, Paper & Board 3.86 percent, Non-metallic mineral product 4.96 percent and Textile 0.30 percent. The Mining and Quarrying sector declined by 1.96 percent during Jul-Feb FY 2019 in contrast to the growth of 7.7 percent during the same period last year. Chromite, Magnesite, Rock salt, Barytes, Ocher and Crude oil posted a positive growth of 228.69 percent, 159.63 percent, 12.65 percent,

A strong, efficient and affordable infrastructure is a critical element of a good investment climate and therefore, is a pre-condition to sustain the growth momentum. Transport and Communications both are important elements of infrastructure services and are essential in maintaining economic growth and competitiveness.

NHA network comprises of 47 national highways, motorways, expressways and strategic roads with cumulative length of 12,743 km. NHA's portfolio consists of 38 on-going projects with an allocation of PKR 176,636.80 million in PSDP 2018-19 out of which 66,700.00 million is the Foreign Exchange Component (FEC) and PKR 109,936.80 million is the local component. There are 08 new schemes as well in PSDP 2018-19 with total estimated cost of PKR 8,561.00 million. On Eastern Alignment, as a short-term project, NHA in corroboration with China-Pakistan Economic Corridor (CPEC) is completing 3,005 Km length of roads on 17 different projects while on western alignment, as short to medium term projects, a total of 1,799 Km length of roads construction on 6 different projects is in progress and on central alignment, as medium to long term projects, a total of 626 Km length of roads on 3 segments are under study with indicated plan period of 2025-30. NHA has already constructed four segments of Pakistan Motorway Network i.e., Peshawar -Islamabad Motorway (M-1), Islamabad - Lahore Motorway (M-2), Lahore - Abdul Hakeem Motorway (M-3) and Pindi Bhattian- Gojra Section and Khanewal - Multan Section of Motorway (M-4) on a virgin corridor. NHA is now constructing the remaining section of M-4 from Gojra - Khanewal. Work on Karachi - Hyderabad Motorway (M-9) on BOT basis is also substantially

completed. After completing its current projects by December 2019, the total length of motorways will become 2,362.2 Km.

CPEC is the flagship and most actively implemented project of Belt & Road Initiative (BRI) where Pakistan and China have successfully launched 22 projects on the ground, costing more than US$ 28.5 billion. Chinese and Pakistani workforce, in a large number, is employed to ensure timely completion of the infrastructure projects and launch new projects like ML-1, Eastbay Expressway and Airport at Gawadar. Pakistan and China are also executing Cross-border Fibre optic project (Khunjerab-Rawalpindi).

Pakistan Railways comprises of 470 locomotives (458 Diesel Engine and 12 Steam Engines) for 7,791-kilometre length of route. During FY 2019(July -February), gross earnings grew by 10.3 percent to Rs 34,0661 million against Rs 30891.1 million during the same period last year. During the period July- February FY 2019, number of passengers carried increased to 39.9 million against 35.9 million during the same period last year, thereby, recording a growth of 11.0 percent. Likewise, passenger traffic Km (million), freight carried tons million, and freight tons Km (million) grew by 11.9 percent, 2.9 percent and 7.8 percent, respectively.

Pakistan International Airlinesair (PIA) is in the process of implementing its Strategic Business Plan 2019-23 to improve its performance by acquiring new aircrafts for its fleet.

PNSC has achieved substantial growth of 35 percent in its revenue (from PKR 1,272 million to PKR 1,717 million) in managed bulk carrier segment and growth of 28 percent (from PKR 3,001 million to PKR 3,833 million) in liquid cargo segment through its managed vessels. Fleet Direct operating expenses decreased to PKR 5,500 million (including PKR 1,104 million from PNSC) from PKR 5,747 million (including PKR 1,738 million from PNSC), thereby resulting in gross profit of PKR 1,852 million as against PKR 1,656 million for the same period last year. PNSC profitability has increased by 61 percent with Profit after Tax of PKR 1,402 million during this period against PKR 872 million in the same period last year. Earnings per share for the PNSC increased to PKR 10.62 against PKR 6.60 during the corresponding period of last year. Two LR-1 tankers have been added in PNSC's managed fleet namely "M.T. Bolan" and "M.T. Khairpur".

The Karachi Port Trust’s operational performance during FY 2018-19 (July-March) stood at 35,361,000 t. The export cargo handled 10,415,000 t as compared to 9,206,000 t last

year, showing a substantial increase of 13 percent, while volume of import cargo stood at 24,945,000 t, as against the 31,379,000 t handled last year, showing a decrease of 22 percent. The restricted import is due to government's measures to discourage non essential imports.

Total through put of Port Qasim Authority increased by 12.6 percent. The port's operational performance during FY 2018-19 (July-March) stood at 36.580 million tonnes, showing an increase of 12.6 percent over the corresponding period of last year. The volume of import cargo during July-March 2018-19 stood at 31.293 million t, as against the 27.342 million t handled during corresponding period last year, showing an increase of 14.4 percent. The export cargo handled was 5.287 million tons during first nine months of FY 2018-19, as compared to 5.127 million t handled during corresponding period last year, showing an increase of 3.7 percent. A total of 1,139 ships called on Port, which comprised 371 Container ships and 768 Non-Container ships.

Gawadar Port is the second greatest monument of Pak-China friendship after Karakoram Highway linking Pakistan and China. Gawadar has handled last year around 7.156 Metric Ton Cargo from 53 ships.

The telecommunication market in Pakistan is open and deregulated, offering level playing field to operators. The Universal Services Fund Company (USF Co.) launched projects to provide telecommunication coverage to approximately 12,000 unserved mauzas with a population of around 15 million, across all provinces of Pakistan. In current fiscal year USF has successfully launched a project to provide coverage to the unserved segments, spanning 669 kms, on National Highway 10 and National Highway 25 (partially). There has been a consistent growth in IT&ITeS-BPO remittances over last 5 years, with 151 percent growth in IT&ITeS-BPO remittances at a compound annual growth rate (CAGR) of 20 percent, the highest growth rate amongst all industries, and the highest in the region. Pakistan's IT &ITeS-BPO exports are estimated to have crossed US $ 3.3 billion a year at present. In addition, export remittances earned by MSMEs and freelancers are estimated to be $500 million. Whereas annual domestic revenue exceeds $1 billion. A new state of the art IT Park in Islamabad is being established under financing from Korea Exim Bank through the Economic Development Cooperation Fund (EDCF), spreading over an area of 14.9 acres of land. The construction of IT Park will be undertaken in two phases. Cost estimate for first phase is USD 88.25 million for which loan agreement has been signed. It is expected that design and construction of IT Park will be completed by 2022. The cellular mobile sector has invested US $158.3 million during the first two quarters of FY

2018-19. By the end of March 2019, the total number of mobile subscriptions in Pakistan reached 159 million with the net addition of 8.8 million subscribers during July, 2018 to March 2019. Biometric re-verification of SIMs in 2014-15 had an adverse impact on the cellular subscriber base. The number of broadband subscriber addition during first nine months of 2018-19 stood at 10 million. Pakistan Telecommunication Authority (PTA) has generated over PKR 209 billion during June 2013 to March 2019 through its levies, fee and other charges.

Total number of registered TV sets holders as on 31st March, 2019 are 19,138,693.

Pakistan Post has launched "The Same Day Delivery Services" to facilitate the delivery of packets and documents within the city. The service was launched in November 2018 in 26 cities and will be extended to other cities in future. During the first six months (July to December) of the current fiscal year 2018-19 Pakistan Post Office Department has received the foreign remittances amounting to Rs 4,256.478 million. Total number of Post Offices in Pakistan as on March 2019 are 10496.

2.1.5 Environmental Overview

Sustainable development remains the cornerstone of government policies, and the concern for environment, its protection, renewal and enrichment is recognized as an obligation for the betterment of all citizens. The poverty environment nexus has been of particular interest in the recent years, as poverty in Pakistan, like in many other middle-income countries, plays an important role in increasing the vulnerability of the poor to pollution and environmental degradation.

Several policies, plans, programs and projects have been initiated for environmental protection and conservation in the areas of water and air pollution control, land use, forest management, energy efficiency, biodiversity conservation, and waste management, etc. One of the major achievements during 2005-06 was the formulation of the "National Environmental Policy 2005" which addresses the issues such as (a) water management and conservations, (b) energy efficiency and renewable energy, (c) agriculture and livestock, (d) forestry and plantation, (e) biodiversity and protected areas, (f) climate change, air quality and noise, and (g) pollution and waste management.

The key factors contributing to air pollution in Pakistan are: a) rapidly growing energy demand; b) increasing industrial and domestic demand and c) a fast growing transport sector. In the cities, widespread use of low-quality fuel, combined with a dramatic expansion in the number of vehicles on roads, has led to significant air pollution

problems. Air pollution levels in Pakistan's most populated cities are among the highest in the world, causing serious health issues in the process. The government is promoting the use of Compressed natural gas (CNG) in a big way to reduce the pollution level. Presently, some 935 CNG stations are operational throughout the country, while another 200 are under construction.

As of April 2006, the total number of CNG vehicles stood at 950,000, compared to 700,000 vehicles in April 2005, making Pakistan's CNG fleet the largest in Asia and the third largest in the world after Argentina and Brazil. Water availability in Pakistan continues to decrease, both in total amount of water as well as in the per capita water availability in Pakistan. In 1951, when population stood at 34 million, per capita availability of water was 5300 cubic meter, which has now decreased to 1105 cubic meter, just touching water scarcity level of 1000 cubic meter. With a present growth in population and the low rainfall, the threshold limit of water scarcity i.e. 1000 m^3 of water per capita per year may be reached as early as the year 2010. Various mega initiatives have been planned especially under WAPDA vision 2025. The estimates show that the current water shortage of 9 million acre feet would aggravate to 25 MAF if all planned dams under Vision 2025 are not constructed by 2016.

The Government is committed to supply safe drinking water to its people and in this regard has started implementation of a "Clean Drinking Water Initiative" Project in 2005, which caters for the installation of 544 water purification plants of 2000 gallons/ hour capacity, one in each Tehsil of Pakistan. A new project on "Clean Drinking Water for All" under Khushal Pakistan Program, has been recently approved and caters for installation of around 6035 water purification plants of different capacities (500/ 1000/ 2000 gallons/ hour), one in each union council of Pakistan. Like many other developing countries, dry lands in Pakistan are severely affected by land degradation and desertification due to unsustainable land management practices and increasing demand of natural resources causing enormous environmental problems. The situation is further aggravated by scarcity of water, frequent droughts and miss-management of land resources, contributing to expansion of deserts, reduced productivity and consequently increases in rural poverty. In order to address the problems of land degradation and desertification, the Ministry of Environment, Government of Pakistan has taken an initiative and designed a full-scale project on "Sustainable Land Management to Combat Desertification in Pakistan". The project aims at combating desertification and improving land management practices to eradicate poverty in arid and semi-arid regions of Pakistan.

Forestry sector plays an important role in soil conservation, water regulation for irrigation and power generation, reduction of sedimentation in water conveyances and reservoirs, employment and maintenance of ecological balance. Under the Millennium Development Goals of the Forestry Sector, Pakistan was committed to increase forest cover from 5 % to 5.7% by the year 2011 and to 6% by the year 2015. Furthermore the "Billion Tree Tsunami" was launched in 2014, by the government of KPK as a response to the challenge of global warming. In 2018 the "Green Clean Pakistan" project started with the aim of planting millions of trees and cleaning the country within the 5 years project.

The Government of Pakistan is implementing a number of Policies and programs in the Environment Sector. National Environment Action Plan (NEAP) remains the Flagship program of the Ministry of Climate Change. The main objectives of NEAP are to safeguard public health, promote sustainable livelihood and enhance quality of life for the people of Pakistan. It focuses on clean air, clean water, solid waste management and eco-system management.

2.2 Environmental Policy and General Legislative Framework

2.2.1 National environmental policy 2005 (NEP-2005)

The National Environment Policy (NEP) provides an overarching framework for addressing the environmental issues facing Pakistan, particularly pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change. It also gives directions for addressing the cross sector issues as well as the underlying causes of environmental degradation and meeting international obligations.

NEP-2005, while recognizing the goals and objective of the National Conservation Strategy, National Environmental Action Plan and other existing environment related national policies, strategies and action plans, provides broad guidelines to the Federal Government, Provincial Governments, Federally Administrated Territories and Local Governments for addressing environmental concerns and ensuring effective management of their environmental resources. The Provincial, AJK, Northern Areas and Local, Governments, however, may devise their own strategies, plans and programs in pursuit of this Policy.

NEP-2005 Goal is to protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development.

NEP-2005 Objectives are:

i. Conservation, restoration and efficient management of environmental resources.

ii. Integration of environmental consideration in policy making and planning processes.

iii. Capacity building of government agencies and other stakeholders at all levels for better environment management.

iv. Meeting international obligation effectively in line with the national aspirations.

v. Creation of a demand for environment through mass awareness and community mobilization.

NEP-2005 provides guidelines for the sectors: water supply and management, air quality and noise, waste management, forestry, biodiversity and protected areas, climate change and ozone depletion, energy efficiency and renewable energy, agriculture and livestock, and multilateral environmental agreements. It also provides guidelines for the cross-sectors: environment- poverty, - population, - gender, -health, -trade, -local government and natural disaster management.

For achieving the objectives of NEP-2005, the following policy instruments are identified:

- Integration of environment into development planning;
- Legislation and regulatory framework;
- Capacity development;
- Economic and market-based instruments;
- Public awareness and education.

2.2.2 Public-Private-Civil Society Partnership

The National Environment - Policy envisages that:

i. Federal, provincial and local governments would be encouraged to build strategic partnerships with private sector and civil society organizations for

effective environmental management through creation of enabling environment.

ii. Public private partnership for expansion and improvement of environmental services such as potable water supply, sewage disposal, efficient transport and efficient energy production would be promoted.

iii. Sector specific advisory committees involving public, private and civil society organizations would be established.

iv. The concept of participatory approaches and practices would be included in the curriculum of environmental education and training program.

2.2.3 Implementation and Monitoring

The Ministry of Environment is striving for implementation of NEP. All relevant Ministries, Departments and Agencies would also devise plans and programs to implement the policy provisions relating to their respective sector/ sub-sector. Similarly, the Provincial Governments, Federally Administrated Territories and local governments would also devise their own strategies, plans and programs for implementation of the Policy.

To ensure effective coordination of Policy implementation and oversee the progress in this regard, a National Environment Policy Implementation Committee established at the Federal level. The composition of the Committee is a follows:

i. Secretary, Ministry of Environment (Chair);

ii. Secretary, Planning and Development Division;

iii. Secretary, Ministry of Industries;

iv. Secretary, Ministry of Finance;

v. Secretary, Ministry of Food, Agriculture and Livestock

vi. Secretary, Ministry of National Health Services, Regulations and Coordination;

vii. Secretaries of Provincial/ AJK/NA Environment Department;

viii. Three representatives from the Corporate Sector/Chambers of Commerce and Industry;

ix. Three representatives from the Civil Society Organizations;

x. Directors General (Environment), Ministry of Environment (Secretary/Member) "National Environment Policy Implementation Committee" would meet biannually. The Committee would report the status of implementation of the Policy to Pakistan Environmental Protection Council on regular basis.

An "Environment Policy Directorate" would be established in the Ministry of Environment to serve as the Secretariat to the Committee. All relevant Federal Ministries as well as Provincial Government's would also create special cells to coordinate implementation of the Policy. Furthermore, Provincial, District and Tehsil Governments would also constitute "Policy Implementation Committees" in order to ensure coordinated implementation of the Policy through effective participation of all stakeholders, including corporate and civil society organizations.

2.2.4 General Legislative framework

In Pakistan there is Federal System of Government comprising of 4 provinces (Sindh, Punjab, KPK and Balochistan) and other areas as defined in article 1 of the Constitution of the Islamic Republic of Pakistan, 1973. Amongst others these areas include the federally administered Tribal Areas (FATA) and the Provincially administered Tribal Areas (PATA). Along with the North Eastern Frontier of Pakistan there is also the territory of Azad Jammu & Kashmir (AJK), which is for all intents and purposes under the administrative control of the Government of Pakistan.

Acts:

The federal laws are made by the Parliament i.e. National Assembly, Senate and the President. These laws are for the whole of the country and those dealing with foreign affairs. The procedure is detailed in articles 70 onwards of the Constitution of Pakistan. The subjects on which legislation can be done by the Parliament and Provincial Assemblies are contained in the Federal Legislative List and Concurrent Legislative List, in the fourth schedule to the Constitution. Legislation can be done on the matters contained on the concurrent list by either the National or Provincial Assemblies. However legislation on the matters not contained in either of the lists can be done only by the Provincial Assemblies.

Laws getting approval from the National Assembly are sent to the Senate for approval and then for approval by the President, where after they become the law of the land. The laws

can also be initiated from the Senate wherefrom, they can be sent to the National Assembly and then to the President.

Laws getting approval from the Provincial Assembly are sent to the respective Governor of the province after whose assent it becomes the law of the province.

Ordinances:

When the National Assembly is not in session, the President of Pakistan can, under article 89 of the Constitution of Pakistan issue Ordinances. An Ordinance remains valid for a period of 4 months.

Rules:

These are the principles to which an action or procedure is intended to conform and are always framed in the exercise of power delegated under a statute.

Regulations:

These provide for specific measures required to put an act or ordinance into effect. Article 247 of the Constitution of the Islamic Republic of Pakistan, 1973 gives the President and / or Provincial Government, the authority to make regulations "for the peace and good government" of the tribal areas.

Orders:

These may deal with a broad range of substantive issues such as the provincial constitutional order and legal framework order, or with a specific and limited situation as in the case of Environment Protection Orders that can be issued under the Pakistan Environmental Protection Act, 1997.

Administrative orders are issued by a designated authority in exercise of a delegated power to administer a particular issue. The status of an order depends on the delegated power under which it is issued.

Notifications:

These are not a separate class of legal instrument. They are the mechanism by which the executive branch of government promulgates rules and regulations. In certain cases, notifications also serve as a means to communicate specific official actions taken to accomplish a particular, limited purpose, such as designating a protected area.

Federal Shariat Court:

There is a Federal Shariat Court created under article 203/C of the Constitution of Pakistan. It has the exclusive jurisdiction to examine any law, whether it is against the

principles of Islam or not. The court can declare any law to be against the injunctions of Islam and can give the government a deadline to make changes or enact new law, after which it ceases to be on the statute book

Powers of Superior Courts:

The superior courts i.e. High Courts and Supreme Court of Pakistan can declare any law to be ultra vires of the Constitution and strike down the same.

Money Bill:

A money bill goes only in the National Assembly, however through an amendment in the Constitution, now it goes to the Senate which sends its recommendations to the National Assembly for considerations before passing the same.

Conflict of Laws:

If there is any conflict between any provision of Constitution and any law or Ordinance, the provision of Constitution will prevail. Similarly if there is conflict between any rules / regulations and any law, the law will prevail.

Interpretation of Laws:

The Parliament has the exclusive jurisdiction for legislation and to make changes / amendments in existing laws, however it is for the superior courts to interpret laws.

Case Law:

The judgements of the Superior Courts of Pakistan are called case law or precedents. The High Court is the highest court in the province, decisions given by which can be challenged before the Supreme Court, which is the highest court in the country. A judgement given by a High Court is binding on all courts subordinate to it and a judgement of the Supreme Court is binding on all courts, tribunals and executive authorities throughout Pakistan.

2.2.5 Legislation and Regulations Addressing POPs Chemicals

Since 1860 laws have addressed certain aspects of the environment, such as measures against the fouling of public water or the protection of specific species. However, these laws were insufficient for environmental protection as a whole. The laws were either not enacted for the purpose of environmental protection and resource conservation, and their environmental content was ancillary. Other laws were narrowly focused on a selected aspect. Most lacked a proper definition of the environment, lacked measurable standards, implementation tools, were not backed up by adequate resources, and were punitive in

character, while the prescribed fines were eroded by inflation. For the first time in Pakistan a constitutional provision relating to "Environmental Pollution and Ecology" was added as item 24 in the Concurrent Legislative List whereby both the Federal as well as the Provincial Legislature were authorized on the subject.

The first law formally designated as Environmental Law was the Pakistan Environmental Protection Ordinance, 1983.

A study was carried out in the early 90s when the National Conservation Strategy was formulated. This Strategy forms the basis of today's policies and laws relating to environment.

In 1997 the Pakistan Environmental Protection Act ("Act") received the assent of the Parliament with a comprehensive definition of environment and a Sustainable Development Fund for its implementation. This law provides the general framework for environmental legislation. Pakistan Environmental Protection Act 1997 (PEPA-97) is a comprehensive document and provides for the protection, conservation, rehabilitation and improvement of the environment and promotion of sustainable development. The Act covers air, water, soil, noise pollution and hazardous waste.

Prior to the adoption of the 18th Constitutional Amendment, the Pakistan Environmental Protection Act (PEPA) 1997, was the governing law for environmental conservation in the country. Under PEPA 1997, the Pakistan Environmental Protection Council (PEPC) and Pak EPA were primarily responsible for administering PEPA 1997. Post the adoption of the 18th Constitutional Amendment in 2011, the subject of environment was devolved and the provinces have been empowered for environmental protection and conservation.

PEPA-1997 section 11 prohibits any emissions or discharges in excess of national environmental quality standards (NEQS). Sections 13 and 14 specifically deal with the prohibition of imports of hazardous waste and handling of hazardous substances, respectively.

Other pieces of laws in Pakistan's legal and regulatory framework that governs the toxic and hazardous substances and wastes are "Hazardous Substances Rules-1999" for safe handling, storage of hazardous substance/ Pesticides at a workplace, "Import Trade and Procedures Order-2000", "Guidelines for Hazardous Waste Management in Pakistan", "The Explosive Act-1884," "The Factory Act-1934" regulating the working environment to accommodate the safety and wellbeing of labourers, "The Customs Act-1969" and "Pakistan Nuclear Safety and Radiation Protection Ordinance-1984".

2.2.5.1 Regulatory frame for POPs Pesticides

Agricultural Pesticides Ordinance, 1971

The only law having any significance with respect to POPs in Pakistan is the Agricultural Pesticides Ordinance, 1971. This law was promulgated in 1971 with the purpose of regulating the import, manufacture, formulation, sale, distribution and use of Pesticides in Pakistan. The provisions of this law are supposed to be applied parallel to other laws. Eight POPs are included in pesticides.

Agricultural Pesticides Rules, 1973

Pursuant to the above enactment, rules were made by the name of Agricultural Pesticides Rules, 1973. The rules give the detailed procedures for complying with the provisions of the main law. They contain provisions giving details of registration procedure, grounds for refusal to register. Certain pesticides including certain POPs are required to be labelled as POISON. Recently in January, 2004 rule 12-A was added which makes it incumbent upon the importers, manufacturers and formulators to themselves supervise the packing of pesticides. They are also required to certify that the pesticides are not on the negative list in the developed countries like those of the European Union, as well as other chemicals producing countries such as China and India. The penalty for violating provisions of this law range with imprisonment between 1 and 3 years and with fine up to PKR 500,000/-

West Pakistan Agricultural Pests Ordinance, 1959

This law empowers the government to prohibit the employment of such methods of cultivation as help the spread of agricultural pests either generally or with respect to any particular crop.

This law was promulgated with the aim of preserving quality of land. However it serves a very useful purpose i.e. if the spreading of pests can be controlled then no pesticides whatsoever would be required.

West Pakistan Agricultural Pests Rules, 1960

These rules were made pursuant to above which make it obligatory on the owners of cultivated land to clear the land of all plant remains some time after harvesting of crops.

The Pakistan Plant Quarantine Act, 1976

Section 3 empowers the Federal Government to prohibit imports of articles that are likely to cause infection to any crop or plant.

Almost all of POPs pesticides are banned (

Table 3) only the most recent listed dicofol is still registered. Pentachlorophenol and the PFOS precursor sulfluramide is not banned but also not registered for use.

Table 3. Pesticides banned in Pakistan (Anjum Ali 2018)[19]

ACTIVE INGREDIENTS			
1.	BHC	14.	Disulfoton
2.	Binapacryl	15.	Endrin
3.	Bromophos ethyle	16.	Ethylane dichloride+ Carbontenachloride
4.	Captafol	17.	Leptophos
5.	Chlorodimeform	18.	Mercury compunds
6.	Chlorobenzilate	19.	Mevinphos
7.	Chlorthiophos	20.	Toxaphene
8.	Cyhexatin	21.	Zineb
9.	Dalapon	22.	Heptachlor
10.	DDT	23.	Methyl Parathion
11.	Dibromochloropropane+ Dibromochloropropene	24.	Monocrotophos
12.	Dicrotophos	25.	Methamidophos
13.	Dieldrin	26.	Endosulfan
FORMULATIONS			
1.	Dichlorvos (above 500 g/l)	3.	Methamidophos (above 600 g/l)
2.	Monocrotophos (above 400g /l)	4.	Phosphamidon (above 500 g/l)
NOT REGISTERED			
1.	Aldrin (POP/PIC)	5.	Ethyle di bromide (PIC)
2.	Mirex (POP)	6.	Parathion (PIC)
3.	Chlordan (POP/PIC)	7.	Fluroacetate (PIC)
4.	Dinoseb (PIC)		

2.2.5.2 Industrial POPs - Polychlorinated Biphenyls (PCBs)

The production, supply and use of PCBs is not specifically regulated in Pakistan. Sections 13 & 14 of Pakistan Environmental Protection Act.1997 (PEPA-97) deal, in general, with prohibition of import of hazardous wastes & handling of hazardous substances. PEPA-1997, Section 11 prohibits discharges/emissions into environment above National Environmental Quality Standards (NEQS). However, PCBs have not been specifically

[19] Muhammad Anjum Ali (2018) A Handbook for Agricultural Extension agents on the Pesticides Registered with Recommendatins for Safe Handing and Use in Pakistan Plant Science Devision Pakistan Agricultural Research council Ministry of National Food Security and Research, Islamabad

included in the list of NEQS but as “Phenolic Compounds.” Under the recently introduced “Self-Monitoring and Reporting/SMART ” program for industry in the country, only petrochemicals, petroleum, oil & gas, tanning and leather finishing industries are required to periodically report “Phenolic Compounds” levels (measured as phenol) in their industrial liquid discharges/ effluents. PCBs are not listed as “Banned Items” (Negative List) or “Restricted Items” in the “Import Trade and Procedures Order, 2000.” Nor are PCBs mentioned in “Hazardous Substances Rules 1999.” There is no specific law on polychlorinated biphenyls (PCBs).

Due to the adverse health and environmental impacts caused by PCBs, it is essential that PCBs specific regulations for its complete phase out be developed and implemented in the country. The following action are proposed for strengthening the Legislation on PCBs:

- Ban on export or import of PCBs.
- Law on the phasing out of PCB containing transformers.
- Ban on recovery for the purpose of re-use in other transformers of liquids with PCB contents above 0.005%.
- Law on examination of PCB polluted areas and electrical equipment.
- Law on the requirement on cleaning PCB polluted areas.
- Law on establishment of special facilities for destruction of PCB and PCB containing substances and wastes.
- Law on requirements on collection and transportation of PCB and PCB-containing wastes.
- Law on requirements on labelling/ marking of existing PCB containing transformers.

2.2.5.3 Regulatory frame industrial POPs – POP-BFRs (PBDEs, HBCD, HBB)

There is no specific legislation or regulation for POP-BFRs and related substances. There is a need to identify the short-comings in the regulatory frame that can be modified to bring them in accordance with the Stockholm Convention (action plan).

2.2.5.4 Regulatory frame industrial POPs –PFOS and related substances

There is no specific legislation or regulation for PFOS and related substances. There is a need to identify the short-comings in the regulatory frame that can be modified to bring them in accordance with the Stockholm Convention (action plan).

2.2.5.5 Regulatory frame Unintentional POPs (U-POPs)

There is no specific law on unintentional POPs, such as polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs).

There is a need to identify the short-comings in the regulatory frame that can be modified to bring them in accordance with the Stockholm Convention (action plan).

2.2.6 Climate Change Act 2017

The 2017 Act establishes the Pakistan Climate Change Council (PCCC) to approve, oversee and monitor the implementation of adaptation and mitigation policies by federal and provincial ministries, divisions, departments and agencies across all sectors of the economy. To complement the PCCC, the Act establishes a separate body called the Pakistan Climate Change Authority (PCCA) tasked with researching, preparing and advising the government regarding legislative, policy and implementation measures related to climate change. This includes formulating comprehensive adaptation and mitigation policies and measures designed to primarily do the following:

i) address the effects of climate change,

ii) meet Pakistan's obligations under international conventions and agreements relating to climate change, and

iii) give effect to the national climate change policy.

2.3 Assessment of POPs issues in the country

Assessment of current POPs management in the Pakistan is based on inventories of: pesticides, PCBs, POP-PBDE, HBCD, DDT, PFOS and related substances, and unintentional production of POPs (UPOPs) in particular: PCDDs and PCDFs are described in this section. This section also presents information on current POPs stockpiles, contaminated areas and waste, on remediation of contaminated areas, POPs levels in different environmental media, prediction of future POPs production, use and release, POPs monitoring in Pakistan, as well as current information level, knowledge and education levels of each target group, and the mechanism for information exchange with other parties of the SC.

2.3.1 Assessment of POPs Pesticides (Annex A, Part I)

2.3.1.1 General

Ever since the inception industrial era in early 20th century, use of synthetic pesticides has increased many folds in agricultural. Through agricultural use and runoff, pesticides were and are discharged in large quantity into the environment with adverse effect on non-target organisms including humans. All organochlorine POPs pesticides are lipophilic, bioaccumulate and are toxic to humans and wildlife and DDT is still one of organohalogen compounds detected at highest level in human milk. The adverse effects of persistent pesticides and other pesticides have been known since long, but the ground-breaking revelation of Rachel Carson's book "silent spring" in the year 1962 had, for the first time drawn the attention of global community about the intimidating environmental concern of pesticides with POPs properties like DDT or heptachlor.

Nine of the compounds listed as initial POPs (dirty dozens) under Stockholm Convention were pesticides including aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex and toxaphene. New listed pesticides include chlordecone, lindane (gamma-HCH), alpha- and beta-HCH, endosulfan and PCP. They are listed in Annex A of the SC and are chemicals to be eliminated. Only DDT is listed in Annex B.

After the adverse effects of POPs pesticides were established, the production of these chemicals were banned since early 1970s throughout the developed world and have been substituted in the past 40 years by other pesticides. Often the alternatives pesticides used were not sufficiently assessed and frequently other highly hazardous pesticides (HHPs) have been introduces or pesticides with an impact on pollinators and ecosystem.[20,21]However several developing countries continued production and their illegal use has been and still continued in some developing countries due to poor enforcement of international restriction for these chemicals or the lack of alternatives. From the listed POPs pesticides several exemptions are listed in the Convention including the use of DDT for malaria control, the use of endosulfan as insecticide, the use of PCP for wood treatment of utility poles and cross arms and the use of lindane against head lice and scabies (see

[20] Rahman MM, Weber R, Tennekes H, Sanchez-Bayo F (2012) Substitutes of persistent organic pollutant (POP) pesticides in Bangladesh and the need for a sustainable substitution process. Organohalogen Compounds 74, 1178-1181 http://www.dioxin20xx.org/wp-content/uploads/pdfs/2012/1302.pdf

[21] Chagnon M, Kreutzweiser D, et al. (2015) Risks of large-scale use of systemic insecticides to ecosystem functioning and services. Environ Sci Pollut Res Int. 22(1):119-134. doi: 10.1007/s11356-014-3277-x.

Table 2). Furthermore in many parts of the developing world, poorly stored obsolete POPs-pesticides stocks and other hazardous pesticides in dumpsites, landfills, and warehouses exist and await cleanup and final disposal. The first NIP of Pakistan revealed that at least 6033 t of obsolete pesticides stocks were found throughout the country.

For the update of the NIP the life cycle situation is assessed for initial and new listed POPs pesticides to estimate the current status of POPs pesticides in Pakistan. A major purpose of this NIP update is to assess the remaining stock available in different stores of Pakistan as well as identify the use, storage and disposal activities of POPs.

2.3.1.2 Legislation

Most POPs pesticides have already been banned (

Table **3**)[19] Other POPs pesticides such as pentachlorophenol (PCP) and the PFOS precursor sulfluramide are not banned but also not registered for use. Only Dicofol which just has been listed as POPs in 2019 is still registered as acaricide against mites.

2.3.1.3 Production

Currently there is no production of POPs pesticides in Pakistan. Previously some of the POPs pesticides have been synthesized in Pakistan. For example, DDT has been synthesized at a DDT factory at Aman garh, Nowshehra near Peshawar from 1963 to 1994.[22] Similarly, some other POPs pesticides such as lindane/technical HCH (BHC) has been synthesized by Ittehad chemicals manufacturers at Kala Sha Kaku near Lahore. Once the use of POPs pesticides was banned in Pakistan, these factories stopped producing these pesticides more than 20 years ago. However, the already produced stocks were stored in government and privately owned stores. These produced materials have been applied on crops either in its original form or after mixing it with some other pesticides. Nevertheless, there is no current POPs pesticides production Pakistan.

2.3.1.4 Import

Currently no POPs pesticide is registered in Pakistan and officially imported to Pakistan. However by illegal import of pesticides also POPs pesticides might enter the country. There is no quantitative estimate on the amount of POPs pesticides illegally imported to the country. In particular, it is found that DDT is illegally imported across the Afghan border which originally comes from India. However, there is no correct estimate available for the quantity of POPs pesticides which are illegally imported into Pakistan.

2.3.1.5 Use

A compilation of pesticides registered and used in Pakistan was recently published.[23]POPs pesticides (e.g. DDT, dieldrin, endosulfan, heptachlor, lindane) have been widely used to eliminate various insects and fungi from agricultural crops. PCP has been used in the leather industry and in wood treatment. Similarly, lindane has been used against head lice and scabies control. It may be possible that both PCP and lindane are still used in Pakistan. However, there is no information available about the current use status of these compounds.

[22] Younas A, Hilber I, ur Rehman S, Khwaja M, Bucheli TD (2013) Former DDT factory in Pakistan revisited for remediation: severe DDT concentrations in soils and plants from within the area. Environ Sci Pollut Res Int. 20, 1966-1976.

[23] Muhammad Anjum Ali (2018) A Handbook for Agricultural Extension agents on the Pesticides Registered with Recommendatins for Safe Handing and Use in Pakistan Plant Science Devision Pakistan Agricultural Research council Ministry of National Food Security and Research, Islamabad.

As in many other parts of the world DDT has been widely used in Pakistan to protect the crops from insects. In addition, pesticides have also been used in control of vectors to avoid epidemics. Currently no POPs pesticides are used in Pakistan for any purpose. Because of relatively lesser influence of vector-borne diseases, DDT exemption is not required for Pakistan.

Hence there is no more current use of any confirmed use of POPs pesticides in Pakistan. However, as mentioned earlier, illegal import and use of DDT as well as some other POPs pesticides are still going on in some parts of Pakistan.

2.3.1.6 Release

Currently there are no official direct releases of POPs pesticides since no POPs pesticides are used in agriculture or vector control. However, due to the illegal import of pesticides, also POPs pesticides are still available and used. This results in ongoing direct release of POPs pesticides in Pakistan. Some theft cases of POPs pesticides from the stores of remote areas are also reported. These pesticides are sometimes taken from local population and are applied after mixing with some other pesticides. Spillage of POPs pesticides during their removal and the left over in emptied containers are further sources of POPs dissemination in the environment.

Some release of POPs pesticides from the remaining stocks are likely taking place including releases from wastes and contaminated sites. The stocks are the major sources of release of POPs pesticides in Pakistan. These pesticides stores are located in far-flung areas of Pakistan as well as in major cities under the control of agriculture and plant protection departments. Most of these POPs pesticides stores are locked since more than thirty to forty years. Because of poor storage these POPs pesticides are under the pressure of environmental variables. Under increasing temperature the fumes come out of these stores, spread through the air and create irritating conditions for the local population and wildlife. It has been found that an unknown quantity of POPs pesticides was deteriorated and distributed through the devastating flood of 2010 which hit almost every province of the country. Furthermore, various small scale flash floods have led to the release of an unknown quantity of POPs pesticides that enter the aquatic system and are distributed to soils and sediments.

During NIP update assessment, it was discovered that POPs are handled in an unprofessional way. When containers of POPs pesticides are managed and transported or loaded for destruction, frequently some quantity spills out and reaches the soil directly and is eventually

disseminated in the environment. Both spillage and left over from the sites where POP pesticides were eliminated are a serious threat of POPs pesticides release into the environment. One of the major factor is that these pesticides are used by untrained farmers. Furthermore, they don't use the required personal protective equipment (PPEs). This may not only harm the farmers' health, but also the health of their families[24].

2.3.1.7 Future Use of Pesticides

There is no plan of future use of POPs pesticides in Pakistan. However, dicofol which was listed as POP in May 2019 is still registered and used in Pakistan for cotton.[23]

2.3.1.8 Storage

In the former NIP document, the estimated total quantity of POPs pesticides was 6033 tonnes. Out of total 6033 t, 3800 t were present in Punjab followed by 2016 t in Sindh, 135 t in Balochistan, 48 t in KPK and the rest in AJ&K and GB. The current estimate of remaining POPs pesticides in stockpiles is around 275 t out of total 6033 t reported in the previous NIP. Out of this 275 t, 134 t are now remaining in Sindh, followed by 65.8 t in Punjab, 60 t in Balochistan and 15 t in KPK. The amount present in AJ&K and GB is not estimated in this updated NIP document. The rest is either destroyed through POPs elimination project and government development projects, deteriorated, or spread into the environment through floods. A comparison of former and current POPs pesticides status is compiled in Table 4 whereas province wise storage contents and condition of POPs pesticides is described for each province.

Table 4. Comparison of POPs pesticides quantity (in t) between former and updated NIP

Province	Former NIP	Updated NIP
Punjab	3800	66
Sindh	2016	134
KPK	48	15
Balochistan	135	60
Total	5999	275

[24] Curwin, B. D., Hein, M. J., Sanderson, W. T., et al. (2005). Pesticide contamination inside farm and nonfarm homes. Journal of occupational and environmental hygiene, 2(7), 357-367.

A) POPs pesticide situation in Balochistan Province

In the first phase of this plan to update the existing NIP, the POPs pesticide team visited Baluchistan province and monitored the obsolete POPs pesticide stores under federal and provincial plant protection as well as Agri-extension department. Under the POPs elimination program about 117.73 t of POPs pesticides were removed from the pesticide store, Bohri road, Quetta. But the empty containers of POPs pesticides were lying there causing pungent smell and affecting employees and local population. Currently, about 6 t of HCH (BHC) and 3.5 t of malathion are still present in that store. About 50 t of obsolete pesticides containing HCH (BHC), Heptachlor, DDT etc. and some unidentified containers are found in provincial plant protection store, Seryab road, Quetta. The pesticides were present in two stores as well as in the adjacent open yards which is seriously smelly and unhygienic for the employees and local population. There were many old containers lying open in the yards adjacent to the store and offices. Their labels were not readable. Another store visited was the Agri extension pesticide store at Zarandra bazar, District, Ziarat. This store was relatively small containing an approximate amount of 600 kg of obsolete pesticides. These pesticides contained HCH (BHC), Dieldrin and few unidentified (because of faint labelling) containers and packets. Some obsolete pesticides were stolen from the store by the local growers to apply them upon the local agriculture to improve yield. Fumes of this store were irritating the public all around and particularly in the bazar. The team also inspected the agri-extension store of Muslim town, District Qilla Saifullah. This was an old store containing an approximate amount of 350 kg of obsolete pesticides. When opened pungent fumes were coming out of the store causing suffocation. We noticed that, ventilators were there in the stores walls through which theses fumes come out and irritate the public all around. Also at the agri-extension store of District Loralai, where approximately, 1.5 t of obsolete pesticides were present. This store was located in the center of residential houses and offices, causing serious problems. The Agri extension store of Dalbandin, District Chaghicontains about 0.5 t of obsolete pesticides including 50 liters of heptachlor and the store was smelly. Furthermore, a few other stores under agri-extension department with relatively smaller quantities of obsolete POPs pesticides were identified i.e. Kharan store (approx. 0.5 t), Kohlu store (300 kg), Turbat store (110 kg), Sibi store (approx. 205 liters, spilled and empty bottles), Jhal magsi (105 liters), Noshki district store (10 liters), Noshki Tehsil store (approx.150 kg), Balochistan. In the previous NIP report, total POPs pesticides estimated were about 135 t in Balochistan, out of

which 117.73 t has been removed and destroyed in the POPs pesticide project. But according to our findings, approximately 64 t of obsolete pesticides still exist in different stores of Balochistan with additional further unknown amount of pesticides spread by flooding. Also organized stealing of pesticides from the stores with the purpose of mixing with moderately hazardous chemicals to enhance their toxic efficiency reduced the stockpiles. This discrepancy in the quantity arises perhaps because some of the pesticides stores were not identified in previous NIP assessment and report.

B) POPs pesticide situation in Sindh Province

In the Sindh province, previous NIP report estimate was about 2016 t of obsolete pesticides present in different stores. However, we were able to identify a total of 134 t of obsolete pesticides in current POPs pesticides investigation campaign. The rest is either deteriorated or ruined through floods. From the province of Sindh, quantities of 72.83 t from Mirpur Khas and 116.6 t from Mirpurkhas Larkana warehouse have been removed and destructed under POPs elimination project of UNDP. The POPs pesticide team visited the federal plant protection head office in Malir Halt of Karachi to investigate the current status of obsolete pesticides. All of the pesticides were removed from the plant protection store of Mirpurkhas, Sukkar and Larkana District. Unfortunately, the clean-up was not done in ESM in Mirpurkhas store and in the Larkana and Sukkar store. Despite removal, fumes and pungent smell causing suffocation is released from the stores and adjacent areas where pesticides were loaded on trucks. Dozens of empty containers are lying in the stores. The soil in and outside the store is contaminated with the liquid and powder of the pesticides which actually spilled during removal and loading process. Therefore a further cleanup and removal of those empty containers, empty packets, wrappers, and the contaminated soil is needed. The team collected soil samples in and around these stores to assess the pollution levels. The Additional secretary Agriculture and Director General of Agri extension Sindh, in Sindh Secretariat provided a document with ten districts of Sindh having obsolete pesticides stores Sanghar, Shikarpur, Benazirabad, Jacobabad, and Umerkot, Mirpurkhas, N, Feroz, Thatta, Sajawal and Larkana. These stores were locked since long, and there was no investigation before including the first NIP. In the NIP update project the content and conditions of the pesticides were assessed. The content was in poor conditions without proper labelling and the drums and packets were inventoried as potential POPs pesticides and the cumulative amounts for each store were documented.

Also formerly an unknown amount of pesticide stocks were buried at the seashore at Gharo town.

C) POPs pesticide situation in KPK Province

The whole of the pesticides stores present in KPK province are under the agriculture department of KPK in six different districts. A total of about 15 t POPs pesticides is still present in six districts of KPK. These district includes Peshawar, Charsadda, Lower Dir, Bunair, Kohat and Malakand. Some recently expired pesticides (not POPs pesticides) is also present in Peshawar agricultural directorate store. According to the former NIP about 48 t of pesticides were present in KPK under various stores. It is reported that around 40.07 t of pesticides have been removed by the POPs elimination project from Peshawar whereas the rest of the amount was deteriorated through the large flood in 2010 and further smaller flash floods and self-decay process. Currently, no pesticide stock is known by the plant protection department in KPK.

All the pesticides stock were present under the agriculture department of KPK. The store under directorate of agriculture contained about one ton of recently ceased pesticides. But the team was unable to identify any POPs pesticides present in this store. Secondly, the team visited the agriculture extension regional store at Ternab, near Peshawar where about 0.4 t of POPs pesticides was present. It was told that a large but unknown quantity of POPs pesticides has been deteriorated in the 2010 flood. After Ternab the team of POPs pesticides visited the old DDT factory Nowshehra which is now turned into a residential housing area called “DDT colony”. The people told that EPA has issued the NOC to build housings in the former DDT factory area. However they are not allowed to use the ground water but they have to bring the water from nearby areas through water supply. A total of around 5.3 t of POPs pesticides were present in the Charsadda store. Furthermore, according to the statistics of the local authority the Charsadda district has around 7.8 t POPs pesticides currently the rest of which is present in Tangi (0.16 t), Shabqadar (0.52 t), Dakki (0.35 t) and Naari (1.18 t) sub-divisional store of Charsadda. The stores are in poor condition and locked since decades. There was pungent pesticide smell released from the stores and associated exposure and risk to the nearby public and employees. Out of total around 15 t of KPK’s whole pesticide burden, around 7.9 t is present in Charsadda district. Whereas the share of other districts are as follows; Peshawar 0.4 t, lower Dir 0.82 t, Kohat 0.19 t, Bunair 0.18 t, Malak and 0.38 t.

D) POPs pesticide situation in Punjab Province

In the former NIP, the contribution of POPs pesticides in Punjab Province was 3800 t which was 56% of the entire stockpile. In the NIP update assessment the remaining stock was just 65.8 t. This POPs pesticides quantity is stored in the stores of the plant protection department at Rahim Yar Khan and Bahawalpur stores. Some quantity was also reported from Multan store. Under POPs elimination programme 85.8 t from Bahawalpur and 10.7 t from Lahore have been removed and destroyed from Punjab province. It is reported that a large quantity of POPs pesticides were buried in the Yazman area of Cholistan which is now a threat for the environment. However, there is no official record available for the buried quantity. Secondly, Punjab officials informed that most of the quantity of POPs pesticides present under agriculture extension department of Government of the Punjab was managed by Punjab government. For the management, the "Disposal of obsolete pesticides in Punjab province 2009-2011" project was initiated in 2009 to incinerate the obsolete pesticides. A total quantity of 813,197 kg of obsolete pesticides from 169 stores under provincial agriculture department and plant protection department, was incinerated by a private company ("Global waste management, Lahore") under this project near Kala Sha Kaku. It was told that incineration was done according to international standards. According to the project reports 814 t were destroyed for 40,659,850 Rupees completed June 2011. Therefore from the 3800 t of former stock around 814 t were destroyed by a Punjab provincial project and 85.8 t were destroyed under the POPs elimination programme. Considering the 65 t still present in Punjab the fate of 2835 t is unknown. A share of this amount deteriorated through the major flood in 2010 and another unknown quantity was buried in Yazman area of Cholistan. Furthermore the number from the first inventory might have been wrong. In any case the fate of the 2900 t of pesticides need to be further assessed and investigated.

2.3.1.9 Management

In Pakistan, the remaining pesticide stocks are under the control of either Plant Protection Department or Agriculture Department. The unknown quantity with faded labelling is stored in miserable condition in different stores. The stores are locked and poor hygienic conditions prevails in and around the stores. Despite the update of the POPs pesticide inventory there are still some uncertainties on the total quantity of POPs pesticides due to the size of the country and uncertainty if there are further stores and since POPs pesticides are lumped together with other obsolete pesticides which could not be segregated. In any case also the expired non-POP pesticides need to be managed in an ESM and be managed together with the POPs.

The Federal plant protection department and provincial agriculture department in coordination with the ministry of climate change is trying hard to eliminate the remaining POPs pesticides. However, a dedicated effort is needed to eliminate the POPs pesticides from different stores of Pakistan. Ministry of climate change in coordination with UNDP is running a project for complete destruction and elimination of POPs pesticides from Pakistan. Through this project large quantities have been removed from different stores of Balochistan, Sindh, KPK and Punjab province and incinerated in Bestway cement factory at Kalarkahar, which is a dedicated facility for POPs destruction.

2.3.1.10 Disposal

In Pakistan proper disposal of POPs pesticides is a big challenge partly because of lack of resources and non-professional handling/management. It has been reported that a large quantity of POPs was buried in Yazman area of Cholistan desert during disposal activities of POPs pesticides. But no record is available for that buried quantity. Similarly, a relevant but unknown quantity of POPs pesticides was buried in Malir, Karachi, at the location where the Malir district court is now established. This was done to get rid of POPs pesticides, at a time when the concerns and potential impacts of POPs pesticides were not known by the management. In recent years after being informed from NIP activities, the Punjab government has developed a dedicated project to incinerate and irreversibly destroy the POPs pesticides. For this purpose, Punjab government hired a private company “Global Waste Management” for POPs pesticides incineration. A large quantity has been incinerated at the facility of Global Waste Management, company at Kala Sha Kaku, near Lahore, without proper monitoring and documentation of destruction efficiency. Therefore there are concerns of the scientific and local communities about the destruction efficiency of the POPs pesticides and possible pollutant releases and potential environmental impacts. For this purpose, it is recommended to conduct a study measuring the residual concentrations in the local environment (air and soils) as well as extract information from the company about the proper disposal/incineration of POPs pesticides and monitoring studies for proper documentation.

A dedicated facility for POPs destruction has been established at Bestway cement factory, located in the Punjab province of Pakistan. This facility has been established by the Ministry of Climate Change and UNDP, Pakistan. A quantity of 443.77 t POPs pesticides has been destroyed in this facility so far. While the cement kiln has capacity to destroy POPs pesticides, there are no detailed monitoring data available on tests or the continuous

performance. However, stack emission needs to be monitored during POPs destruction and results should be evaluated taking into account regulatory limits and the impact on humans and environment. The area where the facility is located is the cluster of cement and crushing industry.

The POPs elimination project under Ministry of Climate Change is under way which is targeting to eliminate the POPs pesticides available in different stores. However, there are concerns from local public about a proof of the destruction efficiency of POPs pesticides in the facility and possible releases. Therefore the facility needs to be appropriately monitored on regular basis and a careful estimation of potential impacts is needed. The detail quantity of POP pesticides destroyed under the POPs elimination program is provided in Table 5.

Table 5. Quantities (t) of POPs pesticides removed and disposed of under POPs elimination program, Pakistan

Site	Province	Quantity removed (t)
Hore	Punjab	10.74
Awalpur	Punjab	85.8
Mirpur Khas	Sindh	72.83
Sukkur Larkana warehouse	Sindh	116.6
Quetta	Balochistan	117.73
Peshawar	KPK	40.07
Total		443.77

2.3.1.11 Potential Impacts

Because of the toxicity of POPs, high chlorine content and stability, environmentally sound management and destruction of POPs pesticides is a real challenge. In Pakistan, this problem is multiplied because of the lack of management and monitoring capacity for POPs pesticides.

The failures of the past with large buried quantity of POPs pesticides in Cholistan desert and under Malir Court, Karachi, is a real threat for local public and wildlife. There is no information that how these stocks were buried. Similarly, the stores where POPs pesticides are present are located in major cities adjacent to human habitations. Public is exposed and complaining about the pungent smell and fumes which escalates in summer due to the high

temperature. Due to the lack of education sometimes the containers of POPs pesticides are dumped in open air, in yards which is a large potential for the local population and environment. There is agriculture as well as horticulture activities are being carried out in the vicinity of these contaminated areas. The POPs pesticides are distributed by evaporation, flooding and wind into the environment which poses a real threat to humans and wildlife. Further, the stores from where POPs pesticides are removed, left over and empty containers are posing a real threat for soil and air contamination and direct exposure risk by the reuse of the containers. The significant distribution of POPs pesticide stocks by flooding in recent years are likely a large threat and need to be assessed. Lastly, the POPs pesticides destruction/incineration facilities are not monitored and the performance level is unknown. The improper destruction/incineration of POPs and their residual concentration in the environment could pose a real threat for local public and wildlife. So, a proper and carefully monitored destruction/incineration of POPs pesticides is needed and recommended.

2.3.2 Assessment of PCBs (Annex A, Part II) and PCNs (Annex A, Part I)

2.3.2.1 General

Polychlorinated Biphenyls (PCBs) are a class of chlorinated aromatic compounds with 2 to 10 chlorine atoms substituted to biphenyl (a molecule composed of two benzene rings). The chemical formula for PCB is $C_{12}H_{10-x}Cl_x$. PCBs are man-made chemicals; they are not flammable, have high electrical resistance, and possess good insulating properties. In addition, PCBs are unintentionally formed in thermal processes and in organochlorine production of e.g. certain pigments (see Section 2.3.7).

Chronic effects of low-level exposure include liver damage, reproductive and developmental effects and cancer (Category 1). Other health effects include immune dysfunction, neurological and behavioural abnormalities and reproductive disorders.

PCBs were widely used for many applications, especially as dielectric fluids − in transformers, capacitors, and coolants − but also in open applications like sealants, paints, plastic additives, or non-carbon copy paper. PCBs are carcinogens (category 1) and some congeners have dioxin-like activity. Further toxic effects associated with PCB congeners are endocrine disruption and neurotoxicity. Approximately 1.3 to 2 million tonnes of PCBs were manufactured over the period from 1930 to 1993, half of which were produced by Monsanto

mainly in the US. In recent global inventory it was estimated that approx. 14 million tonnes of contaminated equipment (transformer, capacitor) and contaminated oils exist.[25]

PCB stockpiles existed and exist in Pakistan but unfortunately remained ignored until Pakistan signed the Stockholm Convention on POPs. Article 3 of the Convention describes the measures to reduce or eliminate releases from intentional production and use of POPs and states that each state shall (a) prohibit and /or take the legal measures necessary to eliminate (i) production and use of the chemicals listed in Annex A (which includes PCBs) and (ii) their import and export.

Specific measures to reduce/eliminate PCBs are described in Part 2 of Annex A of the SC, binding each state to make determined efforts to identify, label and remove from use, equipment containing (i) greater than 10% PCBs and volume greater than 5 liters (ii) greater than 0.05% PCBs and volume greater than 5 litres and (iii) greater than 0.005% PCBs and volume greater than 0.05 litres.

Pakistan has developed with UNDP a POPs elimination project under GEF including assessment and elimination of PCB. First capacity building workshops were conducted in 2018 and assessment and monitoring of closed application are planned for 2019 and 2020.

Polychlorinated naphthalenes (PCNs) are a class of chlorinated aromatic compounds with 2 to 8 chlorine atoms substituted to naphthalene and have been listed as POPs in 2017. The chemical formula for PCN is $C_{10}H_{8-x}Cl_x$. PCNs are man-made chemicals; they are not flammable, have high electrical resistance, and possess good insulating properties.

PCNs have been used in the same applications as PCBs including closed applications (capacitors, transformers) and open applications (e.g. paints, coatings, sealants, flame retardants in cables).[26] However, PCNs were mainly produced/used from 1930 to 1960 with lower productions in the 1970s and production was stopped around 2000.[26] Furthermore, the historic production volume was only about 10% of PCBs (150,000 tonnes versus 1.5 million tonnes). PCNs are unintentional POPs (see Section 2.3.7) present in technical PCBs at concentrations between 39 to 1300 mg/kg.[26] Therefore, stocks and waste of PCNs can be addressed within the management of PCBs and therefore are addressed together with PCBs here. Also the Basel Convention has included PCNs into the technical guidelines for

[25] UNEP (2016) Consolidated Assessment of Efforts made towards the elimination of polychlorinated biphenyls. UNEP/DTIE CHEMICALS AND WASTE BRANCH, January 2016

[26]Secretariat of the Stockholm Convention (2017) Draft guidance on preparing inventories of polychlorinated naphthalenes (PCNs).Draft March 2017. UNEP/POPS/COP.8/INF/19

managing PCBs.[27] While the low POPs content for PCBs has been set at 50 mg/kg (ppm), the low POPs content for PCNs were set at 10 mg/kg which need to be considered in the management.[26]

The present inventory of PCBs does not address hydraulic fluids and open application (like sealants and paints). PCB/PCN inventories for open applications as well as hydraulic fluids are considered in the updated action plan.

2.3.2.2 Legal situation; registration and control

As described in Chapter 2.2, the production, supply and use of PCBs is not specifically regulated in Pakistan. PCBs have also not been specifically included in the National Environmental Quality Standards (NEQS). Therefore present, limited regulatory and registration frameworks for PCBs exist in Pakistan including the electric power sector. This situation needs to be improved by establishing an adequate regulatory framework for PCBs.

For reducing exposure and risk of PCBs in the electric sector, handling of all the related equipment (transformers, capacitors etc.) should be done by developing an integrated management frameworks by considering and addressing the whole life cycle of PCBs. The main focus of the regulatory and implementing agencies should be to implement the existing rules in Pakistan in general and in electric sectors in specific ways. It's also suggested by a review committee on POPs (UNDP) that implementation of control and verification system of PCBs may be coupled with specific Pollutant Emission Transfer Register mechanism for effective control strategies. Another important strategy for control mechanisms is to follow the "Storage Rules" as the warehouse plays a central role in the electric sector. Initially, the whole registration and control mechanisms for PCBs equipment can be started on paper and can then be moved toward a web-based platform (after 5-7 years).

2.3.2.3 Production

There was no PCB production in Pakistan. However transformers were produced in the past in Pakistan and are still produced in Pakistan. In transformers, PCB oils might have been used PCB. Leading transformers manufacturing companies in the country are ALIMITAC, Pak Elektron Limited (PEL), TRANSFEB, SIEMENS, Climax, and Heavy Electrical

[27]UNEP (2017b) Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with polychlorinated biphenyls, polychlorinated terphenyls, polychlorinated naphthalenes or polybrominated biphenyls including hexabromobiphenyl. UNEP/CHW.13/6/Add.4.

Complex, and Taxila.[28] These producers have likely used PCB oils in the past in particular before 1990s.

2.3.2.4 Import

Electric sector equipment (transformers, capacitors, circuit breakers) have been imported to Pakistan since 1950s. This equipment was mainly imported from ex-Soviet Union, Romania, China, Bulgaria, Iran and Germany.[28]

Furthermore PCBs are imported to Pakistan by the ship-breaking industry. 50 km away from Karachi, 38 breakers operate 132 shipbreaking plots on a 10 km-long stretch of beach. The industry employs 12000 to 25000 workers. 100 steel sites and 200,000 jobs rely on the scrap iron from ship demolition. From an assessment in Bangladesh it is estimated that the typical merchant ship dismantled for scrap contains between 250 kg to 800 kg of PCBs, found principally in the paint, as well as in the machinery, of the vessel. Some studies have made the assumption that ships from the WWII era (1940s) would have the greatest amounts of PCBs in materials, such as paint, cable sheathing and hydraulic fluids. However, until PCBs were banned, they continued to be used in ships, i.e., up through the mid-1970s and 1980s. Also PCNs were used in ship paints since the 1940s and might be present and released in ship breaking.

Furthermore, a large amount of electronic scrap is imported to Pakistan for recycling. Such scrap might contain PCB capacitors or might be contaminated with PCB oils.

2.3.2.5 Export

The PCB management project has not started with elimination activities and therefore no PCB containing equipment has been exported for final disposal up to now.

2.3.2.6 Transformers and other Equipment in Use

The widespread prohibition on manufacture, distribution and processing of PCBs from the 1980s onward means that older equipment produced before 1989 in general is likely to have higher PCB content and might be PCB (“Ascarel”) transformers. However, some equipment imported as recently as 2000 was found during the survey labelled as PCB containing transformers. Additionally transformers get maintenance including the practice of “topping up” the level of transformer oil in electrical equipment with unlabelled or even PCB transformer oils in the past and can get cross-contaminated which means that the age of

[28] Mahmood A. Khwaja and Jan Glavin, “Environmental and health impacts of PCBs and measures for PCBs phase out in Pakistan,” Science, Technology and Development 2006. Provincial POPs inventories, Pak-EPA/UNDP, Islamabad, Pakistan

equipment is not, in itself, a reliable indication if a transformer is potentially contaminated with PCBs. Therefore, also equipment produced after 1990 will need to be sampled and analysed to assess if the PCB content is above 50 ppm from cross contamination from maintenance activities.

In Pakistan the main use seems to be in transformer oil used in power and distribution transformers for cooling and insulation purposes. Sealed or compact transformers with capacity of 10 - 20 MVA, power transformers of 20/26 & 10/13 MVA (average life of 8 – 10 years) and mostly locally manufactured are in use. WAPDA employs distribution transformers of 10, 15, 25, 50, 100, 200 KVA. However, in the private sector 400, 600 and 730 KVA capacity distribution transformers are also in use. For transformer installation both the Pole & Pad systems are used in practice. Among the damaged transformers received at the repairing/recycling workshops the number of Pole transformers has been reported to be higher than the Pad transformers and hence the former type are more likely source of PCBs cross contamination.

The initial survey reports in the first NIP from Sindh, Punjab and KPK have indicated with chlorine screening tests that about 80% of the samples tested in the provinces had PCB levels higher than the safe limits (> than 50 ppm). This high share of PCB impacted transformers have however not yet been confirmed by instrumental analysis.

During the NIP update the status of operated transformers in Pakistan were updated by the PCB task team for the different provinces.

Table **6** to **Error! Reference source not found.** contain the updated information.

Like many other countries, PCBs and its related compounds are still in use in Pakistan especially in closed applications such as transformers and capacitors in the power sector. In the present situation, Pakistan is lacking analytical facilities both in the power generation sector as well as in government departments for identification of PCBs content in particular equipment.

As result of preliminary visits, inception workshops, official visits and interviews, the updated (till 2018) data has been collected from the following distribution companies from multiple provinces of Pakistan:

- Quetta Electric Supply Company (QESCO);
- K-Electric;
- Hyderabad Electric Supply company (HESCO);
- Sukkar Electric Supply company (SEPCO);
- Lahore Electric Supply Company (LESCO);
- Multan Electric Supply Company (MEPCO);
- Faisalabad Electric Supply Company (FESCO);
- Gujranwala Electric Supply Company (GEPCO);
- Islamabad Electric Supply company (IESCO);
- Peshawar Electric Supply company (PESCO).

The total number of distribution transformers working in different localities under Quetta Electric Supply Company (QESCO) are compiled in

Table **6**. The updated status of total number of power transformers located at multiple locations of distribution companies of the power sector in Pakistan are compiled in Table **7**. The updated status of total number of distribution transformers located at multiple locations of distribution companies of the power sector in Pakistan is compiled in Table 8. The updated status of total number of 11KV feeders at different distribution companies of Pakistan are summarized in Table 9. Finally, former and updated status of the number of distribution transformers working in different localities under Quetta Electric Supply Company (QESCO) is compiled.

Table 6. Old and updated status of the number of distribution transformers working in different localities under the loop of Quetta Electric Supply Company (QESCO)

Transformers Capacity Wise Distribution (KVA)	Number (as in Old NIP)	Updated (2018)
10 KVA	3	765
15 KVA	7	2080
25 KVA	9294	18555
50 KVA	10212	28111
75 KVA	16	0
100 KVA	3499	7325
200 KVA	699	1387
250 KVA	1	0
400 KVA	36	76
450 KVA	2	0
630 KVA	53	78
1000 KVA	20	4
1600 KVA	9	1
Total	23851	58382

Table 7. Updated status of the total number of power transformers located at multiple locations of distribution companies of the power sector in Pakistan

Distribution Companies	2015-2016	2016-2017
PESCO	220	230
TESCO	35	38
IESCO	194	202
GEPCO	154	160
LESCO	333	351
FESCO	188	195
MEPCO	269	282
HESCO	109	119
SEPCO	116	118
QESCO	125	133
TOTAL	1743	1828

Source; State of the Industry Report by NEPRA Pakistan 2017

Table 8. Updated status of the total number of distribution transformers located at multiple locations of distribution companies of the power sector in Pakistan

Distribution Companies	2015-2016	2016-2017
PESCO	60365	72078
TESCO	15634	16612
IESCO	45438	46359
GEPCO	60080	61661
LESCO	97048	100718
FESCO	97761	100276
MEPCO	152806	156460
HESCO	35334	35996
SEPCO	35029	35875
QESCO	53646	55770
TOTAL	653141	681805

Table 9. Updated status of the total number of 11KV feeders at different distribution companies of Pakistan

Distribution Companies	2015-2016	2016-2017
PESCO	907	946
TESCO	195	203
IESCO	1036	1058
GEPCO	779	805
LESCO	1580	1650
FESCO	936	998
MEPCO	1165	1241
HESCO	435	463
SEPCO	453	462
QESCO	613	628
KEL	1524	1653
Total	9623	10107

Source; State of the Industry Report by NEPRA Pakistan 2017

Also, current status of the transformers repairing workshop operated by Quetta Electric Supply Company (QUESCO) were assessed (Table 10). The mentioned transformers repair workshop has a total area of approximately one acre. The main entity surrounded by the

mentioned workshop is the thermal power plant. The workshop area has three sections 1) loading/unloading area 2) storage site for old transformers 3) site for storage of new transformers for distribution throughout Balochistan province.

Soil samples for analysis of PCBs have been collected from the three sections for further analysis. Transformer oil samples were also collected i.e. oil samples were collected as new oil samples (that are used for repairing transformers nowadays) plus oil samples from old transformers. In total more than 14 samples have been collected, labelled and stored properly.

Table 10. Status of Reclaimed Transformers repaired from registered repairing workshops* under the domain of HESCO. Data generated from the year January 2017-April 2018

	Name of Workshops	**Capacity of Transformers repaired (KVA)**						
Updated Status Until April 2018		25	50	100	200	400	630	Total
	Ajmer	13	63	0	146	0	0	222
	Ameeh	16	0	260	40	0	0	316
	Transwave	0	0	0	120	0	0	120
	Total	29	63	260	306	0	0	658

***Registered workshops** Ajmer, Ameeh and Transwave Repairing Workshop

During the current assignment, data regarding damaged capacitors from multiple localities around the province were also gathered and calculated (Table 11). In Balochistan province, we revealed an activity of Private Transformers Repairing Workshops mainly dedicated for agriculture purposes. From that private transformer workshops (in Suraj Gunj road), we also collected soil plus oil samples. In total 08 samples were collected for further analysis. Visit of Killa Abdullah grid station, Balochistan for data generation plus confirmation of damaged capacitors that were mentioned in the NIP document and meeting with concerned representative and official of Killa Abdullah grid station, Balochistan province. Confirmation regarding damaged capacitors (31 damaged capacitors) were present at the mentioned grid station (Table 11).

In the KP province, there were three old transformers having manufacturing date back to 1976, 1981 and 1982 respectively. These mentioned power transformers were imported from Russia, Serbia and Czech Republic. These transformers had oil volumes of 25 t, and twice 22 t and were manufactured before 1989 with associated PCBs risk. Therefore, transformer oil and soil samples were collected at these sites.

Table 11. Old/updated status of damaged capacitors at different grid stations in Balochistan

Grid Station (132 KV)	Capacity Installed	Number of damaged capacitors	
		As in Old NIP	Updated (2018)
Qilla Abdullah, Balochistan	36 mvar	32	31
Mangocher[1], Balochistan	36 mvar	30	0
Surab[1], Balochistan	24 mvar	12	0
Mustong[1], Balochistan	24 mvar	12	0

[1] All the damaged cells of capacitors at the mentioned locations have been shifted to the central workshop of QESCO in Quetta city circle.

Table 12. Number of distribution transformers of QESCO working in Balochistan province. This old data may be of special concern regarding PCBs addition in the system.

Capacity wise distribution of transformers (KVA)										
Year of Installation	**25 KVA**	**45 KVA**	**50 KVA**	**100 KVA**	**200 KVA**	**400 KVA**	**500 KVA**	**630 KVA**	**1000 KVA**	**Total**
1987-1988	2880	16	2101	949	129	1	1	9	2	6088
1988-1989	387	0	187	146	10	1	0	1	0	732
1989-1990	228	0	525	191	33	1	0	1	0	979
1990-1991	278	0	340	55	5	0	0	0	0	678
1991-1992	147	0	108	38	17	0	0	1	0	311
1992-1993	211	0	447	111	28	2	0	3	0	802
1993-1994	340	0	377	427	7	0	0	0	0	1151
1994-1995	513	0	445	63	13	0	0	1	0	1035
1995-1996	402	0	506	91	30	0	0	0	0	1029
1996-1997	335	0	404	127	46	0	0	1	0	913
1997-1998	191	0	215	66	10	0	0	0	0	482
1998-1999	740	0	168	28	17	0	0	1	0	954
1999-2000	451	0	185	77	20	0	0	0	0	733
2000-2001	121	0	226	100	20	0	0	4	0	471
2001-2002	41	0	250	33	7	0	0	3	0	334
Grand Total										**16692**

2.3.2.7 Registration and Control

While all transformers in Pakistan are registered, there has not been a wider assessment on PCB transformers up to now. Therefore, there is no registration and no specific control of transformers containing PCBs. In the current PCB project such registration and control will be established.

2.3.2.8 Storage and Release

As described above, at the repair workshops oils are partly released. Also at the ship breaking sites no particular care is taken for oils or lubricants and they are partly released contaminating land, shore and waters. Some of the equipment disappeared before it could be appropriately sampled.

2.3.2.9 Potential Impacts

PCB can contaminate humans and the environment for long time during the entire life cycle.[29] Also they can cause feed and food crises if not appropriately managed. The WHO survey demonstrate that human milk in all nations is above TDI and RfD for PCBs.[30] Therefore PCBs impact the general population and specifically exposed population such as maintenance and remediation workers.[31]

Up to now, no PCB monitoring of workers or neighbouring population have been conducted due to the lack of PCB analysis capacity in Pakistan. Therefore, the impacts from the (former) use of PCBs on workers or population could not be assessed yet. However in the frame of international cooperation soil, sediment and indoor dust have been measured.

Samples from soils and waste oils have been taken for a first insight into PCB contamination at storage, maintenance and use sites.

By the inventory and other workshop activities awareness have been raised on the risk of PCBs the last years. This reduces the risk of current and future impacts.

[29]Weber et al. (2018) Life cycle of PCBs and contamination of the environment and of food products from animal origin. Environ Sci Pollut Res Int. 25(17), 16325-16343

[30]UNEP (2013) Results of the global survey on concentrations in human milk of persistent organic pollutants by the United Nations Environment Programme and the World Health Organization. UNEP/POPS/COP.6/INF/33

[31] Haga et al. (2018) Monitoring OH-PCBs in PCB transport worker's urine as a non-invasive exposure assessment tool. Environ Sci Pollut Res Int. 25(17):16446-16454

2.3.3 Assessment of PBDEs (Annex A, Part IV & Part V), HBB (Annex A, Part I)

2.3.3.1 General

In order to update the current national implementation plan (NIP), an inventory of commercial PentaBDE, commercial OctaBDE, their current use, initial flow, and disposal have been conducted in Pakistan based on the PBDE inventory guidance documents.

PBDEs are brominated flame retardants (BFRs) used in various products such as plastic in electronics, polyurethane foams in vehicles and, textiles, to reduce their ignitability to meet certain flammability standards. Due to the increase of flammable polymer materials, the global demand for PBDEs (and other flame retardants) has been growing rapidly from the 1970s to 1990s. This was also partly driven by industry lobby. Three commercial PBDE mixtures were produced and used in the market: commercial PentaBDE, OctaBDE and DecaBDE. However, due to their characteristics of persistence, bioaccumulation potential, long-range environmental transport and adverse effects on wildlife and humans, PBDEs have become ubiquitous environmental contaminants and aroused increasing concern. Appreciable levels of PBDEs have been reported in various environmental media and biota, including air, soil, marine mammals and human blood. PBDEs can affect neurodevelopment, neurobehavioral and thyroid hormone regulation in exposed animals and individuals.[32]

Due to the environmental and health risk, commercial PentaBDE (c-PentaBDE) and commercial OctaBDE (c-OctaBDE) technical mixtures production stopped in 2004 and where parly substituted by DecaBDE. Plastics are important parts of electrical and electronic equipment (EEE) products and PBDEs are widely used as additives in these plastics.

The challenge is how to practically control PBDEs in articles and the recycling flows. This is a problem for developing countries like Pakistan where state of the art recycling plants with monitoring/separation capacity do not exist and measurement capacity is not established. Pakistan (like other developing countries) lack appropriate recycling and destruction facilities which leads to open burning or dumping of such hazardous wastes or release to water bodies causing environmental pollution including marine litter.

For c-PentaBDE the main use (90%) was in polyurethane foam with use in car/transport, furniture, construction, or baby products with the major use in the US.

[32] Shaw et, al. (2010) Halogenated Flame Retardants: Do the Fire Safety Benefits Justify the Risks? Reviews on Environmental Health 25(4) 261-305

The aim of this inventory was to evaluate the situation in Pakistan of the major articles and products in use and stocks and wastes impacted with PBDEs. For PBDEs the inventory mainly focused on electrical and electronic equipment (EEE) and related waste (WEEE) and the transport sector. The methodology used to carry out the inventory was based on the Stockholm Convention inventory guidance document. Methods used were survey, the use of data of the official statistics (e.g. from Ministry of Commerce or customs).

2.3.3.2 EEE and WEEE containing PBDEs

Plastic in certain electrical and electronic equipment (EEE) and related waste (WEEE) in particular Cathode Ray Tube (CRT) casings is considered to contain the largest share of POP-PBDEs.[33]

Please note: c-DecaBDE has been listed in 2017 as POPs and due to the recent listing was not part of this inventory. Due to the considerable larger amount of DecaBDE use in CRTs and also in other EEE plastic, the actual amount of total PBDEs is considerable larger than the currently estimated amount of c-OctaBDE. Since no inventory guidance is available yet, it can currently not be calculated how much DecaBDE is in the EEE/WEEE plastic. Since the DecaBDE use was approx. 10 times the c-OctaBDE use, the total amount might be an order of magnitude higher. Since DecaBDE is still produced and has also been used more recently than c-OctaBDE, more recent equipment is impacted by DecaBDE.

The problems associated with WEEE in Pakistan started evolving after the first phase of economic liberalization with an average GDP growth rate of 6.8% during the 1960s[34],[35]. Pakistan was a model of economic development around the world[36]. Due to increasing population and purchasing capacity, there is currently an increasing demand for electronic goods industry in Pakistan, especially for home appliances (TV, refrigerator, washing machine, air condition ovens, etc.), telecommunication, IT, and computers. All major components in electrical equipment is imported or smuggled and, only assembled in Pakistan which means entire electronics and electrical appliances industry is running on imported

[33] Secretariat of the Stockholm Convention (2015) Guidance for the Inventory of commercial Pentabromodiphenyl ether (c-PentaBDE), commercial Octabromodiphenyl ether (c-OctaBDE) and Hexabromobiphenyls (HBB) under the Stockholm Convention on Persistent Organic Pollutants; Draft. UNEP/POPS/COP.7/INF/27

[34]Hussain, A., Institutions, Economic Structure and Poverty in Pakistan. *South Asia Economic Journal* **2004,***5* (1), 69-102.

[35]Husain, I. In *Economy of Pakistan: an overview*, Key Note Address at the Expo 2005 Conference held at Karachi on February, 2005; p 2005.

[36]Bashar, A., ELECTRONICS INDUSTRY Threatened by tariff discrepancies, corruption and smuggling. *Pakistan and Gulf Economist* June 19-25, 2000, 2000.

parts[37]. The scenario illustrates that increasing sales and importation of electronics will result in an increasing future generation of e-waste in Pakistan. The rapidly increasing sales along with indigenous technological advancements, have led to significant e-waste generation from households, organizations, industries and public sectors. Solid waste management, which is already a mammoth task in Pakistan[38] has become even more challenging by the invasion of e-waste generated domestically as well as imported from developed countries. The evaluation of available and relevant national data on the selected sectors was conducted using the tiered approach suggested by the Stockholm Convention PBDE Inventory Guidance with the collected available data. The POP-PBDE inventory was developed following the tiered inventory approach provided by the POP-PBDE Inventory Guidance. Tier 1 (preliminary survey of data and selection of main sectors for the preliminary inventory) and tier 2 (establishing an inventory by gathering, screening and evaluating available data and compiling these data) out of the three tiers were carried out for this study. For the preliminary inventory, stakeholders were directly contacted to collect the required information.

For a more detailed inventory an assessment of EEE/WEEE containing POP-PBDE is necessary based on a preliminary assessment of EEE/WEEE in Pakistan (Tier 2 approach). Only cathode ray tubes (CRT) of PCs & TVs are the EEE taken into consideration for this inventory since they are considered as containing the largest share of c-OctaBDE.

Table 13. Percentage Households hat owned computers and TVs (2017)

% of house	**Rural**	**Urban**	**Total number (Calculated)**
A citicen of which owned a computer	36.8	90.3	**9,711,981**
Mean number of computers per household	1.0	1.0	**7,851,415**
% HH which used a computer from any place	18.6	70.3	**23,754.000**
% HH who owned a TV	64.6	97.4	**54,032,000**

The difference between the number of computers owned by the household sector and the number of those calculated from the household members who use a computer from any place may represent the number of computers present in commercial places such as internet cafes.

[37]Altaf, M. A.; Deshazo, J., Household demand for improved solid waste management: A case study of Gujranwala, Pakistan. *World Development* **1996,***24* (5), 857-868.

[38]Khan, A. A.; Ahmed, Z.; Siddiqui, M. A., Issues with solid waste management in South Asian countries: A situational analysis of Pakistan. *Journal of Environmental and Occupational Science* **2012,***1* (2), 129-131.

Table 14. The total number of TVs and PCs in the household sector

Year	Households	HH Number	PC %	TV %	PC Number	TV Number
2018	Rural	18216838	39	56	7,104,566	**10,201,429**
	Urban	9501160	87	95	8,266,009	**9,026,102**
	Total	**27717998**			**15.370,575**	**19,227,531**

Tables for the two years show the increase in the PCs and TVs use in this sector. These statistics do not differentiate between CRT and flat screens but represents the minimum number of PC and TV for the household. Since c-OctaBDE has not been used in flat screens these overall statistics for PCs and TVs are not used for the estimation of the amount of POP-PBDEs in CRTs in the household sector.

According to the UNEP Guidance for a first estimation (Tier 1), EEE stockpiled (in use or stored) at the households can be approximated by using penetration rate data (e.g. installed appliances per person in a country) for specific appliances from other countries, which best represent the consumer patterns in the target country. For Pakistan the penetration rate for an Asian country without particulate WEEE imports was used (see table 4-1 PBDE inventory guidance): The penetration rate 0.17 appliance/person or 4.1 kg CRT/person (see table 4-1 PBDE inventory guidance) including both TV CRTs and PC CRTs.

With this the total number of CRTs units in households in Pakistan is estimated to: 0.17 CRT/person x 212,742,631 (Pakistani population, Census 2017) = 36,166,247. The total CRT weight(kg) in Pakistan is estimated to be: 4.1 kg CRT/person x 212,742,631 (Pakistani population, Census 2017)= 872, 245 tonnes

Out of the total volume of CRTs in use/stock in households the polymer fraction (30% as mentioned in the Table 4-9 of the UNEP Guidance) is 261,673 tonnes. The total amount of c-OctaBDE in CRTs is estimated to 0.87 kg/tonne to 2.54 kg/tonne and therefore between 227,655 kg to 664,649 kg. For calculating POP-PBDE the HexaBDE amount (11%) and HeptaBDE amount (43%) from the total c-OctaBDE needs to be calculated: The HeptaBDE amount is estimated between 25,042 kg to 73,111 kg. The HexaBDE is estimated between 97,891 kg to 285,799 kg respectively.

2.3.3.2.1 Import and Export

According to World Bank data IT imports accounted for 3.8% of total goods imported in 2013. Since lifting of GST exemption in 2005, increased import of used PC/scrap and undocumented import has been noticed. The 3.8% is the official or legal figure for imports while as per some estimates 50% of PC products are smuggled or brought in through illegal means. No accurate official data or estimates of EEE imports into Pakistan have been presented yet. Along with domestically generated e-waste, imports also represent a fraction of net e-waste produced in Pakistan. Most of the e-waste imported to Pakistan is still in category of unknown imports, which are not documented by customs department. Yearly import data of 2014 for old and used computers from the customs department was accessed which was received from known sources and had known quantities. All the computers imported were old and used which were in following order with respect of most imports; US> UK> Canada> UAE> Singapore> Australia> Spain> China> Korea. A total of 70-80% of the imports was from US while 10-15% was from UK and 5% from other countries. The data from the customs department provides evidence that e-waste is being imported into Pakistan from countries camouflaged as second hand or used items.

First e-waste management need to be established and then appropriate treatment, recycling and possibly export options need to be evaluated. Pakistan still lacks the appropriate technology and expertise to establish a viable industrial base in the electronics sector and majorly relies on imports of EEE. There was no particular information on e-waste exports.

2.3.3.2.2 Current use/storage

There is a considerable increase in electronics in the last decade in Pakistan. Pakistan ranks 6th in population among all the countries worldwide and is expected to be in 5th place till 2050 but is considered as a developing country due to its still developing infrastructure and economy. Most people residing in Pakistan have a limited capability of purchasing new and advanced electrical/electronic items, so they mostly buy second hand products. This situation creates a market demand for cheaper 2nd hand or end of life equipment to be imported into the country. Negligence of governmental bodies and legislative organizations has led to a situation in which Pakistan has no inventory on the domestic generation of e-waste nor the illegal import of 2nd hand equipment or e-waste.

In 2013, the highest retail and purchasing power was recorded for Pakistan which also translates into increased use of electronics. In April 2014, the country’s total mobile phone

subscriptions were recorded to be all time high of 137.68 million, which also indicates the high consumption of mobile phones which will eventually increase the amount of e-waste generated. Purchasing of TVs and monitors are also forecasted to increase at annual growth rate of 12% due to rapid replacement of technologies. The market for PCs continues to increase because of increasing demand from consumers, enterprises and the public sector. Computer sales increased from 409mn $ in 2014 to 432mn $ in 2015 with 5.8% annual increase in sales and cell phone sales recorded an annual increase of 9.1%. Rapid urbanization is also a major drive for increased consumption, as people become introduced to newer technologies and are attracted to buy the products. The increased consumption will eventually lead to higher amounts of domestic e-waste generated.

2.3.3.2.3 End-of-life

In Pakistan, there is an active informal sector with an established network for collection of end-of-life products and their recycling, particularly repair, refurbishment and parts harvesting. The residues left after the extraction of reusable components, and recyclable materials are disposed with solid wastes, burned by owners or discarded in dumpsites or landfills.an **activity** in the action plan.

Table 15 presents the estimated generation of e-waste in Pakistan for the year 2012, according to Solving the E-waste Problem (StEP) Initiative . (www.step-initiative.org)

Using the information from StEP as a reference, the amount of e-waste in Pakistan is estimated for the year 2014 and is calculated as 316 kt approximately while UNU estimated it to be 266 kt with 1.4 kg per individual in 2014[39]. Assuming these estimates are reasonable, this implies that the e-waste generation in Pakistan may have increased by up to about 50% over the last decade. Furthermore e-waste is imported to Pakistan. One study that has attempted to estimate import shows an annual average import of e-waste to Pakistan of around 95,4 kt (mostly computers and related products).[40]

All WEEE generated from refurbishing, dismantling, recycling or any WEEE management operations are collected and disposed with the domestic general waste. There is no formal or institutional recycling of WEEE now in Pakistan. (Informal) Recyclers are private persons dismantling, separating fractions and recovering material from WEEE. All the wastes are taken to the dump site (surface dumping) where waste pickers remove any waste with economic value and sell it to interested retailers around the dumping sites.

[39]Baldé, C. P., Wang, F., Kuehr, R., Huisman, J. *The global e-waste monitor – 2014*; United Nations University, IAS – SCYCLE, Bonn, Germany.: 2015.

[40]United Nation University (2017) The Global E-waste Monitor 2017.

Imran M, Haydar S, Kim J (2017). E-waste flows, resource recovery and improvement of legal framework in Pakistan. Resources, Conservation and Recycling, 125, 131-138.

2.3.3.2.4 Preliminary material flow assessment (MFA) model considerations

For a comprehensive assessment of the waste and information needed for the management of the waste the material flow assessment is useful or essential. The life cycle stages of EEE/WEEE in Pakistan include legal and illegal import, distribution through retailers, refurbishment, consumption, repairs, disposal and retailers of dismantled scraps. Once the equipment reaches the end of life it is normally stored for (currently) unspecified time with all stakeholders (governmental sector, private companies and households). Only initial information is currently available. E.g. after storage, computers in the government sector and in private companies are sold directly to second hand consumers, which in most cases are private households. Other options are the use as source of spare parts by technicians or as source for valuable substances such as copper.

Therefore, at this stage of inventory work the number of CRTs entering the waste stream and the way how this waste is treated could not be inventoried. This needs to be addressed in the implementation work and is suggested as an activity in the action plan.

Table 15. Overview of e-waste related information from Pakistan

Subject	**Unit**	**2005**	**2012**	**2015**
Population	(total inhabitants in million)	-	179	185
Purchasing Power	(USD per Inhabitant)	-	2876	-
EEE Put on Market	(kg per inhabitant)	-	2.68	-
	(total in kilotonnes)	-	479	-
E-waste Generated	(kg per inhabitant)	-	1.68	-
	(total in kilotonnes)	210	300	317

2.3.3.3 Transport sector

c-PentaBDE (containing tetraBDE, pentaBDE, hexaBDE and heptaBDE homologues) has partly been used in polyurethane (PUR) foam in seats or head rest in cars, trucks and other vehicles. Mainly vehicles from the US are impacted where the largest share of c-PentaBDE has been used with production until 2004. Furthermore c-DecaBDE has been and is used in vehicles for a range of plastic/polymers with exemptions for further use in vehicles.[41]

[41] Kajiwara et al. (2014) Brominated flame retardants and related substances in the interior materials and cabin dusts of end-of-life vehicles collected in Japan. Organohalogen Compd. 76,1022–1025.

Domestic transport is presented through four indicators: Railways, road transport, water transport and airways. The inventory team focused on the road transport with the highest volume. It needs to be stressed that fire safety is high in airplanes and in trains. Therefore, also polymers from airplanes and trains need to be managed in an environmentally sound manner at end of life.

No national inventory on the transport sector was available which could have been used as a base for this POP-PBDE inventory in Pakistan. Furthermore, no national policy or strategy on end-of-life vehicle (ELV) management has been established. It was also not known if and to which extent polymers from the end-of-life management of vehicles are recycled. Therefore, a preliminary inventory of the transport sector of Pakistan was established in this NIP update.

Since POP-PBDEs listed 2009 were produced and used (mainly) in the period from approx. 1975 to 2004, vehicles produced within this period were considered for this POP-PBDE inventory following the POP-PBDE Inventory Guidance approach. Also, the impact factors of the POP-PBDE Inventory Guidance[42]are used.

The POP-PBDEs(2009) inventory of the transport sector addresses the following life cycle stages:

- Vehicles imported and/or domestically produced between 1995 and 2009 as a basis for estimating or evaluating stocks;
- Registered vehicles
- ELVs entering the waste stream;
- Polymers from end-of-life vehicles recycled or disposed in the past.

The preliminary inventory focused only on cars and other road vehicles (busses and trucks) as the major portion of the transport sector.

2.3.3.3.1 Import of vehicles

Vehicles are increasingly imported to Pakistan. While in 1995 only 28,123 cars were imported whereas this increased to 881,200 by the year 2009.

Assumptions:

- The vehicles imported in 2009 are of five years or less years old;

[42] Secretariat of the Stockholm Convention (2015) Guidance for the Inventory of commercial Pentabromodiphenyl ether (c-PentaBDE), commercial Octabromodiphenyl ether (c-OctaBDE) and Hexabromobiphenyls (HBB) under the Stockholm Convention on Persistent Organic Pollutants; Draft. UNEP/POPS/COP.7/INF/27

- For calculations of POP PBDEs listed in 2009 80%, 70%, 60%, 50% and 40% of vehicles imported in the years 2005 to 2009 were assumed to have been produced in before 2005.

Amount of POP-PBDEs$_{\text{Vehicle category}}$ =Number of vehicles$_{\text{category}}$ (manufactured 1995 to 2004) **x** amount POP-PBDEs$_{\text{category}}$**x** F$_{\text{regional}}$

Impact factor for those vehicles containing PBDEs in PUR foam: 160 g c-PentaBDE for cars and trucks and 640 g c-PentaBDE for buses.

F$_{\text{regional}}$: regional factor of 0.05 for all imports as rarely vehicles were imported to Pakistan from USA (which would have a higher impact factor of 0.5)

TetraBDE, pentaBDE, hexaBDE and heptaBDE percentage of the amount of c-PentaBDEs are 33%, 58%, 8% and 0.5% respectively (Stockholm Convention 2012).

The total amount of estimated POP-PBDE(2009) imported was approx. 30.1 t and potentially impacted vehicles were nearly 2.5 million (Table 16).

Table 16. Estimated amount of c-Penta (TetraBDE, PentaBDE, HexaBDE and HeptaBDE) in impacted imported vehicles (cars, busses and trucks)

Years	Vehicle Type	No. of impacted Vehicles	Amount of c-Penta BDE kg	TetraBDE Kg	PentaBDE kg	HexaBDE kg	HeptaBDE kg
1995 to 2009	**Cars**	2,478,222	28052	9256	16270	2244	99.01
1995 to 2009	**Bus**es	23,982	1349	444	782	107.9	3.72
1995 to 2009	**Trucks**	54,311	735,1	242,6	426,4	58,8	2.17
	Total	**2,556,515**	**30,137**	**9,942**	**17,478**	**2,410**	**151**

Calculation of total PUR foam in cars, trucks and busses

Concerning the polymer fraction, for c-PentaBDE only PUR foam is considered since there is no impact factor given on PBDE in plastic in transport (e.g. dash board) in the cars/vehicles. Also, it is currently not possible to determine which car contains PBDE in PUR foam. Therefore, all PUR foam from cars needs to be considered. For the calculation the PUR foam quantity was consider according to the inventory guidance: 16 kg of PUR foam/ car or truck. For busses Pakistan considered small average size compared to the busses in the inventory guidance and consider an average of 64 kg of PUR foam/bus.

An average car contains approx. 16 kg of PUR foam = 0.016 t of PUR foam/car and 200 kg total plastic/polymers per car. The imported 2,478,222 cars in Pakistan produced before 2005 contain then in total 39,650 tonnes of PUR foam and 495,644 t total plastic/polymers.
The imported 37,577 trucks in Pakistan produced before 2005 contain in total 601 tonnes of PUR Foam. The 18,860 buses in Pakistan produced before 2005 contain 1207 t of PUR foam.

2.3.3.3.2 Vehicles in Use

The amount of vehicles in use was assessed from the registered vehicles. The registration data are listed in Table **17**.

Table 17. Total estimated amount of tetraBDE, pentaBDE, hexaBDE and heptaBDE from c-PentaBDE of impacted registered in use vehicles (1975-2009)

POP-PBDE	No. of impacted registered vehicles	Amount of c-PentaPBDEs Kg	Amount of TetraBDE kg	Amount of PentaBDE kg	Amount of HexaBDE kg	Amount of HeptaBDE kg
Cars	3121970	249,757	82, 420	144, 859	19, 980	1248
Buses	274700	13,735	4, 533	7, 966	1,099	69
Trucks	235035	18, 803	6, 204	10, 906	1504	94
Total	**3,631,705**	**282,295**	**93,157**	**163,731**	**22583**	**1411**

The total amount of PUR foam from the registered in use possibly impacted vehicles (cars, trucks, busses) in the period of 1975-2009 is 71,210 t, out of which 49,950 t of PUR foam in cars, 17,580 t of PUR foam in buses and 3760 t of PUR foam in trucks. The level of PBDE contamination of these PUR foam impacted vehicles is not known. The inventory guidance considers that only 5% of the cars from regions other than US might be impacted with higher share in US vehicles. Further assessment (e.g. by XRF screening) is necessary to conclude on the contamination level and on options of separation and management.
Furthermore, the currently registered 2,955,000 vehicle contain approx. 591,000 t plastic and other polymers which need an environmentally sound management.
Since the levels of decaBDE listed as POP in 2017 (not covered in the current inventory) is higher than the POP-PBDE listed 2009[43], the total POP-PBDE content in vehicles is considerably higher than this initial estimate.

[43]Liu H, Yano J, Kajiwara N, Sakai S (2019) Dynamic stock, flow, and emissions of brominated flame retardants for vehicles in Japan. Journal of Cleaner Production 232, DOI: 10.1016/j.jclepro.2019.05.370

2.3.3.3.3 End-of-life of vehicles

There was no statistics available on scraped vehicles. A structured end-of-life vehicle management has not been developed in Pakistan. The establishment of an end-of-live vehicle management is needed for optimum resource recovery and environmentally sound management of pollutants including PBDEs.

2.3.3.4 Furniture and insulation materials for buildings

The collected data from different sources on furniture, seats, and isolation foam are not used for the estimation of POP-PBDEs because no flammability standards exist for these articles in Pakistan and it is therefore considered that PBDE were not used in furniture. The data collected from the Ministry of Industry records the locally manufactured articles (mattresses) until the production year 2018 and most of them started production after 2004 where c-PentaBDE and c-OctaBDE use were stopped. These and other products can to be assessed with XRF device for bromine content as an indicator for PBDEs.

2.3.3.5 Potential impacts

Exposure to PBDEs occurs along the life cycle of the products and materials.[44] In particular c-PentaBDE treated PUR foam in vehicles, furniture or pillows or recycled materials can result in high exposure.[45] The exposure to PBDEs from WEEE plastic is lower with e.g. lower levels of PBDE in recyclers from BAT e-waste recycling facilities.[46] A high concern is the open burning of PBDE containing waste. The smouldering of e-waste and cables can result in contaminated sites. All the workers involved in the e-waste dismantling, repair or recycling of EEE and disposal of WEEE are at risk of short- and long-term exposure to POP-PBDE and other hazardous substances through absorption via skin or by inhalation.

Pakistan is becoming one of the major e-waste destinations, with large (informal) worker force involved in this activity. With an e-waste generation increase of 5% from 2012 to 2014 and a 1.6% population growth rate[47], Pakistan might be among one of the leading countries of

[44] Shaw SD, Blum A, Weber R, et al. (2010) Halogenated Flame Retardants: Do the Fire Safety Benefits Justify the Risks? Reviews on Environmental Health 25(4) 261-305

[45] Stapleton HM, Sjödin A, Jones RS, Niehüser S, Zhang Y, Patterson DG Jr (2008) Serum levels of polybrominated diphenyl ethers (PBDEs) in foam recyclers and carpet installers working in the United States. Environ Sci Technol. 42(9):3453-3458.

[46] Thuresson K, Bergman K, Rothenbacher K, Herrmann T, Sjölin S, Hagmar L, Päpke O, Jakobsson K (2006) Polybrominated diphenyl ether exposure to electronics recycling workers--a follow up study. Chemosphere. 64(11), 1855-1861.

[47]Iqbal M, Syed, JH, Malik, R.N. (2017). E-waste driven pollution in Pakistan: The first evidence of environmental and human exposure to flame retardants (FRs) in Karachi City. Environmental Science & Technology, DOI: 10.1021/acs.est.7b03159.

e-waste generation soon, which calls for regulatory efforts to minimize possibly harmful impacts on environmental and human health. Findings from other developing countries confirms informal e-waste recycling activities as major potential emission sources of FRs to the environment. Comparison with other studies from Pakistan shows e-waste to be a primary cause of the high amounts of flame retardants in Karachi's environment[47].

While the human health risks associated with inhalation and soil ingestion of FRs are likely low, other possible human exposure pathways merit further investigation (e.g., direct dermal contact and diet). Future studies should also target exposures from a broader range of well-known toxins either formed or released as a result of informal e-waste activities, such as PCBs, PCDD/F, PAHs, and metals (e.g., mercury, lead, and cadmium). Given the increasing amount of e-waste and expanding business for informal e-waste recycling in Pakistan, further research on this topic could help inform and thereby support future regulatory efforts to minimize the negative impacts of informal e-waste recycling on environmental and human health.

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

2.3.4.1 General

HBCD is another prominent brominated flame retardant listed in Annex A of the Convention and used mainly (90%) in expanded and extruded polystyrene (EPS/XPS) in building insulation. Minor uses were in textiles and in high impact polystyrene (HIPS) in electronics. These latter uses are considered to have stopped globally in production.

The HBCD inventory has been developed based on the Stockholm Convention inventory guidance for HBCD.

2.3.4.2 Production

There is no HBCD production in Pakistan. However, EPS/XPS containing HBCD is produced in Pakistan since more than 10 years but only limited information has been shared by the stake holders. Only one industry, Diamond Jumbolon in Lahore, has provided information on usage of HBCD in the production of insulation boards for the years 2015 to 2018 with a total of 56 t (

Table **18**) used in approx. 5600 t of EPS/XPS.

Table 18. Use of HBCD in production of insulation boards at Diamond Jumbolon Industry, Lahore

Year	2015	2016	2017	2018
HBCD (kg)	3089	21920	24084	6975

Furthermore 798 t of EPS and 7 t of XPS foam board sheets of polymers of styrene were imported to Pakistan in 2018. This corresponds to approx. 5.6 t HBCD in EPS and approx. 70 kg in XPS, based on the content suggested by the Stockholm Convention guidance.

The use of HBCD in XPS for 2018 was estimated to 27,930 kg and for expandable Polystyrene (EPS): 11730 kg.

2.3.4.3 Inventory of HBCD in polystyrene (EPS and XPS) in current use and stock

2.3.4.3.1 Inventory of HBCD in EPS/XPS in construction and use

Since only limited information on import has been provided and only from 2015 to 2018, no reasonable estimate can currently be made for the current stock of HBCD in EPS/XPS in Pakistan. Based on the import data of HBCD, EPS and XPS provided by FBR for the year 2018-2019, no HBCD has been imported to Pakistan.

For other XPS products imported for drinking cups and boxes and food contact materials it was assumed that no HBCD is present and were therefore not considered for HBCD inventory.

Since EPS and XPS containing HBCD might be recycled or might be used for other purposes than insulation foam including food contact materials such as fish boxes[48], further assessment of EPS/XPS in other uses will be conducted in future.

2.3.4.3.2 Impact Polystyrene (HIPS) in Electronics

A minor amount of HBCD has been used in High Impact Polystyrene (HIPS). HIPS is a versatile, economical and impact-resistant plastic that is easy to machine and fabricate. HIPS is often specified for low strength structural applications when impact resistance, machinability, and low cost are required. It is used for TV and audio-visual equipment parts, bicycle trailer, as well as in automotive industry for instrument panels and fittings.

Within this first inventory it could not be assessed how much of the EEE contain HIPS and if HBCD has been used as flame retardant.

[48] Rani M, Shim WJ, Han GM, Jang M, Song YK, Hong SH (2014) Hexabromocyclododecane in polystyrene based consumer products: an evidence of unregulated use. Chemosphere 110:111-119.

2.3.4.3.3 HBCD use in textiles

Flame retarded textiles are used in cars, furniture, curtains, tents or uniforms. In this first inventory of POP-BFRs no assessment of the textile sector has been made but will be conducted in implementation when also monitoring capacity is developed.

2.3.4.3.4 End of life management

An assessment on current and future waste management practice of EPS/XPS has not been conducted in this first assessment. This would be best developed within the frame of an overall polymer management in Pakistan.

2.3.4.4 Potential Impacts

The overall exposure from HBCD in polystyrene is considered low. Workers cutting polystyrene with hot wires are exposed at elevated levels[49]. Furthermore, polystyrene can contribute to marine litter if not appropriately managed.

The exposure HBCD in textiles might have a higher risk from fibres and related house dust ingestion. However it is not clear to what extent HBCD has been used in textiles in Pakistan.

2.3.5 Assessment with respect to DDT (Annex B, Part II)

2.3.5.1 General

Dichlorodiphenyltrichloroethane (DDT) is one of the most prominent POPs pesticides and is listed in Annex B of the convention with the exemption of malaria vector control. The global production of DDT for vector control is estimated to 4740 tonnes in 2005 and 6300 tonnes in 2007 in India alone.

In Pakistan DDT was prohibited in 1994 and no exemption is taken for the use of DDT for malarial control. Hence there is no current legal use of DDT in Pakistan. However, it is found that DDT is illegally imported into Pakistan and used in agriculture. Secondly, some stock of DDT is remaining in stores of obsolete POPs pesticides stockpiles.

2.3.5.2 Production

In Pakistan one factory produced DDT from 1963-1994 in Amman Garh near Nowshera,in Khyber Pakhtunkhwa province.[50]Since then no DDT was produced in Pakistan. The total

[49] Zhang H, Kuo YY, Gerecke AC, Wang J. (2012) Co-release of hexabromocyclododecane (HBCD) and Nano- and microparticles from thermal cutting of polystyrene foams. Environ Sci Technol. 46(20):10990-10996.

[50] Younas A, Hilber I, ur Rehman S, Khwaja M, Bucheli TD (2013) Former DDT factory in Pakistan revisited for remediation: severe DDT concentrations in soils and plants from within the area. Environ Sci Pollut Res Int. 20(4):1966-1976. doi: 10.1007/s11356-012-1317-y.

installed capacity of DDT was 2020 t per year. However, there is no current production and/or legal use of DDT in Pakistan.

2.3.5.3 Import

DDT has been imported to Pakistan until the 1990s. After the ban of DDT no import has been registered. It is found that DDT is currently been illegally imported to the country. Most of the illegal import occurs across the border between Afghanistan and Pakistan. In Afghanistan it is usually imported from India, where it is exempted for vector control. The presence of DDT in Pakistan is only found in stockpiles and through illegal import.

2.3.5.4 Export

There has been no export of DDT from the country after the DDT factory closed in 1994.

2.3.5.5 Use

DDT has been used to control agricultural pests as well as for vector control. Since it was produced and imported until 1990s it was extensively used for these purposes in Pakistan. Use of DDT was banned in Pakistan properly in 1994 since then there is no legal use of DDT in Pakistan. However, it is reported that DDT is still illegally imported from India across the Afghanistan border and used to control agricultural pests.

2.3.5.6 Release and storage

DDT stocks are stored in several stores around the country. The soil at the former DDT factory is contaminated[50] and might still contribute to releases by soil erosion and dust release. Further, illegal import and use of DDT is a major source of increasing concentrations of DDT in various environmental matrices in Pakistan. The destruction facilities could be another sources of DDT dissemination in the environment. Since there are various concerns raised by scientific and local communities about the improper destruction of POPs pesticides in the destruction facilities. Empty containers and left over from the stores from where DDT has been removed for destruction is another source of DDT release in the environment. Many of the recent studies have reported very high concentration of DDT in abiotic as well as biotic matrices of the environment of Pakistan which is alarming.

2.3.5.7 Potential impacts

Sites where DDT has been used in the past might still be contaminated (indoor, soil, or sediments). In these areas still exposure to DDT and the more stable metabolite DDE might

take place e.g. via soil-chicken[51]. Recent studies in Pakistan revealed a very high concentration of DDT in environmental matrices of Pakistan. This shows that classical and current illegal use of DDT is a real challenge which is needed to be addressed. There is also some contamination around the former DDT factory[50] which might still contribute to exposure of the surrounding. Moreover, left over and empty containers at POPs removal sites are posing a real health risk for human and wildlife.

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

2.3.6.1 General

Per- and polyfluoroalkyl substances (PFAS) are a large group of more than 4500 fluorinated compounds[52], including oligomers and polymers, which consist of neutral and anionic often surface-active compounds with high thermal, chemical and biological inertness. PFAS are used in many different chemical products and articles because of their desirable properties and as a result they find their way into the environment. The substances have extremely poor environmental biodegradability (persistent, P) and some of them accumulate in living organisms (bio-accumulating, B) and are toxic (T). There is a lack of overall knowledge of highly fluorinated substances and to prevent further pre-existing health and environmental problems from building up and persisting for a long time, it is important to control and where necessary to eliminate the use of these substances[53]. Therefore, PFAS have been listed as issue of concern under the Strategic Approach of International Chemical Management (SAICM).

Perfluorooctanesulfonate (PFOS) is one of the most relevant and toxic PFAS. PFOS and their salts are produced since the 1950s. PFOS and precursors of PFOS (PFOS related substances) were listed in 2009 in Annex B with a range of specific exemptions and acceptable purposes. Historically the major global manufacturer was the American 3M Company with a total historic production volume of approx. 96000 t[54] and a production volume of approx. 4500 t in 2000. In 2003 3M voluntary stopped the sales of PFOS. Since then, PFOS has been phased

[51] Weber R, Herold C, Hollert H, Kamphues J, Blepp M, Ballschmiter K (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

[52] OECD (2018) Towards a new comprehensive global database of Per- and Polyfluoroalkyl Substances

[53] Blum A, Balan SA, Scheringer M, Trier X, Goldenman G, Cousins IT, Diamond M, Fletcher T, Higgins C, Lindeman AE, Peaslee G, de Voogt P, Wang Z, Weber R (2015) The Madrid Statement on Poly- and Perfluoroalkyl Substances (PFASs). Environ Health Perspect 1235 A107–A111.

[54] Paul AG, Jones KC, Sweetman AJ. (2009) Environ Sci Technol. A first global production, emission, and environmental inventory for perfluorooctane sulfonate 43(2), 386-392.

out for several uses in some regions. At around the same time production started in China at lower production volumes of ca. 200 t/year.

Furthermore perfluorooctanoic acid (PFOA) was listed as POPs in May 2019 with a range of exemptions. Additionally, perfluorohexanesulfonic acid (PFHxS) is currently assessed by the POPs Review Committee (POPRC) and it has been concluded that it meets the POPs properties. Other PFAS are not listed in the Stockholm Convention but are considered an issue of concern under SAICM.

Although the main global producing companies like 3M phased out production since 2003 but still some other companies are producing PFOS. The current remaining major uses of PFOS are aqueous film forming foams (AFFFs), plating industry, insecticides (sulfluramide) and oil drilling.

2.3.6.2 Production

PFOS and related substances are not produced in Pakistan but are only imported in products.

2.3.6.3 Import of PFOS and related substances

An assessment of imports considering HS codes have been conducted. The customs provided data on imported firefighting foam, aviation hydraulic fluid and PFAS containing pesticides for 2018 (

Table **19**). Since it has been described that HS codes are not specific enough to determine the individual chemical in product, the generated data rather only indicate the total amount of a product category.[55]Therefore the data on imported 554 t of firefighting foams, 62 t of PFAS containing insecticides and 199 t of aviation hydraulic fluids are only the information on total imports of these categories and further assessment are needed to clarify the share of products actually containing PFOS or PFOA and related substances.

[55] Korucu et al. (2015) Inventory development for perfluorooctane sulfonic acid (PFOS) in Turkey: challenges to control chemicals in articles and products. Environ Sci Pollut Res Int. 22(19):14537-45.

Table 19. Information on import of potentially PFOS containing product categories (firefighting foam, insecticides and aviation hydraulic fluids (2018).

HS Code	Item Description	Quantity (t)
2901.1010	PFAS containing insecticides	62
3813.0000	Firefighting foam	554
3819.0090	Aviation hydraulic fluid	199

2.3.6.4 Use and stocks of PFOS

2.3.6.4.1 Stock and use of PFOS in firefighting foam

PFOS-based firefighting foams are mainly used to extinguish flammables hydrocarbons liquid fires at chemical plants, fuel storage facilities, airports, military, oil production, refining and underground parking facilities. The main stakeholders or professional users are oil refineries, on-shore gas terminals, airports, military, fire and rescue brigades and firefighting training sites. As firefighting foams have a long shelf life (10-20 years or longer), PFOS-containing firefighting foams will remain for long period as stockpiles. The use of AFFF causes contamination of local terrestrial and aquatic environments.

Preliminary investigation indicated that there is no manufacturing of firefighting foam in Pakistan. The country obtains its firefighting foams by import from different countries.

According to the Bureau of Revenues, 554 tonnes of firefighting foam was imported in 2018. To determine the amount of firefighting foam containing PFOS (AFFF foams and other foams used for hydrocarbon fires) a list of importers was obtained from custom authority. Other important source of information is the General Civil Defence Administration which is responsible for registration of all imported firefighting foams. From these two sources a list of all importers and users was obtained. From desk study of the gathered information the following relevant professional users were identified:

- General Civil Defence Administration (responsible for use of foam for all categories) and national firefighters;
- Private companies involved on petroleum operations;
- Pakistanis Company to generate heat & power;
- Military;
- Airports;
- Traders (suppliers only).

The stakeholders identified in step 1 were contacted and the situation of PFOS listing was explained. The responsible personnel in identified sectors were however not providing information on their stockpiles and use of PFOS-based firefighting foams.
In this first inventory it could not be clarified which share of these imported foams contains PFOS and related substances or other PFAS including PFOA and related substances listed as POP at COP 05/2019 or PFHxS currently evaluated in the POPs Review Committee.

2.3.6.4.2 Sulfluramide insecticide against ants and termite

Data from import indicated that 62 t PFOS precursor containing insecticides are imported to Pakistan. The PFOS related substance content of such pesticides is normally around 0.5%. Therefore approx. 310 kg of PFOS related substance were imported in 2018 to Pakistan. As mentioned, further assessment is needed since this estimate is based on HS code which is normally not specific enough.[55]

2.3.6.4.3 Aviation hydraulic fluid

Information on import showed that 199 t of aviation hydraulic fluids was imported to Pakistan. However these aviation hydraulic fluids do most likely not contain PFOS since no production is known in recent years and other countries submitting NIPs have also not found PFOS containing aviation hydraulic fluids.

2.3.6.4.4 Chromium plating and other plating

Pakistan has chromium plating industries and other metal or plastic plating process. However, the industry and other stakeholders involved in chromium and other plating processes did not provide information on the use of PFOS or other mist suppressants. Since PFOS is still used as a major mist suppressant in plating industries, it is most likely that PFOS is still used in plating industries in Pakistan.

2.3.6.4.5 Carpets and other treated material

Certain synthetic carpets and synthetic textiles might be treated with PFOS or PFOA related substances and polymers. Synthetic carpets are produced in Pakistan. Synthetic carpets/textiles in particular those produced before 2002 might contain PFOS. Due to the long service life of carpets, some of these carpets might still be in use. Synthetic carpets/textiles produced or imported after 2002 might rather contain other PFAS such as PFOA and related substances. An assessment of potential quantities has not been conducted in this first inventory.

2.3.6.5 Potential impacts

From studies in other countries contamination of ground water reservoirs and drinking water are known.[56] Currently very limited information is available for Pakistan on the PFOS or PFOA contamination in surface and ground water and related drinking water due to the lack of monitoring capacity and therefore an impact cannot be estimated but are urgently needed.

2.3.7 Assessment of releases of unintentional produced POPs (Annex C)

2.3.7.1 Background

Polychlorinated dibenz*o*-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), together with polychlorinated biphenyls (PCBs), polychlorinated naphthalenes (PCNs), hexachlorobenzene (HCB), pentachlorobenzene (PeCB) and hexachlorobutadiene (HCBD) are listed in Annex C of the SC as unintentionally produced POPs (UPOPs). PCBs, PCNs, HCB and PeCB have also been industrially-produced and used in several applications. PCDD/Fs were not produced commercially,[57] and they have no known use.

PCDD/Fs and other UPOP formation and/or releases arise mainly from four types of sources:

Three releases are process-related:

- Chemical production processes – e.g., the production of chlorine, chlorinated phenols and other chlorinated aromatic compounds; the production of chlorinated solvents and oxychlorination of mixed feeds to make chlorinated solvents; the use of chlorine in industrial process like the production of magnesium, titanium oxide or pulp and paper;
- Thermal and combustion processes: destruction of POPs and other organochlorine containing waste, incineration of wastes, the thermal processing of metals scraps;
- Biogenic processes or photolytic processes, which can form PCDD/Fs from precursors mostly of anthropogenic origin such as pentachlorophenol and other chlorinated phenols. Also, the degradation of certain organochlorines can form UPOPs; e.g., pentachloronitrobenzene (PCNB) (Quintozene) partly degrades to PeCB and is considered one of the largest (historic) sources of PeCB.[58]

[56] 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. 3(10):344-350.

[57] With the exception of analytical standards.

[58] POP Reviewing Committee document (UNEP/POPS/POPRC.6/INF/21)

Meanwhile, the fourth, and by far the largest source, is related to past releases of UPOPs[59]:

- Soils and sediments - which have accumulated PCDD/Fs and other (U)POPs over the last 100 years of releases from application of organochlorines containing UPOPs (e.g. historic pesticide use in Japan released approx. 460 kg TEQ[59] or spraying of defoliants released more than 366 kg TEQ in the Vietnam War[60]) or releases from incinerators, metal industries or open burning. The PCDD/F-contaminated sites, soils, and sediments from the past release are still relevant sources of food contamination (e.g. fishes, chicken/egg, grazing cattle and milk/dairy products).[61]
- Reservoir sources, such as landfills/dumps containing wastes from chlorine and organochlorine production with high PCDD/Fs and other UPOPs levels. Landfills containing chemical waste from a single pesticide production in Germany contain 330 to 854 kg TEQ[62] or single solvent productions generated thousands of tonnes of HCB waste.

The legacies in such dioxin contaminated sites and waste reservoirs are far exceeding the total contemporary global releases of 100 kg TEQ/year[63] and need to be appropriately addressed.

Stockholm Convention obligation in respect to dioxins/UPOPs (Article 5)

The framework for the activities and the action plan for PCDD/Fs and other Annex C chemicals is given by the obligations of Article 5 of the Convention, covering the measures to reduce and eliminate releases from unintentional production. It states that each Party shall, at a minimum, take the following measures to reduce the total releases derived from anthropogenic sources of each of the chemicals listed in Annex C, with the goal of their continuing minimization, and, where feasible, ultimate elimination (paraphrased and summarized):

Article 5 (a): Develop an action plan with the elements 5a (i-v) to facilitate its implementation (subparagraph (b) to (e))

[59] For an overview: Weber R, Gaus C, Tysklind M et al. (2008) Dioxin- and POP-contaminated sites—contemporary and future relevance and challenges. Env Sci Pollut Res 15, 363-393.

[60] Stellmann MJ, Stellmann SD, Christian R, Weber T, Tomasallo C (2003) The extent and patterns of usage of Agent Orange and other herbicides in Vietnam. Nature 422, 681-687.

[61] Weber R, Herold C, Hollert H, Kamphues J, Blepp M, Ballschmiter K (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

[62] Götz R, Sokollek V, Weber R (2013). The Dioxin/POPs legacy of pesticide production in Hamburg: Part 2: Waste deposits and remediation of Georgswerder landfill. Env Sci Pollut Res. 20, 1925-1936.

[63] Wang B, Fiedler H, Huang J, Deng S, Wang Y, Yu G (2016) A primary estimate of global PCDD/F release based on the quantity and quality of national economic and social activities. Chemosphere. 151, 303-309.

Article 5 (a) (i): Evaluate current and projected releases, including the development and maintenance of source inventories and release estimates.

Article 5 (a) (ii): Evaluate the efficacy of laws and policies to manage releases.

Article 5 (a) (iii): Identify strategies to meet dioxin reduction obligations, taking into account the evaluations in (i) and (ii).

Article 5 (a) (iv): Take steps to promote education and raise awareness of the strategies.

Article 5 (a) (v): Review, evaluate, and report on strategies every five years in meeting release-reduction obligations.

Article 5 (a) (vi): Develop a schedule for implementation of the action plan, including the strategies and the measures identified in them.

Article 5 (b): Promote the application of available, feasible, and practical measures that can readily achieve a realistic and meaningful level of release reduction or source elimination.

Article 5 (c): Promote the development and use of substitute or modified materials, products, and processes to prevent the release of Annex C chemicals.

Article 5 (d): Promote and, as soon as practicable, require BAT/BEP for new installations (sources) listed in Annex C Part II.

Article 5 (e): Promote BAT/BEP for existing installations (sources) listed in Annex C Parts II and III and for new sources listed in Annex C Part II.

2.3.7.2 Inventory of PCDD/Fs and Other Unintentionally-Produced POPs

The purpose of the unintentional POPs inventory was to evaluate the release of PCDD/F of all relevant sources in Pakistan and to update and reflect the baseline inventory. Since PCDD/Fs and the other listed unintentional-POPs (PCBs, PCNs, HCB and PeCB) are formed in incineration and other thermal processes, together, the Toolkit recommends, for practical reasons, that inventory activities be focused on PCDD/Fs, as these substances are indicative of the presence of other unintentional POPs[64]. For these sources PCDD/Fs are considered to constitute a sufficient basis for identifying and prioritizing sources and control measures for all Annex C POPs and for evaluating their efficacy. Since major UPOPs emission sources in Pakistan are incineration, open burning and other thermal sources, the inventory focused on PCDD/Fs as representative for all UPOP. However certain organochlorine production such as chlorinated solvents do not have an emission factor for PCDD/F but are highly contaminated

[64]UNEP (2013) 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 http://toolkit.pops.int/

with HCBD and PCNs[65,66] Also certain pigments contain PCBs as UPOPs but no PCDD/Fs.[67] Therefore these organochlorines need to be assessed separately for specific UPOP releases.

The Toolkit assists countries in identifying sources and estimating releases of PCDD/Fs from all sources and selected other UPOPs for some sources. The procedures proposed by the toolkit and used by the project team was the five-step approach:

1. Apply Screening Matrix to identify Main Source Categories;
2. Check source categories to identify existing activities and sources in the country;
3. Gather detailed information on the processes and classify processes into similar groups by applying the Standard Questionnaire;
4. Quantify identified sources with default/measured emission factors;
5. Apply nation-wide to establish full inventory and report results using guidance given in the standard format;

These 5 steps were conducted for all 10 source groups and related source categories were assessed in the inventory (see Table 20).

Potential releases of PCDD/Fs to air, water, land, product and residue in Pakistan were calculated by multiplying mass production (tonne/annual) and emission factor proposed by the updated UNEP Toolkit 2013[64].

The summary of PCDD/F releases in Pakistan in 2016 is compiled in Table 20. The total emissions from inventoried sources were 4491.6 g TEQ/a. The highest share of PCDD/F released stem from open burning with an estimated release of 2049 g TEQ/a (45.6% of total). The second most relevant source was waste incineration emitting 1136.2 g TEQ/a (25.3% of total). Further major source categories were metal industries (436.8 g; 9.7% of total) the production of mineral products (386 g TEQ/a; 8.6%) and chemical production and use with 328.6 g TEQ/a (7.3%) (Table 20).

It needs to be stressed that the gathering of activity rates and information to decide on emission factors for major sources were challenging. Due to the large size of the country and lack of information on national level, major information for a robust update of the PCDD/F

[65]Secretariat of the Stockholm Convention (2017) Draft guidance on preparing inventories of polychlorinated naphthalenes (PCNs).Draft March 2017. UNEP/POPS/COP.8/INF/19

[66]Secretariat of the Stockholm Convention (2017) Draft guidance on preparing inventories of hexachlorobutadiene (HCBD). UNEP/POPS/COP.8/INF/18

[67] Weber R (2015) Formation and release of unintentional POPs from production processes for pesticides and industrial chemicals: Review of (new) information for reducing or preventing releases and related information gaps. Report for the UNEP Toolkit and BAT/BEP Expert Group, 29.09 - 1.10.2015, Bratislava, Slovakia, UNEP/POPS/TOOLKIT/BATBEP/2015/2UNEP/POPS/TOOLKIT/BATBEP/2015/2

inventory could only be gathered to some extent. For some of the major sources categories like waste incineration it was not possible to gather country wide data. Therefore the approach taken to update the inventory was:

- To compile updated information on activity rates and selection of emission factors where accessible;
- To utilize information from the baseline inventory. Since after the first NIP no BAT/BEP project has been implemented, the sectors where robust information has been compiled in the baseline inventory were also considered in the current inventory considering the population growth where appropriate (33% increase from 147.7 to 197 million) since the time of baseline inventory (2003 versus 2016).

Table 20. PCDD/F release in Pakistan for the updated inventory 2016

Group	**Source Groups**	Annual Releases (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	1130,51	0,00	0,00	0,00	5,71
2	Ferrous and Non-Ferrous Metal Production	265,42	0,00	0,00	0,00	171,42
3	Heat and Power Generation	4,44	0,00	0,00	0,00	2,23
4	Production of Mineral Products	335,14	0,00	0,00	38,21	12,74
5	Transportation	4,82	0,00	0,00	0,00	0,00
6	Open Burning Processes	1833,50	0,00	215,90	0,00	0,00
7	Production of Chemicals & Consumer Goods	0,01	43,83	0,00	236,66	48,12
8	Miscellaneous	0,01	0,00	0,00	0,00	0,01
9	Disposal	0,00	1,42	0,00	0,00	141,53
10	Identification of Potential Hot-Spots	NA	Unknown	unknown	NA	NA
1-10	**Total**	**3573,8**	**45,2**	**215,9**	**274,9**	**381,8**
	Grand Total			**4491,6**		

The update of the inventory revealed the following:

- Further assessment is necessary;
- Better national database on key industrial sectors on national level is needed including information on the technology level for the individual plants and industries;
- Description of the technology level of major emission sources;
- The need of further updating and refining of the inventory.

In the following the releases of the individual source groups and relevant source categories are described with information on approach and gaps.

Source Group 1: Incineration

In the baseline inventory Punjab compiled detailed information on hospital waste incineration with assessment of individual plants. The total amount of hospital waste in 2003 was 27590 t with 75% incinerated in Category 1 incinerator and 25% in Category 2. Considering the 33% increase in population development, the waste has increased to 36700 t. In addition in the updated inventory data from Faislabad, Quetta and Peshawar were generated and added. The total emission from hospital waste incineration based on former and current assessed facilities are estimated to total of 1136.2 g TEQ (1130.5 g TEQ to air and 5.7 g TEQ to residues) and 25.3% of total release.

However this estimate does not appropriately consider the emissions from other provinces. In the baseline inventory other provinces have reported minor emissions from medicalwaste incineration. This is likely due to a lack in former detailed assessment.

For a further update of PCDD/F releases from hospital waste incineration the situation in the individual provinces need to be better assessed. In any case hospital waste incineration is a major PCDD/F emission source in Pakistan and emissions need to be reduced.

Municipal waste is currently largely dumped. In the current inventory only a small incinerator with 16 t of waste/year and a release of 0.06 g TEQ/year is listed. However, currently the first full scale waste to energy plant is constructed in Lahore with a planned capacity of 2000 t/day built by a Chinese company and is not in operation yet.[68]

At least one hazardous waste incinerator has operated and has destroyed POPs pesticides and other pesticides. The total emission for this incinerator could not be assessed.

Source Group 2: Metal Industry

Pakistan has a range of metal industries with an estimated total PCDD/F release of 436.8 g TEQ/a (9.7 % of total releases). Major emissions result from secondary iron industry with 236 g TEQ/a release (94.4 g TEQ to air; 141.6 g to residues; 5.3% of total). Other sources were zinc production (131 g TEQ/year), aluminium production (43.8 g TEQ/year), sintering process (13.5 g TEQ/year), open burning of cables (11.1 g TEQ/year) and secondary copper production (1.32 g TEQ/year).

The current inventory can be considered a preliminary estimate since a detailed assessment of individual plants in respect to the technologies used were not conducted. Also the amount of

[68] The Express Tribune (2018) Pakistan's first waste-to-energy plant gets licence. July 16, 2018.

cables processed by the informal sector could only be roughly estimated and was considered at least the official amount of secondary copper production (926 t/year).

Source Group 3: Heat and power generation

Pakistan has a range of heat and power generation industries and sources with an estimated total PCDD/F release of 6.7 g TEQ/year (0,15% of total) and therefore only a minor UPOPs source. Major emissions result from coal power plants with 3.8 g TEQ/year release (1.6 g TEQ to air; 2.2 g TEQ to residues). Other sources were heavy fuel fired power boilers (2.2 g TEQ/year).

Household heating and cooking with biomass was not estimated in the current inventory but might be a relevant source of PCDD/Fs, PAHs and particulate releases and human exposure.

Source Group 4: Production of mineral products

Pakistan has a range of mineral producing industries with an estimated total PCDD/F release of 386.1 g TEQ/year (8.6% of total).There are 25 cement production industries in Pakistan as of 2018 and they have a total production of 49.442 tonnes. Pakistan is the third largest brick producing country in South Asia, producing more than 45 billion bricks per year and there are around 18,000 brick kilns across the country. Modern brick production where fuel oil is used covers less than 2% of the total annual brick production. Therefore, biomass fuels, especially fuel wood, are the main fuels used in clay brick firing. Consumption of biomass fuels (fuel wood, crop residues, dried animal waste etc.) is often considered to be neutral with respect to emissions of carbonaceous greenhouse gases, which means all the CO2 emitted in the burning process. There are many brick manufacturing units across the country for which emission factor of class 1 has been adopted.

Major emissions result from brick production with 178.3 g TEQ/year (4% of total) and from cement industry with 136.9 g TEQ/year release (3% of total). Other sources were lime production with an estimated release of 70.8 g TEQ/year and asphalt mixing with a release of 0.01 g TEQ/year.

The current inventory can be considered a preliminary estimate since a detailed assessment of individual plants in respect to the technologies used were not conducted. For lime production the production volume were estimated as 10% of mined lime while the largest share of raw material was going to cement production.

Source Group 5: Transport sector

The transport and communication sector plays a significant role in the socio-economic development of the country. The estimated number of vehicles in Pakistan has jumped from approximately 3 million to around 15 million in 2018 over the period of the last 20 years, causing severe air pollution due to a variety of reasons. There was no leaded gasoline use in Pakistan with regulation in place since 2001 and stop of production of leaded gasoline around 2000 to 2002.[69]

Due to the low PCDD/F emission factor of unleaded gasoline, Pakistan has minor release of PCDD/Fs from transport sector estimated to 4.8 g TEQ/year (1.1% of total). The largest emissions result from 2 stroke engines (2.0 g TEQ/year) and from heavy fuel engines (1.9 g TEQ/year).

Surce Group 6: Open Burning

Burning of waste has the potential for comparatively high unintentional formation and release of dioxins and furans to the environment. In Pakistan the following gaps have been identified in the management of uncontrolled combustion process:

- Lack of public awareness of UPOPs generation and their hazards.
- Insufficient regulation related to UPOPs open burning and control
- Lack of regular monitoring.

Open burning is one of the most popular waste disposal methods in Pakistan. Household waste, landfill waste, agriculture residue are burned in an uncontrolled manner.

Open burnings of landfills and dumpsites occur frequently in Pakistan. It is estimated that approx. 15 % of the waste is subjected to open burning on landfills and 5% of waste is burned in backyards with an estimated total release of 1359.4 g TEQ/a (30.3% of total).

Furthermore harvest residue burning is still a common practice in Pakistan. It was estimated that at least 25% of the 69 million t of crop residues are burned in the open with a total release of 690 g TEQ/a (15.3% of total release).

Source Group 7: Production and Use of Chemicals and Consumer Goods

Category 7 were estimated in the first PCDD/F inventory to 14962 g TEQ/a. Unfortunately there were no records available for this estimate in particular from Sindh Province where an emission of 13737 g TEQ/a has been estimated for Category 7. In the current inventory this sector could not be assessed in detail. However it was found that a range of chemical

[69]Rose P, White F, Luby S (2003) Trends in lead content of petrol in Pakistan.Bulletin of the World Health Organization 2003, 81 (6), 468.

productions are present with PCDD/F formation and release potential. Several chlorine productions operated and operate in Pakistan. These chlorine is used in several industries such as EDC production and PVC production where PCDD/F formation is known. For the EDC production the former data were used. Based on this an emission of 92 g TEQ/a is estimated for this source. For a detailed inventory of this sector the individual processes and use of chlorine need to be better assessed during implementation of the NIP (action plan).

Other industries generating PCDD/Fs are pulp and paper. The main process generating PCDD/Fs is in the stage of bleaching via the reaction of chlorine. As database the production from 2005-06 was used where 133 paper and pulp mills were present and manufacturing paper products with an estimated release of 2.7 g TEQ/a into the paper products.

Furthermore contamination with PCDD/Fs has been reported in textile and leather products due to the use of chlorinated aromatic chemicals, especially pentachlorophenol to protect the raw materials (e.g. cotton, wool or other fibres, leather); and use of PCDD/F-contaminated dyestuffs (e.g. chloranil or phthalocyanines). For the leather industry 210.5 g TEQ/a (4.7% of total) release is estimated while for textile industry the estimate is 23.1 g TEQ/a release.

Source Group 8: Miscellaneous

The UNEP Toolkit indicates that dioxin emissions can occur from the drying of biomass if contaminated wood is used as fuel. The drying of biomass using combustion does not widely take place in Pakistan, as most wood chip and green fodder are air dried. Therefore, dioxin emissions from the drying of biomass are expected to be insignificant. The use of crematoria is very insignificant.

Smoke houses use the combustion of biomass to produce smoke in a closed chamber to preserve food. PCDD/F emissions to air from the combustion products of biomass and to land from ash disposal are possible. It is assumed that smoke house activity is small and dioxin emissions are negligible.

As any other thermal process, cigarettes and cigars produce PCDD/Fs. According to Pakistan Bureau of Statistics in 2018 there was a total production 59 billion cigarettes in Pakistan. The PCDD/Fs from tobacco smoking was calculated as 0.006 g TEQ/a.

Source Group 9: Disposal

The PCDD/F amount from disposal of waste is estimated to 140.5 g TEQ/a. From this waste it is estimated that 1.4 g is leaching per year into water phase. Since industrial waste

potentially containing higher levels of PCDD/Fs is not considered due to the lack of information, this is rather a low estimate.

Sewage sludge generated in Islamabad was estimated to contain 1 g TEQ/year. The total amount of sewage sludge generated in entire Pakistan is higher but data were not available.

2.3.7.3 Update of the former UPOPs inventory

Pakistan had an extreme high first PCDD/F inventory with an estimate of 29668 g TEQ/a. Comparing with the global PCDD/F inventory of approx. 100 kg TEQ/a[70], this would mean that the PCDD/F release from Pakistan would have been 30% of the global PCDD/F release and approx. 3 times the total inventoried release of China. Therefore, the former estimate was obviously too high. A major estimated release was from Category 7 of production of chemicals from one province (16 kg TEQ/a) which could not be verified in the current inventory. Another high estimate was from the mineral sector (4320 g TEQ/a). The reassessment indicated that rather 386 g TEQ/a are released from this sector. A reason is likely that the total amount of processed raw materials was overestimated from mined amount. For open burning the reason for the higher estimate for 2003 was the higher emission factors from the UNEP Toolkit (2005) compared to UNEP Toolkit (2013) edition.

Overall, the updated estimate of PCDD/F release of 4491.6 g TEQ/a for 2016 seems a reasonable estimate with distinct major sources to address in the action plan (see Chapter 3.3.8). As mentioned above, there are further assessment needed for the development of a more robust PCDD/F and other UPOPs inventory (action plan).

Information on sites potentially contaminated with PCDD/F is compiled in chapter 2.3.8.5 below.

2.3.8 Information on the state of knowledge on contaminated sites and wastes, identification, likely numbers, remediation measures, and data on releases from sites

This section compiles information on potentially contaminated sites for individual POPs. The inventory of stocks and wastes for the individual POPs are included in the individual POPs section above.

[70] Wang B, Fiedler H, Huang J, et al. (2016) A primary estimate of global PCDD/F release based on the quantity and quality of national economic and social activities. Chemosphere. 151, 303-309.

2.3.8.1 POPs pesticides contaminated sites and hot spots

There is no proper inventory available in Pakistan regarding the contaminated sites and hotspots for POPs pesticides. Further, no criterion has yet been developed to declare a site as a contaminated site. However, few hot spots sites for POPs pesticides has been identified which are the rea sources for POPs dissemination in the local environment. Among these, the foremost are the POPs pesticides stores located at breadth and width of Pakistan. Major stores are located at Quetta, Sukkar, Larkana, Peshawar, Rahim yar Khan and Bahawalpur. Besides these a huge number of small stores are located throughout the country. These stores with large and small quantity of POPs pesticides are poorly managed (see chapter 2.3.1). As a result of deterioration of the stores and containment, these POPs pesticides are continuously evaporated into the environment. Further, these POPs pesticides are spread into the environment as a result of flooding and possibly earth quakes. For example, a huge quantity has been released into the environment through the major flood of 2010 and several smaller flash floods and such releases have likely caused contamination of soils and sediments. Secondly, the sites from where POPs pesticides are removed have left over as well as empty container which area source of POPs pesticides contamination and further dissemination. Beside these, the Yazman area of Cholistan and Malir, Karachi, where a huge but unknown quantity of POPs pesticides has been buried are contaminated sites and hotspots for potential POPs release into the environment. Besides these, poorly managed POPs destruction facilities are also a threat for potential POPs release and are potentially PPs pesticides contaminated sites. These POPs pesticide hotspot sites are a threat for further POPs dissemination in the environment which consequently poses major health risk for human and wildlife.

2.3.8.2 PCB/PCN contaminated sites

PCB contaminated sites are generated along the life cycle of PCBs – production, use in production, use in products and end of life treatment.[71]

For Pakistan the maintenance sites of transformers and scrap yards are likely contaminated with PCBs and other oils. Samples were taken within the NIP update project for further assessment. Also, sites where (many) transformer were/are operated can become contaminated from leaking.[71]

Also areas of open PCB applications become contaminated by the slow release and secondary contamination over time including buildings and the surrounding.

[71]Weber R, Herold C, Hollert H, Kamphues J, Ballschmiter K, et al. (2018) Life cycle of PCBs and contamination of the environment and of food products from animal origin. Environ Sci Pollut Res Int. 25(17), 16325-16343;

The ship-breaking sector is another potential source of PCBs and release to the environment with potential contamination over time. PCBs have been used in transformers on ship, possibly hydraulic fluids and in ship paints. Within the NIP update the team conducted sampling at allotted plots at Gadani Ship Breaking site to determine the presence of PCB contamination. This included 40 soils and sediment samples from random plots where practical dismantling of ships was observed at the site visit.

2.3.8.3 POP-PBDE, HBB and HBCD waste and contaminated sites and hotspots

In terms of contaminated sites for POP-PBDE, HBB and HBCD, plastic and e- wastes disposal sites should be taken into account. In Pakistan, there is no rules and regulations related to management of plastic wastes and management of plastic from e-waste or end-of-life vehicles and products are not issued yet. Some plastic wastes are recycled and some are disposed with solid wastes in dumpsites or landfills with frequent open burning and associate releases. According to data inventory, there are many e-waste and plastic recycling factories in Pakistan with potential releases and contamination.

Furthermore smouldering of cables and e-waste like circuit boards release POP-BFRs and other pollutants and generate contaminated sites.

2.3.8.4 PFOS contaminated sites and hotspots

Information related to PFOS and other PFAS contaminated sites resulted from the use of firefighting foams such as sites of fire events and firefighting practice where firefighting foam was used for practice at these areas.[72]From desk study of the gathered information the following relevant professional users were identified:

- General Civil Defence Administration (responsible for use of foam for all categories) and national firefighters;
- Private companies involved on petroleum operations;
- Military;
- Airports;
- Company to generate heat & power;
- Traders (suppliers only);

[72]Hu XC, Andrews DQ, Lindstrom AB, 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. 3, 344−350.

Another reported source of PFOS and other PFAS contaminated sites are plating industries using PFOS or other PFAS as mist suppressant.[73]However no detailed data is available for the contaminated sites at this stage.

2.3.8.5 PCDD/F and UPOPs contaminated sites and hotspots

Most of the major PCDD/F and UPOPs contaminated sites listed in the UNEP toolkit can likely be found in Pakistan with associated risk for food and feed contamination.[61] (See http://toolkit.pops.int/Publish/Main/II_10_HotSpots.html) This includes the following:

a) Production sites of chlorine

There are several chlorine production units in Pakistan.From experience in other countries contaminated sites were generated from themismanagement of residues from chloralkali production.

b) Production sites of chlorinated organics

Pakistan had a factory which produced DDT and other organochlorine compounds, and which has been abandoned.[74]The landfill and former production site might be contaminated with unintentional POPs in addition to the DDT contamination.

c) Application sites of PCDD/PCDF containing pesticides and chemicals

Some pesticides (formerly) used in Pakistancontained PCDD/F (e.g. PCP, 2,4-D, 2,4,5-T, chlonitrofen, quintozene/PCNB)[75]. Areas with frequent pesticide application might be impacted by long term pesticide use.

d) Timber manufacture and treatment sites

There are wood treatment sites which are potentially contaminated with chemicals used for wood preservation. In this first inventory a detailed assessment of chemicals used for wood preservation has not been conducted. PCP might have been used at some of these sites with potential contamination of PCDD/PCDF. PCP was only listed 2015 and has not been assessed in this NIP update but will be addressed in the next NIP update.

e) Textile and leather factories

[73] Huang J, Yu G, Gao J, et al. (2015) Footprint of fluorinated mist suppressant in ambient environment caused by chrome plating industry. Organohalogen Compounds 77, 715-718 715 http://dioxin20xx.org/wp-content/uploads/pdfs/2015/15-184.pdf

[74] Younas A, Hilber I, Rehman S, Khwaja M, Bucheli TD (2013) Former DDT factory in Pakistan revisited for remediation: severe DDT concentrations in soils and plants from within the area. Environ Sci Pollut Res 20, 1966-76.

[75]Holt E, Weber R, Stevenson G, Gaus C (2010) Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/F) Impurities in Pesticides: A Neglected Source of Contemporary Relevance. Environ. Sci. Technol 44, 5409–5415

Pakistan has a large textiles and leather industry operating since decades. Both industries have used chemicals containing PCDD/Fs in the past (e.g. PCP or chloranil).

f) Use of PCB

PCBs have been used in Pakistan in transformers and capacitors and possibly other uses. Some potentially contaminated sites have been found during the development of the PCB inventory and soils were sampled but are not analysed yet. These soils might also be contaminated with PCDFs present in the PCBs.

g) Waste incinerators and open burning of wastes

There are a range of waste incinerators in Pakistan. The medical waste incinerators are mostly small scale batch incinerators with high emissions (emission category 1). Areas close to the incinerator might become contaminated with PCDD/PCDF and other UPOPs over time. Also the management of (fly) ashes from waste incinerators can result in contaminated sites if not appropriately disposed of.

The frequent open burning of wastes can also contaminate soils and is practiced all over Pakistan also in small cities and rural areas.

h) Metal industries

Also the long term release from metal industries can result in PCDD/PCDF contamination in the surrounding if not operated with BAT/BEP. BAT/BEP has not yet been implemented in Pakistan for metal industries. Therefore areas at and around these industries might be contaminated by PCDD/PCDF and heavy metals.

i) Dumps of wastes/residues from groups 1-9

Areas where ashes from waste incinerators or fly ashes from metal industries are disposed of contain PCDD/PCDF and other UPOPs and heavy meals. A detailed assessment for the disposal sites for the individual facilities have not been conducted in this first inventory.

Also open burning of dump sites lead to UPOPs and POPs releases and contaminate of soils in the surrounding.

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

2.3.9.1 Background

A range of POPs have been listed with specific exemptions or acceptable purposes and can be used if a country has registered for an exemption (Table 2). If a country has registered for an exemption it can import and use the exempted POPs for the registered use.

In this section the current and potential future use of POPs are shortly summarized for Pakistan and the need for an exemption is mentioned.

2.3.9.2 Production, Use, Import and Export of Annex A and B POPs

a) Production of Annex A and B POPs

According to the information obtained during the assessment, there is no current production of any POPs in Pakistan. DDT has been produced in the country until 1994. There is currently no plan of future production of any POPs listed in Annex A and B in the country.

b) Use of Annex A and B POPs and exemptions needed

HBCD is used in polystyrene foam production in Pakistan and the producer will not substitute in short term. Therefore, Pakistan will register for exemption for continued use of HBCD in EPS/XPS for insulation in construction.

Also Pakistan will register for exemption for the use of PFOS in plating industry foams. There are currently PFOS containing foams in stocks. In the NIP implementation the detailed assessment of the continued need will be done (see action plan).

Pakistan has already banned endosulfan and lindane. Therefore, no exemption is needed for these POPs.

The recently listed POPs in 2015 and 2017 have not been assessed in this NIP update. Therefore, it is not known yet if the POPs with listed exemptions – PCP, short chain chlorinated paraffins (SCCPs) and decaBDE - are currently used and if there is a need of exemption for future use. This assessment needs to be conducted in the implementation ad update of the NIP (see action plan).

There are still transformers and possible other equipment in use containing PCBs. Pakistan is currently developing a PCB inventory for an overview of current use and further planning for phase out. For the continued use of PCB containing equipment, the plan is to stop the use before the Convention deadline 2025.

c) Import and Export of Annex A and B POPs

HBCD is imported for the use in polystyrene production. Also there is likely import of PFOS for fighting foams and mist suppressant for plating industry.

There is no known export of POPs from Pakistan.

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

As a consequence of both increasing population and industrialization in agro-economic sector, Pakistan has inevitably been confronted by multicomplex environmental challenges. Owing in part to poor regulatory framework, pollution due to persistent organic pollutants (POPs) has caused serious problems throughout the country. Resultantly, extensive use of POPs is causing vigorous deterioration of environment and human health

There is no systematic POPs monitoring in Pakistan and no specific monitoring programs. Despite the fact that Pakistan became signatory of this convention in 2001, there is still a lack of precise management and legislation plan to monitor and control POPs level in various environmental sectors of the country. Moreover, to date, these compounds have not been incorporated into the NEQS (National Environmental Quality Standards), thus reflecting the unavailability of the standards at local context.

Currently, around 60-70 studies associated with monitoring, fate, spatial variations, source apportionment and ecotoxicological aspects of POPs in Pakistan are available. However, most of the studies have been conducted in collaboration with research groups from China, UK, USA, Belgium and other countries. In these studies, a wide range of POPs groups (OCPs, PCBs, PCDD/Fs, HCB, PBDEs, OPFRs, PCNs, SCCPs) have been analyzed in different environmental compartments including, air, soil, water, biota (vegetables, fish, invertebrates, human etc.). However, the knowledge achieved and understanding of POPs contamination in the environmental compartments are still limited. Recently published literature has been a key to explore new emerging POPs from the environment of the country. POPs contamination data in soils in Pakistan have been reviewed.[76]

For PCBs there are no systematic data available for assessment in different environmental compartments, but several research studies have been published that quantify the concentrations of PCBs present in multiple environmental samples such as groundwater, soil,

[76] Zehra A, Eqani SA, Katsoyiannis A, Schuster JK, Moeckel (2016) Environmental monitoring of organo-halogenated contaminants (OHCs) in surface soils from Pakistan.C4, Jones KC4, Malik RN5Sci Total Environ. 506-507:344-352. doi: 10.1016/j.scitotenv.2014.10.055. Epub 2014 Nov 24..

and air. Additionally, few reports also showed the extent of PCBs pollution in marine and riverine sediments of Pakistan (

Table **21**).

Table 21. PCBs monitoringin different environmental matrices in Pakistan

Location	Time	Testing method	Media	PCBs Levels	Source
Karachi, Lahore, Pakistan	2014	GC-MS	Air	48−61 ng/PAS	Nasir et al., 2014[77]
River Ravi and its associated tributaries, Pakistan	2017	GC-MS	Water, sediments	Sediments: 1.06-95.76 ng/g (dw) Water:1.94 -11.66 ng/L	Baqir et al., 2017[78]
River Chenab, Pakistan	2015	GC-MS	Water, fish and sediments	∑7dl-PCBs in Water; 0.43-10.7 ng L−1 Fish; 2.6 -10.4 ng g−1, ww	Eqani et al., 2015[79]
Indus river basin, Pakistan	2015	GC-MS	surface soils,passive air samples	∑26–PCBs PAS; 0.002–3.03 pg m−3 Soils;0.26–1.89 ng g−1 dw	Ali et al., 2015[80]
Industrial and agricultural areas of Punjab, Pakistan	2013	GC-MS	Air and Soil samples	∑31–PCBs Air: 34 to 389 pg m−3 Soils: 7 to 45 ng g−1 dw	Syed et al., 2013[81]
River Chenab, Pakistan	2012	GC-MS	Sediments	∑31–PCBs in sediments 9.3-144.2 ng g−1 dw	Eqani et al., 2012[82]
River Chenab, Pakistan	2014	GC-MS	Cereal crops, sediments	∑33PCB Wheat;0.15–2.22 ng g− 1 dw Rice; 0.05–9.21 ng g− 1 dw Soil; 0.70–30.5 ng g− 1 dw Air; 41–299 pg m− 3	Mahmood et al., 2014[83]
Two tributaries of River Chenab, Pakistan	2014	GC-MS	Sediments, water	∑32PCB Sediments; 0.80-60 ng/g dw	Mahmood et al., 2014[84]

[77]Nasir J, Wang X, Xu B, et al. (2014). Selected organochlorine pesticides and PCBs in urban atmosphere of Pakistan: concentration, spatial variation and sources. ES&T, 48(5), 2610-2618.

[78] Baqar, M., Sadef, Y., Ahmad SR, et al. (2017). Occurrence, ecological risk assessment, and spatio-temporal variation of polychlorinated biphenyls (PCBs) in water and sediments along River Ravi and its northern tributaries, Pakistan. Environ Sci Pollut Res. 24(36), 27913-27930.

[79]Eqani SAMAS, Cincinelli A, Mehmood A, et al. (2015). Occurrence, bioaccumulation and risk assessment of dioxin-like PCBs along the Chenab river, Pakistan. Environ Pollut. 206, 688-695.

[80] Ali U, Syed JH, Mahmood A, et al. (2015). Influential role of black carbon in the soil–air partitioning of polychlorinated biphenyls (PCBs) in the Indus River Basin, Pakistan. Chemosphere, 134, 172-180.

[81] Syed, J. H., Malik, R. N., Li J, et al. (2013). Levels, distribution and air–soil exchange fluxes of PCBs in the environment of Punjab Province, Pakistan. Ecotoxicol Environ Saf. 97, 189-195.

[82]Eqani, SAMAS, Malik RN, Zhang G, Mohammad A, Chakraborty P (2012). PCBs in the sediments of the River Chenab, Pakistan. Chemistry and Ecology, 28(4), 327-339.

[83]Mahmood A., Syed, J. H., Malik RN, et al. (2014). PCBs in air, soil, and cereal crops along the two tributaries of River Chenab, Pakistan: concentrations, distribution, and screening level. Sci Total Environ. 481, 596-604.

[84]Mahmood, A., Malik, R. N., Li, J., & Zhang, G. (2014). Levels, distribution profile, and risk assessment of PCBs in water and sediment from two tributaries of the River Chenab, Pakistan. Environ Sci Pollut Res. 21, 7847-7855.

Location	Time	Testing method	Media	PCBs Levels	Source
				Water; 0.20 -28 ng/L	
Gujrat, Pakistan	2011	GC-MS	Indoor floor dust	∑PCBs 0.30–6.10 ng/g dw	Ali et al., 2011[85]
Okara, Sahiwal, Lahore and Sheikhupura, Pakistan	2016	GC-MS	Rice grains and rice straw	Σ30 PCB (ng g− 1) Rice grains; 4.31 to 29.68 Rice straw 6.11–25.35	Mumtaz et al., 2016[86]

Also, for POPs pesticides a range of studies have been conducted. This include e.g. the assessment of POPs pesticide pollution at the (former) pesticide production sites[87,88]

Already for the first NIP a Pakistan institution (Sustainable Development Policy Institute (SDPI)) participated in the global egg monitoring study of the International POPs Elimination Network IPEN. The PCDD/F level detected in the sampled free range egg (2.9 Toxic Equivalent, Picogram per gram egg fat, WHO-TEQ pg/g) was found to be close to the limit (3.0 WHO-TEQ pg/g) set by the European Union (EU).[89] Another study assessed the PCDD/F and dioxin-like PCB level in sediments of the Indus river which were found relatively low (0.6 to 4.8 pg TEQ/g; mean 1.9 pg TEQ/g).[90]

Also, studies on PBDE in the environment in Pakistan were conducted in soils, sediments and biota.[91,92] Also initial human exposure assessment studies for PBDEs were conducted along two tributaries of the River Chenab.[93]

[85]Ali N, Van den Eede N, Dirtu AC, Neels H, Covaci A. (2012).Assessment of human exposure to indoor organic contaminants via dust ingestion in Pakistan.Indoor air. 22, 200-211.

[86]Mumtaz, M., Mehmood, A., Qadir, A et al. (2016). Polychlorinated biphenyl (PCBs) in rice grains and straw; risk surveillance, congener specific analysis, distribution and source apportionment from selected districts of Punjab Province, Pakistan. Sci Total Environ. 543, 620-627.

[87] Syed J, Malik RN (2011). Occurrence and source identification of organochlorine pesticides in the surrounding surface soils of the Ittehad Chemical Industries Kalashah Kaku, Pakistan. Environ Earth Sci 62, 1311–1321

[88] Younas A, Hilber I, Rehman S, Khwaja M, Bucheli TD (2013) Former DDT factory in Pakistan revisited for remediation: severe DDT concentrations in soils and plants from the area. Environ Sci Pollut Res. 20, 1966-1976.

[89]DiGangi J, Petrlik J (2005) "The Egg Report," www.ipen.org International POPs Elimination Network (IPEN).

Khwaja M A, Petrlik J (2005) "Study on contamination of chicken eggs by POPs in Peshawar, NWFP, Pakistan," Arnika, Czech Republic and SDPI, Islamabad, Pakistan (April 2005)

[90] Khan N, Inam A, Mueller JF, Herrmann T, Paepke O (2004) Determination of Dioxins, dioxin-like PCBs and Flame Retardants (PBDEs) in Sediments Collected in Pakistan. Organohalogen Compounds 66, 1394-1399.

[91] Malik RN, Moeckel C, Jones KC, Hughes D (2011) Polybrominated diphenyl ethers (PBDEs) in feathers of colonial water-bird species from Pakistan. Environ Pollut. 159(10):3044-3050.

[92] Syed JH, Malik RN, Li J, et al (2013) Levels, profile and distribution of Dechloran Plus (DP) and Polybrominated Diphenyl Ethers (PBDEs) in the environment of Pakistan Chemosphere 93, 1646-53.

[93] Mahmood A, Malik RN, Syed JH, Li J, Zhang G (2015) Dietary exposure and screening-level risk assessment of polybrominated diphenyl ethers (PBDEs) and dechloran plus (DP) in wheat, rice, soil and air along two tributaries of the River Chenab, Pakistan. Chemosphere 118, 57-64.

Overall, the situation in Pakistan reveals that it is not yet prepared to monitor POPs to support the management of the POPs challenges ahead, attributed to the increasing amounts of new listed industrial POPs, the increased pesticide usage, contaminated sites, illegal import of e-waste and their potential harmful effects on environmental and human health. It is therefore a critical need for further research into these issues in Pakistan to obtain a more holistic and nuanced perspective on relevant issues and get robust data to reduce human exposure and release to the environment. A strengthened research effort into these issues in Pakistan could significantly build upon and benefit from international collaboration, reflecting the experience and knowledge base already established from studies in other developing regions and emerging economies, such as China and Vietnam. Clearly, a better knowledge base through intensified research efforts is essential to support the government, the industry, the public and other relevant stakeholders, to agree upon sound control strategies in the future to better manage the increasing chemical use and waste management problems in Pakistan.

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

The United Nations Development Programme (UNDP), in cooperation with the government, has developed a webpage and information platform for POPs in Pakistan, including updates on ongoing POPs projects and background information (http://popspakistan.com/).

The Ministry of Climate Change in Pakistan is communicating activities on NIP update in major national newspapers (e.g. The Express Tribune, 2016; The Nation, 2017; The News, 2017). In cooperation with a member of the Sustainable Development Policy Institute (SDPI), POPs-related issues and workshop outcomes were communicated on the radio following the NIP update inception and inventory workshop.

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Institute (SDPI), POPs-related issues and workshop outcomes were communicated on the radio following the NIP update inception and inventory workshop.[94]

The conclusion of the former survey by POPs Enabling Activity Project on the current national capacity to deal with issues of public information, education and awareness on POPs in accordance with Article 10 of the Stockholm Convention is still valid to some extent.

The survey revealed that there are several policy and legal instruments that promote public awareness and involvement in environmental protection issues. Several initiatives that demonstrated active public involvement were identified. Several information dissemination pathways exist that could be utilized for dissemination of POPs information. Some of these include print media, radio; television; seminars/workshops/meetings; school curricula; and Environmental Clubs.

Some of the identified gaps include:- lack of database on POPs; weak information dissemination infrastructure (but improved by the UNDP website); very limited awareness on POPs issue by key actors including several industries and the general public; lack of awareness programs specifically for POPs; inadequate capacity and experience to manage and monitor releases of POPs into the environment; lack of POPs management guidelines; and limited information on the available BATs/BEPs to minimize releases of POPs.

In view of the existing gaps, capacity building in information generation, storage, management and dissemination is very important for successful implementation of the Stockholm Convention.

2.3.12 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

2.3.12.1 Background

Under Article 15 of the Stockholm Convention, Parties to the Convention are required to report to the COP on the measures which have been taken to implement the provisions of the Stockholm Convention and on the effectiveness of such measures in meeting the objectives

[94]UN Environment (2018) FROM NIPs TO IMPLEMENTATION: LESSONS LEARNED REPORT, December 2018. http://wedocs.unep.org/handle/20.500.11822/27399

of the Convention. The national reports shall be submitted every four years with first reporting cycle in 2006 and the fourth ongoing reporting cycle 08/2018.

2.3.12.2 Country Reporting

Regarding the reporting on the implementation of Stockholm Convention, Pakistan had reported the third round reporting on 22/01/2016 pursuant to article 15 of the Stockholm Convention via electronic reporting system to the COP to fulfil the obligations of the Stockholm Convention. This reporting document consists of four sections (Part A, B, C and D). Pakistan have not reported in the first and second reporting rounds.

Pakistan plans to report for the fourth Article 15 reporting after all necessary information has been generated by the current NIP update activity.

2.3.13 Information Exchange Mechanism

2.3.13.1 Background

The Article 9 of the Stockholm Convention states the following:

1. Each Party shall facilitate or undertake the exchange of information relevant to:
    i. The reduction or elimination of the production, use and release of persistent organic pollutants; and
    ii. Alternatives to persistent organic pollutants, including information relating to their risks as well as to their economic and social costs.

2. The Parties shall exchange the information referred to in paragraph 1 directly or through the Secretariat.

3. Each Party shall designate a national focal point for the exchange of such information.

4. The Secretariat shall serve as a clearing-house mechanism for information on persistent organic pollutants, including information provided by Parties, intergovernmental organizations and non-governmental organizations.

5. For the purposes of this Convention, information on health and safety of humans and the environment shall not be regarded as confidential. Parties that exchange other information pursuant to this Convention shall protect any confidential information as mutually agreed.

2.3.13.2 Information Exchange with Other Parties to the Convention

Pakistan has information exchange with other Parties to the Convention. Pakistan is participating to the Conference of Parties and regional meetings. Pakistan is also actively participating in the POPs Review Committee meetings.

Furthermore, members of the research community of Pakistan are participating in scientific conferences related to POPs topics and research exchange and established an international network with information exchange on scientific topics related to POPs.

2.3.14 Relevant Activities of Non-Governmental Stakeholders

A number of non-governmental organizations are working for awareness-raising of public on environmental pollution issues and resulting environmental and health impacts, especially on children. Some of the leading NGOs in the country, with technical staff and capacity like WWF Pakistan, SDPI, LEAD-Pakistan, SCOPE and IUCN-Pakistan are also contributing significantly in capacity building of stakeholders, environmental monitoring and data collection.

SDPI, WWF Pakistan and SABAWON International are members of International POPs Elimination Network (IPEN) and Global Alliance for Incineration Alternatives (GAIA). SDPI, the IPEN National Focal point participated in International POPs Elimination Project (IPEP), South Asia activities and in collaboration with Pak-EPA and KPK EPA, undertook studies on the abandoned DDT Factory, Nowshera, POPs Contamination of Chicken Eggs and POPs levels in ash samples from hospitals and brick-kilns in Pakistan. SDPI also organized awareness raising workshops on “Chemicals Health Impacts” for journalists, representatives of local government, primary teachers, farmers and industrial workers. Recently, SDPI has been made NGOs Focal Point for Strategic International Approach for Chemical management (SAICM) and member of UNEP Cadmium and Mercury working Group. Several civil society organization exist at gross root level. These organizations have direct contact with the public in their own areas. There is urgent need to build capacity of these Community Based Organizations (CBOs), Village organizations (VOs) and other Non-Governmental Organizations (NGOs) spread the information at gross-roots level.

Furthermore, the Academia has conducted a range of POPs research often with cooperation with international partners (see Chapter 2.3.10).

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

A few pesticides testing facilities are available in Pakistan in the National Agricultural Research Council Islamabad (NARC) Pakistan Council of Research in Water Resources (PCRWR) and SUPARCO. In addition, some academic/research groups at Quaid-I-Azam University Islamabad, Comsats University Islamabad, Government College University Lahore and Punjab University are also involved in research on POPs with international collaborators.

The Pakistan Council of Research in Water Resources (PCRWR) . The National Water Quality Laboratory is a well-equipped laboratory (GC/MS, GC/MS-MS, LC/MS-MS,) capable of analysing the necessary parameters of drinking water and waste water along with research activities on various water quality issues. PCRWR is a collaborator with United Nation University in Tokyo for implementation of the project titled Environmental Monitoring and Governance in the East Asian Hydrosphere". The main objectives of the project were:

i. Developing capacity of Asian countries to analyse POPs in ecosystem and water

ii. Monitoring POPs in ecosystem and water resources

iii. Developing a chemical monitoring network in the Asian countries

iv. Assisting policy-making decisions in Asian countries on sound chemical management

PCRWR has implemented different phases of the UNU funded project. From 2005 to 2008 on organo-chlorine pesticides (OCPs)/POPs pesticides analysis in water, fish, shrimp and sediment. From 2008-2011 monitoring of PCBs in water and PBDEs in sediments. From 2012-2015 perfluorinated PFAS in surface water samples were monitored from pre-selected sites and from 2016-2019 PFAS in surface water, drinking water and sediment been analysed.PCRWR have state of the art instruments and developed analytical method for POPs and thus can play a vital role in the monitoring tasks. However further upgrading of the laboratory with standards and laboratory capacity is needed.

Overall the lack of proper technical equipment, laboratory facilities in governmental or research laboratories is one bottleneck to generate POPs data in the country. However,

several Pakistan researchers have been trained in POPs analysis abroad (Australia, China, Germany, Japan and UK) and therefore researchers with analytical skills are available.

These researchers have generated a wide range of POPs data based on projects mostly with international collaboration. Most of the samples (both biotic & abiotic) collected from Pakistan have been analysed in different international laboratories (Chinese Academy of Sciences, Lancaster Environment Center, University of Antwerp, Belgium).

Currently, a larger project named "Southern Contaminant Program" funded by Chinese Academy of Sciences (CAS) and Natural & National Science Foundation China (NSFC) has been initiated by Prof. Gan Zhang, Guangzhou Institute of Geochemistry, CAS to monitor the coastal zone countries under Belt & Road Initiative (BRI). Another bilateral research project entitled "Investigation of Persistent Organic Pollutants (POPs) and Heavy Metals from E-waste recycling facilities across Pakistan" has been funded by Pakistan Science Foundation (PSF) and TUBITAK in June 2019. Both these projects will enhance capacity building and awareness of POPs research among Pakistani scientists. However, still there is a dire need to develop technical infrastructure for POPs assessment, measurement and analysis in the country. Such infrastructure will help to assess and understand the POPs contamination situation across the country which is highly relevant for a country with large industrial sectors.

2.3.16 Overview of technical infrastructure for POPs management and destruction

2.3.16.1.1 Waste management including POPs management and destruction

In recent years POPs management has started in Pakistan with POPs pesticide stockpiles management. As described above in chapter 2.3.1, large challenges were discovered for POPs management and destruction:

a) The cement kiln used for destruction was not sufficiently evaluated in respect to appropriateness of technology and emissions and no emission monitoring was conducted. While modern cement kiln basically have the capacity to destroy POPs if feeding is at appropriate feeding point and temperature/residence time, there is a risk of selecting wrong feeding points. Therefore in the NIP implementation the cement kilns of Pakistan will be assessed for the capacity to destroy POPs (see action plan).

b) A small incinerator also was accepting POPs pesticides for destruction. Also for this facility no documentation has been made if the technology and the air pollution control system is appropriate for treating POPs waste. Also for this facility no monitoring data in

particular PCDD/Fs and POPs emission were conducted during the destruction. Recentlythe National Electric Power Regulatory Authority (Nepra) has approved Pakistan's first waste-to-energy plant with 40-megawatt production capacity in Lakhodair, Lahore district.[95] After construction, this facility should also be assessed for the capacity to treat certain POPs containing waste fractions.

c) There is no monitoring capacity in Pakistan for PCDD/F. Therefore it is difficult and expensive to guide POPs destruction projects in respect to emission monitoring. Therefore the options to develop sampling capacity in Pakistan including stack emission capacity.

d) The sites where POPs pesticides have been removed were still found contaminated with pesticides and empty containers. Therefore the company having removed the pesticides seems not trained appropriately and comprehensive training to manage POPs stockpiles and waste should be conducted.

e) Some of pesticides stocks which have been removed where dumped at other area. This demonstrate that no appropriate system seems in place in Pakistan for environmental sound management of POPs waste.

Therefore overall there is an urgent need to improve the capacity to manage POPs waste in Pakistan, to assess facilities like cement kiln and incinerators for their appropriateness to destroy POPs according to Basel/Stockholm Convention criteria and to develop monitoring scheme for POPs destruction projects.

2.3.16.1.2 Capacity and Infrastructure for Contaminated Sites Assessment, Securing and Remediation

In the past Pakistan didn't have sufficient capacity and technology to assess and remediate POPs in contaminated sites and minimize the exposure. The former DDT production site were assessed for contamination with international cooperation demonstrating the usefulness of international cooperation for this complex matter.[50]Within the current UNDP POPs project, pesticide contaminated sites will be assessed which can be utilized for further capacity building. Therefore, with the collaboration of some national instate/institutes and international collaboration Pakistan will be able to control many POPs and in future will be able to secure and remediate contaminated sites for different POPs groups including the recently listed POPs.

[95] https://tribune.com.pk/story/1759576/2-pakistans-first-waste-energy-plant-gets-licence/.

During the update of the NIP sampling of many sites potentially contaminated by PCBs have been made. The analysis and interpretation of the data will be a part of the NIP implementation and will contribute to capacity building.

2.3.17 Identification of impacted populations or environments

Pesticide exposure is since long an issue of concern in Pakistan.[96] Due to the remaining badly controlled stocks, polluted former production sites, the pesticides dumped in unknown places and the distribution of pesticide wastes due to flooding (see Chapter 2.3.1), exposure to POPs pesticides occur. Furthermore, farmers can still be exposed to banned POPs pesticides since they are available in the informal market including DDT, endosulfan, aldrin and dieldrin. Furthermore, dicofol is still officially used. Overall the consumption of pesticide is increasing due to the drastic increase in the demand for agricultural products, which leads to an increasing use of pesticides. These higher applications of pesticides resulted in higher contamination of workers, the environment and foodstuff, i.e., fruits and vegetables. Recent studies showed that POPs-pesticides can enter into the blood serum and milk of cotton pickers via multiples sources viz; contaminated air, water, vegetables, fish, meat and other food commodities and milk.[97]Cotton pickers had higher DNA damage compared to control group.[98]

Since until today PCB in electrical equipment is not comprehensively monitored in Pakistan and therefore not appropriately managed yet, workers doing maintenance work and scrap dealers recycling old transformers and capacitors and associated waste oils are likely exposed andlikely generate contaminated sites with long term exposure risk.[99]

The lack of proper waste management and recycling result in dumping of waste with associated risk of the surrounding of landfills for pollution. Studies showed that dumping sites are direct potential sources of POPs also in Pakistan.[100]

[96] UNDP 2001: Policy and Strategy for the rational Use of Pesticides in Pakistan, Building Consensus for Action, UNDP / FAO Paper, Rome, Italy.

[97] Abbas M, Mehmood I, Bashir A (2015) Woman Cotton Pickers' Perception about health hazards due to pesticide use in irrigated Punjap. Pakistan J. Agric. Res. Vol. 28 No.1, 2015

[98] Ali T, Ismail M, Asad F, Ashraf A, Waheed U, Khan QM (2018) Pesticide genotoxicity in cotton picking women in Pakistan evaluated using comet assay. Drug Chem Toxicol. 41(2), 213-220.

[99] Weber R, Herold C, Hollert H, Kamphues J, Ungemach L, Blepp M, Ballschmiter K (2018) Life cycle of PCBs and contamination of the environment and of food products from animal origin. Environ Sci Pollut Res Int. 25(17), 16325-16343

[100] Hafeez S, Mahmood A, Syed JH, Li J, Ali U, Malik RN, Zhang G (2016) Waste dumping sites as a potential source of POPs and associated health risks in perspective of current waste management practices in Lahore city, Pakistan. Sci Total Environ. 562, 953-961.

Furthermore, Pakistan is one of major e-waste destinations, with thousands of workers involved in this activity.[101] Findings from other developing countries, which implicate informal e-waste recycling activities as major pollution sources of emerging POPs like PBDEs and other flame retardants and heavy metals.[102] Comparison with other studies from Pakistan shows e-waste to be a primary cause of the high amounts of FRs in urban environment. While the human health risks associated with inhalation and soil ingestion of FRs are likely negligible, other possible human exposure pathways merit further investigation (e.g., direct dermal contact and diet).

Assessment studies of other pollutants revealed that in areas of POPs exposure also other hazardous chemicals need to be assessed. Indoor cooking related to UPOPs have even a higher risk from carcinogenic PAHs.[103]Also workers in the metal sector possibly exposed to chlorinated paraffins used as metal working fluids can be heavily exposed to heavy metals.[104]

Therefore, future studies should also target exposures from a broader range of relevant pollutants e.g. informal e-waste activities result in releases and exposure of PCBs, dioxins, PBDEs, PAHs, and various heavy metals (e.g., mercury, lead, and cadmium). Detailed studies on the negative impacts of e.g. PCB pollution, pesticide pollution or informal e-waste recycling, are needed. Initial sampling of contaminated soils at PCB and pesticide sites have been conducted to initiate such assessments.

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

Pesticides which want to enter the market in Pakistan are assessed according to the scheme established.

Regarding current registration of new industrial chemicals, there is no particular assessment of these industrial chemicals on their POPs properties. Also there is no implementation of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) in Pakistan yet.

[101] Umair S, Anderberg S, Potting J (2016) Informal Electronic Waste Recycling in Pakistan. Journal of Solid Waste Technology and Management 42(3), 222-235.

[102] Labunska I, Harrad S, Wang M, Santillo D, Johnston P (2014) Human dietary exposure to PBDEs around E-waste recycling sites in Eastern China. Environ Sci Technol. 48(10):5555-64.

[103] Kamal A, Malik RN, Martellini T, Cincinelli A (2015) Exposure to dust-bound PAHs and associated carcinogenic risk in primitive and traditional cooking practices in Pakistan Environ Sci Pollut Res 22, 12644-54.

[104]Junaid M, Hashmi MZ, Malik RN (2016) Evaluating levels and health risk of heavy metals in exposed workers from surgical instrument manufacturing industries of Sialkot, Pakistan. Environ Sci Pollut Res Int. 23, 18010-26.

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

The pesticides currently used on the market have been assessed according to the scheme established for pesticides.

There is no particular assessment of industrial chemicals on their POPs properties.

2.4 Implementation status

The implementation status and the level of compliance with the SC requirements is compiled with reference to the individual chapters in this NIP detailing the status of individual POPs. The action plans for the new listed POPs and initial POPs are presented in Chapter 3.

Table 22. Implementation status of the Stockholm Convention in Pakistan

Convention Article	Level of compliance	Comments
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.***	
	For DDT see ***Section 2.3.5.***	
	For PFOS see ***Section 2.3.6.***	
ARTICLE 4Register of exemptions	Pakistan is not registered for any specific exemptions, as listed in SC Annexes.	Was previously registered for DDT use for disease vector control (2006 - 2016), but withdraw its registration in February 2012.
ARTICLE 5 Measures to reduce or eliminate releases of UPOPs	See **Section*2.3.7.***	
ARTICLE 6 Measures to reduce or eliminate releases from stockpiles and wastes	For pesticides see **Section *2.3.1.***	
	For PCBs see ***Section 2.3.2.***	
	For DDT see ***Section 2.3.5.***	
ARTICLE 7 Implementation plans	Pakistan has submitted the first NIP on15.12.2009 and with the current document also the updated NIP with chemicals listed up to COP 6.	
ARTICLE 8 Listing of chemicals in Annexes A, B and C	Up to now Pakistan 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 2.3.13***	
ARTICLE 10 Public information, awareness and education	See S***ection 2.3.11.***	
ARTICLE 11 Research, development and monitoring	See ***Section 2.3.10.***	
ARTICLE 12 Technical assistance	Pakistan is a recipient developing country Party.	
ARTICLE 13 Financial	Financial resources are needed for the	

Convention Article	Level of compliance	Comments
resources and mechanisms	implementation of the Convention.	
ARTICLE 15 Reporting	Pakistan has reported in the third reporting round (22/01/2016) but not the first and second reporting.	The fourth reporting is currently prepared based on the updated NIP
ARTICLE 16 Effectiveness evaluation	Up to now Pakistan has not participated in the human milk study or the Global Monitoring Plan.	
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	Pakistanis regularly attending the Stockholm Convention COPs	Pakistan has participated at COP 9 in 2019
ARTICLE 21 Amendments to the Convention	Pakistan 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	Pakistan ratified the Stockholm Convention on 16. April 2008.	
ARTICLE 26 Entry into force	The SC entered into force for Pakistan on 16. July 2008.	

3 Strategy and action plan elements of the NIP

Chapter 3 addresses the formal policy statement and the implementation strategy and action plan. The implementation strategy sets out specific action plans or strategies to achieve Convention obligations and other additional objectives set by the country.

3.1 Policy statement

3.1.1 Government's Commitment to Address the POPs Issue

The Government of Pakistan is determined to eliminate the POPs as soon as practicable by implementing the NIP in line with the requirements of the Stockholm Convention and to undertake review of the relevant policies and legislation for effective implementation of the Stockholm Convention as well as other related conventions and international processes on chemicals management. This shall facilitate strengthening of capacity of institutions that deal with POPs including the establishment of mechanisms for coordination, reporting and monitoring of POPs and the review and updating of the NIP. The Government also realizes the importance of generating and dissemination of public information and creation of public awareness at all levels to tackle concerns of POPs in a comprehensive way. In doing so, the Government within its limited capacity, shall make deliberate efforts to implement its obligations under the Stockholm Convention and hence eliminate POPs as scheduled.

The Government is aware that POPs are only a part of the sound chemical management task and the hazardous waste management challenge. Therefore, Pakistan is aiming to link and harmonize the different activities on chemical (other chemical Conventions and SAICM) and related hazardous waste management (POPs, mercury, ozone depleting substances, SAICM issues of concern).

Also the waste management and the destruction of hazardous chemicals need to be addressed in a holistic manner and should address all type of hazardous chemical wastes and their destruction where appropriate securing co-funding in implementation.

It is Government's view that dealing with the POPs issues in an integrative manner, as part of country's framework action plans (chemicals management plans, waste management plans, contaminated sites management, plastic management etc.), will result in an effective implementation, as well as attract international development partners.

The Government would take appropriate measures to ensure implementation of the national priorities on POPs as would be specified in the Action Plans. The main priority issues would

be grouped in six major areas namely, elimination of POPs, rational management of obsolete stockpiles/ contaminated sites, strengthening legal and institutional framework for life cycle management of POPs and chemical pollutants; establishing monitoring program for POPs and other chemical pollutants; enhancing transfer of appropriate technology for control of POPs releases; and improving information, awareness and education to all stakeholders.

The Government targeted milestones for some specific themes are as follows:

- Elimination of pesticide POPs and rational management of obsolete stocks/contaminated sites
- Promotion awareness in relation to all action plans, but particularly for POPs.
- Strengthening of the information base, surveillance and data management for POPs
- Strengthening the legislative infrastructure for control and enforcement of POPs
- Institutional strengthening.
- Human resources development for implementation of the Stockholm convention as envisaged in the National Implementation Plan (NIP).

It is anticipated that successful implementation of the identified priorities would reduce/eliminate the major POPs chemicals and wastes containing POPs.

3.1.2 Endorsement of NIP

The process of the development of the NIP involved the active participation of broad-base of relevant national stakeholders, including government ministries, departments and agencies; research institutions and academia, and non-governmental organizations. The NIP has been commented and endorsed by the national stakeholders.

3.2 Implementation Strategy

3.2.1 Inter-ministerial and stakeholder coordination and coordination with related national plans

At the governmental level, all relevant ministries will be involved in the NIP implementation in which each ministry will have different responsibilities with respect to its function.

Activities on POPs will be synchronized with national plans on chemical management and waste management and POPs will be used as impulse to facilitate related activities on general hazardous chemical and waste management.

Chemicals and waste and their management are important for a range SDGs of the 2030 Sustainable Development Agenda and therefore contribute to Pakistan SDG[105] implementation. In particular chemicals and waste are key for SDG 12 on sustainable production and consumption and can support Pakistan's NAP for SDG 12[106] with close links to vision 2025[107]of Pakistan. Chemical and waste management also significantly contribute to the implementation of other SDG goals in particular for:

- Goal 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture considering the impact of POPs on food safety[108]
- Goal 3: Ensure healthy lives and promote wellbeing for all at all ages (specifically Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination).
- Goal 6. Ensure availability and sustainable management of water and sanitation for all (specifically Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally).
- Goal 8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (Specifically Target 8.8 Protect labour rights and promote safe and secure working environments for all workers…)
- Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable.
- Goal 12: Ensure sustainable consumption and production patterns (specifically Target 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment).
- Goal 14 on life below water contributing to reduction of marine litter and related POPs contamination of the marine environment.[109]

[105] Government of Pakistan (2018) SUMMARY FOR THE NATIONAL ECONOMIC COUNCIL (NEC) SUSTAINABLE DEVELOPMENT GOALS (SDGS) NATIONAL FRAMEWORK PLANNING COMMISSION, Ministry pf Planning, Development and Reform, March 2018.

[106] Government of Pakistan (2017) Pakistan National Action Plan on SDG 12 Sustainable Consumption and Production. Ministry of Climate Change, May 2017.

[107]Government of Pakistan (2014) Pakistan2025 One Nation – One Vision.Ministry pf Planning, Development and Reform.

[108]Weber R, Herold C, Hollert H, Kamphues J, Blepp M, Ballschmiter K (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

- Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss (specifically Target 15.1: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements; and Target 15.3: By 2030, combat desertification, restore degraded land and soil).

The NIP can also contribute to the Climate Change Policy of Pakistan[110] and in particular to reduced CO2 footprint by waste recycling/recovery and improved resilience from pollution related to flooding. During flooding events POPs and other persistent chemicals play a particular role when they are distributed from storages at industrial sites or from stockpiles or from landfills/dumpsites into the environment.[111,112] This lead to the contamination of soils and sediments with POPs and other persistent chemicals with associated risk for food producing animals raised on such soils.[113] Such flooding also mobilize waste from dump sites to the wider environment including plastic with associated pollution including marine litter.

At the governmental level, all relevant ministries will be involved in the NIP implementation in which each ministry will have different responsibilities with respect to its function. As interministerial coordination the NIP will use the related committees of the National Environmental Conservation and Climate Change Central Committee and the supervision committees in the states/regions. This inter-ministerial coordinating mechanism is considered vital in addressing chemicals and waste management issues (including POPs). This inter-ministerial coordination group would address relevant chemical, waste and circular economy/3R and related SDG topics. To address the national priority of chemicals and waste, a coordinated approach will be adopted, with co-operation among all relevant stakeholders at

[109]Gallo F, Fossi C; Weber R; Santillo D; Sousa J; Nadal A, Romano D (2018) Marine litter plastics and microplastics and their toxic chemicals components: the need for urgent preventive measures. Environmental Sciences Europe DOI:10.1186/s12302-018-0139-z

[110]Government of Pakistan Ministry of Climate Change (2012) National Climate Change Policy. Islamabad, September 2012.

[111] Weber R, Tysklind M, Laner D, Watson A, Forter M, Vijgen J (2012) The need for inventories of reservoirs of persistent and toxic substances (PTS) in the face of climate change. Organohalogen Compounds 74, 1186-1189 http://www.dioxin20xx.org/wp-content/uploads/pdfs/2012/1304.pdf

[112] Weber R, Watson A, Forter M, Oliaei F (2011) Persistent Organic Pollutants and Landfills - A Review of Past Experiences and Future Challenges. Waste Management & Research 29 (1) 107-121.

[113] Weber R, Herold C, Hollert H, Kamphues J, Blepp M, Ballschmiter K (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

all levels and sectors. Responsibilities related to the sound management of chemicals and waste as well as those involved in activities that influence chemical safety, including the private sector, industry, labour, science and public interest groups will be assigned.

For this also the science–policy interfaces would be better developed. A well-established science-policy interface is critical in shaping environmental governance and sustainable development. Currently science and other forms of knowledge are often not used effectively in policymaking; and policymakers do not always effectively inform scientists about their needs for scientific knowledge. For this strategy element, an improvement of science-policy interface is needed as well as an upgrade of research institutions in respect to chemicals and waste management and is included in the action plan.

3.2.2 Adequate legal, institutional, administrative and technical infrastructure

For the implementation an adequate legal, institutional, administrative and technical infrastructure needs to be in place. This should consider three levels:

1. Policy level: preparative and executive legislative actions, international co-operation on policy issues.

2. Management level: support legislative work, daily scientific/technical expert implementation work, and coordination/co-operation between ministries.

3. Enforcement level: enforcement and monitoring, co-operation/co-ordination between institutions for enforcement and supervision

The legal frame need to consider approaches which support financing of chemicals and waste. An international guidance has been developed to support financing of chemical management this respect.[114] Furthermore, Extended Producer Responsibility (EPR)[115] and Polluter Pays Principle (PPP) are approaches supporting sustainable financing of chemical and waste management (see below Section 3.6).

Furthermore, an adequate technical infrastructure is needed for the management of POPs impacted wastes or the analysis and monitoring of relevant POPs.

Appropriate actions are proposed in the action plans below.

[114] UNEP (2015) Development of Legal and Institutional Infrastructures for Sound Management of Chemicals and Measures for Recovering Costs of National Administration (LIRA-Guidance).

[115] OECD (2016) Extended Producer Responsibility - Updated Guidance for Efficient Waste Management

3.2.3 Synergies among related Multilateral Environmental Agreements

At the international level, the COPs to the chemical conventions called for greater cooperation and coordination, and measures to be taken for a more harmonized implementation. Pakistan has ratified and is a signatory to the Basel Convention, the Rotterdam Convention and other international conventions and agreements (see Chapter 2.2) and is also aware that efforts should to be made for a harmonized implementation at the national level.

Moreover, the Strategic Approach to International Chemicals Management (SAICM; www.saicm.org/) aims at an overall management of chemicals and has POPs related emerging policy issues and issues of concern.[116] Here the implementation of the SC can and should facilitate the implementation of SAICM and vice versa. The government seek to follow the SAICM beyond 2020 process and to strive for an overall chemical and waste management considering all hazardous substances and waste including POPs.

Hazardous waste management is an important requirement for the adequate implementation of SC and BC. However, Pakistan has limited waste destruction capacity, and therefore, is currently disposing most of the chemicals, products and materials imported to the country at the end of their useful life to dumpsites. A growing fraction of materials is recycled.

Due to the challenge of POPs management and the high cost of export, the Government became aware that hazardous chemicals, which cannot be disposed in the country, are a burden, which need to be tackled and solved. A part of POPs pesticide waste has been destroyed in Pakistan. However the related releases were not measured and a better assessment frame is needed for further POPs destruction projects. The Government and the private sector is seeking an overall more sustainable management frame of POPs and hazardous chemicals and products containing POPs and hazardous chemicals.

Furthermore, international efforts in protecting the Ozone Layer (Montreal Protocol/Vienna Convention) on ODS address partly the same waste categories containing POPs: air conditioners in cars or HBCD containing extruded polystyrene (XPS) normally containing 8% hydrofluorocarbon (HFC) as blowing agent (often HFC-134a with high global warming potential (GWP) value of 1300). The inventory of vehicles, electronic waste and building insulation in the framework of the SC for POP-PBDEs and the improvement of their end-of-

[116]http://www.saicm.org/Implementation/EmergingPolicyIssues

life management can at the same time be used for a better management of ODS present in these products and wastes.

Overall, it became obvious that another policy for imports of chemicals and products containing hazardous chemicals is needed. This becomes also obvious considering consumer products and related waste fractions containing to some extent new industrial POPs like plastic from electrical and electronic waste (WEEE; e-waste), car shredder residues, synthetic carpets, waste wood treated with PCP or waste oils or impregnated furniture, mattresses, synthetic carpets, textiles or paper. Such bulk wastes containing POPs, POPs-like chemicals or other hazardous chemicals have entered the country in thousands of tonnes over the last three decades and are currently largely disposed in dumpsites. This highlights that another waste management, extended producer/importer responsibility and import policy is needed to cope with the materials and articles containing hazardous chemicals of modern consumer society.

3.2.4 Addressing POPs substitution and Clean Material Cycles within Sustainable Consumption and Production (SDG12) implementation

In accordance with the provisions of the Article 7(3) of SC, "Parties shall endeavour to utilize and, where necessary, establish the means to integrate national implementation plans for persistent organic pollutants in their sustainable development strategies where appropriate", the country is aiming to address POPs in connection to sustainable development and consumption and production efforts (SDG 12). Chemicals and waste including POPs should be linked to the implementation of Pakistan Vision 2025 were appropriate[117]. The implementation of the NIP can complement the Pakistan Vision 2025 by contributing to the topic of chemical management and by facilitate a more circular economy by phase out of POPs.

The contamination of several potential recycling flows by POPs revealed the negative impact and threat for a more circular economy and resource recovery and conservation important for resource conservation and sustainable development[118]. This includes e.g. treated wood or polymer fractions such as WEEE plastic or PVC and BFR containing polymer fraction of end-of-life vehicles and construction & demolition wastes. Also rubber and lubricants/industrial oils can be impacted by new industrial POPs. These wastes are at the

[117] Pakistan Planning Commission (2015) Pakistan2025 One Nation – One Vision. https://fics.seecs.edu.pk/Vision/Vision-2025/Pakistan-Vision-2025.pdf

[118] European Commission; Circular Economy http://ec.europa.eu/environment/circular-economy/index_en.htm

same time important resources for recycling and recovery. The policy is to recycle the non-impacted products and treat POPs containing wastes in an environmentally sound manner possibly with energy recovery. For thermal recovery the negative impact of halogens need to be considered.

A policy approach considered, is extended producer and importer responsibility as stipulated e.g. by the European WEEE Directive[119]. The option of a better management of resources in these material flows can contribute to SCP if waste management can be improved. Improved recycling and recovery are also opportunities for development of small and medium sized companies and therefore of eradication of poverty and improvement of standard of living for people. The recycling efforts are linked to sustainable production and consumption. Considering the challenges of managing POPs, a policy and strategy will be developed within the implementation of SC and BC that POPs and similar chemicals should not be imported.

Several POPs have exemptions for continued use often in products (HBCD, DecaBDE, SCCP, PFOS, PFOA). The use of these POPs would generate more POPs stockpiles and waste in the future. Furthermore, there are hundreds of POPs-like chemicals[120] and chemicals of concern[121] (SAICM synergy) which need to be controlled to protect human health and the environment. The implementation strategy is not to use POPs or POP-like chemicals but to use the most appropriate alternatives considering green and sustainable chemistry principles. The alternative chemicals are best selected considering a "green and sustainable chemistry "approach, which represents the design of chemicals and processes that reduce or eliminate the use and generation of hazardous substances. This approach is securing recycling and reuse and therefore supporting circular economy and SCP.

Such efforts can also be linked to sustainable consumption of the population. POPs can be used here as an awareness raising tool for stakeholder groups.

3.2.5 Objectives and Constraints of the Action Plan

The goal of the SC Action Plan is to ensure reduction and ultimate elimination of POPs and their releases so as to protect human health and environment. The Action Plan addresses the identified gaps and deficiencies in order for Pakistan to meet the requirements of the Stockholm Convention in elimination of POP releases. It also defines

[119] http://ec.europa.eu/environment/waste/weee/index_en.htm

[120] Scheringer et al. (2012) How many Persistent Organic Pollutants should we expect? Atmospheric Pollution Research 3, 383–391.

[121] Muir DC, Howard PH (2006) Are there other persistent organic pollutants? A challenge for environmental chemists. Environ Sci Technol. 40(23):7157-7166.

objectives, time bound activities and required resources. The implementation of the Action Plan envisages the participation of a broad spectrum of stakeholders. The priority areas are compiled in Chapter 3.4.

3.2.5.1 Overall Objectives

The overall objectives of the Action Plan are:

i. To build national capacities in POPs management in terms of human resources and infrastructure;

ii. To raise stakeholder's awareness on POPs hazards and management;

iii. To minimize risks on environment and human health from POPs;

iv. To promote environmentally sound technology for disposal of POPs wastes;

v. To promote POPs networking;

vi. To strengthen legal framework and enforcement mechanisms;

vii. To promote research and development of alternatives to POPs, and

viii. To develop mechanisms for promoting proper management of POPs stockpiles and the contaminated sites;

ix. To develop rules and regulation for industries using this type of chemical or producing as product or by-products;

x. Strengthen the academia industrial collaboration to develop technologies to cop up with these POPs contamination issues.

The overall objectives provide basis for identifying/formulating the specific objectives and actions needed to strengthen management and control of POPs consistent with Article 3 and 6 of the Stockholm Convention as well as articles 5, 6 and 10 of the Rotterdam Convention in the course of implementation of the Action Plan.

3.2.5.2 Constraints

By comparing the inventory findings with the Convention requirements and the available legislation, the following gaps and deficiencies were identified: -

i Inadequate legal provisions on POPs production, screening, importation, use and disposal of their waste. Also, on identification, liability and management of contaminated sites;

ii Weak enforcement mechanisms, for example on disposal of wastes;

iii The Plant Protection Act does not provide for the identification and quantification of pesticides stockpiles;

iv Lack of legal provision focusing on public awareness on health and environmental risks associated with POPs;

v There is no legal provision for monitoring of POPs release and their effects to human and environment;

vi There are no legal provisions focusing on the life cycle of POPs and hazardous chemicals;

vii Inadequate awareness of importers and custom officers on imports requirements;

viii Inadequate information on the past production, use, import and export;

ix Lack of continuing education to update skills for evaluation of technical data submitted during registration of pesticides;

x Lack of specialized skills and analytical equipment foridentification of undeclared pesticides ingredients and monitoringof POPs levels;

xi Inadequate training POPs inspectorate services;

xii Lack of guidelines on risk minimization procedures for handling, transportation, storage and disposal of obsolete stocks;

xiii Inadequate specialized skills, financial resources, equipment andworking tools by respective institutions dealing with POPs;

xiv Poor storage facilities and inappropriate disposal facilities;

xv Improper disposal of pesticides empty containers and PCBs equipment;

xvi Only few studies on POPs environmental and health impacts;

xvii Poor information exchange, question response and data keeping;

xviii Inadequate resources for dissemination of information on the viable POPs alternatives;

xix Lack of resources to ascertain suitability of alternatives and assesstheir risks to human health and the environment;

xx Inadequate resources to support preparation and execution of training and awareness raising programs;

xxi Lack of socio-economic and cultural studies on the acceptabilityand affordability of alternatives; and

xxii Incomplete inventories for POPs.

3.3 Action plans, including respective activities and strategies

3.3.1 Institutional and regulatory strengthening measures

The issue of hazardous chemicals and wastes (including POPs) is of great concern and a priority. However, there is no comprehensive and streamlined legislation for chemicals management and waste management in the country although some aspects are found in various laws within the country.

The Stockholm Convention on POPs requires Parties to take certain measures to achieve the objective of the Convention. Furthermore, other ratified chemical Conventions should be considered in particular Rotterdam and Basel Conventions. Moreover, the Strategic Approach on International Chemical Management (SAICM) aims at an overall management of chemicals and has POPs related emerging policy issues and issues of concern. Here the implementation of the Stockholm Convention can facilitate the implementation of SAICM and vice versa.

A successful implementation of the Convention would therefore attempt an integrated approach with Basel/Rotterdam Convention and SAICM and integration of related provisions into the institutional and regulatory framework for managing chemicals.

The most readily available tool for government 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 internationally agreed information system found in the GHS.[122] Introduction of this system on chemical labelling and safety data sheets will also be an important step to raise enterprise, worker and public awareness of chemical risks.

The POPs action plan aims at improving the existing institutional and regulatory framework in Pakistan and facilitates chemical and waste management. One objective is to support the development of an overall frame of chemical and waste management by a synergy approach with Basel Convention and SAICM implementation.

The current action plan want to support the development of a larger institutional frame for chemical management (synergy SAICM) and waste management (synergy with national waste management and hazardous waste plan developed with a cooperation with Norwegian project and Basel Convention).

[122] It need to be stressed that GHS does not adequately address chemicals in products and wastes which is a major issue and problem for POPs and other hazardous chemicals in products and related waste management.

Table 23. Action plan institutional and regulatory strengthening measures

Objectives	Activities	Indicators	Time Frame	Implementers
To assess, harmonize existing legal/policy framework on POPs hazardous chemicals including POPs	• 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 POPs and other hazardous chemicals in selected other countries. • Draft and promulgate regulations to prohibit/eliminate the production, use, import and export of listed POPs (considering exemptions). • Improve or develop an overall chemical regulatory frame including the assessment of chemicals in use and chemicals for registration for their POPs (and other hazardous properties).	Compiled and updated inventory. Proposals for legislative and policy review. Draft regulation. An overall draft chemicals law	5 years	MoCC (Ministry of Climate Change) MoI&P MoST MoE/NEPRA PSQCA FPCCI Customs Environmental Agencies, Academia/ Research organization.
Assessment of responsibilities of ministries and other authorities for the life cycle management of POPs (and other hazardous chemicals)	• 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 for the life cycle management of POPs (and other hazardous chemicals). • Developing materials for education and conduct trainings and workshops. • Assessment if the responsible institutions can implement the respective legislation, further gap assessment and improvement	Needs assessment conducted Modalities for upgrading physical capacities in place	6 months	
To inform, sensitize and capacitate institutions and stakeholders on regulations and on enforcement and compliance of regulations on POPs and other hazardous	• Development of information materials on regulatory requirements for the respective POPs tailored for institutions and industrial and other stakeholders. • Organize information and sensitisation workshop on regulatory issues for stakeholder groups for individual POPs	Workshop organised	3 months	MoCC MoST FPCCI

Objectives	Activities	Indicators	Time Frame	Implementers
chemicals (SAICM)				
To assist relevant institutions implement compliance and enforcement for POPs ((i) POPs Pesticides (ii) PCBs (iii) new industrial POPs (iii) UPOPs.) and other hazardous chemicals (SAICM)	• Assign institutions with specific responsibilities to control POPs and hazardous chemicals in the life cycle • Customs training • 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.	MOU in place Compliance and enforcement network operational. Well-equipped institutions Operational monitoring plans Improved custom control	3 years	MoCC, MoI&P, MoST, MNFSR Customs
Development and update of an adequate legislative frame and policy for POPs pesticides	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 ▪	4 years	MNFSR(Federal plant protection department)
	Assessing of the need and possibly listing of exemptions (DDT, endosulfan, PCP, lindane, PFOS, dicofol)	▪ Pesticides needing an exemption reported to Secretariat	Already under implementation	
	Implementation of GHS and related labelling	▪ GHS implemented	Already under implementation	
	Assess the regulatory frame for import and export of POPs and products containing POPs and update	Updated import and export regulations in place	3 years	MoCC, Customs Rotterdam Focal Point
	Develop regulatory measures to combat illegal traffic of banned pesticides and counterfeit pesticides Special clauses should be included for smuggled pesticides for strict actions against peoples/agency involved	Regulatory measures in place ▪ Strict crackdown against people/agencies involved in smuggling of banned pesticides	4 years	Custom Authorities, Ministry of national food security and Research, Notified pesticides inspectors
	Regulatory frame for good agricultural practice,IPMand organic farming	Regulatory measures in place	5 years	MNFSR Provincial agriculture

Objectives	Activities	Indicators	Time Frame	Implementers
	Capacity building required for all stakeholders, Linkage of organic farmers with industry	Capacity building and training in place ▪ Industry facilitated for organic farming		department
	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	Already under implement ation	MNFSR through provincial forest departments and other concerned district administration
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.	▪ Regulations in place ▪ PCBs included in NEQS	2 year	MoCC (Central Coordinator) MoI&P (NEPRA MoE (Power Division) DISCOs (To provide storages/disposal s)
	Establishing penalties/fines for the improper management of PCB/PCN containing equipment.	▪ Legal frame in place and documented implementation	3 years	
	Developing and implementing incentives for electric utilities to comply with the phase-out of PCBs/PCNs,	▪ Incentives in place	3 years	
	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	▪ Elimination plan	3 years	
	Strengthening the control/inspection for PCB/PCN containing equipment still in use, and for interim storages and disposal facilities.	▪ Inspectors trained	3 years	
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. (or list as exemption)	▪ PBDE, PBB and HBCD restricted (or exemption listed)	2 years	MOCC Ministry of Justice MoI&P Acadamia law enforcement MOCC plus academia
	Assessment of regulatory frameworks for these substances and the products and wastes containing these substances.	Overview of international regulations compiled	2 year	
	Development of regulatory frame for EEE/WEEE management[123]	Regulatory frames for EEE/WEEE	3 years	

[123] 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	Indicators	Time Frame	Implementers
		developed		/NGO/plus law enforcement
	Development of a regulatory frame for vehicles management (importation, end of life management; see e.g. EU ELV directive).	Regulatory frames for vehicles developed	3 years	
	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	5 years	
	Inclusion of PBDEs, PBB and HBCD in list of banned or restricted substances. (or list as exemption)	▪ PBDE, PBB and HBCD restricted (or exemption listed)	1 years	
To establish policy and regulatory framework for management of PFOS and related substances and other PFAS (SAICM synergy)	Assessment of regulatory frames of other countries for controlling PFOS and related substances and PFAS	Assessment report	6 months	EPA Industries Academia Ministry Custom department proper training
	Amend existing laws, or develop new laws related to the control and management of PFOS and PFAS. Banning of PFOS with exemption for plating industry	Law and policy in place Exemptions listed/registered	1 year	
	• Custom control and improvement of the traceability of PFOS and PFAS in imports (including chemicals in products. including GHS)	GHS and customs trained	1 year	
	• Extended producer/user responsibility for management of PFOS and PFAS for the life cycle (including disposal)	EPR in place	1.5 year	
	• Regulatory frame for a database on PFOS and related substances and PFAS (within the establishment of a chemical database)	Database established including PFOS and PFAS	1 year	
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 products • 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	Updated inventory with robust data and list of data gaps	1 year	MoCC, MoI&P EPA ACADEMIA OGD RESEARCH INSTITUTIONS LOCAL GOVERNMENT WASA Sea ports

Objectives	Activities	Indicators	Time Frame	Implementers
	release of PFOS and PFAS (see contaminated site action plan) • (Option) Material and substance flow analysis of PFOS/PFAS • Custom or international export stores should be monitored			management authority
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 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. • Regulatory frame for waste hierarchy and circular economy • Regulatory frame for control of open burning	Assessment report compiled and presented to relevant stakeholders Legislation frame for UPOPs and regulation on open burning established and implemented Waste related activities are mainstreamed into MPHWM and National Waste Management Strategy. Awareness and education workshops and training for stakeholders conducted		MoCC MoI&P PSQCA FPCCI
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		MoCC MoI&P PSQCA

3.3.2 Production, import and export, use, stockpiles, and waste of Annex A POPs pesticides (Annex A, Part I chemicals)

Most POPs pesticides listed in the Convention have been banned in Pakistan. Dicofol suggested for listing in the convention in 2019 has not been banned yet. Also the presence of PCP listed in 2015 has not been assessed in this NIP. Therefore there is the need for assessment and control. Activities required are included in this action plan.

Most of POPs pesticides have been substituted in the past 20 years by other pesticides. Often the alternatives pesticides used were not sufficiently assessed and frequently other highly hazardous pesticides (HHPs) have been introduces or pesticides with an impact on pollinators and ecosystem.[124,125] Also in Pakistan imidacloprid and other neonicotinoids were a main substitute of POPs pesticides where somewhere recently banned in Europe due to the impact on biodiversity in particular pollinators.

For successful implementation of the strategy, the gaps in the current system should be addressed in particular the selection of alternative pesticides. Another gap is that information about the risks of pesticides to the environment and ecosystem including pollinators and human health should be analysed to ensure the safety of farmers, consumers, and pesticide dealers.

Furthermore, clear guidelines should be developed for the storage, disposal, and transportation of pesticides.

The overall objective of the NIP Strategy and Action Plan in respect to pesticides is to use less pesticides and to ensure a safe use of pesticides for environmental and human health. The strategy that is currently being executed is based on:

1. Banning the use of POPs and highly hazardous pesticides
2. Integrated Pest Management (IPM) and organic farming
3. Use of environmentally safe pesticides and responsible and safe use of potential hazardous pesticides
4. Disposal of pesticide contaminated waste including empty pesticide containers.

[124] Rahman MM, Weber R, Tennekes H, Sanchez-Bayo F (2012) Substitutes of persistent organic pollutant (POP) pesticides in Bangladesh and the need for a sustainable substitution process. Organohalogen Compounds 74, 1178-1181 http://www.dioxin20xx.org/wp-content/uploads/pdfs/2012/1302.pdf

[125] Chagnon M, Kreutzweiser D, Mitchell EA, Morrissey CA, Noome DA, Van der Sluijs JP.Environ Sci Pollut Res Int. 2015 Jan;22(1):119-34. doi: 10.1007/s11356-014-3277-x. Epub 2014 Jul 19. Risks of large-scale use of systemic insecticides to ecosystem functioning and services.

Table 24. Action plan import and export, use, stockpiles, and wastes of POPs pesticides (Annex A) and highly hazardous pesticides (SAICM synergy)

Objective	Activities	Indicator	Time	Time
Please note: The regulatory and policy actions for pesticides is integrated in the regulatory action plan in 3.3.1				
Develop/update POPs pesticides inventory	Improvement of POPs Pesticide inventory possibly considering FAO PSMS (overall stockpiles; avoiding reoccurrence of obsolete pesticides stocks)	Updated inventory	2 years	MoCC and MNFSR Research and provincial agriculture framework
	Inventory of PCP treated wood and PCP wood treatment sites (link to Dioxin/UPOP)	Validated Inventory; Inventory yet not developed in Pakistan	3 years	MNFSR through provincial forest departments and other concerned district administration
	Inventory of former PCP use and treated materials (leather, textile, paper, agriculture)	Validated inventory	3 yeas	MoI&P MoCC
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	3 years	MoCC with MNFSR; provincial agriculture departments
	Establishing of an empty containers collecting and management system, with specific attention to address the use and recycling of pesticides empty containers	Report on empty container program Inventory yet not developed in Pakistan	3 years	MoCC with MNFSR; Pakistan crop protection association, Crop life Pakistan, Dealers association in coordination with media and CSOs; provincial agriculture departments
	Establishing of proper POPs and waste pesticide storages and securing them	Sufficient pesticide storage built	Already under implementation	MoCC with MNFSR and provincial agriculture departments;
	Establishing capacity to address emergencies and disasters related to POPs pesticides and HHPs (poisoning,spillage, fire scontamination)	Poisoning centre established and operative	3-5 years	MoCC and provincial disaster management authority, Provincial health departments
	Assessing the country's	Capacity assessed and	2-3 years	MoCC and MNFSR,

Objective	Activities	Indicator	Time	Time
	capacity for disposing of obsolete POPs pesticides stockpiles and/or considering the export for environmental sound disposal	options of disposal documented (report)		provincial agriculture departments and stakeholders
	Disposal of POPs pesticide	POPs pesticides are disposed in an environmental sound manner	2 year	MoCC and MNFSR, provincial agriculture departments and stakeholders
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 competent authority, farmers, dealers, distributors, impostors, manufacturers; formulators	1-2 year	MoCC and MNFSR, Customs And other stakeholders
	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	2 year	MoCC, MNFSR, MoNHSR&C,
	Education of farmers on POPs pesticides, HHPs, counterfeit pesticides and the use of IPM and organic farming	Number and share of educated farmers	2 years	MNFSR, Provincial agriculture departments
	Education of citizens and NGOs on POPs pesticides, HHPs, counterfeit pesticides and organic farming and organic products	Number of educated citizens and NGOs	2 years	MoCC, MNFSR, MoNHSR&C,
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	Report on assessment on alternatives to POPs and HHPs.	2 years	MoCC in coordination with MNFSR

Objective	Activities	Indicator	Time	Time
	indicators			
	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)	3-5 years	MNFSR and provincial agricultural departments
	Selection of the most sustainable alternative chemicals and non- chemical solutions in the different applications and including promotion of organic farming.	Report on alternatives Promote for organic farming	2-3 years	MNFSR and provincial agricultural departments MoCC
	Education and capacity building on alternatives and organic farming and implementation	Number of farmers educated Share of alternatives and organic farming	2-3 years	MNFSR and provincial agricultural departments
Established analysis and monitoring of POPs pesticides and HHPs (SAICM synergy)(products, environment, food, exposure)	Strengthening and developing laboratory capacity to analyse pesticides (including POP/HHP)	Laboratory capacity established and accredited	3-5 years	MNFSR and provincial agricultural departments
	Assessment of occupational exposure to POPs pesticides and HHPs	Report on occupational risk	2 years	Ministry of Climate change, MNFSR, MoNHSR&C Academia
	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	2-3 years	MNFSR and provincial agricultural departments Academia
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	2-3 years	Ministry of Climate Change in coordination with relevant ministries

3.3.3 Import and export, use, identification, labelling, storage, and disposal of PCBs and equipment containing PCBs (Annex A, Part II Chemicals)

The overall objective of the strategy and action plan is to have PCBs-free equipment and materials being used in the country. Acknowledging that currently PCBs are found in electrical devices and that alternatives to these devices are being used, the strategy and action plan for eliminating the use of PCB- containing and contaminated equipment should focus on the proper management and phase-out of this equipment.

While the major focus of this action plan is on management of PCBs, also PCNs are addressed in this action plan. PCNs have been listed in the Convention in Annex 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)[126]. 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 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. SCCP have substituted PCB and PCN in a wide range of open applications (e.g. paints, coatings, sealants, plastic additive/flame retardant, rubber, lubricants, and 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.

To adequately implement such a strategy and action plan it is necessary that a comprehensive inventory takes place together with risk assessments on both electrical devices and other sources of PCB, PCNs and SCCPs such as ‘open applications’.

The proposed activities define specific actions in respect of managing PCBs/PCNs, both in the short and the long term in a manner that is consistent with the obligations of the Stockholm Convention. The overall objective is a reduction and ultimate elimination of PCBs

[126]UNEP (2017) Draft guidance on preparing inventories of polychlorinated naphthalenes. UNEP/POPS/COP.8/INF/19.

use, the prevention of releases of the chemical into the environment, and to provide for environmentally sound disposal or final elimination of PCBs waste.

The strategy and action plan focus on provisions and measures in following areas: legislation, institutional setting, technical capacity, life cycle management, alternatives as well as awareness.

Table 25. Action Plan import and export, use, identification, labelling, removal, storage and disposal of PCBs/PCNs and equipment containing PCBs/PCNs (Annex A, Part II chemicals)

Objective	**Activity**	**Indicators**	**Time**	**Implementers**
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).	Detailed inventory data of transformers, capacitors and other equipment	2 years	NEPRA DISCOs
	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 of use (report). Inventory of open applications	2 years	MoCC **(Central Coordinator)** MoI&P FPCCI Academia PSQCA
	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 consumer products.	Monitoring (Biological Matrices Sampling, /inventory report	2 years	MoI&P MoST/PSQCA Universities
	Developing and regularly updating a database for PCB/PCN containing equipment (in use and storage) and open applications (e.g. buildings/constructions)	Database	3 years	MoCC **(Central Coordinator)** MoI&P MoST/PSQCA MoE/NEPRA EPAs
Life cycle management (handling, storage, transport and disposal) of	Assessing the current situation and improvement needs of interim storage and disposal for PCB/PCN containing equipment and wastes	Assessment report	1 year	MoCC MoE/NEPRA MoST

Objective	Activity	Indicators	Time	Implementers
PCBs/PCNs, PCB/PCN-containing equipment, open applications and PCB/PCN containing and contaminated wastes	Establishing ESM/ISO procedures for PCBs/PCNs equipment and wastes considering existing technical guidelines.	Authorities and staff trained	1 year	MoCC Academia / Universities
	Establishing inspection/control on the handling, storage, transfer and disposal of PCB/PCN containing equipment and PCB/PCN containing wastes	Inspectors trained Inspections conducted (reports)	1 year	MoCC (Central Coordinator) EPAs
	Phase-out PCB/PCN in closed and open applications and monitoring of the progress	Phase out of equipment by 2025. Documented management and export	4 years (1 year as buffer)	MoCC (Central Coordinator) MoI&P MoE/NEPRA
	Environmentally sound management and disposal of PCB/PCN containing equipment and waste	Disposal of equipment by 2027. Certification from institutions and organization that PCB has been eliminated	7 years (one year buffer to 2028 deadline)	MoCC (Central Coordinator)
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	3 years	MoCC NEPRA MoI&P (Chambers of Commerce & Industries, Industrial Associations) HEC; EPAs Universities (TOT)
	Strengthen the inspection capacity for customs and other competent authority (in use; mark/sales, storage, disposal).	Customs and inspectors trained (number of trainings; participants) Inspection authority of DISCOs, Rep of PSQCAs	2 years	MoCC FBR / Customs NEPRA MoST / PSQCA MoI&P EPAs Universities
	Education of utility sector, maintenance workers and industry possessing capacitors, transformers, and other PCB/PCN containing closed equipment and open applications on PCBs, PCNs and alternatives.	Seminar/workshop (at each DISCOs separately) on two tier system for a) senior management team[127] and b) for field formations	2 year	MoCC FBR / Customs NEPRA MoST / PSQCA MoI&P EPAs Universities

[127]Senior management are decision maker for implementation of PCB project; field formations are the front line workers.

Objective	Activity	Indicators	Time	Implementers
	Education of citizens and NGOs on PCBs and PCNs including open applications relevant for consumers (paints and sealants).	Workers, stakeholders, media (TV) trained (number of trainings; participants)	2 years	MoCC Universities Media
Established monitoring and analysis of PCBs and PCNs (closed and open applications, environment, food, exposure)	Training of staff on monitoring Monitoring and analysis of PCBs and PCNs for closed and open applications (see above) Self monitoring of industries	Test kits applied & confirmation analysis (Reports of industries) PCB/PCN inventory in closed application (Inventory report)	2 years	MoCC NEPRA MoST / PSQCA MoI&P EPAs Companies possessing equipment
	Monitoring of occupational exposure (maintenance and management/remediation staff)	Monitoring data of potentially exposed staff	5 years	MoCC NEPRA MoST / PSQCA MoI&P EPAs OHSAs
	Monitoring of PCB/PCNs and SCCP (human, environment biota, imports, food) by own capacity or regional/international collaboration	Monitoring data	5 years	MoCC FBR / Customs NEPRA MoST / PSQCA MoI&PEPAs Universities
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)	3 years	MoCC Universities
	Education on alternatives of PCBs/PCNs and SCCP in closed and open applications	Trainings conducted Media involved (numbers of participants)	3 years	MoCC R&D Organizations Universities
	Promotion of most sustainable alternatives in closed applications considering chemical and energy aspects	Selected alternative equipment (e.g. ecolabel; Green public procurement)	5 years	MoCC R&D Organizations Universities
	Promotion of the most sustainable alternatives in (former) open applications of PCBs/PCNs and SCCP	Selected alternatives (e.g. ecolabel)	5 years	MoCC R&D Organizations Universities
The action plan for PCB/PCN contaminated sites is integrated in the action plan on POPs contaminated sites below				

3.3.4 Import and export, use, stockpiles, and wastes of POP-PBDEs (Annex A, Part IV & V chemicals), HBCD and HBB (Annex A, Part I chemical)

According to the POP-PBDE inventory POP-PBDEs listed in 2009 have been imported in EEE and in vehicles and possibly other goods. Therefore they are present in stocks at consumer levels or as wastes (see Section 2.3.3). Pakistan is still a large importer of WEEE.

The amount of POP-PBDE is considerably higher than the current PBDE inventory since decaBDE has been listed as POP in 2017 and is present in these articles and wastes in considerably higher concentration but was not part of the PBDE inventory.

The action plan focuses on setting actions and measures whose implementation will lead to managing and controlling POP-PBDEs containing products. 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 and to a less extend PBDEs are used in insulation of housings (polyurethane and polystyrene).

For these three large material and waste flows resource recovery and recycling need to be considered, following the waste management hierarchy for recovery. At the same time pollutants such as PBDE, HBCD and other POPs/PTS need to be phased out of the recycling.[128]

PBDEs might also be partly included in polyurethane or textiles from imported furniture from North America which needs also further assessment.

Table 26. Action plan elimination and management of POP-BFRs (PBDEs, HBCD and PBB) including timelines, responsible authorities and stakeholders

Objectives/aims	Activities	Indicators	Time	Implementer
The action plan for regulatory frame for POP-BFRs is integrated in the general action plan in 3.3.1				

[128] Stockholm Convention (2017) Guidance on best available techniques and best environmental practices for the recycling and disposal of articles containing polybrominated diphenyl ethers (PBDEs) listed under the Stockholm Convention on Persistent Organic Pollutants; Draft 2017

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 of E-Waste & Transport and other consumer goods. Identification of hot-spots with primary and secondary data	2 years	MOCC MoI&P Acadamia NGO E-Waste Importers, Informal E-waste recyclers/ Retailers/repair people Transport Auto scrap importers. Automanufacturers association. Auto-repair shops Transporters Association Insulation industry/ and waste industry Customs Electronic database developers & other IT specialists for
	▪ Develop dynamic MFA/SFA inventory for POPs/PTS (and resources) in EEE/WEEE, vehicles, EPS/XPS in construction.	▪ Dynamic substance flow analysis of POP-BFR containing products and waste (report)	3 years	
	▪ Data management system for product and waste categories containing BFRs (for general waste management)	Databank for EEE/WEEE, vehicles, established Tracking system or labelling of BFR containing products	2 years	
Assessment of DecaBDE in current production and substitution of DecaBDE with better alternatives	● Assessment if DecaBDE is used in production (textiles, plastic, PUR foam insulation). ● Assessment of chemical alternatives and non-chemical alternatives, ranking of alternatives and selection of the best alternatives. ● Education and capacity building on alternatives assessment. ● Phase in of substitutes for DecaBDE in the respective uses.	▪ Inventory of current use of decaBDE in production ▪ Report on alternatives for decaBDE suitable for Pakistan (using available documents) ▪ decaBDE substituted in the uses and documentation	5 years	MoCC International and National academics Inspectors

To apply BAT/BEP if HBCD or DecaBDE in exemptions is uses 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	▪ Implementation product and documentation	2 years	Clear labeling of products containing HBCD and DecaBDE
Assess of current use of HBCD and substitution with better alternatives	▪ Compilation of information on alternatives to HBCD containing EPS/XPS insulation (see SC HBCD BAT/BEP guidance; POPRC). ▪ Selection of the most sustainable alternative chemicals and non-chemical solutions in the different applications. ▪ Phase in of sustainable chemicals and non-chemical alternatives to HBCD.	▪	3 years	MoCC, MoI&P, FPCCI EPS/XPS Industry Academia
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,	▪ Report on the pollutants including possibly monitoring of pollutants. ▪ Compilation on current situation of the treatment and evaluation of the individual	5 years	MoCC, MoI, MiST, Customs FPCCI Recycling industry (formal an informal) Academia

	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.	technologies including recommendation for manage. ▪ Guidelines and BAT/BEP (see SC BAT/BEP guideline) adjusted to Pakistan circumstances.		
	● Development of sound management (financing, collection, storage, treatment according 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 ELVs within the frame of hazardous substance management in the life cycle of 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	▪ EEE plastic and related PBDE management is addressed in WEEE ▪ MOU in place ▪ Compliance and enforcement network operational. ▪ Institutions have appropriate capacity ▪ Operational monitoring plans in place	3-5 years	

	● Including POP-BFRs and other hazardous substances in a larger frame of plastic management (link to marine litter etc)			
	▪ 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 options programmes in place	5 years	
Awareness of major stakeholders on POP-BFR containing products and 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)	▪ 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, 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	▪ Development of awareness creation materials	5 years	MoCC, MoI, MoST FPCCI Customs Network of academics, media experts, industry leaders & social workers.

	▪ (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 and related waste	▪ 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.	3-5 years	MoCC, MoI, MoST FPCCI PSQCA Customs Waste recycler (formal and informal) Network of academics,
	▪ Development of education and training materials for life cycle management of POP-BFRs (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.			
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).	▪ Overview report with recommendations ▪ Monitoring capacity established and certified ▪ Relevant waste categories and recycling measured ▪ Updated inventory ▪ Monitoring studies	5 years	MoCC, MoI, MoST FPCCI PSQCA Customs Waste recycler (formal and informal) Network of academics,
Action plan for POP-BFR contaminated sites is within the action plan on POPs contaminated sites				

3.3.5 Import and export, use, stockpiles export, use and wastes of DDT (Annex B Chemicals) if used in the country

DDT is prohibited in Pakistan and not registered for exemption. DDT was produced and used in Pakistan in the past.

Since the use was prohibited, no export, registration, and control of DDT have been recorded. However still illegal imports of DDT are discovered. Also some DDT stocks in the country remain which will be addressed by the UNDP project.

Table 27. Action plan Import and export, use, stockpiles and wastes of DDT (Annex B chemical)

Objectives	Activities	Outputs	Time Frame	Implementers
Further assessing and controlling illegal imports of pesticides including DDT	Further assessment of illegal import activities including counterfeit pesticides Training of custom to control imports of illegal pesticides	Report on the import situation of illegal pesticides Training on illegal pesticide import included in general training for customs	3 years	MoCC, MoI&P, MNFSR Customs
Manage the DDT stockpile	Storage of remaining stockpile in an ESM Destruction of remaining stockpile in an ESM	Stockpile destroyed in an ESM		MoCC MoNHSR&C

3.3.6 Import and export, use, stockpiles, and wastes of PFOS, its salts and PFOSF (Annex B, Part III chemicals)

PFOS and related substances entered the country in consumer products and articles. The major stocks of PFOS in Pakistan are likely firefighting foams. Furthermore some consumer products like synthetic carpets (tufted carpets) probably contained PFOS related substances in the past and currently contain other PFAS including PFOA and related substances.

Currently there is no monitoring capacity to assess potentially PFOS containing products or contaminated sites.

PFOS and related substances have been substituted mainly by other PFAS. PFAS are an issue

of concern under SAICM. To promote the synergy of the Stockholm Convention and SAICM, the action plan is extended to other PFAS where appropriate.

Table 28. Action plan for measures to reduce or eliminate PFOS and control PFAS (SAICM Synergy)

Objectives	Activities/tasks	Indicators	Time	Implementer
Please note: The action plan for regulatory frame for PFOS is integrated in the general action plan (3.3.1)				
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 products Refining of inventory of PFOS and PFAS in industrial use Refining of inventory of stocks and waste of PFOS and other PFAS Refining inventory of historic use and release of PFOS and PFAS (see contaminated site action plan) (Option) Material and substance flow analysis of PFOS/PFAS Custom or international export stores should be monitored	Updated inventory with robust data and list of data gaps	2 year	MoCC, MoI&P, FPCCI EPA Academia RESEARCH INSTITUTIONS OGD LOCAL GOVERNMENT WASA Sea ports management authority
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, research, publications,	1.5 year	MoCC, MoI&P, MoWR (Ministry of Water Resources) FPCCI EPA Academia Industry WASA Local government NGO'S Regional Stockholm centre
	Assessment of management and destruction option of PFOS and PFAS containing stocks and wastes	Management and destruction options assesses (report)	1 year	
	Policy and strategy for control and management of PFOS and PFAS containing products and wastes	Strategy incorporated in National Chemical and Waste Management Plan	1 YEAR	
	Environmental safe storage of PFOS-containing materials	PFOS containing waste stored	1 year	
	Stop recycling of PFOS containing products			
	Destruction or export of PFOS containing waste; ESM of PFAS containing products	PFOS stocks and waste disposed; Compliance and enforcement of the SC	1 year	
PFOS alternatives in used/exempted uses are assessed	Compilation of information on alternatives to PFOS and related substances (considering available information of e.g. POP Reviewing	Information materials developed (report) and disseminated.	1 year	MoCC, MoST, MoWR (Ministry of Water Resources)

Objectives	Activities/tasks	Indicators	Time	Implementer
and PFOS is substituted by the most sustainable chemical and non-chemical solution	Committee)			FPCCI NDMA, EPA, Industries International partners Regional Stockholm Centre
	Assessment of human health effect and environmental hazards of PFAS and other alternatives			
	Education and capacity building on alternatives and alternative assessment	Research, publications, case study reports	1 year	
	Selection of the most sustainable alternative chemicals and non- chemical solutions in the different applications Part of curriculum for related departments	Phase in and use of alternatives	1 year	
Training and awareness raising for stakeholder groups on PFOS and other PFAS and establishing approach for information exchange (key point)	Inform and sensitize 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 sensitize workshops/seminar conducted Education materials developed Awareness created	1.5 year	MoCC, MoI&P, MoWR (Ministry of Water Resources) FPCCI Media, NGO's, EPA, Ministry of climate change workers technical training departments, Academia, Research institutions, local government, WASA, health and safety departments
	Training/education of customs authorities on PFOS (and other POPs and other hazardous substances) in articles and products.	Number of trained personnel	1.5 years	
	Development of related education and awareness materials for (considering already available materials)	Education/awareness programs conducted	1.5 years	
	Dissemination of information on PFOS and PFAS (labelling)	Reports, publications, awareness broacher's at community level, industrial safety catalogues ,	1.5 year	
BAT/BEP application in exempted uses	Using BAT/BEP in case PFOS and related chemicals are used in industrial applications, including closed-loop systems. Incentive based policies should be introduced	BAT/BEP applied Minimum/zero emission achieved.	1 year	EPA, MoCC, MoI&P, FPCCI ,
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 building 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 approach for PFOS and related substances has been established. Monitoring of Priority areas including major drinking water reservoirs conducted Timely review	1.5 year	MoCC, MoWR, MoI&P PSQCA, EPA, FPCCI NGO's , relevant academia, research institutions, small scale industries, regulatory authority

Objectives	Activities/tasks	Indicators	Time	Implementer
	Monitoring biota and soil samples for PFOS especially in vicinity of suspected contaminated sites (see contaminated site action plan). Regular monitoring of industries possibly using PFOS and other PFAS	Proper check and balance		
The action plan for PFOS contaminated sites can be integrated in the general action plan on POPs contaminated sites. Or can be integrated here.				

3.3.7 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 needs to be made considering alternative chemicals and non-chemical solutions. Such an assessment is made by appropriate technical/research institutions and committees. 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 if an exemption is needed to appropriately meet the obligations under Article 4 in future.

Table 29. Register for Specific Exemptions and Continuing need for Exemptions (Article 4)

Objectives	Activities	Indicators	Time Frame	Implementers
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.	Stakeholder consultation held and outcomes documented Country assessment of current listed POPs with exemptions	Annually	MoCC, MoI&P, EPA, MES, CEPS, FPCCI

	(c) Notification of Convention Secretariat on specific exemptions if needed (d) Periodic review to assess the need for continued exemptions and alternatives and stop exemption and use more sustainable alternatives as soon as feasible	Notification submitted and exemption listed Review report		
Registration of exemption	Inform Secretariat of the Stockholm Convention/COP on the need 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	1 year	MoCC, MoI&P

3.3.8 Measures to reduce releases of unintentional POPs (Article 5)

Activities are proposed for the action plan to reduce the release from unintentionally produced POPs (PCDD/Fs, PCBs, PCNs, PeCB. HCB and HCBD). In the action plan the activities have been set by considering the listing of the priority sources in Annex C of the SC, the total amount of contemporary releases as an outcome of the inventory process and considering point sources with potential risk to humans.

The action plan addresses the UPOPs sources with the highest share of PCDD/F released (open burning of waste and agricultural residues). Also BAT/BEP for major emitting installations like waste incinerators, metal industries and mineral products are addressed. Another relevant source is the release from chemical production and use in chemical industry like EDC/PVC production and other chlorine/organochlorine production.The chemical industry and use sector had the largest emissions in the first dioxin inventory which was, however, not documented in detail in the first NIP and could not been assessed in detail during NIP update. Therefore chemical industry needs to be assessed in the NIP implementation with the guidance to identify PCDD/F sources described in the UNEP toolkit.[129]

For an adequate integrated assessment and priority setting of UPOP emissions from sources and related impact of reduction, the total impact of release reduction from individual sources (industrial emissions, open burning, indoor cooking/heating and transport etc.) are needed. This includes other major pollutants to be considered for an appropriate risk assessment on air and soil pollution prevention. Other major pollutants to consider include:

[129] http://toolkit.pops.int/Publish/Annexes/A_02_Annex02.html

- other releases from industrial processes (e.g. heavy metals, particulate matter (PM), carbon black, PAHs).
- other releases from open burning, cooking/heating, transport (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 in particular in developing countries (WHO 2016[130], Lancet Commission on Pollution and Health[131]), 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 (IPPC).

BAT/BEP (Best Available Technique and Best Environmental Practice)

The technology level of the thermal sources is not according to BAT/BEP with possible exposure of operating staff and the surrounding. BAT/BEP in respect to PCDD/F control and reduction, is described in the "Guidelines on BAT and provisional guidance on BEP" developed within the SC [132]. UPOPs reduction efforts should be combined with reduction of mercury and other heavy metals and pollutant releases for industrial sources (e.g. in incinerators, cement kilns, metal industries) in an integrated manner. Comprehensive BAT Reference Documents (BREFs)[133] for incinerators, cement plans, metal industries and other industries have been developed by the European Commission within the Integrated Pollution Prevention and Control (IPCP) process of the EU. These documents are publicly available[133] and can be used in Environmental Impact Assessment (EIA) and permits. Since BAT is continuously improving, the implementation of BAT/BEP is a continuous and long term process. BAT often require investments which takes time in planning. Therefore most BAT implementation are long term projects.

Waste Management. Addressing open burning and improvement of waste management will have also relevant effect on the reduction of dioxin/UPOPs release but also other related releases like particulate matter (PM), PAHs and carbon black. Therefore, improved waste

[130] WHO (2015) http://www.who.int/mediacentre/news/releases/2016/deaths-attributable-to-unhealthy-environments/en/

[131] The Lancet Commission on pollution and health. http://www.thelancet.com/commissions/pollution-and-health

[132] Stockholm Convention (2009) "Guidelines on best available techniques and provisional guidance on best environmental practices" http://chm.pops.int/Programmes/BAT/BEP/Guidelines/tabid/187/language/en-US/Default.aspx

[133] EU BAT Reference (BREF) documents download page: http://eippcb.jrc.ec.europa.eu/reference/

management is of crucial importance to avoid threats posed to the nation's air and soil integrity. Sustainable industrial development is only possible in the long run if there is proper developed waste management and related recycling and recovery schemes. The 3 R[134] approach and the circular economy policy[135] emphasize that the principles of reduce, reuse, and recycle are the preferable options in the waste hierarchy; they should take precedence over other management options like incineration or landfill disposal where appropriate.

Synergies in inventory making, Pakistan is establishing inventories for different pollutant release (e.g. UPOPs, Greenhouse Gases, mercury, short-lived climate pollutant (SLCP)). It should be assessed where efforts could be harmonized, and if they could be addressed within a common database or approach, such as e.g. Pollution Release Transfer Register.[136]

Table 30. Action plan for reduction and elimination of dioxins/UPOPs

Objectives	Activities	Indicators	Time frame	Implementers
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 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.	Legislation and Regulation developed with appropriate limits Workshops conducted; stakeholders trained	3 years	MoCC, MoI&P, EPD/ EPAs PSQCA FPCCI Energy Dept. Information& culture dept.
Updated sources inventories for PCDD/F and possibly other listed UPOPs with data management and	▪ Refine/update Dioxin/UPOP inventory considering the guidance for identifying sources of UNEP toolkit[129] ▪ Incorporate new listed UPOPs where useful ▪ Regularly update of the UPOP	Toolkit group 7 sources better identified Regularly and improved updated UPOPs inventory Integrated inventory of	4 years	MoCC, MoI&P, Pakistan Bureau of Statistics Academia FPCCI

[134] UNEP Strategic Elements in implementing the 3R Platform http://www.unep.or.jp/ietc/spc/3R_Strategic_Elements.pdf
[135] UNIDO (2016) Circular Economy; EU http://ec.europa.eu/environment/circular-economy/index_en.htm
[136] (PRTR; http://www.unitar.org/cwm/prtr/).

Objectives	Activities	Indicators	Time frame	Implementers
harmonization with related release inventories.	inventory and reporting as appropriate ▪ Quantify other co-pollutants (e.g. PAHs; carbon black)	pollutant releases		EPD/EPAs
	▪ 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	Integrated data storage developed	2 to 4 years	
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 • Closure of dump sites and stop illegal dumping of wastes (fines). • Construct engineered landfills for remaining waste disposal	Circular economy & waste hierarchy integrated in legislation Waste catalogue Recycling rates increased Waste to energy concept assessed and implemented Dumps closed and sanitary landfills constructed	5 - 10 years	MoCC, MoI&P, MoST, MNFSR EPD/EPAs FPCCI Local Govt Agriculture WMC Industries Dept. Transport Dept. Waste management stakeholders
	• Develop a guidance and awareness materials for detection, extinguishing and prevention of landfill/dumpsite fires. • Develop an awareness for landfill 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	Awareness materials on UPOPs adjusted to Pakistan published Awareness for stakeholder groups on open burning, BAT/BEP conducted and materials compiled on Ministry platform	1 to 2 years	MoCC, Waste management stakeholders Media
To reduce and	• Monitoring of hazardous and municipal	Monitoring capacity	5 years &	MoCC

Objectives	Activities	Indicators	Time frame	Implementers
minimize release of UPOPs from waste incinerators	waste incinerators for releases and improvement programs to meeting standards • Education of operators and competent authorities on minimizing Dioxin/UPOPs release and emission control • Implementation of regulatory frame including BEP and/or BAT for meeting regulation limits (appropriate time frame). • Monitoring frame for incinerators	developed and measurement campaigns documented Education program and workshop documented	Continuous implementation	EPDD/EPAs Health Dept. LG&CD(concerns municipality)
	• 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	WHO guidelines assessed and adjust needs for Pakistan documented Hospital waste management pilot projects documented	5 years and continuous implementation	MoCC MoI&P MoNHSR&C Cities Hospitals
Adoption of BAT/BEP and IPPC in Ferrous and non-Ferrous metal production and minerals production processes to reduce and minimize release of PCDD/F, UPOPs and other priority pollutants	• Assessment of the individual industries for BEP options for UPOPs reduction and need and options for BAT including Environmental Impact Assessment (EIA) • Assessing synergies for the reduction of unintentional POPs, mercury, PM, GHG and other relevant pollutants and where feasible address pollutants in an integrated manner. • Introduce and effectively implement BEP and where required/possible BAT UPOP reduction measures (best within	Assessment report on BAT/BEP for key industries including integrated approach for pollutant reduction. BAT/BEP pilot projects for release reduction developed, conducted and assessed. Strategy for country wide pollution	5 to 10 years	MoCC MoI&P FPCCI PSQCA EPA/EPD

Objectives	Activities	Indicators	Time frame	Implementers
	integrated pollution prevention and control) • Develop/promote institutions with technical capacity to support implementation of cleaner production (BEP), BAT for IPPC	reduction established Institutions evaluated and selected and capacity built		
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 campaigns on Dioxins and UPOPs and other pollutants of concern for relevant stakeholders and sources (open burning, industrial sources, industries, waste wood).	Awareness material for UPOPs adjusted to Pakistan developed. Awareness campaigns documented for the different stakeholder groups	3 years and continued through out the activities	MoCC EPA/EPDs Media/Inforamtin Deptt Academia Health Deptt
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 Annex II and III priority sources releasing 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	Report on monitoring needs Capacity for UPOPs monitoring established Major sources monitored (report) Report on monitoring results in (industry, food, impacted sites and chemicals)	3 to 5 years	MoCC MoST MNFSR PSQCA EPA/EPDs Industrial Dept. Food Authorities Food Department Health Deptt Agriculture Live Stock

Objectives	Activities	Indicators	Time frame	Implementers
	UPOPs.			
The action plan for Dioxin/UPOPs contaminated sites is in the contaminated site action plan below.				

3.3.9 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 below and in the action plans 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 related containing stockpile (carpets and possibly others). Additionally PFOA and related substances were just listed as POPs in May 2019 andcurrently PFHxSis evaluated by POPRC as POPs.Furthermore SAICM has all perfluorinated alkylated substances as an issue of concern and related wastes (treated synthetic carpets, impregnated paper, textiles and furniture) will need to be managed and possibly destroyed in future.

Furthermore, SCCP have been listed in 2017 which is still used in a wide range of applications (e.g. lubricants, metal working fluids, PVC, rubber, textiles). By this current and past use, further POPs stockpiles are/were generated which will need to be managed in future.

Wastes containing these POPs and other PBT chemicals need to be managed in an environmentally sound manner. Activities for the management of POPs specific waste are listed in the individual action plans and would be linked to the activities listed in this generic action plan for POPs stockpiles.

The overall goal is to develop and implement a programme to manage the POPs stockpiles/wastes and reduce releases from stockpiles and waste in accordance with internationally-accepted guidelines.

Table 31. General action plan to reduce releases from stockpiles and wastes (Article 6)

Objectives	Activities	Outputs/Indicators	Time	Implementers
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	2 years	MoCC, MoI&P, MNFSR, FAO
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 cement kilns for destruction of waste (chemicals and chemicals in products) ▪ Evaluation the option and limitation of other facilities for destruction or other ESM measures for chemicals and chemicals in products (CiP) in country ▪ Needs assessment for improvement of destruction capacity	▪ Documentation on destruction capacity of cement kilns (positive and negative list) (report) ▪ Documentation of other destruction or otherwise ESM options in the country ▪ Need assessment report	2 years	MoCC, MoI&P, MNFSR, FAO Cement industry
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	MoCC, MoI&P, MNFSR, FAO PSQCA FPCCI
Destruction, disposal or export of POPs and other hazardous chemicals and waste in an ESM	▪ Upgrading of cement kiln or incinerator and development of monitoring frame ▪ Destruction of POPs containing waste and other hazardous chemicals containing waste in an ESM ▪ Export of POPs and other	▪ Cement kiln or waste incinerator meet BAT and BEP for destruction of (selected) POPs ▪ POPs and other hazardous chemical waste (including hazardous chemicals in products) managed in	5 years	MoCC, MoI&P, MNFSR, FAO PSQCA FPCCI Cement industry Customs

	hazardous chemical waste which cannot be treated or disposed in the country ▪ Disposal of selected hazardous waste	ESM		

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

To date, there is no intergovernmental policy instrument that addresses the identification and remediation of contaminated sites. Countries that have ratified the Stockholm Convention (Parties) should however endeavour to develop strategies for identifying sites contaminated with POPs (Article 6 SC). While not explicitly requiring remediation of contaminated sites, the Stockholm Convention stipulates that any remediation attempts must be carried out in an environmentally sound manner (Article 6 SC)

The activities for the identification and assessment of POPs-contaminated sites should be harmonized with the general strategy of Pakistan to assess and remediate contaminated sites and hotspots. Since 2016 aPOPs contaminated site working group has been established in the UNEP BAT/BEP group and it is recommended that Pakistan follow the progress and use outcomes of this work for promoting the assessment.

The individual POPs inventories have shown that all POPs groups have resulted or have likely resulted in some contaminated land. The details are compiled above in Section 2.3.8.

Depending on the pollutant, different securing and remediation technologies might be applied which need to be explored for the individual location and pollutant.

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.

Table 32. Action plan for identification of contaminated sites (Annex A, B and C chemicals) and securing and remediation in an environmentally sound manner.

Objectives	Activities	Indicators	Time Frame	Implementers
Regulatory frame for contaminated	▪ Develop/update legislation to set criteria for determining	Draft regulation developed on	3 years	MoCC, MoI&P, MNFSR,

Objectives	Activities	Indicators	Time Frame	Implementers
sites	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.	contaminated sites and soils. Draft Legislation on liability (Polluter Pays Principle (PPP) related to contamination and clean-up		MoNHSR&C, MoST PSQCA
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[137] ▪ 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	2 years	MoCC, MoI&P, MoNHSR&C, PSQCA Academia
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 EPA	5 years	MoCC, MoI&P MoNHSR&C, MoST Academia PSQCA FPCCI

[137] 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	Indicators	Time Frame	Implementers
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 database considering co-pollutants integrated in a general contaminated site database	▪ Report on database with recommendation ▪ Database selected and established	3 years	MoCC, MoI&P MoNHSR&C, MoST Academia PSQCA FPCCI
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)[138] and prioritizing sites ▪ Securing of sites and remediation of sites as appropriate	Potential POPs pesticide contaminated sites are assessed, ranked for priority and secured	3 years	MoCC, MNFSR MoNHSR&C, Academia FAO
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 PCB contaminated sites are assessed, ranked for priority and secured	3 years	MoCC, MoI&P, Academia Utility sector FPCCI
Identification, assessment, securing and possibly remediation of POP-PBDE contaminated sites.[139]	▪ Develop methods for risk assessment of sites where WEEE, ELV 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 selected Best securing and remediation measures identified and personnel trained	5 years	MoCC, MoI&P, Academia FPCCI

[138] 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 Sci Pollut Res Int. 22:14442-14454.

[139] 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 WJ, 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	Indicators	Time Frame	Implementers
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 determined Pollution assessed Strategies for addressing sites developed ▪ Measures to secure sites implemented	3 years	MoCC, MoWR (Ministry of Water Resources) MoI&P, Academia FPCCI

Objectives	Activities	Indicators	Time Frame	Implementers
Assessment, management, database of potentially PCDD/PCDF and other UPOPs contaminated sites and securing /remediation needs	▪ Use guidelines[140] for identification and assessment of UPOPs contaminated sites (see Chapter 2.3.8.5) ▪ 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 Pollution assessed Strategies for addressing sites developed Measures to secure sites implemented	3 years	MoCC, MoI&P, MNFSR Academia FPCCI Industries

[140] 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

3.3.11 Facilitating or undertaking information exchange and stakeholder participation

This activity 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.

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 Section 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 for continuous updated information.

Table 33. Action plan for facilitating information exchange and stakeholder participation

Objectives	Activities	Performance indicator	Time frame	Implementers
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.	Information exchange on POPs in the region and internationally is ensured	3 years (continuously)	MoCC, MoST Academia Regional Stockholm and Basel Centre NGOs

	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			
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. Evaluation Stockholm Convention documents and decide if any document should be translated,	Key documents and information accessible to stakeholders	3 years	MoCC, MoI&P, MoENT Ministry of Federal Education and Professional Training Academia FPCCI NGOs
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	MoCC, MoI&P, MoENT Ministry of Federal Education and Professional Training Academia, NGOs

3.3.12 Public/stakeholder information, awareness and education (Article 10)

Article 10 of the Stockholm Convention on 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 products and 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.

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.

Table 34. Action plan for public awareness, information and education activities

Objectives	Activities	Indicators	Time	Implementers
For specific awareness activities for individual POPs see the respective action plans of individual POPs and coordinate where appropriate				
General Awareness on POPs and on POPs-related SAICM issues and general hazardous chemicals as appropriate)	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	2 year	MoCC, MoI&P, MoST, PSQCA MoNHSR&C, MoENT Business Associations, FPCCI Academia NGOs Media
	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	
	Updated syllabus and information for technician and industrial workers with POPs a hazardous chemicals	Syllabus for technicians and industrial workers in place and taught	3 years	
	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	

	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	
	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 communication activities and number of stakeholders reached		
	Implement the activities to raise awareness and training for inspectors; customs, environmental police, on the contents related to POPs management	Trainings and workshops conducted		MoCC, MoI&P Competent authorities Customs
	Integrating POPs and hazardous chemicals in the environmental education syllabus of basic and secondary schools	Updated syllabus of basic and secondary schools	3 years	MoENT, MoCC, Academia International partners
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	MoENT, MoCC, MoST, Academia International partners
	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	
	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	MoI&T, MoCC, FPCCI, Academia

3.3.13 Effectiveness evaluation (Article 16)

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 in the frame of the global POPs. UNEP together with WHO and the Stockholm Convention Secretariat are conducting and supporting human milk surveys in developing countries.[141]Pakistan has not participated in the WHO human milk survey or GMP but has established POPs monitoring capacity in recent years.

Table 35. Action plan for effectiveness evaluation (Article 16)

Objectives	Activities	Indicator	Time	Implementers
Conduct a monitoring of POPs in human milk or human blood	Monitoring of POPs in human milk	Updated data on POPs in human milk/blood	3 years	MoCC, MoNHSR&C, Academia
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	MoCC, MoI&P, Academia NGOs

3.3.14 Reporting (Article 15)

According to Article 15 (here paraphrased): 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

[141] http://www.who.int/foodsafety/areas_work/chemical-riskschem/pops/en/index1index.html

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 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 36. Action plan for reporting under Article 15 of the Stockholm Convention

Objectives	Activities	Indicator	Time	Implementers
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	MoCC, Stockholm Focal Point
	Setting up responsibilities for data compilation and filling the reporting form	Data compiled	1 year (for 2018 reporting)	
Complying with article 15 reporting	Compile information for reporting (updated inventory and other information) Submit report to the secretariat (website)	Reporting submitted deadlines met	reporting 2018; then 4 year cycles	

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. The overall research capacity in Pakistan on POPs has improved in recent years particularly by international research cooperation. However, research efforts are not coordinated and the development of analytical capacity in the country is a major bottleneck. For POPs research and monitoring, international cooperation with experienced institutions should be further promoted and better coordinated. In this respect, capacity building activities offered in the frame of the Stockholm Convention such as the Global Monitoring Plan or capacity building within the Belt Road Initiative should be explored and supported from Pakistan side.

Another relevant research area are alternative assessments to POPs and candidate POPs. Considering that several POPs are in use and a large amount of POPs-like chemicals are

identified in international research[10], a wider frame of research and monitoring capacity is needed to address POPs and hazardous chemicals and to select appropriate alternatives to POPs and other hazardous chemicals of concern.

Science–policy interfaces are critical in shaping environmental governance and sustainable development and a draft road map has been developed by BRS Conventions. The science community has delivered many assessments, syntheses and reviews to inform on chemical pollution and health effects which could facilitate the conventions' implementation such as the UNEP Global Chemical Outlooks. 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 and 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 identifies activities in addressing the research, monitoring and science-policy needs.

Table 37. Action plan for research, development and monitoring (Article 11)

Objectives	**Activities**	**Indicator**	**Time**	**Implementer**
To develop institutional and research capacity to manage POPs and other PBTs and other hazardous chemicals (SAICM synergy)	▪ Identify institutions with the potential to undertake research into POPs and other hazardous chemicals (SAICM Synergy) ▪ Strengthen national scientific and technical research capacity and infrastructure to gather, evaluate and exchange information on chemicals ▪ Establish capacity on health, exposure and risk assessment to POPs and other hazardous chemicals ▪ Develop networks among identified research institutions on national and international level ▪ Establish procedures for communicating research and development findings to the	▪ Institutions identified, contacted and agreement ▪ Needs of national scientific and technical research capabilities relation to POPs and other hazardous chemicals established ▪ Meetings to identify proper avenues for networking ▪ Research into health effects of POP initiated ▪ Linkages for communication established	5 years	MoCC, MoI&P, MoST, MoENT PSQCA FPCCI Academia PCRWR

Objectives	Activities	Indicator	Time	Implementer
	public			
Improved and operative science-policy interface established and contributing to decision making	▪ Assessment of current science-policy interface in decision making. gaps and improvement needs ▪ Establish/improve science policy interface for chemicals and waste/resources ▪ Use the S-P-interface for assessing the impact of POPs and hazardous chemicals to the SDGs and ecosystem services indicators,[142] and other policy drivers.	▪ Gap assessment of science-policy interface ▪ Compilation of impact of hazardous chemicals to SDGs and related indicators ▪ Science-policy assessment report on chemicals and waste/resources	3 years	MoCC, MoI&P, MoST, MoENT, MoC PSQCA FPCCI Academia PCRWR
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 ▪ Contribute information on life cycle cost, external cost and socio-economic assessment on POPs and hazardous chemicals to the science-policy dialogue	▪ Institute or working group with expertise on external costing and socio-economic established. ▪ Reports and policy documents for key areas ▪ Information reached policy makers and are referenced in policy decisions and policy and legislation background documents	3 years	MoCC, MoST, MoENT Academia FPCCI NGOs
Appropriate analytical capacity for POPs developed	▪ Assessment on analytical capacity need (see individual POPs action plans) ▪ Develop laboratory capacity and/or international cooperation for POPs considered relevant for the country. ▪ To identify cooperation partners for POPs and PBT monitoring and research on national and international level	▪ Laboratories established ▪ Equipment purchased ▪ Staff trained ▪ International standard methods selected ▪ Laboratories accredited for all relevant matrices including products ▪ Cooperation with partners established	5 year	MoCC, MoI&P, MoST, MoENT, MoC PSQCA FPCCI Academia PCRWR

[142] Stockholm Environmental Institute (2010) Impacts of Pollution on Ecosystem Services for the Millennium Development Goals.

Objectives	Activities	Indicator	Time	Implementer
To monitor POPs and other relevant PBTs needed for the implementation of the individual action plans (see other POPs AP)	▪ Support the monitoring needs of the action plans of the individual POPs groups	▪ Sample matrices identified ▪ Methods for sampling selected ▪ Sample collected ▪ Analysis Results	5 years	MoCC, MoI&P, MoST, MoENT FPCCI; PCRWR Academia
To establish mechanism for quality assurance and control of monitoring activities	▪ Establish effective quality assurance and quality control system ▪ Setting up of review panel to evaluate data prior to acceptance	▪ Protocol for ensuring QA/QC in place ▪ Procedure for data evaluation developed ▪ Workshop to identify review panel organised	3 years	MoCC, MoST, MoENT PSQCA FPCCI, PCRWR Academia
Proper management of data	▪ Establish procedures for the management of analysis results and other data ▪ Consider internationally 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 ▪ Harmonized methodology for reporting interpretation of results	3 years	MoCC, MoI&P. Pakistan Bureau of Statistics
Research on alternatives to POPs and Green and Sustainable Chemistry	▪ Compilation of information on alternative assessment ▪ Research on alternatives to POPs ▪ Develop research into Green and Sustainable Chemistry (G&SC))	▪ Workshops on G&SC ▪ Research project(s) on G&SC developed ▪ G&SC modules included into curricula ▪ Research initiatives into finding alternatives to POPs	3 years	MoCC, MoI&P MoST, MoENT FPCCI Academia

3.3.16 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. Pakistan needs technical and financial assistance and will seek this assistance when implementing its NIP.

The following actions are suggested 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 38. Action plan for technical and financial assistance (Articles 12 and 13)

Objectives	**Activities**	**Key performance indicator**	**Time frame**	**Implementers**
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	MoCC, MoI&P, Universities and Research Institutions Stockholm and Basel Regional Center
To source for financial assistance towards the successful implementation of the Convention (see 3.6)	▪ 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	5 years	MoCC, MoF, International donors

3.5 Priority areas and capacity building needs

As priority areas for the implementation of the SC, the following topics have been discovered during the NIP development process and the stakeholder workshops and steering committee meetings. The order of the priority areas listed below does not mean a prioritization between the areas.

The SC activities should be linked and harmonized with national plans and priorities and should support the sustainable development of the country.

Where possible and appropriate, the implementation of the SC should also seek synergies with the implementation of other chemical Conventions and SAICM.

A large share of activities in the different action plans are addressed by these high priority areas. These activities are not repeated in this summary of priorities but can be found in the action plans described for the different areas and are listed in the action plan tables in section 3.3.

3.5.1 Strengthening the coordination between institutions and stakeholders and development of capacity and knowledge in relevant committees

A strong coordination mechanism between the different ministries, institutions and other stakeholders is needed for an effective implementation of the action plan and for general hazardous chemical and waste management. The coordination mechanism for the NIP implementation are the topic-related committees of Climate Change, SDGs and Vision2025. Capacity for POPs and hazardous chemicals and hazardous waste need to be developed in the related coordination groupsto the topics.Also support is needed including the link to communication of outcomes on provincial and city level and education of implementation.

This capacity building and the strengthening and development of cooperation between the different ministries, institutions, industry, research/education and other stakeholder is an important factor for an effective implementation of the Stockholm Convention NIP and other conventions on chemical and waste including SAICM (synergy approach) and therefore a priority. Such a coordination mechanism should facilitate the overall management of chemicals and waste and link it to the SDG implementation of Pakistan and in particular to

Pakistan's NAP for SDG12 on Sustainable Consumption and Production[143]and the Vision 2025[144].

The activity contributes to SDG 3, 4, 11, 12 and 16. It can also contribute to SDG 8 and 9.

Time frame: This activity should start as soon as possible considering that also capacity need to be built in the country regions and provinces.

3.5.2 Development of legislation and related implementation

Improvement and development of legislation on POPs and general chemicals and their management is needed. While most POPs pesticides are banned, there is a lack of legislation for industrial POPs. Also an improved legislation for wastes containing POPs and general hazardous waste management is needed. A range of waste fractions potentially containing POPs need particular control and regulatory frames for their management (e.g. PCB equipment; e-waste and related plastic; end-of-life vehicles, waste oils, waste wood).Here the activities should be coordinated/mainstreamed with the Master Plan for Hazardous Waste Management.

Where gaps have been discovered appropriate legislation should be developed. This is detailed for POPs in the respective action plans in 3.3.

There is a need for institutional strengthening of chemical and waste possibly with employment of additional staff for chemical and waste management to have the necessary capacity for the needed national tasks. Also other ministries need institutional strengthening for chemical and waste management. This strengthening of institutions is needed for the development of the appropriate legislation and regulation and for the implementation of the regulatory framework and the action plans.

The activity contributes to SDG 3, 4, 8, 9, 11, 12 and 16.

Time frame: This activity should start as soon as possible for development of the different legislation with long term tasks over 10 years considering that the development of implementation capacity takes long time and is a continuous process.

[143] Government of Pakistan (2017) Pakistan National Action Plan on SDG 12 Sustainable Consumption and Production. Ministry of Climate Change, May 2017.

[144]Government of Pakistan (2014) Pakistan2025 One Nation – One Vision.Ministry pf Planning, Development and Reform.

3.5.3 Capacity building, research, education, information and awareness raising

The overall research capacityon POPs in general and contamination in the environment, food or humans is low. The development of research on POPs and pollutants but also research on waste management and recycling is relevant including the science-policy dialogue on chemicals and waste. It is also a necessary base for the sustainable development of Pakistan.

For all POPs groups (pesticides, unintentional POPs, PCBs, PFOS and related substances, POP-PBDEs, HBCD) education and awareness raising activities are needed. This includes the education and awareness of the public but also of policy makers and individual stakeholder groups including those particularly exposed.

The awareness on POPs would best be integrated in a general education and awareness on hazardous chemicals and related risks and health impacts. This also should include awareness and education on waste management for policy makers, relevant stakeholders and the public. Synergies with other chemical and waste conventions should be elaborated with a common but differentiated approach.

Since some of the new industrial POPs are present in consumer products (electronics, vehicles, synthetic carpets, treated textiles, furniture, mattresses, etc.), the awareness raising materials and awareness communication can nicely be linked to sustainable consumption and production.

The activity contributes to SDG 1, 2, 3, 5, 8, 9, and 12 and 16.

Time frame: This activity should start as soon as possible. It includes actions on awareness raising which are short term. The development/improvement of curricula takeslonger and can be considered medium-term Capacity building on POPs and general chemical and hazardous waste management is a continuous process which will continuously be addressed in future.

3.5.4 Environmental sound management of POPs stockpiles (PCB, pesticides; POP-PBDES, HBCD and PFOS)

The management of existing POPs stockpiles is considered a priority to protect human health and the environment.

Management capacity for POPs and generally hazardous waste in Pakistan needs to be built and the limitations and options for destruction capacity in the country need to be further assessed and developed..

The POPs-pesticide stock has largely been destroyed and the remaining stock need further management and destruction. The ongoing POPs project will possibly finalize this task.

Of particular relevance is the management of the PCB in current use and stocks with large risk for humans, the environment and food which need to be destroyed as soon as possible.[145]The current POPs management project is addressing the PCB stock and after a detailed inventory then the need for further projects will be seen.

Large stocks of POP-BFR containing wastes are present in plastics and polymers of e-waste, end-of-life vehicles, insulation in construction and other uses. While the exposure risk is normally lower compared to PCBs or pesticides, these materials are “fuel” for landfill fires and backyard burning with associated releases of POPs, unintentional POPs, particulate matter and carbon black. Furthermore, these plastics and polymers are sources for marine litter and associated pollution.

PFOS stocks in particular in firefighting foam are a threat to ground water, drinking water and soil and the use need to be stopped and stocks managed appropriately. Also PFOA stockpiles and wastes are likely present. Furthermore, PFAS is an emerging issue of concern under SAICM and should be addressed in a synergistic way.

The activity contributes to SDG 3, 12, 14 and 15.

Timeframe: This activity has started for POPs pesticides and PCBs. The management of PCBs will likely take at least 5 years and need to be finalized by 2028. The management of POP-BFR containing stocks in particular in construction can take many decades and up to a century[146] considering the use duration in this application.

3.5.5 Improvement of waste management and introduction of waste hierarchy towards (more) circular economy and reduction of unintentionally formed POPs from open burning.

Open waste burning is a relevant source of PCDD/F and other unintentional POPs release. Also Pakistanhas not assessed the facilities for the destruction of POPs waste. Thefacilities needs to be assessed for further POPs containing waste (PCBs; pesticides) destruction.

[145] Weber R, Herold C, Hollert H, Kamphues J, Ungemach L, Blepp M, Ballschmiter K (2018) Life cycle of PCBs and contamination of the environment and of food products from animal origin. Environ Sci Pollut Res Int. 25(17), 16325-16343.

[146] Li L, Weber R, Liu J, Hu J (2016) Long-term emissions of hexabromocyclododecane as a chemical of concern in products in China. Environ Int. 91, 291-300.

New industrial POPs (in particular PBDEs, HBCD, PFOS and SCCPs) can be present in several large waste streams (electronic waste, car shredder residues, treated synthetic carpets, textiles, rubber, and PVC etc.). These wastes are currently largely disposed in dumpsites. Therefore, and considering other contaminants (e.g. heavy metals) in the waste, the lack of waste management presents a serious threat to soils and related food safety (SDGs 2,3,6, 11,12)[147], to ground water, and the wider environment.

The improvement of waste management is, therefore, of high priority for current and future control of unintentionally produced POPs release and for the management of new industrial POPs in waste streams. This include also the development of an overall concept to finance waste management.

Furthermore, the introduction and implementation of the waste hierarchy towards a more circular economy is crucial for recovery of valuable resources contributing to sustainable consumption and production and it contribute to the reduction of GHG emission and carbon footprint. This contributes to SDG implementation of Pakistan and in particular to Pakistan's NAP for SDG12 on Sustainable Consumption and Production[148]and the Vision 2025[149].

The improvement of waste management and the implementation of the waste hierarchy towards a (more) circular economy therefore contribute to the integrated approach to tackling interconnected issues and generating multiple benefits as aimed in the GEF 7 strategy. At the same time increased recycling lead to job creation and generation and involvement of green and sustainable industries and therefore can catalyse private sector activities.

The activity contributes to SDGs 1, 2, 3, 6, 8, 11 and 12.

Time frame: This activity should start as soon as possible. The management of the DDT stockpile can be short time (within 2 years) while the management of PCBs will likely take at least 5 years and need to be finalized by 2028. The management of POP-BFR containing stocks in construction can take decades and up to a century considering the use duration in this application.

[147] Bell et al (2016) Assessment of POPs contaminated sites and the need for stringent soil standards for food and feed safety. Working document for UNEP Dioxin Toolkit and BAT/BEP group. October 2016.

[148] Government of Pakistan (2017) Pakistan National Action Plan on SDG 12 Sustainable Consumption and Production. Ministry of Climate Change, May 2017.

[149]Government of Pakistan (2014) Pakistan2025 One Nation – One Vision.Ministry pf Planning, Development and Reform.

3.5.6 BAT/BEP for Dioxin/UPOPs reduction and integrated pollutant prevention and control

Most of the facilities in Pakistan which are listed in Annex C of the Stockholm Convention with PCDD/F release (medical waste incinerator, metal smelters, cement kilns, brick kilns) do not comply with BAT/BEP. The improvement of technology for facilities with relevant PCDD/F release is a priority to reduce total PCDD/F and other UPOPs.

The Stockholm Convention BAT/BEP guidance stresses the integrated pollution prevention and control as mentioned as a general guiding principle. The approach of Pakistan is that the implementation of BAT/BEP should contribute to the overall reduction of pollution release (UPOPs, heavy metals, particulate matter) and is an important cornerstone for the overall reduction and control of soil, air and water pollution.

This contributes to SDG Goal 3 Job Creation & Private Sector-led Growth in particular Strategy 3.6: “Build a priority infrastructure base that facilitates sustainable growth and economic diversification” and Strategy 3.2: “Support job creation in industry and services…” needed to develop, operate and maintain BAT/BEP. This prevention of pollution release is also an important contribution to Goal 5 in particular Strategy 5.1: “Ensure a clean environment together with healthy and functioning ecosystems”.

BAT/BEP also can contribute to reduction of energy consumption and related reduction of GHG emission.

BAT/BEP with an integrated pollution prevention and control approach of facilities and industries therefore contribute to the integrated and system approach to tackling interconnected issues and generating multiple benefits as aimed in the GEF 6 and 7 strategy.

The activity contributes to SDG 2, 3, 6, 11 and 12 and can contribute to SDG1 and 8 in particular if local working force and technologies are used where possible and appropriate.

Time frame: Some of these activities should start as soon as possible in particular on hospital waste incinerators where currently activities are planned in Yangon and Mandalay. BAT activities in industries can be considered medium- to long-term activities without a specific urgency.

3.5.7 Monitoring of POPs, effectiveness evaluation and collaboration

There is a lack of analytical and POPs monitoring capacity in Pakistan. For the implementation of the Convention, levels of POPs in human are needed for effectiveness evaluation and support for priority setting. POPs monitoring is needed for assessment of

POPs in products, the assessment of contaminated sites, contaminated drinking water or the implantation of BAT/BEP and release control. These activities should be combined and lead to the establishment and improvement of POPs and hazardous chemical research and international collaboration also contributing to science-policy advice.

The activity contributes to SDG 3, 4, 5, 6, 8, 11, 12, 14 and 16.

Time frame: This activity will likely start soon within the Norwegian project (NIVA) but is a long term activity over 10 years considering that the development of laboratories as well as the capacity building of staff take time.

3.5.8 Substitution of POPs and selection of green/sustainable alternatives to promote circular economy

Some of the new listed POPs including SCCPs, PFOS/PFOA, DecaBDE and HBCD are still used in products (insulation foams, textiles, PVC, rubber) or in processes (e.g. lubricants, metal working oils, fatliquoring) and increase the total POPs stockpiles and waste increasing future exposure, management challenge and cost. Therefore, assessment and substitution of POPs and POPs-like chemicals are needed. Strengthening of capacity for assessment of alternative and selection of green and sustainable chemicals or non-chemical alternatives is needed to avoid regrettable substitution.[150]

This activity also contributes to GEF Strategic Priorities[151].

Considering the SAICM synergy and that Pakistan has a large agricultural sector, also highly hazardous pesticides (HHPs) and other pesticides with serious health and environmental threats should be substituted by more sustainable alternatives, IPM and organic agriculture.

Furthermore the substitution of highly persistent and water soluble PFOS, PFOA and other PFAS (SAICM synergy) contribute to Enhancing Water Security (GEF International Water Focal Area).

The activity contributes to SDG 3, 4, 6, 8, 9, 12, 14 and 16. The use of green and sustainable chemicals also contributes to SDG 2, 14 and 15.

[150] Fantke P, Weber R, Scheringer M (2015) From incremental to fundamental substitution in chemical alternatives assessment. Sustainable Chemistry and Pharmacy 1, 1-8.

[151] GEF (2017) GEF-7 REPLENISHMENT OVERVIEW: GEF-7--GLOBAL CONTEXT AND STRATEGIC PRIORITIES. December 22, 2017, GEF/R.7/11

Time frame: This activity should start as soon as possible in particular considering of the new POPs currently in use and the uncontrolled import of pesticides with unclear labelling. This activity is considered continuous since new chemicals are invented continuously and also are continuously introduced to market.

3.5.9 Contaminated site assessment and management

The assessment and inventory in this updated NIP revealed that for all POPs groups (Pesticides, PCBs/PCNs, Dioxin/UPOPs, PFOS and PBDEs) a range of sites are possibly or likely contaminated.

Contaminated sites negatively impact several SDGs including 3, 6, 11, 14 and 15. Currently, there was only a preliminary measurement of pesticide contaminated soils. Therefore, it is of high priority to initiate a more comprehensive assessment, mapping and securing of POPs and other contaminated sites. In particular sites with potential contamination of ground and drinking water with PFOS or sites where food producing animals are grazing/feeding. The activities should result in the establishment of a database of contaminated-sites.

The activity contributes to SDG 3, 6, 11, 14 and 15.

Time frame: The main activities can start in a few years after development of a regulatory frame and analytical capacity. Only the assessments of contaminated ground water and drinking water reservoirs should start as soon as possible in cooperation with partner laboratories in countries where cooperation exists. Otherwise the activity is long-term considering the experience made in other countries.

3.6 Time frame for the implementation strategy and action plans

For the priorities areas listed above in 4.1, considerations on the time frame are included in the individual action areas. Most of the priority activities should start as soon as practical.

The individual time frame for action plans and activities developed and compiled in detail in Section 3.3 are integrated to this time frame shown below in **Error! Reference source not found.** with short-term (within next 3 years), mid-term (until 2025) and long-term (until 2030).

3.7 Resource requirements

For the priority areas, tentative budget requirements have been estimated (Table 39). Details on funding requirement will be elaborated during the respective development of projects. Pakistan is aware that the financial resources from GEF and other UN funding do not

sufficiently cover the full implementation costs; hence, co-funding has to be considered. Therefore, potential sources of funding need to be identified. The government shall ensure the necessary 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. In addition, National Plan implementing authorities should take maximum advantage of the financial resources allocated by international financial organizations and other countries by conducting appropriate campaigns to attract capital from donors for the National Planning, creating a legal basis for encourage international sponsorship.

This framework will take into consideration and identify specific human resources, stakeholder contributions and requirements for possible GEF incremental cost and funding by development/donor partners. Considering the larger share of co-funding needed for GEF projects, appropriate and robust co-funding sources and approaches are needed. Following approaches and strategies are considered for co-funding:

The SC NIP will be coordinated and mainstreamed where appropriate with other related national plans and programs in particular the SDG implementation, waste management plans, plans on resources management, related activities to address climate change, or programs or projects on science and technology, in order to attract investments and increase capital efficiency. By linking to general chemical and waste management co-funding can partly come from national budgets dedicated to chemical and in particular to waste management.

For the management of POPs contaminated stocks and wastes, extended producer responsibility (EPR) contributions can become an important funding source for the environmentally sound management of waste fractions. Several waste fractions related to POPs could be addressed by an extended producer responsibility frame:

- PCBs and related equipment;
- E-waste including e-waste plastic;
- End of life vehicle (including the polymers);
- Empty pesticides containers and stockpiles;
- Synthetic carpets;

The implementation of extended producer responsibility needs the development of a respective policy and regulatory frame. Such a frame is already existing in some countries for some of the categories and the OECD has developed related information.[152]

Owners of POPs waste have to contribute a share of the management cost:

- Owners of PCBs (utility sector) have major responsibility for a large share of the PCB containing transformers and other equipment;
- Owners of buildings with POPs containing insulation foams, sealants or paints;
- PFOS firefighting foams;
- End of life vehicle (including the polymers).

Since a range of POPs and other pollutants are included in consumer products, also the consumers need to bear a part of the cost by appropriate waste management fees.

In the set-up of funding of the waste management also the value of the waste need to be considered as co-financing source. E.g. vehicles have an inherent value (200 to 400 US$) mainly from metals and this value should be used to also manage the non-valuable fraction of plastic and other polymers and pollutants. Also certain e-waste fraction have a value and can contribute to the finance of e-waste management. This requires the development of a waste management frame which does not allowing to just pick out the valuables like metals ("cherry picking") without consideration on managing the remaining non-valuable fractions.

The improvement or establishment of recycling and recovery schemes also can contribute to financing of waste management including POPs management. E.g. from experience in Europe, more than 50% of e-waste plastic can be recycled after separation with a reasonable price for the separated plastic fraction. The separation of recyclable plastic at the same time reduces the volume of the plastic fraction which need to be treated/disposed.

The polluter pays principle (PPP) can be used in the area of contaminated sites and hot spots. Before the principle can be applied the related regulatory frame need to be set-up that PPP can be used as co-financing source.

Overall, the NIP will be implemented through mobilization of various finance resources such as state budget, bilateral grant aid, GEF grants, financing from organizations and individuals, extended producer responsibility contribution, polluter pays principle contributions, loan, improved resource recovery from wastes, and other appropriate options.

[152] OECD resources http://www.oecd.org/env/tools-evaluation/extendedproducerresponsibility.htm

Strengthening international cooperation should be carried out in various areas such as technical cooperation, grant aid for project development, improve capacity, institutional improvement, supporting under projects, resolving health and social benefits problems for the stakeholders.

The elaboration, allocation, and cost estimate decisions, as well as the management, use and settlement of funds for implementation of the National Plan will be conducted transparent in accordance with regulations.

Table 40 gives an overview on budget estimates for priority activities for POPs management in Pakistan. These budgets are indicative and a rough estimate. Some of the activities cannot be estimated since the necessary data are not available but are generated during the implementation of the NIP. E.g. the cost for the PCB management can only be estimated after the amount of PCB containing transformers, capacitors and other wastes is known based on a detailed inventory. Also, the cost for the management of PBDE can only be calculated within the overall management of e-waste, end-of-life vehicle and other impacted wastes. Only after such a frame is established and the approach for plastic/polymer management from e-waste and ELVs is clarified (separation/recycling or just disposal or energy recovery in e.g. cement kiln) the cost for the treatment of POP containing plastic/polymers can be calculated.

As described above, the financing of the suggested budget would be a mix of governmental funding, international funding and funding from industries and citizens. E.g. the estimated cost for contaminated site assessment would come also from the owner of potentially contaminated sites like the airport.

Furthermore, the proposed activities can partly be financed by the regular waste management budget since PBDE in e-waste or end-of-life vehicles belongs to the general waste management tasks of the country. Here funding can come largely from extended producer responsibility and for vehicles and some of the electronics co-funding can (partly) come from the value of the resources in the waste.

Furthermore integrated implementation with other national and internationally funded activities can be a (co-)funding source. The Norwegian project on hazardous waste management should be linked to the activities where appropriate. A range of activities like the coordination mechanism, strengthening institutions, regulatory development and implementation of chemical and waste management can be done in a synergistic and integrated manner with related co-funding considerations.

Table 39. Estimated budget for priority activities for POPs management in Pakistan

Priority Activities (details are in individual action plans in 3.3)	**Tentative Budget estimate (US $)**
Coordination, institutional strengthening, regulatory development and implementation	
Coordination between ministries, institutions and stakeholders for POPs, hazardous chemicals and waste management (SAICM synergy)*	1000,000
Strengthening governmental institutions on POPs and hazardous chemicals including additional employment of staff (SAICM synergy)*	2,000,000
Development of policy, legislation and regulatory (SAICM synergy)*	1600,000
Capacity building for the implementation of the regulatory framework	1000,000
Education, information and awareness raising*	
Information and awareness raising on POPs, hazardous chemicals and chemistry[153] for general population of all age (SAICM synergy)	1000,000
Education and capacity building for policy makes and authorities on POPs and hazardous chemicals (SAICM synergy).	600,000
Education and capacity building for industry on POPs and other hazardous chemicals, GHS (SAICM synergy).	1000,000
Education and awareness on POPs and other hazardous chemicals in curricula (school and university)	800,000
*Please note: Education and capacity for experts is in individual priority action below	
Management of POPs stockpiles (PCBs/PCNs, pesticides; POP-PBDES, HBCD and PFOS)	
Assessment of options for destruction/management of POPs containing waste in Pakistan and developing frameworks for ESM	1000,000 Covered partly by current UNDP project
Develop further technical capacity for management of POPs	Covered partly by current

[153] The use of functional chemicals is necessity in daily life. In addition to education on the risks of POPs and other hazardous chemicals, also the basics of chemistry of chemicals used in everyday life could be included in the education including benefits and drawbacks for informed decisions on use.

Priority Activities (details are in individual action plans in 3.3)	Tentative Budget estimate (US $)
pesticide wastes (and HHPs and empty containers)	UNDP project 600,000
Management of the remaining pesticide stockpile	Partly covered by current UNDP project
Inventory development of PCBs	Covered by current UNDP project
Knowledge and technical capacity for the management of PCBs	Covered by current UNDP project
Management and destruction of PCB in transformers and other wastes	Estimate after robust inventory
Knowledge and technical capacity for management of POP-BFRs containing waste (plastic in WEEE, ELVs, others)	2,000,000
Management of POP-PBDE containing waste (Basel Convention synergy)	Within the management of WEEE and ELVs (see below)
Management of HBCD containing stock (Basel Convention synergy)	Estimate after refined inventory and stop of further use
Education and capacity for management of PFOS and other PFAS (SAICM; Basel Convention synergy) containing waste (Firefighting foams, carpets, treated textiles, furniture, paper etc.)	400,000
Management of PFOS containing waste	Estimate after decision if PFOS foams need destruction
Reduction of unintentionally formed POPs and management of POPs in consumer products by improvement of waste management and introduction of the waste hierarchy	
Improvement of waste management of waste categories containing POPs which can be recycled for a large clean share (e.g. WEEE plastic; ELV polymers, waste oil, waste wood, synthetic carpets)	Cost depend on recovery of cost by recycling, reuse & reduction
Overall improvement of waste management for reduction of open burning of dumps/landfills and on private level	Cost depend on recovery of cost by recycling, reuse & reduction
Awareness, education and capacity building of stakeholders (authorities, industries, academia, NGOs and the public) on	1500,000

Priority Activities (details are in individual action plans in 3.3)	Tentative Budget estimate (US $)
reduction, reuse and recycling (3R), waste separation, and circular economy	
Development of a university curricula on waste and resource management	1000,000
BAT/BEP for Dioxin/UPOPs reduction and integrated pollutant prevention and control	
Development of knowledge and technical capacity for the control and reduction of PCDD/F and other UPOPs	500,000
Implementation of BAT/BEP for UPOPs reduction from medical waste incinerators	Cost estimate need a detailed assessment
Implementation of BAT and/or BEP for UPOPs reduction and integrated in other sectors (metal industry, cement production)	Cost estimate need a detailed assessment of facilities
Monitoring of POPs, effectiveness evaluation and initiate research and collaborations	
Update inventories including measurements, databases for POPs, hazardous chemicals, pollutant releases/PRTR (SAICM synergy)	1000,000
Development, improvement and coordination of technical analytical capacity	2,000,000 (and more)
Knowledge development for analysis/monitoring of POPs and other priority pollutants (SAICM synergy)	1000,000
Network development and cooperation with international partners for monitoring and assessment of POPs and POPs-like chemicals	500,000
Monitoring projects in priority area.	1000,000
Substitution of POPs and selection of green and sustainable alternatives	
Capacity building and curricula for the assessment of alternatives chemicals and non-chemical alternatives and green/sustainable chemistry	400,000
Substitution of POPs in use (SCCP, PFOA, PFOS, DecaBDE, HBCD) and other POPs-like chemicals by green and more sustainable chemicals and non-chemical alternatives	Estimate after assessment of recent listed POPs in use
Contaminated site assessment and management	

Priority Activities (details are in individual action plans in 3.3)	**Tentative Budget estimate (US $)**
Capacity building for the assessment, inventory, securing and remediation of POPs contaminated sites	400,000 (partly covered by current POP project)
Database for (potentially) contaminated sites	200,000
Assessment of pesticides contaminated sites	800,000
Securing and possibly remediation of pesticides contaminated sites	Estimate after assessment
Assessment of PCB contaminated sites	800,000
Securing and possibly remediation of PCB contaminated sites	Estimate after assessment
Assessment of potential PFOS/PFOA contaminated sites	1500,000
Securing and possibly remediation of PFOS/PFAS contaminated sites and cleaning of drinking water if pollution discovered	Estimate after assessment
Assessment of POP-BFR contaminated sites	200,000
Securing and possibly remediation of POP-BFR contaminated sites	Estimate after assessment
Assessment of potential Dioxin/UPOPs contaminated sites	800,000
Securing and possibly remediation of Dioxin/UPOP contaminated sites	Estimate after assessment

Annex

Annex 1. Further inventory data from the PCB assessment

Table A-1. Updated status of power transformers (Rahimyar Khan Region) operated/handled by MEPCO

Location	Capacity (KV)	Made by (Country)	Year of Manufacturing	Current status
Feroza	132	Elta	1972	In Service
Feroza	132	Siemens	1991	In Service
R.Y.Khan 11	132	Meiden	1984	In Service
Mianwali Qureshian	132	Meiden	1988	In Service
Khan Bela	132	Meiden	1988	In Service
J.D Wali	132	Meiden	1987	In Service
A.P. East	66	Electroputere	1993	In Service
Uch Sharif	132	Elprom	1978	In Service
Khan Pur	132	Elprom	1997	Dismantled
R.Y.Khan 11	132	Elprom	1997	Dismantled
J.D Wali	132	Elta Poland	1978	Dismantled
Uch Sharif	132	Person pebbles	1972	Dismantled
Head Rajkan	66	Siemens	1961	Dismantled
Head Rajkan	66	Elprom	1979	Dismantled

Table A-2. Updated status of power transformers (Muzaffargarh) operated/handled by MEPCO

Location	Capacity (KV)	Made by (Country)	Year of Manufacturing	Current status
Choubara	132	Energo	1973	In Service
Damar Wala	132	Energo	1970	In Service
Gujrat South	132	Electroputere	1996	In Service
Jattoi	132	Energo	1970	In Service

Kot Addu	132	Electroputere	1994	In Service
Nawan Kot	66	Marali	1987	In Service
Karor Lal Easan	66	Electroputere	1995	In Service

Table A-3. Updated status of circuit breakers operated/handled by MEPCO

Location	**Quantity**	**Year of Manufacturing**	**Current Status**
Bahawal Pur	6	1963,1973,1974, 1977	Dismantled
Bosan Road Multan	4	1978	Dismantled
Industrial estate Multan	3	1970 and 1973	Dismantled
Khanewal Road Multan	2	1970 and 1973	Dismantled
Lodhran	1	1970	Dismantled
Qasim Pur Multan	2	1972 and 1973	Dismantled
Yazman	2	1969 and 1982	In Service
Dera Ghazi Khan	7	1964-1985	Mixed
Rahim Yar khan	27	1064-1989	Mostly dismantled
Muzaffargarh	8	1961-1991	Mostly in service

Table A-4. Updated status of circuit breakers operated/handled by MEPCO

	Capacity wise distribution (KVA)				
Months	**25**	**50**	**100**	**200**	**others**
July 2017	24	143	103	133	03
August 2017	05	010	258	107	11
September 2017	03	005	185	061	16
October 2017	19	040	037	096	01
November 2017	33	009	130	071	00
December 2017	195	093	011	109	01

January 2018	56	255	025	070	00
February 2018	03	015	063	082	13
March 2018	00	039	167	134	41
April 2018	01	053	255	120	05
May 2018	00	113	113	088	24
June 2018	41	001	046	115	01
Total	380	776	1363	1186	116
Grand Total					3821

Table A-5. Transformers in Shalimar workshop Lahore

TRW Shalimar	10 KVA	15 KVA	25 KVA	50 KVA	100 KVA	200 KVA	Others#	Total
LESCO	16	8	112	397	861	120	42	1556
IESCO	32	42	87	250	242	215	2	870
MEPCO	0	0	0	0	0	0	9	9
FESCO	0	0	0	0	0	0	0	0
GEPCO	0	0	38	21	8	0	3	70
HESCO	0	0	0	0	0	0	0	0
ROHRI	0	0	0	0	0	0	0	0
SARGODHA	0	0	0	0	0	0	0	0
OTHERS	0	0	0	1	7	3	7	28
TOTAL	48	50	237	669	1118	348	63	2533

Table A-6. Capacity wise transformer distribution data both in terms of distribution and power sectors (updated 2018) FESCO

Capacity (KVA)	Quantity (number)

10	7183
15	07369
25	41520
30	00072
45	00018
50	23234
75	00253
100	12458
150	00029
200	07815
225	00001
250	00004
300	00006
315	00003
400	00704
430	00001
500	00026
530	00002
630	00537
750	00055
1000	0094
1200	00003
1250	00028
1500	00073
2000	00039
2500	00012
3000	00003
3500	00003
4000	00004
Total	101551