IN THE LAHORE HIGH COURT, LAHORE

Writ Petition No. 34789/2016

Walid Iqbal

versus

Federation of Pakistan

Report of the Smog Commission

28 May 2018

The thirteen (13) members Smog Commission comprises Dr. Parvez Hassan (Chair); Secretaries, Government of Punjab: (1) Environment, (2) Health, (3) Specialized Health Care and Medical Education, and (4) Primary and Secondary, Health Care Departments; Mr. Anwaar Hussain, Additional Advocate General, Punjab; Mr. Anwaar-ul-Haq Pannun, President, Lahore High Court Bar Association; Mr. Ali Habib, Managing Partner, Hima-verte; Ms. Sarah Belal, Advocate; Mr. Sheraz Zaka, Advocate; Dr. Abu Bakr, Syed Babar Ali School of Engineering, LUMS; Ms. Tehmina Saeed Chaudhry, Lahore Chamber of Commerce and Industry; and Mr. Bilal Mustafa Syed, Managing Director, Lahore Waste Management Company Limited.

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Glossary

AERONET	Aerosol Robotic Network
AOD	Aerosol Optical Depth
AQI	Air Quality Index
AQMS	Ambient Air Quality Monitoring Stations
ASEAN	Association of Southeast Asian Nations
BAT	Best Available Technology
BKOAP	Brick Kiln Owners' Association Pakistan
BOD_5	Five-day Biochemical Oxygen Demand
CEM	Continuous Emission Monitoring
CETP	Combined Effluent Treatment Plant
CMB	Chemical Mass Balance
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DOCs	Diesel Oxidation Catalysts
DPFs	Diesel Particulate Filters
EMC	Environmental Monitoring Center
EP&CCD	Environment Protection and Climate Change Department, Government of the Punjab
EPA	Environmental Protection Agency, Government of the Punjab
EPD	Environment Protection Department, Government of the Punjab
EPO	Environmental Protection Order
Euro II	European Emission Standard Stage II for Vehicular Emissions
FCBTK	Fixed Chimney Bull's Trench Kiln
GDP	Gross Domestic Product
HUD&PHED	Housing, Urban Development & Public Health Engineering Department
ICIMOD	International Centre for Integrated Mountain Development
ICP-OES	Inductively Coupled Plasma – Optical Emission Spectrometry
ICT	Information & Communication Technology
IE	Industrial Estate
IETT	Institute of Environment Technology and Training
JICA	Japan International Cooperation Agency
LCCI	Lahore Chambers of Commerce & Industry
LED	Light Emitting Diode
LGCD	Local Government & Community Development
LUMS	Lahore University of Management Sciences
LWMC	Lahore Waste Management Company Limited
MBI	Market Based Instrument
MEAs	Multilateral Environmental Agreements
NAAQS	National Ambient Air Quality Standard (of USEPA)
NASA	National Aeronautics and Space Administration, USA
NGO	Non-Governmental Organization
NOx	Oxides of Nitrogen
P&D Board	Planning & Development Board, Government of the Punjab
Pak II	Pakistan Emission Standard Stage II for Vehicular Emissions
PCA	Principal Component Analysis
PEQS	Punjab Environmental Quality Standards
PGDP	Punjab Green Development Program
PLD	Pakistan Law Decisions

PM	Particulate Matter
PM_{10}	Particulate Matter finer than 10 microns
$PM_{2.5}$	Particulate Matter finer than 2.5 microns
PMF	Positive Matrix Factorization
SO_2	Sulphur Dioxide
SOP	Standard Operating Procedure
SOx	Oxides of Sulphur
SP&IU	Strategic Planning & Implementation Unit
SRI	Sustainable Rice Initiative
SUPARCO	Pakistan Space and Upper Atmosphere Research Commission
TOR	Terms of Reference
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
VSBK	Vertical Shaft Brick Kiln
WHO	World Health Organization
WWF	World Wide Fund for Nature Pakistan

Report of the Smog Commission*

A. Appointment of the Commission

The Punjab experiences periods of low visibility due to fog, mist, and smog between November and February each year for an average of 10 to 25 days. In recent years, however, the situation is deteriorating to a sensation of burning of eyes and foul smell. Data shows that this is a regional phenomenon, covering large areas of South Asia from Delhi to Faisalabad and beyond. In 2016, several writ petitions (the "Petitions") were filed before the Lahore High Court (the "Court") against the high levels of smog, air pollution, and poor air quality, especially in Lahore and its vicinity.

By his order dated 19 December 2017 (the "Order") (Annexure A), in Walid Iqbal vs. Federation of Pakistan, Writ Petition No. 34789/2016, Mr. Syed Mansoor Ali Shah, the then Chief Justice of the Lahore High Court, constituted the Smog Commission (the "Commission") under Order 26 of the Code of Civil Procedure, 1908, to combat smog and to formulate a Smog Policy for Punjab, which identifies the root causes and prescribes a plan to protect and safeguard the life and health of the people of Punjab. Dr. Parvez Hassan was appointed the Chair of the Commission.[1]

The Court noted in the Order that the Secretary Environment, Government of Punjab, conducted deliberations with the international and local organizations, including United States Environmental Protection Agency, World Bank, International Institute for Applied Scientific Authority, Italy/France, Beijing Environmental Protection Bureau, NASA, World Health Organization and SUPARCO, from which following information has come to the surface:

> (1) … the smog/air pollution has been persistent in Pakistan, in particular, in Punjab since 2011 or even before according to the data supplied by NASA ….
>
> (2) … according to NASA, smog/air pollution levels remain high throughout the year; lowering mercury, high humidity, and lowering of inversion layer, only aggravate and make it visible in winters.
>
> (3) The Provincial Government has come up with five (5) years plan, which is still at the draft stage, however, in pursuance to the last order of this Court revised "Punjab Clean Air Action Plan" and "Standing Instructions for Management of Episodes of Poor Air Quality in the Punjab 2018" have been placed on the record.
>
> (4) … quality of air pollution in Pakistan, particularly in Punjab, is the same as is in 91% of the big cities in the world, however, EPA has started working to identify the main sources of such pollution in order to address the issues of Smog.

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* The thirteen (13) members Smog Commission comprises Dr. Parvez Hassan (Chair); Secretaries, Government of Punjab: (1) Environment, (2) Health, (3) Specialized Health Care and Medical Education, and (4) Primary and Secondary, Health Care Departments; Mr. Anwaar Hussain, Additional Advocate General, Punjab; Mr. Anwaar-ul-Haq Pannun, President, Lahore High Court Bar Association; Mr. Ali Habib, Managing Partner, Hima-verte; Ms. Sarah Belal, Advocate; Mr. Sheraz Zaka, Advocate; Dr. Abu Bakr, Syed Babar Ali School of Engineering, LUMS; Ms. Tehmina Saeed Chaudhry, Lahore Chamber of Commerce and Industry; and Mr. Bilal Mustafa Syed, Managing Director, Lahore Waste Management Company Limited.

[1] The superior courts of Pakistan are increasingly using Commissions to resolve complex environmental issues; see, generally, Dr. Parvez Hassan, Resolving Environmental Disputes in Pakistan: The Role of Judicial Commissions (Pakistan Law House, 2018)

The Commission was empowered in the Order to seek assistance of any Provincial Government Department by approaching the concerned Department and the concerned Departments were directed to render full assistance to the Commission.

It is noted that the Lahore High Court had appointed a Lahore Clean Air Commission in 2003 with Dr. Parvez Hassan as its Chairman. This Commission had made several recommendations including with respect to 4-stroke rickshaw engines, public transport, and fuel and emission standards as per Euro II, Euro III, and Euro IV. These recommendations were accepted by the Lahore High Court as per its judgment in Mansoor Ali Shah vs. Government of Punjab, PLD 2007 Lah. 403. Many of these recommendations remain relevant in this Report of the Smog Commission.

B. Terms of Reference

The Terms of Reference (the "TOR") of the Commission as per the Order are:

> To formulate a holistic Smog Policy for Punjab, which identifies the root cause(s) and prescribes a plan to protect and safeguard the life and health of the people of Punjab. The plan must specifically set standards which trigger preventive intervention by the Government as described in the earlier order of this case. The concept of Heath Emergency is required to be recognized through the said Policy.

C. Membership of the Commission

1. Appointed by the Court

The original membership of the Commission as per the Order was:

(1) Dr. Parvez Hassan
(2) Secretary, Environment, Government of Punjab
(3) Secretary, Health Department, Government of Punjab
(4) Mr. Anwaar Hussain, Additional Advocate General, Punjab
(5) Nominee of the Lahore High Court Bar Association
(6) Mr. Ali Habib, Managing Partner, HIMA^Verte
(7) Ms. Sarah Belal, Advocate
(8) Mr. Sheraz Zaka, Advocate

Mr. Anwaar-ul-Haq Pannun represented the Lahore High Court Bar Association as its President.

2. Co-opted Members

The Commission was empowered to co-opt any person or expert, at any stage with information to the Court. In the first meeting of the Commission on 5 January 2018, the Chairman requested all members of the Commission to identify other experts and members at the next meeting whose association might be useful for the Commission. After the co-options, the members of the Commission are:

(1) Dr. Parvez Hassan
(2) Secretary, Environment, Government of Punjab
(3) Secretary, Health Department, Government of Punjab

(4) Secretary, Specialized Health Care and Medical Education, Government of the Punjab, Lahore
(5) Secretary, Primary and Secondary, Health Care Department, Government of the Punjab, Lahore
(6) Mr. Anwaar Hussain, Additional Advocate General, Punjab
(7) Mr. Anwaar-ul-Haq Pannun, President, Lahore High Court Bar Association
(8) Mr. Ali Habib, Managing Partner, HIMA^Verte
(9) Ms. Sarah Belal, Advocate
(10) Mr. Sheraz Zaka, Advocate
(11) Dr. Abu Bakr, Syed Babar Ali School of Engineering, LUMS
(12) Ms. Tehmina Saeed Chaudhry, LCCI
(13) Mr. Bilal Mustafa Syed, LWMC

The Chair received several requests for inclusion in the membership of the Commission. Most of these were received after the process of co-option had been completed in the Commission. The Chair replied all these requests accordingly. Copies of these communications are Annexures B1 – B6.

D. Meetings of the Commission

As per the direction of the Court in the Order, the first meeting of the Commission was held on 5 January 2018 at 11:00 AM at the offices of Hassan & Hassan (Advocates), 7D Kashmir Egerton Road, Lahore. It was decided in the first meeting of the Commission that the Secretary EPD, will be the Secretary of the Commission, and Mr. Tauqueer Ahmed, Director EPA, will assist him for the purposes of the Commission. The minutes of the first meeting are attached as Annexure C-1.

The second meeting of the Commission was held at the office of EPD, Government of the Punjab, at 11:00 AM on 13 January 2018. The minutes of the second meeting are attached as Annexure C-2.

The third meeting of the Commission was held at the office of EPD, Government of the Punjab, at 11:00 AM on 30 April 2018. The minutes of the third meeting are attached as Annexure C-3.

The fourth meeting of the Commission was held at 2:00 p.m. on 18 May 2018 at the office of EPD, Government of Punjab, Lahore to draft and finalize the report. The minutes of the fourth meeting are attached as Annexure C-4.

The fifth meeting of the Commission was held at 2.00 p.m. on 26 May 2018 at the offices of EPD. The minutes of the fifth meeting are attached as Annexure C-5.

When some members could not attend meetings, they deputized representation. These representatives made useful contributions but the attendance of such meetings only, generally, records the members.

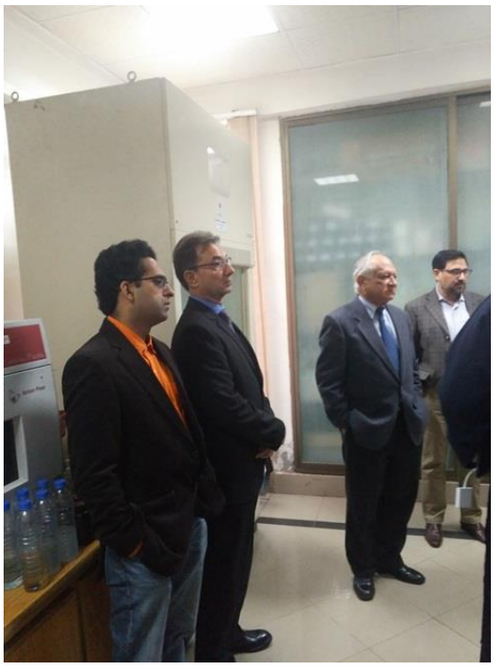
The Commission Meeting to Discuss and Finalize its Report

E. Site Visit

The Commission visited the EPA Headquarters Laboratory on 13 January 2018, and witnessed first hand, the equipment, laboratories and functioning of the EPA Headquarters Laboratory. The Commission was informed that the laboratory is fully functional to measure almost all the criterial pollutants in wastewaters, stack emissions and ambient air, albiet with a limited capacity. The functioning of various instruments – ICP-OES, Ambient Air Quality Monitoring Station, BOD_5 Setup – were demonstrated to the Commission. Plans for future expansion of the analytical capacities were also presented to the Commission.


The Commission Inspecting the Working of ICP-OES, EPA Laboratory


The Commission Examining the Wastewater Section of EPA Laboratory




Ambient Air Quality Measurements Demonstration to the Commission

F. Appointment of the Committees

In the second meeting of the Commission, the following five (5) Committees, with the indicated Chairs, were constituted by the Chairman:

1. Root Causes Committee, to identify the sources and contributions of these sources to pollutant concentrations in ambient air (Dr. Abu Bakr, Chair);

2. Smog Policy Committee, to recommend elements of Smog Policy of Government of the Punjab (Mr. Saif Anjum, EPD, Chair);

3. Capacity Building Committee, to identify what capacity is needed to deliver the recommendations of the Committees (Mr. Saif Anjum, EPD, Chair).

4. Public Health Emergency Committee, to suggest and draft health emergency response of Government of the Punjab (at different levels: province, division, district) in an event of high pollutant levels in ambient air (Mr. Anwaar Hussain, Chair);

5. Voluntary Action Committee, to identify Short-Term, Medium-Term and Long-Term voluntary actions by general public aimed at mitigation of air pollution and improving air quality in the province (Mr. Ali Habib, Chair);

The Chairs of the Committees were empowered to co-opt members from within and outside the Commission for their Committees.

G. Reports of Committees

1. Root Causes, 2. Smog Policy and 3. Capacity Building Committees

The Root Causes, Smog Policy, and Capacity Building Committees comprised the following members:

(1) Saif Anjum, Secretary Government of the Punjab
(2) Dr Maudood N Khan, Ambient Air Quality Expert
(3) Dr Javed Iqbal, Project Director (SP&IU)

(4) Dr Abu Bakr, Associate Professor, LUMS
(5) Dr Arifa Lodhi, General Manager, SUPARCO
(6) Dr Makshoof, Director, Institute of Chemistry, Punjab University, Lahore
(7) M Shoaib Shafiq, SUPARCO
(8) Ali Abbas, Deputy Director (Laboratories), EPA Punjab
(9) Muhammad Arfan, Analyst, EPA Punjab Headquarters Laboratory
(10) Tauqueer Ahmed, Director, EPA Punjab

1. Root Causes Committee

The Terms of Reference of the Root Cause Committee were to identify the sources and the contributions of these sources to pollutant concentrations in ambient air. The Committee gathered data on all available sources, including EPA Punjab, Pakistan Space and Upper Atmosphere Research Commission (SUPARCO), NASA Satellite Imagery, and the Urban Unit on ambient air quality and also resorted to literature review.

Robust data on ambient air quality in the province is scant. The root causes of deteriorating air quality, especially of smog episodes, in the province have, therefore, been derived from literature review and also from the ambient air quality data, notwithstanding its paucity and inadequacy.

(1) Data on Air Pollutants

Historic data on concentrations of pollutants in ambient air is sporadic and is available for only two sites - Township and Town Hall - in Lahore. The two stations were installed by Federal EPA under a JICA assisted program in 2007. The data gathered through these monitoring stations is intermittent. The available data covers too narrow a scope for any conclusion to be based on it for the province as a whole, and it is also somewhat out of date. Air pollution control in a developing economy like that of Pakistan requires defining a set of priorities which cannot be arrived at on the basis of scant data available. Also, reduction in concentrations of these pollutants is an enormous task, which requires not only huge financial resources but also efforts consistently spanned over a time frame of years, if not decades.

(2) Historically High Concentrations of Air Pollutants

Punjab experiences periods of low visibility during the months of October through February, which are commonly referred to as *winter smog*. The intensity, duration and the spatial extent of these events has increased over the last several years. Health effects of these episodes of smog, such as burning and irritation of eyes have been reported. Non-availability of a reliable air quality observations is a serious challenge to our understanding of the phenomena of winter smog.

Satellite imagery shows that high pollution concentration during this time period are prevalent over large parts of north and north-western India; central and north-eastern parts of Punjab, Pakistan. Aerosol Optical Depth (AOD) derived from satellite measurements and ground-stations is a measure of light attenuation as it travels through the atmosphere. An optical thickness of less than 0.1 (pale yellow) indicates a crystal-clear sky with maximum visibility, whereas a value of 1.0 (reddish brown) indicates hazy conditions. Therefore, high AOD is indicative of high pollutant concentrations in the atmosphere. Analysis of five years of data (i.e., 2006-2011) recorded by Moderate Resolution Imaging Radiometer (MODIS) sensors on-board Terra and Aqua satellites indicate that AOD is highest in the months of June, July, October and November (Figure G.1). Ground based stations that are part of the National Aeronautics and Space Administration (NASA) funded Aerosol Robotic Network (AERONET) operated by SUPARCO show similar trends (Figure G.2).

The AOD data reveals that particulate matter in ambient air of Lahore remains high not only throughout the year but also it is high for the last many years.

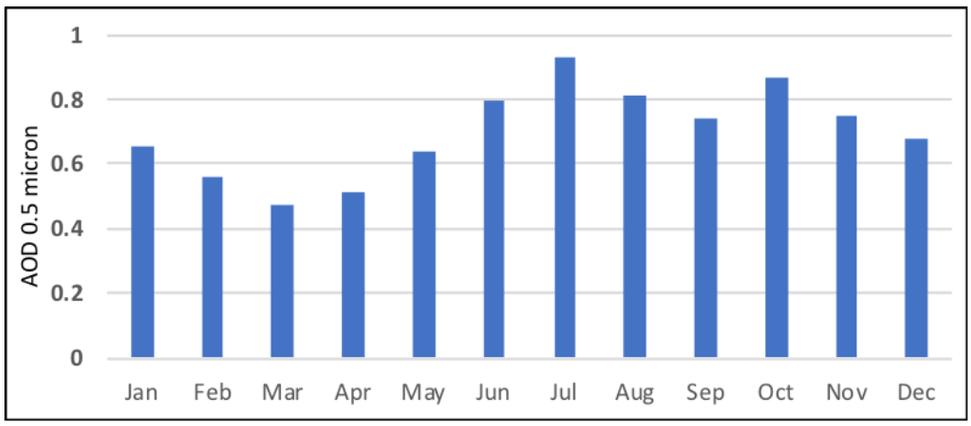


Figure: G.1 —Average AOD AERONET 2011-2016 Lahore

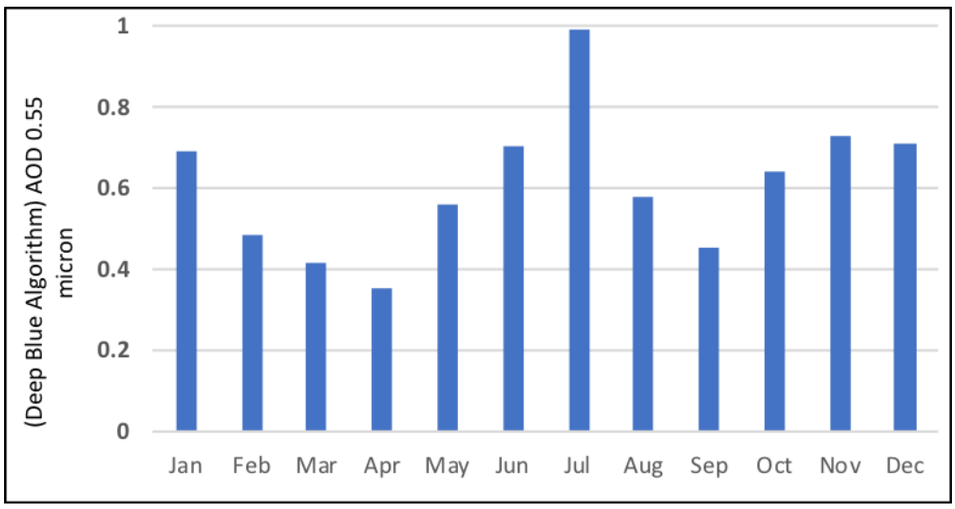


Figure G.2 —2011-2016 AOD Satellite (Aqua Terra) Lahore

The data gathered by EPA Punjab from 2007 to 2015 for the month of November at Township and Town Hall stations shows that monthly average concentrations of $PM_{2.5}$ are 280 µg/m^3 and 175 µg/m^3, respectively.

The Punjab Environmental Protection Agency (EPA) is in charge of monitoring air pollution in the province. From 2006 to 2009, Japanese International Cooperation Agency (JICA) provided financial and technical assistance to Government of Pakistan in designing and installing air quality monitoring in all the five capital cities of Pakistan (Islamabad, Karachi, Lahore, Peshawar, and Quetta). EPA Punjab received two fixed and one mobile monitoring station under the JICA assisted program. Of the two fixed stations, one was installed at Township and the other in Town Hall, Lahore.

These stations collected information on concentrations of particulate matter (PM), carbon monoxide, sulfur and nitrogen oxides, ozone, and other parameters only in Lahore. Despite its flaws, this in the only data available to form a picture of air quality in the province.

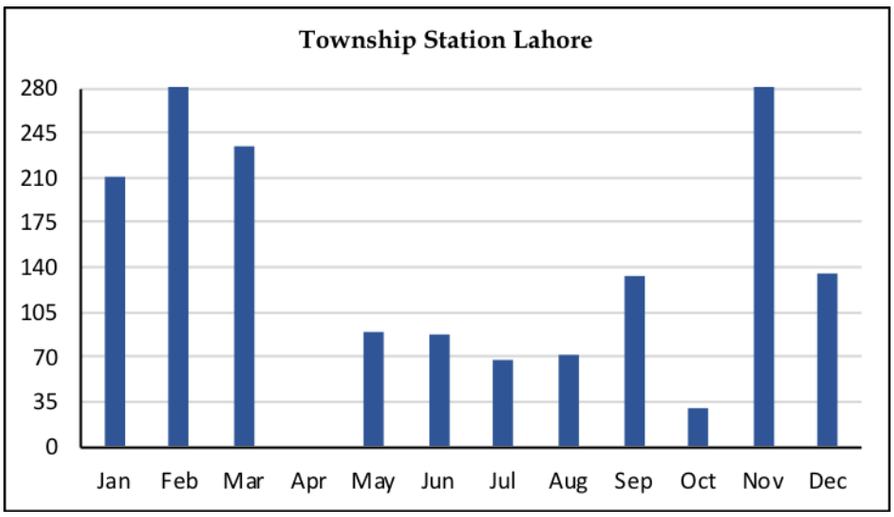


Figure G.3 — Monthly Average Mass Concentration (ug/m^3) [2007-2015]

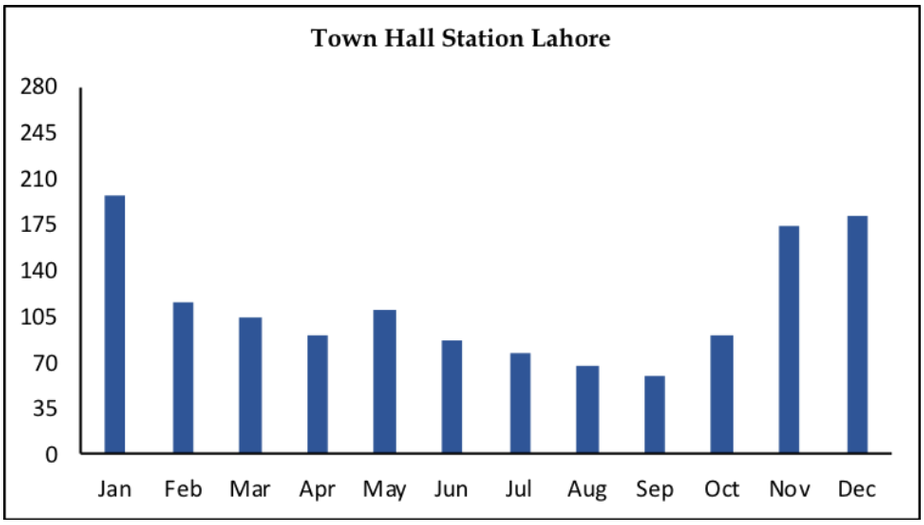


Figure G.4 — Monthly Average Mass Concentration (ug/m^3) [2007-2015]

The available data, despite its paucity, reveals that urban air pollution in Pakistan is among the most severe in the world, and it is potentially capable of significantly damaging human health and the economy. Pakistan is the most urbanized country in South Asia, and it is undergoing rapid motorization and increasing energy use. Air pollution, particularly in large urban centers, damages the populations' health and quality of life, and contributes to environmental degradation. From 2007 to 2011, the reported levels of particulate matter (PM), and sulfur dioxide (SO_2) were many times higher than the World Health Organization (WHO) air quality guidelines.[2] Studies link the deterioration of air quality to higher levels of air pollutants from, inter alia, vehicular emissions, industrial activities, and fugitive dust.

(3) Vehicular Emissions

Transport sector's contribution to air pollution is primarily though motor vehicle exhaust, exacerbated by adulterated fuel, lack of emission control devices such as catalytic convertors, low efficiency engines, and poorly maintained vehicle fleet. Transport sector contributes to emissions of carbon monoxide, nitrogen oxides (NOx), sulfur dioxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), and Volatile Organic Compounds (VOC) such as Benzene and Toluene which are know carcinogens. These compounds are not only harmful to human health, but are precursors to the formation of ozone (O_3) and enhanced production of particulate matter. Absence of mass transit, rapid migration from rural to urban areas of Punjab has resulted in

[2] Aziz, J. A. 2006. "Towards Establishing Air Quality Guidelines for Pakistan." East Mediterranean Health Journal 12 (6): 886–93.

substantial increase in the number of vehicles in Punjab. The number of vehicles in Pakistan has jumped from approximately 2 million to 10.6 million over the last 20 years, an average annual growth rate in excess of 8.5%. From 1991 to 2012, the number of motorcycles and scooters grew more than 450%, and motorcars, close to 650%. The growth rate of mobile sources increased after 2003. Encroachment, unplanned, and illegal land development for residential and commercial use increases congestion. The increase in frequency of vehicle starts and stops has a substantial impact on tail pipe emissions. The conversion or illegal use of residential buildings for commercial purposes has substantial impact on congestion, emissions, air quality and public exposure to harmful pollutants.

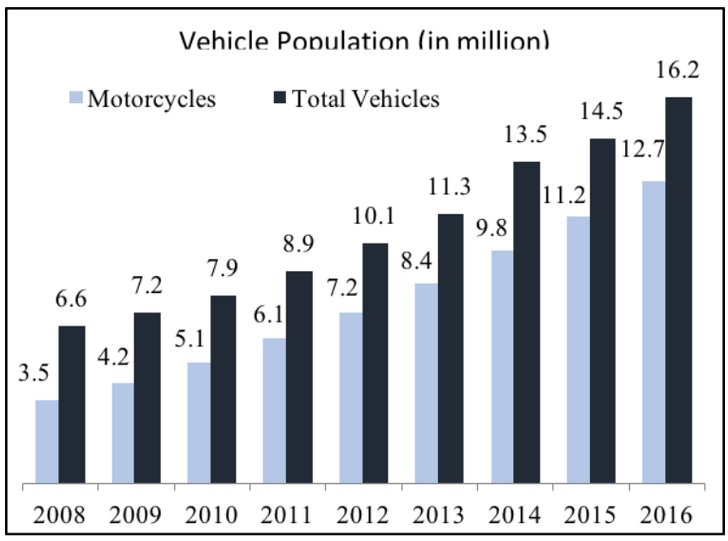


Figure G.5 — Vehicle Population in Punjab

(4) Industrial Emissions

Industrial facilities, particularly those consuming fossil fuels, emit significant amounts of air pollutants. Emissions from large-scale facilities, such as cement, fertilizer, sugar, steel, and thermal power plants — many of which use furnace oil high in sulfur content — are a major contributor to poor air quality.[3] A wide range of small-scale to medium-scale industries, including brick kilns, steel furnaces, and steel rerolling, also contribute substantially to urban air pollution through their use of "waste" fuels, including old tires, paper, wood, and textile waste.

Air quality is further exacerbated by the widespread use of small diesel electric generators in commercial and residential areas in the wake of electricity outages. Poor maintenance of boilers is another contributor to air pollution in the province.

(5) Waste Burning

Different non-point (diffuse) sources also contribute to air pollution in the province. These include burning of solid wastes, rice stubble and sugarcane fields. The solid waste generated daily in the province is either dumped in low-lying areas or burned. The burning of solid waste at low temperatures produces carbon monoxide (CO), particulate matter (PM), and volatile organic compounds (VOCs), including toxic and carcinogenic pollutants (dioxins and furans).

Farmers burn fields to ease harvesting. During field burning, high concentrations of particulate matter of less than 10 microns (PM_{10}) are found in rural areas in the province.

[3] Ghauri B., A. Lodhi, and M. Mansha. 2007. "Development of Baseline (Air Quality) Data in Pakistan." Environmental Monitoring and Assessment 127: 237–52.

(6) Transboundary Waste Burning

Various studies have linked smog to the burning of rice stubbles in the Indian states of Punjab, Haryana and Uttar Pradesh. During 2016 alone around 32 M tons of rice stubble were estimated to be burnt in Indian Punjab.

Coal- and oil-fired power plants are a very large source of gas and particle emissions. Because of higher stack heights and gas exit velocity, emission plumes from such sources travel longer distances. Continuous Emission Monitoring (CEM) equipment is generally installed at these facilities, allowing better characterization of the impact such plants have on air pollution levels. A number of plants are located in north western India, which may be contributing to elevated pollution levels in Lahore during winter as well as summer months.

(7) Dust Clouds

Predominantly dry weather in arid conditions and strong winds also generate substantial dust in most parts of the southern Punjab, elevating PM_{10} levels in the air. Due to high summer temperatures (40–50°C), fine dust is transported into the atmosphere with the rising hot air and forms "dust clouds" and haze over many cities of southern Punjab. Dust storms are also generated from deserts (Thal and Cholistan), particularly during the summer and adversely affect air quality in the cities of the province.

Dry conditions accompanied by strong winds kick-off dust (fine and coarse mass) in southern Punjab, which may get transported to central and northeastern Punjab on specific days. Assessing the magnitude, extent and frequency of such events is currently unknown.

(8) Source Apportionment of Particulate Matter

Source apportionment analyses in the province (mainly for Lahore) from 2006 to 2012 have found high concentrations of primary and secondary pollutants, particularly, $PM_{2.5}$. Elevated levels of $PM_{2.5}$ at Lahore ranged from 2 to 14 times higher than the prescribed United States Environmental Protection Agency (USEPA) limits.[4]

In Lahore, the annual average concentration (±one standard deviation) of particulate matter of less than 2.5 microns ($PM_{2.5}$) was 194 ± 94 micrograms per cubic meter ($\mu g/m^3$).[5] Crustal sources like dust dominated coarse aerosol, whereas carbonaceous aerosol dominated fine particles. While motor vehicle contributions were relatively consistent over the course of the year-long study, biomass and coal sources demonstrated seasonal variability and peaked in the wintertime. Secondary organic aerosols' contributions also peaked in the wintertime, potentially enhanced by winter fogs.

Source apportionment performed on short duration analysis results of November 2005 to March 2006, using a Positive Matrix Factorization (PMF) model, indicated major contributors to $PM_{2.5}$ in Lahore are: soil/road dust, industrial emissions, vehicular emissions, and secondary aerosols.[6] Trans-boundary air pollutants also affect the province, particularly due to secondary aerosols during winter. The sulfate particles also facilitate haze/fog formation during calm and highly humid conditions, and thus reduce visibility and increase the incidence of respiratory diseases encountered in the city annually.

The source of $PM_{2.5}$ concentrations in Lahore from November 2005 to January 2006 included: diesel emissions (28%), biomass burning (15%), coal combustion (13%), secondary PM (30%),

[4] Lodhi, A., G. Badar, M. K. Rafiq, S. Rahman, and S. Shoaib. 2009. "Particulate Matter (PM2.5) Concentration and Source Apportionment in Lahore." Journal of the Brazilian Chemical Society 20 (10): 1811–20.
[5] Stone, E., J. Schauer, T. A. Qureshi, and A. Mahmood. 2010. "Chemical Characterization and Source Apportionment of Fine and Coarse Particulate Matter in Lahore, Pakistan." Atmospheric Environment 44: 1062–70.
[6] Ibid.

exhaust from two-stroke vehicles (8%), and industrial sources (6%).[7] Diesel and two-stroke vehicle emissions accounted for much (36%) of the measured high $PM_{2.5}$. Although a large component of the carbonaceous aerosols in Lahore originated from fossil fuel combustion, a significant fraction was derived from biomass burning.[8] Molecular marker based Chemical Mass Balance (CMB) receptor model showed that vehicular pollution, including exhaust from gasoline- and diesel-powered vehicles, was the predominant source of PM_{10} carbonaceous aerosols.[9]

A 2010 study on toxic metal concentrations in Lahore reveled dust sources to contribute on average 41% of PM_{10} mass and 14% of $PM_{2.5}$ mass on monthly-average basis. Seasonally, concentrations were found to be lowest during the monsoon season (July–September). Principal Component Analysis (PCA) identified seven sources: industrial sources, re-suspended soil, mobile sources, and regional secondary aerosol sources likely from coal and/or biomass burning.[10]

(9) Highly Polluted Indo-Gangetic Plains

The Indo-Gangetic Plains, composed of the Indus (areas in Pakistan, and parts of Punjab and Haryana in India) and the Gangetic Plains (Uttar Pradesh (UP), Bihar, and West Bengal in India, Nepal and Bangladesh (Figure G.6), have been identified as one of the most polluted region due to high aerosol concentration and related episode of haze, fog, and smog.

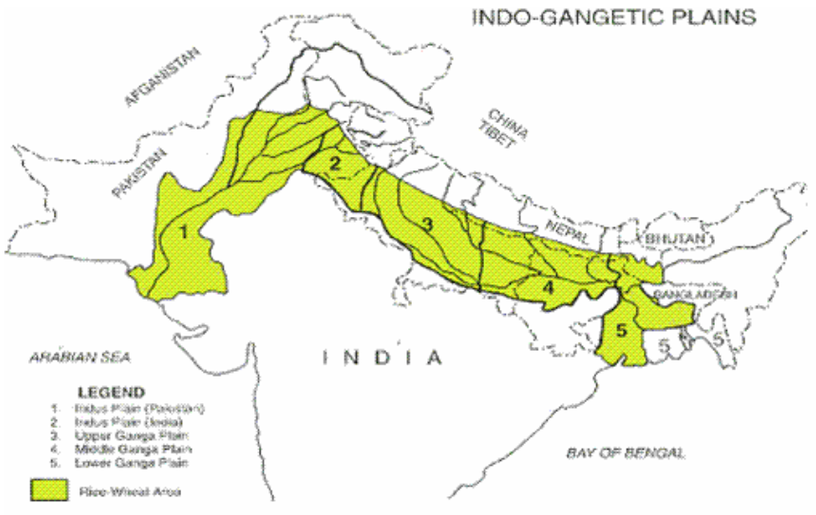


Figure G.6: Indo-Gangetic Plains in India and Pakistan

These plains have humid subtropical climates. Winters are typically mild, dry and relatively short and tend to be foggy. Summers tend to be long and very hot, with high temperatures sometimes exceeding 40 °C. They also tend to be extremely dry, accompanied by dust storms. This is followed by the monsoons where the region experiences heavy rains. This results in hot and humid conditions, similar to summers in humid subtropical climates. Indian cities such as New Delhi, Lucknow and Kanpur and Pakistani cities Islamabad, Rawalpindi, Lahore, Shekhupura, Gujranwala, exhibit this peculiar form of the climate. The Indo-Gangetic basin is characterized by high pollutant levels, visible smoke, dense smog/fog, and haze events especially

[7] Raja, S., F. K. Biswaw, P. K. Hopke, and L. Husain. 2010. "Source Apportionment of the Atmospheric Aerosol in Lahore, Pakistan." Water, Soil, and Air Pollution 208: 43–57.
[8] Husain, L., V. A. Dutkiewicz, A. J. Khan, and B. M. Ghauri. 2007. "Characterization of Carbonaceous Aerosols in Urban Air." Atmospheric Environment 41 (32): 6872–83.
[9] Zhang, Y. X., T. Quraishi, and J. J. Schauer. 2008. "Daily Variations in Sources of Carbonaceous Aerosol in Lahore, Pakistan during a High Pollution Spring Episode." Aerosol and Air Quality Research 8 (2): 130–46.
[10] von Schneidemesser, E., E. A. Stone, T. Quraishi, M. M. Shafer, and J. J. Schauer. 2010. "Toxic Metals in the Atmosphere in Lahore, Pakistan." Science of the Total Environment 408 (7): 1640–48.

from October to April each year. Dense smog/fog follow the path of Indo-Gangetic basin hampering the normal life and livelihood of millions of people.

(10) Challenges

Data on air quality in the province is scant. Sporadic monitoring of air pollutants suggests that ambient air standards for particulate matter with size finer than 2.5 microns ($PM_{2.5}$), oxides of Nitrogen (NOx) and Sulphur (SOx) are exceeded frequently. Industrial units both large and small, many of which use furnace oil high in Sulphur contents, burning of agricultural residual and municipal waste, and vehicular emissions are the main source of these pollutants.

A wide range of small to medium-scale industries, including brick kilns and steel re-rolling mills make a much larger contribution relative to the size of their economic activity due to the use of "waste" fuels such as old tires, paper, wood, and textile waste.

At the micro level, air quality is further impaired by the widespread use of small diesel electric generators in commercial and residential areas in the wake of electricity outages.

2. Smog Policy

The Terms of Reference of the Smog Policy Committee was to identify the to recommend elements of Smog Policy of Government of the Punjab. Based on the findings of the Root Causes and International Best Practices, the Committee recommended the following essential elements of Smog Policy of Government of the Punjab to combat and arrest the ever-intensifying episodes of smog in the province.

The Committee favorably reviewed the following policies and plans that have been formulated by EPD:

(1) Policy and Action Plan for Control, Mitigation, Advisory, and Protective Measures in Extreme Weather Conditions of Dense Smog in the Punjab: (Annexure D-1)

(2) Punjab Clean Air Action Plan: (Annexure D-2)

(3) Standing Instructions for Management of Episodes of Poor Air Quality (2018): (Annexure D-3)

(4) Project PC-I "Enhanced Environmental Quality Monitoring System for Punjab's Air, Surface, and Ground Water Resources": (Annexure D-4)

(5) Punjab Green Development Program – Project Appraisal Document: (Annexure D-5)

Each of these plans and policies is well-conceived and will give the appropriate direction to the efforts of EPD for clean air in the Punjab. The Committee decided to place these documents before the Commission for its consideration and support.

The Standing Instructions (Annexure-D-4) are of particular importance for public health perspective and these, importantly, identify threat levels and health impacts of air quality. Its Tables 2 and 3 recognize the internationally-evolving color codes for such threats and impacts.

The AQI uses five levels indicated through different colors: Green, Light Green, Yellow, Orange, Red and Maroon respectively representing good, satisfactory, moderate, poor, very poor and extremely poor quality of ambient air. Each of these levels is based on likely health impacts of the concentration levels of criteria pollutants and hence provide a proxy for break points for initiating a host of health advisories.

Table 2: Ad-Interim Air Quality Index and Indicator Color Code

PM_{10} [11]	$PM_{2.5}$ [12]	SO_2[13]	NO_2[14]	O_3[15]	CO[16]	AQI	Indicator Color
0-150	0-35	0-120	0-80	0-130	0-5	0-100	Green
151-200	36-70	121-240	80-160	131-260	5-10	101-200	Light Green
201-250	71-105	241-360	161-320	261-450	11-25	200-300	Yellow
251-350	106-140	361-700	321-560	451-550	26-40	301-400	Orange
351-430	141-300	701-1600	561-800	551-1900	41-50	401-500	Red
430 +	300 +	1600 +	800 +	1900 +	50 +	500+	Maroon

Table 3: Ad-Interim Air Quality Index and Relevant Health Impacts

AQI	Indicator Color	Overall Associated Health Impact
0-100	Green	**Good** – Minimal impact
101-200	Light Green	**Satisfactory** – May cause minor breathing discomfort to sensitive people.
200-300	Yellow	**Moderately Polluted** – May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults.
301-400	Orange	**Poor** – May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease.
401-500	Red	**Very Poor** – May cause respiratory illness to people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases.
500+	Maroon	**Extremely Poor** – May cause respiratory impact even on healthy people, and serious health impacts on people with lung/heart disease. The health impacts may be experienced even during light physical activity.

The Committee observed that being a regional and complex phenomenon, the problem of air pollution and resulting smog can only be dealt with through concerted and planned efforts of various departments of the provincial and federal government spread over a medium to long term framework. However, to achieve the desired results, government efforts need to be supplemented by whole hearted involvement of citizens at large. The immediate, short and long-term actions recommended are:

(1) Immediate Actions

(a) Open burning being the major source of smog, every year, in early October, Home Department should impose a complete ban on open burning of rice stubble, solid waste and other

[11] Twenty-four-hour average concentration in $\mu g/m^3$ (PEQS limit is 150 $\mu g/m^3$)
[12] Twenty-four-hour average concentration in $\mu g/m^3$ (PEQS limit is 35 $\mu g/m^3$)
[13]Twenty-four-hour average concentration in $\mu g/m^3$ (PEQS limit is 120 $\mu g/m^3$)
[14] Twenty-four-hour average concentration in $\mu g/m^3$ (PEQS limit is 80 $\mu g/m^3$)
[15] Hourly average concentration in $\mu g/m^3$ (PEQS limit is 130 $\mu g/m^3$)
[16] Eight-hour average concentration in mg/m^3 (PEQS limit is 5 $\mu g/m^3$)

hazardous materials. This ban shall be implemented through the respective Deputy Commissioners and District Police Officers. Similar instructions shall be passed to their field offices by Agriculture and Local Government Departments.

(b) EPD should closely monitor rice stubble burning activities in the Punjab as well as in the region using, inter alia, satellite data obtained through various sources including SUPARCO and timely inform all relevant agencies, including those given below, for adopting suitable mitigation measures. This information shall be supplemented with air quality parameters observed through the monitoring stations currently (and soon to be) available with the EPA.

(c) In the event of a forecast or actual smog event, immediate advisories shall be issued to in the following manner:

(i) EPD shall issue advisory to all concerned departments based on the AQI for $PM_{2.5}$ and other parameters;

(ii) Primary and Secondary Health Care Departments shall issue health advisory and ensure its maximum dissemination including through such means as paper, electronic, and social media.

(iii) Additional Inspector General of Traffic shall issue advisory on use of roads, especially highlighting the forecasted or prevailing visibility levels and their likely impact of safe use of roads.

(d) If the situation so demands, masks shall be distributed at schools and selected public places in the most effected districts by respective Deputy Commissioners. Similarly, steel furnaces and other industrial units which are working without emission control equipment or violating applicable PEQS or using substandard fuels shall be shut down by the EPA with the support of respective Deputy Commissioner and District Police Officer.

(e) Air pollution indices quantitatively determine potential hazard levels at a given time to trigger a set of specific actions to mitigate harmful effects of smog at that particular level. These include a wide variety of measures which will be advised by the EPA to the respective department for implementation.

(2) Short to Long-Term Action Plan

An action plan clearly delineating measures to mitigate and control occurrence of smog and responsibilities of each department in this respect should include:

(a) Introduction of Low-Sulphur fuels

Fuels used in Pakistan are high in Sulphur contents. Fuel Sulphur contributes significantly to particulate matter (PM) and Sulphur Dioxide (SO_2) emissions. Maximum allowable content of Sulphur for all fuels used in the country was originally scheduled to be reduced from 10,000 ppm to 500 ppm by 2008, but it was postponed until 2010, and then again until 2012. The primary reason for such postponements was that oil refineries needed more time to retrofit. The deadline to lower Sulphur contents in fuels was last extended to December 2017. Accordingly:

(i) Relevant Ministry in the Federal Government be approached to ensure implementation of clean fuel regime by this deadline; and

(ii) EPA not accord Environmental Approval for the establishment of or expansion in a fuel refinery unless it complies with clean fuel regime, especially vis-à-vis Sulphur contents.

(b) Adopting Euro-II Standards for vehicular emission

While stringent vehicular emission standards can only be implemented for diesel vehicles once Low-Sulphur diesel is available; these can be extended to petrol vehicles immediately. A preferable standard is Euro II. It is obvious that adoption of such a standard will be meaningless unless it is backed up by a strict vehicle inspection regime. Such standards may be mandated for both new and second-hand imported vehicles. Particulate matter control technologies can effectively be installed on in-use vehicles, such as diesel oxidation catalysts (DOCs) and diesel particulate filters (DPFs). DOCs require a maximum of 500-ppm Sulphur in diesel and DPFs require a maximum of 50 ppm to function effectively. Therefore, for adopting Euro II/Pak II standards:

(i) Relevant Ministry in the Federal Government should be approached for restricting the import of used gasoline vehicles which do not comply with Euro II standard.

(ii) In coordination with the Transport Department, EPA should devise a time bound plan to restrict awarding Environmental Approval to the manufacture of any three and four wheeled vehicles which do not comply with the Euro II standard.

(c) Installation of vehicular pollution control devices

This measure is closely related to the foregoing measure. Vehicular emissions contain oxides of Nitrogen (NOx), oxides of Sulphur (SOx) and Carbon Monoxide (CO) which can transform into secondary compounds. These secondary compounds then contribute to what is called the Los Angeles or photo-chemical smog. The aim is to adopt a phased approach towards installation of appropriate devices in the vehicles, such as the Catalytic Converter, to convert NOx, SOx and CO into simpler non-harmful forms before escaping the exhaust pipe. With this in view:

(i) Federal Government should be approached to make it mandatory upon all vehicle manufacturers and importers to install appropriate devices by a mutually agreed cut-off date.

(ii) Relevant Ministry in the Federal Government should also be approached for ensuring prohibition of additives, if any, which may interfere with the functioning of catalytic converters.

(d) Better traffic management

Experience indicates that Particulate Matter (PM) emissions can also be reduced by better traffic control, restricting the number of vehicles plying on the roads during high pollution episodes, avoiding road congestion, and improvement of road infrastructure. Further, a systematic public awareness campaign focusing the advantages of the use of alternatives to motor vehicles, such as bicycles, needs to be carried out consistently. This should be supported by parallel development of enabling infrastructure such as pedestrian walk ways. Therefore, for better traffic management:

(i) Additional Inspector General of Traffic and other traffic management authorities should work towards better traffic management;

(ii) Respective municipal administration should be asked to identify and remove permanent and temporary encroachments within their jurisdictions for ensuring smooth flow of traffic; and

(iii) EPA should not accord Environmental Approval to any housing society unless it ensures provision of lanes for non-motorized traffic.

(e) Controlling burning of municipal waste and crop residue

Diffused sources of air pollution in the province include burning of municipal waste and crop residue, and formation of dust clouds due to dry meteorological conditions. Due to their heterogeneity, non-point source pollution is more difficult to monitor and control.

Solid waste collection by government-owned and government-operated services in the cities currently averages only a portion of the waste generated; however, for cities to be relatively clean, at least 75% of these quantities should be collected. None of the cities in the province has a complete solid waste management system extending from collection of solid waste up to its proper disposal.

So far as crop residue, Agriculture Department needs to launch a systemic campaign for educating farmers on fertility losses suffered due to burning of crop residues and at the same time introduce alternative technologies for quick and environmentally safe disposal of crop residue such as converting it into mulch.

Therefore, for controlling burning of municipal waste and of crop residue:

(i) Agriculture Department should prepare and execute plan(s) for disposal of crop residue in an environmentally friendly manner;

(ii) All municipal authorities and waste management agencies should ensure at least 75% collection efficiency of solid waste; and

(iii) EPA should not accord Environmental Approval to any housing society unless it provides comprehensive solid waste management (collection and final disposal) system.

(f) Building capacity to monitor and forecast episodes of high air pollution

Presently EPA has only six ambient air quality monitoring systems. The data from such stations helps in identifying the real cause of the problem and thus is crucial for informed decision making. One of the key constraints to controlling air pollution in the province is the lack of an effective program for monitoring air quality emissions from stationary and diffused sources. Given the need for regular monitoring of air quality in the Punjab – at least eight large cities, various industrial clusters and diffused sources – a much larger than available number of ambient air quality monitoring stations are required.

As part of its on-going restructuring process, the EPA is in the process of establishing a network of such stations as well as stations for monitoring the quality of water and soil. These stations will be linked to a central Environmental Monitoring Center (EMC) where information relayed through them will be analyzed using computer simulations to generate information for operational (such as forecasting episode of high air pollution) and policy level decisions. At the same time, there is also a need to collect air quality data from significant point sources, most importantly large scale industrial units with heavy air pollution footprints (cement, sugar, large boilers, power plants etc.). There is a need to require them to install continuous stack emissions monitoring equipment and ambient air quality monitoring stations with full access to EPA. With this in view:

(i) EPD should work closely with the Planning & Development and Finance Department for establishment of Environmental Monitoring Center;

(ii) While according Environmental Approvals, EPA should make it mandatory for industrial units with significant level of gaseous emissions to install either continuous emission analyzers for each criteria pollutant and, where necessary, also install ambient air quality monitoring station(s) with analyzers for each criteria pollutant.

(g) Tree Plantations in and around major cities

Trees are highly effective, cheap and environmentally safe agents to fix carbon and other noxious elements. At the same time, trees produce oxygen and release moisture through transpiration which helps in controlling temperature, maintaining humidity and bringing rains. It is estimated that a single average tree can fix 20 kg of carbon dioxides every year and can sequester 1 ton of carbon dioxide by the time it is 40 years' old. Unfortunately, trees have been a victim of unplanned urban development. In order to restore this situation:

(i) EPA should closely work with the Board of Revenue to identify and earmark state-land wherever available in the vicinity of large cities/towns for tree plantation;

(ii) EPA should work with the Forest Department to identify suitable tree species in view of intended purpose and economic value and establish and maintain woodlands on the indicated pieces of land. Preference should be given to tree species traditionally planted in the different zones of Punjab including Neem, Draik, Bakain, Amaltas, Kikar, Pipal, Sohanjana, Lasura, Simal and Shirin. Ecologically inappropriate tree species such as Cornocopis and Eucalyptus should be excluded from tree plantation plans.

(h) Controlling Fugitive/Construction dust

Fugitive/construction dust is an important cause of particulate pollution of ambient air. All construction project proponents shall ensure that appropriate measures are undertaken to control construction dust. EPA should ensure that suitable construction dust control plan is prepared and rigorously implemented by all major construction and road projects in the Punjab.

(i) While according Environmental Approvals, EPA should make it mandatory, for each new housing colony and road project to implement the recommended control of construction dust;

(ii) EPD should work closely with the Communication & Works Department for development of standards and guidelines for design and construction of roads shoulders which minimize escape of fugitive dust;

(iii) EPD should also work closely with the Communication & Works Department for development of standards and guidelines for control of dust from construction activities of all types.

(i) Planned urban and industrial development

There is no substitute for planned development. For this purpose, there is a need to develop master land-use plans for cities as well as their adjacent country sides. Such plans should then be strictly followed. These plans should, inter alia, indicate industrial zones and a deadline by which all industrial units located within urban areas shall shift to such industrial zones. This is a long-term measure and for this purpose:

(i) Local Government & Community Development and Housing & Urban Development Departments should ensure development of master land-use plans through their respective subordinate offices. In view of resource and capacity constraints, such plans may initially be developed for major cities and eventually encompass intermediate and small cities and then towns as well.

(ii) At the same time, while according Environmental Approval, EPA should make it mandatory for each project to be in accordance with the developed master land-use plan.

(j) Greening of industrial processes

Industrial processes can be made green by mandating new industries to use such plants, machinery, and processes which are environmental friendly. There are a number of barriers to adoption of the green process which include technology, entrepreneurial capacity and financing.

(i) While according Environmental Approvals, EPA should make it mandatory upon major contributors to air pollution such as cement manufacturing plants, steel mills and thermal power plants to install such technologies which are suitable vis-à-vis energy and resource efficiencies and emission reductions.

(ii) EPD should conceive and implement projects for greening of existing industrial units by removing technological, entrepreneurial capacity and financial barriers.

(k) Regional environmental agreement

Smog being a regional problem cannot be effectively controlled by eliminating local sources of pollution alone. Comprehensive solution to this and other environmental problems such as contamination of water bodies flowing into the Punjab from across eastern borders requires a cooperative approach at the regional level. For this purpose, Federal Government will be approached to put environmental concerns on agenda of bilateral and multilateral dialogues between India and Pakistan. Although this may prove to be slow and difficult process, there is no way to save environment in the Punjab without such a collaborative agreement. A good example on regional environmental cooperation is the "Agreement on Transboundary Haze Pollution" concluded between ten ASEAN countries in 2002.

3. Capacity Building Committee

The Terms of Reference of the Capacity Building Committee was to identify what capacity is needed to deliver the recommendations of the Committees. Based on the findings of the Root Causes, Smog Policy, Public Health Emergency, and Voluntary Action Committees, and International Best Practices, the Committee presented a detailed and all-encompassing programme to arrest deterioration and improvement in air quality in the province. The Committee, deriving much from on-going initiatives of EPD, presented capacity building needs in terms of:

(1) Restructuring and Capacity Building of EPA Punjab for Effective Enforcement of Environment Standards in Punjab;

(2) Punjab Clean Air Action Plan recommending 25 policy measures aimed at improvement in air quality in the province;

(3) Enhanced Environmental Quality Monitoring System for Punjab's Air, Surface and Ground Water Resources.

The Government of the Punjab has approved the project. "Restructuring and Capacity Building of EPA Punjab for Effective Enforcement of Environment Standards in Punjab" which is Phase I of the overall project "Capacity Building of EPA Punjab including Combined Effluent Treatment Plants (CETPs) and Industrial Estates (IEs) under Jobs & Competitive (J&C) Program".

The state of ambient air quality in the province necessitates introduction of a specialized Punjab Clean Air Action Plan for defining emission reduction requirements, emission monitoring and reporting requirements for industry, installation of emission control systems by polluters, demarcating air pollution control areas, penal provisions, and revision of existing Vehicular Emission Standards for making them progressively more stringent. The Plan comprises 25 policy measures:

(1) Strengthening and expanding vehicle inspection regime

(2) Import and refining of low sulfur diesel and furnace oil (<50 ppm)

(3) Checking fuel adulteration

(4) Installation of catalytic converter

(5) Fleet turn-over to low emission vehicles

(6) Reintroduction of CNG as vehicular fuel

(7) Mandatory use of bus transport for 75 percent of students in major cities

(8) Road denial during high pollution period

(9) Retiring excessively old vehicles

(10) Technology diffusion through demonstration in most polluting sectors through matching grants

The clay brick manufacturing sector in Pakistan, with an estimated 1.5% contribution to the GDP, is still a highly un-regulated and un-documented area. There are about 10,000 conventional brick kilns in the Punjab. The typical processes for production of bricks consist of hand-made bricks which are baked in about two centuries old Bull's Trench Kilns. Mechanized brick making plants and different types of kilns like the tunnel kiln, Hoffman kiln, modified FCBTK and the VSBKs have also been introduced in different countries. Earlier attempts to introduce mechanized brick making and brick baking did not meet success owing to a mix of techno-operational and adaptability/ acceptability problems.

Most of the brick kilns, producing clay bricks, are located in or around the urban cities of the province. They emit thick black smoke containing several air pollutants (carbon monoxide, carbon dioxide, sulphur dioxide, nitrogen oxides) and fine particulate matter, which present serious health hazards (human illnesses, animal and plant life destruction) to communities living around them.

EPD is introducing an environment friendly and cost effective technology of brick kilns in collaboration with All Pakistan Brick Kiln Owners Association. The technology is a significant improvement on the currently prevalent Bull's Trench Kilns by modification in the flow of hot air used to progressively bake brick. This is called Induced Draught Zig Zag Brick Kiln. This technology was developed by International Centre for Integrated Mountain Development (ICIMOD) while working in Nepal.

Zig Zag Kilns are claimed to reduce 70% emissions while improving fuel efficiency by 40% as compared to the conventional Bull's Trench brick kilns.

Traditional Bull Trench Vs. Zig-Zag Induced Draught Brick Kiln

Under this policy measure, 200 brick kilns will be upgraded to more efficient Induced Draft Zig-Zag Brick Kiln technology; energy conservation, process improvement and end of pipe treatment will be introduced for steel furnaces; process improvement and control of dust and air pollution from rice husking mils will be achieved; and dust control and process improvement in stone crushing units will be introduced.

(11) Credit facility for large scale roll out

(12) Building capacity for technology transfer

(13) Bridging sustainability issue

(14) Relocation of industry

(15) Energy Efficiency

(16) Pollution inventories

(17) Increasing urban tree cover

(18) Promoting non-motorized travelling

(19) Controlling fugitive dust from road shoulders

(20) Improved collection and disposal of municipal and industrial waste

(21) Reducing generator emissions

(22) Urban planning and land zoning

(23) Discouraging Crop Burning

(24) Legislative action

(25) Capacity Building

In the short term, EPD shall provide necessary resources to EPA field and laboratory staff so as to enable them to enhance their capacity in monitoring environment (especially, ambient air quality) and analyzing data. For this purpose, EPD would execute "Enhanced Environmental Quality Monitoring System for Punjab's Air, Surface and Ground Water Resources" project, funded through Annual Development Programme of the Punjab Government. Under this project, the following activities are anticipated:

(a) To enhance capacity of EPA for ambient air quality monitoring as per "Punjab Environmental Quality Standards for Ambient Air" by purchasing and installing **30 ambient air quality monitoring stations** (AAQMS) at the following locations all over the province. These include both fixed and mobile stations; the mobile stations will be professionally installed on vans containing all requisite accessories.

DISTRICT	Number of AAQMS
Lahore	8
Sheikhupura	1
Faisalabad	3
Rawalpindi	3
Multan	2
Gujranwala	2
Sialkot	1
Bahawalpur	2
D.G Khan	1
Sargodha	2
Mobile AQMS	5
Total	**30**

(b) Provision of necessary equipment (especially, for stack emission measurements) and transport to EPA for enhanced monitoring industrial sources of pollution for development of pollution inventory of the province.

(c) Provision of purpose-specific vehicles for on-spot vehicular emission measurements.

4. Punjab Green Development Programme

EPD approached the World Bank in October, 2016 to seek technical and financial support for a medium-term plan to improve air quality in the Punjab and after many rounds of consultative sessions with the World Bank missions, a general agreement was reached to roll out a five year "Punjab Green Development Program" (PGDP) which has been approved by the World Bank Board in its meeting held on 25 May, 2018. The overall outlay of the PGDP is US$ 273m out of which US$ 73m will be contributed by Government of the Punjab.

PGDP focuses on two main areas (a) investments in building regulatory capacities in EPA and other related agencies for effective enforcement – the push factor; and (b) making investments in technology diffusion in priority areas (brick kilns, steel furnaces, rice husking mills, industrial boilers, stone crushing units, plastics, relocation of industries and transport) – the pull factor, with the expectation that this combination of the push and pull factors will lead to overall improvement in environmental quality in the province.

Under PGDP, the institutions of environmental governance in the province have been based on the concept of separation of powers into three distinctive branches; Legislative, Executive and Judiciary. The roles within the proposed environmental arrangement have been divided into four authoritative areas: (a) Regulation and policy, (b) Enforcement, (c) Monitoring, and (d) Advisory and support. The institutions envisaged to be established/strengthened are as follows:

Environment Protection and Climate Change Department (EP&CCD): EPD, to be renamed as EP&CCD, will perform the **Regulation and Policy** role and will be the administrative department of the new institutions being created under PGDP and Multilateral Environmental Agreements (MEAs) directorate.

Environment Protection Agency (EPA): Strengthened EPA will concentrate on its **Enforcement** role with strong and independent regulation through environmental approvals, environmental permitting, and prosecution of polluters.

Environmental Monitoring Centre (EMC): EMC, an attached institution of EP&CCD and an environmental reference laboratory, will perform the **Monitoring** role through deployment of state-of-art monitoring equipment, remotely sensed observations, and on-line real-time gathering of environmental data from major polluters from across the province. EMC will have facilities for environmental modeling to assist EPA in environmental approvals. EMC will, thus, serve as repository of environmental data on the province which will be available to academia for research and general public for assessing state of environment in the province.

Institute of Environment Technology and Training (IETT): IETT, an attached institution of EP&CCD, will primarily perform the **Advisory** role on environmental issues include, inter alia, organizing information mechanisms with industries, development of Best Available Technology (BAT) reference documents, decisions on emission limits, advising polluters on how to comply with environmental legislation, policies, standards and enforcement decisions, capacity building programs for environment sector, supporting pilot plants.

Directorate of Multilateral Environmental Agreements: Directorate of Multilateral Agreements (MEAs), an attached institution of EP&CCD, will help establish a comprehensive Federal-Provincial linkage for effective implementation of MEAs.

Market Based Instruments (MBIs): To help create appropriate patterns of incentives or disincentives for polluters to achieve desired results of environmental control, EPD will develop and introduce Market Based Instruments (MBIs) such as Tradable Permits, Deposit Refund, etc.

4. Public Health Emergency Committee

The Public Health Emergency Committee comprised the following:

(1) Mr. Anwaar Hussain, Additional Advocate General, Chair of the Committee;
(2) Dr. Tariq Banuri, Executive Director, Global Change Impact Studies Centre;
(3) Mr. Abid Omar, Member of Pakistan Air Quality Initiative;
(4) Mr. Aleem Cheema, Senior Law Officer of Primary and Secondary Healthcare Department;
(5) Vaiza Siddique, Law Officer of Primary and Secondary Healthcare Department;
(6) Ms. Sarah Belal;
(7) Mr. Suleman A. Zeb;
(8) Mr. Haaris Ramzan, Primary and Secondary Health Care Department;
(9) Mr. Saif Anjum, Secretary, EPD; and
(10) Dr. Salman Kazmi, Secretary Young Doctors Association.

The Order of the Honourable Lahore High Court dated 19th December, 2018 states that "the concept of Health Emergency is required to be recognized through the said policy." Keeping this in mind, the Committee formulated the following objectives:

(1) Identifying the scope of Public Health (Emergency Provisions) Ordinance, 1944 read with provisions of Punjab Local Government Act, 2013,

(2) Draft emergency policy measures that the Government of Punjab (the "Provincial Government") should undertake at provincial and local levels when the air quality

reaches extremely harmful levels, keeping in view the provisions of Punjab Local Government Act, 2013,

(3) Identify the impacts of the air quality on the public health, and

(4) Identify strategies on preventing the air pollution from reaching uncontrollable levels.

The Committee's Recommendations:

(1) Improvements in the legal and operational framework

(a) The Public Health (Emergency Provisions) Ordinance, 1944 should be used to its fullest extent while reading conjunctively with Section 94 of Punjab Local Government Act, 2013.

The Committee discussed the relevance and practicality of the Public Health (Emergency Provisions) Ordinance, 1944 and observed that after the 18th Amendment to the Constitution, the powers regarding health and response of public medical services has devolved greatly. Therefore, the Ordinance, while being dated, was useful as it allows the Provincial Government to mobilize various government departments by making rules, prohibiting harmful activities, relocating medical personnel and allocating resources to tackle high levels of air pollution on an emergency basis.

The Committee, therefore, recommended that the Health and Environment Protection Departments should study the Ordinance and formulate interdepartmental strategies on how to operationalize its provisions as well as suggest improvements while keeping in mind provisions of the Punjab Local Government Act, 2013.

(b) Increased coordination between the Environmental Protection Department and the Healthcare Departments is required to respond to poor air quality and its effects on public health

The Committee conferred that looking at the smog through the lens of a public health emergency requires increased coordination and cooperation between various government departments like both wings of the Health Department, Government of Punjab and the Environmental Protection Department. It suggested that regular monthly meetings take place between the Environment Protection Department and Healthcare Departments in order to better monitor the public health risks of the bad air quality throughout the year.

The Committee also recommended that a special desk should be appointed at the Environment Protection Department where both an officer of the Health Departments and the Environment Protection Department may sit and work as liaison between the two departments. Such a liaison can alert the relevant department when it comes to high levels of pollutants in the air quality, thus resulting in the departments acting accordingly. Upon receiving an alert, the Health Departments need to monitor all effected patients in hospitals including the categories of patients and make all relevant recommendations to the Punjab Government for effective action (e.g. shutting down schools for children or closing of parks for the elderly etc.). The Committee recommended Health Advisory/Health Emergency Response of Government proposed by Health Department for deliberations by the membership of the Commission.

The Committee also recommended that, as the matter is a devolved subject and bad air quality can affect anytime in any city in the province besides Lahore, the proposed model is required to be replicated at district level as well.

(2) Accumulating and Reporting Data

(a) Different Pollutants should be taken in to account when reporting the AQI:

The Committee pointed out that although the Hon'ble High Court's Order specified targets based on existing Punjab Environment Quality Standards (PEQS), it focuses only on one pollutant, i.e. $PM_{2.5}$. The Committee deliberated on whether the thresholds specified in the order need to be updated, and whether there is a need to establish similar thresholds for other pollutants, especially PM_{10} and SOx/NOx.

The 2005 "WHO Air Quality Guidelines" offer global guidance on thresholds and limits for key air pollutants that pose health risks. It was pointed out that most global frameworks are based on the World Health Organization's guidelines.

For example, the United States of America's Environment Protection Agency calculates the Air Quality Index (AQI) based on the five "criteria" pollutants regulated under the Clean Air Act. The EPA has established National Ambient Air Quality Standards (NAAQS) for each of these pollutants in order to protect public health. An AQI value of 100 generally corresponds to the level of the NAAQS for the pollutant. If multiple pollutants are measured at a monitoring site, then the largest or "dominant" AQI value is reported for the location.

Looking at data available with the Punjab Government, $PM_{2.5}$ and PM_{10} levels are already at dangerously high levels. They are 2.5 times above the safe level for Nitrogen Dioxide and 1.7 times above the safe levels for Carbon Dioxide.

The Committee, therefore, recommended that:

(i) The five criteria pollutants should be included in the Smog Policy so that emissions can be tackled efficiently;

(ii) Additionally, real-time monitoring data from continuous monitors should be publically available in 1-8 hour averages;

(iii) While emergency levels are at AQI of 300 and higher, actions need to be initiated at lower levels to avoid entering the emergency stage.

(b) Health Department must use a holistic approach to gather medical data

The Committee reviewed accredited international research, such as the *WHO Guidelines* on the effects of poor air quality on public health. It was pointed out that the primary healthcare issues resulting from the air pollution were both respiratory and cardiovascular in nature.

The Committee discussed how the Health Department should study the health effects of bad air quality in the Province and generate its data and findings. Such data will be critical in formulating effective policies to reduce the impact of air pollution on public health. It was also pointed by the Health Department and Environment Protection Department that most of the primary data available to the Health Departments will be from public hospitals, however the private sector should also be brought into play. Private hospitals, and more importantly, private clinics treat a large number of patients, and this data is not readily available to the Health Department. Thus, a public private collaboration will be useful here.

In this respect, the Committee recommended:

(i) The Health Department must generate and collect its own data on the effects of air quality on public health, as well as devise policy measures/SOPs on how to respond to dangerous levels of air quality as a public health hazard;

(ii) Health Department not only to collect and collate data from public hospitals but also private clinics to develop strategies for reducing the harmful effects of poor air quality on public health;

(iii) That a long-term research programs in all major metropolises be established and awarded to local universities to gather relevant data on air quality and its effects on citizens exposed to air at different AQI levels.

(iv) District Health Authorities are required to be involved effectively for finalizing health emergency response at district level.

(3) Public Awareness Campaigns must be incorporated in the Smog Policy

The Committee discussed the need to improve public awareness campaigns when bad air quality levels create a public health emergency. During a public health emergency, a swift public awareness campaign must kick off as soon as possible and continue for the duration until air quality levels decrease to an acceptable amount. Such a campaign must incorporate different methods of marketing, such as the use of billboards, news castings, weather reports etc.

Different types of Public Awareness Campaigns were discussed, looking primarily at Beijing, and how they informed the public during periods of poor air quality through public billboards carrying live air quality readings, newspaper articles, weather reports, etc. It was also pointed out that this is something that must be done between the Punjab Government and the Private Sector as public awareness is a big issue for the government to take on its own.

When the poor air quality reaches dangerous levels, a public awareness campaign must be initiated by the Provincial Government in aid of District Health Authroities that should have two components:

(a) AQI data on air pollution conditions;

(i) Reporting daily reports and forecasts in newspapers in the weather report section;

(ii) Reporting real-time air quality conditions during television and radio broadcast of weather conditions;

(iii) Reporting real-time air quality conditions on newspaper websites;

(iv) Reporting through non-conventional information systems in public areas, such as billboards on major streets, LED displays in government offices and banks, etc.

(b) Health impact of air pollution;

(i) Creating awareness of the AQI particularly amongst medical practitioners;

(ii) Educational advertisements campaign on health impacts via the Health Department;

(iii) Seminars for doctors, media, etc.;

(iv) Public-Private Partnerships with hospitals, NGOs, etc. to create further awareness amongst the public and warning them about the effects of poor air quality levels on their health.

It was also recommended by the Committee that since the health emergency measures are interlinked with reference to the smog policy, the discussion and deliberations of this Sub-Committee be combined with the Sub-Committee on Smog Policy as each value level of the AQI that will be decided upon will be triggering emergency steps. A joint meeting was convened by the Secretary EPD and held on 6 April, 2018, where the Committee on Smog was apprised of discussion in Committee on Public Health Emergency. Smog Committee was requested to ensure that proposed advisory at provincial level is required to be replicated at district level as well to which chair of the Smog Committee in principal agreed. This will require engagement with District Health Authorities under Section 2(a) read with Section 92 & 94 of the Punjab Local Government Act, 2013 in order to chalk out the emergency plan at district level. The Committee, therefore, proposes that Health Departments of the Punjab Government must replicate the health emergency measures, whenever and wherever required, at district level. For this, they must coordinate with concerned representatives of District Health Authorities and provide them requisite health emergency response/advisory.

5. Voluntary Action Committee

The Voluntary Action Committee comprised the following members:

(1) Mr. Ali Habib, Chair of the Committee;
(2) Mr. Bilal Mustafa Syed, Managing Director, LWMC;
(3) Mr. Naseem Ur Rehman Shah, Director, EPA;
(4) Dr. Abu Bakr, School of Engineering, LUMS;
(5) Ms. Tehmina Saeed Chaudhry, Environment Focal Person LCCI;
(6) Ms. Nazifa Butt, WWF-Pakistan;
(7) Mr. Nawaz Manik, Director Legal, EPA;
(8) Dr. Tauqeer Akhtar, President Consumer Forum;
(9) Mr. Shoaib Niazi, President, Brick Kiln Owners' Association Pakistan ("BKOAP"); and
(10) Representative of the Punjab Agriculture Department

The Committee focused on voluntary action by various segments of society in mitigating the harmful effects of smog while identifying the following three (3) most harmful sources of winter smog:

(1) Burning of agricultural residue

The burning of rice stubble just before the sowing of wheat around November.

(2) Industrial emissions

Emissions from the industrial estates in and around Lahore, such as Kot-Lakhpat, Kala-Shah Kaku, Sundar was prioritized, along with highly polluting sectors, such as steel smelting furnaces and brick-kilns.

(3) Burning of municipal waste

The practices of burning waste in and around the city of Lahore is common, though it is not legal.

(1) Deliberations and recommendations

(a) Voluntary actions to reduce burning of agricultural residue

The Sustainable Rice Global Initiative is an association of rice businesses that have set environmental standards. These standards include a restriction on burning of crop residue for farmers that sell to the member companies. Many rice exporters from Pakistan are now supplying to these companies, and will increasingly be under scrutiny to stop burning of residue. The Mars Company of UK sells its rice with the brand of Uncle Ben's rice, and 16,000 tons of rice are imported from Pakistan each year.

WWF, which is working with the Sustainable Rice Organization, offered to assist in coordinating with the Pakistani rice exporters to voluntarily start reducing the burning of crop residue, which in October, November is mainly rice stubble. The participants stated that the Punjab Agriculture Department should also be actively involved in this initiative.

Short-Term Action: Arrange a workshop of rice exporters to adopt the principles of the Sustainable Rice Global Initiative which does not allow burning of rice stubble by source farmers.

Medium Term: Encourage appropriate farming methods, agricultural technology that discourages farmers from burning rice stubble, such as the "Happy Seeder"

(b) Brick Kiln Owners' Association Pakistan (BKOAP)

Based upon the success of the Zig-Zag design introduced by professionals from Nepal, four brick kiln owners are in the process of converting to this better technology. The EPD Punjab already has plans to collaborate with the brick kiln owners to expedite these efforts for adoption of this new Zig-Zag technology.

The Committee observed that the brick kiln owners recognize that they are aggravating the condition of smog, and thus are willing to make a sacrifice by closing down all brick kilns during the most sensitive periods for two months. The Brick Kiln representatives agreed that they would shut down their brick kilns by 20th October each year for a period of about two months to cover the period in which the smog is likely to occur. They would agree upon the date to shut down the brick kilns through joint coordination with the EPD. In addition, they committed that any new brick kiln will only be allowed to be set up if it adopts the new Zig-Zag technology.

Short-Term Action: Brick kiln owners of Pakistan will voluntarily shut down the brick kilns around end October on a date pre-agreed with the EPD.

Medium Term: 50% of brick kiln owners convert to the more environment friendly zig-zag technology with the subsidy support of the EPD.

Long Term: All of the brick kilns of Punjab convert to the more environment friendly zig-zag technology with the subsidy support of the EPD.

(c) Steel Rerolling Mills

The Committee discussed the contribution of steel rerolling mills to smog formation, and, with the concurrence of the Lahore Chambers of Commerce & Industry (LCCI) recommended the EPD to allow the grace period to extend latest to September 2018, after which any polluting rerolling mill may be ordered shut down.

Short-Term Action: EPD with the support of the LCCI will issue EPOs to shut down any steel rerolling mill that continues to cause pollution beyond the level set by the Punjab Environmental Quality standards (PEQs) after 30th September 2018.

Medium Term: All steel rerolling mills have converted to technologies to limit their pollution within the acceptable limits set by the PEQS.

(d) Burning of municipal waste

The Committee was informed by the LWMC representative that previously there there were about 600 unofficial sites where solid waste was being disposed of by open burning, which have now been reduced to around 40, thus reducing the incidence of burning substantially. The Committee, however, observed that burning of waste was still common, even in cantonment areas.

The Committee, therefore, recognized that the issue of burning of municipal waste remains a problem, and these messages need to be included in awareness programmes.

Short-Term Action: The remaining 40 unofficial sites of waste collection should be eliminated by the LWMC.

Short-Term Action: The Lahore Cantonment Board should ban burning of waste and leaf litter in areas under their jurisdiction.

Medium Term: Public campaigns for encouraging citizen's vigilance to identify illegal burning of waste. Encourage citizens to join neighborhood groups to organize local level collection of organic matter for composting. WWF-Pakistan has offered to integrate these aspects in their awareness campaigns.

H. Directions of the Supreme Court on 21 April 2018

In Action taken by HCJ Regarding Air Pollution Prevailing in the Country, HRC 6257-P/2018, the Supreme Court, in its order dated 24 March 2018, required the members of the Commission to appear before the Supreme Court on 21 April 2018 (Annexure E). The Chairman and the members of the Commission appeared before the Supreme Court and submitted the Progress Report (Annexure F).

The Supreme Court, in its Order dated 21 April 2018 (Annexure G), required the Commission to finalize its recommendations and submit the same within six (6) weeks.

I. Recommendations of the Commission

The Commission supports the Recommendations of the Committees. It specifically reiterates the following seventeen (17):

A. Voluntary Actions

These voluntary action recommendations are based on the report of the Voluntary Action Committee.

(1) The initiative of Sustainable Rice be encouraged in Pakistan, which requires exporters to stop burning rice stubble. Worldwide Fund Pakistan will assist in awareness raising with the rice exporters, involving the Punjab Agriculture Department.

(a) Actions:

(i) Rice Exporters Association volunteered to stop burning rice stuble as part of their Sustainable Rice Initiative. Additionally, they undertook to significantly increase the production of SRI from the existing 16,000 tons per annum.

(ii) Worldwide Fund for Nature Pakistan will provide necessary support.

(b) Lead Agency:

(i) Rice Exporters Association

(c) Supporting/Follow-up Agency:

(i) Agriculture Department

(ii) Environment Protection Department

(2) Brick Kiln Owners' Association Pakistan (BKOAP) agreed to shut down all brick kilns during the winter smog season (October – December) each year in collaboration with EPD, at least on a two-week notice. EPD must continue to coordinate with BKOAP to speed up the adoption of Zig-Zag technology or any other appropriate technologies that reduces emissions of harmful pollutants.

(a) Actions:

(i) BKOAP volunteered to shut down brick kilns in winter smogs (October – December), at least on a two-week notice.

(ii) BKOAP also undertook to speed up the adoption of Zig-Zag Technology by the existing conventional brick kilns.

(b) Lead Agency:

(i) BKOAP

(c) Supporting/Follow-up Agency:

(i) Environment Protection Department

(3) Steel rerolling mills be given a grace period till September 2018 to convert to cleaner technologies, especially those effectively arresting $PM_{2.5}$ emissions, after which any polluting unit will be ordered to shut by EPD. LCCI is directed to work with rerolling mills to ensure that technology upgrade targets are achieved.

(a) Actions:

(i) LCCI volunteered to shut down steel rerolling in winter smogs (October – December).

(ii) LCCI will work with rerolling mills to ensure technology upgrade targets.

(b) Lead Agency:

(i) LCCI

(c) Supporting/Follow-up Agency:

(i) Industries Department

(ii) Environment Protection Department

B. Mandatory Actions

These mandatory actions recommendations are based on the reports by the Committees.

(4) The prohibition of burning of municipal waste and urban biomass under the Punjab Local Government Act, 2013 must be implemented.

(a) Lead Agency:

(i) Local Government & Community Development Department

(ii) Housing, Urban Development & Public Health Engineering Department

(iii) Cantonment Boards

(b) Supporting/Follow-up Agency:

(i) Environment Protection Department

(5) Immediate adoption and subsequent implementation by Government of the Punjab of the Punjab Clean Air Action Plan with its supplemental policy documents, projects, and initiatives.

(a) Lead Agency:

(i) Ministries of Petroleum, Industries, Foreign Affairs, Climate Change of Federal Government

(ii) Environment Protection Department

(iii) Industries Department

(iv) Finance Department

(v) P&D Board Punjab

(b) Supporting/Follow-up Agency:

(i) Environment Protection Department

(6) The Public Health (Emergency Provisions) Ordinance, 1944 should be used to its fullest extent. It is therefore imperative that Health and EPD must, within a maximum of twelve weeks, formulate interdepartmental strategy on how to operationalize its provisions as well as suggest improvements keeping in view provisions of Punjab Local Government Act, 2013 in general related to health and clauses (g), (k), and (o) in particular of Section 94.

(a) Lead Agency:

(i) Specialized Healthcare and Medical Education Department

(ii) Primary & Secondary Healthcare Department

(iii) Environment Protection Department

(b) Supporting/Follow-up Agency:

(i) Director General Health Services

(ii) District Health Authorities

(iii) Punjab Information Technology Board

(7) Since most of the primary data available to the Health Departments is from public hospitals, therefore, the private sector should also be included as the private hospitals, and more important, private clinics treat a large number of patients including those effected by polluted air and/or smog, and this data is not readily available for the Health Departments. Thus, a public private collaboration will be useful here.

(a) Lead Agency:

(i) Specialized Healthcare and Medical Education Department

(ii) Primary & Secondary Healthcare Department

(iii) Punjab Healthcare Commission

(b) Supporting/Follow-up Agency:

(i) Punjab Information Technology Board for assisting with an ICT-based platform for disease prevalence related to smog episodes in the province

(ii) Punjab Healthcare Commission

(iii) Director General Health Services

(iv) District Health Authorities

(v) Environment Protection Department

(8) EPD and the Health Department must establish *Smog Response ICT Application(s)*. Officers designated for its maintenance and operation of would be responsible for collating and transmitting information to and from their respective departments in a timely manner. These focal persons should be mentioned on the official websites of the Departments. They will be responsible for issuing an Air Quality Alert. The departments should collaborate to develop Standard Operating Procedures.

(9) EPD and the Health Department must establish *Smog Response Desks* at the district levels.

(10) Immediate adoption, dissemination, and subsequent implementation by Government of the Punjab of Standing Instructions for Management of Episodes of Poor Air Quality (2018). The Commission specifically recommends that the health alerts for preventive interventions be issued beginning with an AQI of 300.

(a) Lead Agency:

(i) Environment Protection Department

(ii) Director General Public Relations

(11) Immediate approval and execution of the project "Enhanced Environmental Quality Monitoring Systems for Punjab's Air, Surface, and Ground Water Resources".

(a) Lead Agency:

(i) Environment Protection Department

(ii) P&D Board Punjab

(iii) Finance Department

(b) Supporting/Follow-up Agency:

(i) Environment Protection Department

(12) The Commission recommends a vigorous and dedicated, preferably target-led, afforestation campaign with special emphasis on native species such as *Neem*, *Draik*, *Bakain*, *Amaltas*, *Kikar*, *Pipal*, *Sohanjana*, *Lasura*, *Simal* and *Shirin*. Ecologically inappropriate (and exotic) tree species such as Cornucopias and Eucalyptus should be excluded from tree plantation plans.

(a) Lead Agency:

(i) Forest Department

(ii) P&D Board Punjab

(iii) Finance Department

(iv) Parks & Horticulture Authorities

(iv) Environment Protection Department

(b) Supporting/Follow-up Agency:

(i) Forest Department

(13) The Commission recommends implementation of the "Punjab Green Development Programme" being executed by EPD with the assistance of the World Bank.

(a) Lead Agency:

(i) Environment Protection Department

(ii) P&D Board Punjab

(iii) Finance Department

(b) Supporting/Follow-up Agency:

(i) Environment Protection Department

(14) The Commission recommends the placement and updating of environmental quality data, including AQI, on the website of EPD.

(a) Lead Agency:

(i) Environment Protection Department

(b) Supporting/Follow-up Agency:

(i) Environment Protection Department

C. Public Awareness

(15) The Commission acknowledges the need of and strongly recommends public investments and participations in research, knowledge sharing, awareness campaigns on environmental issues impacting health. The academic community and civil society need to be more fully involved in these efforts.

D. Transboundary Agreement

(16) The Commission acknowledges that since smog is a regional problem it cannot be effectively controlled by eliminating local sources of pollution alone; a comprehensive solution to this requires a cooperative approach at the regional level. For this purpose, the Federal Government may be directed to put environmental concerns on the agenda of bilateral and multilateral dialogues between India and Pakistan. A good example on regional environmental cooperation is the "Agreement on Transboundary Haze Pollution" concluded between ten ASEAN countries in 2002.

(a) Lead Agency:

(i) Ministry of Foreign Affairs

(ii) Ministry of Climate Change

(b) Supporting/Follow-up Agency:

(i) Environment Protection Department

E. Implementational Framework

(17) The Recommendations of the Commission, including the above, need to be implemented by various Ministries, Departments and Agencies of the Federal and Provincial Governments to reduce and eliminate smog in the coming years. For this, the most important, and in fact, over-arching recommendation of the Commission is the appointment of a permanent/standing Punjab Clean Air Commission that periodically reports to the Court and seeks such further instructions as may be necessary. The proposed Implementation Commission may comprise (a) concerned governmental departments, (b) public representatives, (c) academic community, (d) civil society organizations, and (e) eminent opinion leaders. Secretary EPD may serve as Secretary to the Punjab Clean Air Commission to provide secretariat support but also develop standard formats for gathering and reporting implementation status of the recommendations of this Commission.

J. Acknowledgements

The Chair appreciated and records his gratitude to all the members of the Commission and the Committees, and to the EPD and its Secretary for their support to the work of the Commission.

Each member gave his (and her) time and effort pro bono and this voluntary dedication proved important in this resultant Report.

_____	_____
Mr. Saif Anjum	Dr. Parvez Hassan
Secretary	Chair
Environment Protection Department	Senior Advocate
	Supreme Court of Pakistan