Report of the Committee

in

(O.A.) No. 19/2021

in the matter of

Sanjay Kumar versus State of UP & Ors

In Compliance with the

Order dated* 09.09.2021 *of the HON'BLE NATIONAL GREEN TRIBUNAL

Central Pollution Control Board

December 2022

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Chapter 1: Background and Structure of Report

1.1 The Hon'ble National Green Tribunal (NGT) Order

The Hon'ble National Green Tribunal, Principal Bench vide its order dated 09.09.2021 (**Annexure-I**) in the matter of Original Application (O.A.) No. 19/2021, Sanjay Kumar versus State of UP & Ors. issued the following directions:

".... While we have no option except to enforce the environmental norms and stop hot mix plants not sustainable due to lack of carrying capacity, 9210/2021/LAW-HO 41 24 we are mindful of difficulty which will arise not only for the operators of such plants but also those who need such services. While GRAP is already operative which results in closure of certain polluting activities on deterioration of air quality, to maintain air standards further restrictions on polluting activities are necessary in the interest of public health. At the same time, ways and means need to be explored to sustain such activities to the extent possible without adversely affecting the public health. Since PM concentrations in the Central Indian/Indo- Gangetic Plains are higher compared to Southern and East and North-Eastern parts of the country, to maintain regional balance in Developmental and industrial activities throughout the country and to support economy as well as the need of public, it is necessary that better technological options and advanced air pollution abatement measures are explored which enable sustainability of such activities. For this purpose, we constitute a seven-member joint Committee which will have statutory authorities and subject matter experts to look into the issue and to give science-based expert report. The Committee will comprise MoEF & CC, CPCB, State PCB, District Magistrate, Prof. Mukesh Khare, IIT Delhi, Prof. Mukesh Sharma, IIT Kanpur and Prof. Shiva Nagendra SM, IIT Chennai."

In the above context, Hon'ble NGT has specifically ordered,

"The hot mix plants beyond carrying capacity may be closed at the earliest and as far as possible from 01.11.2021 by the statutory 9210/2021/LAW-HO 42 25 regulators in exercise of their jurisdiction under the Air Act, 1981 and the EP Act, 1986. In other words, no hot mix plant – old or new may be allowed beyond carrying capacity and without compliance of the laid down siting norms from 01.11.2021. ii. A joint Committee comprising MoEF & CC, CPCB, State PCB, District Magistrate, Prof Mukesh Khare, IIT Delhi, Prof Mukesh Sharma,

IIT Kanpur and Prof Shiva Nagendra SM, IIT Chennai may give a report in terms of Para 25 above within three months by email at judicial-ngt@gov.in preferably in the form of searchable PDF/OCR Support PDF and not in the form of Image PDF."

1.2 Expert Committee and Deliberations

In compliance to the aforementioned order, a science-based report on developmental and industrial activities especially in the Indo-Gangetic Plains has been prepared by the Joint Committee comprising of the following members:

1. Dr. Prashant Gargava, Member Secretary, CPCB, Chairman
2. Prof. Mukesh Sharma, Department of Civil Engineering, IIT Kanpur, Member
3. Prof. Mukesh Khare, Department of Civil Engineering, IIT Delhi, Member
4. Prof. Shiva Nagendra SM, Department of Civil Engineering, IIT Madras, Member
5. The District Magistrate, Gautam Budh Nagar
6. Dr. Satya, Additional Director, IRO Lucknow, MoEFCC
7. Shri Praveen Kumar, RO, UPPCB (representing UPPCB)

The Joint Committee convened its first meeting on October 13, 2021 and had initial discussions on designing scope and framework of the study as specified in the order of the Hon'ble NGT. Further, as suggested in the 1st meeting, Prof. Sagnik Dey, Centre for Atmospheric Sciences, IIT Delhi was invited to seek expert advice on satellite-based measurements of air pollution. Dr. Abhinandan Ghosh, Post-Doctoral Fellow in Department of Civil Engineering, IIT-Kanpur and Ms. Sakshi Batra, Sc. B, CPCB assisted in the data interpretation and preparation of report.

Second meeting of the Joint Committee was convened on December 14, 2021 and the Committee deliberated on the broad activities for report preparation as well as finalized States and UTs to be considered for the study. It was also suggested to share a format for collecting activity data from the identified areas.

A meeting with 07 State Pollution Control Boards/ Committees (SPCBs/ PCCs) of Indo-Gangetic Plain (IGP), namely 1. Punjab, 2. Haryana, 3. Delhi, 4. Uttar Pradesh, 5. Bihar 6. West Bengal and 7. Chandigarh was also convened on January 10, 2021 to expedite the collection of emission data.

Subsequently, meetings were held on February 07, March 29 and April 07, 2022, April 29, June 01 and September 01, 2022, to finalize the report. (Minutes of meetings are enclosed as Annexure-II)

1.3 Preamble and Structure of Report

From satellite observations and in situ measurements (Althaf et al.2022, Dey et al. 2020), it can be stated that the observations of Hon'ble NGT on the air quality levels exceeding the National Ambient Air Quality Standards (NAAQS) by a large margin in Indo-Gangetic Plain (IGP) and that the levels in IGP are much higher than Southern, Eastern and North-Eastern parts of the country are well recognized. The high levels of pollution have significant health implications that have been documented by several agencies (Global Health Depository of the World Health Organization (Landrigan and Fuller2015), Chittaranjan National Cancer Institute (CNCI), Kolkata (Sapkota et al. 2008), etc.). The Hon'ble NGT has observed that to maintain the regional balance in developmental and industrial activities throughout the country as well as to support the economy, better technological interventions and advanced air pollution abatement measures must be explored for sustainability of such developmental activities.

Pursuant to the order, the committee has investigated the causes of air pollution and made a detailed district-wise emission inventory of fine particles ($PM_{2.5}$) over the IGP for different emitting sectors. The meteorological effects on the pollution scenario were also examined. This has enabled the identification of regions of poor air quality and local hotspots where air quality is very poor. Since industrial development is the backbone of economic progress, growth should be sustainable with a low emission trajectory for better public health. The Committee gives special emphasis on the industrial sector and identified the nature of the emissions from different types of industries at the district level as well local sources at hot spots. The Committee has specifically concluded the requirement of advanced technology and management interventions for air pollution sources in IGP. Due consideration was given that technological options and other actions are realistic and time-worthy for air quality improvements without any major recommendation of closure or restriction on economic activities. Specific action plans are also suggested for the October-November episodic air pollution observed in IGP. The Committee has proposed overall recommendations which may be implemented in a time-bound manner.

After rigorous discussions, data analysis and feasibility considerations, the Committee has made this report on the current scenario of particulate matter in IGP, corrective actions and expected improvement in air quality. The report comprises of seven chapters.

Chapter 1: The first Chapter briefly presents the directions of the Hon'ble NGT in the matter OA 19/2021, details of the Expert Joint Committee, their deliberations and overall structure of the report.

Chapter 2: It describes the IGP, its States and basic information/data of the region including demography, economy (GDP growth), weather and meteorological parameters responsible for pollutant dispersal capacity of various regions.

Chapter 3: The third Chapter presents source-wise spatial emissions of particulate matter (PM) concentration using satellite data in different seasons. The regions of high pollution levels and local hot spots have been identified including airsheds (areas impacting a region or a city).

Chapter 4: The fourth Chapter describes district wise emission inventory for $PM_{2.5}$ aerosols. Contribution of different sectors to pollution emission provides first-hand information on large sources. The information on emissions was overlapped with the satellite retrieved PM data to develop a broad association among sources and air quality in different parts of the IGP.

Chapter 5: This chapter is about the special episodic issues of crop residue burning over Punjab and Haryana and associated air pollution over the NCR.

Chapter 6: This chapter presents recommendations for non-industrial and industrial sectors to control air pollution. Specifically, best available technology for different sources, stringency of emission standards, siting of polluting industries in respect of sizeable population agglomeration and expected reduction in emissions. This chapter provides sector-wise technological interventions. A section is devoted to a stringent emission control regime during air pollution episodic period (October-November) for prevention of significant deterioration in air quality.

Chapter 7: The seventh chapter presents an overall summary, conclusions, and sector-wise recommendations.

Chapter 2: Site Description and Adopted Methodology

2.1 Study Site

The Indo-Gangetic Plain

The Indo-Gangetic Plain (IGP) is a 172-million-acre of fertile land including most of northern and eastern India, around half of Pakistan, virtually all of Bangladesh and southern plains of Nepal (Taneja et al. 2014). The region is named after the Indus and the Ganges rivers. The plain is bound on the north by the Himalayas, which feed its numerous rivers and are the source of the fertile alluvium deposited across the region by the two-river systems Indus and Ganges. The southern edge of the plain is marked by the Chhota Nagpur Plateau.

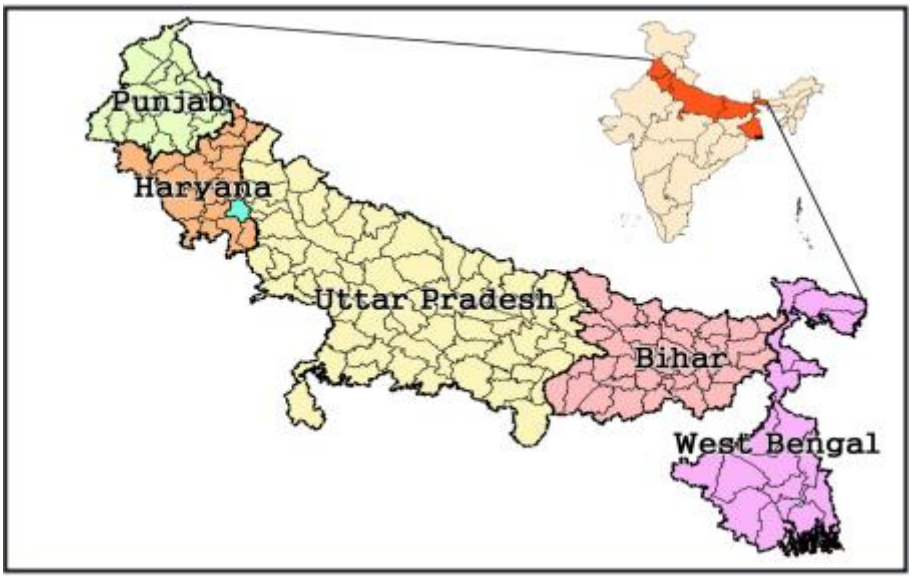


Figure 1: Geographical position of Indo Gangetic Plains (ICAR, 2013)

Many developed cities like Kolkata, Delhi, Lucknow, and Patna are located in the Indo-Gangetic Plain. Indian portion of IGP is shown in Figure 1 that includes the States of Punjab, Haryana, Delhi, Uttar Pradesh, Bihar, and West Bengal, in all further discussions IGP refers to the Indian portion. The plain is among the world's most intensely farmed areas. The Indus-Ganga belt is the world's most extensive expanse of uninterrupted alluvium formed by the deposition of silt by the numerous rivers. The plains are flat, making it conducive for irrigation through canals. The area is also rich in ground water sources. The main crops grown are rice and wheat that are grown in rotation. Others include maize, sugarcane and cotton. The Indo-Gangetic plains rank among the world's most densely populated areas with a

total population exceeding 450 million (Census, 2011). Around half of the India's total population lives in IGP.

Climate

A tropical climate prevails in most of the IGP region. Monsoon circulation weakens toward the west, and there is an increase in aridity of climate. Over large areas of the IGP, average temperatures in July range from 30° to 36°C. Temperatures in January are approximately 20°C (in the northwest, 12°C). Temperature drops to 0°C occur in the Himalayan adjacent regions. Annual total precipitation declines from 1,500 mm in the southeast to 100-150 mm in the northwest (Figure 2).

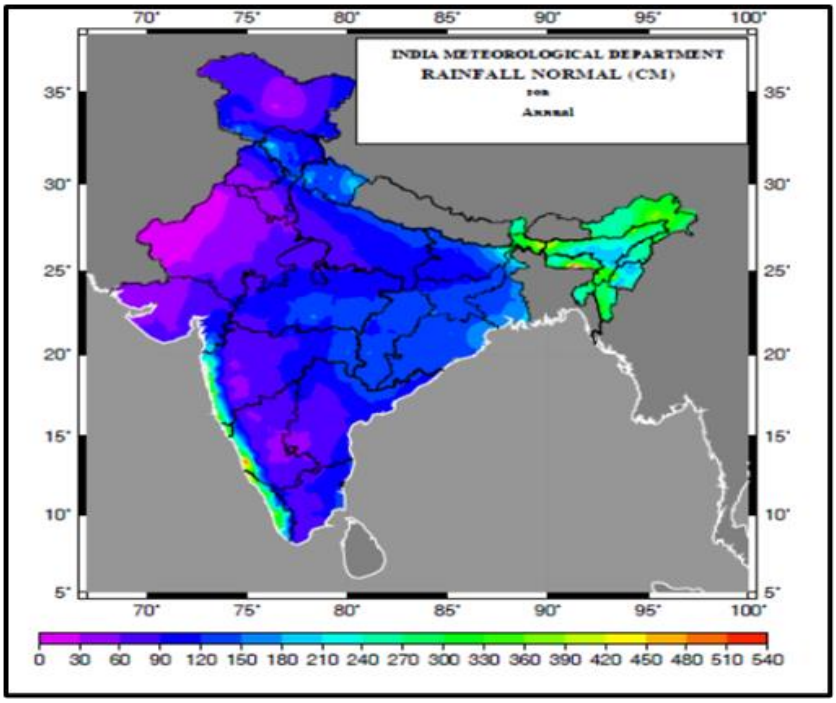


Figure 2: Annual normal rainfall pattern (cm) over India (Source: IMD)

Pollutant Dispersion Capacity

The accumulation and dispersion of the atmospheric pollutants greatly depend on the stability of the atmosphere (unstable: turbulence better dispersion, and Stable: calm conditions poor dispersion). With high mixing layer depth (vertical extent of pollutant dispersion) and elevated wind speed, the pollutants get vertically or horizontally dispersed leading to decrease in concentrations. Rainfall also can reduce pollutant concentrations substantially by in cloud and below clouds scavenging. On the other hand, when the atmosphere becomes calm and stable, with shallow mixing layer height, pollutants get trapped near the earth surface leading to elevated pollutant concentrations (mostly in winter season).

The IGP is situated mostly in tropical regime with well-marked monsoon. Thus, the phenomenal seasonal variability of weather parameters leads a seasonal behavior of the pollutants. While during pre-monsoon and monsoon dispersion and scavenging of the pollutants are frequent, the reverse occurs during post monsoon and winter for the shallow mixing layer height and calm atmospheric conditions. A combined factor to define dispersal capacity is the ventilation coefficient (i.e., mean wind speed multiplied by mixing height); higher the ventilation coefficient, better the dispersion. In October, we have observed relatively high ventilation coefficient in eastern or lower Indo Gangetic Plain (4000 – 6000 m^2/s) compared to the upper or northern IGP (2000 – 4000 m^2/s) and it is the lowest in the country (Figure 3).

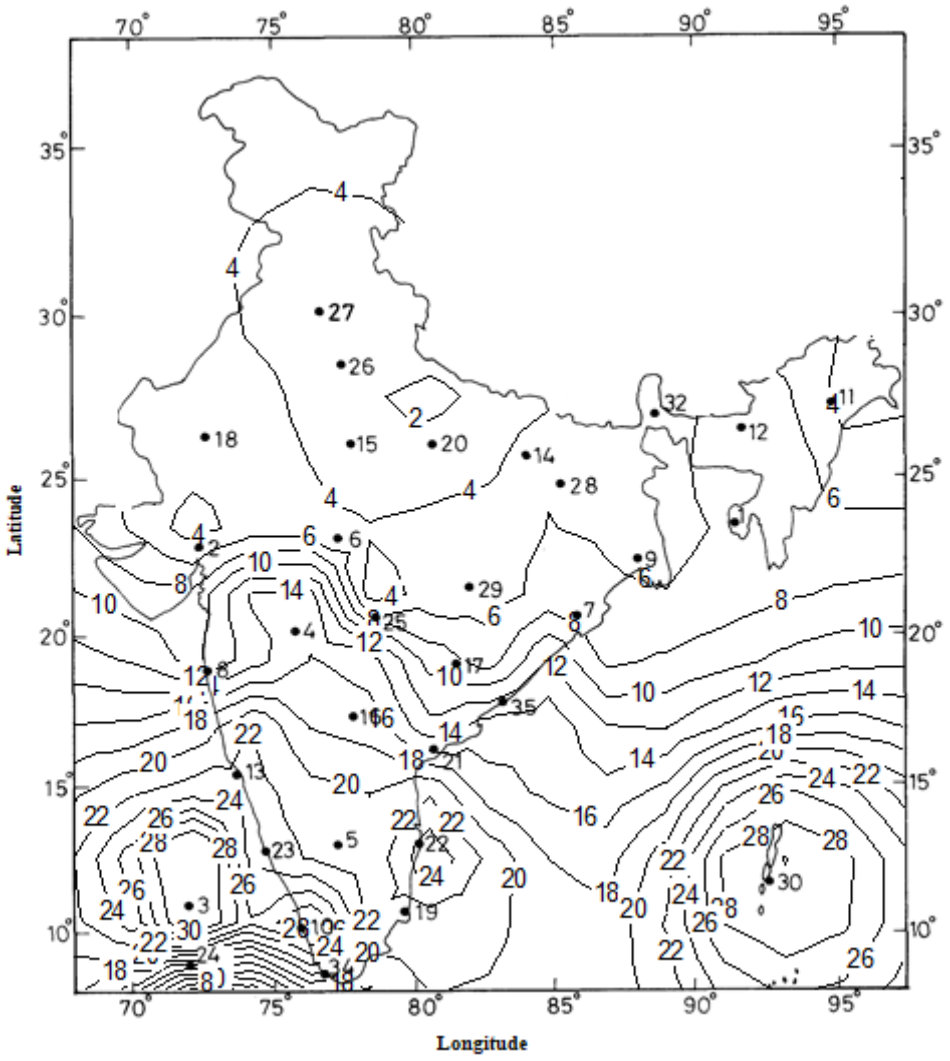


Figure 3: Spatial Distribution of Ventilation Coefficient (in 1000s m^2/s), October

State Wise Features

There are five States and two UTs in the Indian IGP. These are Punjab, Chandigarh, Haryana, Delhi, Uttar Pradesh, Bihar, and West Bengal. Some of the salient features are as described in Table 1.

Table 1: Demography (Census 2011), GDP and Installed Power Capacity of the States and UTs of IGP

State/UT	Area (Sq. km.)	Population (Lakh)	% Urban population	% Rural population	GDP (Lakh Cr.) (2018)	Installed power capacity (2018) (MW)
Punjab	50,362	277.04	37.5	62.5	5.18	13,432
Haryana	44,212	253.51	35	65	6.87	11,260
Uttar Pradesh	2,40,928	2000	22.5	77.5	14.88	24,909
Bihar	94,163	1041	11.5	88.5	5.15	4,341
West Bengal	88,752	913	32	68	10.4	10,518
Chandigarh	114	10.5	97.5	2.5	0.4	193.2
Delhi	1483	168	98	2	6.86	2100

Uttar Pradesh is the most populated and largest State among the identified areas and its population is almost ~ 40 % of the cumulative population of IGP States and UTs together. Among the States, highest fraction of urban population is in Punjab and lowest in Bihar. The GDP was found to be highest in Uttar Pradesh followed by West Bengal, Haryana, Punjab and lowest in Bihar. However, in terms of per capita GDP, Punjab and Haryana are way ahead than other States. Uttar Pradesh and West Bengal also exhibited higher value for the installed power capacity than the other States. Among the UTs, both Delhi and Chandigarh are almost urban areas with very high population density in Delhi. Interestingly, the GDP of Delhi is higher than the States of Bihar and Punjab and almost equal to Haryana.

2.2 Overall Methodology for Air Quality Management

2.2.1 Emission Inventory

Emission inventory (EI) is a basic necessity for planning air pollution control activities. EI provides a reliable estimate of total emissions of different pollutants, their spatial and temporal distribution, and identification and characterization of main sources. This information on EI is an essential input to air quality models for developing strategies and policies. In this section the emission inventory of the IGP for the year 2018 is presented.

The methodology used in this study for developing EI can be divided into two parts (Figure 4, represents a schematic diagram of the methodology adopted in this study). First the procedure used for determining regional emissions and uncertainty over the whole IGP, and second a robust approach for preparing district wise emission inventory. For determining regional emissions, multiple activity data and emission factors (EFs) available from published sources were collected for various emission sources. Wherever possible, a bottom-up approach from the block level was used to determine regional activity. For preparing the State wise gridded inventory, the emissions were determined within a Geographic Information System using polygons at the district level. An image of the political map of India (Census of India 2011) was georeferenced using Google Earth and all the districts within the Indo Gangetic Basin were digitized as polygons to generate a shape file. This shape file had an attribute table containing all the districts and yearly emission quantities were recorded for each district.

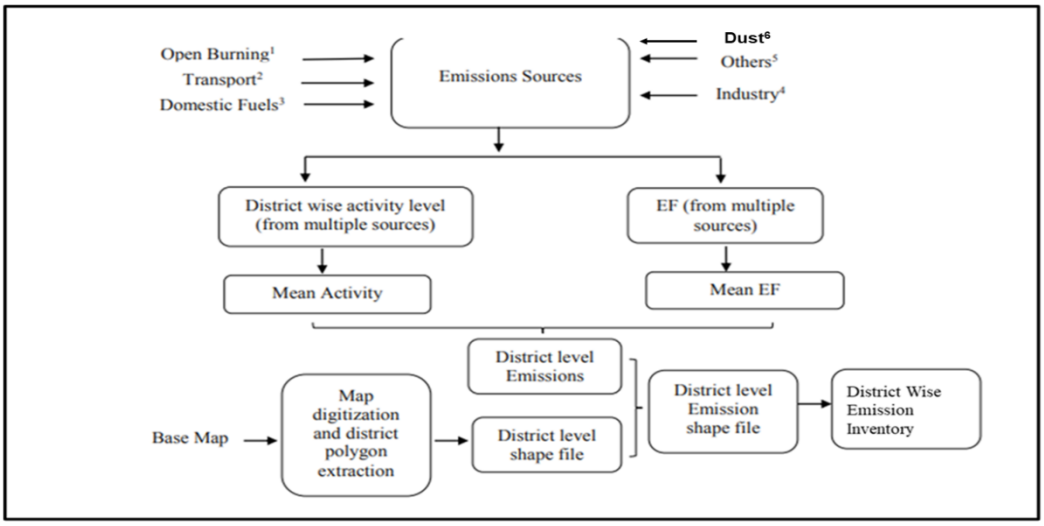


Figure 4: A schematic diagram for approaching state wise emissions inventory of different sectors over IGP

Following 6 broad sectors (Figure 4) have been considered for preparing the emission inventory; sources have been identified within the sector.

1. Open Burning: Forest fires, Crop residue burning and MSW burning
2. Transport: 2-wheeler, Car, Taxies, Truck, LMV, LCV, Bus and Tractor & Trailer, Railways, Aviation, Ships, Tractor and Construction equipment
3. Domestic Fuels: Dung Cake, Agricultural Residue, Firewood, Coal, Kerosene and LPG
4. Industry: Brick, Steel, Sugar, Cement, Coal washery, Aluminium and Power, MSME
5. Others: Construction Dust, Irrigation Pumps and Mobile Towers, Coal uses other than different industries and residential fuel
6. Soil and Road Dust

Emission from industrial sources in each grid was estimated as following:

$$E_I = \sum_i \sum_j (A_{i,j} \times \mathrm{EF}_{i,j}) \times \left(1 - \frac{\mathrm{ER}_{i,j}}{100}\right)$$

Where E_I is the mass emission of any air pollutant from industrial sources per day, i is the type of industry (e.g., boiler, cupola, smelter), j is the type of fuel used, A is the quantity of fuel use, EF is the emission factor and ER overall emission reduction efficiency of devices installed (in percentage). All industries in the IGP were identified to collect the relevant primary and secondary activity data. The State Pollution Control Boards/ Committees (SPCBs/PCCs) were requested to provide industry specific data in a pre-designed format and other sources (e.g., Paliwal et. al. 2016) were also utilized for data collection. The emission factors were mostly taken from the USEPA AP-42 (USEPA, 1996) in absence of factors developed in India.

Emission from fuel burnt in domestic cooking in each grid was estimated using the underneath equation:

$$E_d = \sum_i \sum_j (A_{i,j} \times \mathrm{EF}_{i,j})$$

Where E_d is mass emission of any pollutant per day from domestic cooking, hotel and restaurant, i is the type of source, j is the fuel type (e.g., LPG, coal, wood, and kerosene), A is

the activity data (i.e., mass consumption of fuel per day) and *EF* is mass emission factor. The emission factors were taken from the literature suitable for Indian conditions.

Emission from the vehicles was estimated using the following expression:

$$E_v = \sum (Veh_i \times D_i) \times EF_i$$

Where, E_v is pollutant mass emission per day, i is the vehicle category, *Veh* is number of vehicles, *D* is distance travelled in km in one day and *EF* is the mass emission factor for one kilometer (km) travel.

The emissions from other area sources will be estimated as

$$E_o = \sum_{\text{source\_cat}} (\text{Activity data}_{\text{source\_cat}}) \times (\text{Emission factor}_{\text{source\_cat}})$$

Where, E_o is the emission of any pollutant from all other source categories. The activity data for these sources were taken from the secondary data.

2.2.1.1 Activity Data

The five categories of emissions were further classified to various subsectors. For example, biomass burning includes: forest fire emissions, open solid waste burning, and agriculture residue burning. Transportation category included two wheelers, cars, light motor vehicles passenger (LMV), light commercial vehicles (LCV), taxies, trucks, buses, tractors & trailers, Railways, shipping and airways. Domestic fuels category includes emissions from firewood burning, agricultural residue, coal, liquid petroleum gas, etc. Industrial category includes brick industry, cement, steel plants, sugar mills, power plants, etc. Others category incorporates emissions from use of diesel in power generation for mobile towers and irrigation pumps.

Industries -

In this study iron and steel industry, cement plants, sugar industry, brick industry, coal washery, aluminum industry, power plants and MSMEs are considered. Major $PM_{2.5}$ emitting industries were identified and emissions were computed using their fuel consumption and production data as detailed below. Emissions of $PM_{2.5}$ from industries were identified and emissions were calculated using activity data from SPCBs and other sources.

Cement Manufacturing

Plant wise cement production in 2018 was taken from Cement Manufacturers Association. The district wise cement production was computed according to the location of these plants. Since plant wise coal consumption was not available, the national consumption by cement industry was taken from the same source. The fuel consumption was distributed district wise according to their cement production in 2018.

Sugar Mills

India ranks second globally in terms of sugar production. Significant $PM_{2.5}$ and black carbon (BC) emissions result from sugar mills due to the usage of bagasse as a fuel. Bagasse is the fibrous residue obtained from sugarcane juice extraction and consists of cellulose (50 %), hemicellulose (25 %) and lignin (25 %) (Ezhumalai and Thangavelu, 2010; Abhilash and Singh, 2008). From the Sugar Annual Gains Report, 2017, net production and activity data were extracted and assumed to be same in 2018. The total sugarcane crushed was distributed among mills according to their crushing capacity. The bagasse generated was taken as 30 % of the total sugarcane crushed (Pessoa et al., 1997).

Iron & Steel

The amount of Iron & Steel produced in India and consumption of coal for finalizing steel were taken from the annual report of the Ministry of Steel (Ministry of Steel, 2018-19). The plant-wise steel production data was taken from Press Information Bureau, Govt. of India. The coal consumption was distributed among plants according to their steel production. District wise coal consumption in steel plants was subsequently determined from the location of these plants.

Brick Kilns

Bricks in IGP are produced locally in small enterprises at rural scale (Rajaratnam et. al. 2014). It is a seasonal industry operating predominantly from months of October to June (Maithel et. al. 2012). Brick kilns can be classified into two major categories based upon firing practice: intermittent and continuous kilns. Intermittent kilns include Clamp, Scove, Scoth and Down Draft Kilns (DDK). In these kilns bricks are fired in batches. In continuous kilns brick heating and cooling takes place simultaneously in different parts of the kiln. It includes Bull's Trench Kiln (BTK), Hoffman Kiln, Zig Zag Kiln, Tunnel Kiln and Vertical Shaft Brick Kiln (Heierli and Maithel, 2008). In India, majority of the bricks are produced from Fixed Chimney Bull's Trench Kiln (FCBTK) and clamps (Rajaratnam et. al. 2014). For

this study, emissions only from FCBTK's are used (For Delhi NCR only Zig-Zag technology) which account for 70 % of the total bricks produced from IGP and use coal as the primary fuel (Weyant et. al. 2014). The state-wise brick production (in Kg) through these kilns was compiled from consultation with industry experts. It was distributed district wise according to the population of the districts in the state.

Power Plants

For activity data from power plants, Central Electricity Authority (CEA 2018) reports were referred for plant-wise fuel consumption in coal and diesel power plants of India. District-wise fuel consumption was estimated by the location of these plants.

Currently, in India only large-scale industries are equipped with highly efficient equipment, viz., ESPs and bag filters. Based on expert consultation and collected secondary data during the present study, it was found that the efficiency of the control equipment as high as 99 % (e.g., ESP and bag filters), which are rarely used in small- and medium-scale industries. Most of these industries use cyclones (60 %), multi-cyclones (80 %) and dust collectors (10 %). Many of the small and medium-scale industries may operate without or poorly maintained Air Pollution Control Devices (APCDs). Based on this background, it was assumed that all micro- and small-scale industries were equipped with APCDs with efficiency of 40 % and medium-scale industries were equipped with APCDs with efficiency of 70 % (TERI, 2016).

To estimate the emission of $PM_{2.5}$ from MSMEs, the following methodology has been adopted:

Available data on MSMEs were obtained from SPCBs/PCCs in different districts of the IGP. The common fuels used in MSMEs include LSHS, FO, LDO, HSD, LPG, PNG (industries of Delhi are on PNG only) and coal. From this activity data and the emission factors of different fuels used in MSMEs (TERI, 2016), we have calculated the emissions in different districts of the IGP as described below.

The total area of the IGP was estimated as 530×10^3 sq. km and the total number of districts in IGP is 179. Taking an approximate emission intensity of 2 Gg/3000 Sq. km/year (derived from TERI, 2016), we estimated the total emission from the IGP as 350 Gg/year. From CPCB and various SPCBs/PCCs, we have collected the number of MSMEs in each district. Total emissions from the IGP due to MSMEs were then distributed according to the number of MSMEs in each district and plotted in GIS.

Domestic Sector

Domestic fuels are known to be one of the major sources of $PM_{2.5}$ in developing countries. Consumption data of all residential fuels like coal, firewood, dung, kerosene, LPG were taken from National Sample Survey (Petroleum Planning and Analysis Cell, MoPNG, 2016) and same was assumed for the year 2018. It is well known that vast Indian population is dependent on solid fuels for cooking. It is evident that household cooking was a major source of $PM_{2.5}$, particularly from rural areas. With the launch of PMUY in May 2016, the rural emission scenario from the households has dramatically changed. There were over 80 million new connections under this scheme by September 2019 (MoPNG, 2019). This is a massive scheme and has several benefits not only to women cooking in the rural areas for better indoor air quality but also it helps improve outside air quality and reduce high background pollution all over the country.

We have used the reported data that 60 % households now use LPG and rest still rely on solid fuels (NSO Survey Report, 2018). It was further assumed that a household of five person uses 10 LPG cylinders per year and non-LPG users consume on average 90 kg of solid fuel per month (MoPNG, 2016). The $PM_{2.5}$ emissions were estimated based on LPG and solid fuel uses by the above sated activity data and suitable emission factors.

Transport Sector

Road Transport: Under this category, emissions from road vehicles, railways and aviation have been accounted for individually in this inventory. Road vehicles have been divided into 07 categories; two wheelers, cars, LMV, LCV, taxies, trucks, buses and tractors & trailers. State-wise number of registered vehicles in the aforementioned categories were taken from Ministry of Road Transport and Highways (MoRTH Report 2018). Vehicles were distributed among districts according to their population. In determining the emissions for 2018, an estimate of the number of vehicles on road for that year was required. The reported number of registered vehicles represent the cumulative number of first-time registrations (Parikh and Radhakrishna, 2005). In India, vehicles are neither deregistered when they are no longer in use nor are double registrations deducted. The actual number of vehicles on the road is significantly smaller than the number of registered vehicles. Baidya and Borken-Kleefeld, (2009), determined the rolling fleet in 2005 using a survival functions method. The category-wise number of vehicles on road as a fraction of registered vehicles was taken from Baidya

and Borken-Kleefeld, (2009). Emissions from road were determined using the number of vehicles on road and the annual distance travelled per vehicle type.

Emissions from road vehicle have been determined using Equation given below,

$$E_v = \sum_i (V_i \times AKT_i \times EF_i)$$

Were,

E_v = Total $PM_{2.5}$ emissions from different categories of vehicles in a district

V_i = Number of vehicles of category i

AKT_i = Annually kilometers travelled by category I

EF_i = Emission factor of category i

Soil & Road Dust -Dust emissions from paved and unpaved roads vary with the 'silt loading' present on the road surface and the average weight of vehicles traveling on the road. The term silt loading (sL) refers to the mass of the silt-sized material (equal to or less than 75 μm in physical diameter) per unit area of the travel surface. The quantity of dust emissions from the movement of vehicles on a paved or unpaved road can be estimated using the following empirical expression:

$$E_{ext} = [k(sL)^{0.91} \times (W)^{1.02}](1 - P/4N)$$

Where,

E = particulate emission factor (having units matching the units of k),

sL = road surface silt loading (grams per square meter) (g/m^2), and

W = average weight (tons) of the vehicles traveling the road.

E_{ext} = annual or other long-term average emission factor in the same units as k,

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and

N = number of days in the averaging period.

k: constant (a function of particle size) in g VKT^{-1} (Vehicle Kilometer Travel).

Some experimental data from various parts of the IGP have reported an average 8.0 gm silt load per sq. m. An estimate to the extent possible was made to assess VKT for various vehicle and vehicle weight for estimating $PM_{2.5}$. The control measures for road traffic exhaust

emissions can be substantially reduced but non-exhaust emissions from road vehicles cannot be abated. Soil and road dust include emissions from tire wear, brake wear, re-suspension in the wake of traffic and road surface abrasion.

Open Burning

All the three sub-categories namely, municipal solid waste, crop residue burning and forest fire for year 2017-18 have been calculated. Paliwal et. al., (2016 have estimated Black Carbon emission from these sources. The clack carbon fraction was combined with U.S. EPA SPECIATE repository to calculate $PM_{2.5}$ emissions from these sectors. In addition to MSW $PM_{2.5}$ emissions due to open burning of MSW in landfills were also considered. Indian MSW composition is given in Table 2.

Table 2: Physical Composition of Municipal Solid Waste

YEAR	COMPOSITION (%)							
	Biodegradables	**Paper**	**Plastic / Rubber**	**Metal**	**Glass**	**Rags**	**Others**	**Inerts**
1996	42.21	3.63	0.60	0.49	0.60	-	-	45.13
2005	47.43	8.13	9.22	0.50	1.01	4.49	4.016	25.16

Crop Residue Burning

There are mainly two types of crops sown in IGP, Rabi crops and Kharif crops. Rabi crops sown in winter (Oct- Dec) and Kharif crops are sown in monsoon (May- July). During April - May and October - November crop residues are burnt for clearing the land. In atmospheric emission inventories, the crops generally considered are wheat, rice, total pulse, sugarcane, coarse cereals, cotton, jute, oilseeds and mesta. Total pulse includes pigeon pea, gram, split green gram, spit black gram and coarse cereals includes sorghum, pearls, millet, maize and barley. Rice straw is burn in fields because farmers do not prefer to use it as fodder for cattle. In this study for calculation of crop residue burning, Jowar, Cotton, Jute, Barley, Rice, Bajra, Ragi, Groundnut, Wheat, Sugarcane and Rapeseed & Mustard have been considered. The

production of all these crops were taken from Ministry of Agriculture and Corporation (2017) and are distributed at district level according to net sown area.

Other Sectors

Mobile Towers: According to Press of Information Bureau, India has more than half million towers which are mostly located in villages, where gridded connection electricity is not available. So, they used diesel as fuel. Diesel consumption from these generator (DG) sets was considered for the estimating the emissions as per TRAI (2017) and projected to districts according to population.

Irrigation Pumps: In India pump sets are used in agriculture, domestic, construction and industry sectors. In agriculture these pumps sets are used for irrigation purpose. Due to lack of electricity supply farmers used diesel as fuel for irrigation pumps. However, many farmers are ignoring the fact that using technologically efficient pumps will be beneficial to them because of less fuel use. The usage of irrigation pumps and estimated diesel consumption were calculated from the report of MoPNG 2018.

Construction Dust: Dust is defined as all particles of size up to 75 µm (according to BS6069). The emissions from construction can also be estimated using the following equation given by AP 42 (US EPA, 2000). In this equation activity data is area (m^2).

E = 1.2 tons/ acre/ month of activity (tons/m^2/month)

In this study emission from construction has been estimated by using construction emission occurred in Delhi (Mukesh Sharma and Onkar Dikshit, Jan 2016) and cement consumption in year 2017-18 and the district level emission is distributed by population fraction.

2.2.2 Methodology to Identify the Technologies for Industrial Emission Control in Indo-Gangetic Plain

In Indo-Gangetic Plain (IGP), air emissions are majorly contributed from eight major types of industries and micro small and medium enterprises (MSME). The major industries are brick kilns, coal power, coal washeries, cement industries, steel industries, aluminum industries, sugar industries. The total industrial emission is highest in Uttar Pradesh followed by Bihar, West Bengal, Haryana, Punjab, Delhi and Chandigarh. In all States, the major polluting industries are brick kilns, coal power, MSME, and sugar industries. State-wise analysis

shows that Brick kilns are the major sources in Uttar Pradesh and Punjab while MSME in other States. In West Bengal, emissions from coal power are equivalent to MSME.

The methodology to reduce industrial emissions is provided in the flow chart (Fig 05). The first step is to identify the existing technology in industries. In India, many industries are still using old technology due to lack of understanding and proper training. For example in some parts of the IGP states brick kilns are of Fixed Chimney bull trench type which emits high pollution and have low efficiency. It should be replaced by Zig- zag technology which emits comparatively less pollution and produces higher quality bricks (New Brick Kiln notification is enclosed at Annexure - III).

Use clean fuels like piped natural gas (PNG), low sulfur coal, and agriculture residue. Presently, some of the units may be using industrial waste like tires, plastic and low-quality coal (lignite).

The emission standards and required stack height for each industry have been provided by the Ministry of Environment, Forest and Climate Change (MoEFCC). Therefore, it is necessary to ensure that the industries should follow these norms. If the emissions are higher than the required limit, various emission control methods can be used. The PM emissions can be controlled using fabric filters (FF), electrostatic precipitator (ESP), mechanical collectors (MC) and venturi scrubbers (VS). Advantages of the FF include high particle collection efficiency for a wide particle size range, high-level of reliability, resistance to flow changes because of these reasons FF is preferred on ESP. Some FFs have efficiency of removing 99.9 % particulates. MC are efficient for PM greater than 20 microns. Below 20 microns the collection efficiency drops and it is almost negligible below 5 microns. The efficiency of VS for very small particles is much lower. VS generate a wastewater stream which is needed to be subjected to treatment before discharge. NOx emissions can be controlled through selective/nonselective catalytic reduction method. Selective catalytic reduction can remove 70-90 % of NOx while nonselective catalytic reduction can remove 80-90 % of NOx. The SO_2 emissions can be controlled using wet and dry gas desulphurization methods. The methods (Figure 5) to avoid fugitive emissions should also be adopted.

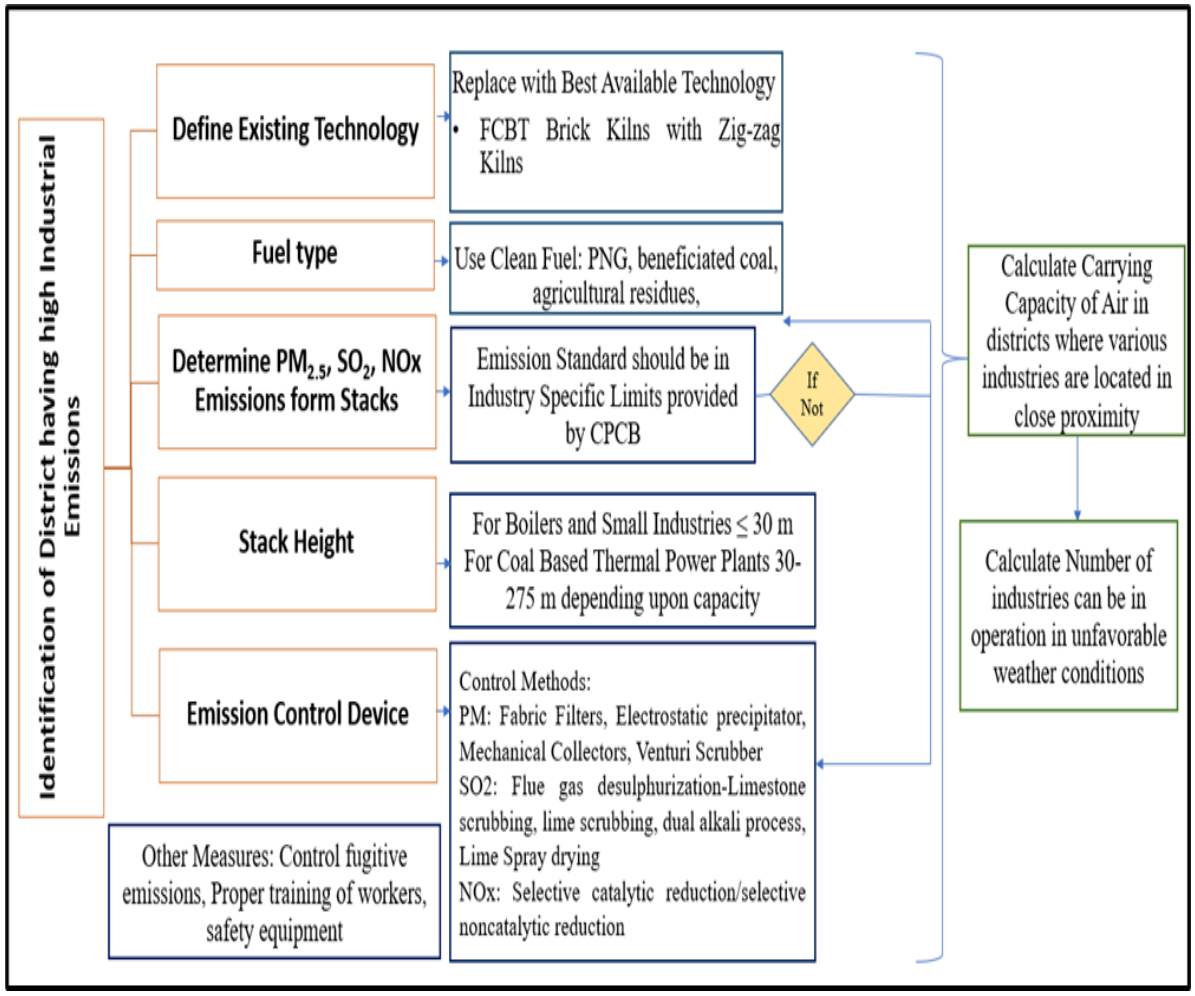


Figure 5: Schematic diagram of how to identify the number and types of Industries which can be operative in unfavorable weather condition

2.2.3 Analysis of Ambient Air Quality Data

Atmospheric Particulate Matter (PM) originates from various sources (both natural and anthropogenic). PM is a complex mixture of different chemical species. The sources of PM in ambient air include anthropogenic sources such as vehicles, industrial activities, domestic activities & combustion processes; and natural sources such as wind-blown dust, sea salt, forest fires & volcanic eruptions. One site (Amritsar, Murthal, New Delhi (ITO), Lucknow, Patna & Kolkata) is selected from each state & UT (Punjab, Haryana, Delhi, Uttar Pradesh, Bihar & West Bengal) to represent the characteristic of complete IGP (Devi et al., 2020). The Map for Selected sites is shown in Figure 6.

Figure 6: Selected Sites for representation of Air Quality Status in IGP

The data for year 2019 is selected for representation of air quality status in IGP plain, the data for years 2020 and 2021 can cause biasness in our analysis due to Covid 19 pandemic and lockdown periods in both years. The data for year 2019 will be more representative for analyzing the air quality trends in IGP. The data for year 2019 is collected from CPCB air quality data management portal (https://app.cpcbccr.com/ccr/#/caaqm-dashboard-all/caaqm-landing). The seasonal variation of the PM levels is done based on seasonal bifurcation given by Sharma et al., 2021; Kumar et al., 2017. There are four major seasons Winter (Dec-Feb), Summer (Mar-May), Monsoon (Jun-Aug) and Post-Monsoon (Sep-Nov). The analysis of the collected data for seasonal variation is done on the basis of this bifurcation.

2.2.4 Identification of PM hotspots using satellite observations

The research employed satellite-based $PM_{2.5}$ exposure calibrated to ground-based observations. Moderate Resolution Imaging Spectroradiometer (MRIS) data were used to determine surface $PM_{2.5}$ concentrations (MODIS). MODIS can recover AOD at 10-km, 3-km, and 1-km spatial resolutions. In this study, we used the Multiangle Implementation of Atmospheric Correction (MAIAC) technique to recover AOD at 1-km resolution and converted it to $PM_{2.5}$ using geographically and temporally changing scaling factors (i.e., $PM_{2.5}$/AOD) from MERRA-2 data. The MERRA-2 scaling factors were compared to ground-

based observations of CPCB locations. MERRA-2's diurnal scaling factor (i.e., the ratio of 24-hr $PM_{2.5}/PM_{2.5}$ during the satellite overpass) was used to transform the satellite-derived instantaneous $PM_{2.5}$ to 24-hr average $PM_{2.5}$ (Joshi et al. 2021). The satellite-derived daily (24-h average) and annual $PM_{2.5}$ show a R^2 of 0.8 and 0.97 and root mean square error of 25.7 and 7.2 $\mu g/m^3$, respectively against surface measurements from the Central Pollution Control Board India network. More details about the retrieval of $PM_{2.5}$ from satellite data, calibration, and validation are available in (Dey et al. 2020). The satellite derived $PM_{2.5}$ product is accessible from our data portal (www. saans.co.in).

Chapter 3: Ambient Air Quality Data Analysis

3.1 Seasonal Variation of $PM_{2.5}$ in IGP

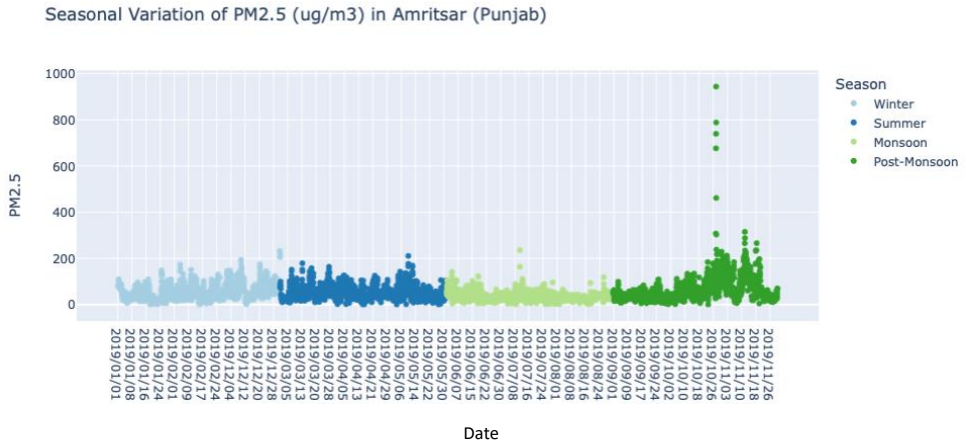
Table 3 shows the seasonal variation of $PM_{2.5}$ in IGP. The maximum concentration is observed in winter seasons on all sites except Amritsar, Punjab which is on the border of India-Pakistan. The maximum concentration during winter season is observed in Patna, Bihar (208 µg/m^3) followed by New Delhi (ITO) (176 µg/m^3); Kolkata, West Bengal (175 µg/m^3); Lucknow, Uttar Pradesh (119 µg/m^3); Murthal, Haryana (85 µg/m^3) and Amritsar, Punjab (53 µg/m^3). The concentration during post-monsoon is observed to be more than summer and monsoon season but less than winter season except for Amritsar, Punjab site where concentration during post-monsoon season is higher than winter season.

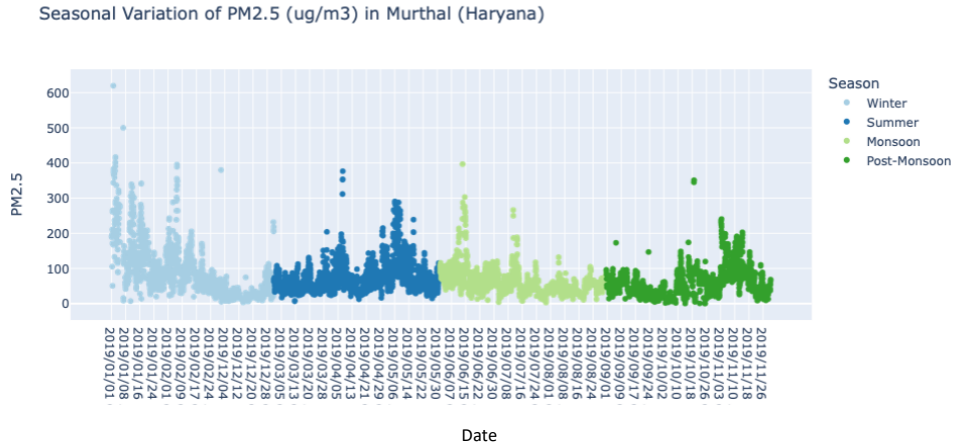
The maximum concentration during post-monsoon season is observed in New Delhi (ITO) (125 µg/m^3) followed by Patna, Bihar (116 µg/m^3); Lucknow, Uttar Pradesh (87 µg/m^3); Kolkata, West Bengal (66 µg/m^3); Amritsar, Punjab (64 µg/m^3) and Murthal, Haryana (58 µg/m^3). The concentration during summer season is only higher than monsoon season. The maximum concentration during summer season is observed in New Delhi (ITO) (87 µg/m^3) followed by Lucknow, Uttar Pradesh (83 µg/m^3); Murthal, Haryana (73 µg/m^3); Patna, Bihar (66 µg/m^3); Kolkata, West Bengal (64 µg/m^3) and Amritsar, Punjab (52 µg/m^3). The concentration during monsoon season is lowest at all sites. The maximum concentration during monsoon season is observed in Murthal, Haryana (59 µg/m^3) followed by New Delhi (ITO) (51 µg/m^3); Kolkata, West Bengal (38 µg/m^3); Lucknow, Uttar Pradesh (37 µg/m^3) & Patna, Bihar (37 µg/m^3); and Amritsar, Punjab (35 µg/m^3).

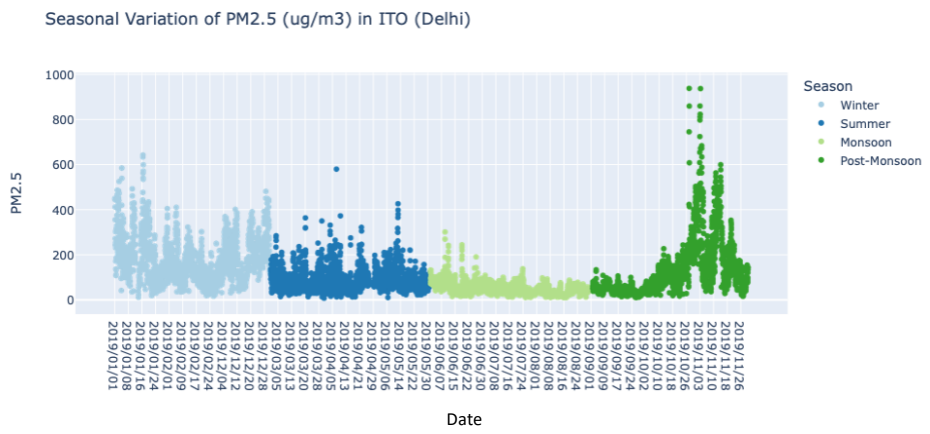
Table 3: Seasonal Variation of $PM_{2.5}$ (in µg/m^3) in IGP

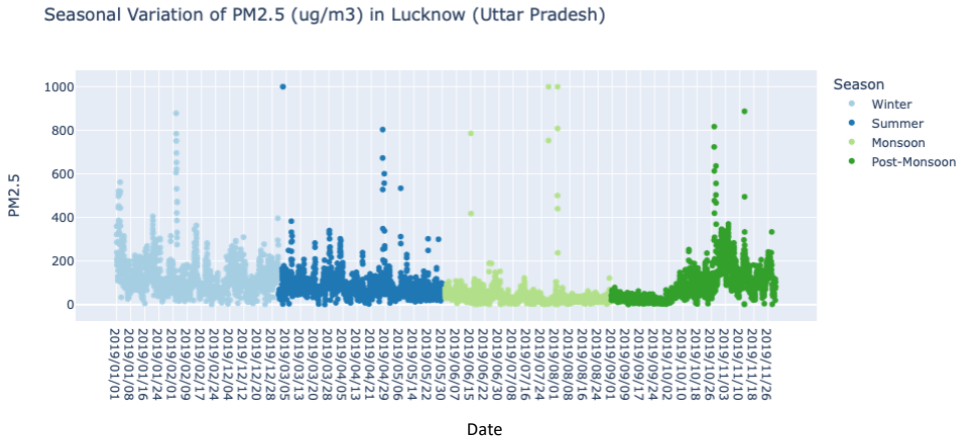
Site	Winter	Summer	Monsoon	Post-Monsoon
Amritsar, Punjab	53	52	35	64
Murthal, Haryana	85	73	59	58
New Delhi (ITO)	176	87	51	125
Lucknow, Uttar Pradesh	119	83	37	87
Patna, Bihar	208	66	37	116
Kolkata, West Bengal	175	64	38	66

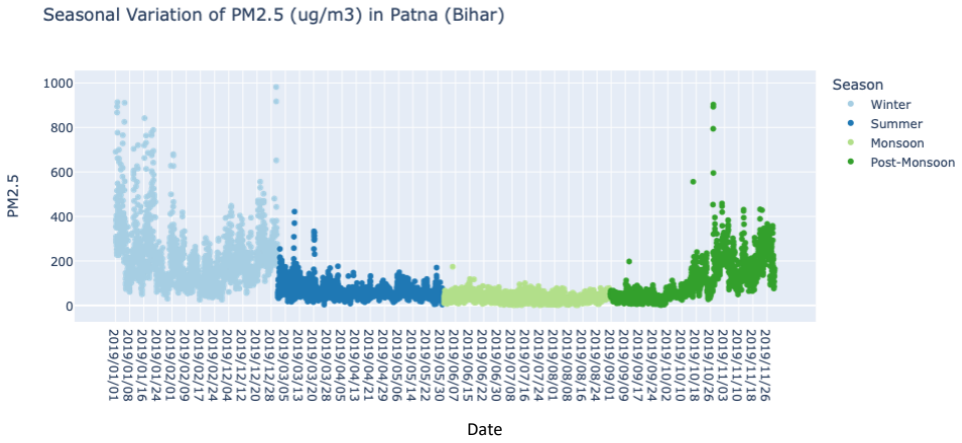
The timeline series-plot for the seasonal variation of $PM_{2.5}$ for all sites are given in Figure 7 The time series plot for winter season i.e., January, February & December are clubbed together in starting of the plot for better representation of seasonal variation of $PM_{2.5}$. In time series plot of $PM_{2.5}$ there are peaks observed in post-monsoon season in Amritsar, Punjab site; the peak observed is during the stubble burning season. During the stubble burning period, peaks are observed in all the sites i.e., New Delhi (ITO), Lucknow, Patna, Kolkata during the same week except at the Murthal site, where very high concentration of $PM_{2.5}$ during stubble burning is not observed.






Seasonal Variation of PM2.5 (ug/m3) in ITO (Delhi)
PM2.5
Date
Season
Winter
Summer
Monsoon
Post-Monsoon


Seasonal Variation of PM2.5 (ug/m3) in Lucknow (Uttar Pradesh)
PM2.5
Date
Season
Winter
Summer
Monsoon
Post-Monsoon


Seasonal Variation of PM2.5 (ug/m3) in Patna (Bihar)
PM2.5
Date
Season
Winter
Summer
Monsoon
Post-Monsoon

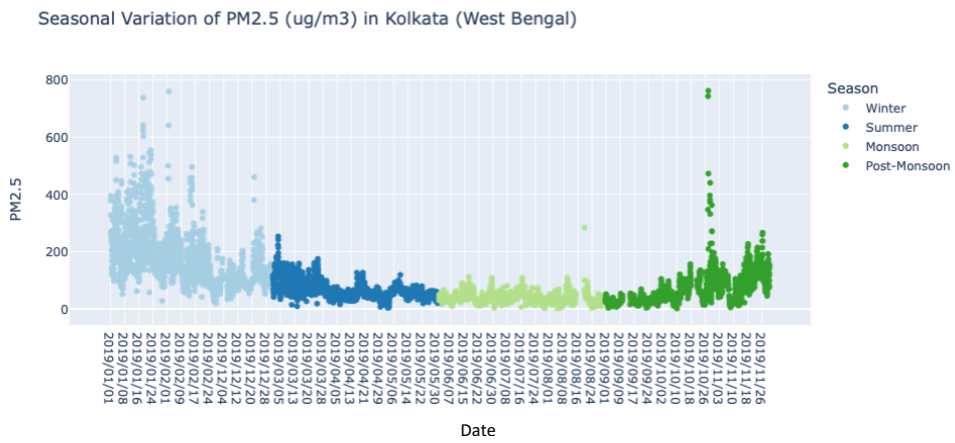


Figure 7: Seasonal Variation of PM2.5 in IGP sites

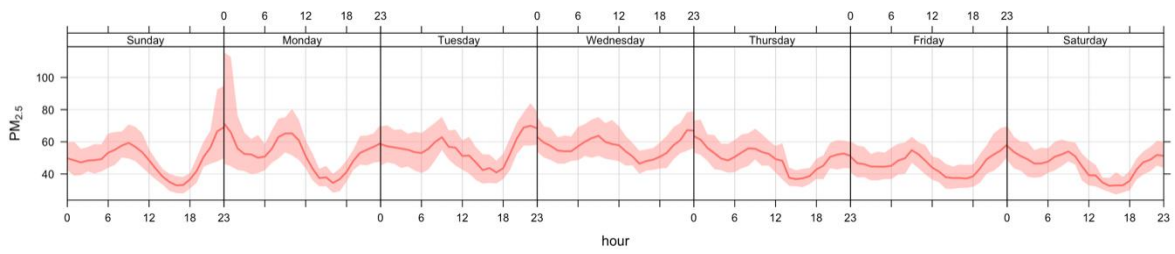
3.2 Annual & Diurnal Variation of $PM_{2.5}$ in IGP

Table 4 shows the annual average of $PM_{2.5}$ in IGP. The highest concentration among all the sites in IGP is observed in New Delhi (ITO) (109 µg/m^3) followed by Patna, Bihar (106 µg/m^3); Kolkata, West Bengal (85 µg/m^3); Lucknow, Uttar Pradesh (81 µg/m^3); Murthal, Haryana (69 µg/m^3) and Amritsar, Punjab (51 µg/m^3).

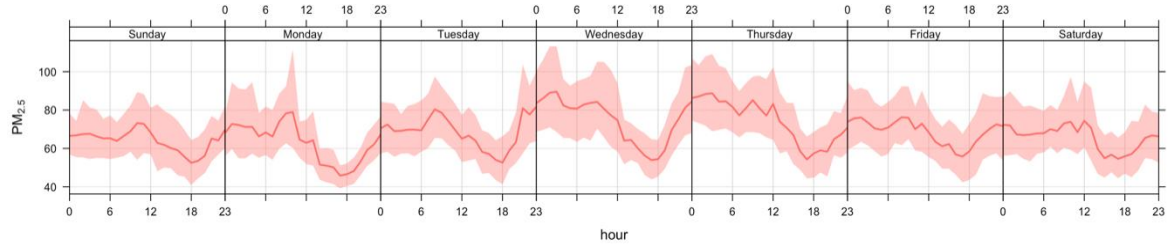
Table 4: Annual Concentration of $PM_{2.5}$ in IGP

Site	**Annual Average (µg/m^3)**
Amritsar, Punjab	51
Murthal, Haryana	69
New Delhi (ITO)	109
Lucknow, Uttar Pradesh	81
Patna, Bihar	106
Kolkata, West Bengal	85

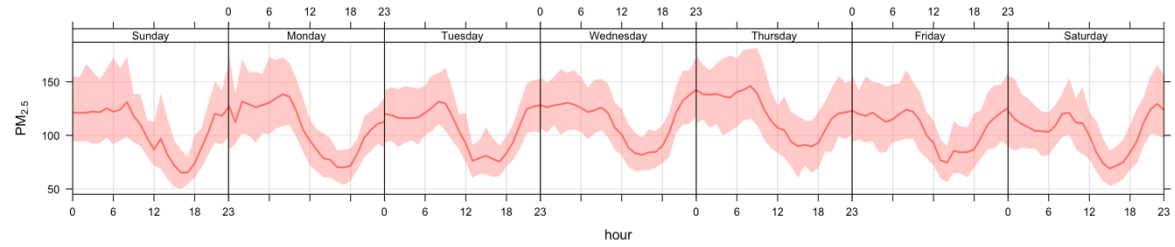
Figure 8 shows the diurnal variation of $PM_{2.5}$ during all the week for all the sites. The data for hourly concentration of $PM_{2.5}$ during every day in the week is averaged and plotted for visualization of $PM_{2.5}$ variation. The solid area around the average line is the standard deviation of the data.



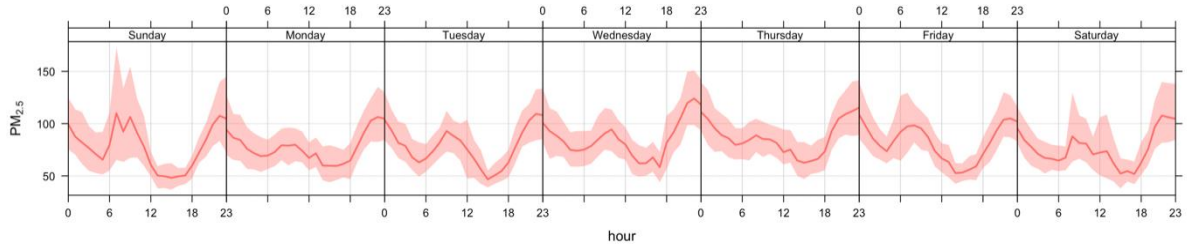
Amritsar, Punjab



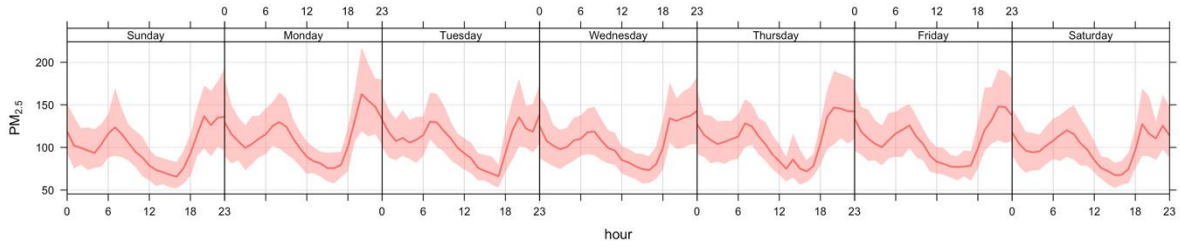
Murthal, Haryana



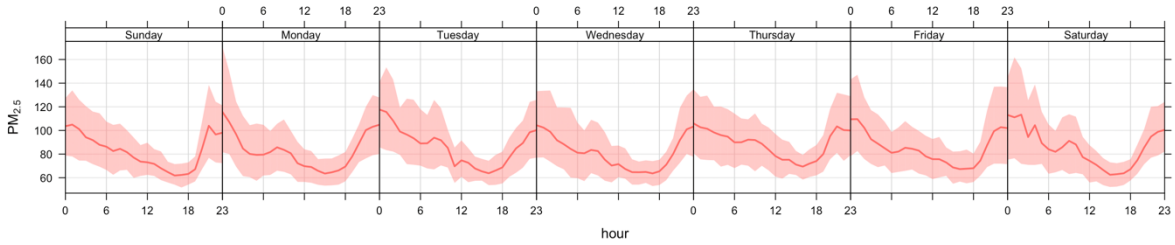
New Delhi (ITO)



Lucknow, Uttar Pradesh



Patna, Bihar

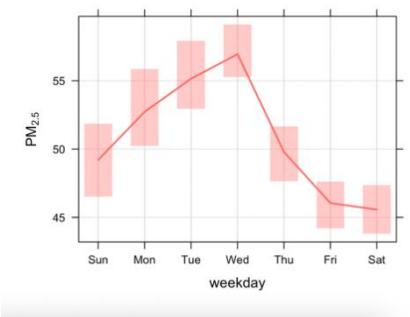


Kolkata, West Bengal

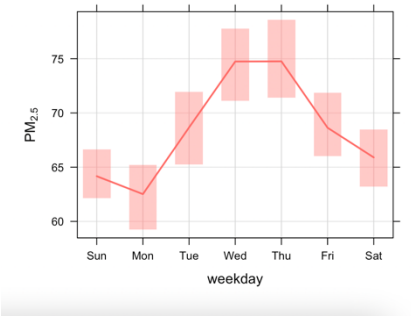
Figure 8: Weekly Diurnal Variation of $PM_{2.5}$ in IGP (Annual)

The weekly diurnal variation plots for sites across IGP shows that the concentration of $PM_{2.5}$ is lowest during the day between 12:00-18:00 hrs, after 18:00 hrs the concentration of $PM_{2.5}$ starts increasing and peaks around midnight. During night hours (0:00-06:00_ the concentration of $PM_{2.5}$ does not show much variation. Between 6:00-12:00 hrs, the concentration shows variation due to morning peak hours, the peaks are generally observed between 08:00-10:00 hrs and afterwards the $PM_{2.5}$ concentration keeps decreasing till 18:00 hrs.

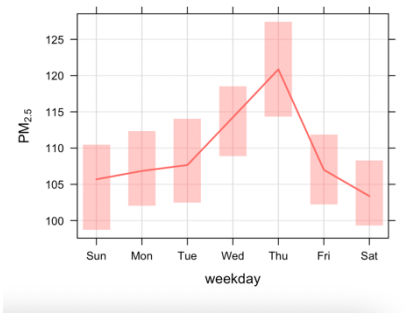
Figure 9 shows the boxplots for average concentration of $PM_{2.5}$ during the different dates of the week. The maximum concentration variation in during the days of the week is observed in New Delhi (ITO) site. The maximum $PM_{2.5}$ concentration is generally observed on Thursday on all sites except Amritsar & Patna. The minimum $PM_{2.5}$ concentration is generally observed on Saturdays on all sites except Murthal & Kolkata. The weekday and weekend effect can be observed on almost all sites. The minimum concentration variation of $PM_{2.5}$ during the days of the week is observed on Amritsar site.



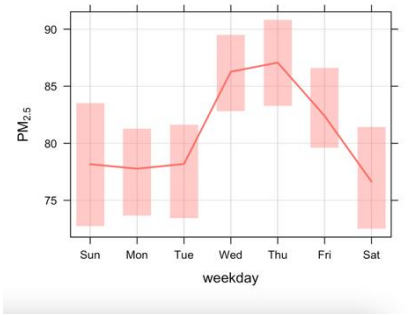
Amritsar, Punjab



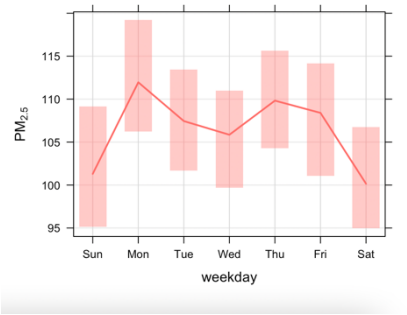
Murthal, Haryana



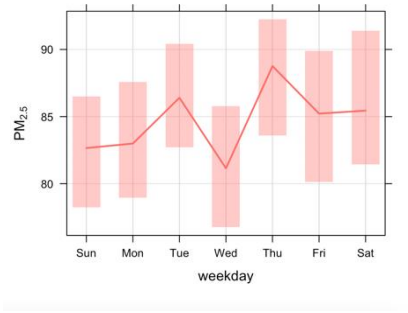
New Delhi (ITO)



Lucknow, Uttar Pradesh



Patna, Bihar



Kolkata, West Bengal

Figure 9: Boxplot for weekday concentration variation of $PM_{2.5}$ in IGP

3.3 Spatial distribution of $PM_{2.5}$ from Aerosol Optical Depth (AOD) over IGP (Identification of poor air quality regions, Identification of aerosol hot spots in IGP):

While the highest $PM_{2.5}$ was observed in the winter (DJF) and the lowest $PM_{2.5}$ was observed in the monsoon (JJAS). One of the factors for the wintertime peak $PM_{2.5}$ pollution is due to poor weather conditions that limit dispersion and so enhance loading of $PM_{2.5}$ pollution near to the surface (Lawrence and Lelieveld 2010). Moreover, winter season establishes a linkage between regional solid-biomass fuel use and crop residue burning activities within IGP region (Ravindra et al. 2022). Furthermore, during the monsoon season, the particles are carried away by the rain. Despite this, most days in the IGP area had $PM_{2.5}$ levels above the 24-hour WHO–AQG (25 g/m^3), indicating the problem's severity (Dey et al. 2020).

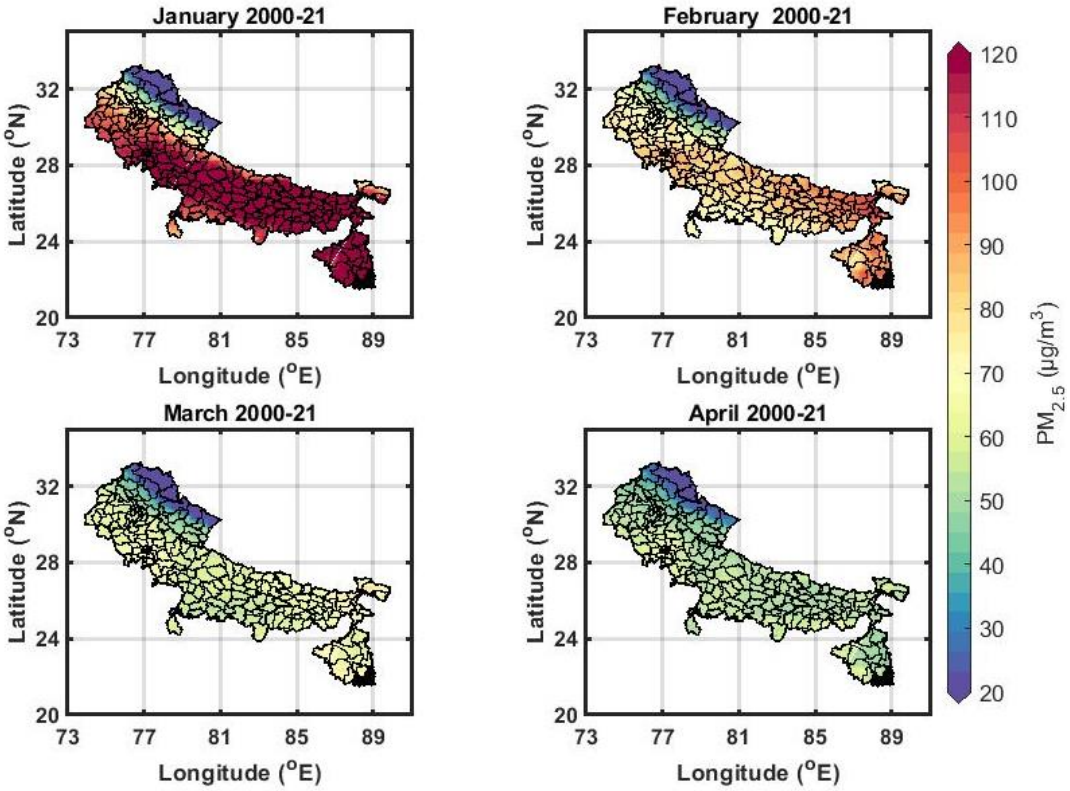


Figure 10: Spatial maps of satelite-$PM_{2.5}$ - monthly climatology (2000-21) for month Jan-April.

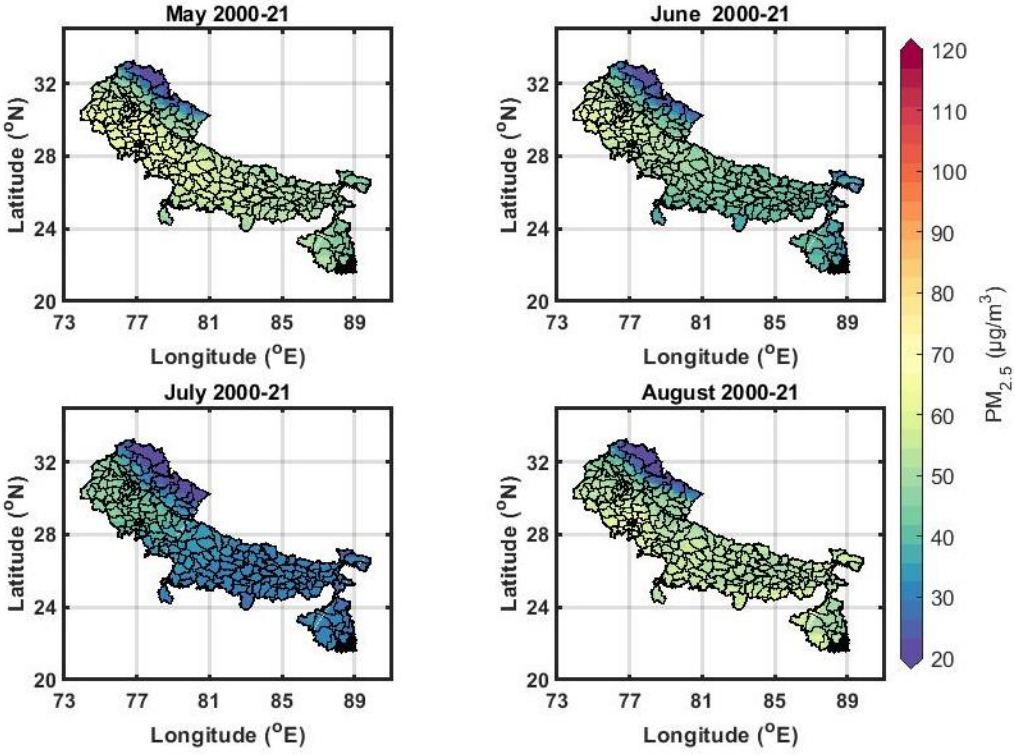


Figure 11: Spatial maps of satelite-$PM_{2.5}$ - monthly climatology (2000-21) for month May-August.

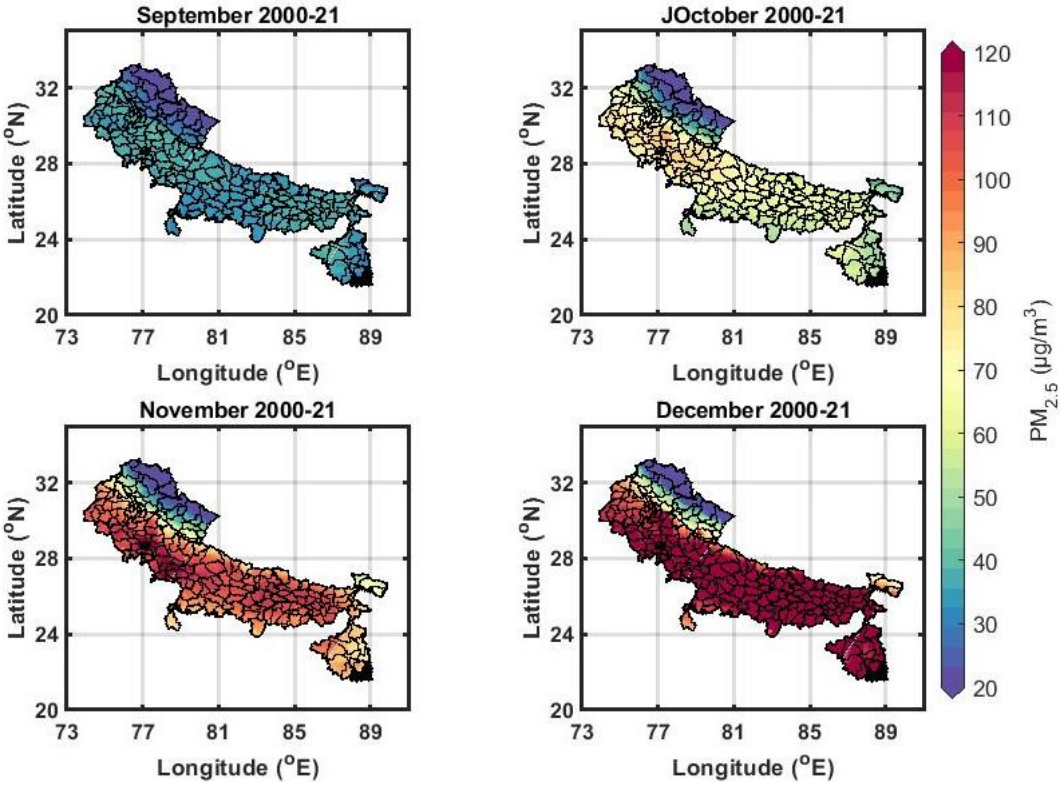


Figure 12: Spatial maps of satelite-$PM_{2.5}$ - monthly climatology (2000-21) for month Sep-Dec.

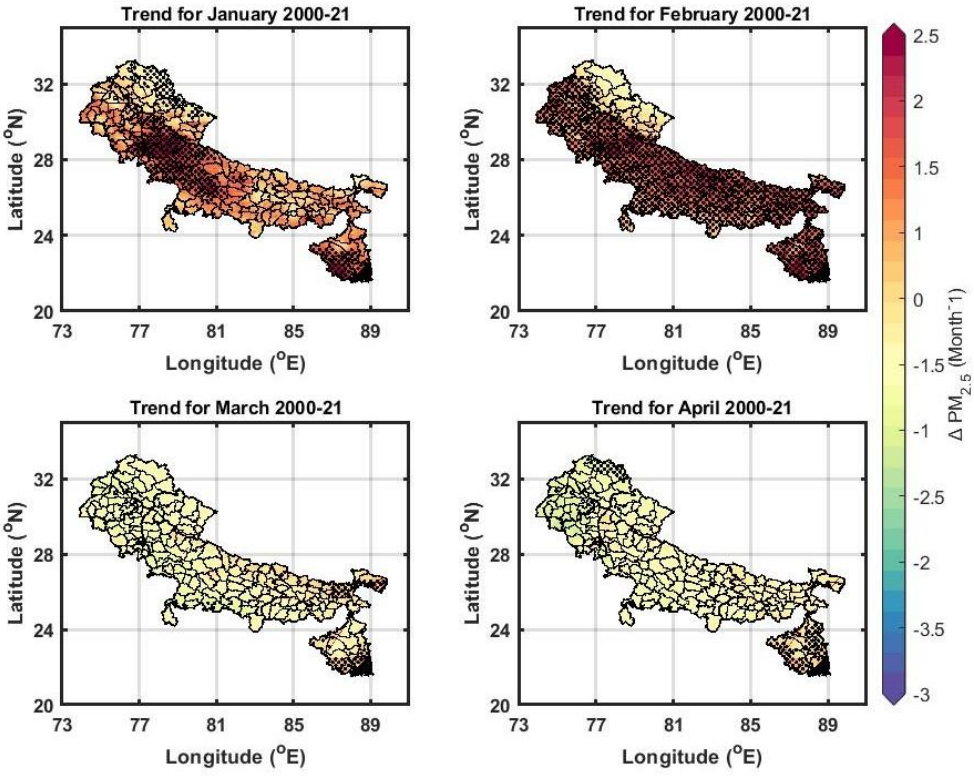


Figure 13: Spatial patterns of the monthly rate of changes in $PM_{2.5}$ (in µg/m^3 per month) for Jan-April.

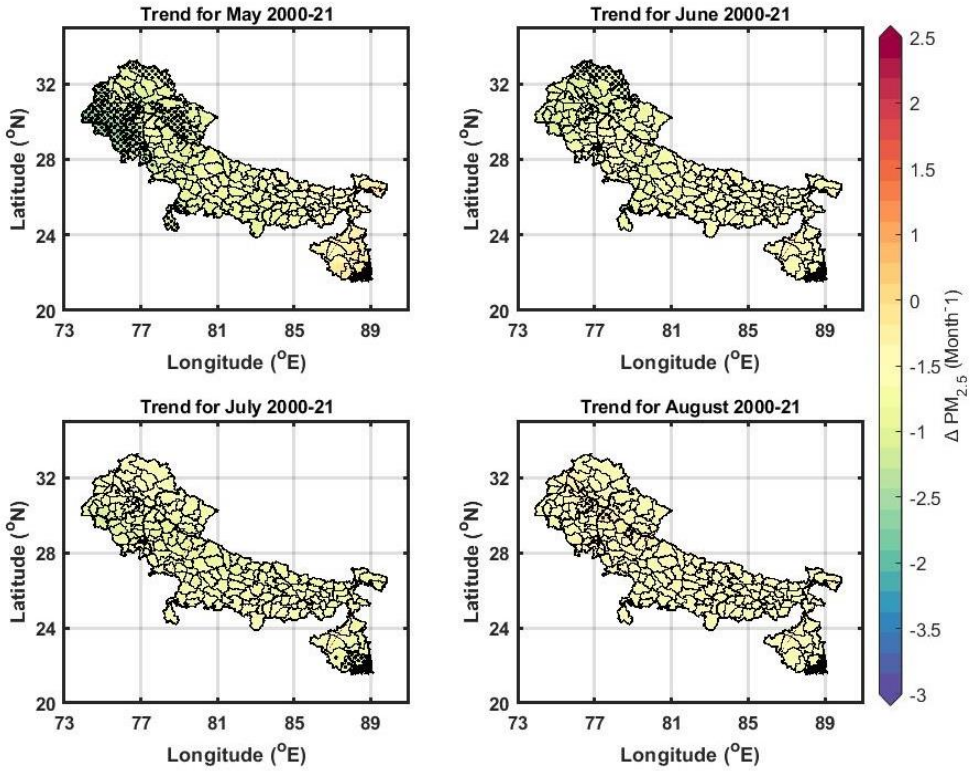


Figure 14: Spatial patterns of the monthly rate of changes in $PM_{2.5}$ (in µg/m^3 per month) for May-August.

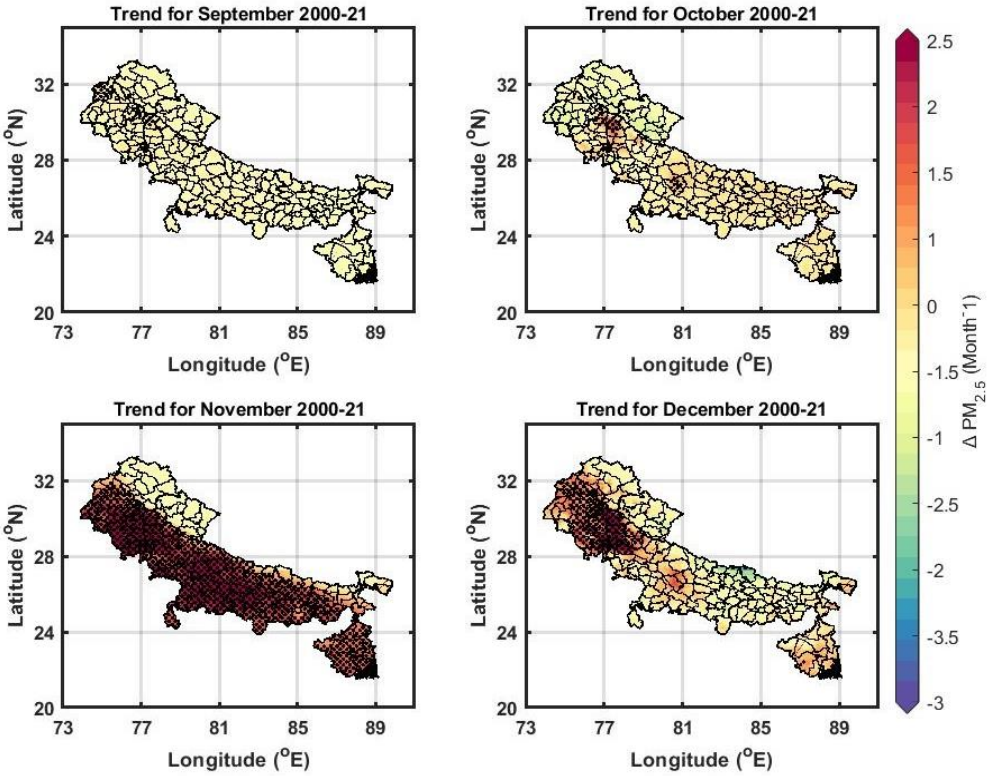


Figure 15: Spatial patterns of the monthly rate of changes in $PM_{2.5}$ (in µg/m^3 per month) for Sep-Dec.

The monthly rate of changes is displayed in Figure 10 through Figure 15. We note several key features. First, ambient $PM_{2.5}$ shows a significant increase (; statistically significant at 95% confidence level) over almost the entire IGP region during January, February, and November month. The hot spots of $PM_{2.5}$ in various IGP districts are listed in Table 5.

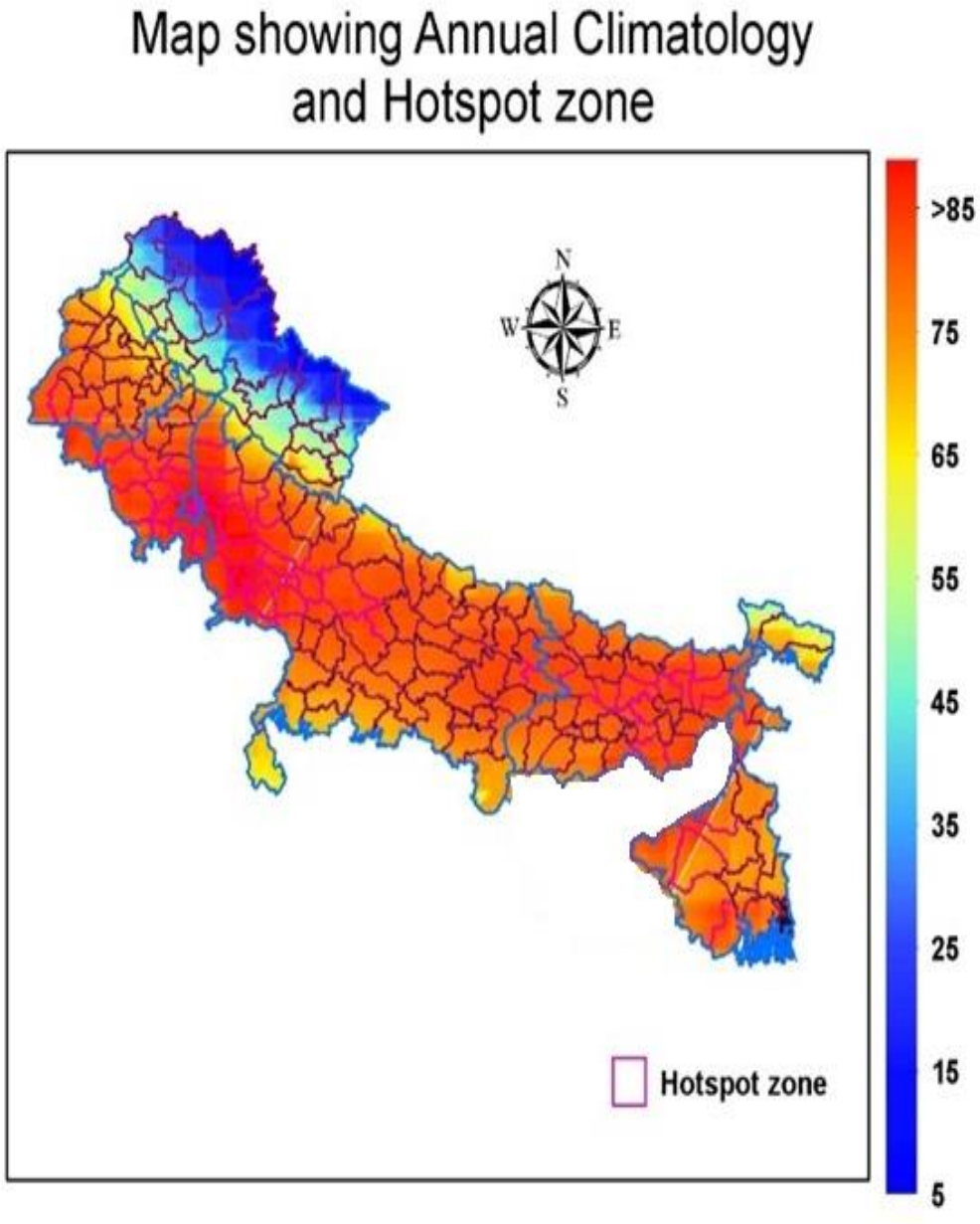


Figure 16: Spatial maps of satelite-$PM_{2.5}$ (µg/m^3) - annually climatology (2000-21) and Hotspot location at IGP region

Table 5: List of Hotspot District with in IGP region

District	State
Aligarh	Uttar Pradesh
Kanpur	Uttar Pradesh
Faridabad	Haryana
Gautam Buddha Nagar	Uttar Pradesh
Mathura	Uttar Pradesh
Palwal	Haryana
Bulandshahr	Uttar Pradesh
Etah	Uttar Pradesh
Mahamaya Nagar	Uttar Pradesh
Kansiram Nagar	Uttar Pradesh
Baghpat	Uttar Pradesh
Ghaziabad	Uttar Pradesh
Meerut	Uttar Pradesh
Muzaffarnagar	Uttar Pradesh
North	NCT of Delhi
North East	NCT of Delhi
North West	NCT of Delhi
Panipat	Haryana
Sonipat	Haryana
Bhiwani	Haryana
Hisar	Haryana
Jhajjar	Haryana
Rohtak	Haryana
Central	NCT of Delhi
East	NCT of Delhi
New Delhi	NCT of Delhi
South West	NCT of Delhi
West	NCT of Delhi
South	NCT of Delhi
Gurgaon	Haryana

District	State
Mewat	Haryana
Firozpur	Punjab
Muktsar	Punjab
Sirsa	Haryana
Firozabad	Uttar Pradesh
Bardhhaman	West Bengal
Birbhum	West Bengal

For identification of Hotspot region with in IGP we have taken annually climatology (2000-21) along with value above 90th percentile.

3.4 Applications for air quality management

The satellite-$PM_{2.5}$ databases that were created for India was reported in Dey *et al* (2020). Comparison of satellite-$PM_{2.5}$ with coincident ground-based measurement from the CPCB network revealed correlation coefficients of 0.9 (for 24-hr) and 0.97 (for annual) and root mean square errors (RMSEs) of 24.6 μg m^{-3} (for 24-hr) and 10.2 μg m^{-3} (for annual), respectively. These error statistics vary spatially. Only except for the mountainous regions (where aerosol retrieval is challenging and no ground monitors exist for calibration), the error is <10 %. Error estimates in rural regions are untenable in the absence of a single ground monitor.

Airshed Identification

We apply the k-means clustering method over two decades of satellite-$PM_{2.5}$ data to demarcate the major air sheds in India. The optimal value of '*k*' in k-means clustering is obtained from the Silhouette score (Rousseeuw 1987) of seasonal $PM_{2.5}$ averaged over the entire duration. We use Python's scikit-learn package to estimate both the Silhouette score and the k-clusters. For clustering the data, we check the highest Silhouette score from an initial four clusters to up to a maximum of 12 clusters.

The Silhouette Score *S* is defined as

$$S = \frac{b-a}{max(a,b)}$$

where *a* is the mean intra-cluster distance and *b* is the distance of the nearest sample point that is not the part of the cluster from the cluster centroid. The maximum limit is capped at 12 clusters to minimize the number of spatially discontinued clusters, which would otherwise diverge from our objective of identifying air sheds based on the cluster analysis. Some of the unresolved spatially discontinuous data are later included in the regional airshed based on the topography and seasonal meteorology. For this, we analyze digital elevation data from the SRTM dataset (Farr *et al* 2007) and wind data from the ERA5 reanalysis (Hersbach *et al* 2020).

Across the seasons, India has 8-9 major air sheds of varying geographic coverage. The Indo-Gangetic Plain (IGP) behaves either as a gigantic single air shed (e.g., during the pre-monsoon season of Mar-May) or as two large air sheds - west and east during monsoon (Jun-Sep), north and south during post-monsoon (Oct-Nov) and north-west and the remaining during winter (Dec-Feb). North-eastern India is divided into two or three (smaller) air sheds. The western arid region remains an isolated air shed during Dec-Sep, while it becomes part of the northern IGP air shed during Oct-Nov. Peninsular India is divided into two air sheds, which vary seasonally. The northern part of India is divided into two air sheds – one covering the mountainous regions and the other covering the foothills. Some of the air sheds (e.g., in northeastern India or northern mountainous regions) do not have a single ground-based monitoring station.

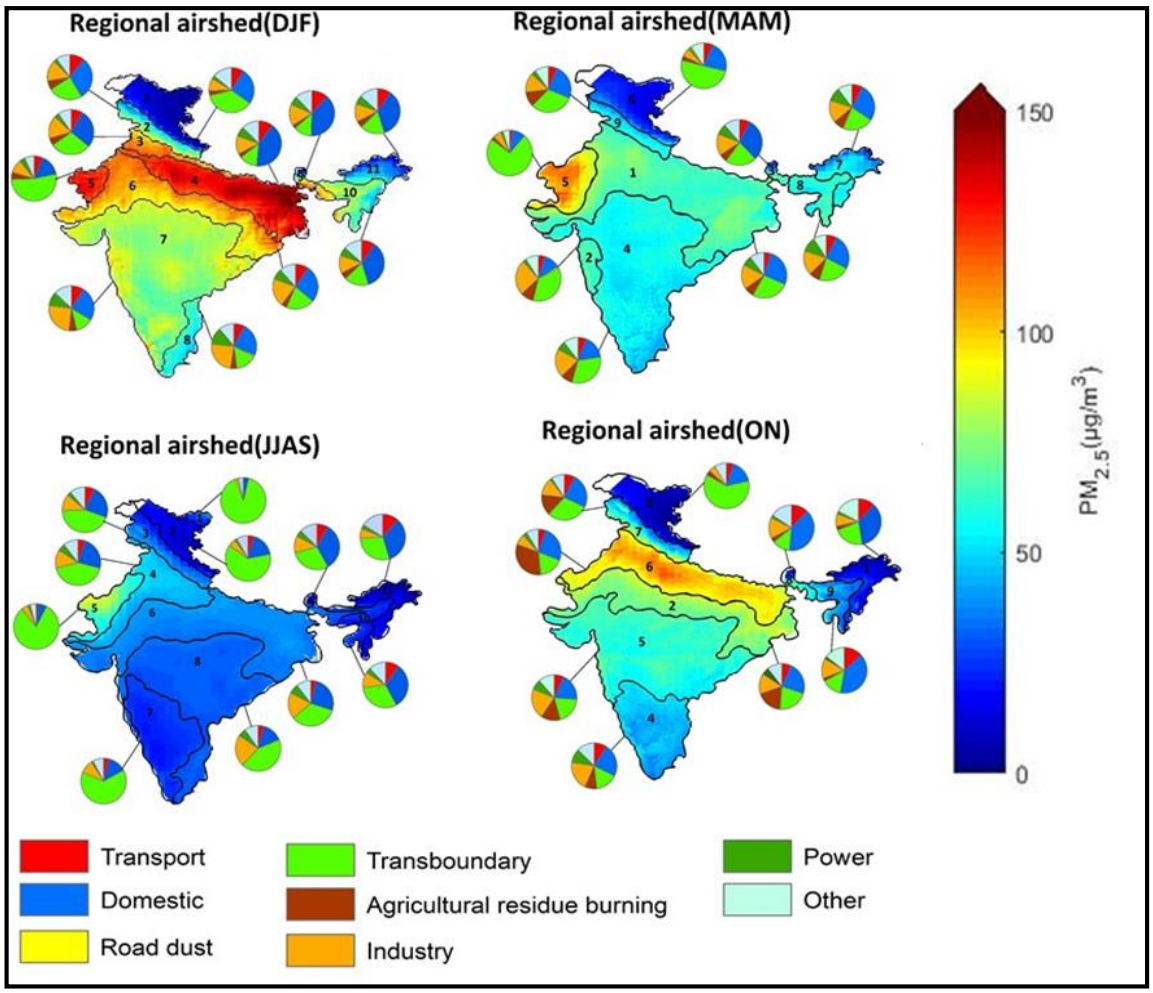


Figure 17: Regional air sheds of India in the (a) winter (Dec-Feb), (b) pre-monsoon (Mar-May), (c) monsoon (Jun-Sep), and post-monsoon (Oct-Nov) seasons along with mean seasonal $PM_{2.5}$ shown by the background colour. Sectoral contributions in each air shed are shown by the pie charts, whose colour codes are provided separately

3.5 Recent improvement and tracking NCAP Era

Since the ground-based PM monitoring coverage is not comprehensive in India, the CPCB is exploring the use of satellite data in monitoring $PM_{2.5}$ on a national scale, particularly in the regions devoid of any ground monitors. The scientific methods to derive surface $PM_{2.5}$ from satellite-derived aerosol optical depth (AOD) has matured over time, from a simple regression-based to a more complex and robust scaling-factor-based approach. However, since there is no fixed method to estimate $PM_{2.5}$ from AOD, the method requires standardization for a particular region. Recently, a national $PM_{2.5}$ database has been developed by standardizing the algorithm (Dey et al., 2020), for India. Comparison between

satellite derived $PM_{2.5}$ with $PM_{2.5}$ measured by the CPCB network showed a high correlation (R=0.97) and low RMSE. The error is less than 10 % at annual $PM_{2.5}$ lower than 200 $\mu g/m^3$. The satellite data was used to estimate the recent trends in $PM_{2.5}$ for the entire country for 2017-2021. Since there are no ground monitors in rural areas, satellite data are the only resource to provide information about air quality in the data void regions.

The number of days with $PM_{2.5}$ exceeding the 24-hr NAAQS standard is evaluated.$PM_{2.5}$ exceeded the NAAQS in more than 120 days in 2017 in most of the States in the IGP region except Himalayan region. The exceedance either remained same or slightly increased in 2018 in most of the States. However, a large improvement was found in 2019, most notably in the IGP. In 2020, the exceedance was only found to be higher than 100 days in Delhi NCR, central Uttar Pradesh. Even in 2021, when the economy bounced back, annual $PM_{2.5}$ did not exceed 2017 levels in most states (though the population increased). Such improvement on a regional scale is an encouraging sign.

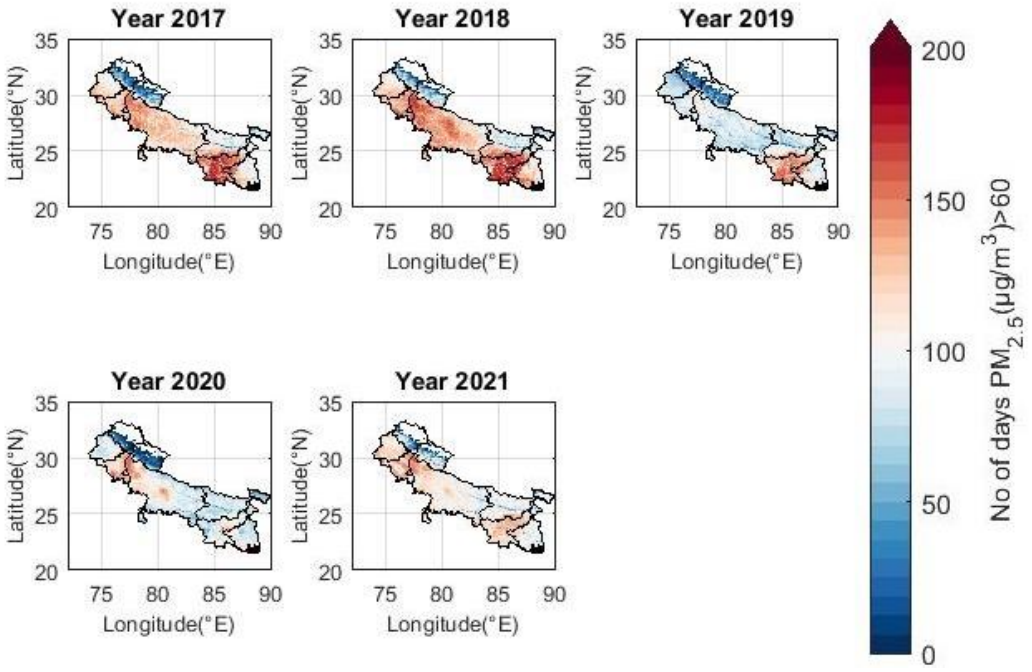


Figure 18: Spatial patterns of the number of days $PM_{2.5}$ exceeded the 24-hr NAAQS from 2017-2021

Chapter 4: Understanding the reasons of the problem and Characterization of the Emission Sources

4.1 Emission Inventory of IGP

In this study, an annual, high spatial resolution, comprehensive spatially gridded emission inventory of $PM_{2.5}$ emissions has been made for IGP States and UTs for the base year 2018. The approach is a ground-up inventory based on activity data from various sectors, combined with emission factors. An attempt has been made to prepare a high-resolution district-wise emission inventory for all the IGP States and UTs. The study considered emissions from industries, road transport, domestic sources, and open burning, soil and road dust and some other unorganized sectors which account for approximately 95 percent of all the criteria pollutants load emitted. As per the best of knowledge, soil and road dust emissions, which was previously unaccounted in many emission inventories, have been included in this study. Detail methodology of the emission inventory has been discussed in earlier section (Chapter 2). Activity data of different sectors were taken from the State Pollution Control Boards/ Committees and various secondary sources. The sector wise spatially distributed emission inventory is discussed as below. The Vehicle Kilometer Travelled (VKT) and various Emission Factors (EF) used are given in the Annexure-IV.

4.1.1 Total Emission Scenario - State Wise

Total PM2.5 emissions for the year 2018 have been estimated to be 2317 Gg (or kilo-tones) for the year 2018 of which 48.5 % originated from industrial sector, 19 % from domestic fuel consumption, 15.5 % from open burning, 10 % from soil and road dust, 5 % from vehicular and 2 % from various unorganized sectors. In previous emission inventories over India, the contribution from domestic and industrial sectors varied between (27-50) % and (21-38) % respectively (CEEW, 2021). But, after the implementation of the Pradhan Mantri Ujjwala Yojana, an initiative of Gov. of India to promote clean domestic fuel nationwide, the emission from the domestic sector has reduced significantly. Hence, the relative contribution of different sectors in PM2.5 emissions of this study differs from previous inventories like Paliwal et al. (2016) for black carbon, TERI, 2016, etc. With the decrease in the domestic emission the relative contribution of other sectors is well above the previous estimation for

PM2.5. Figure 19 represents the state wise emission and relative contribution of $PM_{2.5}$ in different IGP States and UTs.

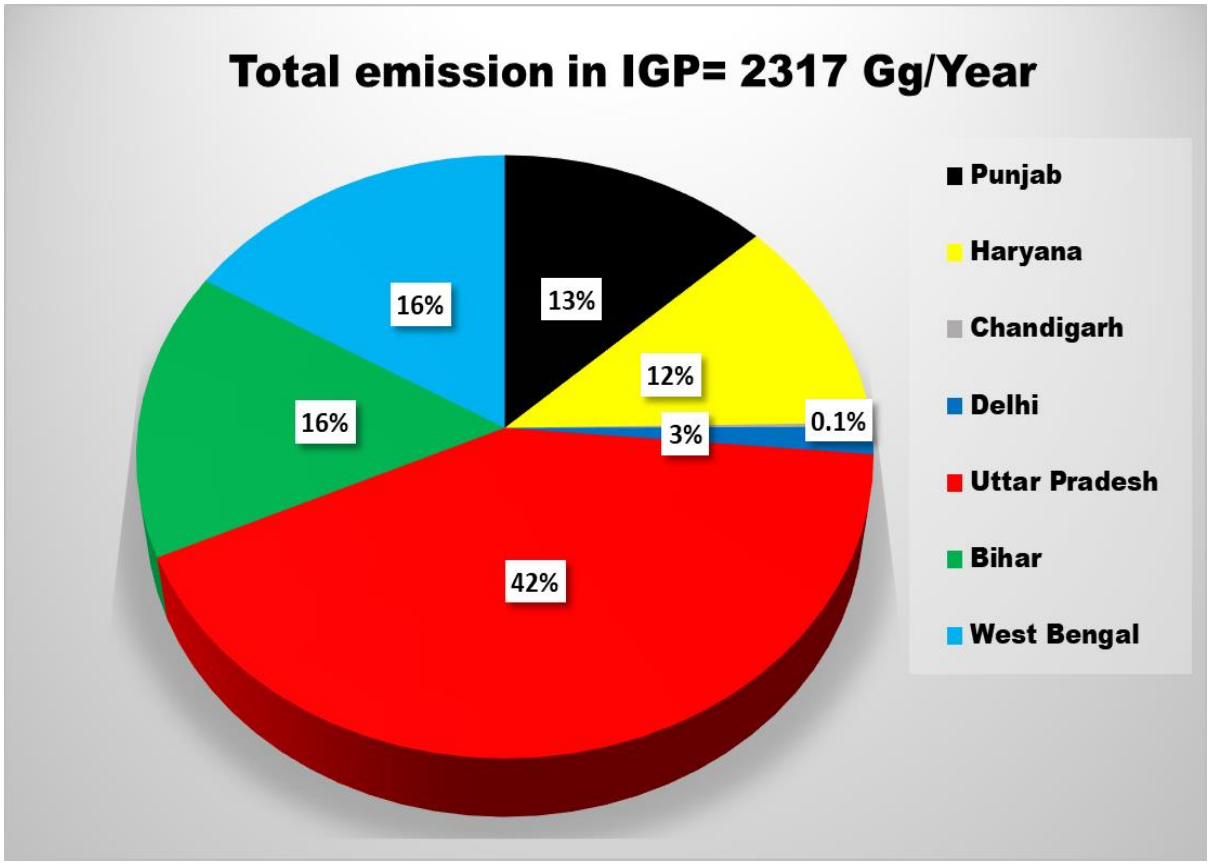


Figure 19: Relative contribution and net emission of composite $PM_{2.5}$ in different IGP states and UTs in India

Results are suggesting that Uttar Pradesh is the highest $PM_{2.5}$ emitter in the region followed by West Bengal, Bihar, Punjab and Haryana. This could be due to the high population density and associated anthropogenic activities in UP, Bihar, Haryana and West Bengal. However, the spatial distribution of $PM_{2.5}$ in different IGP districts (Figure 20) revealed that the districts of the southern part of the West Bengal and NCR region is the hot spot of the $PM_{2.5}$ emission in the plains. High cumulative $PM_{2.5}$ load over Uttar Pradesh is due to its larger size and greater number of districts. However, in terms of district wise emission south Bengal districts and NCR surrounded districts are exhibiting highest loading of $PM_{2.5}$ among the all.

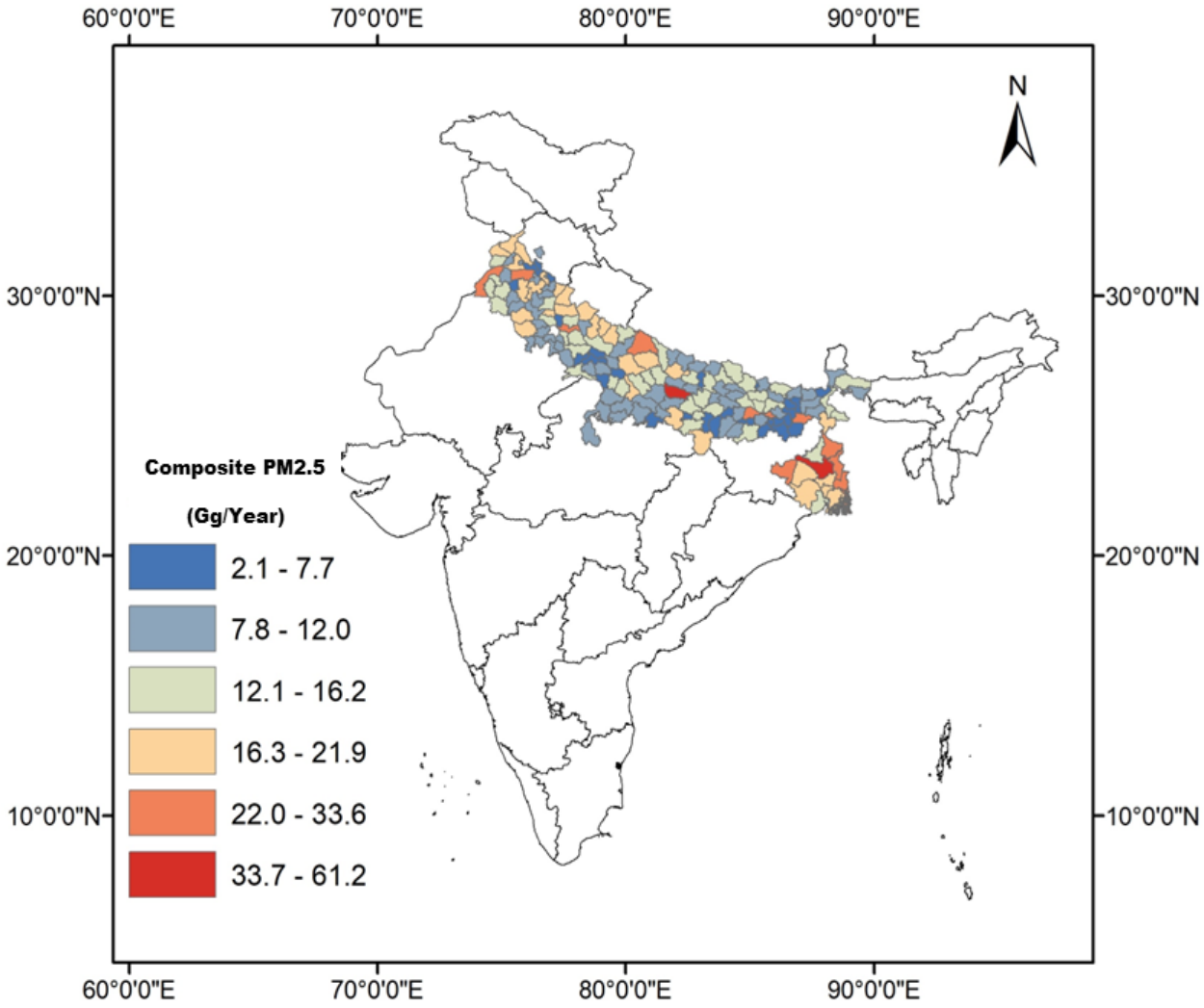


Figure 20: Spatial distribution of composite $PM_{2.5}$ (Gg/year) emission in different districts and UTs over IGP

The sectoral emissions and their characterises are given as follows:

4.1.2 Domestic Sector

India faces a crucial challenge of providing clean and affordable energy sources to its rural households, especially in the cooking sector. According to the IPNG statistics (2020-21) of MoPNG, Gov. of India, more than 90 million new connections of domestic LPG were distributed in India under Pradhan Mantri Ujjwala Yojana (PMUY) (https://www.pmuy.gov.in/index.aspx). However, an assessment report titled "Primary survey on household cooking fuel usage and willingness to convert to LPG" of MoPNG, GoI, 2016, reported that over 80 % of Indian households earn below 5000 INR in a month and spend Rs 354 per month (free procurement – 37 %) and Rs 372 per month (free procurement – 25 %),

respectively, in rural and urban areas for cooking fuels. The availability of free-of-cost solid fuel/biomass is an important reason for households to not to use LPG for cooking. In fact, a significant proportion of households (81 %) still continue to rely on such solid fuel/biomass for some, if not all, of their cooking needs (Council on Energy, Environment and Water, 2018). The data is well indicative of the fact that even after a nationwide promotion of LPG, use of solid fuel is still the major source of domestic cooking fuel in India. We have used the report that 60 % households now use LPG and rest still rely on solid fuels (NSO Survey Report, 2018). It was further assumed that a household of five person uses 10 LPG cylinders per year and non-LPG users consume on average 90 kg of solid fuel per month (MoPNG, 2016). The information on kerosene consumed was available from two sources: MoSPI (2016). The proportion of kerosene used for cooking versus lighting in India was taken from Lam et al. (2012). Another estimate of kerosene consumed in lamps was derived following the methodology described in Lam et al. (2012). The PM2.5 emissions were estimated based on LPG and other fuels used by and suitable emission factors. Figure 21 shows the state wise relative contribution of domestic emission for cooking. The net emission of the PM2.5 from the domestic sector was found to be 437 Gg/Year for the base year of 2018, which contributes nearly 19 % of the total emission over the IGP.

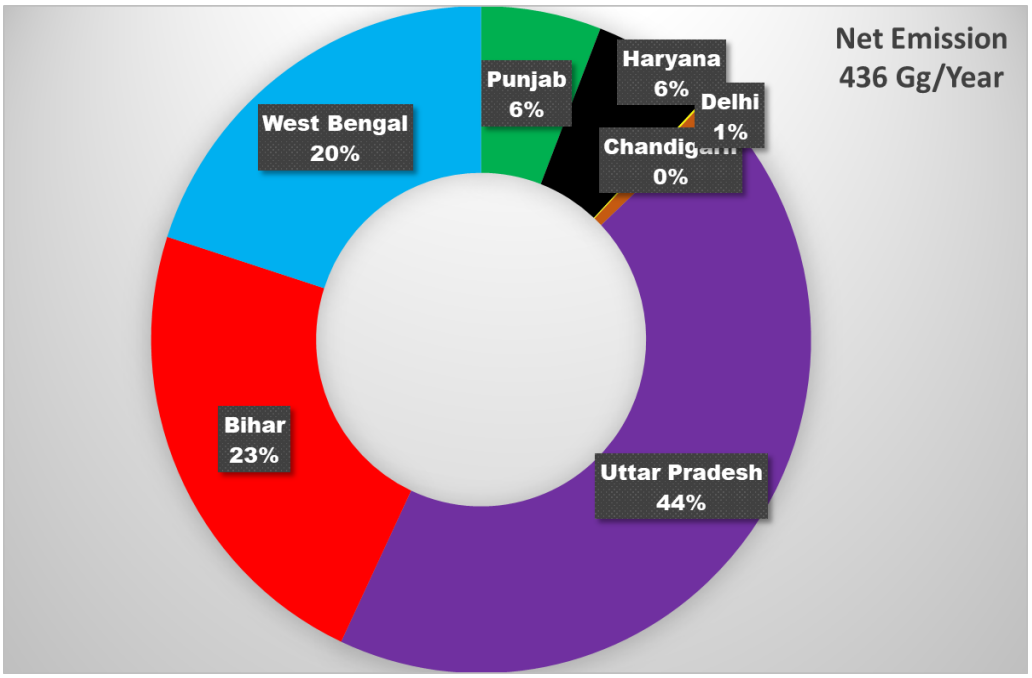


Figure 21: State wise emission of $PM_{2.5}$ (Gg/Year) from the domestic sector in different districts and UTs over IGP.

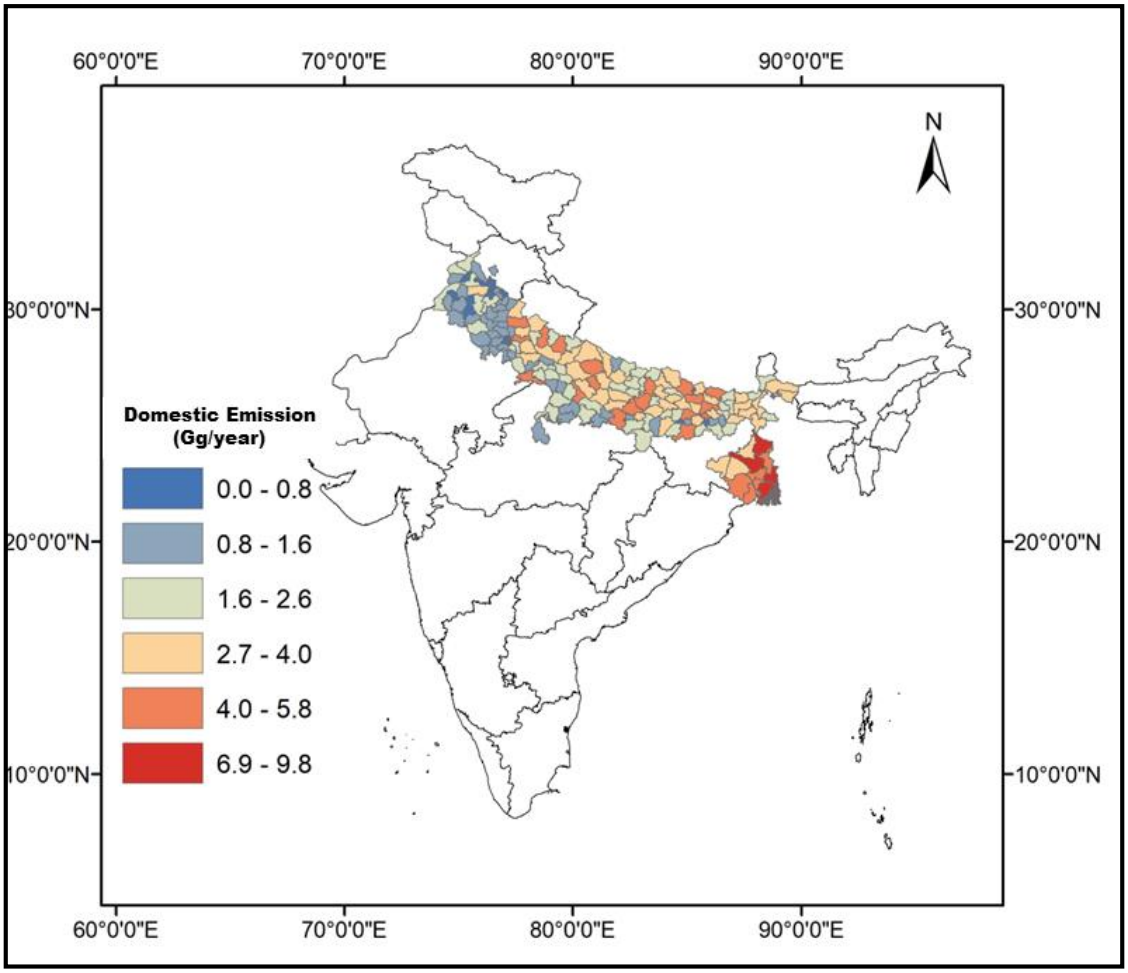


Figure 22: Spatial distribution of $PM_{2.5}$ (Gg/Year) emission from the domestic fuel in different districts and UTs over IGP.

Comparing with previous inventories like TERI SMoG or REAS this value has been significantly decreased. It could be attributable from the enhance usage of LPG in rural sector after the implementation of PMUY scheme. Considering the state wise contribution, it was found that Uttar Pradesh alone contributes nearly 44 % of the domestic emission followed by Bihar (23 %) and West Bengal (20 %). However, keeping view in the districts, south Bengal districts exhibit the maximum loading of $PM_{2.5}$ emission from the domestic sector. This might be because of more population density in these districts. Results have clearly indicated that the upper IGP States and UTs have reduced the domestic emission significantly compare to the lower IGP States (Figure 22).

4.1.3 Industrial Sector

Table 6 shows industries in different states over Indo Gangetic Plain. Highest emission over IGP was observed from the industry sector which alone account for 48.5 % (1128 Gg/Year) of the total emissions in the region. In this sector, brick kiln, MSMEs and coal based power plants contribute the maximum emissions of 41 %, 30 % and 18 % respectively. Sugar Industry and Steel Industry also emit substantial $PM_{2.5}$ load and their net contribution to the total industrial emission is 8 % and 2 % respectively. High emissions were found from the brick kiln and MSMEs industry caused by the use of low-grade fuels and from dated and inefficient systems and processes. State wise contribution in $PM_{2.5}$ from these two sectors is given in Figure 23 and Figure 24. Most of these industries are not equipped with APCD, and even the efficiencies of the installed APCDs in these plants are much lower (40–60 %) than those in large-scale industries (TERI, 2016). In addition, Brick kilns are one of the major consumers of coal in India as well as in IGP. Bull's trench kilns (BTK) and clamp kilns are the two major brick firing technologies used in IGP. Other firing technologies, which are not significant in terms of brick production, are Vertical Shaft Brick Kiln (VSBK), Hoffman, Zig-zag, Down Drought Kiln (DDK), and tunnel kilns. Bull's trench kilns account for about 70 % of total brick production in India (Rajaratnam et al., 2014). The brick manufacturing sector is an unorganized sector, using old technologies with low combustion efficiencies and limited control for air pollutants emissions. Due to rapid increase in brick production, the corresponding fuel consumption has also increased resulting in the emissions of pollutants such as $PM_{2.5}$. In contrast, power plants account for 75 % of coal consumption, their emissions are just 18 % of the total industrial emissions, due to the higher efficiency of combustion in these systems. Production of coke, sinter and pellets, iron ore processing, making of iron and steel, steel casting, combustion of blast furnace and coke oven gases are the major processes involved in iron and steel manufacturing that result in the emissions of $PM_{2.5}$. Generally, iron and steel plants in India are equipped with efficient air pollution control devices such as ESPs and wet scrubbers for reduction of PM. The same argument also goes with aluminum, cement and sugar industries,

Highest contribution from the industrial sector was found from Uttar Pradesh followed Bihar, West Bengal, Haryana, and Punjab. The two UTs, Delhi and Chandigarh exhibited very minimum contribution from the industrial sector. Spatial variation exhibits that the districts of the Uttar Pradesh and Haryana, specially encircling the NCR region are among the hot spots of Industrial PM2.5 emission. However, highest individual emission was estimated over

Burdawan district of West Bengal. State wise emission of PM2.5 from industrial sector, its district wise spatial distribution is given in Figure 23 through Figure 25 along with category of industry in different States.

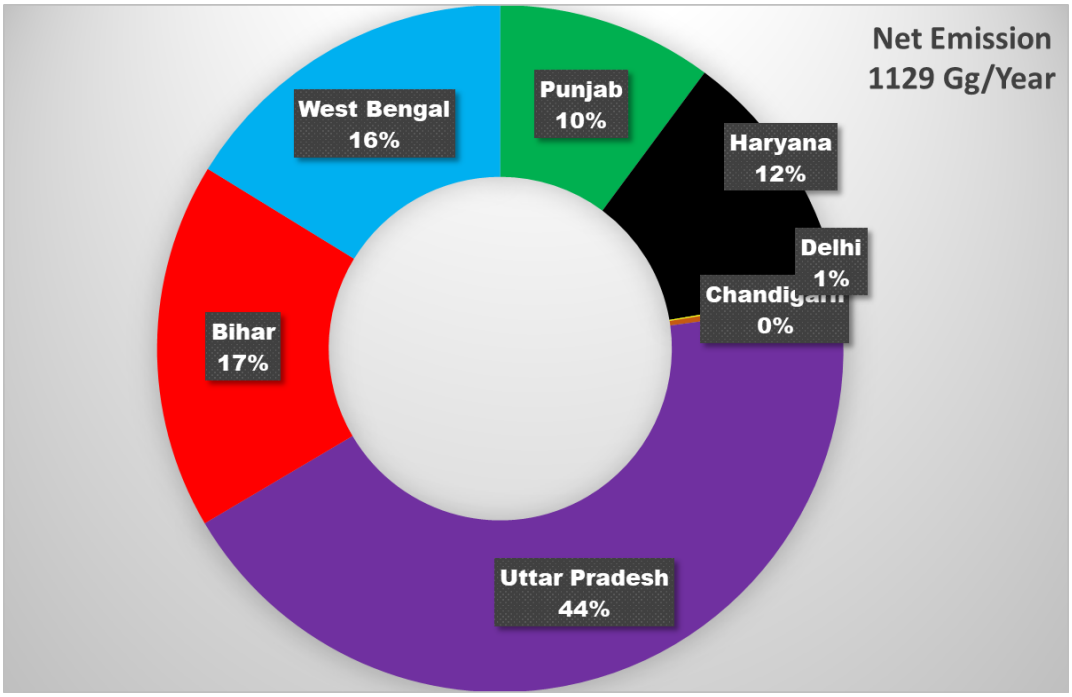


Figure 23: State wise emission of $PM_{2.5}$ (Gg/Year) from the industrial sector

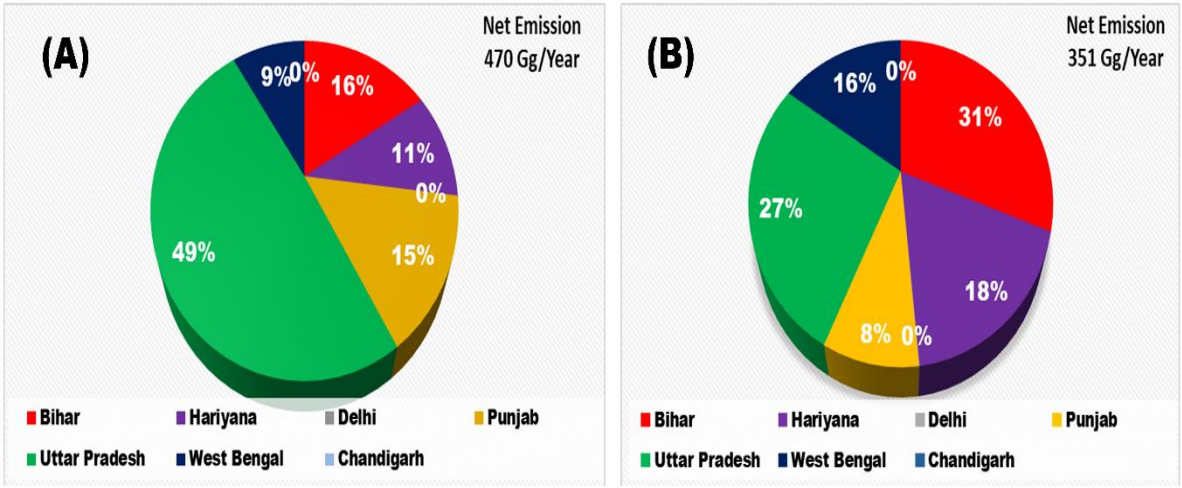


Figure 24: State wise emission of $PM_{2.5}$ (Gg/Year) from the (A) Brick Kilns and (B) MSMEs

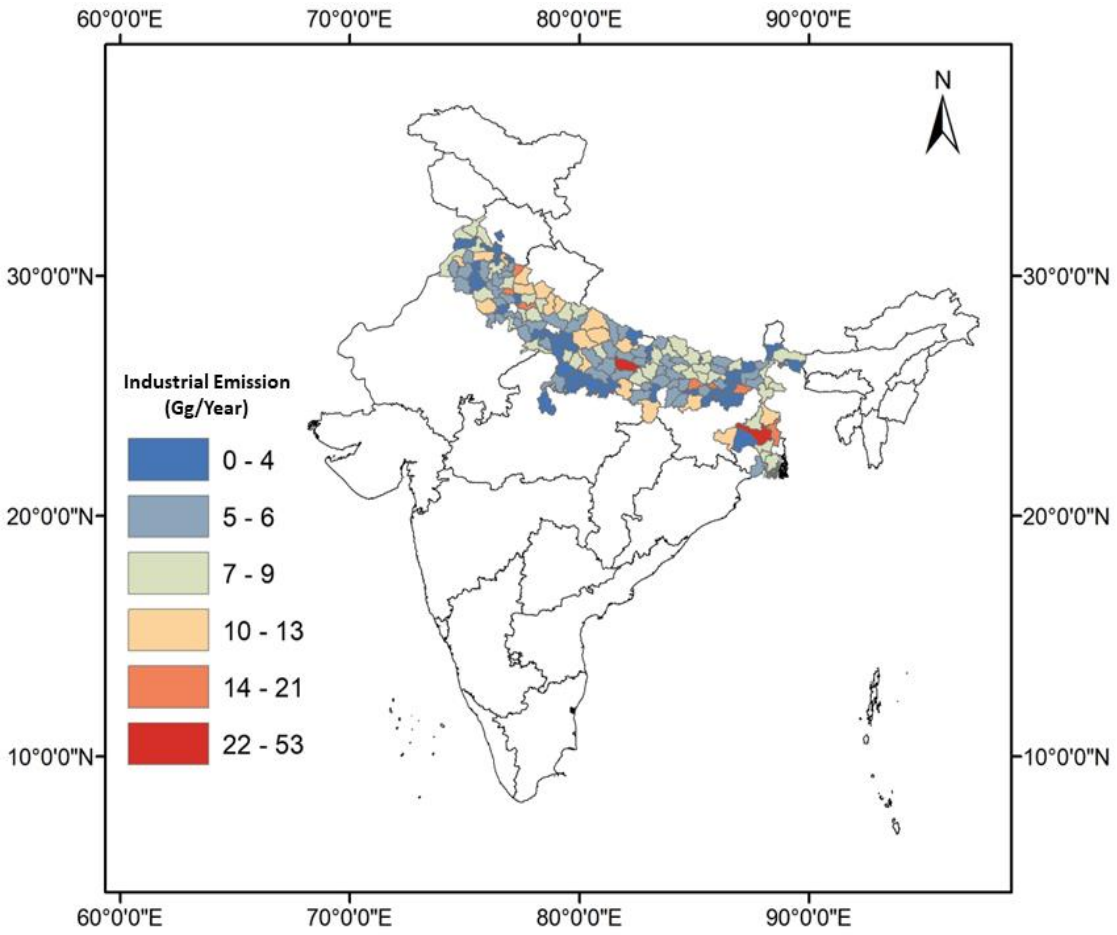


Figure 25: Spatial distribution of $PM_{2.5}$ (Gg/year) emission from the industrial sector in different districts and UTs over IGP

Table 6: Types of Industries in different states over Indo Gangetic Plain

States	Types of Industries
Bihar	Hot Mix plant, Oil & Fat, Food & Dairy, Herbal & Homeopathy, Cement, Construction Fabric & Dyeing. Paint, Agro Products, Chemical, Poultry Feeding, Bricks, Tiles, Steel Iron, Aluminium, Copper, Metals, Crafts paper, Plywood, Stone crusher, Rubber, Medical, Waste Treatment, Automobile, Foundry & Forge, Roll Mills Textile & Clothes, Power, Pharmaceutical, Plastic & Packaging, Hospital, Mineral, Tobacco, Ceramic & Glass
West Bengal	Cement, Agro, Construction, Chemical & Petrochemical Steel, Power, Iron & Metal, Bricks Pharmaceutical & Biochemistry, Paper, Sugar mill, Automobile, Rice mill, Poultry Feeding, Bricks, chemical and

	pharmacies, Jute, Cotton and Textiles, Hot Mix Plant, Dyes etc.
Uttar Pradesh	Iron, Auto works, Metal, Bricks Food and oil, Steel, Rubber, Diesel generator, Chemical, Foundry, Glass, Dairy and poultry, Slaughter houses, Pulp and paper, Cloth, textile and printing, Power and electrical, Tyre, Automobile, Misc, Stone crusher and granite, Construction and infrastructure, LPG bottling, Cement, Pipe and plastic, Aluminium, Dyeing, Paint, Wooden, Lead, Pharmaceutical, Recycling, Roll Mills Ceramic, Bricks, Electronic, Cosmetic, Herbal, Leather and footwear, Refinery, Zinc, Hot Mix plant, Tobacco, Agricultural machinery, Cold storage, Brewery.
Punjab	Hot Mix Plant, Construction & Infrastructure, Bricks, Tiles & Stone Crusher, Dyeing Ceramic, Woollen mill, Garments & Embroidery, Steel, Lead, Aluminium, Food & Dairy, Chemical & Pharmaceutical, Rubber, Soap, Paper, Foundry & Forge, Biomedical, Automotive, Water treatment, Iron, Metal & Alloys Agriculture industry Energy
Haryana	Hot Mix plant, Bricks, Oil & Fat, Food & Dairy, Herbal & Homeopathy, Cement, Infrastructure, Construction, Fabric & Dyeing, Paint, Cosmetic, Agricultural equipment, Agro Products Chemical, Poultry Feeding, Bricks & Tiles, Steel, Iron, Aluminium, Lead, Zinc, Metals Crafts paper, Cotton, Plywood, Stone crusher, Rubber, Medical & surgery, Tyre, E-Waste and Biomedical waste, Leather Chemicals, Automobile, Foundry & Forge, Textile & Clothes, Warehouse, Power and Electrical, Recycling, Energy, Footwear, Breweries, Pharmaceutical, Fireworks, Polymers, Plastic & Packaging, Petrochemical, Sanitaryware, Diamond

4.1.4 Transport Sector

Transport sector emissions account for only ~5 % (118Gg/Year) of the $PM_{2.5}$ emissions in the current scenario over the IGP in 2018. The tailpipe emissions of different pollutants from various categories of on-road vehicles were calculated. Within the transport sector trucks have been found to emit the most (50%), followed by the two wheelers (25%). The main contributors are the metropolitan cities like Delhi, Kolkata, Lucknow and the industrial areas. The district wise spatial distribution of the $PM_{2.5}$ from the transport sector is given in Figure 26.

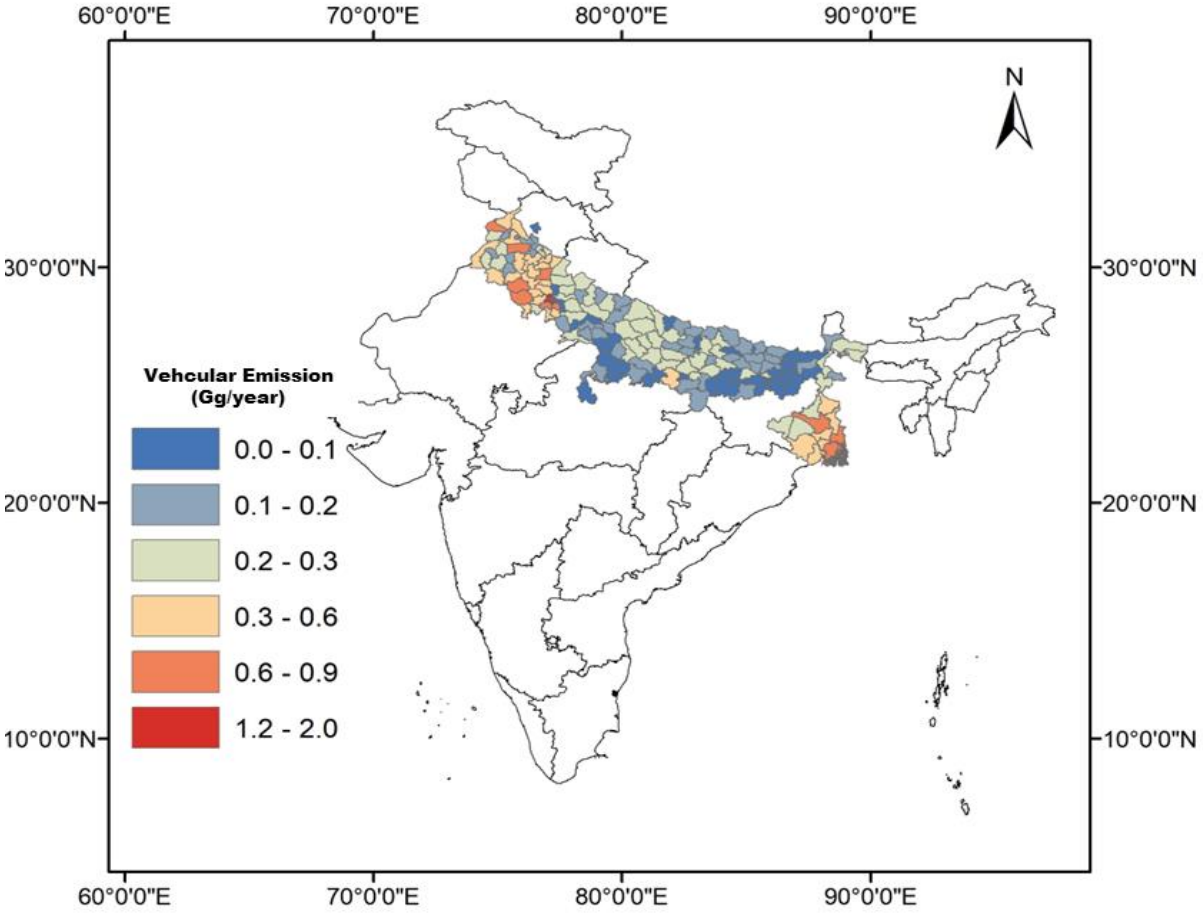


Figure 26: Spatial distribution of $PM_{2.5}$ emissions from the transportation sector in different districts and UTs over IGP.

Among the States and UTs, UP contributes the most in total vehicular emission with almost (36 %) contribution, followed by Haryana (15 %), West Bengal (13 %) and Punjab (13%) (Figure 27). However, emission per district was found to be highest in Delhi region than the other. High number of on road vehicles in the Delhi megacity and adjacent area is reflected from this observation. In case of UP, large population and area of the district makes the cumulative vehicular emission high. In West Bengal, Burdwan district was found to be a hot spot of vehicular emission. High industry related transportation might be the reason of it.

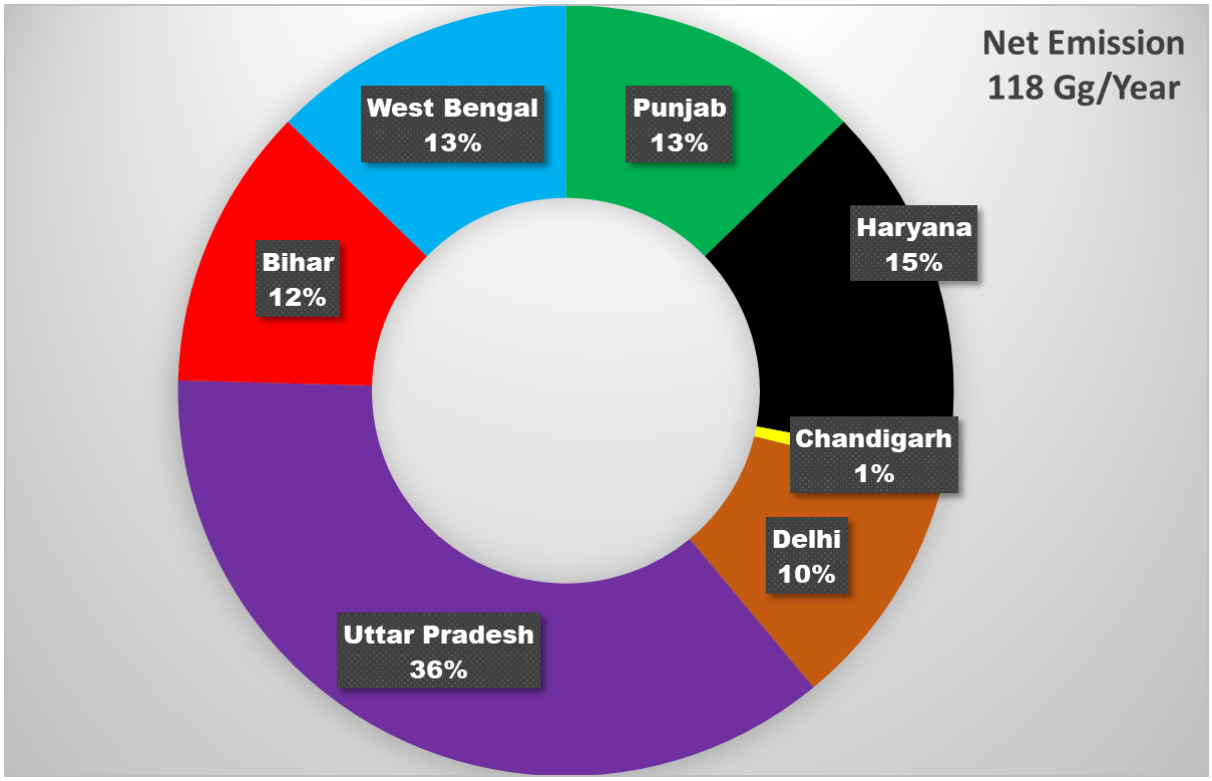


Figure 27: State wise emission of $PM_{2.5}$ (Gg/Year) from the transport sector in different districts and UTs over IGP.

4.1.5 Soil and Road Dust

In urban areas of the IGP due to large number of vehicles, $PM_{2.5}$ emissions from road dust are serious environmental concern. Soil and Road dust contributed ~10 % (225 Gg/Year) to the total emission. The State wise relative contribution and district wise spatial distribution of soil and road dust in the districts of the IGP are given in Figure 28 and Figure 29 respectively. Results showing that the megacities like Delhi, Chandigarh, Kolkata are the hot spots of the soil and road dust emission. However, in terms of cumulative emission Uttar Pradesh is found to be ranked one again with 34 %, followed by West Bengal (20 %), Punjab (16 %) and Haryana (15 %). The control measures can be better construction and maintenance of roads, watering and sweeping of roads. There is one more option to prevent re-suspension of dust, which are growing plants.

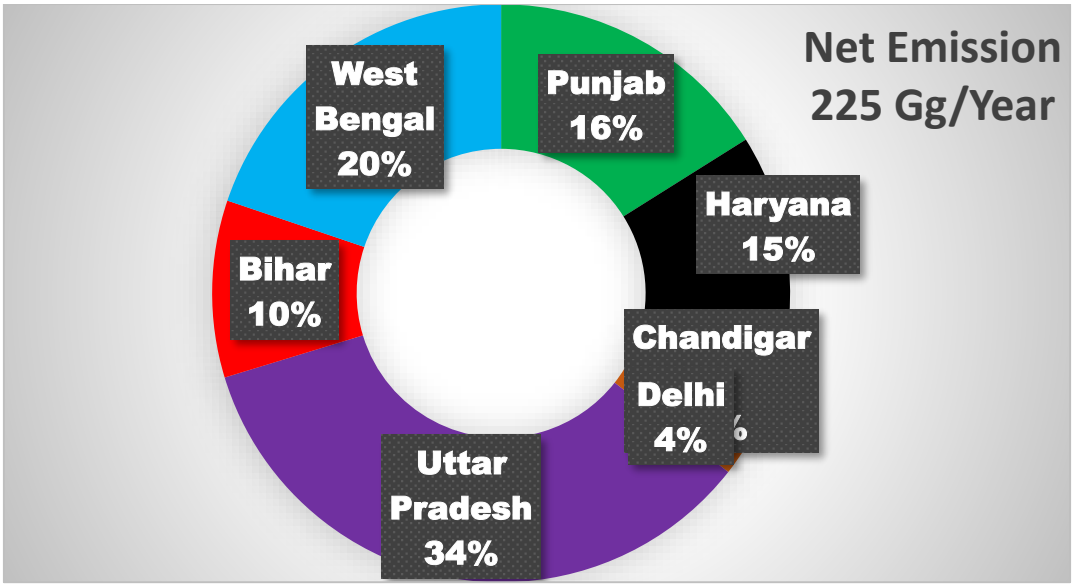


Figure 28: State wise emission of $PM_{2.5}$ (Gg/Year) from soil and road dust in different districts and UTs over IGP.

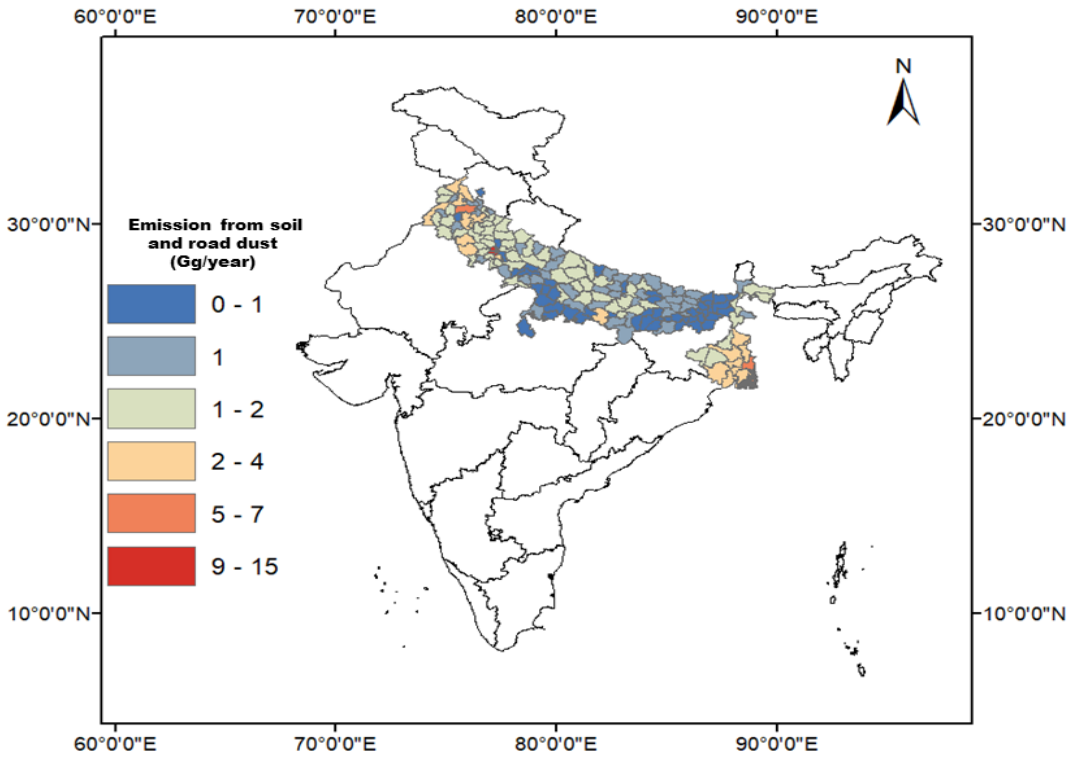


Figure 29: Spatial distribution of $PM_{2.5}$ (Gg/year) emission from the soil and road dust in different districts and UTs over IGP

4.1.6 Open burning

The national level emissions from this sector contribute 15.5 % (358 Gg) to the total emissions. Burning of crop residue has been the major contributor (62 %), followed by forest

fires (18 %). MSW burning contributed 20 % to the open burning emissions. The district-wise spatially distributed open-burning emissions are presented in Figure 30. The emissions from open burning are highest from the northwest States of Punjab and Haryana (crop residue burning). Punjab and Haryana are among the main food-producing States of India. In April, May, October and November, the crop residue is burnt to clear the land for the next crop.

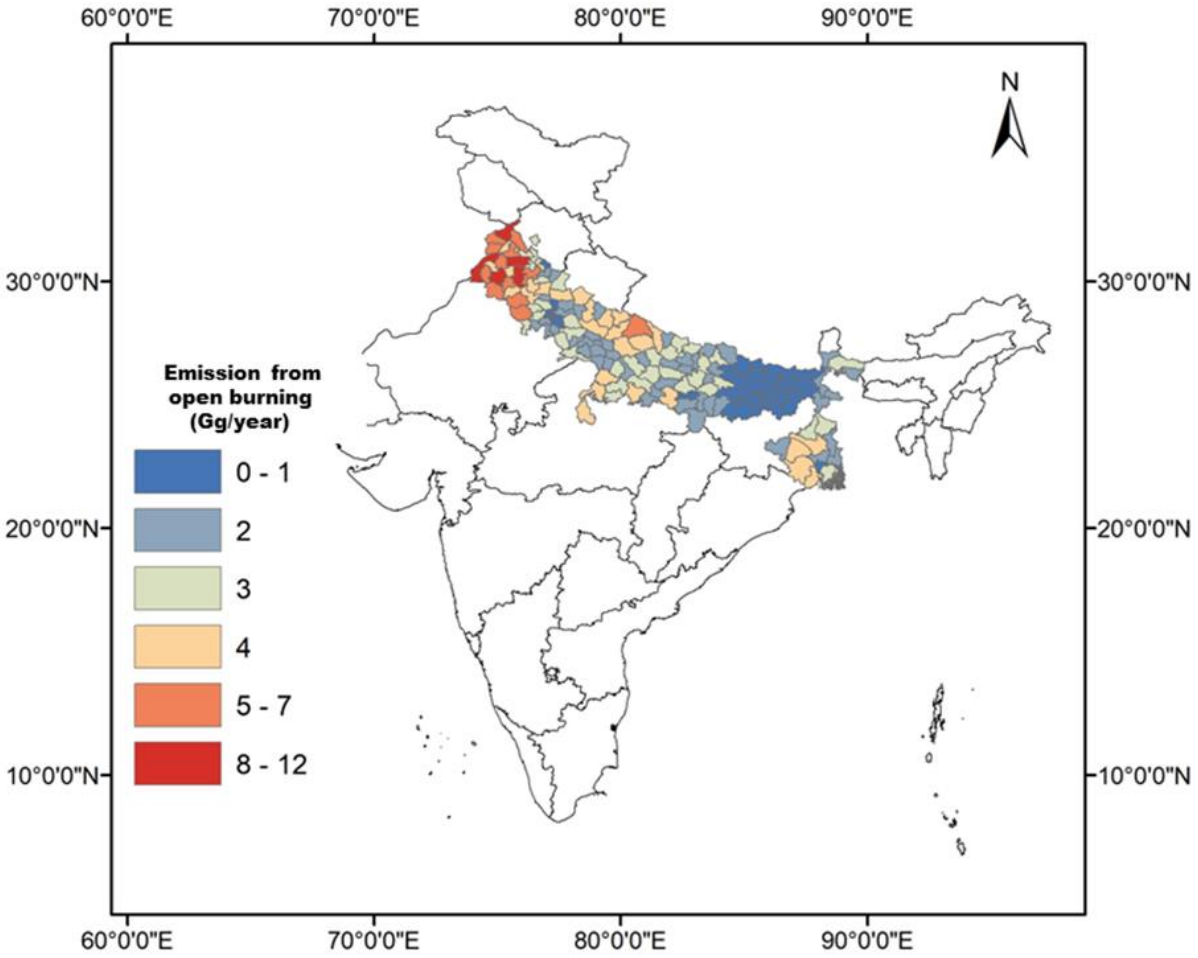


Figure 30: Spatial distribution of $PM_{2.5}$ (Gg/Year) emission from the open burning in different districts and UTs over IGP

4.1.7 Other Sectors

Emissions from this category account for slightly more than 2 % (50 Gg/year) of the total IGP $PM_{2.5}$ emissions. Within this category, emissions from use of diesel in irrigation pumps and mobile generators contribute more than 70 %. Among the diesel generators, their use in mobile towers contributes other applications (private households, small commercial enterprises and industry) account for almost 95 %. Hot spot for this sector is found to be the

southern districts of the West Bengal and West Uttar Pradesh. The district-wise spatially distributed open-burning emissions are presented in Figure 31.

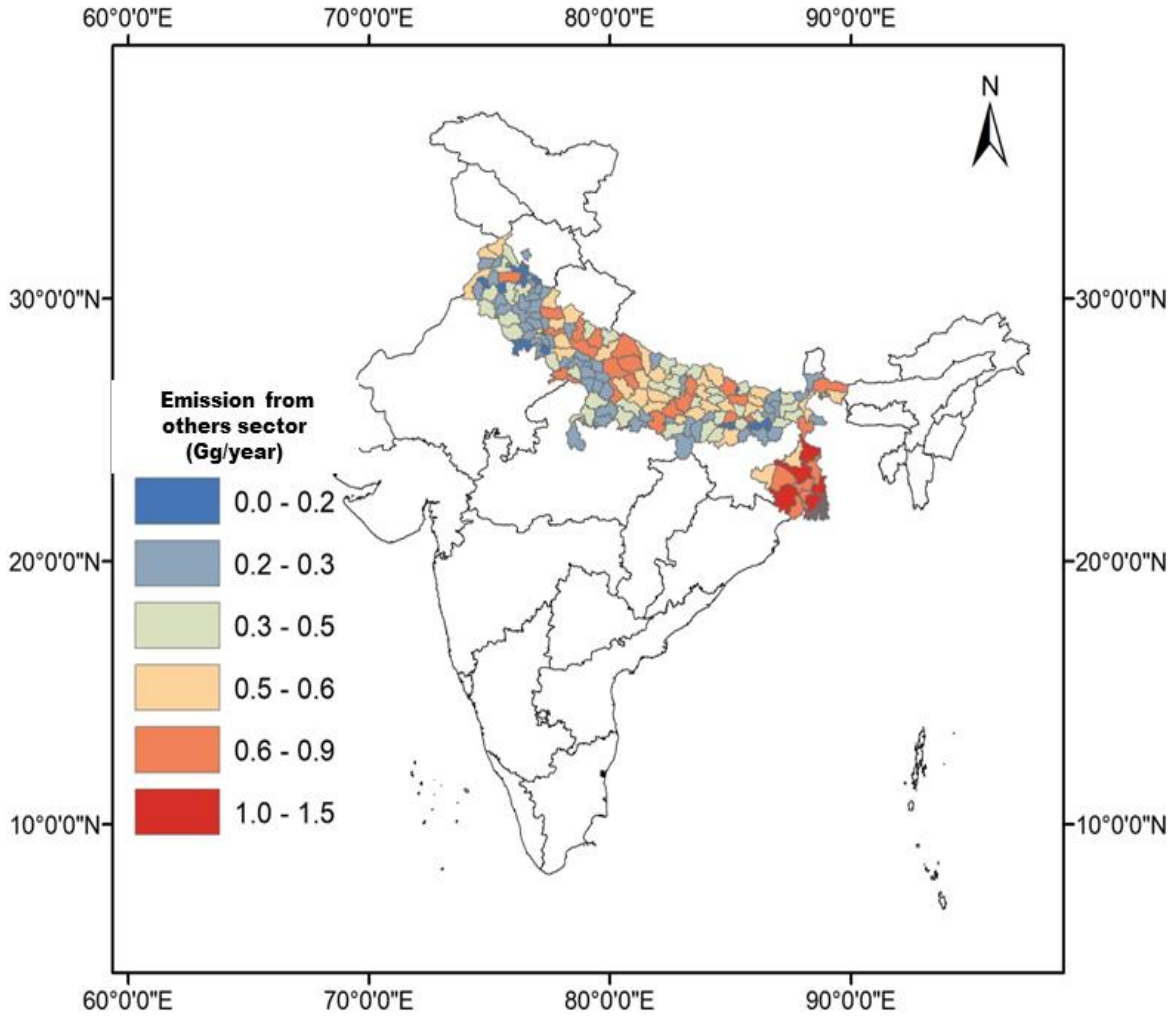


Figure 31: Spatial distribution of $PM_{2.5}$ (Gg/year) emission from others unorganized sector in different districts and UTs over IGP

Chapter 5: October - November Episodic Situation

5.1 Background

Many areas, especially the northern region including Delhi-NCR (National Capital Region) witnesses severe air pollution situations during October and November or it may under anytime when meteorology is very unfavourable and/or there are increased emissions. For example, we may classify such a situation when $PM_{2.5}$ levels exceed 250 $\mu g/m^3$ resulting in widespread panic and discomfort to people. The air quality index (AQI) category falls in 'severe/very poor'; sadly, this situation is in Delhi-NCR is an annual occurrence. The high pollution levels attract the attention and criticism of many national and international agencies including media. This situation must change for better air quality. This will not be easy. What is important is to understand the causal linkage between emissions and impact at receptors which is coupled with meteorology.

A sharp decline in air quality potentially indicates a sudden increase in emission from a variety of a large number of sources and/or unfavourable meteorological conditions. Apart from local & regional emissions and heightened emissions during festivals, meteorology also plays a crucial role in influencing ambient air quality with favourable meteorological conditions generally leading to improvement in air quality due to dispersion, transport or deposition of air pollutants. Wind speed (important factor for horizontal dispersion) and mixing depth (important factor for vertical dispersion) which are key meteorological factors that govern dispersion of air pollutants are generally lower in winters, resulting in deterioration of air quality. Calm surface conditions sometimes also lead to inversion (warmer air is held above cooler air), resulting in trapping of air pollutants and suppression of convection. Other meteorological factors such as light rainfall and humidity sometimes lead to secondary aerosol formation causing a spurt in particulate matter levels.

The deterioration of air quality during winters is evident in the Air Quality Index (AQI) data for Delhi (Fig 32). Delhi witnessed 24 days with severe AQI during 2021, all of which were concentrated in the winter months of January, November & December. These months also saw 0 number of days with Good or Satisfactory AQI. Overall, the period from Jan-Feb 2021 and Oct-Dec 2021 saw just 04 days having Good, Satisfactory or Moderate AQI category, while 116 days witnessed Poor, Very Poor or Severe AQI category.

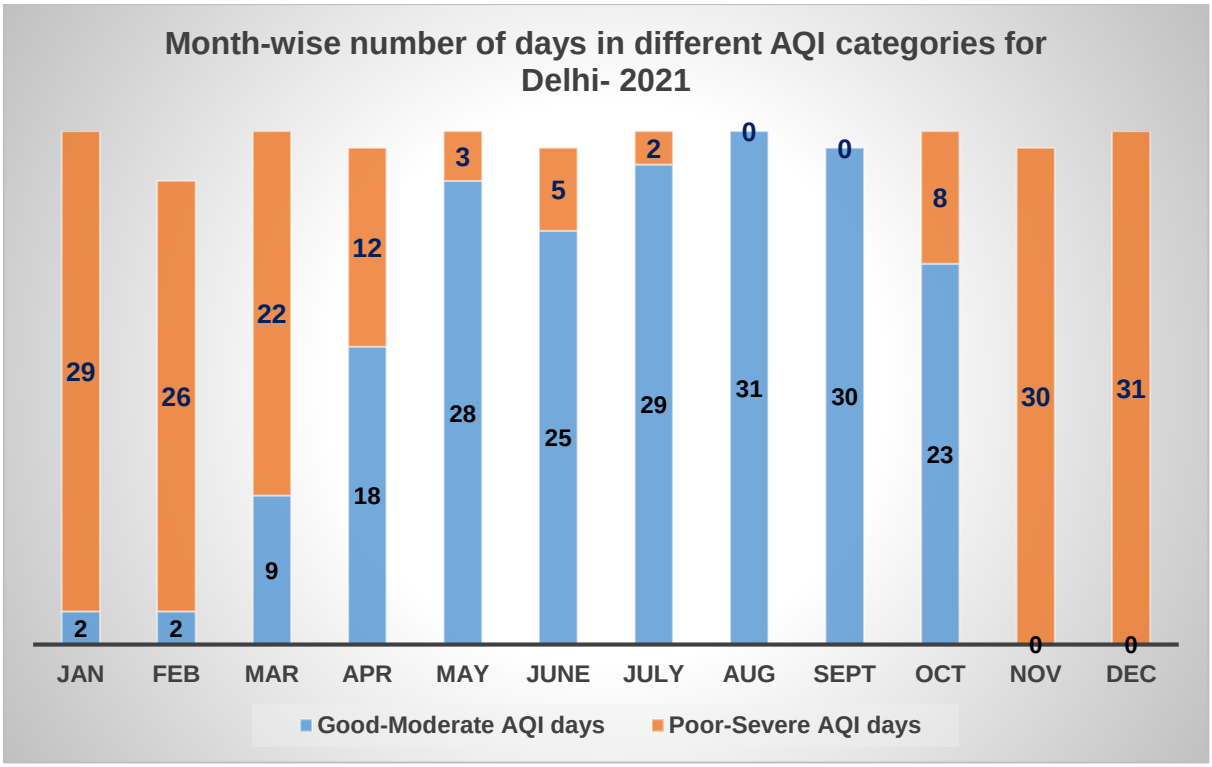


Figure 32: Number of days in different AQI category for Delhi (2021)

AS evident from the Figure 32, during winters, a characteristic rise in air pollution is seen, often resulting in severe deterioration of air quality, which may be attributed to increased emissions from local sources, paddy straw burning, additional emissions due to festivals coupled with unfavourable meteorological conditions.

At best we can regulate the sources and can do very little, if any, to turn the meteorology in our favour. The challenge is which sources, when, for how long, and how far distant needs to be regulated. Undoubtedly, efforts of regulatory agencies at Central and State levels, Judiciary, enforcement of Graded Response Action Plan (GRAP, attached at Annexure-V) for Delhi and NCR have shown conspicuous improvements in air quality (discussed later), however it is still far from being within the acceptable limits.

For Delhi-NCR and the Indo-Gangetic Plain (IGP), we cannot settle the issue of episodic air quality unless we talk about crop residue burning (CRB) in Punjab and Haryana; the estimated $PM_{2.5}$ emissions from CRB is 70 Gg at the end of Kharif season compared to Delhi's annual estimated emission of 25 Gg. Thus, the large CRB emission will impact the NCR and entire IGP.

5.2 Stubble Burning

Paddy stubble burning is practised mainly in the states of Punjab, Haryana, and UP to clear the fields for Rabi crop sowing. The paddy crop is harvested in the month of October. To clear the fields and sow the next crop, paddy residue is burnt.

Satellite remote sensing sensors and its applications help to monitor biomass burning on a large scale. Analysis of Active Fire Events (AFE) count due to paddy crop residue burning over the past years has indicated large scale burning of paddy straw in the States of Punjab and Haryana during winter season. The AFE data recorded is given below Table 7.

Table 7: AFE data recorded over Punjab and Haryana during 2020-2021

States	2021 (15 Sep-30 Nov)	2020 (15 Sep-30 Nov)
Punjab	71304	83002
Haryana	6987	4202

North westerly winds are unfavourable for air quality in Delhi as these may bring the pollutants from the north-western region of India (Punjab and Haryana) emitted due to stubble burning, which results in rise in concentration of PM2.5 in Delhi.

SAFAR (System for Air Quality and Weather Forecasting Research), IITM has developed a model which provides a quantitative estimate of the contribution of biomass burning to $PM_{2.5}$ levels in Delhi during stubble burning period. This is done using satellite data for fire counts, emission inventory data of stubble burning in Punjab and Haryana, emission inventory of Delhi as well as data from ambient air quality monitoring stations and automatic weather monitoring stations. Average and maximum contribution of biomass burning to $PM_{2.5}$ levels in Delhi during the stubble burning season for the year 2020 and 2021 is given Table 8 and Figure 33.

Table 8: Average and maximum contribution of biomass burning to $PM_{2.5}$ levels in Delhi during the stubble burning season for the year 2020 and 2021

States	2021	2020
Average Contribution of stubble burning to PM2.5 in Delhi (SAFAR)	13% (Oct 10- 23 Nov)	13% (Oct 10- 03 Dec)
Maximum Contribution (SAFAR)	48%	42%

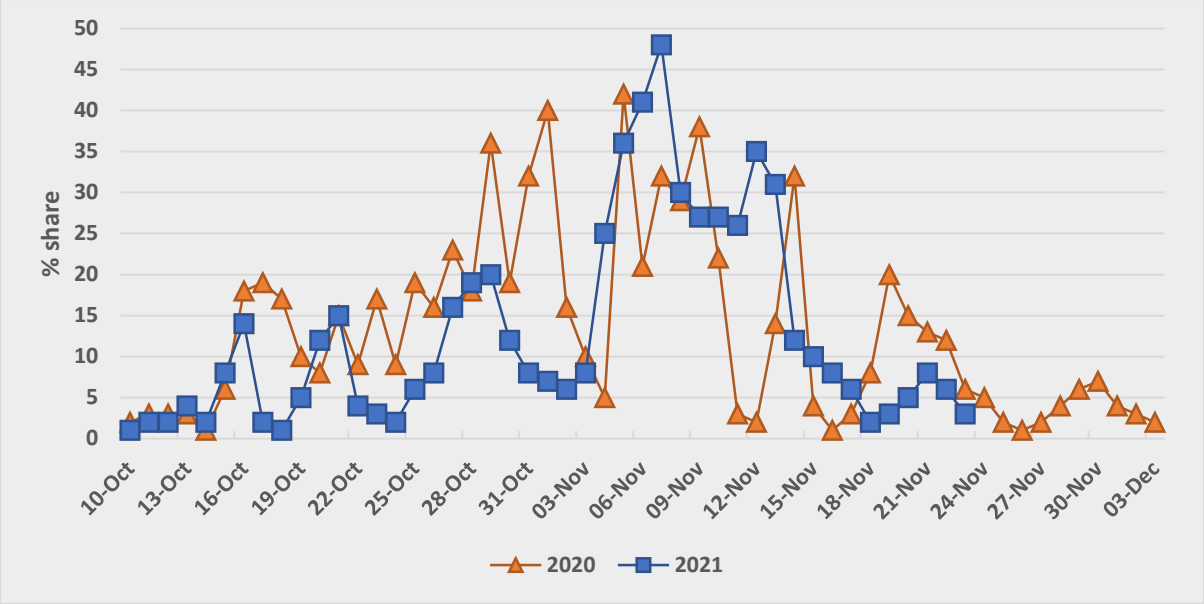


Figure 33: Percentage Share of Stubble burning to PM2.5 in Delhi (SAFAR)

5.2.1 Actions for Stubble management

1. Scheme for 'Promotion of Agricultural Mechanization for In-Situ Management of Crop Residue in the States of Punjab, Haryana, Uttar Pradesh & NCT of Delhi: Central Government in 2018 launched a scheme wherein financial assistance is provided to the farmers for purchase of crop residue management machinery and establishment of custom hiring centers. 50% subsidy on the cost of crop residue management machinery is provided to the individual farmers and 80% subsidy is provided for establishment of Custom Hiring Centers (CHCs) of crop residue management machinery. During 2018-2022, over 2 lakh crop residue machineries have been delivered to individual farmers and CHCs, and over 39,000 CHCs have been established. In 2022, the Scheme has been merged with Sub-Mission on Agricultural Mechanization (SMAM) and SMAM has been merged with Rashtriya Krishi Vikas Yojana (RKVY).

2. PUSA decomposer: Indian Council of Agricultural Research has developed Pusa Decomposer, a microbial consortium of fungal species (both in liquid and capsule forms) for rapid decomposition of paddy straw. Use of this consortium accelerates process of paddy straw decomposition in the field itself.

3. Ethanol plants: Oil Marketing Companies are setting up 2G ethanol plants based on various feed stocks including paddy straw in the country. One 2G Ethanol plant has been

inaugurated at Panipat in August 2022. 2G ethanol plant is expected to utilize 2 lakh MTPA of paddy straw.

4. Compressed Bio-gas plants: MoPNG has approved National Policy on Biofuels- 2018 and also launched 'Sustainable Alternative towards Affordable Transportation' i.e., `SATAT' which promote setting up of Compressed Bio Gas projects using biomass as raw material.
5. Biomass power projects are operational in Punjab and Haryana.

6. Statutory Directions were issued to NCR State Governments/GNCTD to prepare state specific Action Plans based on Framework prepared by the Commission. The framework places emphasis on In-situ crop residue management including bio-decomposer use, Ex-situ crop residue management, IEC activities and Monitoring and effective enforcement.

7. CAQM has also directed the industries located in NCR beyond the jurisdiction of GNCTD, where gas infrastructure and supply are available, to completely switch over to PNG or biomass fuels, by 30.09.2022, and in respect of industrial areas in NCR where PNG infrastructure and supply is not available, such industries to completely switch over to bio-mass fuels by 31.12.2022. Further, CAQM has permitted use of biomass fuel in addition to PNG other cleaner fuels in new/ under commissioning industries in NCR, beyond the jurisdiction of NCT of Delhi.

8. Pollution Control Board has framed guidelines for providing one-time financial assistance for establishment of paddy straw-based palletizations and torrefaction plants. Under these guidelines, individuals /entrepreneurs / companies, interested in setting up palletizations and torrefaction plants, using only paddy straw generated in the NCT of Delhi, States of Punjab & Haryana, and NCR districts of Rajasthan & Uttar Pradesh can submit an application for obtaining a one-time grant on capital investment. Under the guidelines, a maximum grant of Rs. 14lakh per Ton/hr. for non-torrefied pellet plant and Rs. 28 lakhs per Ton/hr. for a torrefied pellet plant is being provided, with an overall cap of Rs. 70 lakhs for the former and Rs. 1.4 crore for the latter. A corpus of Rs. 50 crores has been earmarked for utilization through the guidelines. Assuming complete utilization of the corpus, over 1 million metric tonnes of paddy straw-based pellets are expected to be generated every year.

Chapter 6: General Recommendations to control the emission

6.1 General recommendations for non-industrial sectors to control the emission

6.1.1 Domestic Sector

The domestic sector contributes nearly 437 Gg of $PM_{2.5}$ (19 % of the total $PM_{2.5}$ emission) per year over the IGP. This emission is primarily due to the use of solid fuel and traditional Chulha in rural locations. In a highly populated country like India, giving subsidy in each individual household might not be feasible. But the rural and partly some semi urban and urban population are unwilling to use cleaner fuel (LPG) instead of free or less costly solid fuel. Hence, promoting the cleaner fuel through Pradhan Mantri Ujjwala Yojana and providing support to the economically weaker section like BPL ration card holders should be considered. During critical winter months (November and December), if the families using solid fuel only (estimated number of families 3,60,75,200) use domestic LPG (estimated 7,21,50,401 number of domestic LPG cylinders required @two cylinders per family during the season), 108 Gg of net $PM_{2.5}$ emissions can be reduced over the IGP. Another solution to control the domestic emission might be promoting improved cook stoves in the rural areas. Providing one improved cook stove can run for one or two years for a family and this can significantly reduce the emission from the domestic solid fuel burning. Cattle dung can be used as an alternative of coal in nearby coal-based industries with high PM2.5 control efficiencies and provide some financial benefit to the rural population.

6.1.2 Soil and Dust

All source apportionment and inventory studies in the region show overwhelming impact of dust especially during summer that is inevitable in these geo-climatic conditions. The net emission of soil and road dust is 225 Gg/year (~10 % of the total $PM_{2.5}$ emissions over the region). Loose crustal soil and high wind effect in the Indo-Gangetic Plain contribute to this phenomenon. Dry winters/summers add to the problem. Re-suspension of road dust due to vehicular traffic is of special concern. Dust is a carrier of toxins from combustion sources and therefore, can be harmful. However, the strategy to address this problem has to be diverse and

not limited to only road cleaning and sweeping. A lot of this problem is also created by mismanaged urban construction and roads. Intense rapid action should be taken to repair and building of pavements and vacuum cleaning of roads; implementation of street design guidelines for footpaths and cycle tracks with adequate vegetative buffers and paving of roads; blacktopping/ pavement of road shoulders; phase-in mechanical/ vacuum based street sweeping' introduce wet/ mechanized sweeping of roads; implementation of truck loading guidelines; use of appropriate enclosures for haul trucks; gravel paving for all haul routes; sprinkling of recycled water; water fountains at major intersections; maintenance of pothole free roads, increase in green cover on central verges and on the road sides along the right of ways, enforcement of air pollution control in concrete batching (use of water spray and wind breakers, bag filters at silos and enclosures, hoods, curtains etc.)

Towards dust management on roads and road construction projects, municipal bodies should adopt the road dust control measures. The focus should be largely on the maintenance of roads, identification of hotspots for road dust, mechanical sweeping, sprinkling and scientific disposal of collected waste. The longer-term systemic changes should require more broad-based approaches: (i) Municipal ward wise street network redevelopment plan for paving and greening as per IRC guidelines without impeding the needs of other road users including pedestrians. (ii) Hotspot action for road cleaning with GPS enabled mechanical sweepers; desilting of canals/nullah's side roads brick lining, dedicated helpline with MIS support and citizen interface to enable geo-tagging for complaints; (iii) Urban greening agenda with greening of open areas, gardens, plantation for green walling and protection of all forest areas in IGP.

The exclusive controls of urban dust should include better road conditions, paved shoulders, stabilization of soil surface, sidewalks, and unpaved portions (e.g., parking lots) to have Interlocking Concrete Block Pavement (ICBP) in the megacities over IGP. ICBP technology should be adopted for specific requirements of footpaths, parking areas, etc. It should be the priority that all existing unpaved shoulders, sidewalks, and parking lots are suitably handled and, in the future, all new road constructions incorporate these measures.

All major urban roads, State Highways and NHAI must maintain silt load of 2.0 g/m^2 or less on their roads and assess the silt load twice in a year (winter and summer) at an interval of 50 km on both sides of the road.

Railway siding should construct warehouse for storage of cement bags or other dusty material to minimize fugitive emissions during loading, unloading and storage and avoid these operations on open platforms. Mechanical handling of bags of cement or dusty material be done using conveyor belts, possibly horizontally movable belts. Enclosures in the form of flexible belt curtain may be provided on the warehouse openings used for transfer of material. Warehouse cleaning shall be done with only mechanical means (large size vacuum pump) and it shall be done on regular basis. Cement collected shall be properly stored and records be maintained. Peripheral roads for vehicle movement should be paved and these should be properly maintained.

6.1.3 Construction dust

Construction work all through the country is progressing at a fast rate and as the economy grows, it will further increase. The production of cement, along with poor conditions at the construction sites, are responsible for significant contribution in PM2.5/10. Regulations are adequate but enforcement of these needs to be strengthened (e.g. shielding off the construction sites, storage of materials, loading-unloading, paved road at the construction site) and dust from the construction work. Uses of water cannon to wash the surrounding may be partly useful but what is important is to prevent dust emissions. A condition/policy should be formulated that all building materials and surroundings (except raw cement) will have 2% moisture; this approach will solve the dust problems to a large extent.

6.1.4 Open Burning

This sector emits nearly 358 Gg $PM_{2.5}$ annually (As per the EI report done in this study by IIT-Kanpur) (15.5 % of the total emission of $PM_{2.5}$ over this region) and need to be addressed comprehensively. The following are some recommendations.

Crop residue burning

Our results have clearly shown that the major fraction of open burning is due to the crop residue burning. For the IGP, we cannot settle the issue of episodic air quality unless we talk about crop residue burning (CRB) in Punjab and Haryana; the estimated $PM_{2.5}$ emissions from CRB is 70 Gg at the end of Kharif season is almost three times more than the Delhi's annual estimated emission. Thus, the large CRB emission have paramount impact on the entire IGP. Plan of actions need to be taken well before and implemented. Continue with all efforts to minimize the number of CRB fires through technology, education, awareness,

incentives and limit the mean number of daily fires to less than 1000 (refer to CII-NITI Aayog, 2018). Make all efforts at Block/Panchayat level to educate households not to burn any biomass including dung, encourage and promote LPG usages particularly during this period. Implement GRAP (Annexure - V) fully from October 15 to November 20 and not wait for $PM_{2.5}$ levels to go above 250 $\mu g/m^3$. The GRAP has all the actions that will improve the air quality and reduce the emission to desired levels. But these actions are to be taken from October 15 to November 20, regardless of air quality in this period.

Municipal Solid Waste Burning

MSW is the major cause of air pollution not only because it is burned but also because of its improper disposal. The dumped MSW undergoes decomposition which releases H_2S, NH_3 and harmful volatile compounds like VOCs. The VOCs turn into particles of secondary organic aerosols and add in the formation of ozone. Although there exist MSW disposal Rules, their implementation is far from satisfactory in most urban areas.

The Cl- content, which is an indicator of MSW burning, in urban areas can vary 2-10 percent in PM_{10}. The typical contribution of MSW burning alone is about 8-10 percent and it needs to be controlled.

Any form of garbage burning should be strictly stopped and monitored for its compliance. It will require the development of infrastructure (including access to remote and congested areas) for effective collection of MSW and disposal at the scientific landfill site. Space constraints force the municipal corporations to simply dumped and spread at the low lying area. This must be recognized that the major problem is that of collection. The option of waste to energy plants must be considered with very high pollution control; PM control over 99.99 percent should be ensured. A similar treatment/ disposal of legacy waste should also be taken up on priority.

The municipal corporations should prioritize the MSW collection mechanism starting in a systematic manner in each ward. Special attention is required for fruits, vegetable markets and commercial areas and high-rise residential buildings, where MSW burning is common. A mechanism should be developed to carry out the mass balance of MSW generation and disposal on a daily and monthly basis. These data must be inventorized and available for public scrutiny.

Desilting and cleaning of municipal drains by Municipal Corporation should be undertaken on a regular interval, as the silt with biological activities can cause emission of air pollutants like H_2S, NH_3, VOCs, etc. It is seen that waste is sometimes burned in industrial areas; this must stop and be ensured under the supervision of industrial development agency and pollution control boards. The complete banning of MSW burning in urban areas can significantly reduce $PM_{2.5}$ emissions.

Open burning of waste as well as spontaneous fire in landfills contribute substantially to air pollution and is a source of high toxic exposure for local communities. The enforcement measures that include ground inspection and penalty and emergency response to public complaints have limited impacts. The effective solution lies in proper waste management. However, infrastructure for waste collection, transfer, material recovery and safe disposal is not adequate. As a result, waste accumulates in the open that is burnt for easy disposal. Waste management has to ensure proper quantification of waste generation, 100 % door to door collection of segregated waste, material recovery and recycling and minimize fresh dumping of waste in landfills and full remediation of legacy waste.

6.1.5 Transport Sector

The contribution of particulate matter from the transport sector is relatively low compare to industrial or domestic sector as a whole (118 Gg/year, i.e., 5 % of the total $PM_{2.5}$ emission over the region) (As per the EI report done in this study by IIT-Kanpur). But in point locations such as over the urban agglomeration the relative contribution from transport sector could quite high. According to the Automotive Research Association of India, due to the progressive tightening of the emissions standards for vehicles there has been substantive improvement in tailpipe emissions from new vehicles. With graduating from Bharat Stage-I (BS-I) to Bharat Stage - VI (BS-VI) emissions standards, particulate emissions from diesel cars have reduced 31 times and from heavy duty vehicles by 36 times. While new vehicle technology and emissions control systems have significantly improved and will continue to improve to reduce tailpipe emissions in the driving conditions, equally stringent focus is needed on management of on-road vehicles. The objective is to keep on-road vehicles low emitting during their useful life on the road and to reduce direct exposure to toxic emissions; accelerate fleet renewal to leverage emissions gains from the technology advancement with introduction of BS VI emissions standards; and accelerate zero emissions transition with rapid electrification of targeted vehicle fleet to meet clean air target. Simultaneously,

transportation and mobility strategies will be implemented to reduce vehicle miles travelled and achieve at least 80-85 per cent modal share by public transport systems.

There should be improvement in enforcement systems that include linking of updated PUC and Vahan database, automatic alert to vehicle owners for renewal of PUC certificates, compliance strategy like linking refueling with valid PUC certificate and higher penalty. Linking of PUC with annual vehicle insurance may be useful. Information on the status of action in IGP is not equally adequate. The programme requires uniform strengthening; quality control at a scale and effective fleet screening still remains a daunting challenge. This requires introduction of more advanced inspection and monitoring systems. In addition, all commercial vehicles require annual roadworthiness and fitness tests under Central Motor Vehicle Rules (CMVR). In most part of IGP these tests are done manually with limited testing facilities. There is a need to set up more fully automated high-capacity centralized testing centers for the region. There is scope for better capacity utilization of these testing centers. Vehicle electrification targets for IGP by each of the States need to be set in terms of percentage of the new vehicle sales to be achieved by the end of the 2025-2030 in phased manner and also targeting total e-vehicles in particular categories. All States should have a policy on EV and hybrid vehicles, charging points at State/ private/ household level in a time bound manner. Implement older vehicle phase out policy as per the action plan of MoRTH for National Clean Air Programme (prana.cpcb@gov.in>> partners>>MoRTH plan). All new public transport buses in cities over this region should be targeted to be electric buses. Identification and decongestion of traffic intersections as per the approved city action plans could also lead to reduction in net emission from the transport sector.

Minimizing pollution from in-use old vehicles: Among control devices, the Diesel Particulate Filter (DPF) is useful and proven technology. DPFs are porous ceramic honeycomb devices and filtration in DPFs occurs as exhaust gases are forced to flow through the walls and structure of filter. Such installation is possible in both BS IV two and four-wheelers. Every State should develop/amend vehicle scrappage policy, develop incentive mechanism for scrappage of old vehicles, and set up infrastructure for material recovery and disposal of end-of-life vehicles (Toyota operates one such plant in NOIDA). Develop a plan for CNG/CBG fuelling network in IGP and on highways to shift long haul trucking and other commercial vehicles to CNG.

E-Mobility: Policies on e-mobility for all the IGP states should have priority for million plus cities that encourage EV including strong hybrid vehicles.

Faster EV adoption in intra-city commercial transport and in 2/3-wheeler segments should be ensured. Public city transport including taxis and cabs may be converted to gas/electricity or strong hybrid in a time-bound manner. Diesel auto rickshaws should be phased out. Strategic plan for EV charging infrastructure at each 3 km in urban areas, 25 km on highways (both sides) and 100 km for buses and trucks and swappable battery stations may be set up. Retrofitting of old and overaged petrol/diesel vehicles into electric vehicles.

City transport services (bus and metro services) should be augmented in million plus cities. Public transport can be made cheaper than the two-wheeler cost.

6.1.6 Fugitive emissions

There are several industrial enterprises that are responsible for huge amount of fugitive emissions and dust generation from mining and different phases of crushing and storage. Stone crushers and mineral grinding are the most prominent among them. It is necessary to further reform the industrial structure, modernize production capacity with improved emission control systems and adoption of clean fuels like natural gas and clean electricity for industrial applications. This will have to be supported by smart monitoring and deterrence for compliance and targeted improvement. Other requirements are installation of ambient air quality monitoring stations and online e-Rawaana system to stop illegal mining. These require proper implementation and effective technical approach. Also, further mapping of all sources of fugitive emissions is important.

Construction work all through the country is progressing at a fast rate and as the economy grows, it will further increase. The production of cement, along with poor conditions at the construction sites, result in contamination and pollution. Regulations are adequate but poor implementation of dust control measures (e.g., shielding off the construction sites, proper storage of materials, loading-unloading, paved road at the construction site) may lead to dust from the construction work. Uses of water cannon to wash the surrounding may be partly useful but what is important is to prevent dust emissions. A condition/policy should be formulated that all building materials and surroundings (except raw cement) will have 2 % moisture; this approach should solve the dust problems to a large extent.

CPCB has brought out guidelines for prevention and control of dust from construction activities. State agencies must implement these in later and spirit.

6.1.7 Agriculture Sector

The rural emissions are significant and need to be controlled on priority. The control of rural emissions will improve the air quality in rural area and prevent its contribution to urban areas in the form of background pollution. In rural area tillage from the agricultural land is an important source of $PM_{2.5}$. Use of solar pump can be encouraged for the irrigation purpose in place of diesel or kerosene.

Ploughing should be avoided if the soil is dry and there are high winds. Minimize soil-disturbing field operations such as ploughing, mowing, and tilling. These activities may be avoided when winds are high. Post-harvest tillage may be done on low wind speed days-based weather forecasts. Physical barriers such as fences, straw bales, and large trees may be used to minimize the flow of dust.

6.2 Industry Specific Interventions (Best Available Technology and stringent emission standards)

This study shows that the industrial sectors are the main $PM_{2.5}$ emitters over the IGP region with the net emission of 1128 Gg/year (48 % of the total $PM_{2.5}$ emission) (As per the EI report done in this study by IIT-Kanpur). Hence this sector needs special attention and planning for air quality management. Emission Inventory for Industrial emission of $PM_{2.5}$ shows that in IGP, Uttar Pradesh is the major emitter of industrial PM followed by Bihar, West Bengal, Haryana and Punjab (Figure 34).

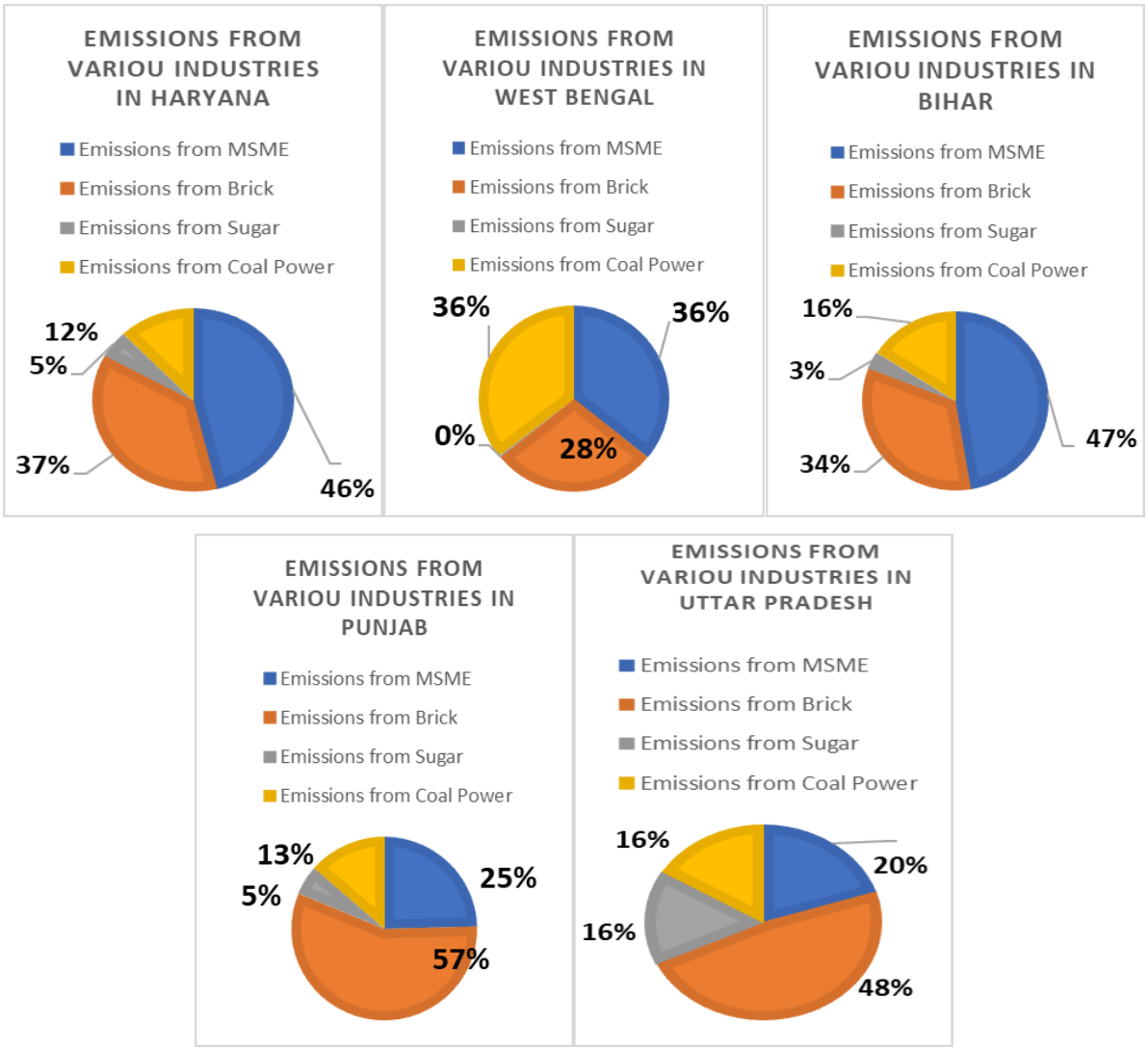


Figure 34: State wise emissions from different industrial sectors

Net industrial emission of different states

Haryana= 133.2 Gg/Year

Punjab= 121.2 Gg/Year

Uttar Pradesh= 492 Gg/Year

Bihar= 208 Gg/Year

West Bengal = 191 Gg/Year

Brick Kilns

Among the industrial emission, the bricks have the largest contribution in IGP with the net emission of 468 Gg/year (41 % of the total industrial emission and 19 % of the total $PM_{2.5}$

emission) (As per the EI report done in this study by IIT-Kanpur). State-wise emission inventory of $PM_{2.5}$ shows that Brick Kilns contribute maximum to $PM_{2.5}$ levels in Uttar Pradesh (230 Gg/year) and Bihar (77 Gg/Year) while the other major emitting States are Punjab (69 Gg/Year), Haryana (49 Gg/Year) and West Bengal (43 Gg/Year). Therefore, it is prerequisite to curb Brick kilns' emissions using latest technology.

Brick kilns are small scale and widely dispersed and are difficult to monitor. There have been several efforts to monitor their operation, set emission standards, mandate adoption of improved zig zag kiln technology and closure during winter in NCR. The MoEFCC has issued a gazette notification on February 22, 2022, on emissions standards and kiln technology. This provides for tighter particulate emissions standards, and specification of stack height by capacity of brick kilns. In intermittent kilns, bricks are fired in batches; fire is allowed to die out and the bricks are allowed to cool after they have been fired. The kiln must be emptied, refilled and a new fire has to be started for each load/batch of bricks. In intermittent kilns, most of the heat contained in the hot flue gases, fired bricks and the kiln structure is thus lost. Intermittent kilns are still widely used in several States of the IGP and can be further sub-divided into two categories: – Intermittent kilns without stack: The kilns which do not have any stack/chimney to guide the flue gases. In these kilns the flue gases can be seen coming out of the kiln from the sides or from all over the top surface of the kiln. Clamps, scove and scotch kilns are the examples of intermittent kilns without stack. This kind of kilns should be strictly banned over the region within next 3 years. All new brick kilns will be allowed only with zig zag technologies or vertical shaft or on piped natural gas. In addition, it is recommended that the brick kilns should be operative after the annual episodic issues of poor air quality (i.e., end of November) over Punjab and Haryana. For vertical shaft kilns the stack height should be 16m and 14m respectively for the Kiln capacity less than 30,000 bricks per day and more than 30000 per day. For rest all kind of kilns it should be 27m and 24m respectively. Brick kilns shall construct permanent facility (port hole and platform) as per the norms or design laid down by the Central Pollution Control Board for monitoring of emissions. Brick kilns should be established at a minimum distance of 0.8 kilometers from habitation and fruit orchards. State Pollution Control Boards/Pollution Control Committees may make siting criteria stringent considering proximity to habitation, population density, water bodies, sensitive receptors. The first step is to identify the type of technology used in existing brick kilns. Table 9 shows types of Brick kilns in use in IGP with their specifications.

Table 9: Types of Kilns used in IGP with their specifications

Type of Kiln	**Fixed Chimney Bull Trench Kiln (FCBTK)**	**Natural Draught Zig Zag**	**Induced Draught Zig Zag**	**Vertical Shaft**
Commonly used Fuel	Coal Biomass: Sawdust, firewood, biomass briquettes Agricultural residue: husk and stalks Industrial waste: tires, plastic	Similar	Similar	Coal
Specific Energy Consumption (MJ/kg)	1.1-1.46	1.02-1.21	0.95-1.11	0.54-1.11
Cause of Heat loss	Incomplete Combustion, Heat loss from kiln surface	Heat Loss from kiln surface	Heat Loss from kiln surface	Flue gas and fired bricks
Production Capacity (million Bricks per year)	3-8	3-8	2.5-6.0	1.5-3.0
Capital Cost (USD)	50,000-80,000	50,000-80,000	50,000-80,000	60,000-80,000
Good Quality Product	60 %	85 %	80 %	90 %

It is evident from the Table 9 that natural draught zig zag type of Brick kilns are the most efficient. Vertical shaft brick kilns are less polluting and their specific energy consumption is also low, however, with respect to capital cost and production capacity it is not viable.

Ministry of Environment, Forest & Climate Change has notified revised emission norms for brick kilns, which should be strictly enforced.

MSMEs

Micro Small and Medium Enterprises (MSME) are the major source of PM2.5 emissions in Bihar, Haryana and West Bengal while second major source in Punjab and Uttar Pradesh. Boilers and furnaces are the most common category of MSME in all States while stone crushers in Uttar Pradesh and Jute industries in West Bengal are also contributing (Table 10).

Among the industrial emission, MSMEs are the second largest (after brick kilns) contributor to the $PM_{2.5}$ with the net emission of 350 Gg/Year which is about 31 % of the industrial emission and 14 % of the total $PM_{2.5}$ emission over the region (As per the EI report done in this study by IIT-Kanpur). State-wise Emission inventory of $PM_{2.5}$ shows that MSMEs contribute maximum to $PM_{2.5}$ levels in Bihar (107 Gg/Year, 30 % of the MSMEs emission) and Uttar Pradesh (96 Gg/Year, 27 % of the MSMEs emission).

Table 10: State wise classification of leading MSME industries

State	Type of MSME
Bihar	Boiler, Furnace, Roll Mills
Haryana	Boiler, Furnace
Punjab	Boiler, Furnace, Hot-mix Plants
Uttar Pradesh	Boiler, Furnace, Stone Crusher, Roll Mills
West Bengal	Boiler, Furnace, Roll Mills, Hot-mix plants, Jute

The following steps can be taken to curb emissions from MSME.

Small scale units and small boilers

Small scale units dominate the industrial sector in the region and are largely dependent on polluting fossil fuels in their individual boilers. Such a system being energy inefficient on one hand, also are a source of high pollution. While several industry specific interventions to improve processes may improve overall technical efficiency for resources and emissions savings, it is necessary to focus on two priority strategies viz. access to clean fuel and replacement of small individual industrial boilers with common boilers, wherever possible. If feasible, such furnaces and industrial processes could also be run on affordable electricity. More than 50 % of the boilers installed in industrial areas are of less than 2 tones per hour

(TPH) capacity. Another 35 % of boilers have capacity in the range of 2–10 TPH. These are used for generating steam for heating purposes. These boilers primarily consume coal and are presently not equipped with effective pollution control measures. Fuel feeding is mostly done manually without any automation and these have poor technical efficiency. Installation of any type of Continuous Emissions Monitoring Systems (CEMS) is not feasible. There are large number of small boilers in several industrial clusters in IGP. Replacement of small boilers with common boilers for steam generation in a cluster of industrial units is an important way forward. There are several advantages of switching from individual small boilers to common boilers. The individual industrial units can avoid a range of costs that include cost of installing small boilers and associated fuel cost, cost of air pollution control devices, operation and maintenance cost and can also avoid the need for getting environmental clearances for boilers. These costs and responsibilities can be borne by the manufacturers/installer and operator of common boilers. This can further reduce inspection requirements of numerous boilers by SPCBs. Common boilers can meet much tighter emissions standards, run on cleaner fuels including natural gas or biomass, adopt emissions control systems and CEMs monitoring and also obtain necessary environmental clearances.

Controlling emissions from the furnaces

There are many industries with induction furnaces, which is very polluting process, with almost no pollution control devices (Figure 35). The maximum emissions occur when the furnace lids and doors are opened during charging, back charging, alloying, oxygen lancing (if done), poking, slag removal, and tapping operations. These emissions escape from sides and top of the building. To address the pollution caused by fugitive emissions using induction furnaces a fume gas capturing device has been developed and commercially available. A side-based suction is far more effective than top suction, which interferes with the movement of the crane.

As efforts are being made to reduce pollution from boilers in industries, it is equally important to restrict the use of furnaces running on dirty fuels. Primarily manufacturing industries, especially metal-based industries, use furnaces. Currently these are largely operating on fuels like coal, wood and liquid fuel. However, several units have also adopted electric furnaces while a few are running on gas-based systems. While non-electric furnaces should not be allowed in new industries, a phase out plan may be planned for the existing

industries with some incentive support for small and medium scale units. Until then ensure all industries using furnaces have installed well maintained air pollution control devices.

Induction furnace

There are several induction furnaces in IGP and these do not have proper collection of fumes and emission due to movement of cranes and almost all emission goes uncollected (Figure 36). The new technology requires the collection of emission from sideways but with much higher suction rate that does not interfere with the movement of crane and should be adopted (Figure 36).

Figure 35: Existing Induction Furnace in a Factory over IGP

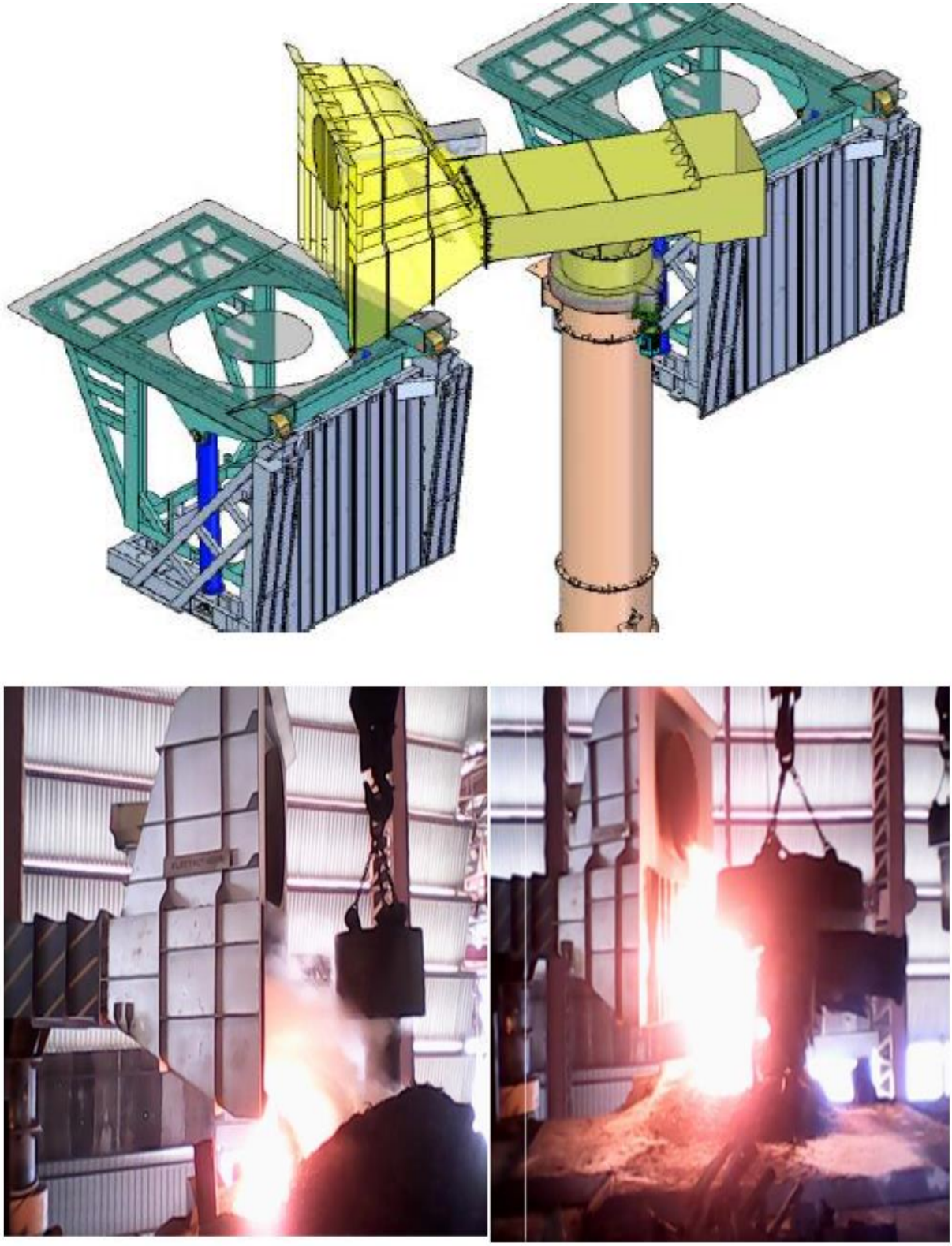


Figure 36: Advance side-ways collection technology in induction furnace

Industrial waste burning

Nearly all industrial areas are prone to open burning of industrial waste that includes plastic, packaging, rubber, textile, ceramic, slag etc. Industrial waste management – both non-hazardous and hazardous waste - has emerged as an important issue in IGP States. There is an urgent need to streamline the collection and disposal of such industrial waste to prevent burning. Industries and industry associations should be made liable for safe collection and disposal. There have been some initiatives as in a few industrial zones where authorities have tied up with service providers to collect industrial waste and recycle and reuse using a material recovery facility. Such initiatives will have to be scaled up for the entire region.

CEMS monitoring in industries

Smart monitoring with the help of continuous emission monitoring (CEMS) is important for effective surveillance and transparent monitoring of industrial stack emissions to assess performance. The concerns regarding CEMS installation is quality control of data generated from the system. Lack of proper calibration and wrong installation, inadequate knowledge and skills required for technology selection, installation, operation and maintenance, compromise the quality of data and this needs immediate attention and action. Also, vendors, industry, service providers lack proper knowledge/skills. Industries lack clarity on suitable technology selection. Suitability of technologies, according to type of stacks, issues related to auto drift, span check etc., or provision of remote calibration of equipment, quality assurance and periodical check of CEMS performance also need to be addressed. There is an urgent requirement to strengthen the CEMS regime so that it can be used as a compliance monitoring tool by the regulators. CPCB has already initiated steps in this regard. Quality data and robust management of data from CEMs is desirable to adopt market-based mechanism like emission trading system.

Sugar Industry

In IGP, sugar industries located in Uttar Pradesh and Punjab are the major contributors to PM emissions. In Uttar Pradesh sugar industries contribute to 16% of PM emissions while in Punjab it is around 5%. Figure 37 shows that in Uttar Pradesh most of the sugarcane industries are in the northern region.

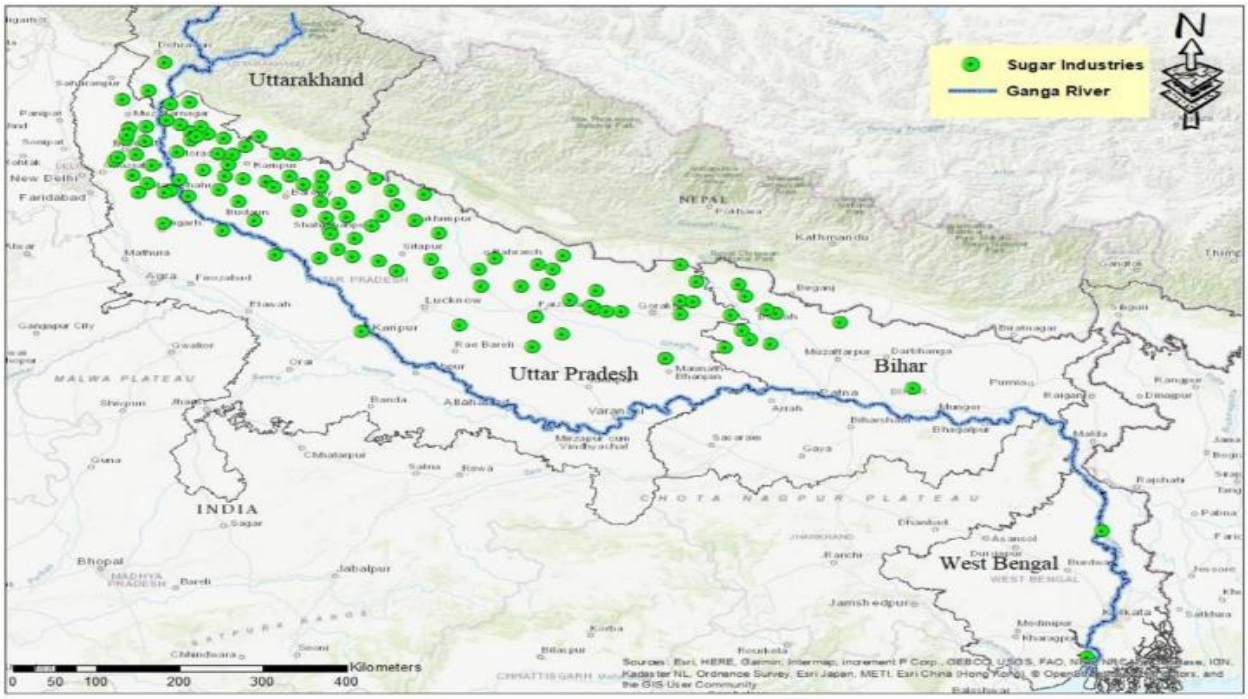


Figure 37: Location of Sugarcane Industries (Ranjan et al., 2021)

Most of the Sugar Industries use bagasse as a fuel in boilers, which produces particulate matter, oxides of nitrogen, carbon, sulfur and water vapors. It has been observed that nearly 45-50% of the Sugar Mills (<1000 tons cursed per day) in this region is small scale sugar manufacturing company (Khandsari) and should be treated as MSMEs. They should shift to forced draft from current practice of natural draft for better combustion and install simple air pollution control devices like cyclones and multi-clones.

For the bigger mills (>1000 tons crushed per day), the particulate matter, usually referred to as fly ash, consists of ash, unburnt bagasse and carbon particles. The MoEF&CC has provided emission standards for sugar industries which has to be stringently followed.

They should install advance air pollution control devices like bag filters, scrubbers and ESPs and should meet the emission standard of 150 mg/m^3.

Coal based Power Plants

Emissions from coal power is also a significant source of $PM_{2.5}$ in most of the States in IGP ranging from 12-16 % while in West Bengal it is one of the primary sources of $PM_{2.5}$ (36 %). Revised emission norms for Coal Power Plants should be implemented within the specified time frame.

Cement Industries

The point source emissions from the cement industry include dust/particulate matter and gaseous emissions. Cement industry deals with various size reduction operations from limestone crushing to clinker grinding, dust emissions are a major pollutant. Gaseous emissions such as sulfur dioxide (SO_2), oxides of nitrogen (NOx), carbon monoxide (CO), carbon dioxide (CO_2), etc., are generated during pyro processing. The major sources for particulate matter emissions are crusher, coal mill, raw mill, kiln, clinker cooler, cement mill and packing plant.

Cement plants are equipped with air pollution control equipment (APCEs) like electrostatic precipitators (ESP), baghouse with glass fiber membrane filters and ESPs modified with bag filters, called hybrid filters. The CPCB norms for fugitive dust control should be strictly followed.

Summary – industry specific

In IGP, industrial $PM_{2.5}$ is primarily emitted by Uttar Pradesh followed by Bihar, West Bengal, Haryana and Punjab. Delhi and Chandigarh are comparatively negligible. In all IGP States four major industries have been identified viz. brick kilns, MSME, sugar and coal-based power plants. The study identified a work plan to be followed to curb emissions from different categories of industries. The first step should be usage of cleaner fuel. Nowadays, in brick kilns, scraps and plastic wastes have been in use which should be replaced by PNG and agricultural waste. Furnaces and boilers should use PNG, electricity and low sulfur coal. The most of the sugar mills are using bagasse fired boilers. Second step should be replacement of old technologies with new, for e.g., FCBT kilns should be replaced by zig-zag technology. Third step is to utilize pollution control technologies. Various types of PM controlling technologies have been identified which can be adopted as per requirement. Electrostatic precipitators and filters bags are the most efficient technologies for the finer particles, while for NOx and SO_2 selective catalytic reduction and flue gas desulfurization are the most efficient methods. The last step is periodic assessment of emissions from stacks and stack height. Industries should follow the emission standards prescribed by MoEFCC. It is recommended that over the identified hot spots of industrial pollution PNG supply network should be started to shift towards the cleaner fuel. No new red category industries should be allowed within 5km radius where population is above 1 million.

Chapter 7: Summary of Actions and Recommendations

Pursuant to the order of the Hon'ble NGT, the Committee has investigated the causes of high air pollution in IGP and made a detailed district-wise emission inventory of fine particles ($PM_{2.5}$) for different emitting sectors. This has enabled the identification of regions of poor air quality and local hotspots where air quality is very poor. Industrial development is the backbone of economic progress; however, the growth should be sustainable with a low emission trajectory for better public health. The Committee has specifically concluded the requirements of advanced technology and management interventions for air pollution sources in IGP. Due consideration was given that technological options and other actions are realistic and time-worthy for air quality improvements without any major recommendation of closure or restriction on economic activities. In addition, specific action plans are also suggested for the October -November episodic air pollution observed in IGP. The Committee has proposed overall recommendations which may be implemented in a time-bound manner. The detailed sector-wise emission control measures are presented in Chapter 6 and specific recommendations are condensed in this chapter.

7.1 Specific Recommendations

Action plans for non-attainment cities for various sectors/activities are already prepared. These include short, medium and long-term actions for abatement and control of particulate matter emissions from transport, industry, domestic, agriculture, construction and demolition, road dust, genset and power sectors. These plans should be implemented aggressively, and various guidelines and norms enforced strictly. The Committee, in addition to the above, suggests the following sector-wise recommendations.

Domestic Sector

(i) A program for switching over from solid to cleaner gaseous fuel for domestic sector should be formulated and implemented in a time-bound manner. The plan may include expansion of LPG network and putting up Compressed Biogas (CBG) network using biomass such as crop residue, dung, wet organic municipal waste, etc., particularly in rural areas. To deal with high air pollution levels in

critical winter months, feasibility of distributing two domestic LPG cylinders free of cost or on subsidized rate among the BPL families may be examined.

(ii) Promotion and rapid distribution of government-approved improved cook stoves in rural areas and among the urban road-side shanties.

(iii) Make all efforts at Block/Panchayat level to educate households through anganwadi workers and ANM nurses not to burn any biomass including dung and encourage and promote LPG usages.

Transport Sector

(i) All the diesel city public transport should be phased out completely in next five years, and city transport should be operated only through metro, e-vehicle or on CNG. All new public transport should be CNG or electric buses.

(ii) Public transport to be strengthened with metro and/or adequate number of buses, route plan based on commute surveys and Mobile App based ticketing and seating system is developed in all major cities.

(iii) Public transport can be made cheaper than two-wheeler cost.

(iv) Adequate vehicle scrappage infrastructure should be developed in next three years. Extended Producer Responsibility (EPR) may be considered for vehicle manufactures, who will have to build required vehicle scrap plants.

(v) Incentivise and aggressively implement e-mobility including required charging infrastructure. Strategic plan for EV charging infrastructure at each 3 km in urban areas, 25 km on highways (both sides) and 100 km for buses and trucks and swappable battery stations.

(vi) Linking of PUC centres with remote server and elimination of manual intervention in PUC testing.

(vii) Use off-peak passenger travel times to move freight (within the city) and restrict the entry of heavy vehicles into cities during 6:00 am to 9:00 pm in winter and 6:00 am to 10:00 pm in other seasons.

(viii) Check Overloading: Use weigh-in-motion bridges/machines (WIM) and Weigh bridges at entry points to the city and at toll plaza to check the payload of commercial vehicles. As per CMVR, a penalty of 10 times the applicable rate for overloaded truck is applicable.

(ix) Prepare plan for improvement of infrastructure for decongestion of roads.

(x) Prepare and implement zonal plans to develop an NMT (non-motorized transport) network

(xi) Proper road maintenance and marking, smart traffic signaling, encroachment-free roads, the standard design of the speed breakers, speed warnings and traffic discipline should be enforced for emission reduction.

(xii) Poor quality lubricants and their inappropriate recycling is important cause of real driving emissions. The quality of lubricants should improve and recycled unorganized sales of the lubricants should be stopped.

(xiii) EVs should be aggressively promoted. However, till the time battery-EVs take over, strong hybrid electric vehicles (HEVs) that blend fuel and electric power are much more fuel-efficient and should be promoted.

(xiv) Control of particulate emission through gasoline particulate filter (GPF) is a new technology and can be adopted in new BSVI vehicles for reducing emissions in the near to mid-term period.

Industry (Brick kiln, MSME, Induction Furnace, etc.)

(i) All the industries must stop using solid and liquid fuel and switch over to cleaner source of energy viz. electricity, gaseous fuel or bio-mass, in a time-bound and phased manner (say five years). Industrial clusters having uncontrolled PM emission of 500 tons per day (equivalent to 100 MW coal power plant) may be taken up on priority. Such clusters should also become candidate for priority of PNG infrastructure.

(ii) In the industrial clusters, wherever feasible, common boilers (to supply steam) with adequate emission control measures may be installed, which will be a win-win option for industries and regulators.

(iii) Brick kilns should be converted to Zig-Zag technology. The revised norms notified by MoEFCC should be strictly enforced.

(iv) In induction furnaces new technology requiring collection of emission from sideways but with much higher suction rate that does not interfere with the movement of crane should be adopted.

(v) Small scale sugar mills (<1000 tons cursed per day) (Khandsari) should be treated as MSMEs. These should shift to forced draft from current practice of natural

draft for better combustion and install simple air pollution control devices like cyclones and multi-clones.

(vi) Technology upgradation must be targeted in MSMEs and adequately supported. Regular training program should be conducted for the skill development.

(vii) Carry out pollution load estimation from industrial sector to enable setting of target for emission.

(viii) For MSMEs, a resource centre on technology-linked emissions achievements and multiple technology options and vendors (with the cost) linked to different levels of control be established at national and state levels; however, standards should be attained with the industry.

Open burning

Action plans for crop residue management are already in place for States of Haryana, Punjab, Delhi and NCR districts of Uttar Pradesh & Rajasthan. These should be implemented expeditiously. Every year, target and focus on at least five districts for zero crop residue burning in the States of Haryana and Punjab during post-monsoon.

Dust Control

(i) Identification and greening of open spaces, green cover on central verges and on the roadsides, repair and re-laying of pavements, grassing of road shoulders, washing and mechanical/vacuum-based street sweeping and proper disposal of collected dust must be ensured in cities and towns with more than 5 lakh population. Indian Road Congress/Bureau of Standards must bring out silt load standards for roads. All major urban roads, State Highways and NHAI must maintain silt load of 2.0 g/m^2 or less on their roads and assess the silt load twice a year (winter and summer) at an interval of 50 km on both sides of the road.

(ii) All the Railway Siding should construct warehouse for storage of cement bags or other dusty material to minimize fugitive emissions during loading, unloading and storage and avoid these operations on open platforms. Mechanical handling of bags of cement or dusty material be done using conveyor belts, possibly horizontally movable belts. Enclosures in the form of flexible belt curtain may be provided on the warehouse openings used for transfer of material.

(iii) Construction & Demolition (C&D) waste processing facilities of adequate capacities should be set up, to begin with, in cities having population more than 5lakh. C&D waste collection points must be created in different zones of the cities, and in no case, it should be allowed to be dumped in non-designated areas, particularly along roadside. Recycling of processed waste must be encouraged, facilitated and, wherever feasible, mandated.

Research & Development, Training and Capacity Building

(i) Focused research on IGP air pollution problems must be taken up, which can be coordinated through a dedicated Center/Cell established specifically for the purpose. The Center may collaborate with research & academic institutes and encourage/facilitate startups for developing affordable cleaner technologies (particularly for small scale polluting industries) and best process practices & guidelines for various air polluting sectors.

(ii) Training and capacity building of regulatory agencies, urban local bodies, panchayats, industries must be taken up as a regular and important component to create skilled human resource.

Enforcement and Administrative Issues

(i) An independent body to better coordinate performance measurement among the Central, State and other agencies (e.g., Industry, Municipal Corporation) responsible for taking air pollution control measures as per the targets should be established. The sector-wise report, clearly stating air quality achievements and evaluate air program results should be published and available for public scrutiny.

(ii) The unorganized sectors should be facilitated to come on the mainstream within a specified timeframe and apply for consent under Air Act and meet emission standards.

(iii) The review of existing technologies, emission norms, guidelines, process practices, etc. should be taken up every three to five years for upgradation.

(iv) Hotspot districts (as per Table 5) must be dealt on priority for implementing various interventions/recommendations.

Approval of the committee Members on Final Report of the Committee in Compliance with the Hon'ble National Green Tribunal Order dated 09.09.2021 in (O.A.) No. 19/2021 in the matter of Sanjay Kumar versus State of UP & Ors:

1.	Dr. Prashant Gargava, Member Secretary, CPCB, Chairman of the Committee	:
2.	Prof. Mukesh Sharma, Department of Civil Engineering, IIT Kanpur, Member	:
3.	Prof. Mukesh Khare, Department of Civil Engineering, IIT Delhi, Member	:
4.	Prof. Shiva Nagendra SM, Department of Civil Engineering, IIT Madras, Member	:
5.	Prof. Sagnik Dey, Centre for Atmospheric Sciences, IIT Delhi, Member	:
6.	The District Magistrate, Gautam Budh Nagar, Member	:
7.	Dr. Satya, Additional Director, IRO Lucknow, MoEFCC	:
8.	Representative of Uttar Pradesh Pollution Control Board, Member	:

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Annexure-I

Item No. 04 (Court No. 1)

BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI

(By Video Conferencing)

Original Application No. 19/2021
(Earlier O.A. No. 618/2016)

(With report dated 22.06.2021)

Sanjay Kumar Applicant

Versus

State of UP & Ors. Respondent(s)

Date of hearing: 09.09.2021

CORAM: HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON
HON'BLE MR. JUSTICE SUDHIR AGARWAL, JUDICIAL MEMBER
HON'BLE MR. JUSTICE BRIJESH SETHI, JUDICIAL MEMBER
HON'BLE DR. NAGIN NANDA, EXPERT MEMBER

Respondent: Mr. Pradeep Misra and Mr. Daleep Dhyani, Advocates for UPPCB

ORDER

1. The issue for consideration is permissibility of operation of hot mix plants at Noida beyond 'carrying capacity' of the ambient air of the area as per assessment of the statutory regulators – the CPCB and the State PCB, thereby adversely affecting the environment and the public health.

2. The matter was considered by the Tribunal earlier, almost five years back, vide order dated 23.11.2016 in O.A. No. 618/2016. Considering the status of compliance and adverse impact on air quality, the Tribunal directed sealing of all the hot mix plants. As a result, many hot mix plants shifted elsewhere. Vide order dated 20.11.2019, the Tribunal directed that the remaining may remain sealed till compliance of norms. The State PCB

was directed to file status report which was to be registered as a fresh OA. Accordingly, on report dated 4.12.2020 being filed by the State PCB, the office registered the present OA. which was considered on 24.02.2021.

3. The Tribunal held that the report does not consider the issue of carrying capacity of the area to sustain activities like hot mix plants and the siting criteria, including the *inter-se* distance followed so as not to violate the right of the citizens in the area to breathe fresh air. The Tribunal accordingly directed consideration of these aspects by a Joint Committee of CPCB and State PCB and to furnish a report to this Tribunal. The operative part of the order is reproduced below:

> *"3. We have considered the above report* ***which has not addressed the issue of carrying capacity of the area to sustain activities like hot mix plants and the siting criteria, including the inter-se distance followed so as not to violate the right of the citizens in the area to breathe fresh air. This observation is in the context of air quality in NCR which led to restrict activities with pollution potential. In this regard reference is made to the order dated 17.02.2021 in O.A. No. 1016/2019, Utkarsh Panwar v. Central Pollution Control Board & Ors., requiring regulation of brick kilns in the NCR in the light of the carrying capacity, till they are fired by coal generating air pollution. Question of use of cleaner fuel may require consideration in the context of hot mix plants also.***
>
> *4.* ***Let a joint Committee of the CPCB and the State PCB look into the above aspects to determine whether and to what extent and subject to what safeguards hot mix plants can be sustained following the "Sustainable Development" and "Precautionary" principles, in the interest of public health.*** *The State PCB will be nodal agency for coordination and compliance. The report be furnished to the Tribunal by 30.04.2021 by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF."*

4. In pursuance of above, report of the Joint Committee dated 22.06.2021 has been filed to the effect that supporting carrying capacity to sustain the hot mix plants in the study area was in the negative. However, in the recommendations it is stated that since hot mix plants are necessary for supplying raw material for repair and maintenance of roads,

the existing hot mix plants be allowed to continue but no new hot mix plants may be allowed to be established. The siting criteria should be applicable only for new establishments. The operative part of the report is reproduced below:-

"2.2 Terms of Reference (TOR) of the Joint Committee

As per orders of Hon'ble NGT, the Joint Committee was required to look into the following aspects and give report:

i. *Assessment of Carrying Capacity of the area to sustain activities like hot mix plants and to determine whether and to what extent and subject to what safeguards hot mix plants can be sustained following the "Sustainable Development" and "Precautionary" principles, in the interest of public health*

ii. *Siting criteria including inter-se distance*

iii. *Consideration of use of cleaner fuel in the context of hot mix plants*

2.3 Report of the Joint Committee

During the first meeting of the Joint committee, the responsibility matrix was discussed and finalized, so as to comply with the directions of the Hon'ble NGT in a time bound manner. Subsequent to the first meeting and site visit of the Joint Committee, various teams with specific tasks visited the site, under the supervision of the Joint Committee.

The Joint Committee deliberated on the various issues based on the outcome of the monitoring conducted and observations made 'during various site visits. The report of the Joint Committee on the various points is submitted as follows:

2.3.1 Observations made by the Joint Committee during site visits

The following are the main observations made by the Joint Committee during site visit:

i. *Out of 8 hot mix plants visited by the Joint Committee on 04.06.2021, it was observed that 7 hot mix plants were not in operation at the time of visit. It was informed by the units that these plants are not in operation from a long time due to implementation of Graded Response Action Plan (GRAP) and afterwards second wave of COVID-19 as a result no work order. The operational status & other details of hot mix plants visited on 04.06.2021 are as under:*

S.No.	Name and address of plant	Geographical location	Operational status	Product &its capacity	Type of Fuel	Consent status
1.	M/s Saroj Construction Co.Village- Nagli	28°29'36" N, 77°23'31" E	Non-operational	Dense Bituminous macadam/Dense	Diesel	Matter under consideration In Hon'ble

	Wazidpur, Sector-135, Noida			bituminous concrete-60 to 90 MT/Hr		NGT, O.A. 618/2016, I.A. No. 399/2019
2.	M/s Maa Bhagwati Construction Co. Village Wazidpur, Yamuna Pusta, Noida	28°29'24" N, 77°23'19" E	Non-operational	Dense Bituminous macadam/Dense bituminous concrete-45 MT/Hr	HSD	Valid upto 31.03.2022
3.	M/s JRD Infratech Pvt Ltd, Village-Nagli Wazidpur, Sector-135, Noida	28°29'17" N, 77°23'22" E	Non-operational	Dense Bituminous macadam/Dense bituminous concrete-60 MT/Hr	Diesel	Valid upto 31.03.2025
4.	M/s PMH Roadtech Pvt Ltd, Village-Nagli Wazidpur, Sector-135, Noida	28°29'20" N, 77°23'16" E	Non-operational	Dense Bituminous macadam/Dense bituminous concrete-60 MT/Hr	Diesel	Valid upto 31.03.2025
5.	M/s S.R. Construction Village-Nagli Wazidpur, Sector-135, Noida	28°29'12" N, 77°23'21" E	Non-operational	Dense Bituminous macadam/Dense bituminous concrete-60-80 MT/Hr	Diesel	Matter under consideration in Hon'ble NGT, O.A. 618/2016, I,A. No. 19/2019
6.	M/s Balaji Construction Village-Wazidpur, Sector-135, Noida	28°29'13" N, 77°23'15" E	Non-operational	Dense Bituminous macadam/Dense bituminous concrete- 60 MT/Hr	HSD	Valid upto 31.03.2024
7.	M/s MYC Infra Pvt Ltd, Village-Nagli Wazidpur, Sector-135, Noida	28°29'14" N, 77°23'39" E	Non-operational	Dense Bituminous macadam/Dense bituminous concrete- 60 MT/Hr	Diesel	Valid upto 31.03.2025
8.	M/s Yash Technobuild Pvt Ltd, Village-Wazidpur, Noida	28°29'23" N, 77°23'43" E	Operational	Dense Bituminous macadam/Dense bituminous concrete- 60 MT/Hr	Diesel	Valid upto 31.03.2026

ii. The Air Pollution Control system "Bag house filter Unit" and chimney of height about 45 ft, from ground level is attached with all the Hot Mix Plants to control the air pollution. All hot mix plants have installed proper monitoring arrangement and water sprinkling arrangement within premises.

2.3.2 Estimation of the Carrying Capacity of the Ambient Air Environment of hot mix cluster area village Wazidpur, Noida

It was directed by Hon'ble NGT to undertake a joint study to estimate the carrying capacity of ambient air environment in the hot mix cluster area village Wazidpur, Noida. It was informed by UPPCB

that nearest Continuous Ambient Air Quality Monitoring Station situated around 9 K.M. from hot mix cluster but the data can't be used for carrying capacity as the location is far away. UPPCB Teams carried out ambient air quality monitoring for two days (08/06/2021 to 09/06/2021 and 19/06/2021 to 20/06/2021) during operation of Hot Mix Plants at Hot Mix Plant Cluster and village- Wazidpur. UPPCB Teams also monitored at aforesaid station for a day (10/06/2021 to 11/06/2021) when Hot Mix Plants are not in operation. The consolidated monitoring results are given below:

Station Name	***Date of Monitoring***	***PM_{10}***	***SO_2***	***NO_2***
Village Wazidpur hot mix plants Cluster	*08/06/2021*	***404***	*22*	*33*
	10/06/2021	***218***	*12*	*24*
	19/06/2021	***202***	*10*	*21*
Village Wazidpur, Sector135, Noida i.e. farm house of Saroj Construction Co.	*08/06/2021*	***336***	*13*	*23*
	10/06/2021	***192***	*9*	*22*
	19/06/2021	***156***	*7*	*17*

Based on the available background concentration of data of air quality, the following approach was followed for estimating the carrying capacity of ambient air environment in the study area of hot mix cluster area village Wazidpur, Noida and applying box model:

a. *It is assumed that the impact of Hot mix Plants in Village- Wazidpur, Noida is restricted to a square of side 1.5 Km then the study area is taken as 2.25 Km^2.*
b. *The carrying capacity is estimated on the day when Hot mix Plants are operational along with other air polluting activities and on the day when Hot mix Plants are nonoperational.*
c. *The atmospheric mixing height in the study area varies between 553 to 670meters on day of Hot mix Plants operating while 730 meters on the day of non-operation of Hot mix Plants. The 90 percentile value which is majorly dominant during the study period is taken and accordingly this value was used to calculate the volume of the ambient air in the study area, as a product of atmospheric mixing height and the study area under reference.*
    d. ***The concentration of PM_{10} in ambient air was found to be varying between 156 to 404 µg/m^3 in study area on the day of operation of Hot mix Plants, while, the day of non-operation of Hot mix Plants in study area, the concentration of PM_{10} varies between 192 to 218 µg/m^3. The 90 percentile value which is majorly dominant during the study period is taken and this value was used to calculate the total load of PM_{10} load in the study area, as a product of predominant PM_{10} particulate matter concentration and volume of the ambient air upto mixing height, in the study area.***
    e. ***The national ambient air quality standard (NAAQS) for PM_{10} i.e. 100 µg/m^3 and when multiplied by the volume of air in the study area, it provided the average assimilative capacity of the study area for the study period.***

f. Supportive carrying capacity of the study area was computed by taking the difference of assimilative carrying capacity of the area & total estimated load of PM_{10} in the study area.

The carrying capacity assessment of ambient air environment, of study area as estimated by the Joint Committee based on the available data of ambient air quality monitored in the study area for the predominant air quality parameter i.e. PM_{10} on day of operation of Hot Mix Plants, is as follows:

Particulars	***Village- Wazidpur, Noida***
Study Area (km^2)	***2.25***
Mixing height (km)	***0.550***
Volume of air in the study area (km^3)	***1.24***
PM_{10} (µg/m3)	***247***
Total Estimated load of particulate matter in ambient air in the study area in a study period (kg)	***306***
Assimilative Carrying Capacity (kg)	***124***
Supportive Carrying Capacity(kg)	***-182***

The carrying capacity assessment of ambient air environment on day of non-operation of Hot mix Plants in study area, is as follows:

Particulars	***Village- Wazidpur, Noida***
Study Area (km2)	*2.25*
Mixing height (km)	*0.657*
Volume of air in the study area km3	*1.48*
PM_{10} (µg/m3)	*185*
Total Estimated load of particulate matter in ambient air in the study area in a study period (kg)	*274*
Assimilative Carrying Capacity (kg)	*148*
Supportive Carrying Capacity (kg)	***-126***

It may be concluded from the above table, as such ***there is no supportive capacity available in the ambient air environment with reference to P1`4$_{10}$, in the study area irrespective of operation of hot mix plants. There is about 30% reduction in supportive carrying capacity when hot mix plants are not in operation. It may require source apportionment study considering the different polluting activities in the study area to assess the contribution of individual activities to propose production limits as one of the preventive measures, so as to keep the ambient air environment within assimilative capacity.***

2.3.5 Source Emission Monitoring

A UPPCB team visited the site on 08/06/2021, 09/06/2021 and 19/06/2021 for source emission monitoring of one, three and one hot mix

plant which were found operational on aforesaid dates, respectively. Source emission monitoring and the results are summarized below:

S. No.	Name & Address of the hot mix plants	Date of monitoring	Stack Height (in m)	Cross Sectional Area of Stack (in m^2)	Average velocity (in m/s)	Average flow in m^3/s)	Concentration of pollutants (in mg/Nm^3)	Pollution load (in kg/day)
1.	M/s Yash Technobuild Pvt LW, Village-Wazidpur, Yamuna Pusta, Noida	08/06/2021	14 (approx)	0.07	5.58 •	0.39	PM- 127 SO_2 — 144 NO_2- 91	PM- 4.28 $S0_2$ — 4.85 NO_2- 3.07
2.	M/s JRD Infratech Pvt Ltd, Village-Nagli Wazidpur, Sector-135, Noida	09/06/2021	14 (approx)	0.07	15.38	1.08	PM- 144 SO_2 — 170 NO_2- 111	PM- 13.44 SO_2 — 15.86 NO_2- 10.36
3.	M/s PMH Roadtech Pvt Ltd, Village-Nagli Wazidpur, Sector-135, Noida	09/06/2021	14 (approx)	0.07	9.44	0.66	PM- 141 $S0_2$— 181 NO_2- 107	PM- 8.04 SO_2 — 10.32 NO_2- 6.10
4.	M/s MYC Infra Pvt Ltd, Village- Nagli Wazidpur, Sector-135, Noida	09/06/2021	14 (approx)	0.07	4.16	0.29	PM- 143 SO_2 — 162 NO_2- 92	PM- 3.58 $S0_2$— 4.06 NO_2- 2.30
5.	M/s Balaji Construction Village-Wazidpur, Sector-135, Noida	19/06/2021	11 (approx)	0.28	3.86	1.08	PM- 173 SO_2 - 181 NO_2- 113	PM- 16.14 50_2- 16.89 NO_2- 10.54

An evaluation of the source emission monitoring of 05 hot mix plants indicated that individual hot mix plant are having PM, SO_2 and NO_2 concentration in between 127 to 173, 144 to 181 and 91 to 113 mg/m^3, respectively. The average pollution load calculated in the study area with respect to PM, SO_2 and NO_2 are 9.10, 10.40 and 6.47 Kg/day, respectively.

2.3.6 DETAILS OF SITING OF HOT MIX PLANT CLUSTER:

A site visit by the joint committee on 04/06/2021 and following are observed with respect to siting of hot mix plants:

i. All these 08 hot mix plants situated in the form of a cluster at Village Wazidpur, Sector-135, Noida and out of which 06 number of hot mix plants were reopened/operate after joint inspection and

recommendation of New Okhla Industrial Development Authority Noida, UPPCB etc. in compliance of the orders passed by Hon'ble NGT New Delhi. Rest 02 hot mix plants (M/s Saroj Construction Co. Village-Nagli Wazidpur, Sector-135, Noida and M/s S.R. Construction Village-Nagli Wazidpur, Sector-135, Noida) which are closed are under consideration in Honible NGT New Delhi in, O.A. 618/2016 as I.A. No. 399/2019 and I.A. No. 19/2019 respectively.

ii. ***Hot mix plant is situated at a minimum distance of***

- ***a. 140 meters (approx.) from residential dwelling (Sector-130, Noida)***
- ***b. 1.9 KMs (approx.) from Yamuna river***
- ***c. 1.3 KMs (approx.) from Noida Greater Noida expressway***
- ***d. 2.1 KMs (approx.) from Felix hospital, Sector-137, Noida***

iii. The inter-se distance between two hot mix plants were found minimum 150 meters (approx.)

A map showing location of all 8 hot mix plants are given.

3.0 RECOMMENDATIONS:

It is to mention that this cluster of hot mix plants is the only cluster supplying raw material for pot-hole free roads, re-surfacing of roads, black topping of earthen roads to the concerned govt. agencies involved in maintenance & development of the rural/urban infrastructure in Noida & Greater Noida. Total 06 hot mix plants are in operation under direction of Hon'ble NGT, New Delhi in the said matter and are under regular monitoring of SPCB.

i. ***Since, the carrying capacity of the study area is estimated to be negative and therefore, following actions are suggested to support & protect the air environment:***

- ***a. No new hot mix plant may be allowed to establish & operate in the area including any expansion of the existing units.***
- ***b. The supporting infrastructure such as road needs to be improved, development of green belts and provision of water sprinkling in in the hot mix plants in order to control the fugitive dust emission.***

ii. Siting criteria will be applicable for new establishment. Existing establishments should take appropriate environmental friendly practices. In future Hot mix plants shall be setup as per siting policy/guidelines. However, they may follow criteria as below:

- ***a. It should be located in area wherever permissible and atleast 100 meters away from residential dwellings, health centres/hospitals & schools,***
- ***b. Atleast 200 meters away from water spread area of major watercourses like Lake, canal and major drinking water sources,***

c. Away from flood plain area of River and areas having shallow groundwater

d. Atleast 50 meters of inter-se distance between two establishments (each establishment should provide 25 meters from each side) should be provided and developed green belt.

e. Carrying capacity of the area may be considered while allowing new hot mix plant.

iii. At present these plants are using diesel as a fuel, recommended installation of additional Alkali scrubber to minimize of SO_2 and NO_2 emission."

5. We have heard learned Counsel for UP State PCB and considered the matter in the light of law laid down by the Hon'ble Supreme Court and orders of this Tribunal on the subject.

6. Since the joint Committee which has given the report comprises of statutory regulators - CPCB and State PCB, who are entrusted with the control of air quality as per laid down norms under the provisions of the Air (Prevention and Control of Pollution) Act, 1981 and the Environment (Protection) Act, 1986, even without issuing notice to the stone crushers, we have taken up the report for consideration to determine whether the said regulators need to take further action for compliance of the law on the point. The issue is *in rem* to balance, on the one hand the rights of general public to breathe fresh air on the principle of 'sustainable development' and on the other right of stone crushers generally to operate in area which has no carrying capacity in terms of ambient air so that activity of hot mix plants does not cause damage to public health in terms of deaths and diseases by inhaling toxic air. Individual actions which may have to be taken against the affected stone crushers by the statutory regulators, following due process. It is also made clear that the aggrieved stone crushers will also be at liberty to take their remedies against any such action as per law. Thus, in our view, under the provisions of Section 15 read with Section 20 of the NGT Act, the Tribunal can certainly require the

statutory regulators to perform their legal obligation to uphold the principle of 'Sustainable Development'.

7. Adverse health impact of polluted air quality has been noted inter-alia in judgement of Hon'ble Supreme Court in M.C. Mehta v. UOI[1], M.C. Mehta v. UOI[2], M.C. Mehta v. UOI[3] and K. Guruprasad Rao v. State of Karnataka[4] and order of this Tribunal dated 17.02.2021 in O.A. No. 1016/2019, *Utkarsh Panwar v. CPCB & Or*s. wherein the Tribunal directed stopping of all brick kilns in NCR beyond the assimilative carrying capacity in the air in NCR, till such brick kilns shift to PNG. Till shifting to PNG, it was directed that the brick kilns cannot operate except in limited number and only from March to June when assimilative air capacity permits such operations. The impact of air pollution on public health is noted in the order of the Hon'ble Supreme Court in Arjun Gopal & Ors. v. UOI & Ors.[5]:

Table 1

AQI	***Associated Health Impacts***
Good (0-50)	***Minimal impact.***
Satisfactory (51-100)	***May cause minor breathing discomfort to sensitive people.***
Moderately polluted (101-200)	***May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults.***
Poor (201-300)	***May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease.***
Very Poor (301-400)	***May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases.***
Severe May (401-500)	***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.***

[1] (1998) 9 SCC 149
[2] (2000) 7 SCC 422
[3] (2002) 4 SCC 378
[4] (2012) 12 SCC 736
[5] (2017) 1 SCC 412

8. In view of acknowledged adverse health effects and extent of carrying capacity to sustain the polluting activity of the hot mix plants, the question is further course of action to be adopted.

9. In Arjun Gopal & Ors. v. UOI & Ors.[6], it was observed that the residents of NCR faced severe air quality standards which were worst in the World. It had serious adverse health impact. Life of citizens in NCR had been brought to virtual standstill. The Capital was placed in an environmental emergency of unseen proportions. It will be appropriate to extract some observations from the judgment:-

> ***"****4. The onset of winter and the festival/ marriage season this year, presented to the residents of NCR severe concerns regarding the air quality standards. According to reports, the air quality standards in early November of this year were the worst in the world.* ***It is reported that the $PM_{2.5}$ levels recorded were "beyond scale" values (see India's Air Quality Among World's Worst Over Diwali Weekend: Report. 4-11-2016, Hindustan Times). The report indicates that 24-hour average of $PM_{2.5}$ levels in South Delhi in 2016 were 38% higher than on the Diwali night of 2015. The day after Diwali, these levels were twice as high as the day after Diwali in 2015, crossing 650 µg/m³, which is 26 times above the WHO's standards or levels considered safe. Shockingly, on the morning of 1-11-2016, Delhi woke up to an average $PM_{2.5}$ level of over 700 µg/m³ — some of the highest levels recorded the world over and 29 times above WHO standards. The report further states that the WHO guideline for 24-hour average $PM_{2.5}$ levels is 25 µg/m³ and with an annual average $PM_{2.5}$ level of 122 µg/m³, Delhi's air is the worst among global megacities with dense populations. We have particularly referred to the PM 2.5 levels because of the extreme effects and near invisibility of this type of particulate matter. $PM_{2.5}$ or particulate matter 2.5 ($PM_{2.5}$), refers to tiny particles or droplets in the air that are two-and-one-half microns or less in width. It may be noted that the widths of the larger particles in the $PM_{2.5}$ size range would be about thirty times smaller than that of a human hair. These particles primarily emanate from vehicle exhausts and other operations that involve the burning of fuels such as wood, heating oil or coal, and of course, use of fire crackers.***
>
> ***5. In India, air quality standards are measured in terms of the Air Quality Index (hereinafter "AQI"). The AQI was launched in India on 17-10-2014 by the Ministry of Environment and Forests. According to the press release of the Press information***

[6] (2017) 1 SCC 412

Bureau of the same date, it consists of a comprehensive set of parameters to monitor and asses the air quality. The AQI considers eight pollutants (PM_{10}, $PM_{2.5}$, NO_2, SO_2, CO, O_3, NH_3, and Pb), and based on the levels of these pollutants six categories of AQI ranging from "Good" to "Severe" have been prescribed. The index also suggests the health effects of the pollution categorywise. The gradation of AQI and its health impact is extracted below:

Tables 1 and 2 have already been reproduced in para 1 above and are not being repeated.

xxx.....xxx xxx
xxx.....xxx xxx

6. Reports indicate that AQI in Delhi was much above the severe standard, shooting off the AQI 500 mark on many days this November. On the day after Diwali, it was more than 14 times the safe limits (see Delhi's Pollution Levels Peaks at 14-16 Times Safe Limits, 31-10-2016, The Hindu). The adverse health effects of these hazardous levels of pollution are only too evident from the table given above. We do not intend to refer to the multiplicity of reports and data on this front.

7. The hazardous levels of air pollution in the last few weeks has spared very few from its ill effects. The life of the citizens of NCR was brought to a virtual standstill, not to speak about the plight of the thousands of mute flora and fauna in NCR. Schools were declared shut, denizens of the city advised to stay indoors, construction activities stopped, power stations shut and ban imposed on burning of garbage and agricultural waste. The fall in air quality has had a significant impact on people's lifestyle as well. The rising costs to protect against air pollution are substantial. It has come to our notice that people are queuing up to purchase protective masks and air purification systems in the wake of dense smog all over the NCR. In short, the capital was "smogged" into an environmental emergency of unseen proportions.

8. The adverse effects of these extreme levels of air pollution spare no one — the young, the old, the infirm and even the future generations. A study of the data of the Global Health Depository of the World Health Organisation reveals that India has the world's highest death rate from chronic respiratory diseases and that about 1.5 million people in India die annually due to indoor and outdoor pollution (see Delhi Wakes up to an Air Pollution Problem it cannot Ignore, 15-2-2015, The New York Times). The Kolkata-based Chittaranjan National Cancer Institute (CNCI), in a study commissioned and handed over to the Central Pollution Control Board, found that key indicators of respiratory health, lung function to palpitation, vision to blood pressure, of children in Delhi, between four and 17 years of age, were worse off than their counterparts elsewhere. It also found that more than 40% of the school children suffer from lung damage (see Landmark Study Lies Buried, 2-4-2015, The Indian

Express). We note with apprehension that there are nascent studies that suggest that pollution can lower children's IQ, hurt their test scores and increase the risks of autism, epilepsy, diabetes and even adult-onset diseases like multiple sclerosis (see Holding Your Breath in India, 29-5-2015, The New York Times).

9. It has been brought to our notice that the severe air pollution in the NCR is leading to multiple diseases and other health related issues amongst the people. It is said that the increase in respiratory diseases like asthma, lung cancer, bronchitis, etc. is primarily attributable to the worsening air quality in the NCR. The damage being caused to people's lungs is said to be irreversible. Other health related issues like allergies, temporary deafness are also on the rise. Various experts have pointed towards multiple adverse effects of air pollution on human health like premature deaths, rise in mortality rates, palpitation, loss of vision, arthritis, heart ailments, cancer, etc.

10. When we refer to these extreme effects, we are not merely referring to the inconvenience caused to people, but to abject deprivation of a range of constitutionally embedded rights that the residents of NCR ought to have enjoyed. Needless to state, the grim situation of air quality adversely affected the right to education, work, health and ultimately, the right to life of the citizens, and this Court is constitutionally bound to address their grave concerns. May we remind ourselves, that this is not the first time that this Court was impelled into ensuring clean air for the citizens of the capital region (see M.C. Mehta v. Union of India [M.C. Mehta v. Union of India, (1998) 6 SCC 60] , [M.C. Mehta v. Union of India, (1998) 9 SCC 589] , M.C. Mehta v. Union of India [M.C. Mehta v. Union of India, (1998) 8 SCC 648] and M.C. Mehta v. Union of India [M.C. Mehta v. Union of India, (1998) 8 SCC 206]).”

10. The precautionary principle has been elaborated in A.P. Pollution Control Board case [A.P. Pollution Control Board v. M.V. Nayudu, (1999) 2 SCC 718] as under:

“31. The “uncertainty” of scientific proof and its changing frontiers from time to time has led to great changes in environmental concepts during the period between the Stockholm Conference of 1972 and the Rio Conference of 1992. In Vellore Citizens' Welfare Forum v. Union of India [Vellore Citizens' Welfare Forum v. Union of India, (1996) 5 SCC 647] a three-Judge Bench of this Court referred to these changes, to the “precautionary principle” and the new concept of “burden of proof” in environmental matters. Kuldip Singh, J. after referring to the principles evolved in various international conferences and to the concept of “sustainable development”, stated that the precautionary principle, the polluter pays principle and the special concept of onus of proof have now emerged and govern the law in our country too, as

is clear from Articles 47, 48-A and 51-A(g) of our Constitution and that, in fact, in the various environmental statutes, such as the Water Act, 1974 and other statutes, including the Environment (Protection) Act, 1986, these concepts are already implied. The learned Judge declared that these principles have now become part of our law. The relevant observations in Vellore case [Vellore Citizens' Welfare Forum v. Union of India, (1996) 5 SCC 647] in this behalf read as follows: (SCC p. 660, para 14)

'14. In view of the abovementioned constitutional and statutory provisions we have no hesitation in holding that the precautionary principle and the polluter pays principle are part of the environmental law of the country.'

The Court observed that even otherwise, the abovesaid principles are accepted as part of the customary international law and hence there should be no difficulty in accepting them as part of our domestic law. In fact, on the facts of the case before this Court, it was directed that the authority to be appointed under Section 3(3) of the Environment (Protection) Act, 1986

'shall implement the "precautionary principle" and the "polluter pays principle"'.

The learned Judges also observed that the new concept which places the burden of proof on the developer or industrialist who is proposing to alter the status quo, has also become part of our environmental law.

32. The Vellore [Vellore Citizens' Welfare Forum v. Union of India, (1996) 5 SCC 647] judgment has referred to these principles briefly but, in our view, it is necessary to explain their meaning in more detail, so that courts and tribunals or environmental authorities can properly apply the said principles in the matters which come before them.

33. ***A basic shift in the approach to environmental protection occurred initially between 1972 and 1982. Earlier, the concept was based on the "assimilative capacity" rule as revealed from Principle 6 of the Stockholm Declaration of the U.N. Conference on Human Environment, 1972. The said principle assumed that science could provide policy-makers with the information and means necessary to avoid encroaching upon the capacity of the environment to assimilate impacts and it presumed that relevant technical expertise would be available when environmental harm was predicted and there would be sufficient time to act in order to avoid such harm. But in the 11th Principle of the U.N. General Assembly Resolution on World Charter for Nature, 1982, the emphasis shifted to the "precautionary principle",*** *and this was reiterated in the Rio Conference of 1992 in its Principle 15 which reads as follows:*

'Principle 15.—In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for proposing cost-effective measures to prevent environmental degradation.'

34. In regard to the cause for the emergence of this principle, Charmian Barton, in the article earlier referred to in "The Status of the

Precautionary Principle in Australia" [(1998) 22 Harvard Environmental Law Review 509 at p. 547] says:

'There is nothing to prevent decision-makers from assessing the record and concluding that there is inadequate information on which to reach a determination. If it is not possible to make a decision with "some" confidence, ***then it makes sense to err on the side of caution and prevent activities that may cause serious or irreversible harm****. An informed decision can be made at a later stage when additional data is available or resources permit further research. To ensure that greater caution is taken in environmental management, implementation of the principle through judicial and legislative means is necessary.'*

In other words, the inadequacies of science is the real basis that has led to the precautionary principle of 1982. It is based on the theory that it is better to err on the side of caution and prevent environmental harm which may indeed become irreversible.

35. The principle of precaution involves the anticipation of environmental harm and taking measures to avoid it or to choose the least environmentally harmful activity. It is based on scientific uncertainty. Environmental protection should not only aim at protecting health, property and economic interest but also protect the environment for its own sake. Precautionary duties must not only be triggered by the suspicion of concrete danger but also by (justified) concern or risk potential. The precautionary principle was recommended by the UNEP Governing Council (1989). The Bomako Convention also lowered the threshold at which scientific evidence might require action by not referring to "serious" or "irreversible" as adjectives qualifying harm. However, summing up the legal status of the precautionary principle, one commentator characterised the principle as still "evolving" for though it is accepted as part of the international customary law, 'the consequences of its application in any potential situation will be influenced by the circumstances of each case'. (See First Report of Dr. Sreenivasa Rao Pemmaraju — Special Rapporteur, International Law Commission dated 3-4-1998, paras 61 to 72.)"

(emphasis in original)

"36. We shall next elaborate the new concept of burden of proof referred to in Vellore case [Vellore Citizens' Welfare Forum v. Union of India, (1996) 5 SCC 647] at p. 658. In that case, Kuldip Singh, J. stated as follows: (SCC p. 658, para 11)

'(iii) The "onus of proof" is on the actor or the developer/industrialist to show that his action is environmentally benign.'

37. It is to be noticed that while the inadequacies of science have led to the "precautionary principle", the said "precautionary principle" in its turn, has led to the special principle of burden of proof in environmental cases where burden as to the absence of injurious effect of the actions proposed, — is placed on those who want to change the status quo (Wynne, "Uncertainty and Environmental Learning: Reconceiving Science and Policy in the Preventive Paradigm" [(1992) 2 Global Environmental Change 111 at p. 123]). This is often termed as a reversal of the burden of proof, because otherwise in environmental cases, those opposing the change would

> *be compelled to shoulder the evidentiary burden, a procedure which is not fair. Therefore, it is necessary that the* ***party attempting to preserve the status quo by maintaining a less polluted state should not carry the burden of proof and the party who wants to alter it, must bear this burden.*** *(See James M. Olson, "Shifting the Burden of Proof: How the Common Law can Safeguard Nature and Promote an Earth Ethic" [(1990) 20 Environmental Law 891 at p. 898] .) (Quoted in "The Status of the Precautionary Principle in Australia" [(1998) 22 Harvard Environmental Law Review 509 at p. 547] at pp. 519, 550.)*
>
> *38. The precautionary principle suggests that where there is an identifiable risk of serious or irreversible harm, including, for example, extinction of species, widespread toxic pollution in major threats to essential ecological processes, it may be appropriate to place the burden of proof on the person or entity proposing the activity that is potentially harmful to the environment. (See Report of Dr Sreenivasa Rao Pemmaraju, Special Rapporteur, International Law Commission, dated 3-4-1998, Para 61.)"*
>
> *(emphasis in original)*

11. In Vellore Citizens' Welfare Forum case, 1996) 5 SCC 647, the Hon'ble Supreme Court banned the tanneries when it was found that they were causing immense damage to the environment. Environment protection, which is a facet of Article 21, was given supremacy over the right to carry on business enshrined in Article 19(1)(g). Following the said principle, it has been held that protection of right to health will have to be given priority. Health hazards in the form of various diseases that are the direct result of air pollution are well known. It leads to asthma, coughing, bronchitis, retarded nervous system breakdown and even cognitive impairment. Some of the diseases continue on a prolonged basis. Some of these which are caused because of high level of $PM_{2.5}$ are even irreversible. In such cases, patients may have to continue to get the medical treatment for much longer period and even for life. Though there are no statistics as to what would be the cost for treating such diseases which are as a direct consequence of fireworks on these occasions like Diwali, it can safely be said that this may also be substantial.

12. It is well known that Carrying capacity is a facet of sustainable development. It is inherent in 'Precautionary Principle' as well as in 'Inter-generational Equity'. In MC Mehta v. UOI & Ors.[7], **construction activity in the catchment area of Badkhal were directed to be restricted/regulated to the level of Carrying capacity.** It was observed that:-

> ***"Preventive measures have to be taken keeping in view of the carrying capacity of the ecosystem operating in the environmental surroundings under consideration."***

13. In Vellore Citizens' Welfare Forum v. UOI & Ors.[8], it was observed that quality of human life is to be improved within the carrying capacity to supporting ecosystem. Relevant extract is as follows:-

> ***"****10……. **During the two decades from Stockholm to Rio "Sustainable Development" has come to be accepted as a viable concept to eradicate poverty and improve the quality of human life while living within the carrying capacity of the supporting ecosystems**. "Sustainable Development" as defined by the Brundtland Report means "Development that meets the needs of the present without compromising the ability of the future generations to meet their own needs". We have no hesitation in holding that "Sustainable Development" as a balancing concept between ecology and development has been accepted as a part of the customary international law though its salient features have yet to be finalised by the international law jurists.***"**

14. These observations are reiterated in (2006) 6 SCC 371.[9]

Tribunal's Approach to the subject

15. The Tribunal has a mandate to follow these principles under Section 20 read with Section 15 of the NGT Act and can issue appropriate directions for enforcement of these principles, as laid down in Mantri

[7] (1997) 3 SCC 715
[8] (1996) 5 SCC 647
[9] Para 66 to 76

Techzone Pvt. Ltd. v. Forward Foundation and Ors.,[10] and the Director General (Road Development) NHAI v. Aam Aadmi Lok Manch.[11] Environmental rule of law requires strict enforcement of these principles as laid down in Hanuman Laxman Aroskar v. UOI).[12]

16. This Tribunal in O.A. No. 681/2018, vide order dated 21.08.2020, dealt with the remedial measures for restoration of air quality in 122 Non-attainment cities, including Delhi where air quality is generally beyond norms. The Tribunal directed stopping polluting activities, including brick kilns and assessment of carrying capacity of urban areas to take policy decisions to control polluting potential activities beyond carrying capacity. The Tribunal observed:-

> *"3. The Tribunal noted the concern arising from such large scale air pollution which grapples the country in spite of statutory mechanism under the Air Act, directions of the CPCB under section 18(1)(b), dated 29.12.2015 and directions of the Hon'ble Supreme Court for control of* ***vehicular pollution[13], industrial and construction sector pollution[14], power sector pollution[15] and agricultural sector pollution[16]*** *and orders of this Tribunal dealing with the said issues[17]. The Tribunal also referred to a Comprehensive Action Plan (CAP) for air pollution control for NCR prepared in pursuance of order of the Hon'ble Supreme Court dated 06.2.2017 by the Environment Pollution (Prevention and Control) Authority (EPCA) in consultation with the CPCB and Delhi Pollution Control Committee (DPCC) on*

[10] 2019 SCC online SC 322, Para 43-47

[11] AIR 2020 (SC) 3471, Para 75

[12] (2019) 15 SCC 401

[13] Rural Litigation and Entitlement Kendra, Dehradune and Others Vs State of U.P. Others (1985) 2 SCC 431, M.C. Mehta v. Union of India (2001) 3 SCC 756, M.C. Mehta v. Union of India (1998) 6 SCC 63, M.C. Mehta v. Union of India (2002) 4 SCC 356, M.C. Mehta v. Union of India (1998) 6 SCC 60

[14] M.C. Mehta v. Union of India (1997) 2 SCC 353, M.C. Mehta v. Union of India and Shriram Foods and Fertilizer Industries and Anr. (1986) 2 SCC 176, Rural Litigation and Entitlement Kendra, Dehradun v. State of U.P. (1985) 2SCC 431, Mohd. Haroon Ansari v. District Collector (2004) 1 SCC 491, Union of India v. Union Carbide Co. (1989) 1 SCC 674, M.C. Mehta v. Union of India (1992) 3 SCC 256, Sterlite Industries (India) Ltd. etc. v. Union of India & Ors.(2013) 4SCC 575 , M.C. Mehta v. Union of India (2004) 6 SCC 588, M.C. Mehta v. Kamal Nath (2000)6 SCC 213

[15] Consumer Education and Research Centre v. Union of India (1995)3 SCC 42, Dahanu Taluka Environment Protection group and Ors. v. Bombay Suburban Electricity Supply Company Ltd. and Ors (1991) 2SCC 539

[16] Arjun Gopal and Ors v. Union of India and Ors (2017) 16 SCC 280, Dr. B.L Wadhera v. Union of India and Ors (1996) 2 SCC 594

[17] Vardhman Kaushik v. Union of India and Ors. O.A no. 21 of 2014, Vikrant Kumar Tongad v. Environment Pollution (Prevention and Control) Authority and Ors, O.A No. 118 of 2013, Satish Kumar v. Union of India and Ors, O.A. No. 56 (T_{HC}) OF 2013, Smt. Ganga Lalwani V. Union of India and Ors. O.A No. 451 of 2018

05.04.2017[18] *and Graded Response Action Plan (GRAP) notified by the MoEF&CC on 12.01.2017 stipulating specific steps for different levels of air quality such* ***as improvement in emission and fuel quality and other measures for vehicles, strategies to reduce vehicle numbers, non-motorised transport network, parking policy, traffic management, closure of polluting power plants and industries including brick kilns, control of generator sets, open burning, open eateries, road dust, construction dust, etc.***[19]

4. Implementation of prescribed norms in the light of legal provisions and court directions remains a challenge. The consequence is that India is being ranked high in terms of level of pollution compared to many other countries with enormous adverse impact on public health. Most victims are children, senior citizens and the poor.[20]

5. ***The GRAP categorises levels of pollution as severe plus, severe, very poor, moderate to poor. The action to be taken in such situations includes stopping entry of trucks, stopping construction activities, odd and even scheme of private vehicles, shutting of schools, closing of brick kilns, stone crushers, hot mix plants, power plants, intensifying public transport services, mechanized cleaning of road, and sprinkling of water, stopping the use of diesel generator sets, enhancing parking fees, etc.***

6. ***The MoEF&CC has by various notifications put restrictions on activities in Coastal areas, Flood plains, Taj corridor Eco-sensitive zones, etc. in view of ecological sensitivity and impact of such activities on environment if such activities are carried out in unregulated areas. This needs to be extended to the NACs in view of impact on public health and environment to give effect to the 'Precautionary' and 'Sustainable Development' principles****."*

7to13..xxx……xxxx……xxx

17. Dealing with the issue of air pollution in manufacture of tiles at Morbi in Gujrat, vide order dated 6.3.2019 OA 20/17 Babubhai v GPCB, this Tribunal directed closure of industries operating with coal unless they shifted to natural gas. While under the orders of the Hon'ble Supreme

[18] Report No.71, EPCA-R/2-17/L-21, Comprehensive Action Plan for air pollution control with the objective to meet ambient air quality standards in the National Capital Territory of Delhi and National Capital Region, including states of Haryana, Rajasthan and Uttar Pradesh.

[19] S.O.118(E), Notification, Ministry of Environment, Forest and Climate Change

[20] https://www.thehindu.com/sci-tech/energy-and-environment/india-ranks-177-out-of-180-in-environmental-performance-index/article22513016.ece, https://www.ndtv.com/delhi-news/delhis-air-pollution-has-caused-of-death-of-15-000-people-study-1883022.

Court, GRAP was laid down providing for closing of specified activities on crossing of air quality norms as laid down in the GRAP, the same did not debar consideration of further situations requiring closure/regulation.

18. We may also refer to direction issued by the CPCB on 27.11.2020 under Section 18 (1) (b) of the Air (Prevention & Control of Pollution) Act, 1981 for upcoming industrial units in NCR **to use only gas** and also refers to an earlier order requiring even the existing industries in NCR Delhi, **to shift to PNG by 31.03.2019 where gas supply is available**. The relevant part of the order is quoted below:-

> *"xx xx xx xx*
>
> *Whereas, considering the Considering deteriorating air quality in NCR-Delhi and also the fact that* ***already directions have been issued to all the existing industries in NCR-Delhi to switch over to cleaner fuels, it is decided that only those new industrial units shall be allowed to set-up in NCR-Delhi, which use cleaner fuels namely, natural gas (PNG/CNG), liquefied petroleum gas, bio gas, propane, butane etc. and***
>
> ***Now therefore, in view of the above and exercising the powers conferred under section 8(1)(b) of Air (Prevention and Control of Pollution) Act, 1981, you are hereby directed to allow only those new industrial units in NCR-Delhi, which are using cleaner fuels, namely, natural gas (PNG/CNG), liquefied petroleum gas, bio-gas, propane, butane etc."***

19. Having regard to the above considerations, the Tribunal has passed recent orders to deal with situation arising out of air pollution caused by brick kilns in the NCR and also in the Mathura District. Order with regard to brick kilns dated 17.02.2021 in *O.A. No. 1016/2019, Utkarsh Panwar v. Central Pollution Control Board & Ors.,* which has already been referred to in the earlier order dated 24.02.2021 wherein the Tribunal directed that the brick kilns in the NCR be regulated in the light of the carrying capacity in the interest of public health unless improved technologies used which doesn't adversely affect the air quality. The Tribunal held that may be it

was a particular brick kiln maintained the standards was not enough if the air quality could not sustain such activities.

20. We may also refer to order of this Tribunal dated 01.12.2020 in O.A. No. 249/2020 whereby the Tribunal banned the fire crackers throughout India where air quality is poor and above in the interest of protection of public health. **Extract from order dated 1.12.2020 in OA 249/2020 is reproduced below:**

> ***"18. .....If the air quality is 'poor' and above, it has been held by the Hon'ble Supreme Court in the table quoted in para 4 above that there is danger of heart diseases, respiratory illness and other serious health impact*** *even before Covid. Covid is going to further aggravate the situation and therefore atleast in areas where air quality is 'poor' and above, no bursting of fire crackers should be permitted in view of 'Precautionary' principle, to be statutorily enforced by this Tribunal under Section 20 read with section 15 of the National Green Tribunal Act, 2010.*
>
> *32. .....In view of above discussion, following directions are issued:*
>
> *i. There will be total ban on sale and use of all kinds of fire crackers during Covid-19 pandemic in the NCR and all cities/towns in the country* ***where the ambient air quality falls under the 'poor' and above category****.*
>
> *v. We further direct that the Air Quality Monitoring Committees (AQMC) in terms of order of this Tribunal dated 08.10.2018 in OA No. 681/2018[21] to coordinate with the District Magistrates.[22] for compliance of the above directions."*

21. This Tribunal, vide order dated 17.02.2021 in OA 1016/2019, *Utkarsh Panwar v. Central Pollution Control Board & Ors.,* considered the

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[21] The said order is as follows:

"15. xxx xxx xxx

i. xxx xxx xxx

ii. The Action Plans may be prepared by six-member committee comprising of **Directors of Environment, Transport, Industries, Urban Development, Agriculture and Member Secretary, State Pollution Control Board or Committee of the concerned State**. The Committee may be called Air Quality Monitoring Committee (AQMC). The AQMC will function under the overall supervision and coordination of Principal Secretary, Environment of the concerned State/Union Territory. This may be further supervised by the Chief Secretaries concerned or their counterparts in Union Territories by ensuring intra-sectoral co-ordination."

[22] The District Environment Committee has been directed to be constituted by this Tribunal to prepare and execute District Environment Plan vide order dated 15.07.2019 in OA No. 710/2017, Shailesh Singh vs. Sheela Hospital & Trauma Centre, Shahjanhanpur & Ors.

issue of permissibility of brick kilns beyond the assimilative carrying capacity in the NCR and in the light of the Expert Committee report. This Tribunal directed that brick kilns be allowed to operate only from March to June using Zig-zag technology only to the extent of such number of brick kilns as were found to be viable in terms of the carrying capacity.

22. In recent order dated 12.08.2021 in *O.A. No. 93/2021, Mukesh Kumar Aggarwal v. Central Pollution Control Board & Anr.,* in the context of brick kilns in Mathura District, the Tribunal held:

> ***"13. Applying the same principles, we are of the view that the brick kilns ought to be permitted to the extent of carrying capacity, correctly calculated, strictly as per consent conditions, siting criteria and other environment norms. When air quality standards are exceeded, only non polluting technology has to be followed. Existing guidelines have to be strictly adhered to. Precautionary principle has to be applied and non compliant activity stopped.***
>
> *14&15…xxx……xxx……xxx*
>
> *16. In view of earlier orders quoted above and discussion in paras 10 to 12, we are of the view that steps need to be forthwith taken to stop operation of brick kilns already found to be operating in violation of environmental norms till compliance by the State PCB in exercise of its statutory power, following due process of law, till compliance. This will include brick kilns not following consent conditions, operating in excess of carrying capacity, CPCB guidelines and orders of this Tribunal, and those violating siting guidelines. Necessary action be ensured within two months. At the same time, there is need for further study of carrying capacity, applying correct data and norms. Air quality monitoring equipments be installed in the concerned area and if online monitoring stations cannot be set up, easily available equipments be used to continuously monitor air quality. Stringent monitoring mechanism be put in place. Process of mechanically giving consents be reviewed by the State PCB in view of binding 'precautionary' principle. Public health needs to be given due preference to the need for establishment of brick kilns. Violators be strictly proceeded against by way of prosecution, recovery of compensation and preventing pollution. While determining carrying capacity, other sources contributing pollution loads may be factored in while considering concentrations of PM_{10} in microgram per cubic metre in addition to loads given in kgs. Further, mixing heights data may be referred from the nearest location of IMD station. It is also necessary to clarify reasons of high CEPI score (91.1) particularly for Air and remedial action plan."*

23. In view of above discussions, we are of the opinion that in view of the report in the present matter that the carrying capacity in the area is negative i.e. the air norms are not being met, while benign activity not adding to the pollution can be allowed, polluting activity can be allowed only by ensuring that it does not add to the air pollution, by taking such stringent measures as may achieve desired result and may not adversely affect public health. Such measures may be use of appropriate technology, mitigation measures like dense forest shelter belts etc.

24. 'Sustainable Development' principle requires that the business activity should not compromise public health. This requires study of carrying capacity. In the present case, such capacity has been determined, though data considered is only of the month of June when air quality is comparatively better, compared to the winter months. Carrying capacity has not been assessed with reference to the average air quality for air quality of the months when air quality is comparatively inferior. The hot mix plants may operate even in winter, which are fast approaching. There is no justification in law for the recommendations that only new hot mix plants may not be allowed and the old hot mix plants may continue even at the cost of public health. Further, there is also no justification for the recommendation that the laid down siting criteria should apply only to new establishments. Already set up hot mix plants need not follow such criteria even if it results in damage to the public health and the environment. While the report with regard to the study can be considered for further action, the recommendations which are not in accordance with the environmental law cannot be accepted.

25. While we have no option except to enforce the environmental norms and stop hot mix plants not sustainable due to lack of carrying capacity,

we are mindful of difficulty which will arise not only for the operators of such plants but also those who need such services. While GRAP is already operative which results in closure of certain polluting activities on deterioration of air quality, to maintain air standards further restrictions on polluting activities are necessary in the interest of public health. At the same time, ways and means need to be explored to sustain such activities to the extent possible without adversely affecting the public health. Since PM concentrations in the Central Indian/Indo- Gangetic Plains are higher compared to Southern and East and North-Eastern parts of the country, to maintain regional balance in Developmental and industrial activities throughout the country and to support economy as well as the need of public, it is necessary that better technological options and advanced air pollution abatement measures are explored which enable sustainability of such activities. For this purpose, we constitute a seven member joint Committee which will have statutory authorities and subject matter experts to look into the issue and to give science-based expert report. The Committee will comprise MoEF & CC, CPCB, State PCB, District Magistrate, Prof. Mukesh Khare, IIT Delhi, Prof. Mukesh Sharma, IIT Kanpur and Prof. Shiva Nagendran, IIT Chennai. Proceedings may be steered by the Member Secretary, CPCB. The Committee may adopt any other expert Institutions or individuals of repute. It may give its report in three months. Pending this report, UP PCB not to allow non- compliant hot mix plants in terms of GRAP and the present carrying capacity study report.

26. Thus, we direct as follows:-

i. The hot mix plants beyond carrying capacity may be closed at the earliest and as far as possible from 01.11.2021 by the statutory

regulators in exercise of their jurisdiction under the Air Act, 1981 and the EP Act, 1986. In other words, no hot mix plant – old or new may be allowed beyond carrying capacity and without compliance of the laid down siting norms from 01.11.2021.

ii. A joint Committee comprising MoEF & CC, CPCB, State PCB, District Magistrate, Prof Mukesh Khare, IIT Delhi, Prof Mukesh Sharma, IIT Kanpur and Prof Shiva Nagendran, IIT Chennai may give a report in terms of para 25 above within three months by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/OCR Support PDF and not in the form of Image PDF.

List for further consideration on receipt of the report.

A copy of this order be forwarded to MoEF & CC and CPCB, State PCB the District Magistrate, Gautam Budh Nagar, UP, Prof Mukesh Khare, IIT Delhi, Prof Mukesh Sharma, IIT Kanpur, Prof Shiva Nagendran, IIT Chennai, by e-mail for compliance.

Adarsh Kumar Goel, CP

Sudhir Agarwal, JM

Brijesh Sethi, JM

Dr. Nagin Nanda, EM

September 09, 2021
Original Application No. 19/2021
(Earlier O.A.No.618/2016)
SN

First Meeting of the Joint Committee in the matter of OA 19/2021 before Hon'ble NGT (PB), New Delhi

First meeting of the Joint Committee constituted by the Hon'ble NGT in the matter of OA no. 19/2021 vide directions dated September 09, 2021, regarding science based expert report on ways and means to sustain activities such as hot mix plant to the extent possible without adversely affecting the public health was held on October 13, 2021 under the chairmanship of Member Secretary (MS), CPCB through video conferencing. The list of the participants is annexed as **Annexure I**.

2. MS, CPCB welcomed all committee members and a brief overview of the matter was presented by Shri Pankaj Agrawal, Scientist E, CPCB.
3. MS, CPCB highlighted the need to maintain balance in developmental activities and environmental protection, air pollution problems of Indo-Gangetic Plain and requirement of a good scientific framework to deal with the issues related to carrying capacity, development, technologies, mitigation measures, etc. for environmentally sound development. He requested members to build a clear understanding on the scope of work so that the problem could be approached in a systematic manner. He also emphasized that it is necessary that better technological options and advanced air pollution abatement measures for all sources are explored to enable sustainability of such activities.
4. Members reviewed the order of Hon'ble NGT with reference to the scope if it is limited to carrying capacity and technology in respect of Noida city and Hot Mix plants or requires intensive study in Indo-Gangetic Plain (IGP) as the region. Accordingly, following points were agreed:

    - The area of study domain will be IGP, with focus on pollution issues, carrying capacity, and recommendations on better technological options and advanced air pollution abatement measures for key air polluting sources.
    - Secondary sources of data for Indo-Gangetic plains including recent Emission Inventory studies ongoing in IGP area, National Emission Inventory study by TERI, etc. may be considered.
    - Detail listing of developmental/industrial activities for quantification of region-wise source contribution along with listing of existing national and city specific actions in

place like switching to BS VI vehicles, greening, enforcement of stringent norms, etc. to curb the pollution may be required. Application of model was suggested for quantification of source contributions toward air pollution, estimation of reduction due to implementation of various control scenarios considering emissions and meteorological aspects.

- It was suggested to utilize AOD based PM2.5 data for analyzing spatial and temporal variations in air quality of IGP and involve Prof. Sagnik Dey from IIT Delhi for the same.
- Further, members were requested to suggest an industry expert for inputs on technical interventions.
- In order to create a background for the study, it was suggested to depute dedicated staff from IIT, Kanpur for literature survey on all available information / data based on the existing Emission Inventories, Source Apportionment and Carrying Capacities studies in the region as well as best available technological interventions for various industrial processes in IGP.
- Committee members were requested to suggest inputs for designing scope and framework of the study based on available data for preparation of the Report.

The meeting ended with a vote of thanks.

List of Participants

1. Dr. Prashant Gargava, Member Secretary, CPCB
2. Dr.(Ms) Satya, Joint Director/Scientist 'D', IRO Lucknow, MoEFCC
3. Shri Diwakar Singh, ADM, Noida
4. Prof. Mukesh Khare, IIT Delhi
5. Prof. Mukesh Sharma, IIT Kanpur
6. Prof. Shiva Nagendra, IIT Madras
7. Shri P. K. Gupta, Scientist E, CPCB
8. Shri Pankaj Agarwal, Scientist E, CPCB
9. Shri Utsav Sharma, UPPCB
10. Shri S. K. Gupta, CPCB
11. Smt. Sakshi Batra, Scientist B, CPCB
12. Ms. Tanya Chhabra, RA, CPCB

Second Meeting of the Joint Committee in the matter of OA 19/2021 before Hon'ble NGT (PB), New Delhi

Second meeting of the Joint Committee constituted by the Hon'ble NGT in the matter of OA no. 19/2021 vide directions dated September 09, 2021, regarding science based expert report on ways and means to sustain activities such as hot mix plant to the extent possible without adversely affecting the public health was held on December 14, 2021 through video conferencing. Meeting was chaired by the Member Secretary (MS), CPCB. The list of the participants is annexed as Annexure I.

MS, CPCB welcomed the Committee members and suggested that various tasks required to be undertaken may be firmed up and distributed among experts for expediting the study. He summarized broad activities as (i) delineating the boundaries of IGP; (ii) review and analysis of existing data and studies; (iii) air quality profile of the area; (iv) identification of key sources contributing to air pollution in the region; (v) assessment of source contribution; (vi) identification of hotspots within the IGP; and (vii) review of technology and mitigation measures for various key sources to facilitate recommendation for sustainable economic development. He also requested experts for a suitable timeline to be submitted to the Hon'ble NGT for submission of the report.

Ms Sakshi Batra, Scientist B, CPCB presented summary of Hon'ble NGT order along with the status of activities as per previous meeting held on October 13, 2021. It was also informed that a Post-Doctoral Fellow for a period of three months has been sanctioned to be associated with IIT Kanpur for supporting the Committee.

Prof. Mukesh Sharma, IIT Kanpur, informed that IIT Kanpur is in the process of recruiting a post-doctoral fellow for the study. He further proposed that States to be considered for the study to be identified, activity data to be collected through a well-designed format, which can be developed by IITK and circulated to concerned State Pollution Control Boards. He added that existing emission database may require scaling up and application of modelling tools for assessment of sector wise and region wise source contributions.

Prof. Sagnik Dey, IIT Delhi, agreed to share air quality profile of IGP along with details of hotspots using satellite and ground monitoring data. He also informed that, State wise sectoral contributions to $PM_{2.5}$ levels from various activities using GAINS model is also available and same may be utilized to correlate modelling results of the proposed study.

Prof. Shiva Nagendra suggested to explore identification of clusters having impact of traffic and hot mix plants and suggest comprehensive abatement actions. ADM, Gautam Budh Nagar informed that transport is a major emission source and technology options related to road and transport sectors shall be useful for air quality management in IGP. RO, UPPCB informed that hot mix plant is an essential industry for road building and also that such plants cannot be established at long distances from cities. Hence, alternative to hot mix or better technological interventions to be implemented at hot mix plans shall be beneficial for controlling emissions.

The Committee also felt that considering the quantum and importance of work, Hon'ble NGT may be requested to grant time up to 31st March 2022 for preparation of the Report.

Based on the discussion, following points were agreed:

a. Prof. Mukesh Sharma, IIT Kanpur will share a draft structure of the report, listing objective and scope of the study with the Committee members for inputs and the format to be circulated to SPCBs/ PCCs for collection of activity data to CPCB by next week.

b. CPCB will circulate the format received from IIT Kanpur to SPCBs for gathering activity data from States.
c. Prof. Sagnik Dey, IIT Delhi will share the air quality profile of IGP, details of hotspots and sectoral contributions using GAINS to CPCB and IIT Kanpur as per discussions with IIT Kanpur.
d. Prof. Shiva Nagendra will share a draft on technological options as per discussions with IIT Kanpur.
e. CPCB will seek extension up to March 31, 2022 for submission of report to the Hon'ble NGT.

The meeting ended with a vote of thanks.

List of Participants

Committee Members

1. Dr. Prashant Gargava, Member Secretary, CPCB
2. Shri Nitin Madan, ADM, Gautam Budh Nagar
3. Dr.(Ms) Satya, Joint Director/Scientist 'D', IRO Lucknow, MoEFCC
4. Prof. Mukesh Sharma, IIT Kanpur
5. Prof. Shiva Nagendra, IIT Madras
6. Shri Praveen Kumar, RO, UPPCB

Other Participants

1. Prof. Sagnik Dey, IIT Delhi - Expert
2. Shri P. K. Gupta, Scientist F, CPCB
3. Shri Abhinav Gosh
4. Shri Pankaj Agarwal, Scientist E, CPCB
5. Ms Sakshi Batra, Scientist B, CPCB
6. Ms Parinita Baruah, SRF, CPCB
7. Shri Satpal, SRF, CPCB

Third Meeting of the Joint Committee in the matter of OA 19/2021 before Hon'ble NGT (PB), New Delhi

Third meeting of the Joint Committee constituted by the Hon'ble NGT in the matter of OA no. 19/2021 vide directions dated September 09, 2021, regarding science based expert report on ways and means to sustain activities such as hot mix plant to the extent possible without adversely affecting the public health was held on February 07, 2022 through video conferencing. Meeting was chaired by the Member Secretary (MS), CPCB. The list of the participants is annexed as Annexure-I.

MS, CPCB welcomed the Committee members and requested for status and inputs from the members of the Committee. Prof. Mukesh Sharma, IIT Kanpur, presented summary of preliminary actions towards preparation of the report. He informed that airshed around major cities in the IGP are being worked out and State-wise contribution to emissions are being examined. He added that modelling, identification of best available technologies and recommendations at local and regional levels will be worked out in the next phase.

MS, CPCB suggested that for broad work areas namely, (i) delineating the boundaries of IGP and identification of hotspots or zoning within the IGP; (ii) review and analysis of industrial and non-industrial emissions in these areas based on available data and studies; (iii) air quality profile and background concentration of the area; and (iv) review of technology and mitigation measures for key sources to facilitate recommendation for sustainable economic development in IGP, a detailed Task Matrix may be prepared. The Task Matrix may include list of tasks to be undertaken, lead expert for each of the broad work areas/tasks, data requirements along with source of data, and timelines. This will help in streamlining, expediting and monitoring the study.

Based on the discussion, following points were agreed:

1. Prof. Mukesh Sharma, IIT Kanpur will share a tabular format defining tasks, timelines and responsibilities for expediting and monitoring the study by this week.
2. Prof. Mukesh Sharma, IIT Kanpur shall share preliminary report for inputs of the Committee members.
3. Prof Sagnik Day, IIT Delhi will share GAINS results, AOD based air quality profile and hotspots data.
4. CPCB will circulate emission data received from SPCBs/other Institutes like TERI (for NEI Report) to all Committee members.
5. CPCB will follow up with Delhi, Chandigarh and Jharkhnad for State level data on emissions.
6. Dr. Satya, IRO Lucknow, MoEFCC will share information on advanced technologies used in power plants.

The meeting ended with a vote of thanks.

List of Participants:

Committee Members

1. Dr. Prashant Gargava, Member Secretary, CPCB
2. Shri Nitin Madan, ADM, Gautam Budh Nagar
3. Dr.(Ms) Satya, Joint Director/Scientist 'D', IRO Lucknow, MoEFCC
4. Prof. Mukesh Sharma, IIT Kanpur
5. Prof. Shiva Nagendra, IIT Madras
6. Shri Praveen Kumar, RO, UPPCB

Other Participants

1. Prof. Sagnik Dey, IIT Delhi - Expert
2. Shri P. K. Gupta, Scientist F, CPCB
3. Ms Sakshi Batra, Scientist B, CPCB
4. Ms Parinita Baruah, SRF, CPCB

Fourth Meeting of the Joint Committee in the matter of OA 19/2021 before Hon'ble NGT (PB), New Delhi

Fourth meeting of the Joint Committee constituted by the Hon'ble NGT in the matter of OA no. 19/2021 for preparation of a science based expert report on ways and means to sustain activities such as hot mix plant to the extent possible without adversely affecting the public health was held on March 29, 2022 through video conferencing. Meeting was chaired by the Member Secretary (MS), CPCB. The list of the participants is annexed.

MS, CPCB welcomed the Committee members and apprised that the preliminary report shared by IIT Kanpur has been examined and a draft structure of the report has been prepared for inputs of the Committee members. He also highlighted that the report shall comprise of sections on directions of the Hon'ble NGT, study area, air quality scenario of the area along with gridded Aerosol Optical Depth based air quality profile, role of meteorology, Indo Gangetic Plain specific plan and interventions for non-industrial and industrial sources. MS CPCB also further emphasized that emission reductions from industries section may include existing technological status and emission standards of the identified industrial sources, along with options to upgrade exploring best available clean technologies for each sector and recommendations to shift to stringent emission standards if feasible.

Ms. Sakshi Batra and Prof. Mukesh Sharma presented the draft report structures and based on the discussion following were agreed:

- Prof. Mukesh Sharma suggested to include a section on action plan during episodic situation during October to November in the IGP.
- Prof. Sagnik Dey informed that if the locations of industrial activities and AOD data can be utilized to derive meaningful conclusions.
- MS, CPCB suggested that information on industrial areas may be shared with Prof. Dey and also requested to share the air quality profile of the IGP.
- Shri Pradeep Kumar, RO, UPPCB informed that the locations of industrial activities have been already shared with IIT Kanpur.
- MS, CPCB stressed that the recommendations made by the committee have to be linked with strong data evidences.
- MS, CPCB also added that the implementation of the recommendations suggested need to be worked out with concerned stakeholders or line ministries and same has to be highlighted in the report.
- He also suggested to review the actions in the city action plans of non-attainment cities, templates of State Action Plans, plans worked out in collaboration with the World Bank or other organizations for comprehensive recommendations by the committee.
- IIT Kanpur informed that the report shall be completed at best by 30th April, 2022.
- CPCB shall share the draft structure of report to IIT Kanpur by today for revision as per inputs of the committee.
- IIT Kanpur shall share the final report structure along with inputs on secondary data available for preparation of each section by tomorrow.
- IIT Kanpur shall further highlight the specific inputs required from other experts or States/ UTs along with timelines by tomorrow.

The meeting ended with a vote of thanks to and from the chair.

List of Participants

Committee Members

1. Dr. Prashant Gargava, Member Secretary, CPCB
2. Prof. Mukesh Sharma, IIT Kanpur
3. Shri Praveen Kumar, RO, UPPCB

Other Participants

1. Prof. Sagnik Dey, IIT Delhi – Co-opted Expert
2. Shri Utsav Sharma, RO, UPPCB
3. Shri Abhinandan Gosh, IIT Kanpur
4. Shri P. K. Gupta, Scientist F, CPCB
5. Ms Sakshi Batra, Scientist B, CPCB
6. Ms Parinita Baruah, Consultant A, CPCB
7. Shri Satpal, SRF, CPCB

Minutes of Fifth Meeting of the Joint Committee in the matter of OA 19/2021 before Hon'ble NGT (PB), New Delhi

Fifth meeting of the Joint Committee constituted by the Hon'ble NGT in the matter of OA no. 19/2021 for preparation of a science based expert report on ways and means to sustain activities such as hot mix plant to the extent possible without adversely affecting the public health was held on April 07, 2022 through video conferencing. Meeting was chaired by the Member Secretary (MS), CPCB. The list of the participants is annexed.

MS, CPCB welcomed the Committee members and highlighted that industrial pockets, areas with million plus population and high emission point sources such as large power plant need to be mapped while identifying hotspots in the Indo Gangetic Plain (IGP). In addition to this, he also suggested to explore if Prof. Sagnik Dey's team at IIT Delhi can define the airshed of IGP and identify contribution to PM levels from other areas. MS, CPCB also emphasized to explore the recommendations such as identification of areas for greening based on satellite data for dust management which is a predominant source in IGP. He also stressed that while recommending technological interventions, implementation limitations in terms of location, size of industries as well as feasibility of financial resources may also be considered.

Shri P.K. Gupta, Head AQM Division displayed the final timelines and requested IIT Kanpur to explain the activities to be carried out by the identified institutes within defined timelines. Copy of the same is enclosed as **Annexure I**. Prof. Mukesh Sharma, IIT Kanpur briefed the committee members and highlighted that the methodology adopted for concerned sections may be drafted by the responsible institute and share with IIT Kanpur for compilation. He also informed that the consolidated report based on contributions from all members shall be submitted to CPCB by May 10, 2022. He further suggested that as few recommendations suggested by the Committee may not be under the purview of city administration, the draft recommendations of the report may be vetted by the State Pollution Control Boards/ Committees/regulatory bodies before submission to the Hon'ble NGT.

MS, CPCB also underscored that recommendations may also highlight the policy directives that has to be adopted and implemented by concerned Ministries in IGP areas. He also suggested to substantiate if the scenario analysis for impact assessment based on recommendations as well as the financial feasibility of implementing the recommended interventions is under the purview and mandate of the committee.

The meeting ended with a vote of thanks to and from the chair.

Annexure I

Structure of Report, Identified Institutes and Timelines

Section	Section Details	Timeline*	Institute
Section I – Introduction	**Background** – Hon'ble NGT Directions	April 11	IITK and CPCB
	Constitution of Joint Expert Committee, meetings	April 11	CPCB
Section II - Methodology adopted for the study by the joint expert committee	**Study Area** - (IGP; demography, GDP, types of industries, agriculture ¾ to 1 page)	April 11	IITK
	Methodology	April 15	IITD, IITM, CPCB, PCBs to write their part of contribution & share with IITK
Section III - Current scenario of air pollution over IGP (write-up, maps and tables)	**State wise analysis of ambient air quality data** (Annual, Seasonal, Diurnal)	April 20	IITD (Prof. Khare)
	Spatial distribution of PM2.5 from Aerosol Optical Depth (AOD) over IGP (Identification of poor air quality regions, Identification of aerosol hot spots in IGP) Identification of Aieshed	April 20	IITD (Prof. Dey)
Section IV – Understanding the reason of the problem & Characterization of the Emission Sources	**Meteorological conditions over IGP and dispersal potential**, **Methodology of Emission Inventory Preparation** – Data sources, emission factor database, A 50 X 50 km gridded emission inventory of PM2.5 over IGP to observe the emission scenario, **State wise Emission Inventory** (Industrial – Industry wise EI, Non Industrial – Vehicles, Road Dust, Crop Residue Burning, Domestic cooking), **Relative role of meteorology and local emissions on the pollution hot spots/regions**	April 25	IITK with support from PCBs
Section V – Emission Reduction Recommendations	**General recommendations for Non-Industry Specific Interventions**		
	1. Mandatory actions of city plan, city action plans of non-attainment cities in IGP, state action plan template to IITK for estimating emission	April 10	CPCB

	reductions, and impact on air quality		
	2. Write up (Sector, Emission reduction based on control scenarios, Recommendations, Impact)	April 30	IITK
	Industry Specific Interventions		
	1. Information on all types of industry to IITM	April 10	IITK
	2. Industry EI and District-wise locations to committee	April 20	IITK
	3. Oct - Nov Episodic Situation	April 25	IITK
	4. Write up - Industry Specific Interventions (Best Available Technology and stringent emission standards) - Sector, Emission, reduction in emission, district-wise recommendations and Impact assessment based on control scenarios	April 30	IITM (Prof. Shiva)
	Summary and recommendations	May 10	IITK, IITM, IITD CPCB; review, modifications and acceptance by PCBs)
Final Report to CPCB		May 10	IITK

**Draft sections may be shared with IIT Kanpur as per the timelines for preparing consolidated report.*

List of Participants

Committee Members

1. Dr. Prashant Gargava, Member Secretary, CPCB
2. Prof. Mukesh Sharma, IIT Kanpur
3. Prof. Shiva Nagendra, IIT Madras
4. Shri Praveen Kumar, RO, UPPCB

Other Participants

1. Shri P. K. Gupta, Scientist F, CPCB
2. Ms Sakshi Batra, Scientist B, CPCB
3. Ms Parinita Baruah, Consultant A, CPCB
4. Shri Satpal, SRF, CPCB

Minutes of Sixth Meeting of the Joint Committee in the matter of OA 19/2021 before Hon'ble NGT (PB), New Delhi

Sixth meeting of the Joint Committee constituted by the Hon'ble NGT in the matter of OA no. 19/2021 for preparation of a science based expert report on ways and means to sustain activities such as hot mix plant to the extent possible without adversely affecting the public health was held on April 29, 2022 through video conferencing. Meeting was chaired by the Member Secretary (MS), CPCB. The list of the participants is annexed.

MS, CPCB welcomed the Committee members and requested Ms. Sakshi Batra, Scientist "B", CPCB to present the status of report preparation. Ms. Batra, CPCB briefed the committee and informed that information received so far has been consolidated in a google drive and link has been shared with all committee members for ready reference.

As most of the information for Section I to III has been received, MS CPCB suggested that IIT Kanpur may consolidate the report till Section III and share the same with the Committee by May 04, 2022. He also recommended to follow up with Prof. Sagnik Dey for write up on spatial distribution of Particulate Matter over the IGP including hotspots and airshed data to ensure timely preparation of the report.

Prof. Shiva Nagendra, IIT Madras informed that methodology adopted for preparing the section titled "Industry Specific Interventions" shall be shared by April 30, 2020 and write up shall be submitted within the next week.

MS, CPCB recommended to share the consolidated draft report by May 07 to the Committee for further review and revisions.

Prof. Mukesh Sharma, IIT Kanpur highlighted that the emission inventory submitted by SPCBs may not present the complete picture as data on small scale industries have not been provided. It was suggested that the data may be presented based on the information provided by the states and also based on the available literature survey.

MS, CPCB suggested that IIT Kanpur may assess the gaps in the emission inventory data and share the same with CPCB for taking up the matter with States/ UTs. He also informed that CPCB shall discuss the matter with NIC for exploring the possibility of utilising data from online consent mechanism. He further requested IIT Kanpur to see the possibilities for suggesting sitting policy for SSIs and also relook the areas defined under IGP to clarify whether information has to be sought from Jharkhand.

MS, CPCB concluded that the revised timelines indicating activities to be carried out by the identified institutes as per the discussions will be shared, and experts are requested to adhere to the timelines so that draft report may be finalized by 15th May.

The meeting ended with a vote of thanks to and from the chair.

Annexure I

Status of Report Preparation in the Matter of OA 19/ 2021

Section	Section Details	Timeline*	Status
Section I – Background and Structure of Report	**Background** – Hon'ble NGT Directions	May 04	Consolidated report (Section I- IV) to be shared by IITK
	Constitution of Joint Expert Committee and Deliberations		
	Preamble & Structure of Report		
Section II - Methodology adopted for the study by the joint expert committee	**Study Area** - (IGP; demography, GDP, types of industries, agriculture ¾ to 1 page)		Study area to be relooked by IITK and communicated to CPCB for requesting data from Jharkhand
	Methodology (Airshed, Hotspots, EI, Interventions)	April 30	Methodology for: Air shed and hotspots by IITD Industrial interventions by IITM
Section III - Current scenario of air pollution over IGP (write-up, maps and tables)	1. **State wise analysis of ambient air quality data** a. Seasonal Variation of PM2.5 in IGP b. Annual & Diurnal Variation of PM2.5 in IGP	May 04	Communication to IITD to be sent by CPCB by April 30.
	2. **Spatial distribution of $PM_{2.5}$ from Aerosol Optical Depth (AOD) over IGP** (Identification of poor air quality regions, Identification of aerosol hot spots in IGP)		Part 2 & 3 to be shared by IIT D (Prof. Dey)
	3. **Identification of Airshed**		Consolidated report (Section I- IV) to be shared by IITK
Section IV – Understanding the reason of the problem & Characterization of the Emission Sources	**Meteorological conditions over IGP and dispersal potential**, **Methodology of Emission Inventory Preparation** – Data sources, emission factor database, A 50 X 50 km gridded emission inventory[#] of PM2.5 over IGP to observe the emission scenario, **State wise Emission Inventory** (Industrial – Industry wise EI, Non Industrial –	May 06	Gaps in EI to be shared by IITK to CPCB for taking it up with States at the earliest. CPCB to consult NIC regarding industry data based on consent details.
			Consolidated report (Section I- IV) to be shared by IITK

	Vehicles, Road Dust, Crop Residue Burning, Domestic cooking), **Relative role of meteorology and local emissions on the pollution hot spots/regions**		
Section V – Emission Reduction Recommendations	**General recommendations for Non-Industry Specific Interventions**	May 06	Consolidated report (Section I –V Part 1) to be shared by IITK
	1. Write up (Sector, Emission reduction based on control scenarios, Recommendations, Impact)		
	Industry Specific Interventions		
	3. Oct - Nov Episodic Situation	May 07	Write up to be shared by IITK
	4. Write up - Industry Specific Interventions (Best Available Technology and stringent emission standards) - Sector, Emission, reduction in emission, district-wise recommendations and Impact assessment based on control scenarios	May 07	Write up to be shared by IITM
	Summary and recommendations	May 10	Consolidated report (Section I –V) to be shared by IITK To be shared with Committee members and PCBs for acceptance.
Final Report to CPCB		May 10	

**Draft sections may be shared with IIT Kanpur as per the timelines for preparing consolidated report.*

 # Jharkhand and Delhi yet to share data on emissions

List of Participants

Committee Members

1. Dr. Prashant Gargava, Member Secretary, CPCB
2. Prof. Mukesh Sharma, IIT Kanpur
3. Prof. Shiva Nagendra, IIT Madras
4. Shri Praveen Kumar, RO, UPPCB

Other Participants

1. Shri Abhinandan, IIT Kanpur
2. Ms Sakshi Batra, Scientist B, CPCB
3. Ms Parinita Baruah, Consultant A, CPCB

Minutes of Seventh Meeting of the Joint Committee in the matter of OA 19/2021 before Hon'ble NGT (PB), New Delhi

Seventh meeting of the Joint Committee constituted by the Hon'ble NGT in the matter of OA no. 19/2021 for preparation of a science based expert report on ways and means to sustain activities such as hot mix plant to the extent possible without adversely affecting the public health was held on June 01, 2022 through video conferencing. Meeting was chaired by the Member Secretary (MS), CPCB. The list of the participants is annexed.

MS, CPCB welcomed the Committee members and requested Ms. Sakshi Batra, Scientist "B", CPCB to present the status of report preparation. Ms. Batra, CPCB briefed the committee and informed that draft report has been shared with committee members for their comments.

It was highlighted that inferences based on the spatial maps of $PM_{2.5}$ may be included in Chapter III. Further, MS, CPCB also suggested to share the list of hotspots with concerned SPCBs/ PCCs for inputs on industrial activities. He also suggested that IIT Kanpur can attempt to estimate emissions in identified hotspots based on Emission Inventory. It was also proposed to request IIT Delhi (Prof. Dey) to share information on activities in identified hotspots from the study undertaken with the World Bank. He recommended that IIT Madras may include the feasibility of deploying identified technological interventions in IGP along with percentage reduction in $PM_{2.5}$ levels due to those technologies. IIT Madras agreed that improvement in the current draft can be done based on the information available through Emission Inventory.

IITK informed that present Emission inventory is based on both secondary sources and information received directly from States/UTs. However, few States are yet to share the revised data and incorporating the same in the report may delay its submission. MS, CPCB suggested to validate the Emission Inventory using the information received from States/ UTs.

MS, CPCB also requested IIT Madras and IIT Kanpur to concur to the timelines for submitting final report after incorporating the inputs of Committee members. Copy of revised timelines is enclosed as **Annexure I**.

The meeting ended with a vote of thanks to and from the chair.

Annexure I

Status of Report Preparation in the Matter of OA 19/ 2021

Section	Section Details	Timeline	Status
Section I – Background and Structure of Report	**Background** – Hon'ble NGT Directions	-	Completed (except methodology for Airshed - to be provided by IITD (Prof. Dey)
	Constitution of Joint Expert Committee and Deliberations		
	Preamble & Structure of Report		
Section II - Methodology adopted for the study by the joint expert committee	**Study Area** - (IGP; demography, GDP, types of industries, agriculture ¾ to 1 page)		
	Methodology (Airshed, Hotspots, EI, Interventions)		
Section III - Current scenario of air pollution over IGP (write-up, maps and tables)	1. **State wise analysis of ambient air quality data** a. Seasonal Variation of PM2.5 in IGP b. Annual & Diurnal Variation of PM2.5 in IGP		
	2. **Spatial distribution of $PM_{2.5}$ from Aerosol Optical Depth (AOD) over IGP** (Identification of poor air quality regions, Identification of aerosol hot spots in IGP)	June 03	Write up - IITK
	3. **Identification of Airshed**	June 03	Write up - IITD (Prof. Dey)
		June 02	CPCB:

Section IV – Understanding the reason of the problem & Characterization of the Emission Sources	**Meteorological conditions over IGP and dispersal potential**, **Methodology of Emission Inventory Preparation** – Data sources, emission factor database, A 50 X 50 km gridded emission inventory[#] of PM2.5 over IGP to observe the emission scenario, **State wise Emission Inventory** (Industrial – Industry wise EI, Non Industrial – Vehicles, Road Dust, Crop Residue Burning, Domestic cooking), **Relative role of meteorology and local emissions on the pollution hot spots/regions**		Share hotspot list to SPCBs/ PCCs Contact IIT D (Prof. Dey) for emission details in hotspots
		June 06	SPCBs: Emissions in identified hotspot districts
		June 14	IITK: Emission Inventory Tables 50 X 50 km gridded emission inventory of PM2.5 over IGP to observe the emission scenario, Emissions in Identified Hotspots based on EI
Section V – Emission Reduction Recommendations	**General recommendations for Non- Industry Specific Interventions**	June 14	IITK
	1. Write up (Sector, Emission reduction based on control scenarios, Recommendations, Impact)		
	Industry Specific Interventions		
	3. Oct - Nov Episodic Situation		Completed
	4. Write up - Industry Specific Interventions (Best Available Technology and stringent emission standards) - Sector, Emission, reduction in emission, district-wise recommendations and Impact assessment based on control scenarios	June 10	IITM: Feasibility of technologies suggested – timeframe/ pilot study if required Percentage reduction that can be achieved due to suggested technologies
	Summary and recommendations	June 14	IITK – Revised report incorporating inputs from experts

Final Report to CPCB		June 15	Final draft to be shared with PCBs for acceptance after finalization.

**Draft sections may be shared with IIT Kanpur as per the timelines for preparing consolidated report.*

 # Delhi yet to share any data on emissions and Punjab yet to share revised data on emissions

Comments/ Inputs on the draft report shared with members – June 10

List of Participants

Committee Members

1. Dr. Prashant Gargava, Member Secretary, CPCB
2. Dr.(Ms) Satya, Joint Director/Scientist 'D', IRO Lucknow, MoEFCC
3. Prof. Mukesh Sharma, IIT Kanpur
4. Prof. Shiva Nagendra, IIT Madras
5. Shri Praveen Kumar, RO, UPPCB

Other Participants

1. Shri P.K Gupta, Scientist F, CPCB
2. Shri Abhinandan, IIT Kanpur
3. Ms Sakshi Batra, Scientist B, CPCB
4. Ms Parinita Baruah, Consultant A, CPCB

Minutes of Eighth Meeting of the Joint Committee in the matter of OA 19/2021 before Hon'ble NGT (PB), New Delhi

Eighth meeting of the Joint Committee constituted by the Hon'ble NGT in the matter of OA No. 19/2021 for preparation of a science based expert report on ways and means to sustain activities such as hot mix plant to the extent possible without adversely affecting the public health was held on September 01, 2022 through video conferencing. Meeting was chaired by the Member Secretary (MS), CPCB. The list of the participants is annexed.

MS, CPCB welcomed the Committee members and requested AQM-Division to present the status of report preparation. Ms. Sakshi Batra, CPCB informed that the draft report prepared by IIT Kanpur has been circulated to all members for comments.

Further, CPCB comments on the draft final report were discussed and following were suggested:

- CPCB may look into existing recommendations for brick kilns, hot mix plants and stone crushers.
- Prof. Shiva Nagendra, IIT Madras suggested to refer TNPCB guidelines for hot mix plants.
- Prof. Sagnik Dey, IIT Delhi was requested to share the revised AOD maps excluding Jharkhand for the report.
- UPPCB was requested to examine the recommendations of the report with respect to future implications if any.
- MS, CPCB requested to experts to share their inputs by Monday, September 05, 2022 to IIT Kanpur and CPCB for finalizing the report.
- It was suggested that IIT Kanpur may share the final report including annexures (tables of emission inventory, emission factors, etc.) and inputs from other experts by September 09, 2022.

The meeting ended with a vote of thanks to and from the chair.

List of Participants:

Committee Members

1. Dr. Prashant Gargava, Member Secretary, CPCB
2. Prof. Mukesh Sharma, IIT Kanpur
3. Prof. Shiva Nagendra, IIT Madras
4. Shri Praveen Kumar, RO, UPPCB

Other Participants

1. Prof. Sagnik Dey, IIT Delhi - Expert
2. Shri P. K. Gupta, Scientist F, CPCB
3. Ms Sakshi Batra, Scientist B, CPCB
4. Ms Parinita Baruah, Consultanat –A, CPCB
5. Shri Satpal, SRF, CPCB

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भारत का राजपत्र
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असाधारण
EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (i)
PART II—Section 3—Sub-section (i)

प्राधिकार से प्रकाशित
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पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय

अधिसूचना

नई दिल्ली, 22 फरवरी, 2022

सा.का.नि. 143(अ).—केन्द्रीय सरकार, पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 6 और धारा 25 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, पर्यावरण (संरक्षण) अधिनियम, 1986 का और संशोधन करते हुए निम्नलिखित नियम बनाती है:, अर्थात्:-

1. संक्षिप्त नाम और प्रारंभ :

(1) इन नियमों का संक्षिप्त नाम पर्यावरण (संरक्षण) संशोधन नियम, 2022 है।

(2) वे राजपत्र में उनके अंतिम प्रकाशन की तारीख से लागू होंगे।

2. पर्यावरण (संरक्षण) नियम, 1986 में, अनुसूची-I में, क्रम सं. 74 पर प्रविष्टि के स्थान पर निम्नलिखित प्रविष्टि को रखा जाएगा, अर्थात्: -

74"	ईंट भट्टे	चिमनी से उत्सर्जन में विविक्त पदार्थ	250 मिलीग्राम/एनएम3
		चिमनी की न्यूनतम ऊंचाई (भट्टों की वर्टिकल साफ्ट) - भट्टा क्षमता 30,000 ईंट प्रतिदिन से कम - भट्टा क्षमता 30,000 ईंट प्रति दिन के बराबर या अधिक	14 मीटर (लोडिंग प्लेटफॉर्म से कम से कम 7.5 मीटर) 16 मीटर (लोडिंग प्लेटफॉर्म से कम से कम 8.5 मीटर)

		चिमनी की न्यूनतम ऊंचाई (भट्टों की वर्टिकल साफ्ट के अलावा)	
		- भट्टा क्षमता 30,000 ईंट प्रतिदिन से कम	24 मीटर
		- भट्टा क्षमता 30,000 ईंट प्रति दिन के बराबर या अधिक	27 मीटर

टिप्पणियां :

1. सभी नए ईंट भट्टों को केवल ज़िग-ज़ैग तकनीक या वर्टिकल शाफ्ट के साथ होने की या ईंट बनाने में ईंधन के रूप में पाइप्ड प्राकृतिक गैस के उपयोग की अनुमति दी जाएगी और इस अधिसूचना में निर्धारित मानकों का पालन करना होगा।

2. विद्यमान ईंट भट्टे जो ज़िग-ज़ैग तकनीक या वर्टिकल शाफ्ट या ईंट बनाने में ईंधन के रूप में पाइप्ड प्राकृतिक गैस (पीएनजी) के उपयोग का पालन नहीं कर रहे हैं, उन्हें (क) गैर-प्राप्ति शहरों के 10 किमी के दायरे में स्थित भट्टों के मामले में एक वर्ष (जैसा कि केंद्रीय प्रदूषण नियंत्रण बोर्ड द्वारा यथापरिभाषित) (ख) अन्य क्षेत्रों के लिए दो वर्ष की अवधि के भीतर ज़िग-ज़ैग तकनीक या वर्टिकल शाफ्ट में परिवर्तित किया जाएगा या पीएनजी का उपयोग ईंट बनाने में ईंधन के रूप में किया जाएगा। इसके अतिरिक्त, ऐसे मामलों में जहां केन्द्रीय प्रदूषण नियंत्रण बोर्ड/राज्य प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समितियां ने रूपांतरण के लिए अलग से समय-सीमाएं निर्धारित की हैं, वहां ऐसे आदेश प्रभावी होंगे।

3. सभी ईंट भट्टे केवल अनुमोदित ईंधन जैसे कि पाइप्ड प्राकृतिक गैस, कोयला, ईंधन लकड़ी और/या कृषि अपशिष्टों का उपयोग करेंगे। पेट कोक, टायरों/प्लास्टिक/ख़तरनाक अपशिष्टों के उपयोग की अनुमति ईंट भट्टों को नहीं दी जाएगी।

4. उत्सर्जन की निगरानी के लिए केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा निर्धारित मापदंडों/रूपरेखा के अनुसार ईंट-भट्टे स्थायी सुविधा (पोर्ट होल और प्लेटफार्म) का निर्माण करेंगे।

5. विविक्त सामग्रियों (पीएम) के निष्कर्ष 4% CO_2 पर प्रसामान्य किए जाएंगे जो निम्नलिखित हैं:

   पीएम (सामान्य) = (पीएम(मापित) X 4%)/ (चिमनी में मापित CO_2 का %, मापित CO_2 के मामले में ≥ 4% कोई प्रसामान्यीकरण नहीं। चिमनी की ऊँचाई (मीटर में) भी $H= 14\ Q^{0.3}$ सूत्र (जहां Q kg/hr में SO_2 उत्सर्जन दर है) द्वारा परिकलित की जाएगी, और अधिकतम दो को काम में ले सकेंगे।

6. ईंट भट्टों को आवासों और फलों के बागों से 0.8 कि.मी. की न्यूनतम दूरी पर स्थापित किया जाना चाहिए। राज्य प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समितियां आवास, जनसंख्या घनत्व, जल निकायों, संवेदनशील रिसेप्टर्स इत्यादि की निकटता का ध्यान रखते हुए स्थापित मापदंडों को सख्त बना सकते हैं।

7. किसी क्षेत्र में भट्टों की अधिक संख्या से बचने के लिए मौजूदा ईंट भट्टों से कम से कम एक किलोमीटर की दूरी पर ईंट भट्टों को स्थापित किया जाना चाहिए।

8. ईंट भट्टों को संबंधित राज्य प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समितियां द्वारा निर्धारित उत्सर्जन प्रक्रिया/पलायक धूल उत्सर्जन नियंत्रण दिशा-निर्देशों का पालन करना होगा।

9. ईंट भट्टों से निकलने वाली राख को ईंट बनाने में उसी परिसर के अंदर ही इस्तेमाल किया जाएगा।

10. ईंट भट्टे में ईंट बनाने के लिए उपयोग की जाने वाली मिट्टी को निकालने के लिए संबंधित राज्य/संघ राज्य क्षेत्र के खनन विभाग सहित संबंधित प्राधिकरणों से सभी आवश्यक अनुमोदन प्राप्त किए जाएंगे।

11. ईंट भट्टा मालिक यह सुनिश्चित करेंगे कि कच्चे माल/ईंटों के परिवहन के लिए उपयोग की जाने वाली सड़के पक्की सड़कें हैं।

12. कच्चे माल/ईंटों के परिवहन के दौरान वाहनों को ढका जाएगा।"

[फा. सं. क्यू-15017/35/2007-सीपीडब्ल्यू]

नरेश पाल गंगवार, अपर सचिव

टिप्पण : मूल नियम भारत के राजपत्र, असाधारण, भाग II, खण्ड 3, उप-खण्ड (i) में तारीख 19 नवंबर, 1986 के का.आ. 844 (अ) द्वारा प्रकाशित किए गए थे और 04 अक्तूबर, 2021 की अधिसूचना सा.का.नि. 724 (अ) द्वारा अंतिम बार संशोधित किए थे।

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 22nd February, 2022

G.S.R. 143(E).—In exercise of the powers conferred by sections 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely:—

1. Short Title and commencement: -

(1) These rules may be called the Environment (Protection) Amendment Rules, 2022.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986, in the SCHEDULE-I, for entry at Sl. No. 74, the following entry shall be substituted, namely: -

"74	**Brick Kilns**	Particulate matter in stack emission	250 mg/Nm^3
		Minimum stack height (Vertical Shaft Brick Kilns)	
		- Kiln capacity less than 30,000 bricks per day	14 m (at least 7.5m from loading platform)
		- Kiln capacity equal or more than 30,000 bricks per day	16 m (at least 8.5m from loading platform)
		Minimum stack height (Other than Vertical Shaft Brick Kilns)	
		- Kiln capacity less than 30,000 bricks per day	24 m
		- Kiln capacity equal or more than 30,000 bricks per day	27 m

Notes :

1. All new brick kilns shall be allowed only with zig-zag technology or vertical shaft or use of Piped Natural Gas as fuel in brick making and shall comply to these standards as stipulated in this notification.
2. The existing brick kilns which are not following zig-zag technology or vertical shaft or use Piped Natural Gas as fuel in brick making shall be converted to zig-zag technology or vertical shaft or use Piped Natural Gas as fuel in brick making within a period of (a) one year in case of kilns located within ten kilometre radius of non-attainment cities as defined by Central Pollution Control Board (b) two years for other areas. Further, in cases where Central Pollution Control Board/State Pollution Control Boards/Pollution Control Committees has separately laid down timelines for conversion, such orders shall prevail.
3. All brick kilns shall use only approved fuel such as Piped Natural Gas, coal, fire wood and/or agricultural residues. Use of pet coke, tyres, plastic, hazardous waste shall not be allowed in brick kilns.
4. Brick kilns shall construct permanent facility (port hole and platform) as per the norms or design laid down by the Central Pollution Control Board for monitoring of emissions.
5. Particulate Matter (PM) results shall be normalized at 4% CO_2 as below:

PM (normalized) = (PM (measured)x 4%)/ (% of CO_2 measured in stack), no normalization in case CO_2 measured $\geq$ 4%. Stack height (in metre) shall also be calculated by formula $H=14Q^{0.3}$ (where Q is SO_2 emission rate in kg/hr), and the maximum of two shall apply.

6. Brick kilns should be established at a minimum distance of 0.8 kilometre from habitation and fruit orchards. State Pollution Control Boards/Pollution Control Committees may make siting criteria stringent considering proximity to habitation, population density, water bodies, sensitive receptors, etc.

7. Brick kilns should be established at a minimum distance of one kilometre from an existing brick kiln to avoid clustering of kilns in an area.

8. Brick kilns shall follow process emission/fugitive dust emission control guidelines as prescribed by concerned State Pollution Control Boards/Pollution Control Committees.

9. The ash generated in the brick kilns shall be fully utilized in-house in brick making.

10. All necessary approvals from the concerned authorities including mining department of the concerned State or Union Territory shall be obtained for extracting the soil to be used for brick making in the brick kiln.

11. The brick kiln owners shall ensure that the road utilized for transporting raw materials or bricks are paved roads.

12. Vehicles shall be covered during transportation of raw material/bricks".

[F. No. Q-15017/35/2007-CPW]

NARESH PAL GANGAWAR, Addl. Secy.

Note : The principle rules were published in the Gazette of India, Extraordinary, Part II, Section 3, Sub-section (i) *vide* number S.O. 844(E), dated the 19th November, 1986 and lastly amended *vide* number G.S.R. 724(E), dated the 04th October, 2021.

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ANNEXTURE -IV

State wise VKT for different categories of vehicles for the year of 2018

States	2W	Bus	Truck	LMV goods	Taxies	LMV passenger	Car	Omini bus	Tractor	Trailer	Total (Billions Km)
Bihar	8.90E+10	1.79E+09	4.20E+09	1.12E+08	1.57E+09	1.85E+09	5.37E+09	5.12E+08	4.13E+08	2.42E+08	105
Chandigarh	9.94E+09	6.14E+08	2.58E+06	1.97E+05	4.32E+06	3.51E+05	6.97E+07	6.81E+04	0	1.66E+05	11
Haryana	7.00E+10	1.78E+09	9.25E+09	3.43E+09	7.19E+08	1.90E+09	6.56E+09	1.22E+07	1.02E+09	1.22E+08	95
Delhi	6.90E+10	2.29E+08	2.59E+07	4.68E+09	2.26E+09	1.81E+09	5.12E+09	1.79E+04	0	2.08E+05	83
Punjab	8.50E+10	1.36E+09	4.48E+09	6.06E+08	5.70E+08	1.16E+09	6.84E+09	2.63E+08	1.04E+09	2.03E+07	101
Uttar Pradesh	1.00E+11	4.14E+09	8.52E+10	4.69E+09	1.71E+09	2.93E+09	9.85E+09	9.31E+08	2.06E+09	3.18E+08	212
West Bengal	7.40E+10	2.60E+09	8.58E+09	1.16E+08	3.03E+09	1.23E+09	7.21E+09	5.09E+08	1.40E+08	3.44E+07	98
~Total (Billions Km)	495	13	113	14	11	10	41	2	5	1	~705

The emission factors for different Sectors used in this study

Domestic Sector	
Fuel Type	$PM_{2.5}$ (g/kg)
Fuel Wood	4.6
Crop Residue	5.7
Dung Cake	4.4
Coal	4.0
Kerosine for cooking	3.0
Kerosine for lightning	91.3
LPG	0.4
Thermal Power	
Fuel Type	$PM_{2.5}$ (Kg/Mg)
Coal	0.6
Gas	121.6 ($kg/10^6$ m^3)
Cement (Dry Process) (kg/Mg)	
Klin (W/O) APCD	94
Kiln APCD	0.98
Grinder (W/O) APCD	257
Grinder APCD	0.21
Cement (Wet Process) (kg/Mg)	
Klin (W/O) APCD	174
Kiln APCD	0.2
Grinder (W/O) APCD	123
Grinder APCD	0.02
Brick Kilns (g/kg)	
FCBTK	0.18
HD	0.18
CLAMP	1
VSBK	0.09
Hoffman	0.08

Tunnel	0.18
DDK	0.97
Other Large Industries (g/kg)	
Aluminium Production	1.0
Glass Manufacturing	0.24
Paper Pulp	0.6
Fertilizer	0.22
Sugar (Bagasse)	3.92
MSMEs (Kt/PJ)	
Coal	2.03
Natural Gas	0.002
Biomass	0.11
Furnace Oil	0.07
Disel	0.26
LDO	0.26
Naphtha	0.1
Transport Sector (g/km)	
Bus	0.4820 ,0.0225
Car	0.08895
LMV	0.08895
LCV	0.08895
Truck	0.3990
Taxi	0.08895
Two-Wheeler	0.0485
Tractor & Trailer	0.3990
Other Sector (g/kg)	
Other Coal uses	8.1
Road Construction Dust	6.9275
Construction Dust	0.12745

(In this study, the Indian emission factors developed by ARAI-Pune, TERI 2016, GAINS 2016 were used).

COMMISSION FOR AIR QUALITY MANAGEMENT
IN NATIONAL CAPITAL REGION AND ADJOINING AREAS

REVISED GRADED RESPONSE ACTION PLAN (GRAP) FOR NCR

(Revised: August 2022)

1. The GRAP for the NCR has now been classified under 4 different stages of adverse air quality in Delhi viz. Stage – I 'Poor' (AQI 201 – 300), Stage – II 'Very Poor (AQI 301-400), Stage – III 'Severe' (AQI 401-450) and Stage – IV 'Severe +' (AQI >450) respectively.

2. Actions under Stages II, III and IV of the GRAP shall be invoked at least three days in advance of the AQI reaching to the projected levels of that stage, based on the dynamic model and weather/ meteorological forecast to be provided to the Commission by IMD / IITM on a day-to-day basis.

3. Restrictive actions undertaken as per previous stages shall be continued, in addition to the air pollution stage under which the restrictive actions are envisaged to be taken. For example, restrictive actions under the Stage III category, whenever invoked, shall be in addition to those under Stage I and II respectively and so on and so forth.

4. The Sub-Committee on GRAP constituted by the Commission shall meet frequently to plan for advance action and issue necessary orders for invoking various provisions of the GRAP, based on the prevalent air quality and the AQI forecast to be provided by IMD from time to time. The Sub-Committee shall also review the actions taken by various agencies responsible towards effective implementation of the GRAP.

5. The Chief Secretaries of NCR States and GNCTD shall frequently review the actions and implementation of the GRAP especially when the air quality falls or is likely to fall in the 'Severe' or 'Severe +' category (Stage III and beyond).

6. The Commission may decide upon additional measures and exceptions to the schedule of the GRAP, under different air pollution categories i.e., Stages I to IV, as per the prevalent AQI and weather forecast.

Schedule under the GRAP for NCR

Stage I – 'Poor' Air Quality (DELHI AQI ranging between 201-300)	
Actions	**Agencies responsible / Implementing Agencies**
1. Ensure proper implementation of guidelines on dust mitigation measures and sound environmental management of Construction and Demolition (C&D) wastes. 2. Stop C&D activities in respect of such projects with plot size equal to or more than 500 sqm which have still not registered on the 'web portal' of the respective state / GNCTD, for remote monitoring in accordance with Direction Nos. 11-18 dated 11.06.2021 issued by the Commission.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - Construction agencies and plot owners (both public & private).
3. Ensure regular lifting of Municipal Solid Waste (MSW), Construction & Demolition (C&D) waste, and Hazardous wastes from dedicated dump sites and ensure that no waste is dumped illegally on open land.	- Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - All land-owning agencies - Construction agencies (both public & private).
4. Carry out periodic mechanized sweeping and/or water sprinkling on roads and ensure disposal of dust collected in designated sites/landfills.	- Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - Chief Executives of all road owning and maintaining agencies.
5. Ensure that C&D materials & waste are properly contained, covered and stored within the premises, and construction & Demolition waste is recycled at the processing facility	- Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - All construction agencies and plot owners (both public & private).

6. Enforce guidelines for use of anti-smog guns at construction sites	- Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - All construction agencies and plot owners (both public & private).
7. Stringently enforce prohibition on open burning of biomass and municipal solid waste. Impose heavy fine upon violation. 8. Strict vigil to ensure that there are no burning incidents in the landfill sites / dumpsites.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - All land-owning agencies.
9. Deploy traffic police for smooth traffic flow at all identified corridors with heavy traffic and congestion prone intersections.	- Commissioner or Head of Traffic Police in Delhi and NCR towns.
10. Strict vigilance and enforcement of PUC norms 11. No tolerance for visible emissions – Stop plying visibly polluting vehicles by impounding and / or levying maximum penalty.	- Commissioner or Head of Transport Department of Delhi and NCR States - Commissioner or Head of Traffic Police of Delhi and NCR towns.
12. Strictly enforce Supreme Court order on diversion of non- destined truck traffic.	- Head of Traffic Police of NCT of Delhi and NCR towns. - District Magistrates / Deputy Commissioners of NCT of Delhi / NCR towns - Municipal Commissioner of Corporations of NCT of Delhi and NCR towns.
13. Ensure strict penal/ legal action against non-compliant and illegal industrial units. 14. Ensure that only approved fuel is used by industries and stringent action is taken against violations. 15. Stringently enforce all pollution control regulations in brick kilns and Industries.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - District Magistrates / Deputy Commissioners of NCT of Delhi / NCR Towns - Commissioners of Urban Local Bodies in Delhi and NCR towns.

16. Stringently enforce emission norms in thermal power plants and strict actions be taken against non-compliance.	- Plant in- charge of Power Plants located within 300 km radius of Delhi. - Chairpersons – CPCB, DPCC, SPCBs (NCR).
17. Ensure fly ash ponds are watered every alternate day during summer months (March- May).	- Plant in- charge of Power Plants located within 300 km radius of Delhi.
18. Strictly enforce Hon'ble Courts / Tribunal orders regarding ban on firecrackers.	- Commissioner of Police of Delhi & IG / DIG / SP of NCR towns or Officer In charge of Licensing. - DMs/ DCs of respective districts in NCR. - Chief controller of Explosives, Petroleum and Explosive Safety Organizations (PESO).
19. Ensure regular lifting and proper disposal of industrial waste from industrial and non-development areas.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners/ Chief Engineers of Urban Local Bodies in Delhi-NCR towns - All land-owning agencies. - District Magistrate / Deputy Commissioners in NCR.
20. DISCOMs to minimise power supply interruptions in NCR.	- Head of Power distribution companies in NCR.
21. Ensure that diesel generator sets are not used as regular source of power supply.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - DMs/ DCs of respective districts of NCR.
22. Information dissemination including through social media, mobile Apps should be used to inform people about the pollution levels, contact details of control room, enable them to report polluting activities / sources to the concerned authorities and actions that will be taken by Government based on the level of Pollution.	- ACS/ Pr. Secretary/ Secretary, Dept. of Environment, GNCTD and NCR States. - Chairpersons – CPCB, DPCC, SPCBs (NCR).

23. Ensure quick actions for redressal of complaints on 311 APP, Green Delhi App, SAMEER App and other such social media platforms to curb polluting activities.	- Head of Urban Local Bodies in NCR towns. - Chairpersons – CPCB, DPCC, SPCBs (NCR). - Construction agencies, land owning agencies, Development agencies and all other concerned implementing agencies.
24. Encourage offices to start unified commute for employs to reduce traffic on road.	- State Governments in NCR and GNCTD.
CITIZEN CHARTER	• Keep engines of your vehicles viz. cars/ bikes/ scooters etc. properly tuned. • Maintain proper air pressure in tyres of your vehicles • Keep PUC certificates of your vehicles up to date. • Do not idle your vehicle, also turn off the engine at red lights. • Do not dispose waste /garbage in the open spaces. • Report air pollution activities through 311 App, Green Delhi App, SAMEER App etc.

Stage II – 'Very Poor' Air Quality (DELHI AQI ranging between 301-400) Actions under the Stage II of the GRAP shall be invoked at least three days in advance of the AQI reaching to the projected levels of 301-400, based on the dynamic air quality forecast system to be provided to the Commission by IMD / IITM on a day-to-day basis.	
Actions	**Agencies responsible / Implementing Agencies**
1. Mechanical/vacuum-based sweeping of roads to be carried out on a daily basis. 2. Ensure water sprinkling along with use of dust suppressants (at least every alternate day) on roads to arrest road dust especially at hotspots, heavy traffic corridors, vulnerable areas (before peak hours) and proper disposal of dust collected in designated sites/landfills.	– Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns – Chief Executives of all road owning and maintaining agencies. – Commissioner of Traffic Police of Delhi & NCR towns to identify roads with heavy traffic and provide information to respective Municipal Commissioners.
3. Regular inspection and strict enforcement of dust control measures at C&D sites.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi and NCR towns.
4. Do not allow coal / firewood including in Tandoors in Hotels, Restaurants and open eateries. 5. Ensure hotels, restaurants and open eateries use only electricity / clean fuel gas-based appliances.	- Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns. - Chairpersons – CPCB, DPCC, SPCBs (NCR).
6. Ensure uninterrupted power supply to discourage use of Generator sets.	- Additional Chief Secretary / Principal Secretary (Power), NCR State Governments / GNCTD - Head of Power Distribution Companies of Delhi and NCR Districts.

7. Stop use of Diesel Generators except for the following emergent and essential services: (i) Medical Services (Hospitals/ Nursing Home / Health care facilities) including units involved in manufacturing of life saving medical equipment / devices, drugs and medicines. (ii) Elevators / Escalators / travelators etc. in various installations. (iii) Railway Services / Railway stations. (iv) Metro Rail Services, including stations. (v) Airports and Inter-State Bus Terminals. (vi) Sewage Treatment Plants. (vii) Water Pumping Stations. (viii) National Security / Defence related activities. (ix) Projects of national importance. (x) Telecommunication / Data Services. ***Note:*** ***(i) In respect of industrial sector, due to operational and technical exigencies and to cater to situations of irregular power supply, regulated use of DG Sets shall be permitted in accordance with Directions No. 54 to 57 dated 08.02.2022, issued by the Commission.*** ***(ii) There shall, however, be no restrictions on operation of CNG / PNG / LPG fired Generator Sets for any sector.***	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi and NCR towns. - District Magistrates / Deputy Commissioners of NCR States and GNCTD.

8. Synchronize traffic movements and deploy adequate personnel at intersections / traffic congestion points for smooth flow of traffic.	- Commissioner or Officer in charge - Traffic Police of Delhi and NCR towns.
9. Alert in newspapers / TV / radio to advise people about air pollution levels and Do's and Don'ts for minimizing polluting activities.	- Chairpersons – CPCB, DPCC, SPCBs (NCR).
10. Enhance Parking fees to discourage private transport.	- Additional Chief Secretary / Principal Secretary, Urban Local Bodies of NCR States and GNCTD. - Commissioners of Urban Local Bodies in Delhi and NCR towns.
11. Augment CNG/ electric bus and metro services by procuring additional fleet and increasing the frequency of service.	- NCR State Governments. - Principal Secretary, Department of Transport. of NCT of Delhi and NCR State Govts. - Delhi Transport Corporation (DTC). - State Transport Corporation in NCR towns. - Delhi Integrated Multi – Model Transit System Ltd. (DIMTS). - Delhi Metro Rail Corporation (DMRC).
12. Resident Welfare Associations to provide electric heaters during winter to security staff to avoid open Bio-Mass and MSW burning.	- Resident Welfare Associations.
CITIZEN CHARTER	• People to use public transport and minimize use of personal vehicles. • Regularly replace air filters at recommended intervals in your automobiles. • Avoid dust generating construction activities during months of October to January.

Stage III – 'Severe' Air Quality (DELHI AQI ranging between 401-450) Actions under the Stage III of the GRAP shall be invoked at least three days in advance of the AQI reaching to the projected levels of > 400, based on the dynamic air quality forecast system to be provided to the Commission by IMD / IITM on a day-to-day basis.	
Actions	**Agencies responsible / Implementing Agencies**
1. Further intensify the frequency of mechanised/ vacuum-based sweeping of roads. 2. Ensure daily water sprinkling along with use of dust suppressants, before peak traffic hours, on roads and right of ways including hotspots, heavy traffic corridors and proper disposal of the collected dust in designated sites/ landfills.	- Commissioners / Chief Engineers of Urban Local Bodies in Delhi-NCR towns - Chief Executives of all road owning and maintaining agencies. - Commissioner of Police / Head of Traffic Police in Delhi & NCR towns to identify roads with heavy traffic and provide information to respective Municipal Commissioners / Head of Municipal Bodies.
3. Further intensify public transport services. Introduce differential rates to encourage off-peak travel.	- Secretary cum Commissioner of Transport Department, NCT of Delhi - Transport Commissioners of NCR States. - Managing Director, Delhi Metro Rail Corporation (DMRC). - Chairpersons, State Transport Corporations.
4. Construction & Demolition activities: (i) Enforce strict ban on construction and demolition activities in the entire NCR, except for the following categories of projects: (a) Railway services / Railway stations (b) Metro Rail Services including stations. (c) Airports and Inter State Bus Terminals. (d) National security/ defence related activities/ projects of national importance; (e) Hospitals/ health care facilities. (f) Linear public projects such as highways, roads, flyovers, over bridges, power transmission, pipelines etc. (g) Sanitation projects like sewage treatment plants and water supply projects etc.; (h) Ancillary activities specific to and supplementing above categories of projects.	- NCR State Governments and GNCTD - Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioners / Chief Engineers of Urban Local Bodies in Delhi and NCR towns.

Note: The above exemptions shall be further subject to strict compliance of the C&D Waste Management Rules, dust prevention/ control norms including compliance with the directions of the Commission issued from time to time in this regard.

(ii) Other than the projects exempted under (i) above, dust generating/ air pollution causing C&D activities to be strictly banned during this period shall include:

- Earthwork for excavation and filling including boring & drilling works.
- All structural construction works including fabrication and welding operations.
- Demolition works.
- Loading & unloading of construction materials anywhere within or outside the project sites.
- Transfer of raw materials either manually or through conveyor belts, including fly ash.
- Movement of vehicles on unpaved roads.
- Operation of batching plant.
- Laying of sewer line, waterline, drainage work and electric cabling by open trench system.
- Cutting and fixing of tiles, stones and other flooring materials.
- Grinding activities.
- Piling work.
- Water Proofing work.
- Road construction/ repair works including paving of sidewalks / pathways and central verges etc.

(iii) For all construction projects in NCR, non-polluting / non-dust generating activities such as plumbing works, interior decoration, electrical works and carpentry related works shall be permitted to be continued.

5. Industrial operations (a) For industrial areas having PNG infrastructure and supply: Strictly enforce closure / ban on such industries/ operations not running on fuels as in the standard list of approved fuels for NCR. (b) For industrial areas not having PNG infrastructure and supply: Regulate operations of such industries not using any of the fuels as per the standard list of approved fuels for NCR, to operate only for maximum 5 days a week as under (till 31.12.2022): (i) Paper and pulp processing, distilleries and captive thermal power plants – to remain inoperative on Saturdays and Sundays. (ii) Paddy / rice processing units – to remain inoperative on Mondays and Tuesdays. (iii) Textile/ garments and apparels including dyeing processes – to remain inoperative on Wednesdays and Thursdays. (iv) Other industries not falling in the above noted categories – to remain inoperative on Fridays and Saturdays. (c) With effect from 01.01.2023, strictly enforce closure/ ban in the entire NCR, on such industries/ operations not running on fuels, as in the standard list of approved fuels for NCR. **Note:** Milk & dairy units and those involved in manufacturing of life saving medical equipments / devices, drugs and medicines shall, however be exempted from the above restrictions.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioner of Police - Delhi and DG of Police of NCR States. - District Magistrates / Deputy Commissioners of respective districts in Delhi and NCR.

6. Close brick kilns, hot mix plants which are not operating on fuels, as in the standard list of approved fuels for NCR.	- Chairpersons – CPCB, DPCC, SPCBs (NCR) - Commissioner of Police - Delhi and DG of Police of NCR States - District Magistrates / Deputy Commissioners of respective districts in Delhi and NCR States.
7. Close down operations of stone crushers	
8. Ban / Close down mining and associated activities in the NCR.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - District Magistrates / Deputy Commissioners of respective districts in NCR. - Commissioner of Police - Delhi and IG / DIG / SP of NCR towns.
9. State Governments in NCR/ GNCTD may impose restrictions on BS III petrol and BS IV diesel LMVs (4 wheelers).	- State Governments in NCR and GNCTD. - Commissioner or Head of Transport Department - Commissioner of Police / Head of Traffic Police of Delhi and NCR towns.
CITIZEN CHARTER	• Choose a cleaner commute - share a ride to work or use public transport or walk or cycle. • People, whose positions allow working from home, may work from home. • Do not use coal and wood for heating purpose. • Individual house owners may provide electric heaters (during winters) to security staff to avoid open burning. • Combine errands and reduce trips. Walk to errands wherever possible.

Stage IV – 'Severe +' Air Quality (DELHI AQI > 450) Actions under the Stage IV of the GRAP shall be invoked at least three days in advance of the AQI reaching to the projected levels of > 450, based on the dynamic air quality forecast system to be provided to the Commission by IMD / IITM on a day-to-day basis.	
Actions	**Agencies responsible / Implementing Agencies**
1. Stop entry of truck traffic into Delhi (except for trucks carrying essential commodities/ providing essential services and all CNG / electric trucks).	- State Governments - Transport Commissioners, GNCTD/ NCR States - Commissioners / Head of Urban Local Bodies in Delhi-NCR towns. - Commissioner of Police / Head of Traffic Police of Delhi and NCR towns.
2. Ban on plying of Delhi registered diesel operated Medium Goods Vehicles (MGV) and Heavy Goods Vehicles (HGV) in Delhi, except those carrying essential commodities / providing essential services.	- State Governments of NCR & GNCTD - Transport Commissioners, GNCTD/ NCR States. - Commissioner of Police / Head of Traffic Police of Delhi and NCR towns.
3. Ban on plying of 4-wheeler diesel LMVs in NCT of Delhi and Districts of NCR bordering Delhi, except BS-VI vehicles and vehicles used for essential / emergency services.	- State Governments of NCR & GNCTD. - Transport Commissioners, GNCTD/ NCR States. - Commissioner of Police / Head of Traffic Police of Delhi and NCR towns.
4. Close down all industries in NCR, even in areas which do not have PNG infrastructure and supply but still running on fuels, other than the fuels as per the Standard list of approved fuels for NCR. **Note:** Industries like milk & dairy units and those involved in manufacturing of life saving medical equipments / devices, drugs and medicines shall however be exempted from the above restrictions.	- Chairpersons – CPCB, DPCC, SPCBs (NCR). - Commissioner of Police - Delhi and IG / DIG / SP of NCR towns. - Deputy Commissioners of respective districts in Delhi and NCR towns.
5. Ban C&D activities in linear public projects such as highways, roads, flyovers, over bridges, power transmission, pipelines etc.	- Chairpersons – CPCB, DPCC, SPCBs - Commissioners / Chief Engineers of Urban Local Bodies in Delhi - NCR towns.

6. NCR State Governments / GNCTD to decide on allowing public, municipal and private offices to work on 50% strength and the rest to work from home.	- State Governments of NCR & GNCTD.
7. Central Government may take a decision on permitting work from home for central government offices.	- Central Government (DoPT).
8. State Governments may consider additional emergency measures like closure of schools/ colleges/ educational institutions, closure of non-emergency commercial activities and plying of vehicles on odd-even basis etc.	- State Governments of NCR & GNCTD.
CITIZEN CHARTER	• Children, elderly and those with respiratory, cardiovascular, cerebrovascular or other chronic diseases to avoid outdoor activities and stay indoors, as much as possible.

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