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AIR POCALYPSE

ASSESSMENT OF AIR POLLUTION IN INDIAN CITIES

CLEANAIR NATION

REPORT

AIRPOCALYPSE: ASSESSMENT OF AIR POLLUTION IN INDIAN CITIES

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A view of the smog-covered smoke stacks of the Indraprastha Power Generation Co. Ltd, a power plant in New Delhi. Image: Subrata Biswas/ Greenpeace

1.2 MILLION

DEATHS EVERY YEAR DUE TO OUTDOOR AIR POLLUTION IN INDIA

3%

GDP LOST DUE TO AIR POLLUTION

EXECUTIVE SUMMARY

This report shows that deadly air pollution is not a problem restricted to Delhi-NCR (National Capital Region) or even to India's metros. It is a national problem that is killing 1.2 million Indians every year and costing the economy an estimated 3% of GDP. If the country's development is important, fighting air pollution has to be a priority.

Data gathered by Greenpeace India from state pollution control boards shows that there are virtually no places in India complying with WHO and National Ambient Air Quality (NAAQ) standards, and most cities are critically polluted. Except for a few places in Southern India which complied with NAAQ standards, the entire country is experiencing a public health crisis due to high air pollution levels.

Due to the range of different sectors responsible for pollutant emissions, urgent and determined action is needed by a number of ministries in the states and central governments, industry and general public.

Greenpeace is calling on the central and state governments to:

1. **Institute robust monitoring of air quality across the country** and make the data publicly available in real time. This should be coupled with a health advisory and 'red alerts' for bad-air days, which would enable the public to take decisions to protect their health and the environment and automatically institute measures to protect citizens, such as shutting down schools, traffic reduction measures, shutting down power plants and industries etc.
2. **Use the data as a basis to fine tune pollution reduction strategies** that must, inter alia seek to improve public transport and reduce petrol/diesel vehicle use, strengthen enforcement to get polluting vehicles off the roads, introduce higher fuel standards (Bharat VI), enforce stricter emission regulations and improved efficiency for thermal power plants and industries, move from diesel generators to rooftop solar, increase use of clean renewable energy, offer incentives for electric vehicles, dust removal from roads, regulate construction activities and stop burning of biomass and waste.

These strategies should be formalized as a time bound action plan which has targets and penalties. While some actions might need to be city or region-specific, there are a broad range of actions that will be universally applicable.

Vocal public participation is critical in reducing air pollution. Our choices in terms of electricity, transportation and waste management can play a major role in managing pollution levels, as are our choices in terms of political leaders who support the goal of reducing air pollution.

In 2016, severe air pollution has disrupted everyday life, especially during the winter.

IN 2015 AIR POLLUTION ($PM_{2.5}$) LEVELS INCREASED IN A RAPID MANNER OVERTAKING EVEN CHINA

In 2016, severe air pollution has disrupted everyday life, especially during the winter. In 2015 air pollution ($PM_{2.5}$) levels increased in a rapid manner overtaking even China. Even though pollution levels are increasing across the country, the emphasis so far has been on Delhi. There has been a growing realization that the majority of Delhi's pollution is coming from outside its borders and that pollution levels in other states like Karnataka, Tamil Nadu and Maharashtra are also increasing. However, the country is yet to come to the full understanding that air pollution is a national problem and to win the fight against it, we need to act as a country and across city or even regional boundaries.

India's air pollution has become a public health and economic crisis. There are increasing numbers of people who die prematurely every year with the increasing pollution levels. **DEATHS DUE TO AIR POLLUTION ARE ONLY A FRACTION LESS THAN THE NUMBER OF DEATHS CAUSED BY TOBACCO USAGE.** Global Burden of Disease (GBD), a comprehensive regional and global research program including 500 researchers representing over 300 institutions and 50 countries, has estimated that 3283 Indians died per day due to outdoor air pollution in India in 2015, making the potential number of deaths due to outdoor air pollution in India in 2015 to 11.98 lakh. On the economic front, loss of productivity and the forced closures of schools and industries have already started impacting our economy. The World Bank estimates that India loses around 3% of its GDP due to air pollution. This makes air pollution one of the biggest issues to fight if we are to protect peoples' lives, public health and our economy.

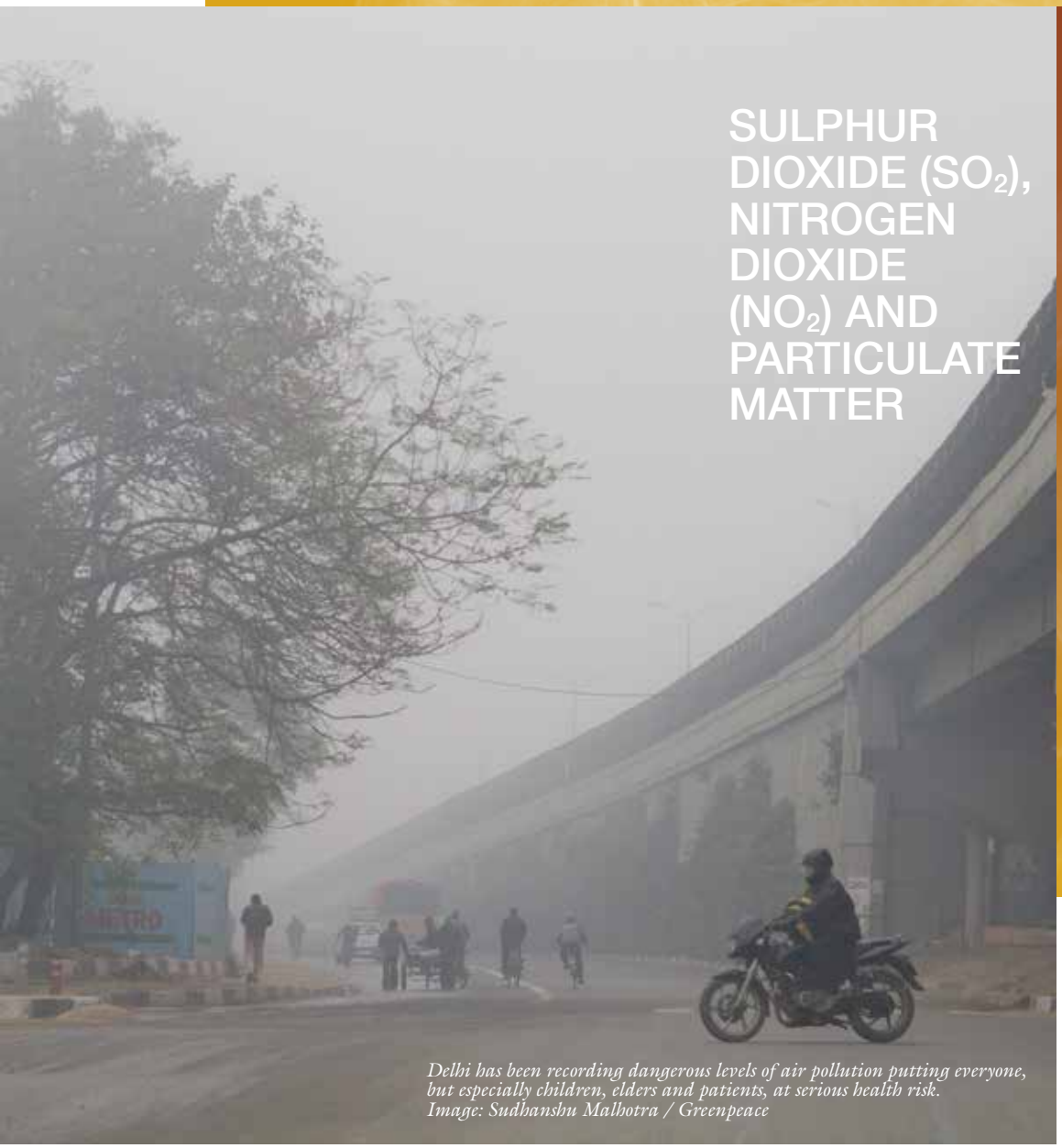
Air pollution is a complex issue, requiring an array of solutions. There are many sources that contribute to pollution across the country. Depending on region and climatic conditions, the contribution of particular sources will also differ. However, what is very clear is that irrespective of where you live, burning of fossil fuels (coal & oil) contributes majorly to air pollution levels across regions.

The purpose of this report is to show that air pollution is a national problem and it needs to be addressed equally across the country and not only in Delhi or the National Capital Region. The report also tries to identify major sources of pollution in parts of the country based on past research. As a way ahead for the country, our long term goals to solve the air pollution crisis can be universal, while short term solutions are to be decided based on the levels of pollution prevailing in the region.

[1] *http://documents.worldbank.org/curated/en/220721468268504319/pdf/700040v10ESW0P0box0374379B00PUBLIC0.pdf*

METHODOLOGY AND DATA

The Central Pollution Control Board has instituted the National Air Quality Monitoring Programme (NAMP). Under NAMP, three air pollutants viz., Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Particulate Matter size equal to or less than 10 micron (PM_{10}), have been identified for regular monitoring at all the locations. The NAMP network presently comprises 621 operating monitoring stations located in 262 cities/towns in 29 states and 5 union territories across the country."[2] Greenpeace tried to collect data on PM_{10} levels for these NAMP station across the country through various sources such as Right to Information (RTI) application filed to SPCB (State Pollution Control Boards) to gather data, SPCB's websites and annual reports of SPCBs etc. Simultaneously, a secondary literature review was carried out to understand the sources of pollution, to capture the most recent source apportionment studies carried out throughout the country.



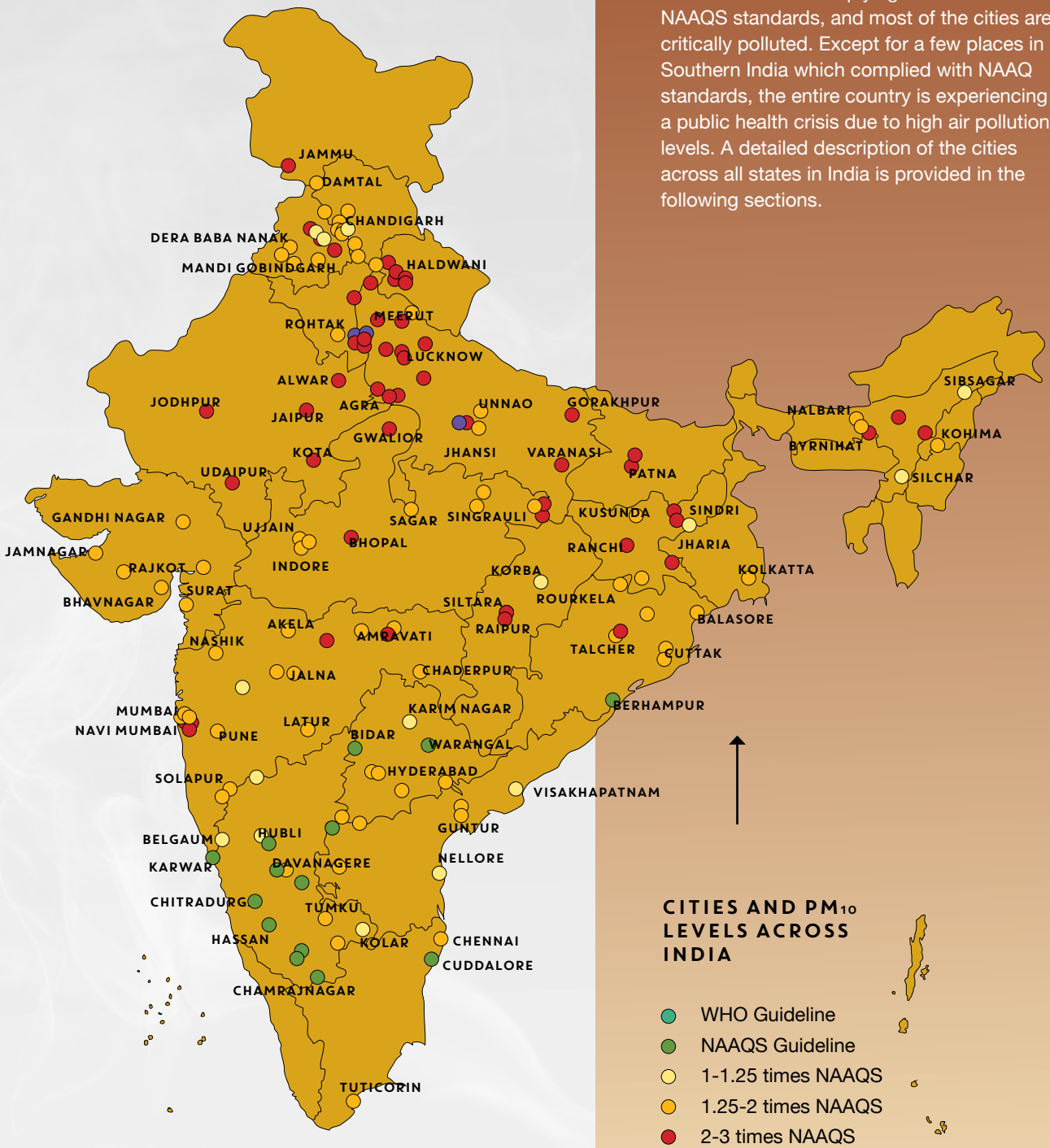
SULPHUR DIOXIDE (SO_2), NITROGEN DIOXIDE (NO_2) AND PARTICULATE MATTER

AIR POLLUTANTS THAT HAVE BEEN IDENTIFIED FOR REGULAR MONITORING AT ALL THE LOCATIONS THROUGHOUT THE COUNTRY

Delhi has been recording dangerous levels of air pollution putting everyone, but especially children, elders and patients, at serious health risk. Image: Sudhanshu Malhotra / Greenpeace

[2] *http://cpcb.nic.in/AQI_NAMP_Rep_June2016.pdf*

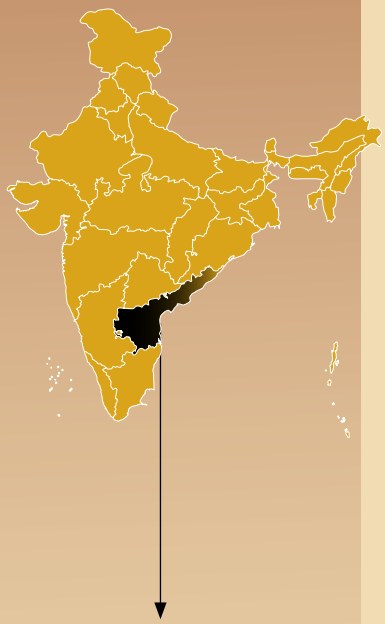
The map plotted from the annual average PM_{10} concentrations across the country suggests that there are no places or cities in northern India complying with WHO and NAAQS standards, and most of the cities are critically polluted. Except for a few places in Southern India which complied with NAAQ standards, the entire country is experiencing a public health crisis due to high air pollution levels. A detailed description of the cities across all states in India is provided in the following sections.



CITIES AND PM_{10} LEVELS ACROSS INDIA

- WHO Guideline
- NAAQS Guideline
- 1-1.25 times NAAQS
- 1.25-2 times NAAQS
- 2-3 times NAAQS
- 3-4 times NAAQS
- > 4 times NAAQS
- Indian state boundary

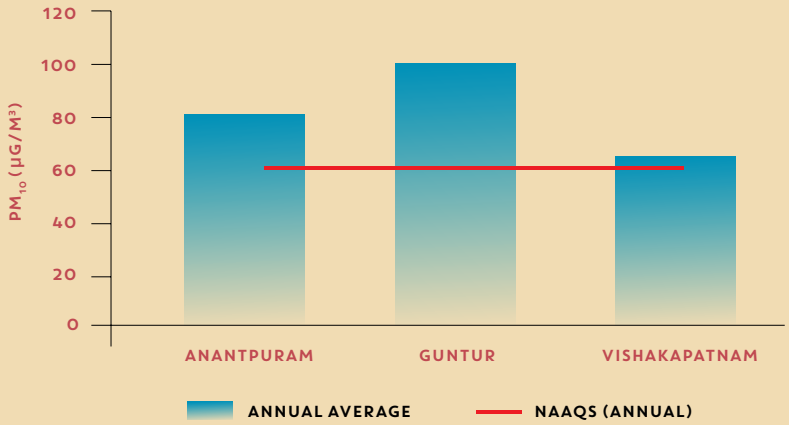
Note: Map not to scale



THREE CITIES IN ANDHRA PRADESH RECORDED PM_{10} LEVELS HIGHER THAN THE ANNUAL AVERAGE OF 60 µG/M³ AS PRESCRIBED UNDER NAAQS

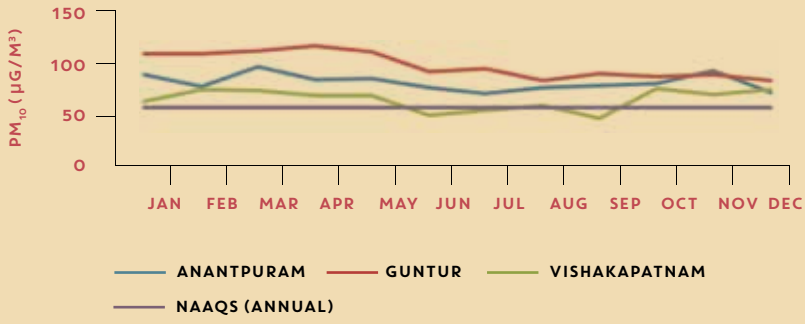
The assessment of Air Pollution levels for cities in Andhra Pradesh highlighted that PM_{10} concentrations in three cities where the data was available from the pollution control board were higher than the annual average of 60 µg/m³ as prescribed under NAAQS. PM_{10} concentrations in Anantpuram, Guntur and Visakhapatnam were respectively 84, 100 and 61 µg/m³ for year 2015.

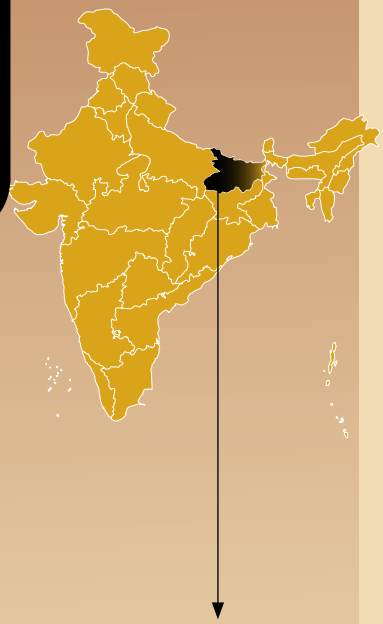
PM_{10} CONCENTRATIONS ACROSS CITIES IN ANDHRA PRADESH DURING 2015



Further analysis of the monthly variations in the data during 2015 suggests that the PM_{10} levels in all three cities were constantly higher than the annual average prescribed by CPCB throughout the year. From PM_{10} concentrations from January to May were relatively high as compared to other time of the year worsening the situation to even dangerous levels.

PM_{10} CONCENTRATIONS ACROSS CITIES IN ANDHRA PRADESH DURING 2015

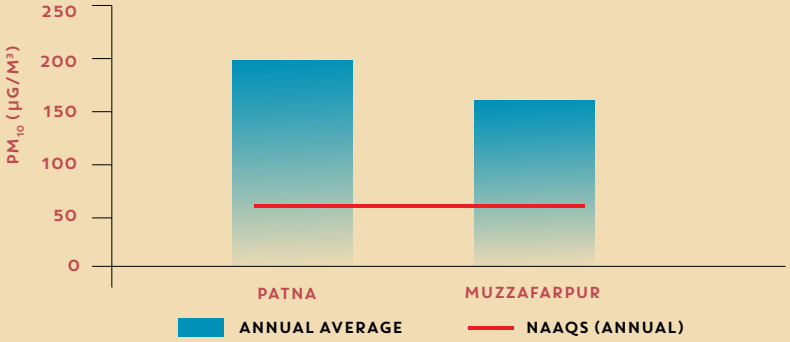




PATNA AND MUZZAFARPUR IN BIHAR RECORDED PM_{10} LEVELS 3 TIMES THE NAAQS ANNUAL LIMIT SET BY CPCB

The assessment of Air Pollution levels for cities in Bihar highlighted that PM_{10} concentrations in Patna and Muzzafarpur were respectively at 200 µg/m^3 and 164 µg/m^3 for year 2015, which were at around 3 times the NAAQS annual limit set by CPCB and 8 to 10 times the annual limit set by WHO for PM_{10}. The data is not just an indicator of hazardous levels of pollution but a continuously ringing alarm for years indicating the health emergency faced by the people inhabiting the area.

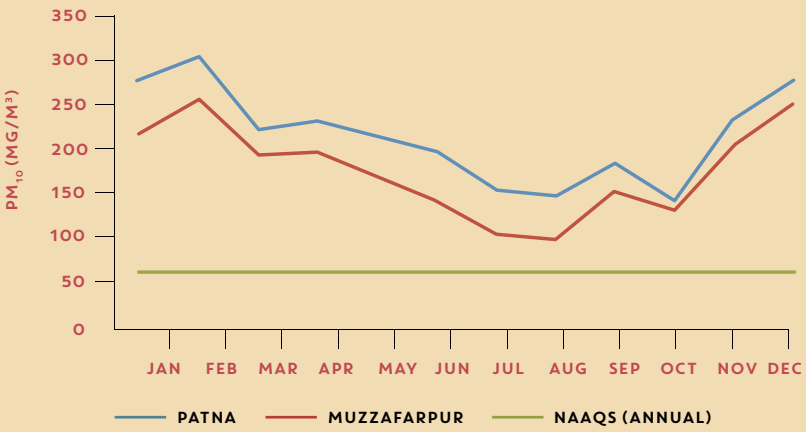
▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN BIHAR DURING 2015**



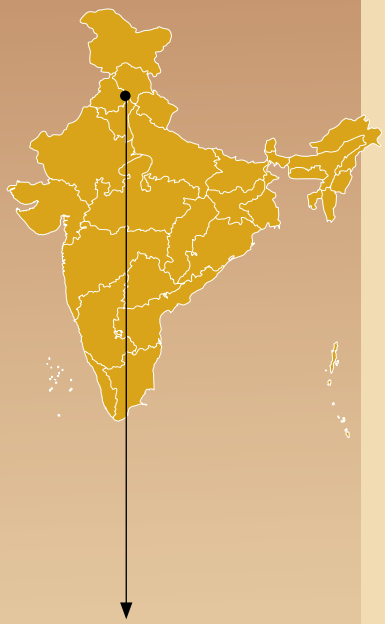
Detailed observation of the data suggests that the PM_{10} levels has been hazardous and very high all around the year for 2015 for both Patna and Muzzafarpur with November to March being the severely polluted months when the PM_{10} concentrations even reached above 300 µg/m^3.

Guttikunda and Jawahar 2014[3], conducted a study to understand pollution contribution within city of Patna for base year 2012. They found that overall contribution to the PM_{10} pollution load within the city varied from source to source. They found that the transport, road dust, domestic sources, generator sets, open waste burning, manufacturing industry, brick kilns and construction activities respectively contributed approximately 13-22%, 14-19%, 12-16%, 5-6%, 9-11%, 5-10%, 11-29% and 8-13% to the total PM_{10} emission load in the city. It is important to note that emissions within the city are different from contributions to ambient levels, as a large part of the pollution in ambient air comes from outside the city. The same paper also mentioned that the Greater Patna area has 2600 premature deaths, 2,00,000 asthma attacks and 1100 cardiac admissions due to exposure to ambient air pollution levels in Patna in 2012.

▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN BIHAR DURING 2015**



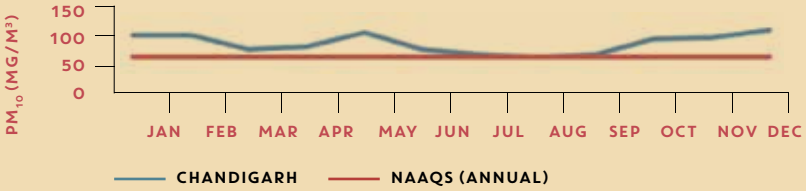
[3] *Guttikunda, S.K. and P. Jawahar, 2014. "Characterizing Patna's Ambient Air Quality and Assessing Opportunities for Policy Intervention", UrbanEmissions.Info (Ed.), New Delhi, India, http://shaktifoundation.in/wp-content/uploads/2014/02/AQM-in-Patna-2014-07-15-Final-Report.pdf*



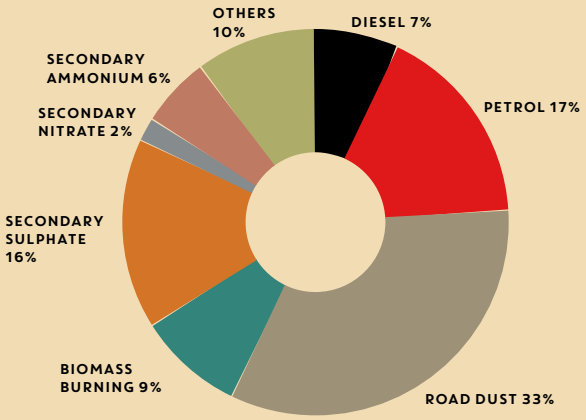
CHANDIGARH RECORDED PM_{10} LEVELS 4 TIMES THE ANNUAL LIMIT SET BY WHO

The assessment of Air Pollution levels for Chandigarh highlighted that PM_{10} concentrations are 85 µg/m^3 for year 2015, which were at higher than the NAAQS annual limit set by CPCB and about 4 times the annual limit set by WHO for PM_{10}. Detailed observation of the data suggests that the PM_{10} levels has been very high all around the year for 2015 for Chandigarh with October to February being the severely polluted months when the PM_{10} concentrations even reached above 100 µg/m^3.

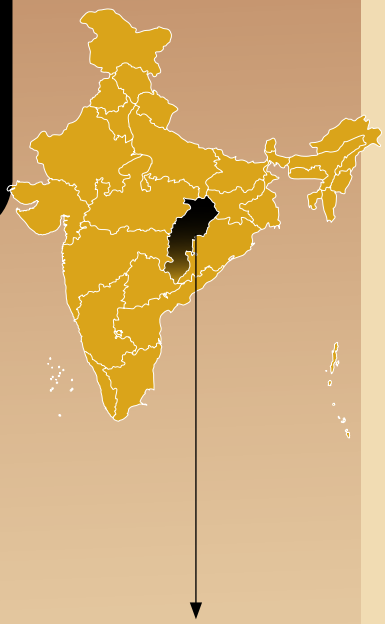
PM_{10} CONCENTRATIONS IN CHANDIGARH DURING 2015



Chaudhary et al., 2004[4] carried out source apportionment study for Chandigarh in 2001, which attributed 24% of total primary $PM_{2.5}$ pollution levels from fossil fuel combustion (coal, diesel, and gasoline) and 9 % to the biomass combustion in Chandigarh. The same study also highlighted that during the summer time secondary particulate formation and oil (Diesel & Petrol) consumption were the biggest contributors to the overall particulate matter concentrations.



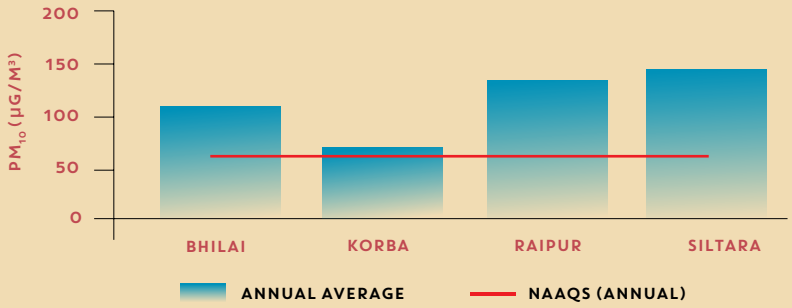
[4] *Chowdhury, Zohir; Zheng, Mei and Russell, Armistead, 2004, "Source Apportionment and Characterization of Ambient Fine Particles in Delhi , Mumbai , Kolkata , and Chandigarh" Georgia Institute of Technology, Atlanta Georgia, https://smartech.gatech.edu/bitstream/handle/1853/10872/E-20-H76_736587.pdf*



DETAILED OBSERVATION OF THE DATA SUGGESTS THAT THE PM_{10} LEVELS HAS BEEN HAZARDOUS AND VERY HIGH ALL AROUND THE YEAR FOR 2015-2016 FOR MOST CITIES

The assessment of Air Pollution levels for cities in Chhattisgarh highlighted that PM_{10} concentrations in four cities where the data was available from pollution control board were higher than the annual average of 60 µg/m^3 as prescribed under NAAQS. PM_{10} concentrations in Bhilai, Korba, Raipur and Siltara were respectively 109, 66, 138 and 145 µg/m^3 for year 2015-2016.

▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN CHHATTISGARH DURING APRIL 2015 - MARCH 2016**

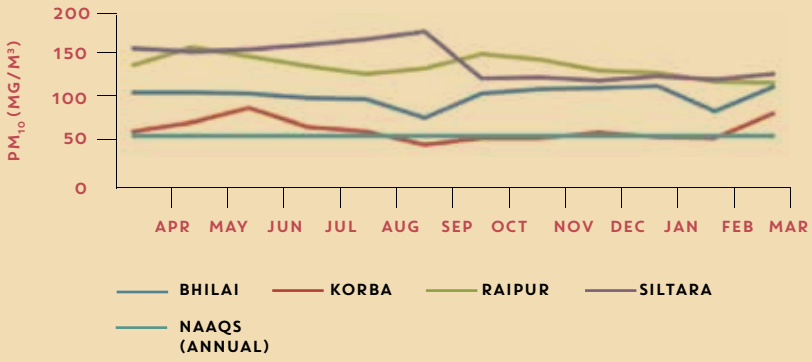


Detailed observation of the data suggests that the PM_{10} levels has been hazardous and very high all around the year for 2015-2016 for all the cities except Korba which shows PM10 levels close to NAAQS throughout the year.

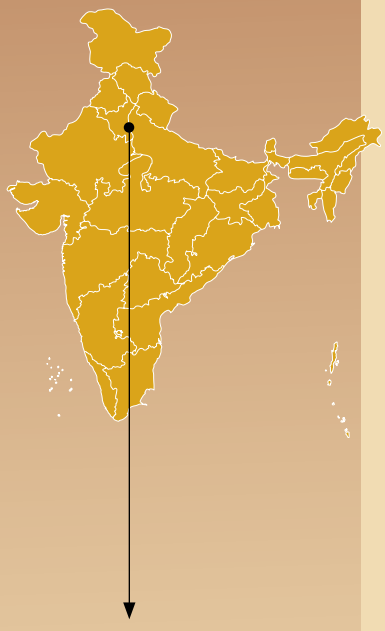
Korba has been declared 5th in the list of the 24 most critically polluted areas in the country[5] by CPCB. The same report also highlighted Coal Based Power Plants and Smelter Plants as major sources of air pollution along with fugitive emissions from coal mines in the area.

Deshmukh et al., 2013[6] highlighted vehicular growth, coal burning in steel industry and thermal power plants, other industrial activities, biomass burning, brick kilns and domestic fuel use as the major factors contributing to air pollution in Raipur, although the contribution to total pollution from respective sources has not been attributed.

▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN CHHATTISGARH DURING APRIL 2015 - MARCH 2016**



[5] *http://cpcb.nic.in/divisionsofheadoffice/ess/Korba.pdf*
[6] *http://link.springer.com.sci-hub.cc/article/10.1007/s11869-011-0169-9*



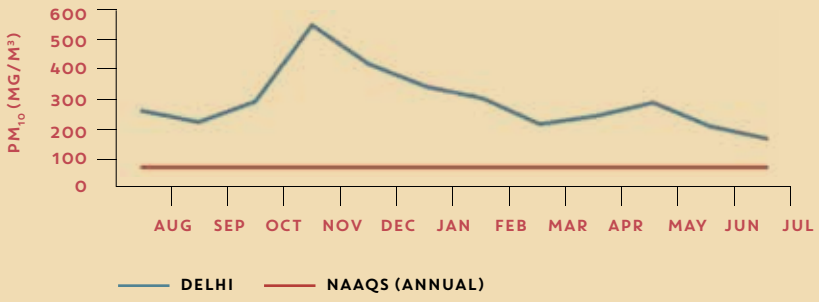
AIR POLLUTION LEVELS FOR DELHI HIGHLIGHTED THAT PM_{10} CONCENTRATIONS ARE 268 µG/M³ FOR YEAR 2015, WHICH WERE AT 4.5 TIMES HIGHER THAN THE NAAQS ANNUAL LIMIT SET BY CPCB AND ABOUT 13 TIMES THE ANNUAL LIMIT SET BY WHO

The assessment of Air Pollution levels for Delhi highlighted that PM_{10} concentrations are 268 µg/m³ for year 2015, which were at 4.5 times higher than the NAAQS annual limit set by CPCB and about 13 times the annual limit set by WHO for PM_{10}. Detailed observation of the data suggests that the PM_{10} levels has been very high all around the year for 2015 for Delhi with October to February being the severely polluted months when the PM_{10} concentrations even touched 500 µg/m³.

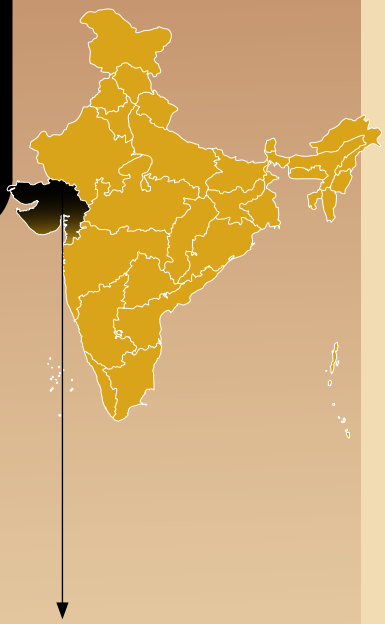
It has been long established as the pollution capital of the world by WHO, 2014[7] and most of the debate on air pollution in India are still centered around Delhi. Various studies have been done to understand the source contribution to Delhi's Air pollution, the most recent being the study by IIT Kanpur[8]. According to the study, "The total PM_{10} emission load in the city is estimated to be 143 t/d (based on average annual activity data). The top four contributors to PM_{10} emissions are road dust (56%), concrete batching (10%), industrial point sources (10%) and vehicles (9%); these are based on annual emissions". According to the study control measures applied at the power plants within 300 KM radius of Delhi will "effectively reduce PM_{10} and $PM_{2.5}$ concentration by about 62 µg/m³ and 35 µg/m³ respectively. Similarly 90% reduction in NO_x can reduce the nitrates by 45%. This will effectively reduce PM_{10} and $PM_{2.5}$ concentration by about 37 µg/m³ and 23 µg/m³ respectively. It implies that control of SO_2 and NO_x from power plants can reduce PM_{10} concentration approximately by 99 µg/m³ and for $PM_{2.5}$ the reduction could be about 57 µg/m³."

Furthermore, the study highlighted that, "The contribution of the biomass burning in winter is quite high at 17% (for PM_{10}) [and] 26% (for $PM_{2.5}$). Biomass burning is prohibited in Delhi and it is not a common practice at a large scale. The enhanced concentration of PM in October-November is possibly due to the effect of post-monsoon crop residue burning (CRB). It can be seen that the biomass contribution in PM_{10} in the month of November could be as high as 140 µg/m³ and about 120 µg/m³ for $PM_{2.5}$ (mean of contribution in entire winter season: 97 µg/m³ and 86 µg/m³ respectively). In all likelihood, the PM from biomass burning is contributed from CRB [crop residue burning] prevalent in Punjab and Haryana in winter".

▼ **PM_{10} CONCENTRATIONS IN DELHI DURING AUGUST 2014- JULY 2015**



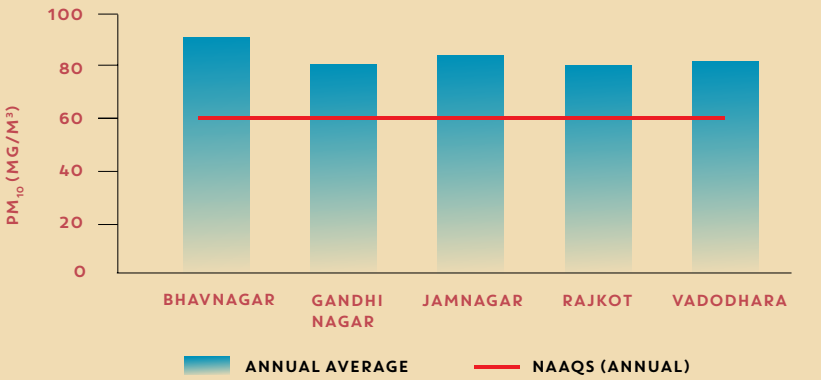
[7] *http://www.who.int/phe/health_topics/outdoorair/databases/cities-2014/en/*
[8] *http://delhi.gov.in/DoIT/Environment/PDFs/Final_Report.pdf*



DETAILED PM_{10} CONCENTRATIONS IN BHAVNAGAR, GANDHI NAGAR, JAMNAGAR, RAJKOT AND VADODHRA WERE RESPECTIVELY 91, 82, 88, 86 AND 86µG/M³ FOR YEAR 2014-2015

The assessment of Air Pollution levels for cities in Gujarat highlighted that PM_{10} concentrations in five cities where the data was available from pollution control board were higher than the annual average of 60 µg/m³ as prescribed under NAAQS. PM_{10} concentrations in Bhavnagar, Gandhi Nagar, Jamnagar, Rajkot and Vadodara were respectively 91, 82, 88, 86 and 86 µg/m³ for financial year 2014-2015.

▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN GUJARAT DURING APRIL 2014 - MARCH 2015**

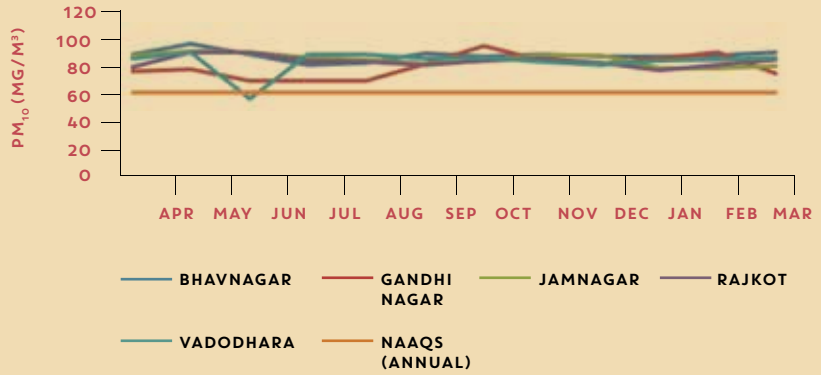


Detailed observation of the data suggests that the PM_{10} levels have been very high all around the year for 2014-2015 for all the cities in Gujarat.

Guttikunda and Jawahar, 2011[9] estimated that power plants contribute to 39% of PM_{10} pollution load in Ahmedabad and 31% to $PM_{2.5}$, with transportation contributing to 16% and 27% to PM_{10} and $PM_{2.5}$ respectively.

In Surat and Rajkot the contribution of transportation to overall PM_{10} were 30% & 26% and $PM_{2.5}$ concentration were 42% & 40% respectively. Contribution from industrial sector to PM_{10} levels of 12 % and 25% and $PM_{2.5}$ levels of 20% and 36% in Surat and Rajkot respectively.

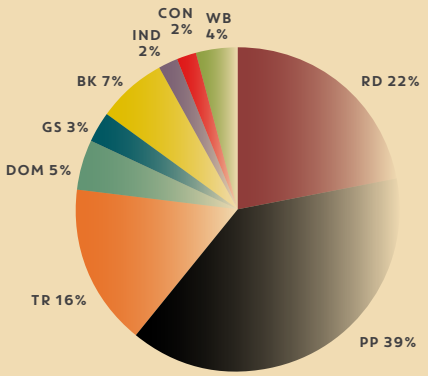
▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN GUJARAT DURING APRIL 2014- MARCH 2015**



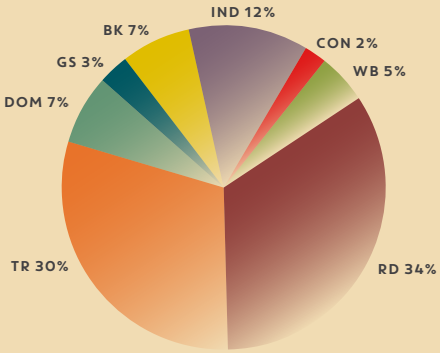
[9] *Guttikunda and Jawahar, 2011, "Simple Interactive Models for Better Air Quality, Urban Air Pollution Analysis in India", UrbanEmissions.Info, New Delhi, India, http://urbanemissions.info/wp-content/uploads/docs/SIM-37-2012.pdf*

CONTRIBUTION OF MAJOR SOURCES TO PM_{10} EMISSIONS INVENTORY

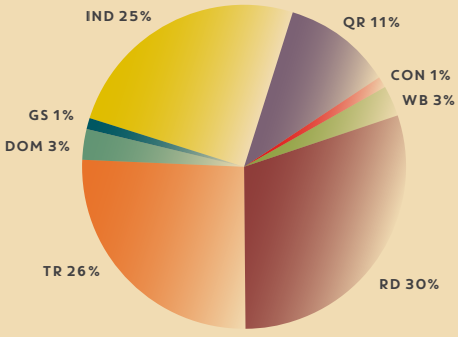
AHMEDABAD



SURAT

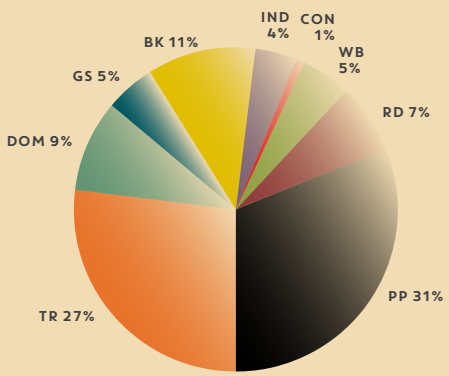


RAJKOT



CONTRIBUTION OF MAJOR SOURCES TO $PM_{2.5}$ EMISSIONS INVENTORY

AHMEDABAD



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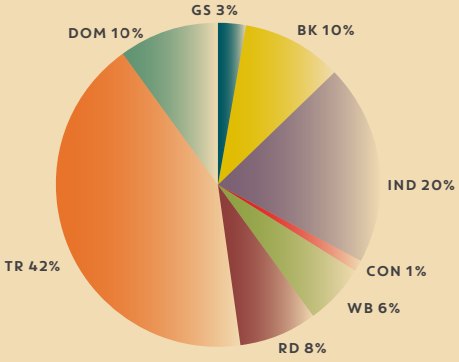
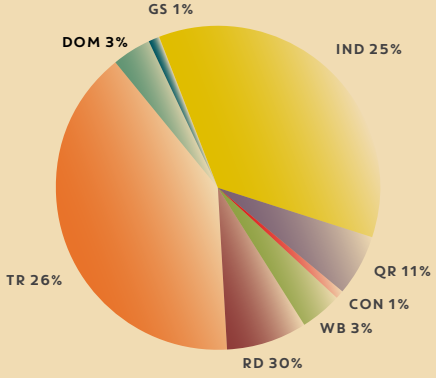
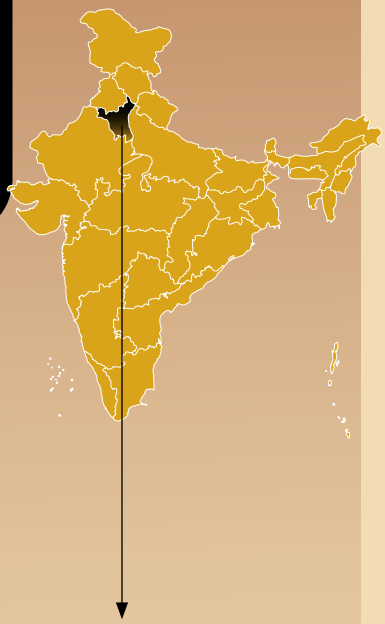


RAJKOT



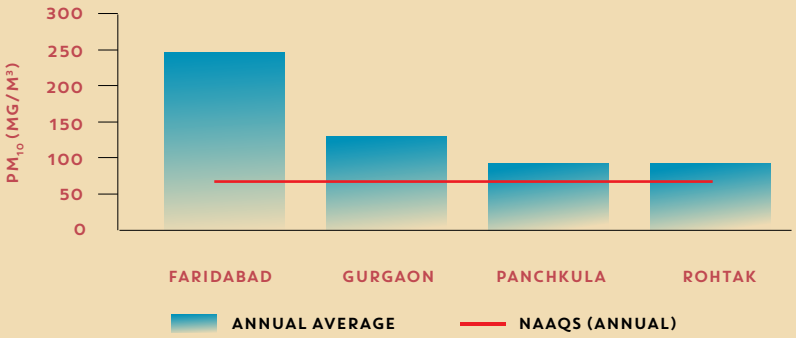
TR- TRANSPORT BK- BRICK KILNS; GS- GENERATOR SETS; DOM- DOMESTIC FUEL COMBUSTION; CMQ- CONSTRUCTION MATERIAL ROCESSINGAT QUARRIES; RD- ROAD DUST; WB- OPEN WASTE BURNING; PP: POWER PLANT



PM_{10} LEVELS HAS BEEN HAZARDOUS ALL AROUND THE YEAR FOR 2015 WITH FARIDABAD AND GURGAON SHOWING SEVERE POLLUTION LEVELS

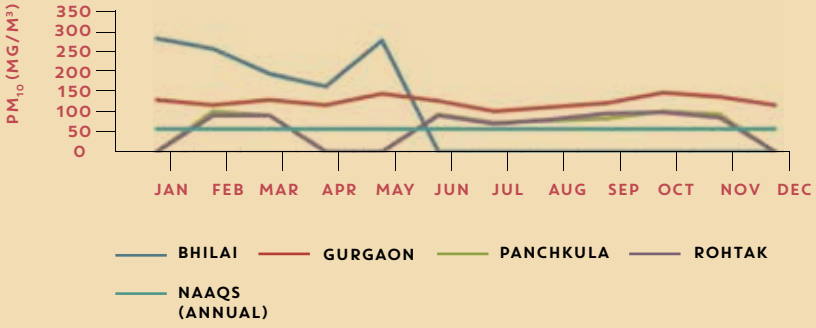
The assessment of Air Pollution levels for cities in Haryana highlighted that PM_{10} concentrations in four cities where the data was available from pollution control board were higher than the annual average of 60 µg/m^3 as prescribed under NAAQS. PM_{10} concentrations in Faridabad, Gurgaon, Panchkula and Rohtak were respectively 240, 129, 92 and 92 µg/m^3 for year 2015.

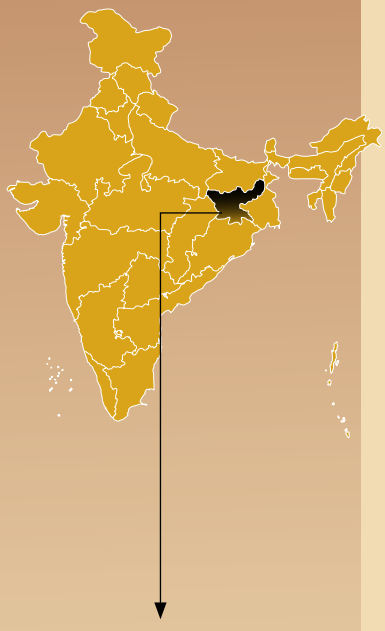
▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN HARYANA DURING 2015**



Detailed observation of the data suggests that the PM_{10} levels have been hazardous and very high all around the year for 2015 for all the cities wherever data is available Faridabad and Gurgaon being the places which are severely polluted along with all other places having higher PM_{10} concentrations reaching above NAAQS.

▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN HARYANA DURING 2015**

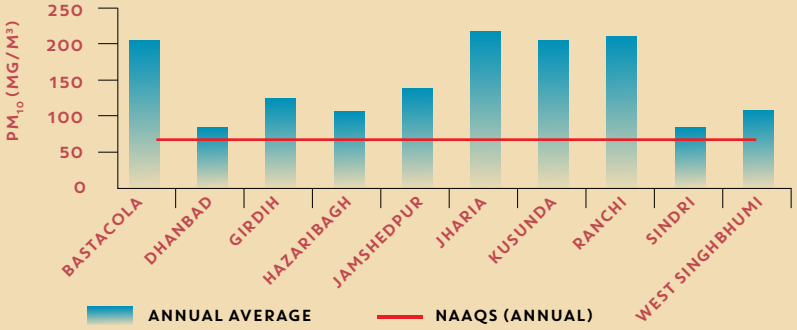




RANCHI, KUSUNDA, JHARIA AND BASTACOLA ARE THE PLACES WHICH ARE SEVERELY POLLUTED WITH PM_{10} LEVELS BEING ABOVE 200 µG/M³ ALL YEAR LONG

The assessment of Air Pollution levels for cities in Jharkhand highlighted that PM_{10} concentrations in all 10 locations where the data was available from pollution control board were higher than the annual average of 60 µg/m³ as prescribed under NAAQS. PM_{10} concentrations in Jharia, Ranchi, Kusunda and Bastacola were respectively 228, 216, 214 and 211 µg/m³ for year 2015.

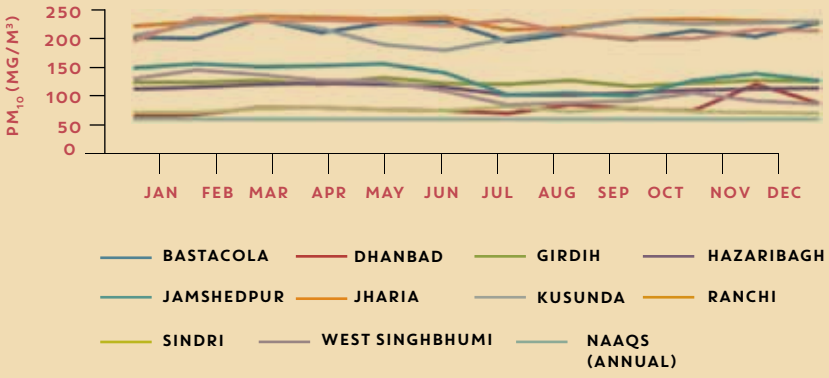
▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN JHARKHAND DURING 2015



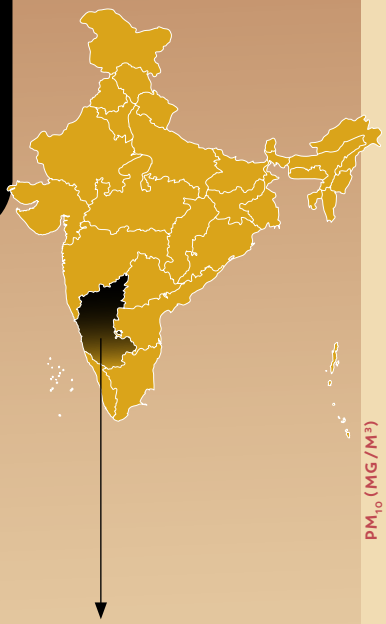
Detailed observation of the data suggests that the PM_{10} levels has been hazardous and very high all around the year for 2015 for all the cities wherever data is available. Ranchi, Kusunda, Jharia and Bastacola are the places which are severely polluted with PM_{10} levels being above 200 µg/m³ all the time during the year along with all other places having higher PM_{10} concentrations reaching above NAAQS.

Pandey et al., 2014[10] highlighted that the major causes of air pollution in area near Jharia including Bastacola, Dhansar, Ena, CIMFR are coal mining, mine fires, vehicular pollution, windblown dust through unpaved roads and over burdens in the area.

▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN JHARKHAND DURING 2015



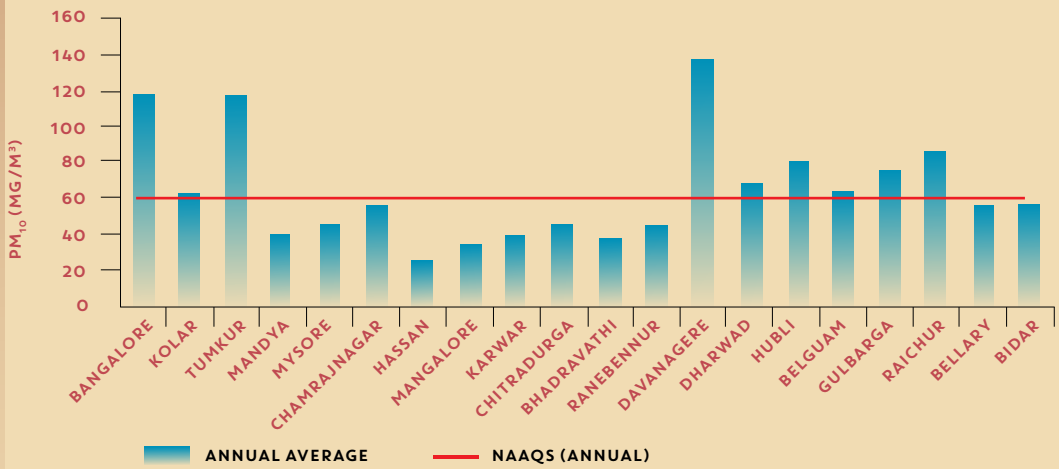
[10] *Pandey et al., 2014, "Assessment of air pollution around coal mining area: Emphasizing on spatial distributions, seasonal variations and heavy metals, using cluster and principal component analysis", Atmospheric Pollution Research, 5, 79-86, http://www.sciencedirect.com/science/article/pii/S1309104215303445*



PM_{10} CONCENTRATIONS IN 9 TOWNS/CITIES OUT OF 21 WERE HIGHER THAN THE ANNUAL AVERAGE OF 60 µG/M³ AS PRESCRIBED UNDER NAAQS

The assessment of Air Pollution levels for cities in Karnataka highlighted that PM_{10} concentrations in 9 towns and cities out of the 21 where data was available from pollution control board were higher than the annual average of 60 µg/m³ as prescribed under NAAQS. PM_{10} concentrations in Davanagere, Bangalore, Tumkur, Raichur and Hubli were respectively 109, 119, 118, 87 and 80 µg/m³ for year 2015-2016.

▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN KARNATAKA DURING APRIL 2015 - MARCH 2016



TERI 2010[11] estimated emission load and source contribution to pollution for Bangalore and estimated that, "At the city level, the major sources of PM_{10} emissions are transport (42%), road dust resuspension (20%), construction (14%), industry (14%), DG set (7%) and domestic (3%). Likewise, at the city level, major sources of NO_x are transport (68%), DG set (23%), industry (8%) and domestic (1%). In case of SO_2, at the city level, industry (56%0, DG set (23%) and transport (16%) are the major sources." The same report through source apportionment also highlighted:

- "Share of transportation increases from 19% in PM_{10} to 50% in $PM_{2.5}$, depicting dominance of finer particles in the vehicular exhaust.
- Share of anthropogenic sources has been eclipsed by dust contribution, in case of PM_{10}. However, $PM_{2.5}$ clearly shows significant contribution of anthropogenic sources.
- DG sets have emerged out as an important source of air pollution. Their contribution is 13% & 25% in PM_{10} and $PM_{2.5}$, respectively.
- Contribution of industries to the particulate matter is low in Bangalore, primarily due to absence of any large scale air polluting unit. However, their contribution in the industrial zone (Peenya) is high.
- Share of secondary particulates is higher in $PM_{2.5}$ than PM_{10}, depicting their finer size."

[11] *Air quality assessment, emission inventory and source apportionment study for Bangalore city: Final report, New Delhi: The Energy Resources Institute, 186 pp. [Project Report No. 2004EE28], http://www.cpcb.nic.in/Bangalore.pdf*

FIGURE: PERCENTAGE SHARE OF DIFFERENT SOURCES IN TOTAL PM_{10} AND NOx EMISSION LOADS

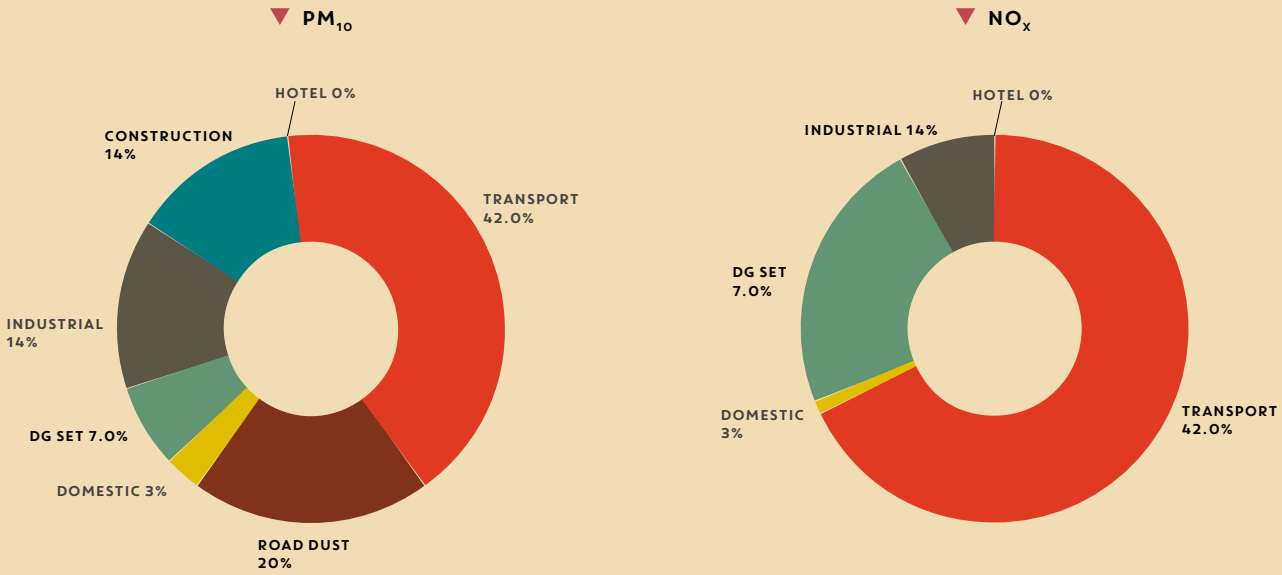
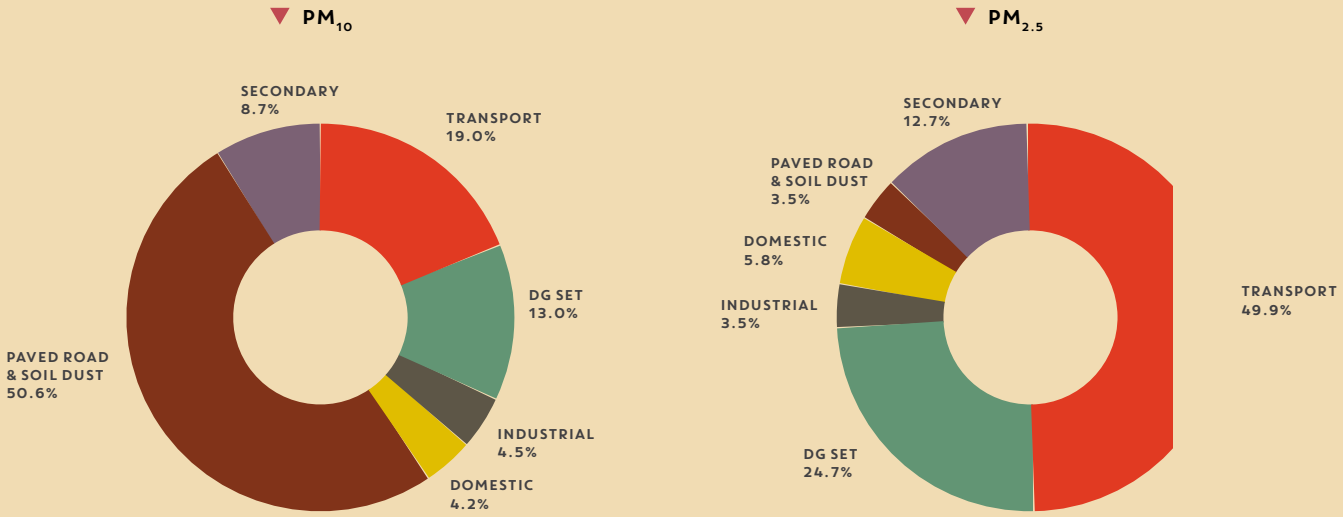
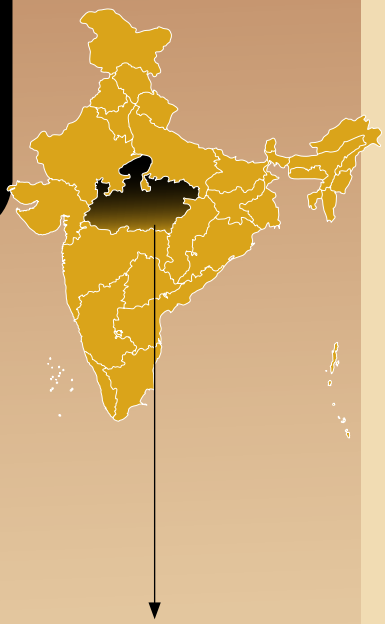


FIGURE: COMPARISON OF PM_{10} AND $PM_{2.5}$ SOURCE CONTRIBUTION IN BANGALORE CITY (AVERAGE OF 3 SEASONS)

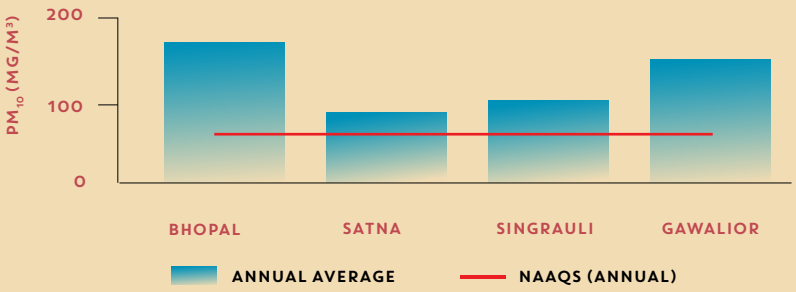




VEHICULAR EMISSIONS, AIR BORN DUST AND INDUSTRIAL EMISSIONS ARE MAJOR EMISSION LOAD CONTRIBUTORS TO PM_{10} IN INDORE

The assessment of Air Pollution levels for cities in Madhya Pradesh highlighted that PM_{10} concentrations in all 4 cities where the data was available from pollution control board were higher than the annual average of 60 µg/m³ as prescribed under NAAQS. PM_{10} concentrations in Bhopal, Satna, Singrauli and Gawalior were respectively 158, 88, 93 and 128 µg/m³ for 2015.

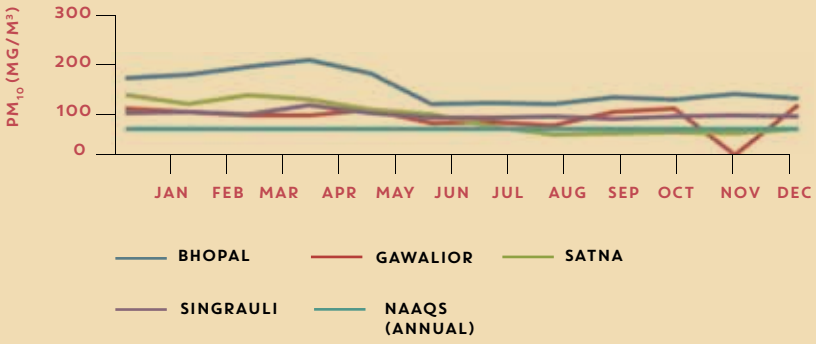
▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN MADHYA PRADESH DURING 2015



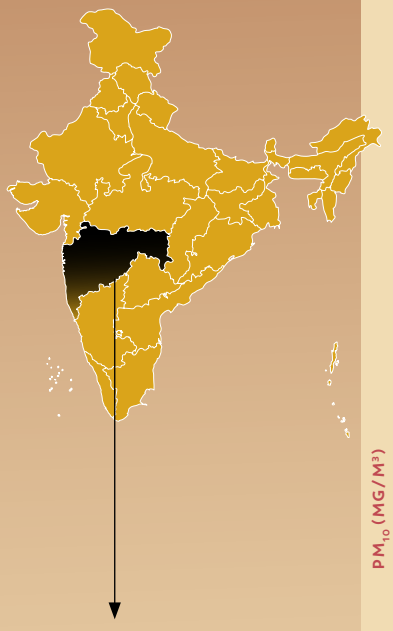
The data suggests that the PM_{10} levels have been hazardous and very high all around the year for 2015 for all the cities, with January to May being the most severely polluted months. Highest recorded monthly average PM_{10} concentration exceeded 200 µg/m³ for Gwalior, in April.

The average PM_{10} levels in Indore between September 2009 and June 2010 were 195 µg/m³ according to a study by MPPCB that also mentioned vehicular emissions, airborne dust, and industrial emissions as major emission load contributors to PM_{10} in Indore by MPPCB[12], in Comprehensive Environment Pollution Abatement action Plan for Critically Polluted area Indore.

▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN MADHYA PRADESH DURING 2015



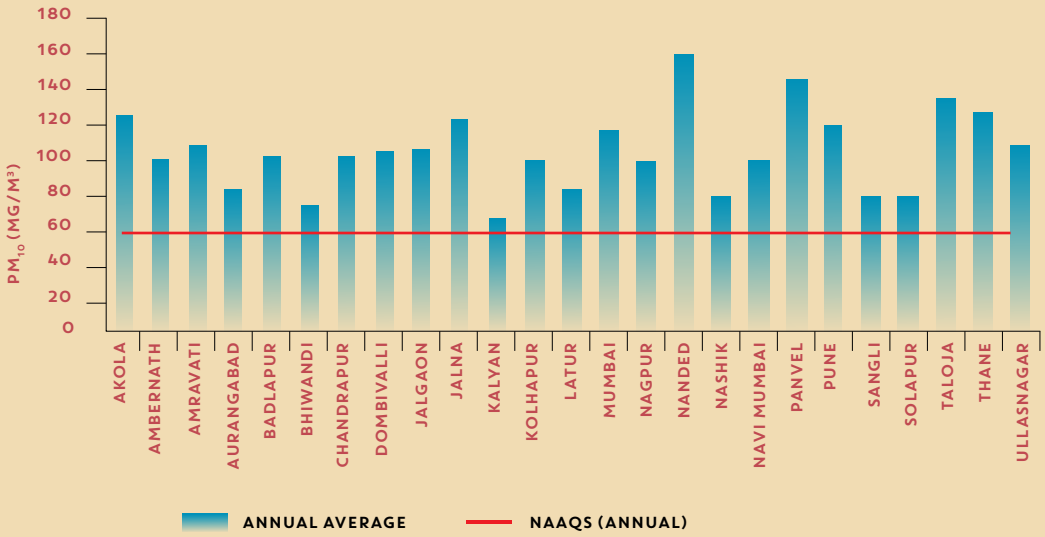
[12] *Madhya Pradesh Pollution Control Board, "Comprehensive Environment Pollution Abatment action Plan for Critically Polluted area Indore", http://cpcb.nic.in/divisionsofheadoffice/ess/F-Indore.pdf*



IN MUMBAI, THE MAIN CONTRIBUTORS FOR PM, LIKE POWER PLANT, OPEN BURNING, COMMERCIAL FOOD SECTOR, AND ROAD TRANSPORT

The assessment of Air Pollution levels for cities in Maharashtra highlighted that PM_{10} concentrations in every single one of the 25 cities where the data was available from pollution control board were higher than the annual average of 60 µg/m³ as prescribed under NAAQS. PM_{10} concentrations in Nanded, Taloja, Akola, Jalna, Thane, Mumbai and Chandrapur were respectively 162, 126, 128, 118, 118, 107 and 103 µg/m³ for year 2015.

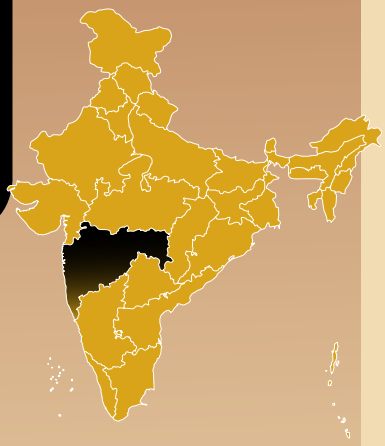
▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN MAHARASHTRA DURING 2015



Detailed observation of the data suggests that the PM_{10} levels were hazardous and very high all around the year for 2015 for all the cities except for the monsoon months. October to January were the most severely polluted months, with average PM_{10} concentrations even exceeding 150 µg/m³.

Maji et al., 2016[13] mentioned, "In Mumbai, different combustion processes are the main contributors for PM, like power plant, open burning, commercial food sector, and road transport, and they contribute 37, 24, 18, and 10%, respectively. A study by National Environmental Engineering Research Institute (NEERI) found that open burning and landfill fires of municipal solid waste (MSW) were a major source of air pollution in Mumbai (CPCB, 2010[14]). The survey results show that about 2% of total generated MSW is burnt on the streets and slum areas, 10% of the total generated MSW is burnt in landfills by management authorities or due to accidental landfill fires, thereby emitting large amounts of CO, PM, carcinogenic HC, and NO_x. In Chandrapur, primary sources of high critical pollutant concentration (i.e. SPM, PM_{10}, SO_2, and NO_2) are open coal mining, lime stone mining, fluoride mining, cement industry, thermal power plant, road dust, natural burning of coal, and domestic coal burning by local people for cooking (MPCB, 2010[15]). Within the city of Pune, highest shares of emissions of PM_{10} come from road dust (61%), vehicular sources (18%), industry (1.25%), vegetative burning, and solid fuels burning. For NO_2 emissions, major contributions are from vehicles (95%), industries (2%), and domestic and commercial fuel burning (3%) (ARAI, 2010[16]), due to absence of major industrial emitters within the city boundaries. Vehicles and industries contribute to high SO_2 emission loads due to fuel burning. Main cause of air pollution in Nashik city is due to plastic industry, food

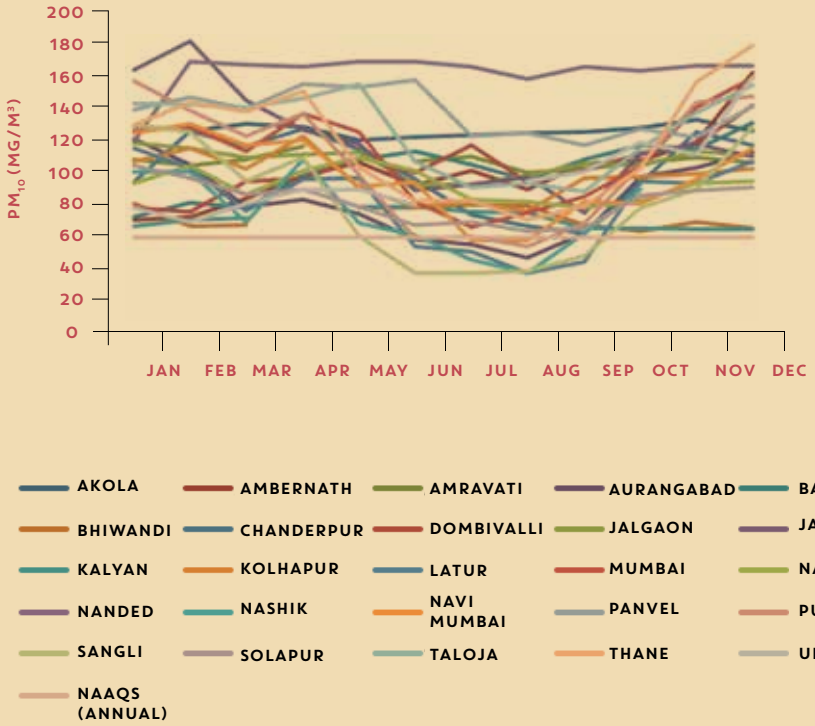
[13] Maji, et al., 2016, "Human health risk assessment due to air pollution in 10 urban cities in Maharashtra, India", Cogent Environmental Science, 2(1), 1193110, https://www.cogentoa.com/article/10.1080/23311843.2016. 1193110.pdf
[14] CPCB. (2010). Air quality assessment, emissions inventory and source apportionment studies: Mumbai [online]. Central Pollution Control Board. Retrieved November 23, 2014, from http://cpcb.nic.in/Mumbai-report.pdf
[15] MPCB. (2010). Action plane for industrial cluster: Chandrapur. Maharashtra Pollution Control Board. Retrieved February 14, 2015, from http://cpcb.nic.in/divisionsofheadoffice/ ess/Action%20plan%20CEPI-Chandrapur.pdf
[16] ARAI. (2010). Air quality monitoring and emission source apportionment study for city of Pune [online]. Pune: The Automotive Research Association of India, [ARAI/IOCLAQM/R-12/2009-10]. Retrieved March 21, 2015, from http://cpcb.nic.in/Pune.pdf



processing factories, and domestic waste burning. Till December 2013, there are 1.13 million registered vehicles in the city, constituting a major source of pollution (TI, 2014[17])".

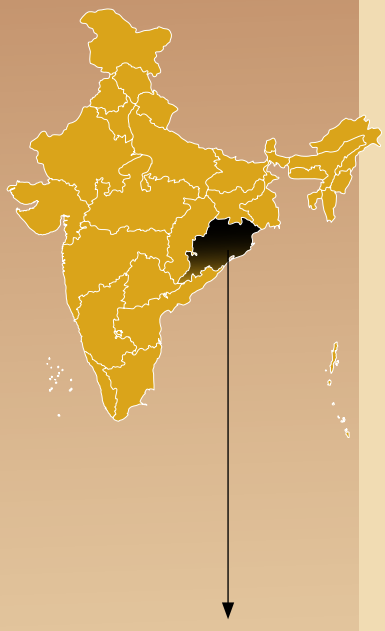
Similarly, Kothai et al., 2008[18] carried out a source apportionment study for Navi Mumbai and estimated that "percentage contribution of soil, two-stroke emission with fugitive dust, industrial emission, motor vehicles and sea salt to the average fine mass concentration was 3%, 18%, 23%, 29% and 9%, respectively"

▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN MAHARASHTRA DURING 2015



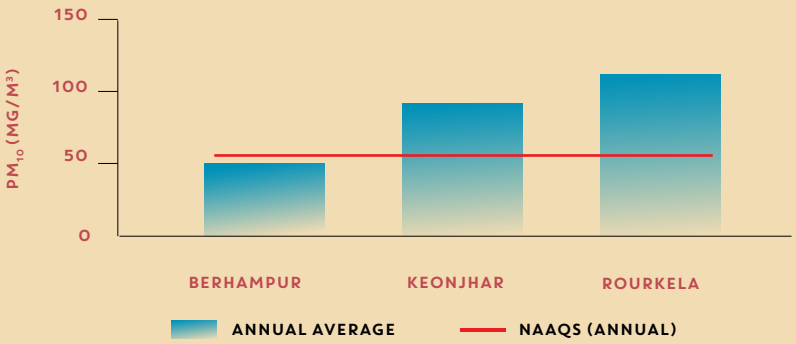
[17] TI. (2014). Vehicles in Nashik region rise by nearly 10% [online]. The Times of India. Retrieved January 23, 2015, from http://timesofindia.indiatimes.com/city/nashik/Vehicles-in-Nashik-region-rise-by-nearly-10/articleshow/29924015.cms Tominz, R., Mazzoleni, B., & Daris, F.

[18] Kothai, et al., 2008, "Source Apportionment of Coarse and Fine Particulate Matter at Navi Mumbai, India", Aerosol and Air Quality Research, Vol. 8, No. 4, pp. 423-436, http://aaqr.org/VOL8_No4_December2008/5_AAQR-08-07-OA-0027_423-436.pdf



The assessment of Air Pollution levels for cities in Odisha highlighted that PM_{10} concentrations in Keonjhar and Rourkela were higher than the annual average of 60 µg/m^3 as prescribed under NAAQS. PM_{10} concentrations in Berhampur were found to be below the NAAQS for year 2015.

▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN ODISHA DURING 2015

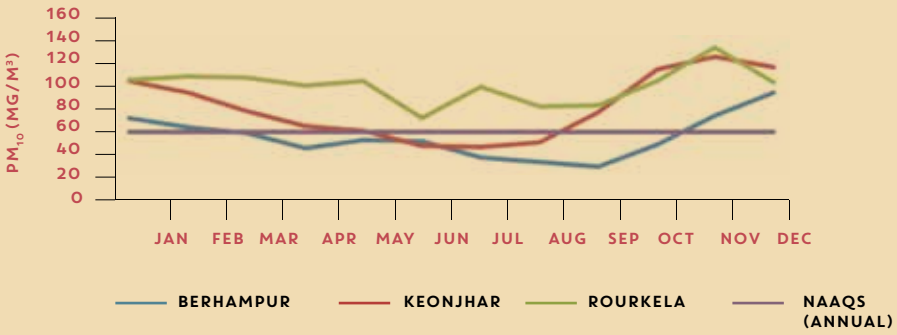


Detailed observation of the data suggests that the PM_{10} levels have been very high all around the year for 2015 at Rourkela whereas for Keonjhar and Berhampur the pollution levels were higher in months of September to January.

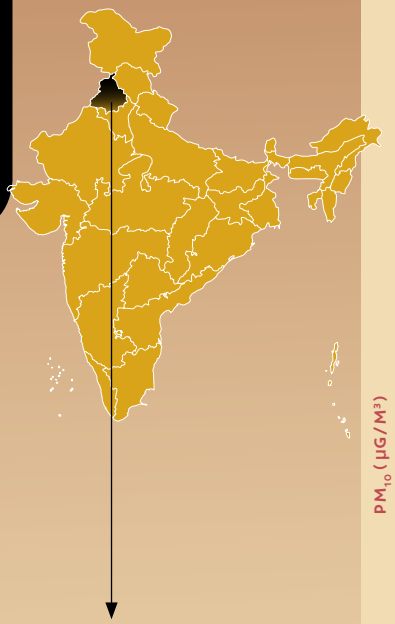
SPCB Odisha, 2010[19] carried out a study to understand the emission loading and pollution contribution in Angul-Talcher area and found out that the average PM_{10} levels were between 85-110 and, "The major industries contributing to air pollution are thermal power plants of NALCO and NTPC and Smelter of NALCO besides sponge iron plants like BRG Iron & Steel and Bhusan Steel Ltd. Apart from the above sources the fugitive emissions from the burning of wood and coal as domestic fuel, transportation of vehicles and emissions from the mines also contribute to air pollution in the area."

SPCB ORISSA, 2010 CARRIED OUT A STUDY TO UNDERSTAND THE EMISSION LOADING AND POLLUTION CONTRIBUTION IN ANGUL-TALCHER AREA AND FOUND OUT THAT THE AVERAGE PM_{10} LEVELS WERE BETWEEN 85-110

▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN ORISSA DURING 2015

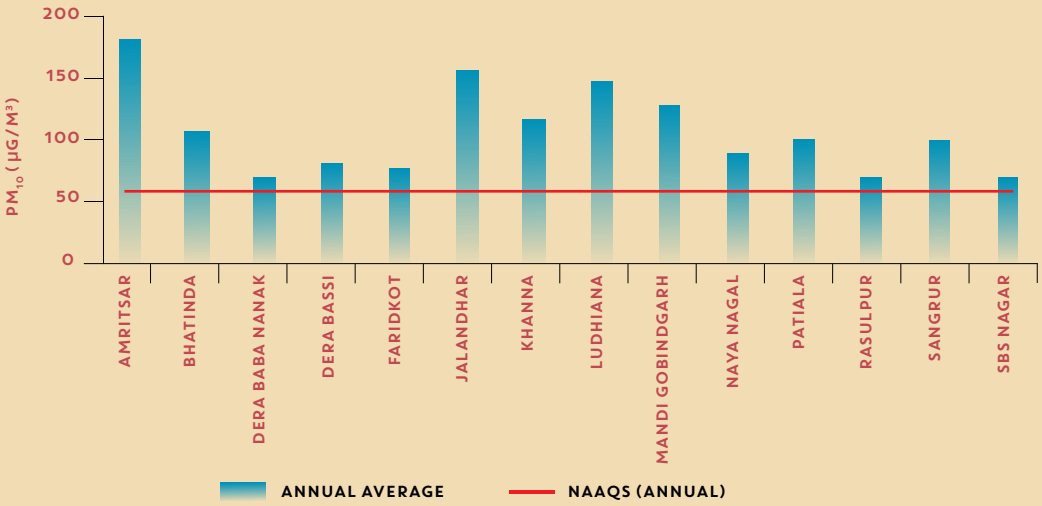


[19] *SPCB Orissa, 2010, "Action plan for abatement of pollution in critically polluted industrial clusters (Angul-Talcher area), http://cpcb.nic.in/divisionsofheadoffice/ess/Action%20Plan%20Angul-Talcher.pdf*



The assessment of Air Pollution levels for cities in Punjab highlighted that PM_{10} concentrations in all 14 cities where the data was available from pollution control board were higher than the annual average of 60 µg/m³ as prescribed under NAAQS. PM_{10} concentrations in Amritsar, Jalandhar, Ludhiana, Mandi Gobindgarh, Khanna and Bhatinda were respectively 184, 151, 139, 130, 122 and 111 µg/m³ for year 2015.

▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN PUNJAB DURING 2015



INDUSTRIAL COMBUSTION CONTRIBUTES 47% OF THE PM_{10} EMISSIONS FOLLOWED BY BRICK AND OPEN BURNING

Detailed observation of the data suggests that the PM_{10} levels were hazardous and very high all around the year for 2015 for all the cities with October to January being the severely polluted months. Highest monthly average PM_{10} levels, exceeding 200 µg/m³ were recorded in Jalandhar in December and in Amritsar in April-May.

"State wise emission assessment study (TERI, 2015[20]) shows sector-wise emissions for the Punjab state (Figure). Industrial combustion contributes 47% of the PM_{10} emissions followed by brick-making and open burning. Almost 56 % of NO_x emissions are contributed by transport sector in Punjab including both road transport and mode of transportation used during agricultural activities."

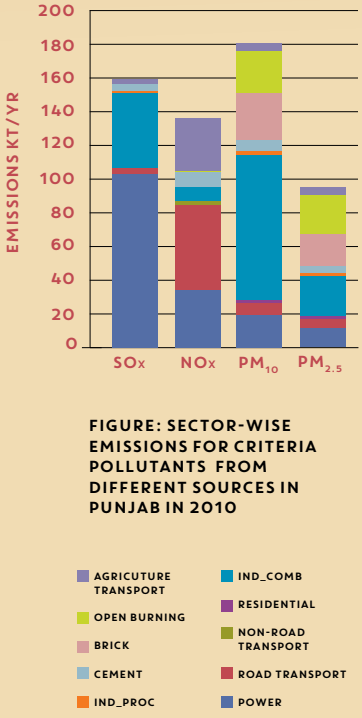
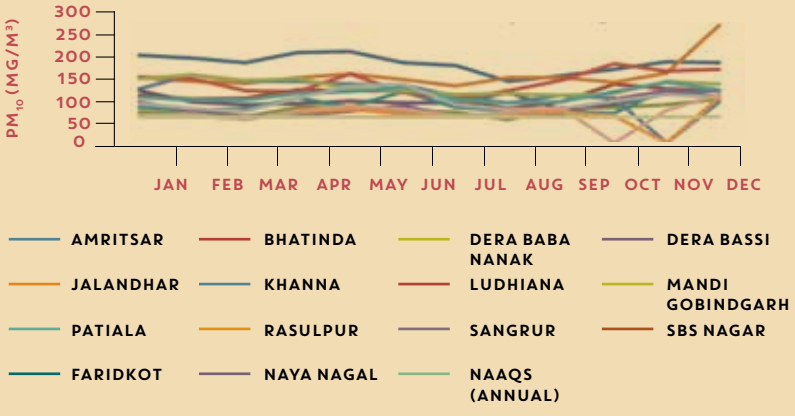
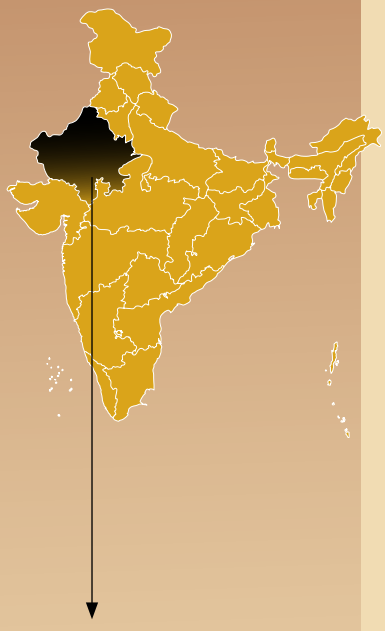


FIGURE: SECTOR-WISE EMISSIONS FOR CRITERIA POLLUTANTS FROM DIFFERENT SOURCES IN PUNJAB IN 2010

▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN PUNJAB DURING 2015



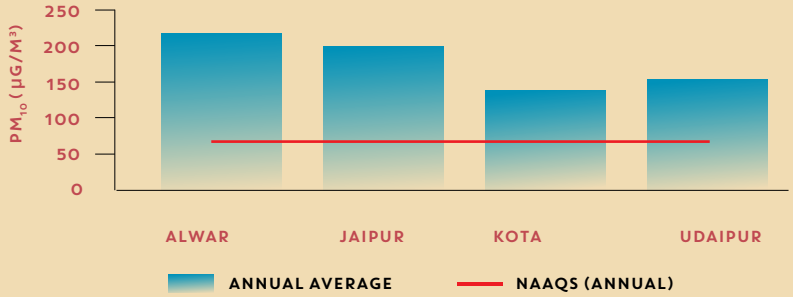
[20] *TERI, 2015. "Air pollution in Punjab", New Delhi: The Energy and Resources Institute. 16 pp., http://www.teriin.org/projects/green/pdf/Punjab-Air-quality.pdf*



PM_{10} CONCENTRATIONS IN ALWAR, JAIPUR, KOTA AND UDAIPUR WERE RESPECTIVELY 227, 209, 134 AND 156 µG/M_3 FOR YEAR 2015

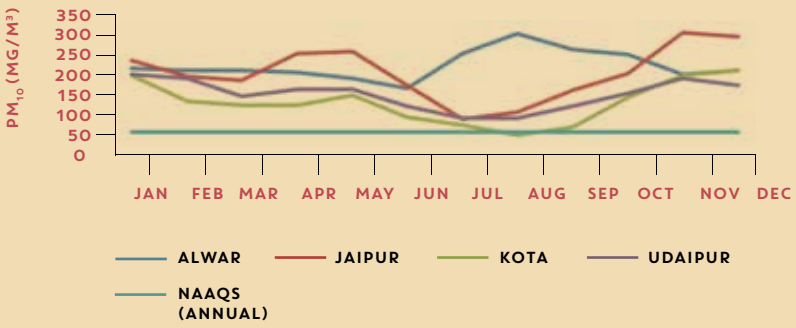
The assessment of Air Pollution levels for cities in Rajasthan highlighted that PM_{10} concentrations in 4 cities where the data was available from pollution control board were higher than the annual average of 60 µg/m^3 as prescribed under NAAQS. PM_{10} concentrations in Alwar, Jaipur, Kota and Udaipur were respectively 227, 171, 134 and 156 µg/m^3 for year 2015.

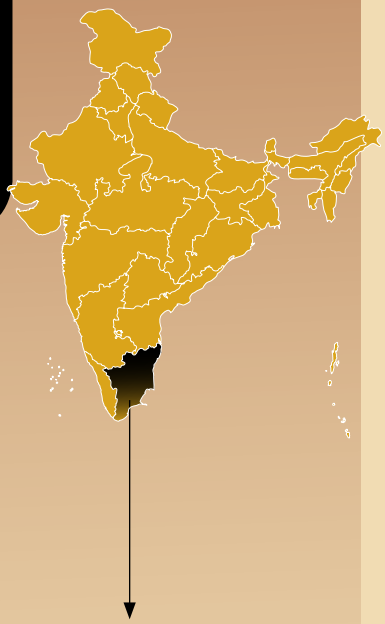
▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN RAJASTHAN DURING 2015**



Detailed observation of the data suggests that the PM_{10} levels were hazardous and very high all around the year for 2015 for all the cities, with the pollution moderating somewhat in most cities in the summer months. October to January were the most severely polluted months, with PM_{10} concentrations reaching above200 µg/m^3.

▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN RAJASTHAN DURING 2015**

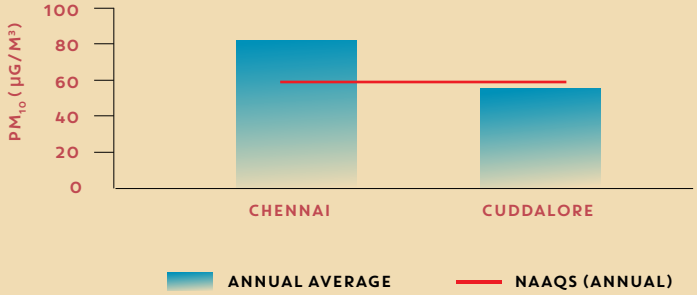




INDUSTRIAL COMBUSTION CONTRIBUTES 47% OF THE PM_{10} EMISSIONS FOLLOWED BY BRICK AND OPEN BURNING

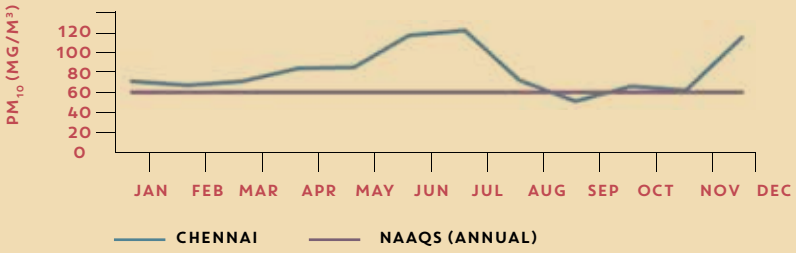
The assessment of Air Pollution levels for cities in Tamilnadu highlighted that PM_{10} concentrations in Chennai were higher than the annual average of 60 µg/m^3 as prescribed under NAAQS. Detailed observation of the data suggests that the PM_{10} levels has been high all around the year for 2015 for Chennai.

PM_{10} CONCENTRATIONS ACROSS CITIES IN TAMIL NADU DURING 2015

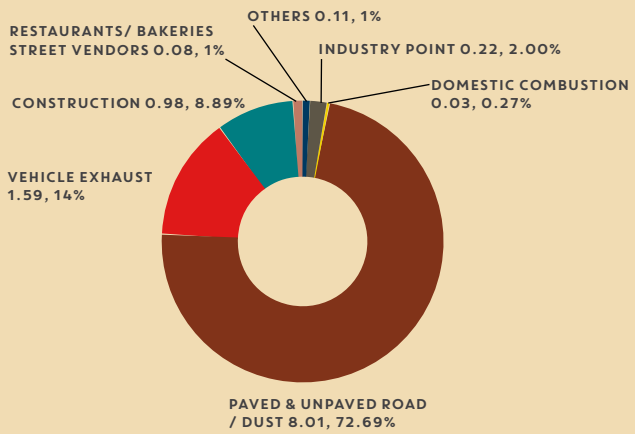


No source apportionment studies were available for Tamil Nadu. Within the city of Chennai, CPCB, 2011[21] highlighted that the share of vehicular exhaust emissions was 14%, industrial sector 2%, DG sets less than 1%, construction activities approx. 9% of total PM_{10} emission load with nearly 72% contribution from fugitive dust emissions.

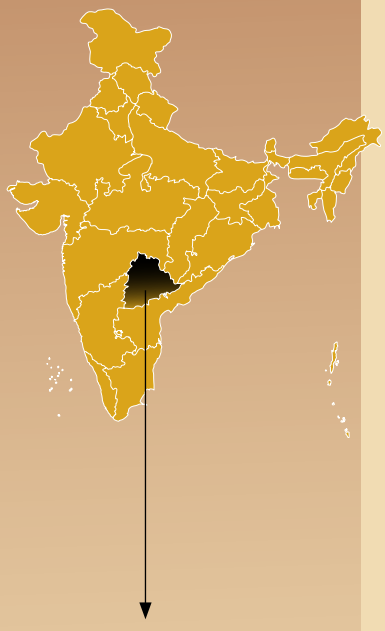
PM_{10} CONCENTRATIONS ACROSS CITIES IN TAMIL NADU DURING 2015



EMISSION INVENTORY PM_{10} CHENNAI



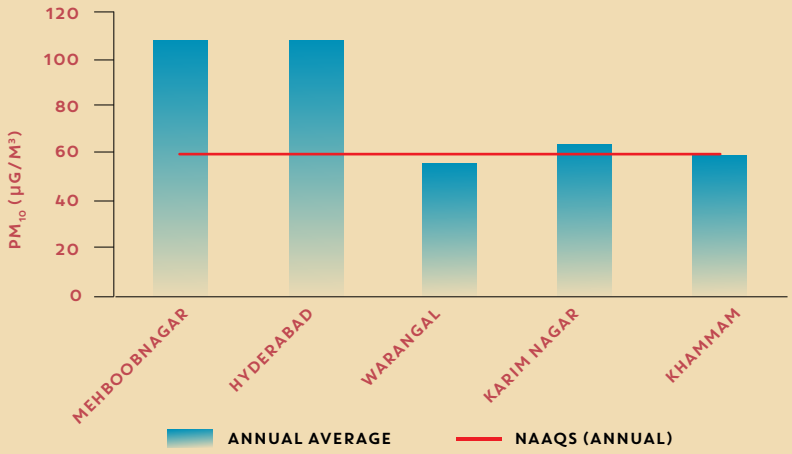
[21] CPCB, 2011, "Air quality monitoring, emission inventory and source apportionment study for Indian cities: National Summary Report", http://www.moef.nic.in/downloads/public-information/Rpt-air-monitoring-17-01-2011.pdf



"RESULTS OF CMB MODEL SHOWED THAT MAJOR SOURCE THROUGHOUT THE STUDY PERIOD WERE RESUSPENDED DUST (40%) FOR PM_{10} AND 31% FOR $PM_{2.5}$"

The assessment of Air Pollution levels for cities in Telangana highlighted that PM_{10} concentrations in 4 cities where the data was available from pollution control board were higher than the annual average of 60 µg/m^3 as prescribed under NAAQS. PM_{10} concentrations in Mahboobnagar, Hyderabad, Karim Nagar and Khammam were respectively 108, 99, 65 and 60 µg/m^3 for year 2015.

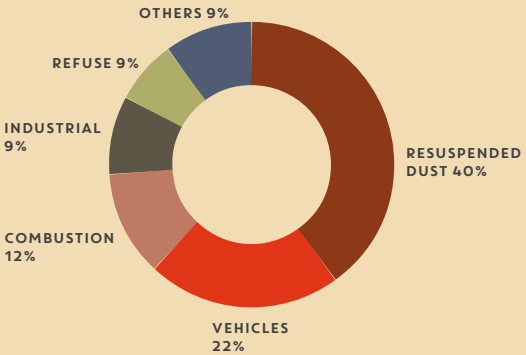
▼ PM_{10} CCONCENTRATIONS ACROSS CITIES IN TELANGANA DURING 2015



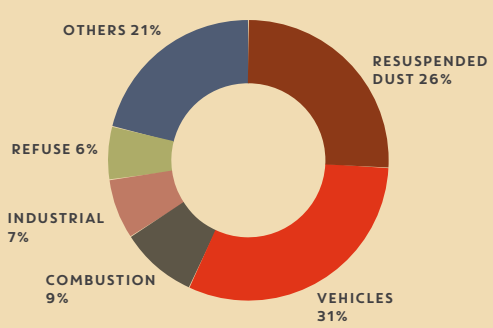
Gummeneni, et al., 2011[22] conducted a source apportionment study for Hyderabad and concluded as, "Results of CMB Model showed that major source throughout the study period were re-suspended dust (40%) for PM_{10} and 31% for $PM_{2.5}$. Vehicles has also contributed significant influence on particulate matter levels at the site for both PM_{10} (22%) and $PM_{2.5}$ (31%). Other major identified sources of particulate matter were industrial emissions, combustion and refuse burning.

▼ FIGURE: SOURCE CONTRIBUTION TO PM_{10} AND $PM_{2.5}$

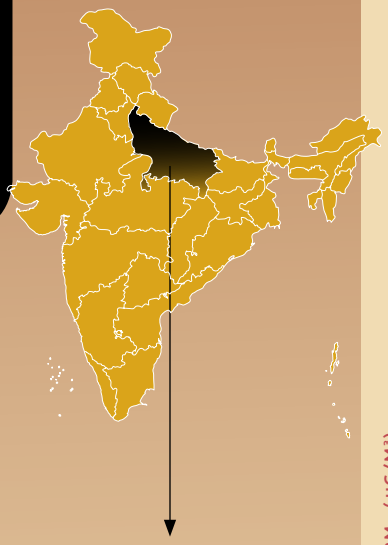
▼ PM_{10}



▼ $PM_{2.5}$



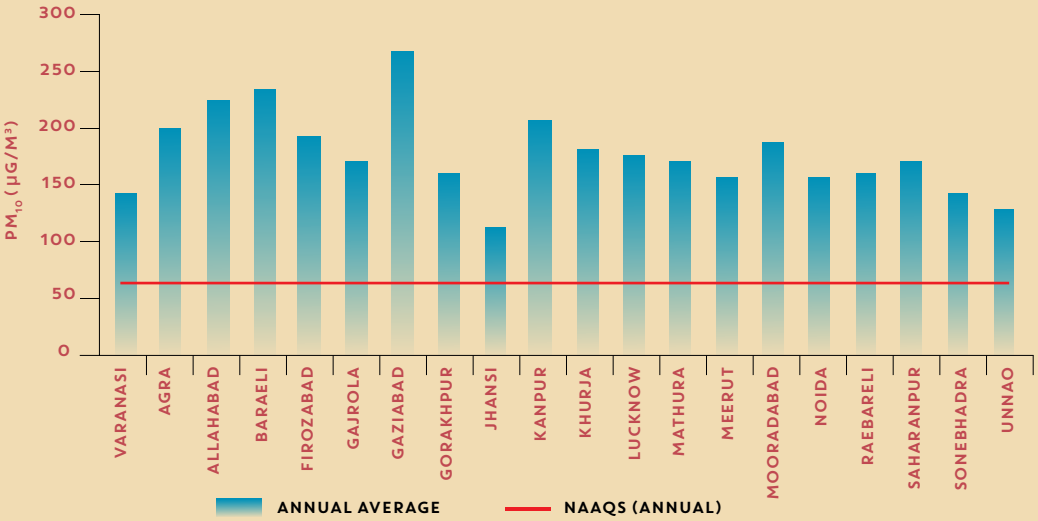
[22] *Gummeneni, S., et al., Source apportionment of particulate matter in the ambient air of Hyderabad city, India, Atmos. Res. (2011), doi:10.1016/j.atmosres.2011.05.002*



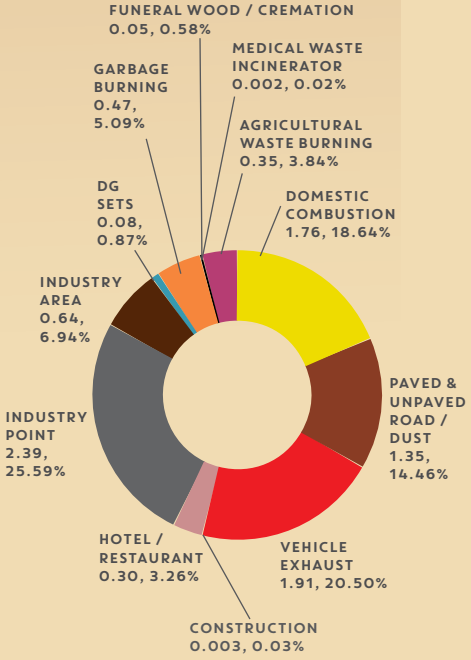
IN KANPUR FOR NO_x EMISSIONS "NEARLY 50% OF EMISSIONS ARE ATTRIBUTED TO VEHICLES THAT OCCUR AT GROUND LEVEL"

The assessment of Air Pollution levels for cities in Uttar Pradesh highlighted that PM_{10} concentrations in all 20 cities[23] where the data was available from pollution control board were higher than the annual average of 60 µg/m³ as prescribed under NAAQS. PM_{10} concentrations in Gaziabad, Braeli, Allahabad, Kanpur, Agra, Lucknow, Varanasi[24] (Average of PM_{10} levels from October 2015 to September 2016 is 228 µg/m³ for Varanasi) and Sonebhadra were respectively 258, 240, 250, 201, 186, 169, 145 and 132 µg/m³ for year 2015.

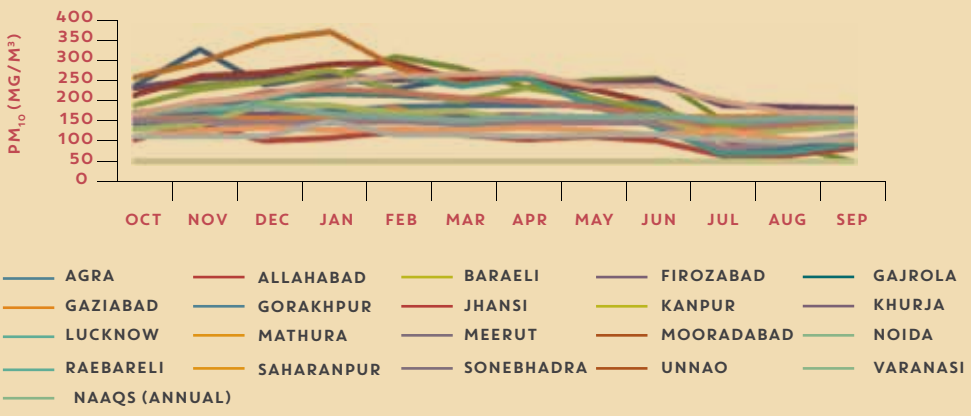
▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN UTTAR PRADESH DURING 2015



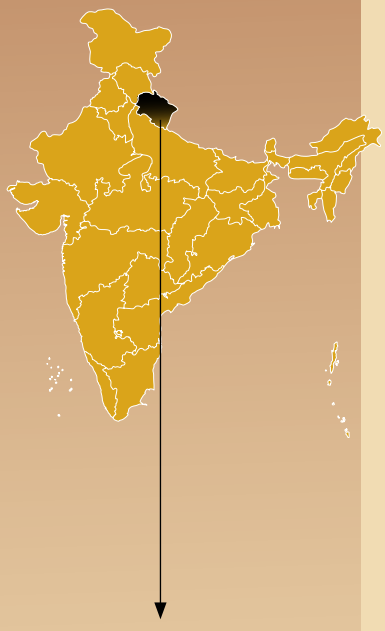
Detailed observation of the data suggests that the PM_{10} levels has been hazardous and very high all around the year for from October 2015 to September 2016 for all the cities, with October to February being the severely polluted months when the PM_{10} concentrations even reached near to 400 µg/m³. Sharma, 2010[25] carried out a source apportionment study for Kanpur and concluded as, "There are several important sources of PM_{10} in the city including industrial point sources (26%), industry area source (7 %), vehicles (21%), domestic fuel burning (19%) paved and unpaved road (15%), garbage burning (5%) and rest others." For NO_x emissions "nearly 50% of emissions are attributed to vehicles that occur at ground level, probably making it the most important pollutant. Vehicle sources are followed by industrial point and area sources (42%), DG sets (5%) and domestic sources and rest others (3%)".



▼ PM_{10} CONCENTRATIONS ACROSS CITIES IN UTTAR PRADESH DURING OCTOBER 2015 - SEPTEMBER 2016



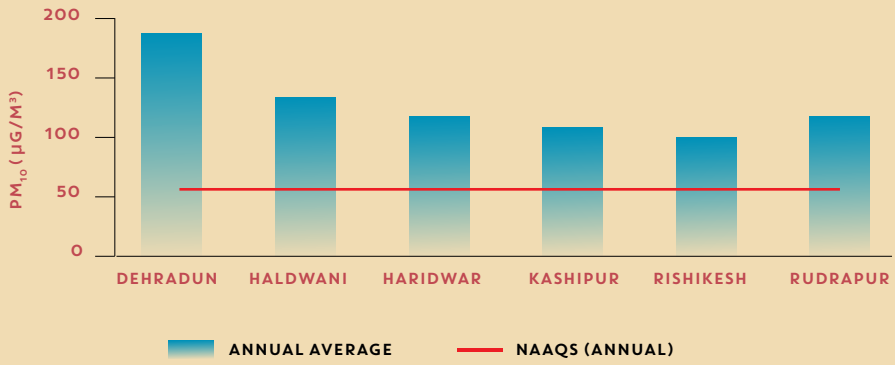
[23, 24, 25] *Footnotes on page 25*



FOR ALL THE CITIES WITH OCTOBER TO FEBRUARY BEING THE SEVERELY POLLUTED MONTHS WHEN THE PM_{10} CONCENTRATIONS REACHED NEAR TO 200 µG/M_3

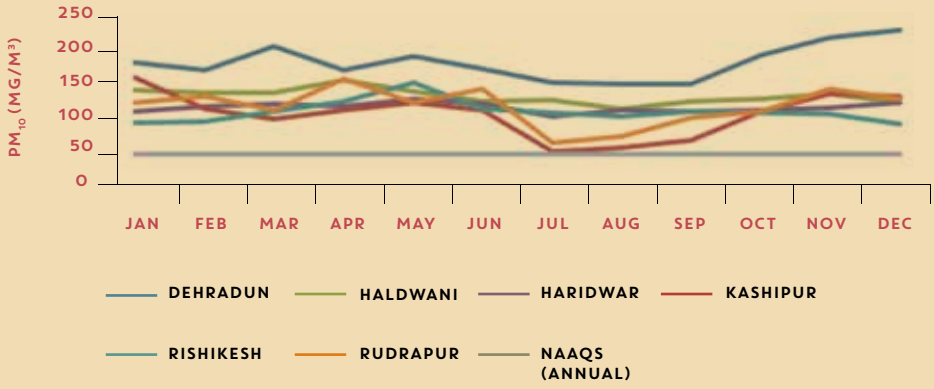
The assessment of Air Pollution levels for cities in Uttarakhand highlighted that PM_{10} concentrations in all 6 cities where the data was available from pollution control board were higher than the annual average of 60 µg/m³ as prescribed under NAAQS. PM_{10} concentrations in Deharadun, Haldwani, Haridwar, Kashipur, Rishikesh and Rudrapur were respectively 186, 139, 123, 107, 121 and 124 µg/m³ for year 2015.

▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN UTTARAKHAND DURING 2015**



Detailed observation of the data suggests that the PM_{10} levels has been hazardous and very high all around the year for from October 2015 to September 2016 for all the cities with October to February being the severely polluted months when the PM_{10} concentrations even reached near to 200 µg/m³.

▼ **PM_{10} CONCENTRATIONS ACROSS CITIES IN UTTRAKHAND DURING 2015**



Page 24 footnotes

[23] Data for Firozabad is from August 2014 to July 2015
[24] Average PM_{10} concentration from October 2015 to September 2016 is 228 µg/m³. whereas for 2015 calendar year it was shown to be 145 µg/m³ by the UPPCB data collected through RTI.
[25] Sharma, 2010, "Air Quality Assessment, Emissions Inventory and Source Apportionment Studies for Kanpur City", IIt Kanpur, Submitted to CPCB, http://cpcb.nic.in/Kanpur.pdf

GOVERNMENT INITIATIVE

It requires a system approach to understand pollution levels regularly and take action. The first step in the direction is having a robust monitoring of air quality across the country to know information in real time and using the data to arrive at strategies that would protect public health and reduce pollution levels. The strategies to reduce pollution should become an action plan which is time bound and has targets and penalties.

ACTION PLAN

Governments of India should adopt time-bound national and regional action plans, which have clear targets for regions and penalties for non-compliance. This should include providing transparent data to the public on air quality, short term and long term measures to reduce air pollution.

TRANSPARENT DATA

Improving NAQI monitoring systems and providing access to data to the public on a real time basis for the whole country. This should be coupled with a health advisory which would enable the public to take decisions to protect their health and the environment.

SHORT TERM MEASURES

Issuing red alert and health advisories during bad air-days, shutting down schools, taking polluting vehicles (odd/even) off the roads, shutting down power plants and industries etc.

LONG TERM MEASURES

Improving public transport, limiting the number of polluting vehicles on the road , Introducing less polluting fuel (Bharat VI), Strict emission regulations and improved efficiency for thermal power plants and industries, moving from diesel generators to rooftop solar, increased use of clean renewable energy, Electric vehicles, Removing dust from roads, regulating construction activities, stopping biomass burning etc.

PEOPLE INITIATIVE

Public participation is critical in reducing air pollution. Our choices for electricity and transportation could play a major role in managing pollution levels in many parts of the country. Efforts should be made in key areas such as:

1. MOVING TOWARDS ROOF TOP SOLAR
2. INCREASED USAGE OF PUBLIC TRANSPORT, CYCLING AND WALKING
3. USING ENERGY EFFICIENT APPLIANCES AND REDUCING HOUSEHOLD ENERGY USAGE
4. WASTE MINIMIZATION, SEGREGATION AND RECYCLING, WHICH WILL REDUCE BURNING OF WASTE IN STREETS AS WELL AS AT THE LANDFILLS ALONG WITH ENERGY REDUCTIONS IN TRANSPORTING HUGE QUANTITIES OF WASTE

COMPARISON OF FACTS ON AIR POLLUTION IN THE WORLD'S FOUR MAJOR ECONOMIES[26]

	CHINA	INDIA	U.S.	EU
Change in satellite-based $PM_{2.5}$ levels from 2010 to 2015	-17%	+13%	-15%	-20% (from 2005 to 2013)
$PM_{2.5}$ trend	Falling since 2011; 2015 was the best on record	Increasing steadily for past 10 years; 2015 was the worst year on record	Falling since measurements started	Falling since measurements started
$PM_{2.5}$ in capital city, annual ($\mu g/m^3$)	81	128	12	18
$PM_{2.5}$ air quality standard, annual ($\mu g/m^3$)	35	40	15	25 (from 2020, 20)
Deaths per day from air pollution in 2013	2,700	1,800	250	640
Online $PM_{2.5}$ monitoring	1,500 stations in 900 cities & towns	39 stations in 23 cities (as of Feb 2016)	770 stations in 540 cities & towns	1,000 stations in 400 cities & towns
Share of thermal power plants with basic pollution controls (desulphu-rization, particle controls)	95%	10%	60%	75%
Deadline for meeting national air quality standards	2030; most key cities have an interim target for 2017	None	2012; violating areas are currently implementing new plans	25 by 2015 20 by 2020
Consequences for missing targets	Promotion of province governors depends on meeting targets	None	States must adopt emission reduction measures into law that are demonstrated to enable meeting targets; must account for pollution transport into downwind states; periodic review	Cities & countries face legal action for not meeting standards
Coverage of government measures	National, regional and city-level action plans with measurable 5-year targets National emission standards for power plants, industrial sectors and vehicles	Mainly action in individual cities with no measurable targets Recently introduced India-wide emission standards for thermal power plants; Introduction of Bharat VI vehicle emission norms is proposed by April 2020	National air quality targets; implementation plans approved on federal level and executed on state level National emission standards for power plants, industrial sectors and vehicles	"Clean Air For Europe" action plan Europe-wide emission standards for power plants, industry and cars Most countries and key cities have own plans

[26] *http://www.greenpeace.org/eastasia/Global/eastasia/publications/reports/climate-energy/2016/Clean%20Air%20Action%20Plan,%20The%20way%20forward.pdf*

APPENDIX-I PM_{10} LEVELS ACROSS INDIA (ANNUAL AVERAGE 2015[27])

CITY	STATE	ANNUAL AVERAGE	NAAQS (ANNUAL)	TIME FRAME	REFERENCE SOURCE[28]
Delhi	Delhi	268	60	2015	26
Gaziabad	Uttar Pradesh	258	60	2015	26
Allahabad	Uttar Pradesh	250	60	2015	22
Braeli	Uttar Pradesh	240	60	2015	22
Faridabad	Haryana	240	60	2015	26
Jharia	Jharkhand	228	60	2015	26
Alwar	Rajasthan	227	60	2015	26
Ranchi	Jharkhand	216	60	2015	26
Kusunda	Jharkhand	214	60	2015	26
Bastacola	Jharkhand	211	60	2015	26
Kanpur	Uttar Pradesh	201	60	2015	26
Patna	Bihar	200	60	2015	26
Firozabad	Uttar Pradesh	194	60	2015	22
Agra	Uttar Pradesh	186	60	2015	22
Deharadun	Uttrakhand	186	60	2015	23
Amritsar	Punjab	184	60	2015	16
Gajrola	Uttar Pradesh	177	60	2015	22
Jaipur	Rajasthan	171	60	2015	18
Lucknow	Uttar Pradesh	169	60	2015	22
Dhanbad	Jharkhand	168	60	2015	7
Mooradabad	Uttar Pradesh	168	60	2015	22
Saharanpur	Uttar Pradesh	168	60	2015	26
Khurja	Uttar Pradesh	167	60	2015	26
Muzzafarpur	Bihar	164	60	2015	26
Nanded	Maharashtra	162	60	2015	11
Gorakhpur	Uttar Pradesh	162	60	2015	26

[27] *For few Cities where annual averages for 2015 were not easily available, lates data as well as for Gwalior data from 2014-2015 is included*
[28] *Provided on after the current table*

CITY	STATE	ANNUAL AVERAGE	NAAQS (ANNUAL)	TIME FRAME	REFERENCE SOURCE[28]
Mathura	Uttar Pradesh	162	60	2015	26
Bhopal	Madhya Pradesh	158	60	2015	10
Raebareli	Uttar Pradesh	157	60	2015	26
Udaipur	Rajasthan	156	60	2015	26
Jodhpur	Rajasthan	152	60	2015	18
Jalandhar	Punjab	151	60	2015	17
Noida	Uttar Pradesh	148	60	2015	26
Meerut	Uttar Pradesh	146	60	2015	26
Siltara	Chhattisgarh	145	60	April 2015 - March 2016	26
Varanasi	Uttar Pradesh	145	60	2015	26
Ludhiana	Punjab	139	60	2015	17
Haldwani	Uttrakhand	139	60	2015	23
Raipur	Chhattisgarh	138	60	April 2015 - March 2016	26
Nagaon	Assam	137	60	2015	2
Panvel	Maharashtra	137	60	2015	11
Anpara	Uttar Pradesh	136	60	2015	22
Talcher	Odisha	135	60	2015	15
Jamshedpur	Jharkhand	134	60	2015	26
Kota	Rajasthan	134	60	2015	26
Sonbhadar	Uttar Pradesh	132	60	2015	26
Mandi Gobindgarh	Punjab	130	60	2015	16
Gurgaon	Haryana	129	60	2015	26
Akola	Maharashtra	128	60	2015	12
Gawalior	Madhya Pradesh	128	60	August 2014 - July 2015	26
Taloja	Maharashtra	126	60	2015	11
Jammu	Jammu & Kashmir	125	60	2015	6

APPENDIX-I PM_{10} LEVELS ACROSS INDIA (ANNUAL AVERAGE 2015[27])

CITY	STATE	ANNUAL AVERAGE	NAAQS (ANNUAL)	TIME FRAME	REFERENCE SOURCE[28]
Navi Mumbai	Maharashtra	125	60	2015	12
Rudrapur	Uttrakhand	124	60	2015	23
Haridwar	Uttrakhand	123	60	2015	23
Girdih	Jharkhand	123	60	2015	26
Byrnihat	Meghalaya	122	60	2015	13
Dimapur	Nagaland	122	60	2015	14
Khanna	Punjab	122	60	2015	16
Rishikesh	Uttrakhand	121	60	2015	24
Nalbari	Assam	120	60	2015	2
Bangalore	Karnataka	119	60	2015	8
Jhansi	Uttar Pradesh	119	60	2015	22
Kala Amb	Himachal Pradesh	118	60	2015	5
Tumku	Karnataka	118	60	April 2015 - March 2016	9
Jalna	Maharashtra	118	60	2015	11
Thane	Maharashtra	118	60	2015	11
Unnao	Uttar Pradesh	118	60	2015	26
Ponta Sahib	Himachal Pradesh	117	60	2015	5
Hazaribagh	Jharkhand	112	60	2015	26
Bhatinda	Punjab	111	60	2015	16
Vijaywada	Andhra Pradesh	110	60	2015	1
Patiala	Punjab	110	60	2015	16
West Singhbhumi	Jharkhand	110	60	2015	26
Bhilai	Chhattisgarh	109	60	2015	3
Davanagere	Karnataka	109	60	2015	8
Amravati	Maharashtra	108	60	2015	12
Jalgaon	Maharashtra	108	60	2015	12
Mahboobnagar	Telangana	108	60	2015	21
Mumbai	Maharashtra	107	60	2015	12

CITY	STATE	ANNUAL AVERAGE	NAAQS (ANNUAL)	TIME FRAME	REFERENCE SOURCE[28]
Ullasnagar	Maharashtra	107	60	2015	12
Kashipur	Uttrakhand	107	60	2015	24
Damtal	Himachal Pradesh	105	60	2015	5
Badlapur	Maharashtra	105	60	2015	12
Kolkata	West Bengal	105	60	2015	25
Sagar	Madhya Pradesh	103	60	2015	10
Domdivali	Maharashtra	103	60	2015	11
Chandrapur	Maharashtra	103	60	2015	12
Angul	Odisha	102	60	2015	15
Baddi	Himachal Pradesh	101	60	2015	5
Ambernath	Maharashtra	101	60	2015	11
Rourkela	Odisha	100	60	2015	15
Guntur	Andhra Pradesh	100	60	2015	26
Sangrur	Punjab	98	60	2015	16
Guwahati	Assam	97	60	2015	2
Indore	Madhya Pradesh	97	60	2015	10
Kolhapur	Maharashtra	97	60	2015	11
Dera Bassi	Punjab	96	60	2015	17
Gulbarga	Karnataka	95	60	2015	8
Ujjain	Madhya Pradesh	93	60	2015	10
Kohima	Nagaland	93	60	2015	14
Hyderabad	Telangana	93	60	2015	21
Singrauli	Madhya Pradesh	93	60	2015	26
Panchkula	Haryana	92	60	2015	26
Rohtak	Haryana	92	60	2015	26
Tuticorin	Tamil Nadu	91	60	2015	19
Bhavnagar	Gujarat	91	60	April 2014 - March 2015	26

APPENDIX-I PM_{10} LEVELS ACROSS INDIA (ANNUAL AVERAGE 2015[27])

CITY	STATE	ANNUAL AVERAGE	NAAQS (ANNUAL)	TIME FRAME	REFERENCE SOURCE[28]
Dewas	Madhya Pradesh	90	60	2015	10
Nagpur	Maharashtra	90	60	2015	12
Faridkot	Punjab	90	60	2015	16
Surat	Gujarat	89	60	2015	4
Nalagarh	Himachal Pradesh	89	60	2015	5
Jamnagar	Gujarat	88	60	April 2014 - March 2015	26
Satna	Madhya Pradesh	88	60	2015	26
Raichur	Karnataka	87	60	April 2015 - March 2016	9
Vadodhra	Gujarat	86	60	April 2014 - March 2015	26
Rajkot	Gujarat	86	60	April 2014 - March 2015	26
Patencheru	Telangana	85	60	2015	21
Chandigarh	Chandigarh	85	60	2015	26
Keonjhar	Odisha	85	60	2015	26
Anantpuram	Andhra Pradesh	84	60	2015	26
Sunder Nagar	Himachal Pradesh	83	60	2015	5
Aurangabad	Maharashtra	83	60	2015	11
Naya Nangal	Punjab	83	60	2015	17
Kurnool	Andhra Pradesh	82	60	2015	1
Sangli	Maharashtra	82	60	2015	11
Balasore	Odisha	82	60	2015	15
Gandhi Nagar	Gujarat	82	60	April 2014 - March 2015	26
Bhubneshwar	Odisha	81	60	2015	15
Cuttak	Odisha	81	60	2015	15
Chennai	Tamil Nadu	81	60	2015	20
Hubli	Karnataka	80	60	April 2015 - March 2016	9

CITY	STATE	ANNUAL AVERAGE	NAAQS (ANNUAL)	TIME FRAME	REFERENCE SOURCE[28]
Latur	Maharashtra	78	60	2015	12
Nashik	Maharashtra	78	60	2015	12
Pune	Maharashtra	77	60	2015	12
Dera Baba Nanak	Punjab	77	60	2015	17
Nalgonda	Telangana	76	60	2015	21
Sindri	Jharkhand	75	60	2015	26
Solapur	Maharashtra	74	60	2015	12
SBS Nagar	Punjab	74	60	2015	16
Bhiwandi	Maharashtra	73	60	2015	11
Silchar	Assam	72	60	2015	2
Kalyan	Maharashtra	71	60	2015	11
Sibsagar	Assam	70	60	2015	2
Rasulpur	Punjab	70	60	2015	16
Dharwad	Karnataka	69	60	April 2015 - March 2016	9
Nellore	Andhra Pradesh	66	60	2015	1
Korba	Chhattisgarh	66	60	April 2015 - March 2016	26
Karim Nagar	Telangana	65	60	2015	21
Belguam	Karnataka	64	60	April 2015 - March 2016	9
Kolar	Karnataka	63	60	April 2015 - March 2016	9
Visakhapatnam	Andhra Pradesh	61	60	2015	1
Parwanoo	Himachal Pradesh	61	60	2015	5
Khammam	Telangana	60	60	2015	21
Bellary	Karnataka	57	60	April 2015 - March 2016	9
Bidar	Karnataka	57	60	April 2015 - March 2016	9
Chamrajnagar	Karnataka	57	60	April 2015 - March 2016	9

APPENDIX-I PM_{10} LEVELS ACROSS INDIA (ANNUAL AVERAGE 2015[27])

CITY	STATE	ANNUAL AVERAGE	NAAQS (ANNUAL)	TIME FRAME	REFERENCE SOURCE[28]
Warangal	Telangana	56	60	2015	21
Cuddalore	Tamil Nadu	56	60	2015	26
Berhampur	Odisha	55	60	2015	26
Chitradurga	Karnataka	46	60	April 2015 - March 2016	9
Mysore	Karnataka	46	60	April 2015 - March 2016	9
Ranebennur	Karnataka	46	60	April 2015 - March 2016	9
Karwar	Karnataka	40	60	April 2015 - March 2016	9
Mandya	Karnataka	40	60	April 2015 - March 2016	9
Bhadravathi	Karnataka	38	60	April 2015 - March 2016	9
Mangalore	Karnataka	35	60	April 2015 - March 2016	9
Hassan	Karnataka	25	60	April 2015 - March 2016	9

APPENDIX-II REFERENCE SOURCE

REFERENCE SOURCE	REFERENCE
1	http://cpcb.nic.in/Andhra_Pradesh_nonattainment.pdf
2	http://cpcb.nic.in/Assam_nonattainment.pdf
3	http://cpcb.nic.in/Chhattisgarh_nonattainment.pdf
4	http://cpcb.nic.in/Gujarat_nonattainment.pdf
5	http://cpcb.nic.in/HimachalPradesh_nonattainment.pdf
6	http://cpcb.nic.in/Jammu&Kashmir_nonattainment.pdf
7	http://cpcb.nic.in/Jharkhand_nonattainment.pdf
8	http://cpcb.nic.in/Karnataka_nonattainment.pdf
9	http://kspcb.kar.nic.in/AAQ-Karnataka-2015-16.pdf
10	http://cpcb.nic.in/MadhyaPradesh_nonattainment.pdf
11	http://mpcb.gov.in/envtdata/demoPage1.php
12	http://cpcb.nic.in/Maharashtra_nonattainment.pdf
13	http://cpcb.nic.in/Meghalaya_nonattainment.pdf
14	http://cpcb.nic.in/Nagaland_nonattainment.pdf
15	http://cpcb.nic.in/Odisha_nonattainment.pdf
16	http://www.ppcb.gov.in/Attachments/Environmental%20Data/4%20year%20Air%20oct%202016.pdf
17	http://cpcb.nic.in/Punjab_nonattainment.pdf
18	http://cpcb.nic.in/Rajasthan_nonattainment.pdf
19	http://cpcb.nic.in/TamilNadu_nonattainment.pdf
20	http://www.tnpcb.gov.in/pdf_2016/ambient_airquality_rpt-2015.pdf
21	http://tspcb.cgg.gov.in/Pages/Envdata.aspx
22	http://cpcb.nic.in/UttarPradesh_nonattainment.pdf
23	http://ueppcb.uk.gov.in/files/Ambient_Air_Quality_2015__(2).pdf
24	http://cpcb.nic.in/Uttarakhand_nonattainment.pdf
25	http://cpcb.nic.in/WestBengal_nonattainment.pdf
26	RTI Data

A ghostly ceremonial boulevard in New Delhi
Image: Subrata Biswas/ Greenpeace

GREENPEACE
ग्रीनपीस

Greenpeace is a global organisation that uses non-violent direct action to tackle the most crucial threats to our planet's biodiversity and environment. Greenpeace is a non-profit organisation, present in 40 countries across Europe, The Americas, Asia and the Pacific.

It speaks for 2.8 million supporters worldwide, and inspires many millions more to take action every day. To maintain its independence, Greenpeace does not accept donations from governments or corporations but relies on contributions from individual supporters and foundation grants.

Greenpeace has been campaigning against environmental degradation since 1971 when a small boat of volunteers and journalists sailed into Amchitka, an area north of Alaska, where the US Government was conducting underground nuclear tests.This tradition of 'bearing witness' in a non-violent manner continues today, and ships are an important part of all its campaign work.

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