INDIAN INSTITUTE OF TROPICAL METEOROLOGY, PUNE
Environmental Information, Awareness, Capacity Building and Livelihood Programme (EIACP) PC-RP
Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India

WINTER AIR POLLUTION

A WAKE-UP CALL FOR CLIMATE ACTION

Volumn: 23 Issuue 01 January - March 2024

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EDITORIAL

As winter fades, the latest analysis of India's air pollution crisis reminds us of the urgent need for action. The recent report on winter pollution highlights a concerning reality—air pollution is no longer just a problem for big cities like Delhi, but a growing crisis across the country.

The report shows that North and East India experienced the worst pollution levels this winter, with North India facing even worse air quality than the previous year. Meanwhile, East India saw some improvements, and South India maintained relatively better air quality. However, high pollution spikes were recorded everywhere, proving that poor air quality is not limited to a few regions. Surprisingly, smaller cities such as Begusarai in Bihar and Hanumangarh in Rajasthan recorded pollution levels similar to those of large metropolitan areas. Even industrial towns in the South and certain Himalayan regions faced severe air pollution.

On the brighter side, cities in the Northeast and Karnataka were among the least polluted, though occasional pollution spikes were still recorded. This data makes one thing clear—air pollution is a nationwide issue, not just a problem for a few urban centers. It's time for collective action to combat this crisis and work towards cleaner air for all.

WINTER AIR POLLUTION - A WAKE-UP CALL FOR CLIMATE ACTION

Source:https://www.researchgate.net/publication/380792379_End_of_winter_report_2023-24_Spread_and_scale_of_air_pollution_crisis_in_India

Indian winter season brings a chill and a significant spike in air pollution levels. The "End of Winter Report 2023-24," compiled by the Centre for Science and Environment (CSE), reveals this crisis's alarming spread and scale. This newsletter delves into key findings, the link between air pollution and climate change, and actionable steps we can take to ensure a cleaner and healthier future.

This winter, toxic air pollution worsened earlier than usual due to low rainfall and weak winds, with North and East India being the most polluted regions. Small cities like Begusarai and Hanumangarh recorded pollution levels comparable to Delhi, while South India had relatively clean air. Despite regional variations, high pollution episodes were common nationwide, highlighting the urgent need for transportation, industry, power plants, and waste management reforms to combat this pervasive issue.

Key Highlights of Winter Air Pollution 2023-24

Most Polluted Regions and Cities:

- **North India:** The most polluted region with PM2.5 levels averaging 89.9 $\mu g/m^3$. Delhi and Begusarai topped the list of worst-affected cities.
- **East India:** While pollution levels improved by 29% compared to the previous winter, cities like Begusarai and Bhagalpur face severe challenges.
- **South India:** The cleanest region, with cities averaging PM2.5 levels of 36.2 $\mu g/m^3$.

Unexpected Hotspots:

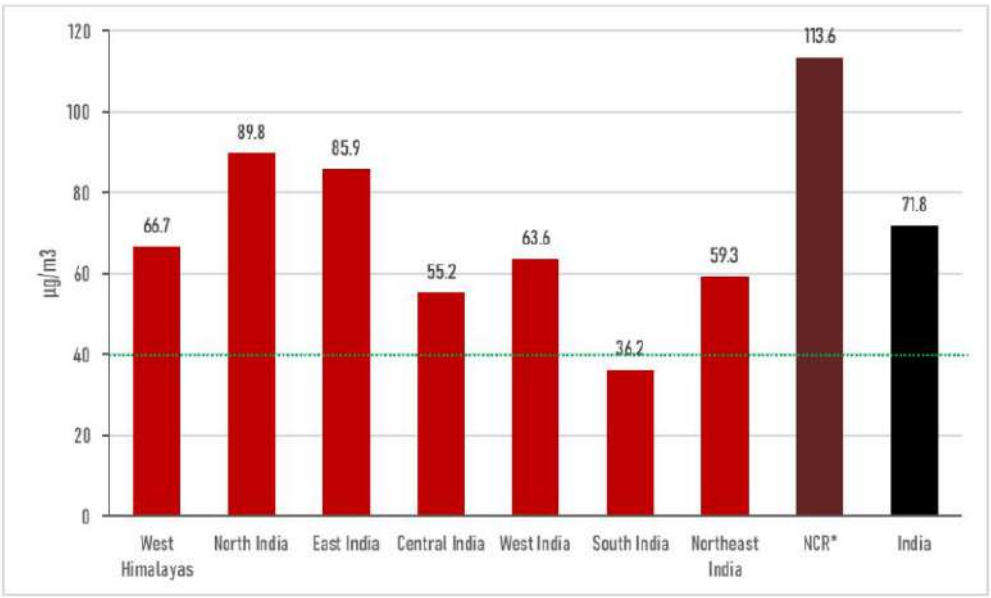
- Smaller towns such as Hanumangarh (Rajasthan) and Begusarai (Bihar) recorded pollution levels comparable to Delhi, highlighting that air pollution is not confined to megacities.

Seasonal and Festive Spikes:

- Diwali remains a major contributor to pollution, with the highest PM2.5 levels recorded nationwide on the day after the festival.
- The Himalayan region saw its worst air quality in January, influenced by low wind speeds and stagnant weather conditions.

❖ **North India and East India were the most polluted regions in the country, while South India was the cleanest:** North and East India were the most polluted regions this winter, while South India was the cleanest. The national average of 71.8 $\mu g/m^3$ was 80% above the annual standard.

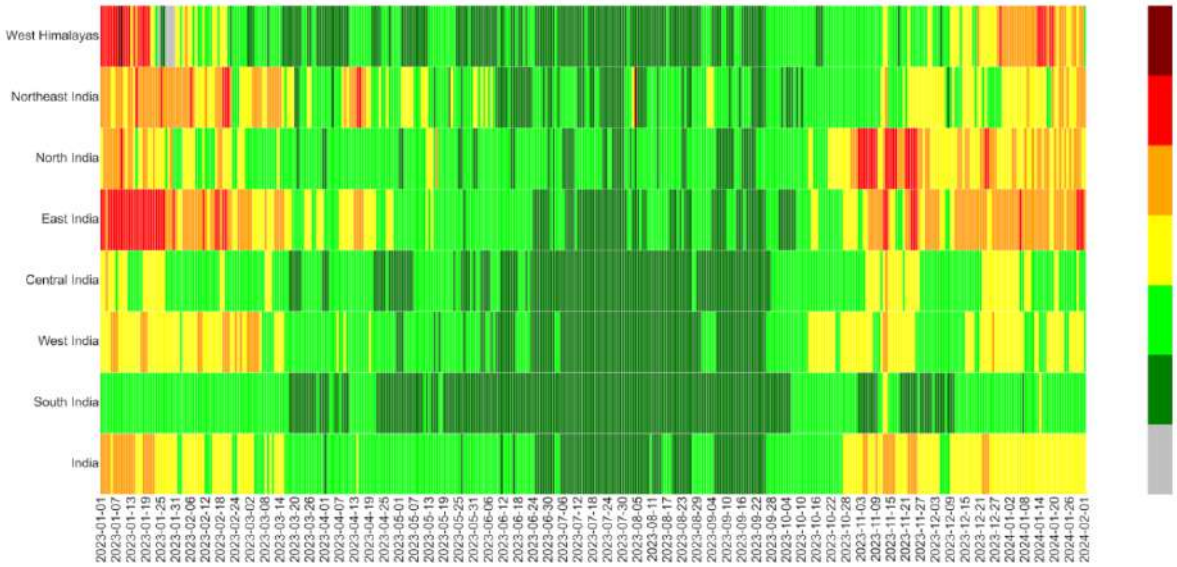
Regional winter average $PM_{2.5}$ levels 2023-24



Note: Regional average PM2.5 level is based on the mean of winter value determined for each city in the region. Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in $\mu g/m^3$.
Source: CSE analysis of CPCB's real time air quality data

- **Worst daily air quality is reported on and around Diwali in all regions except the hills that have the worst air in January; NCR is also an outlier as the worst air quality was recorded 10 days before Diwali:** The nationwide PM2.5 peak of 120 $\mu g/m^3$ was recorded on 13 November 2023, the day after Diwali, with regional peaks reflecting similar patterns. However, NCR saw its highest level of 218.4 $\mu g/m^3$ on 3 November due to stubble burning.

Heatmap of daily regional PM2.5 levels 2023-24



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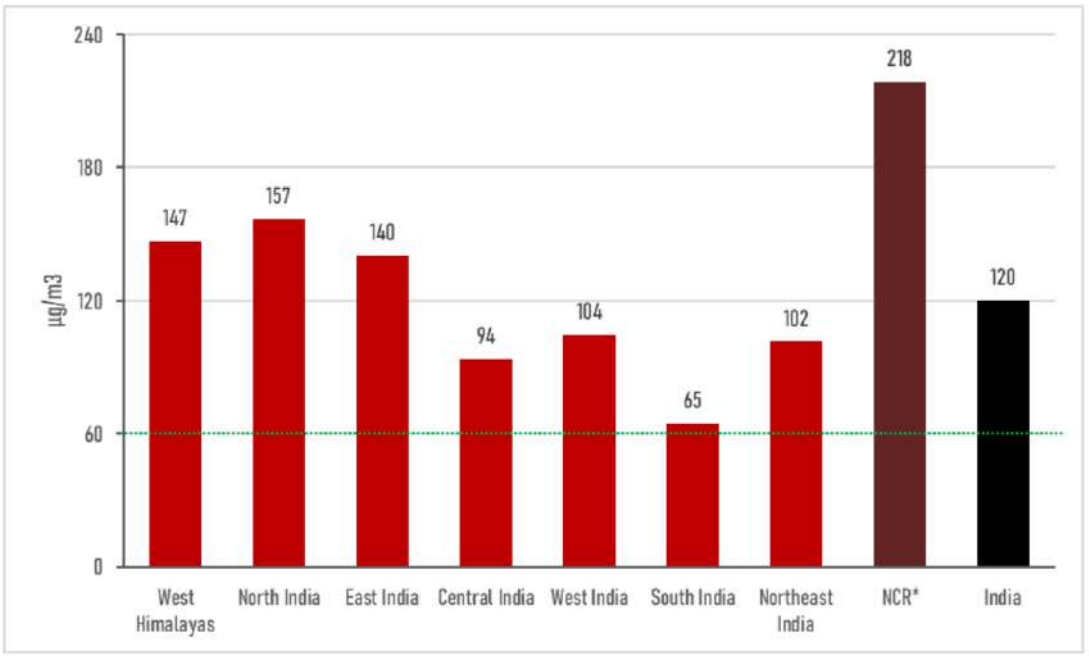
Source: CSE analysis of CPCB's real time air quality data

Regional winter peak PM2.5 levels 2023-24



Note: Regional peak PM2.5 level is based on the mean of daily value determined for each city in the region for each day. Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 18 hours data in a day. The winter is defined as 1 Oct 2023 to 31 Jan 2024.
Source: CSE analysis of CPCB's real time air quality data

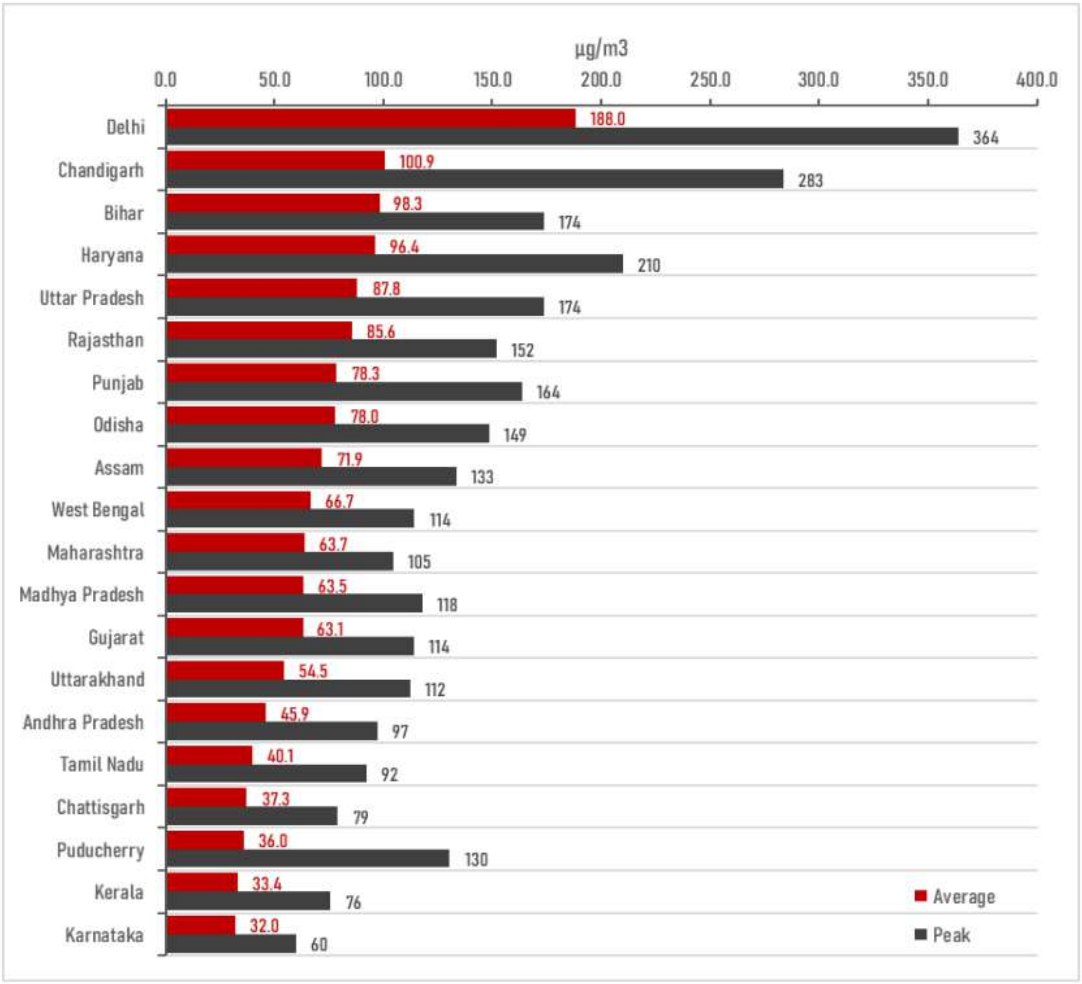
- **Winter average is up for North and Northeast, but pollution is down by 29% in East India:** This winter, PM2.5 levels rose by 13% in Northeast cities and 8% in North cities, while East India saw a 29% decline. Overall, India experienced an 8% reduction in winter pollution compared to 2022-23, with minimal change in Central India and improvements in the West and South.

- **Delhi and Chandigarh were the most polluted UTs while Bihar and Haryana the most polluted states:** Delhi (188 µg/m^3) and Chandigarh (100.9 µg/m^3) were the most polluted UTs, while Bihar (98.3 µg/m^3) and Haryana (96.4 µg/m^3) lead among states, with Karnataka (32 µg/m^3) and Kerala (33.4 µg/m^3) being the cleanest.

PM2.5 is Invisible but Deadly:

PM2.5 particles are smaller than 2.5 micrometers, about 3% the diameter of a human hair, making them easily inhalable and capable of penetrating deep into the lungs and bloodstream.

Graph 6: State-wise winter average and peak $PM_{2.5}$ levels 2023-24



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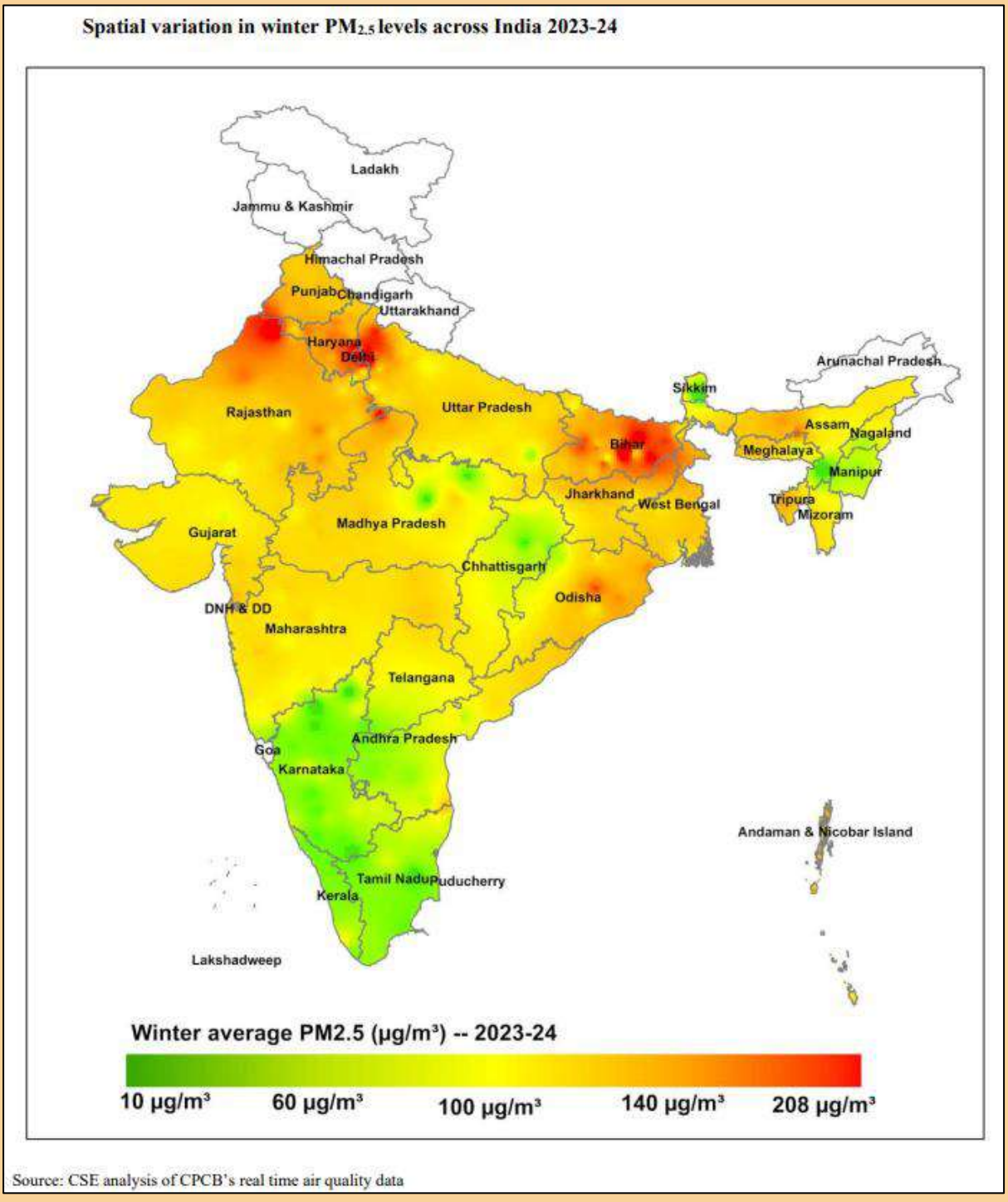
Source: CSE analysis of CPCB's real time air quality data

Trees Are Natural Air Filters:

A single mature tree can absorb up to 48 pounds of carbon dioxide and filter pollutants like PM2.5 and sulfur dioxide every year.

❖ **Map of Spatial Variation in Winter PM2.5 Levels Across India 2023-24** offers a visual representation of how air pollution, specifically PM2.5 levels, varied across different regions of India during the winter season of 2023-24. The map is based on CSE's (Centre for Science and Environment) analysis of real-time air quality data provided by the CPCB (Central Pollution Control Board) from 538 monitoring stations across 254 cities.



Source: CSE analysis of CPCB's real time air quality data

❖ **Small cities in Bihar and Rajasthan are as polluted as big NCR cities:** Begusarai in Bihar was the most polluted city this winter with a PM2.5 level of 213.5 µg/m^3, followed by Delhi (188.0 µg/m^3) and Hanumangarh (171.6 µg/m^3), with 11 of the 20 most polluted cities located in the NCR.

Table 1: Top 20 cities with worst winter air quality 2023-24

	City	State	Winter average
1	Begusarai	BR	213.5
2	Delhi	DL (NCR)	188.0
3	Hanumangarh	RJ	171.6
4	Greater Noida	UP (NCR)	166.2
5	Faridabad	HR (NCR)	153.5
6	Noida	UP (NCR)	152.3
7	Dholpur	RJ	146.3
8	Saharsa	BR	146.0
9	Ghaziabad	UP (NCR)	143.1
10	Bhagalpur	BR	140.6
11	Bhiwadi	RJ (NCR)	136.6
12	Sonipat	HR (NCR)	134.7
13	Muzaffarnagar	UP (NCR)	132.8
14	Byrnihat	AS	130.6
15	Gurugram	HR (NCR)	130.3
16	Bahadurgarh	HR (NCR)	130.0
17	Purnia	BR	129.7
18	Sri Ganganagar	RJ	129.6
19	Angul	OR	128.5
20	Meerut	UP (NCR)	128.3

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

❖ **Small towns in Karnataka and Northeast are the cleanest in the country:** Gangtok in Sikkim recorded the lowest winter PM2.5 levels at 9.8 µg/m^3, making it the cleanest city in India, followed by Silchar in Assam at 14.9 µg/m^3. Other cities with the best air quality include Chamarajanagar, Vijaypura, Kalaburagi, and Mysuru. Ariyalur, Ramanathapuram, and Ooty in Tamilnadu also ranked among the top 20 cleanest cities this winter.

Table 2: Top 20 cities with best winter air quality 2023-24

	City	State	Winter average
1	Gangtok	SK	9.8
2	Silchar	AS	14.9
3	Chamarajanagar	KA	18.1
4	Vijaypura	KA	18.6
5	Kalaburagi	KA	19.4
6	Ariyalur	TN	21.3
7	Satna	MP	21.5
8	Damoh	MP	22.4
9	Korba	CG	22.5
10	Bagalkot	KA	22.7
11	Shivamogga	KA	24.8
12	Chikkamagaluru	KA	25.1
13	Madikeri	KA	25.1
14	Dharwad	KA	25.5
15	Mysuru	KA	25.7
16	Raichur	KA	26.0
17	Koppal	KA	26.5
18	Ramanathapuram	TN	27.0
19	Ooty	TN	27.7
20	Kannur	KL	27.8

Note: Winter value of a city is based on the mean of daily PM2.5 values recorded at CAAQM stations in a city with minimum 50 per cent data for this winter. The winter is defined as 1 Oct 2023 to 31 Jan 2024. Values are in µg/m^3.
Source: CSE analysis of CPCB's real time air quality data

The Scientific Connection: Air Pollution and Climate Change

Emission Sources and Their Dual Impact

1. **Black Carbon:**
    - Source: Incomplete combustion of fossil fuels and biomass.
    - Impact: Contributes to global warming by reducing snow albedo in the Himalayas.
2. **Ground-Level Ozone:**
    - Source: Reaction between nitrogen oxides (NOx) and volatile organic compounds (VOCs) under sunlight.
    - Impact: Damages vegetation, reducing carbon sequestration capacity.

Feedback Loops Between Climate and Air Quality

- Rising temperatures due to climate change worsen pollution dispersion, prolonging high PM2.5 episodes.
- Prolonged dry spells and erratic rainfall patterns hinder the natural cleansing of air pollutants.

Regional Trends of India

- **West Himalayas:** Baddi in Himachal Pradesh is the most polluted city in the West Himalayas, with a winter average of 111.8 $\mu g/m^3$ and a peak of 343 $\mu g/m^3$, marking a 6% increase in pollution compared to the previous winter. Dehradun is the second most polluted, while Rishikesh remains the cleanest city in the region, with an average of 35.8 $\mu g/m^3$.

- **North India:** Delhi and Hanumangarh were the most polluted cities in North India during the winter, with Delhi averaging 188 $\mu g/m^3$ and reaching a peak of 364 $\mu g/m^3$. Hanumangarh followed with a winter average of 171.6 $\mu g/m^3$ and a 339 $\mu g/m^3$ peak. Many of the most polluted cities were in the NCR, with other major cities like Chandigarh and Jaipur also showing high pollution levels.
  Panipat and Sonipat in Haryana saw the steepest increase in pollution, with Panipat rising by 87% and Sonipat by 80%. Of the 62 cities in North India with sufficient data, 39 experienced an increase in winter PM2.5 levels, with other cities like Hapur and Bhiwadi also showing a significant rise. Major cities like Jaipur and Delhi saw moderate growth, while Lucknow recorded a slight decrease.

- **East India:** Begusarai and Saharsa in Bihar are the most polluted cities in East India, with Begusarai recording a winter average of 213.5 $\mu g/m^3$ and a peak of 477 $\mu g/m^3$. Nine of the ten most polluted cities in the region are in Bihar, with Angul in Odisha being the exception. Other cities like Patna, Bhubaneswar, and Kolkata also faced high pollution levels, while Brajrajnagar was the cleanest, with an average of under 40 $\mu g/m^3$.
  Talcher and Haldia in East India saw the steepest increase in pollution, with Talcher rising by 43% and Haldia by 10%. While other cities like Kolkata and

Patan improved, cities like Arrah also experienced increased PM2.5 levels compared to the previous winter.

- **Central India:** Gwalior and Bhopal are the most polluted cities in Central India, with Gwalior averaging 100.1 μg/m^3 and a peak of 253 μg/m^3. Bhopal followed with an average of 81.8 μg/m^3 and a 227 μg/m^3 peak. Bhilai in Chhattisgarh had the lowest pollution in the region, while cities like Satna and Damoh showed low averages, though data accuracy is uncertain.
  Indore and Bilaspur saw the steepest increase in pollution in Central India, with Indore having PM2.5 levels rise by 110% and Bilaspur by 65%. Among other cities, Maihar recorded a 62% increase, Bhopal saw a 3% rise, and Gwalior saw a 21% decrease in pollution levels compared to the previous winter.

- **West India:** Vapi and Ulhasnagar are the most polluted cities in Western India, with Vapi recording a winter average of 88.8 μg/m^3 and a peak of 151 μg/m^3, and Ulhasnagar at 84.2 μg/m^3 and a peak of 210 μg/m^3. Other cities like Pimpri Chinchwad and Surat also faced high pollution levels, while Gandhinagar and Kalyan were the cleanest, with averages under 45 μg/m^3.
  Aurangabad and Gandhinagar saw the steepest increases in pollution in the West, with Aurangabad having PM2.5 levels rise by 23%. Other cities like Gandhinagar and Chandrapur also experienced an increase, while Surat and Kalyan saw improvements of over 30%. In contrast, Mumbai registered a significant 20% decrease.

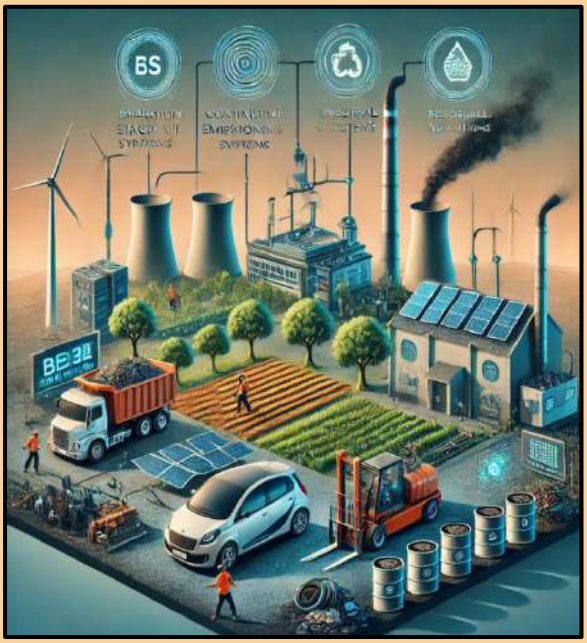
- **South India:** Gummidipoondi and Visakhapatnam were the most polluted cities in South India, with winter averages of 83.4 μg/m^3 and 73.3 μg/m^3, respectively. Other cities like Hyderabad and Bengaluru had moderate pollution levels, while Thiruvananthapuram recorded the cleanest air in the region. Cities like Chamarajanagar and Kalaburagi in Karnataka were the least polluted, with averages under 20 μg/m^3.
  Kollam and Madikeri saw the steepest rise in winter pollution in South India, with Kollam experiencing a 51% increase, the highest in the region. Several cities, particularly in Karnataka, registered increased PM2.5 levels, while cities like Bengaluru, Chennai, and Thiruvananthapuram showed improvements, highlighting regional variations in pollution trends.

- **Northeast India:** Byrnihat and Nalbari in Assam are the most polluted cities in Northeast India, with Byrnihat averaging 130.6 μg/m^3 and a peak of 278 μg/m^3. Agartala in Tripura also faces high pollution levels. While some cities like Kohima and Gangtok saw improvements, Kohima and Agartala experienced the steepest increases in pollution, with Kohima pollution levels rising by 21%.

Data-Driven Solutions: What Needs to Be Done

Policy Recommendations Based on Data

1. **Vehicle Emissions:**
   - Accelerate Bharat Stage VI (BS-VI) standards for vehicles.
   - Incentivize electric and hybrid vehicles.
2. **Industrial Controls:**



- Enforce continuous emissions monitoring systems (CEMS) in all industries.
- Transition to cleaner fuels such as natural gas.

3. **Agricultural Practices:**
   - Expand bio-decomposer use to reduce stubble burning in Punjab, Haryana, and Uttar Pradesh.

Waste Management

- Ban open waste burning, a significant contributor to winter pollution, especially in urban areas.
- Promote decentralized composting and recycling facilities.

Citizen-Led Actions: Small Changes, Big Impact

Daily Practices to Reduce Pollution:

- Reduce reliance on private vehicles—opt for cycling, walking, or public transport.
- Avoid using wood or coal for heating during winter.
- Plant and nurture trees in your locality to increase green cover.

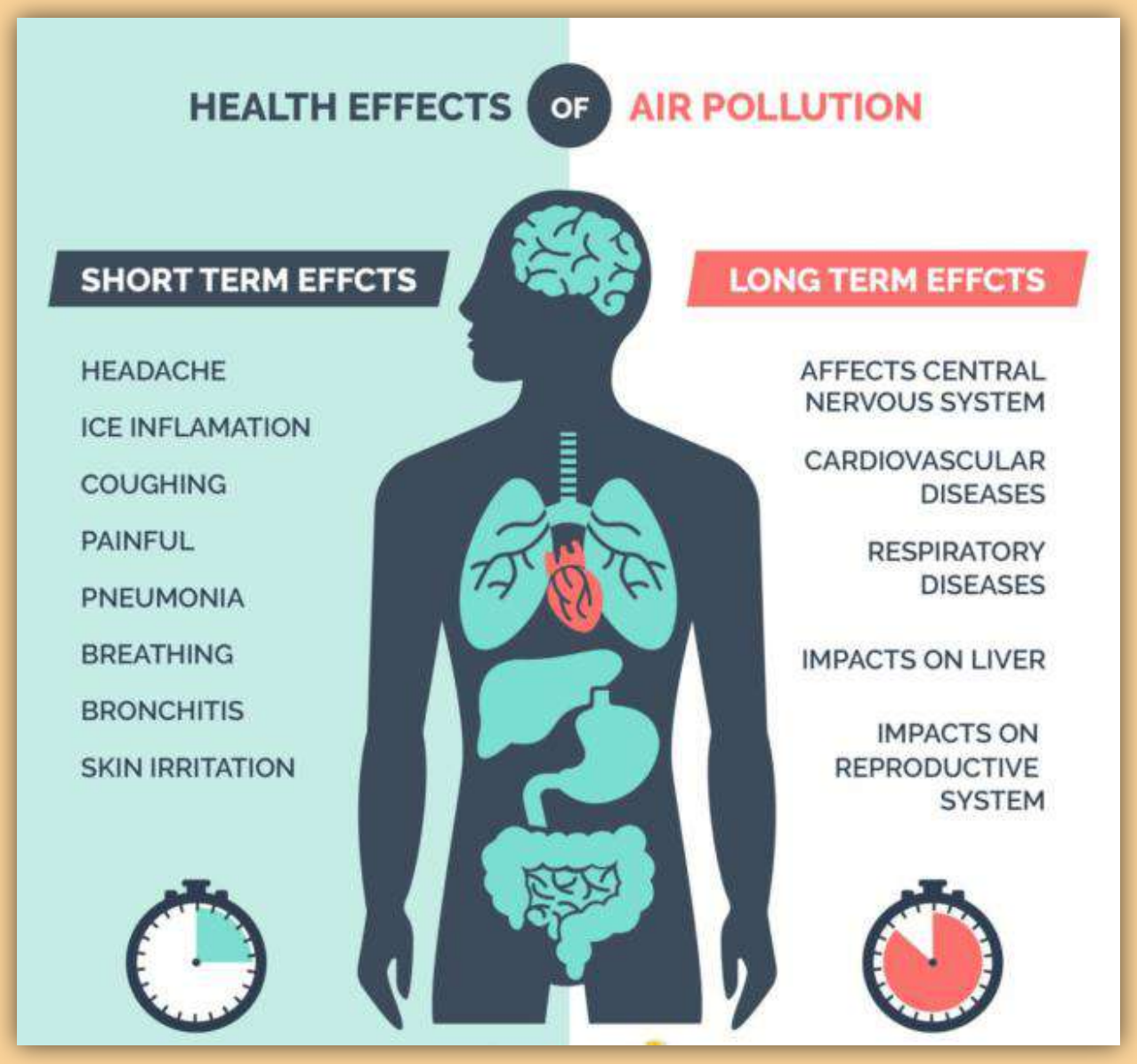
Advocacy and Awareness:

- Spread awareness about the health impacts of air pollution.
- Participate in local clean-up drives and tree-planting initiatives.

Air pollution is not just a local issue but a national crisis that needs immediate attention. We can tackle both challenges by addressing the root causes of pollution and integrating climate goals into air quality management plans.

Join the Movement

Take a Climate Change Action Pledge to adopt sustainable practices and support policies to reduce air pollution. Every small step contributes to a more significant impact.



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