Winter pollution crisis in megacities of India: Going beyond Delhi

Hyderabad

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The winter air quality trend in Hyderabad has remained relatively stable over the past four years, with the seasonal average PM2.5 level dropping to 52 µg/m³ this winter (October 2024 – January 2025), marking a 5 per cent decline compared to the previous three winters. This assessment, based on data from six of Hyderabad's oldest monitoring stations, highlights the gradual improvement in air quality but also underscores the continued seasonal impact of pollution.

While the overall winter average has improved, pollution levels continue to exceed annual averages across many locations. The highest daily PM2.5 level this winter was recorded at 89 µg/m³, with localized spikes at Sanathnagar, where pollution surged to 182 µg/m³. Meanwhile, Ramachandrapuram recorded the cleanest air with a winter average of 25 µg/m³.

Despite an overall decline in seasonal averages, some locations recorded higher pollution levels this winter compared to last year. IITH Kandi experienced the steepest rise, with PM2.5 levels increasing by 31 per cent over the previous winter. In contrast, Nacharam TSIIC saw the most significant improvement, with a 31 per cent drop in PM2.5 levels.

The seasonal impact of winter pollution is evident in the number of 'moderate' and 'poor' air quality days. Sanathnagar recorded the highest number of such days, with eight 'poor' AQI days and 34 'moderate' days. The build-up of bad air days typically begins in mid-November and persists until the end of January due to cooler temperatures, lower wind speeds, and increased emissions. Hyderabad also faces a multi-pollutant challenge, with nitrogen dioxide (NO_2) levels surging during winter. January saw the highest NO_2 concentrations, particularly at Zoo Park, where levels peaked at 93 µg/m³.

This analysis covers 6 older continuous ambient air quality monitoring stations (CAAQMS) across city. Although several new real-time monitors have been installed in some cities, they were not included in the long-term assessment due to data consistency requirements. A substantial dataset was processed using the USEPA methodology to ensure accuracy, addressing data gaps to provide a comprehensive understanding of air quality trends.

Key Findings

Hyderabad records stable winter PM2.5 levels over four years: Hyderabad's winter air quality has remained relatively stable, with the average PM2.5 concentration dropping to 52 µg/m³ this winter (October 2024 – January 2025), marking the lowest level in the past four years. This reflects a 5 per cent decline compared to the average of the previous three winter seasons. *(See Graph 1: Trend in winter average and winter peak in cities of Hyderabad).*

The highest daily PM2.5 level this winter was recorded on November 25, 2024, at 89 µg/m³, reflecting a marginal 0.4% decrease from the average of the past three winter peaks. Among the monitoring stations, Sanathnagar registered the highest daily peak, reaching 182 µg/m³ on October 7, 2024.

The analysis is based on data from six oldest monitoring stations across Hyderabad, with winter trends and peaks assessed for the period of October 1 to January 31. The average and peak values are calculated from the daily mean of available continuous data since 2021.

Graph 1: Trend in winter average and winter peak in cities of Hyderabad (1 Oct 2024 – 31 Jan 2025)
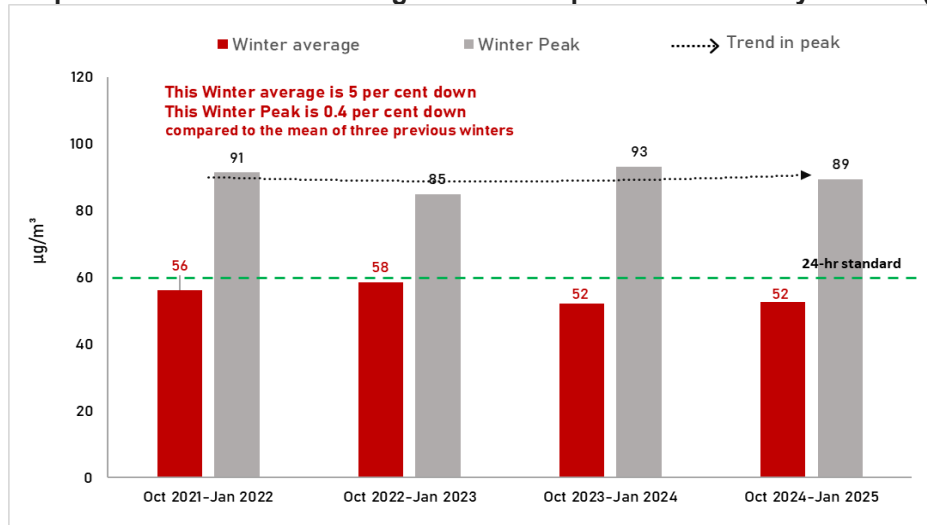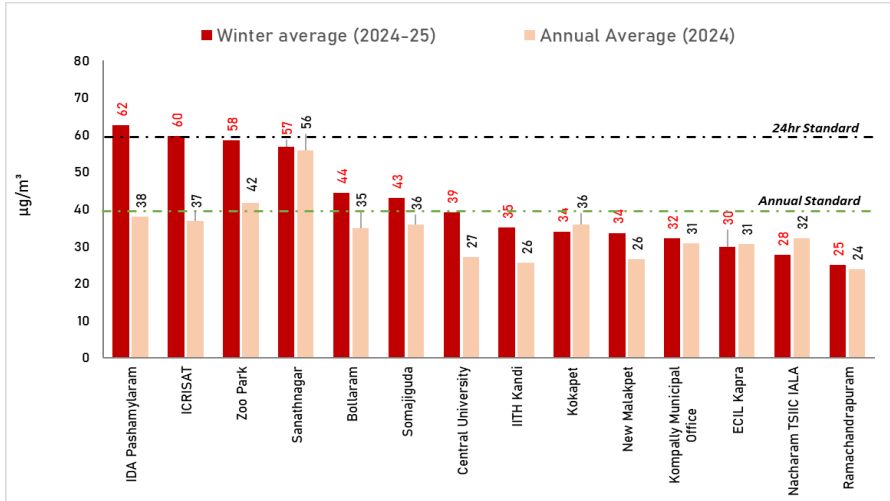

Source: CSE analysis of CPCB real-time data.

Rising winter PM2.5 levels disrupt annual air quality trends: Hyderabad's air quality deteriorates significantly during winter, with PM2.5 concentrations in the 2024-25 winter season surpassing annual averages at most monitoring stations. The only exceptions are Kokapet, ECIL Kapra, and Nacharam TSIIC IALA, where the annual average remains slightly higher than the winter average.

Among the stations, IDA Pashamylaram recorded the highest winter average at 62 µg/m³, exceeding its annual average of 38 µg/m³. It was followed by ICRISAT and Zoo Park, where winter PM2.5 levels reached 60 µg/m³ and 58 µg/m³, compared to their respective annual averages of 37 µg/m³ and 42 µg/m³ (*See Graph 2: Station wise winter and annual PM2.5 levels in cities of Hyderabad).* Across stations, winter pollution levels surged by 2 – 39 per cent above the annual average, indicating a significant seasonal impact.

Graph 2: Station wise winter and annual PM2.5 levels in cities of Hyderabad
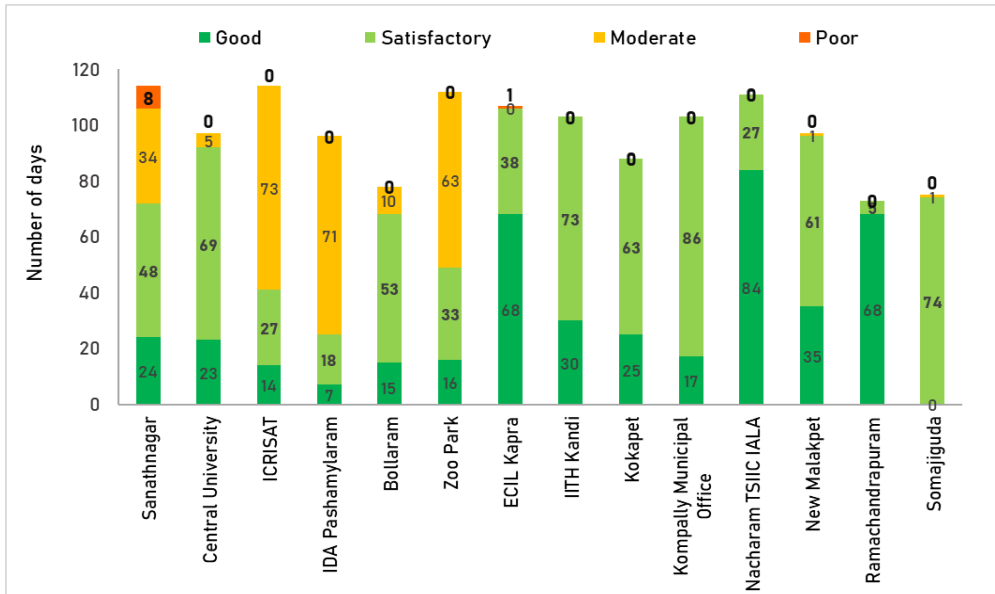
Source: CSE analysis of CPCB real-time data

Despite lower winter PM2.5 average levels, Hyderabad Sees Several Days of 'Moderate' and 'Poor' AQI: While Hyderabad recorded its lowest winter average PM2.5 levels in four years, air quality remained a concern, with a significant number of days falling under the 'moderate' and 'poor' AQI categories. Among the monitoring stations, Sanathnagar recorded the highest number of such days, with 8 days classified as 'poor' and 34 days as 'moderate,' highlighting persistent pollution hotspots in the city.

ICRISAT and IDA Pashamylaram followed closely, experiencing 73 and 71 days of 'moderate' AQI, indicating the widespread impact of winter pollution *(See Graph 3: PM2.5 based AQI categorization of days for cities in Hyderabad).*

Graph 3: PM2.5 based AQI categorization of days for cities in Hyderabad


Note: PM2.5 values for cities that have continuous and adequate data for the complete assessment period. Data from 1 Oct 2024 – 31 Jan 2025.
Source: CSE analysis of real-time data from the CPCB website

Bad air days begin to build up around the same time in the cities of Hyderabad during mid of November and persists till the end of January. Cities in Hyderabad metropolitan area show more pronounced impact of winter pollution. The combination of cooler temperatures, lower wind speeds, and increased emissions leads to the accumulation of pollutants, resulting in a higher number of moderate air quality days. *(See Graph 4: Heat map based on days classified as per PM2.5 air quality index for cities of Hyderabad).*

Graph 4: Heat map based on days classified as per PM2.5 air quality index for cities of Hyderabad
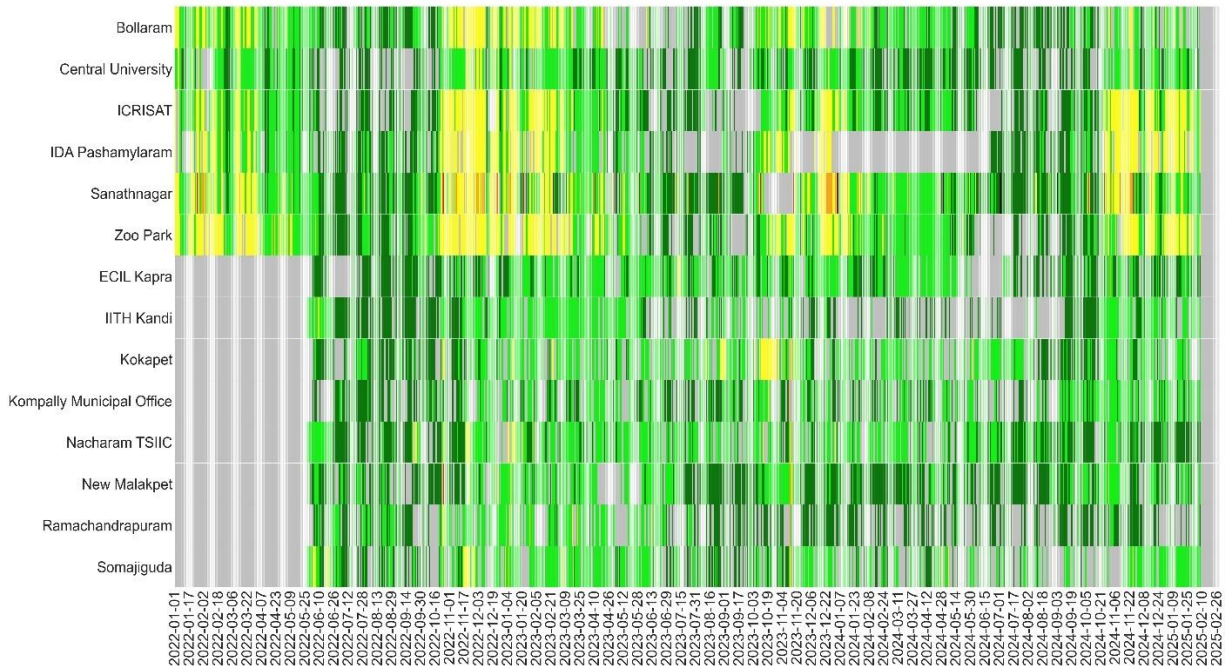
Note: Cell colors are based on the official AQI category colors. Data up till 31 January 2025.
Source: CSE analysis of real-time data from the CPCB portal

The Pollution hotspots and cleaner cities: IDA Pashamylaram is the most polluted among the cities of Hyderabad with winter average PM2.5 level at 63 μg/m³. It is followed by ICRISAT with seasonal average at 60 μg/m³, and Zoo Park at 58 μg/m³ *(See Graph 5: Winter average PM2.5 level in cities of Hyderabad)*. Ramachandrapuram station is the least polluted city with seasonal average of 25 μg/m³, followed by Nacharam TSIIC at 28 μg/m³ of winter average PM2.5 level.

Graph 5: Winter average PM2.5 level in cities of Hyderabad *(1 October 2024-31 January 2025)*
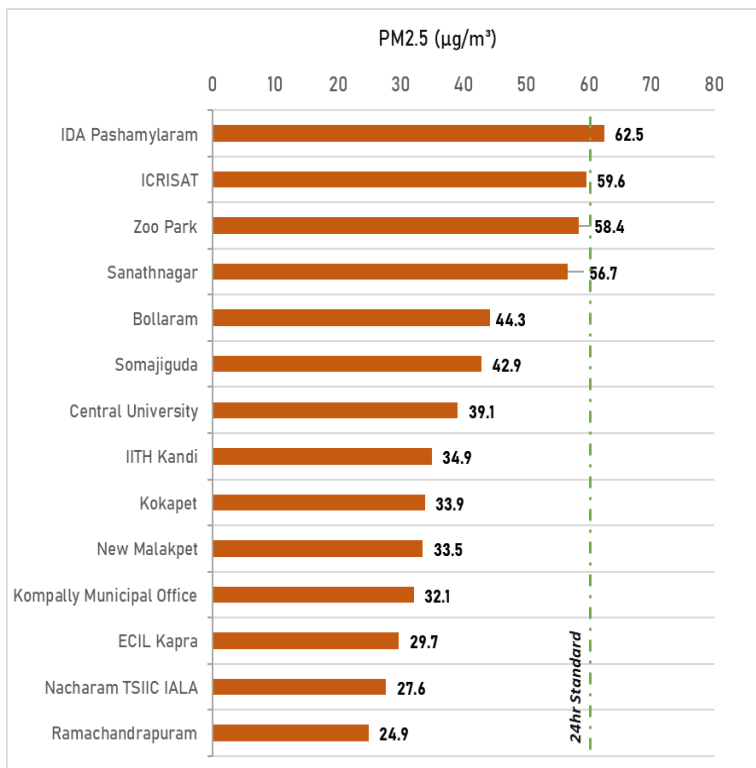
Note: 1 October 2024 – 31 January 2025 average is based on mean of daily averages.
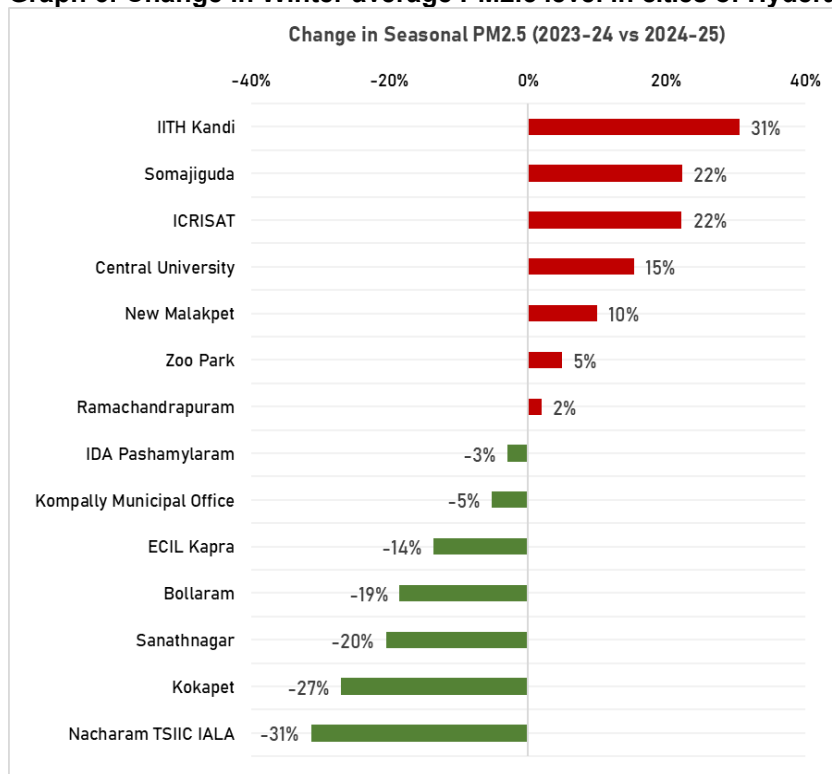Source: CSE analysis of CPCB real-time data

IITH Kandi followed by Somajiguda registered the highest increase in winter pollution: Despite an overall decline in winter average PM2.5 levels, seven out of 14 station has recorded higher pollution levels this winter compared to the previous season. IITH Kandi station in Hyderabad was the worst performer and registered an increase of 31 per cent compared to the preceding winter. It was followed by Somajiguda and ICRISAT each with an increase of 22 per cent, and Central University with an increase of 15 per cent.

Notably, Nacharam TSIIC showed the most significant improvement, with a 31 per cent decline in PM2.5 levels compared to the preceding winter. It was followed by Kokapet and Sanathnagar with substantial reductions of 27 per cent and 20 per cent, respectively *(See Graph 6: Change in Winter average PM2.5 level in cities of Hyderabad (2023-24 vs 2024-25).*

There is a wide variation in pollution concentration among the monitoring locations in cities of Hyderabad. RVCE was the most polluted location with winter PM2.5 averaging at 56.1 µg/m³. Jigani was the second most polluted location. (*See Annex 1: PM2.5 level at station levels 1 Oct 2024-31 Jan 2025).*

Graph 6: Change in Winter average PM2.5 level in cities of Hyderabad *(2023-24 vs 2024-25)*


Note: 1 October-31 January 2023-24 and 2024-25 average is based on mean of daily averages. Cities with data in both 2023 and 2024 are compared.
Source: CSE analysis of CPCB real-time data

Multi-pollutant challenge - increasing levels of Nitrogen dioxide (NO2) during November, December and January: Nitrogen dioxide (NO_2) levels across various locations in Hyderabad showed significant monthly variations, with January recording the highest concentrations. Zoo Park experienced the most notable surge, reaching 93 µg/m³ in January—an increase of 2.9 times compared to October, marking the steepest rise in NO_2 levels. This was followed by IDA Pashamylaram, where NO_2 concentrations climbed to 43 µg/m³, reflecting a 1.4-fold increase over the same period *(See Graph 7: Trend in NO2 levels in the cities of Hyderabad).*

Graph 7: Trend in NO2 levels in the cities of Hyderabad
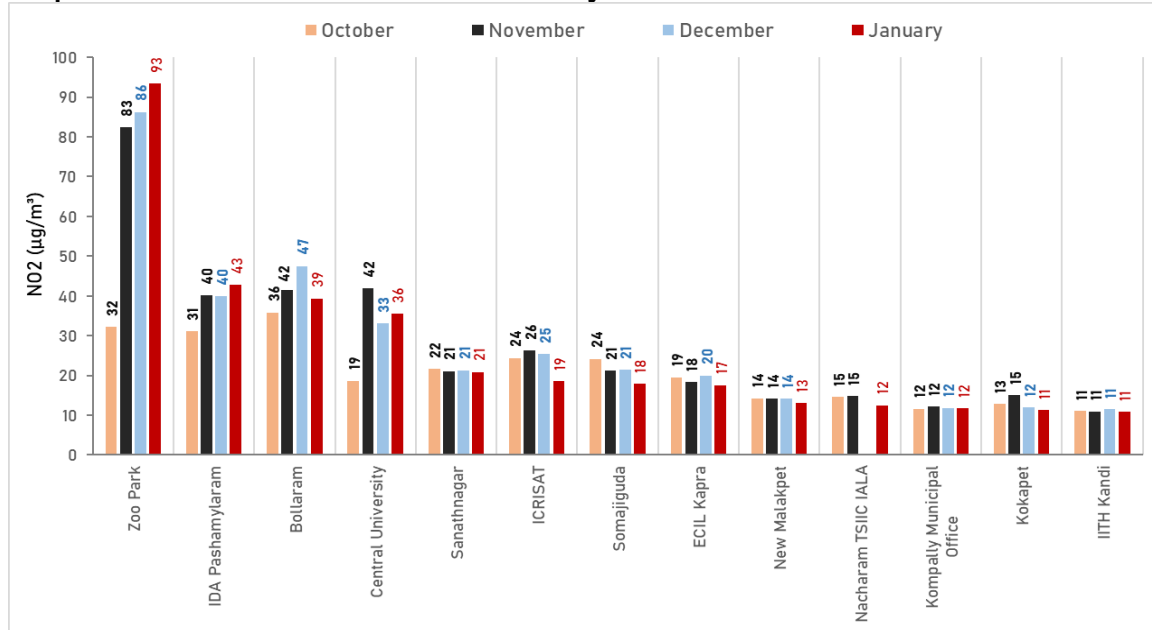
Note: NO2 values for sub-regions are based on the average of citywide values of all the cities in that region. NO2 values is based on average of all stations that have continuous and adequate data for complete assessment period. Data up till 31 Jan 2025.
Source: CSE analysis of real-time data from CPCB portal

Annex 1: PM2.5 levels at station level 1 Oct 2024- 31 Jan 2025

Station	State	1 Oct 2023 - 31 Jan 2024	1 Oct 2024 - 31 Jan 2025
Hyderabad_IDAPashamylaram	Hyderabad	64.4	62.5
Hyderabad_ICRISAT	Hyderabad	48.8	59.6
Hyderabad_ZooPark	Hyderabad	55.7	58.4
Hyderabad_Sanathnagar	Hyderabad	71.2	56.7
Hyderabad_Bollaram	Hyderabad	54.3	44.3
Hyderabad_Somajiguda	Hyderabad	35.1	42.9
Hyderabad_CentralUniversity	Hyderabad	33.9	39.1
Hyderabad_IITHKandi	Hyderabad	26.8	34.9
Hyderabad_Kokapet	Hyderabad	46.4	33.9
Hyderabad_NewMalakpet	Hyderabad	30.5	33.5
Hyderabad_KompallyMunicipalOffice	Hyderabad	33.8	32.1
Hyderabad_ECILKapra	Hyderabad	34.4	29.7
Hyderabad_NacharamTSIICIALA	Hyderabad	40.2	27.6
Hyderabad_Ramachandrapuram	Hyderabad	24.4	24.9

Note: Oct- Jan average is based on mean of daily averages that have continuous and adequate data for both years. All values are in µg/m³.
Source: CSE analysis of CPCB real-time data