Winter is coming: Understanding pre-winter air pollution baseline in Delhi-NCR

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At the onset of winter, Centre for Science and Environment (CSE) has analyzed air quality trends so far in Delhi and the National Capital Region (NCR) and also in the larger Indo-Gangetic Plains (IGP). This is continuation of the air quality tracker initiative of the Urban Data Analytics Lab of CSE that was started last winter. The objective of this new analysis has been to understand the starting line of the onset of the winter pollution season or pre-winter levels in this region. This also helps to locate the winter season within the longer term context of seasonal variation and annual trends in particulate pollution.

This is an assessment of annual and seasonal trends in $PM_{2.5}$ concentration for the period 1 January 2018 to 15 October 2021. This captures three successive winter seasons, pre-winter trends and pre and pandemic era including stages of lockdown in Delhi and the National Capital Region. This analysis is based on the real time data available from the current working air quality monitoring stations in Delhi-NCR and larger Indo Gangetic Plain. A huge volume of data points have been cleaned and data gaps have been addressed based on USEPA method for this analysis. This analysis covers 156 continuous ambient air quality monitoring stations (CAAQMS) spread across 67 cities in Punjab, Chandigarh, Haryana, Delhi, Rajasthan, Uttar Pradesh, Bihar and West Bengal. Meteorological data for the analysis is sourced from the Palam weather station of Indian Meteorological Department (IMD). Fire count data is sourced from NASA's Fire Information for Resource Management System, specifically Visible Infrared Imaging Radiometer Suite (VIIRS) product is used. Estimate of contribution of farm stubble fire smoke to Delhi's air quality is sourced from Ministry of Earth Science's System of Air Quality and Weather Forecasting and Research (SAFAR).

The pre-winter phase this year is quite unusual given the ongoing pandemic disruption combined with the unusual meteorological conditions. This year has witnessed one of the wettest monsoons in many decades. The monsoon period and the phase of extended rains cover the period from 1 July to 15 October. In the analysis winter season is considered from 15 October to 15 February based on dates referred in Delhi's Graded Response Action Plan (GRAP). Summer season is considered from 16 February to 30 June.

Even though the seasonal $PM_{2.5}$ average was lowest compared to all other seasons, it still shows how tough it will be for this region to go down further to meet the new and more stringent threshold that has been set by the WHO for particulate pollution recently.

The 2021 winter is starting with a cleaner threshold compared to the previous years. It is now awaited to see how soon and how intensely the winter pollution will bounce back this year. This demands very stringent advanced action to minimize local pollution across Delhi and National Capita Region (NCR) and the Indo Gangetic Plains (IGP) and also leveraging of winter action for more sustained air quality gains.

Inputs: Shambhavi Shukla

Key highlights

Delhi

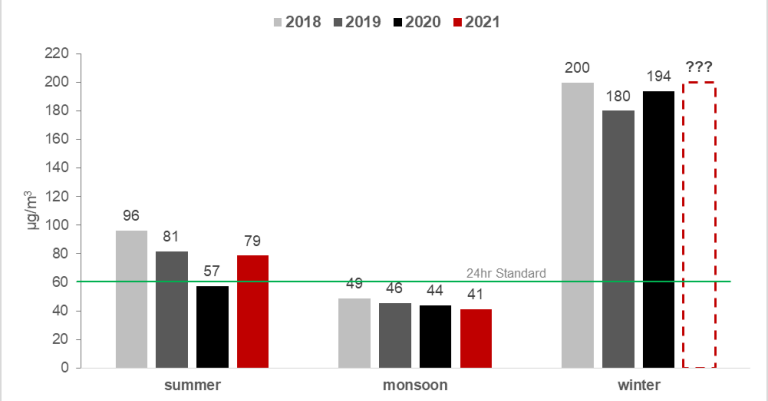
Cleanest monsoon season in last four years: The extraordinarily wet monsoon season also translated into the cleanest monsoon season for Delhi. The citywide average for the monsoon this year stood at 41 µg/m^3 with 96 days meeting the 24hr standard for $PM_{2.5}$. The corresponding seasonal average in 2020 was 44 µg/m^3 with 84 days meeting the 24hr standard. Monsoon season has noted progressive increase in the number of cleaner days with an average 6 per cent annual improvement since 2018 (See *Graph 1: Seasonal trend in Delhi's air quality*). The rainfall has not been of equal intensity in all the monsoons. Even though the 2019 monsoon had registered 40 per cent lesser rain compared to 2018 monsoon, the seasonal $PM_{2.5}$ average improved from 49 µg/m3 to 46 µg/m^3 (See *Graph 2: Relationship between Delhi's seasonal air quality and rainfall*).

In Delhi, Dr. Karni Singh Shooting Range has recorded the lowest seasonal average of 33 µg/m^3, while the National Stadium had 100 days that met the daily standard. Anand Vihar with seasonal average of 61 µg/m^3 had lesser number of days – 54, meeting the standard and was the worst hotspot in the city.

Summer pollution – rising trend: Lockdowns were effective in bringing down $PM_{2.5}$ levels during 2020 summer, with seasonal average of 57 µg/m^3 and about 90 days meeting the 24hr standard. But this advantage was lost during 2021 summer with seasonal average climbing to 79 µg/m^3 and the number of days meeting standard plummeting to 51 from 90 in summer of 2020 (See *Graph 1: Seasonal trend in Delhi's air quality*). In fact, $PM_{2.5}$ levels this summer have almost returned to 2019 summer level despite partial lockdowns that were in place during much of April and May of this year due to the second wave of corona.

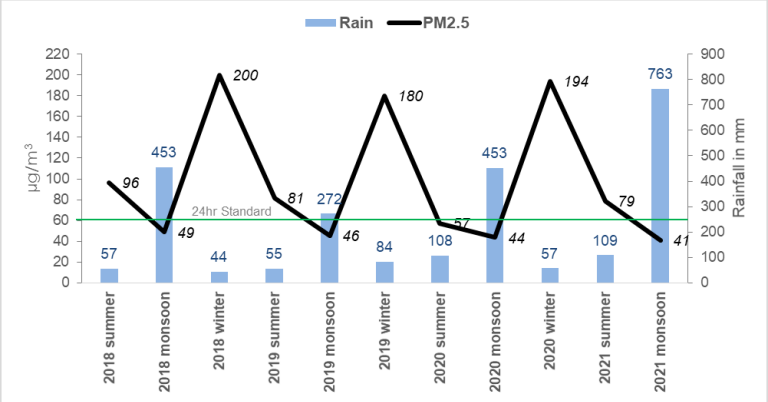
In Delhi, Aya Nagar had cleanest summer average of 54 µg/m^3, while the National Stadium and Sri Aurobindo Marg had 76 days meeting the daily standard. Bawana with seasonal average of 111 µg/m^3 was the most polluted spot during summer. DTU, ITO and Mundaka were other spots in the city that registered seasonal average higher than 100 µg/m^3.

Graph 1: Seasonal trend in Delhi's air quality



Note: Average $PM_{2.5}$ concentration is based on mean of daily values recorded at 36 CAAQM stations in the city that have adequate data for all four years.
Source: CSE analysis of CPCB's real time air quality data

Graph 2: Relationship between Delhi's seasonal air quality and rainfall



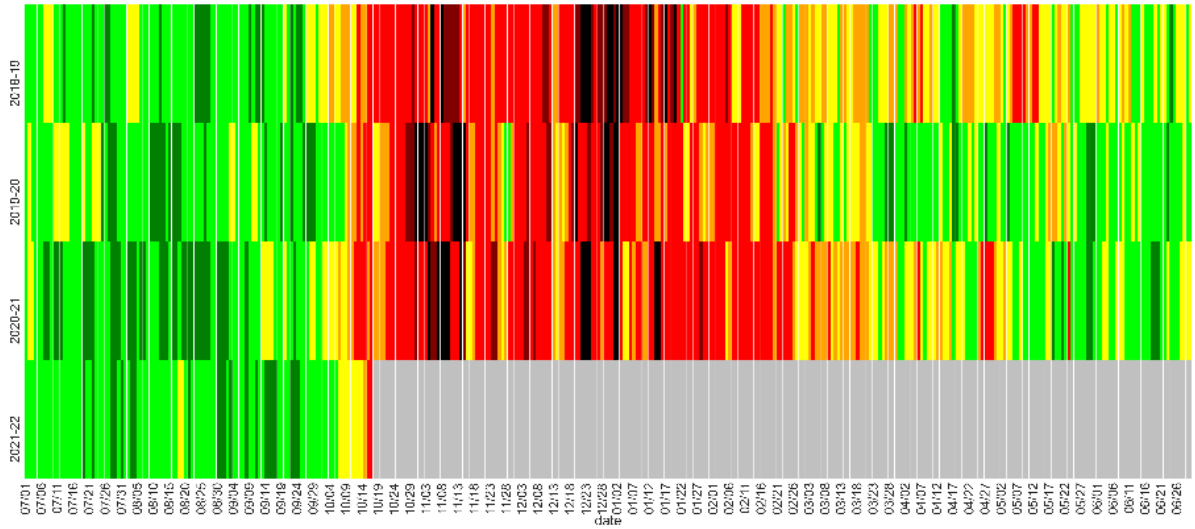
Note: Average $PM_{2.5}$ concentration is based on mean of daily values recorded at 36 CAAQM stations in the city that have adequate data for all four years.
Source: CSE analysis of CPCB's real time air quality data and IMD rainfall data from Palam weather station

Delhi-NCR

Annual heat map of daily $PM_{2.5}$ in Delhi and NCR: Daily $PM_{2.5}$ levels have been further classified according to the air quality index sub-categories for the years 2018, 2019, 2020, and 2021. The number of days in the 'very poor' AQI $PM_{2.5}$ sub-category dramatically increased in Feb-March of 2021 (See *Graph 3: Heatmap of Delhi's daily $PM_{2.5}$ AQI sub-category*). There were 27 days of 'very poor' days this Feb-March compared to 17 in 2020 and 12 in 2019.

Days meeting the standard also plummeted this spring with just two days on record. 2020 had 16 and 2019 had 6 days when the standard was met. Monsoon season this year has relatively lesser 'good' air days compared to 2020 monsoon but due to prolonged rain-spells this year that delayed onset of bad air days that overall seasonal average is lower. The heatmap also shows that the onset of days with 'very poor' air quality has not shifted despite the prolonged rains, even this year it happened around mid-October.

Graph 3: Heatmap of Delhi's daily $PM_{2.5}$ AQI sub-category



Note: Average $PM_{2.5}$ concentration is based on mean of daily values recorded at 36 CAAQM stations in the city that have adequate data for all four years. Cell colour is based on the official colour-scheme of AQI sub-categories.
Source: CSE analysis of CPCB's real time air quality data

Start of bad air days is linked to monsoon retreat: As is logically expected the start of monsoon retreat date almost perfectly coincides with the start of bad air days in Delhi (i.e. daily $PM_{2.5}$ average breaching the standard and mostly remaining above for rest of the season). The pollution build-up is triggered by retreating monsoon winds, and made worse by cool and calm winter condition and the inversion. While this process had started early in September for 2018 and 2020, it was delayed to October in 2019 and 2021 (See *Table1: Relationship between monsoon withdrawal process and exceedance of daily standard for $PM_{2.5}$*).

Table 1: Relationship between monsoon withdrawal process and exceedance of daily standard for $PM_{2.5}$

	Onset of Monsoon Retreat	Onset of bad air days	Withdrawal Completion	First severe day
2018	29-Sep	27-Sep	21-Oct	30-Oct
2019	9-Oct	9-Oct	16-Oct	28-Oct
2020	28-Sep	28-Sep	28-Oct	31-Oct
2021	6-Oct	7-Oct	??	??

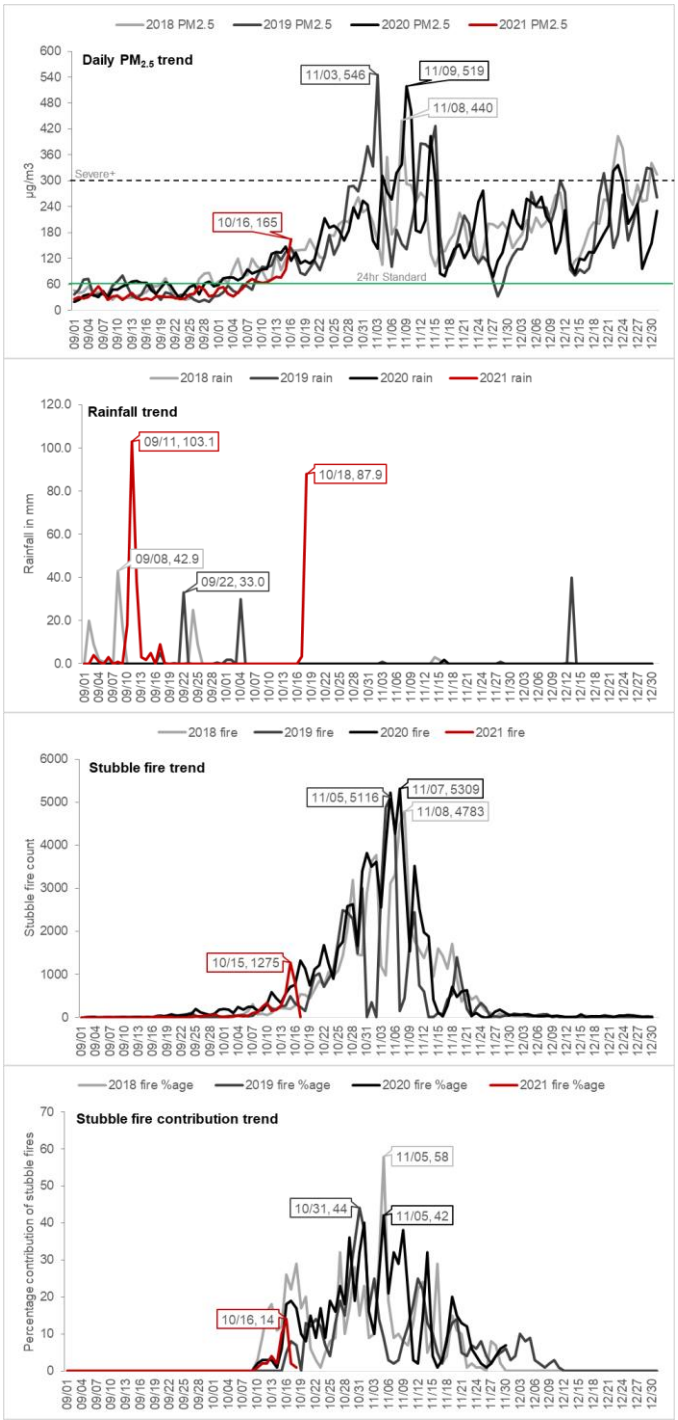
Source: CSE analysis of CPCB's real time air quality data, IMD's monsoon data

Farm stubble fire and early winter smog in Delhi

Normally the first phase of winter smog is often triggered by large scale stubble burning in the region. The contribution of farm stubble fire this year started roughly around October 10, same as 2018 and 2020. This was delayed by a week in 2019. Peak contribution this year so far was registered on October 16 when 14 per cent of Delhi's $PM_{2.5}$ was attributed to stubble fire smoke by SAFAR. Heavy rains following days washed out the first build-up of the season. The smoke season generally peaks around cusp of October and November with contribution spiking over 40 per cent on worst days. (See *Graph 4: Daily trend in $PM_{2.5}$, rainfall, farm stubble fires during pre-winter and winter season*)

The last year burning season (1-Oct to 29-Nov) saw on an average 12.2 per cent contribution per day. This was considerably higher than previous years. In 2019, contributions stood at 8.9 per cent per day, while it stood at 10.9 per cent per day in 2018. (The average contribution of stubble fire to Delhi's daily $PM_{2.5}$ concentration increased by 36 per cent from last year and 12 per cent from 2018.)

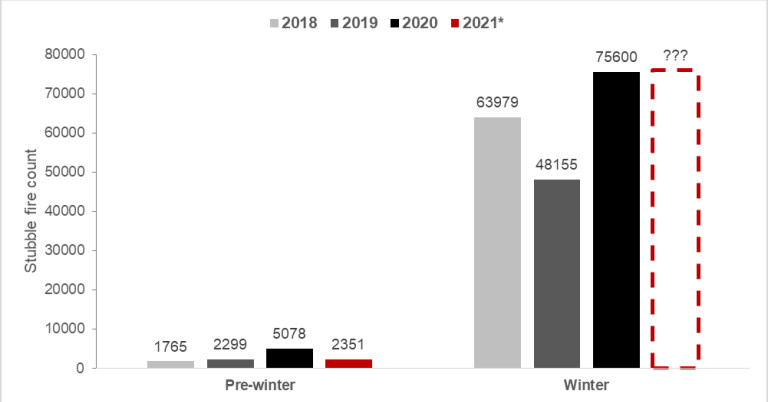
Graph 4: Daily trend in $PM_{2.5}$, rainfall, farm stubble fires during pre-winter and winter season (2018-2021)



Note: Average $PM_{2.5}$ concentration is based on mean of daily values recorded at 36 CAAQM stations in the city that have adequate data for all four years. Farm fire data is aggregate for Punjab and Haryana fires only.
Source: CSE analysis of CPCB's real time air quality data, IMD rainfall data from Palam weather station, fire count data from NASA's VIIRS satellite, and smoke contribution data from SAFAR.

Trend in fire count during pre-winter of 2021: The farm fire count during the pre-winter season of 2021 has been less than half of the number recorded last year (See *Graph 5: Trend in farm fires during pre-winter and winter season*). But this can be due to multiple rain spells this year. Lower count reported by satellite imagery can also be due to increased cloud cover which hinders spotting of fires by the satellites. Nevertheless, lower fire count during pre-winter correlates well with the lower pollution level in Delhi-NCR.

Graph 5: Trend in farm fires during pre-winter and winter season



Note: Farm fire data is aggregate for Punjab and Haryana fires only.
Source: CSE analysis of fire count data from NASA's VIIRS product

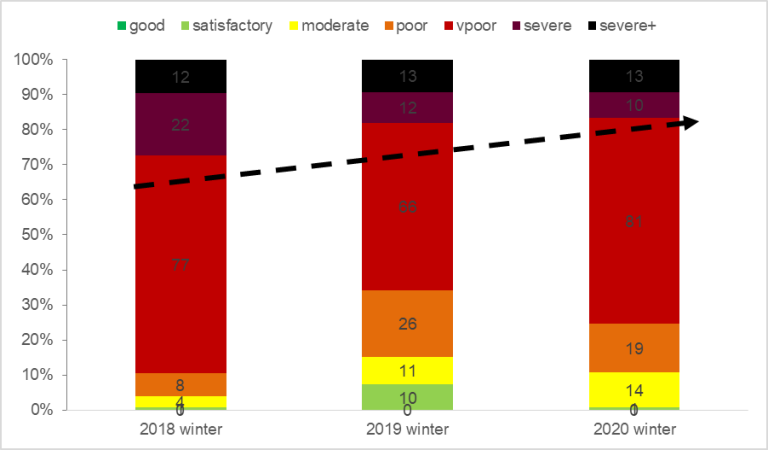
Winter trend in $PM_{2.5}$

It is not possible to predict the trend during this winter. The pre-winter months of September and October have been one of the cleanest over the last four years. But going by the experience of past four years cleaner starting point is no guarantee for cleaner winter. During 2020-21 winter, $PM_{2.5}$ seasonal average was 8 per cent higher than the 2019 winter average. Also 2020-21 winter had an early onset of bad air days and also received lesser rain than 2019 winter. All that advantage of lockdown and monsoon was lost during winter. However, it is helpful to understand the more nuanced variation in winter $PM_{2.5}$ trend since 2018.

Number of days with severe concentration of $PM_{2.5}$ declined and duration of smog episodes were shorter during 2020-21 winter: During the winter of 2020-21, 23 days had citywide average of $PM_{2.5}$ concentration in "severe' or worse AQI sub-category, - this is down from 25 such days in 2019-20 winter and 34 days in 2018-19 winter. (See *Graph 6: Decline in number of "severe" and worse air days in Delhi*). Technically, a smog episode is defined for the purpose of implementing emergency action under the Graded Response Action Plan when the levels of $PM_{2.5}$ remain in "severe" category for three consecutive days. From this perspective, during 2020-21 winter there were two continuous smog episodes. The first episode was of longer duration that started on 3rd November and lasted for 7 days. The second started on 22nd December and lasted for 3 days (See *Graph 7: Map of smog episode in Delhi*). Thus the continuous smog episodes are fewer and shorter compared to previous winters. 2019-20 winter had three smog episodes of 8 days, 6 days and 5 days durations. 2018-19 winter had four smog episodes of 10 days, couple of 6 days and a 3 days durations.

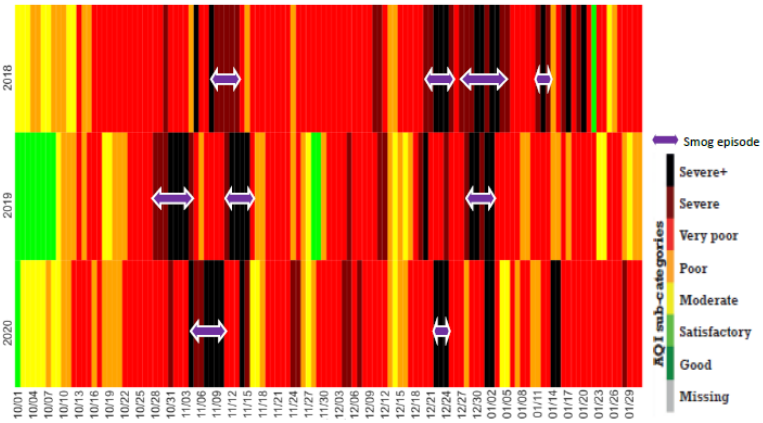
Relatively faster dissipation of smog episodes without any major rainfall or pollution control-emergency action during 2020-21 pointed towards downward trend in the annual average concentration (perhaps residual impact of lockdown). This period also coincides with the gradual unlocking of economy and travel in the air shed. But still persistent high level suggest impact of local pollution.

Graph 6: Decline in number of "severe" and worse air days in Delhi (15 Oct– 15 Feb)



Note: Average $PM_{2.5}$ concentration is based on mean of daily values recorded at 36 CAAQM stations in the city that have adequate data for all three winters. Cell colour is based on the official colour-scheme of AQI sub-categories.
Source: CSE analysis of CPCB's real time air quality data

Graph 7: Map of smog episodes based on PM2.5 concentration during winter in Delhi

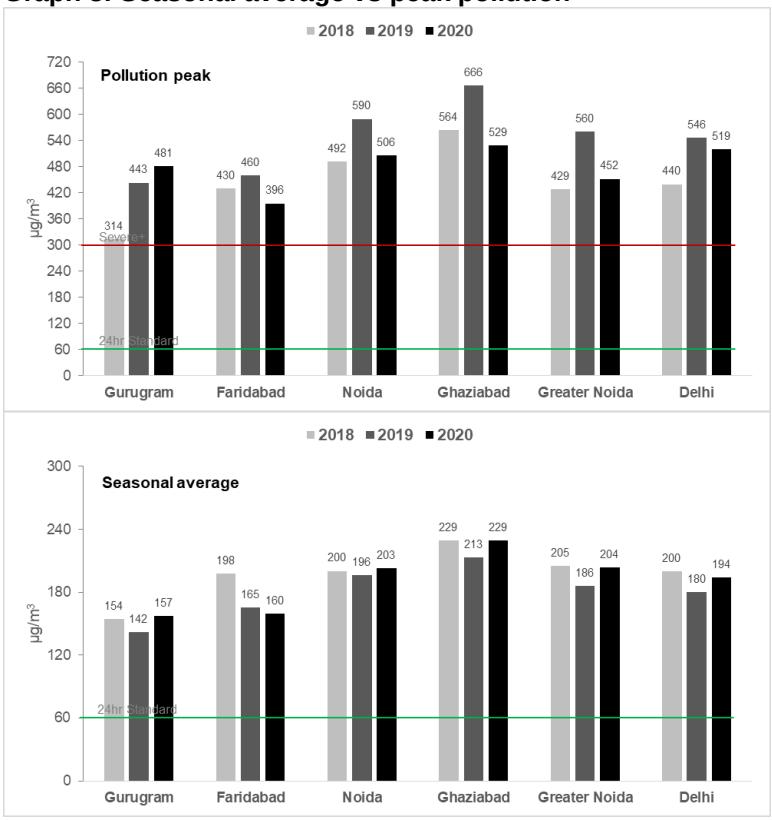


Note: Average $PM_{2.5}$ concentration is based on mean of daily values recorded at 36 CAAQM stations in the city that have adequate data for all three winters. Cell colour is based on the official colour-scheme of AQI sub-categories.
Source: CSE analysis of CPCB's real time air quality data

<u>$PM_{2.5}$ winter trend in NCR:</u> On an average 2020-21 winter season was 5 per cent worse among the major NCR cities and Delhi compared to 2019-20 season but the peak pollution on average was 13 per cent lower (See *Graph 8: Seasonal average vs peak pollution*). Delayed start of the season with multiple spurts of rain that marked 2019-20 is similar to the conditions prevailing this year. Given the experience of 2019-20, it can be expected that smog episode this year might have higher peak pollution if special steps are not taken to reduce the pollution from the sources.

Even though the average level during the earlier winter of 2019-20 was lesser than other winters, the peak daily pollution was considerably higher across all major NCR cities. This can be attributed to September-October rains that pushed and concentrated the farm stubble burning towards the end of October and start of November when winter conditions were turning more adverse.

Graph 8: Seasonal average vs peak pollution



Note: Average $PM_{2.5}$ concentration is based on mean of daily values recorded at all CAAQM stations in the city that have adequate data for all three winters.
Source: CSE analysis of CPCB's real time air quality data

Pollution hotspots in Delhi and NCR

City hotspots record higher $PM_{2.5}$ levels compared to the city and regional average even during monsoon:
There is a broad classification of hotspots. Originally, hotspots were defined as those with annual average levels higher than the mean value of the city – that is any case is much worse than the national ambient air quality standards.

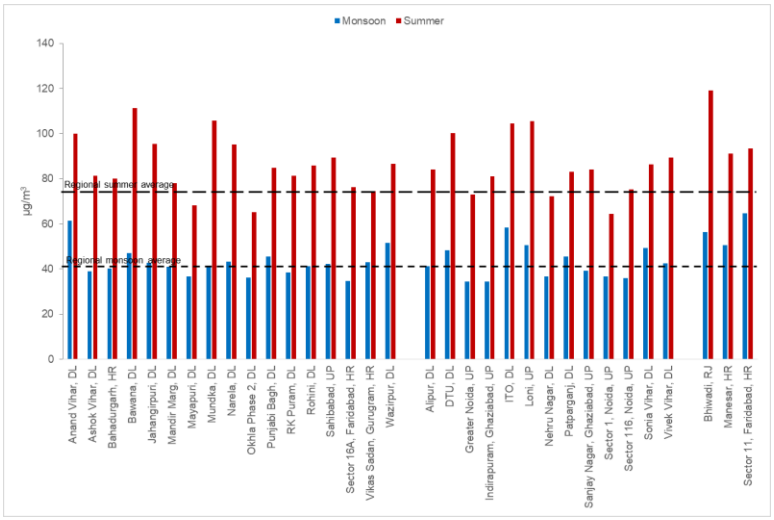
However, there is considerable seasonal variation and in the shifting nature of pollution across hotspots. 11 of 18 recognized hotspot registered higher seasonal average than the city and the region. But only two hotspots (Anand Vihar and Punjabi Bagh) show worsening of air quality during 2021 monsoon compared to 2020 monsoon.

Among 14 new locations in NCR identified last winter by CSE as emerging hotspots half registered lower levels this monsoon compared to city and regional averages. Three more locations have emerged this monsoon as potential hotspots i.e. Bhiwadi (Rajasthan), Manesar (Haryana), and Sector 11 Faridabad (Haryana). These location show significantly higher season average compared to rest of the region. In fact, with 64 µg/m^3 Sector 11 Faridabad had the worst air during this monsoon in the NCR (See *Graph 9: Pollution at hotspots during monsoon*).

From this list of 35 recognized and emerging hotspots only three locations (Mayapuri, Okhla Phase 2, and Sanjay Nagar) had their summer average below the regional average of 75 µg/m^3.

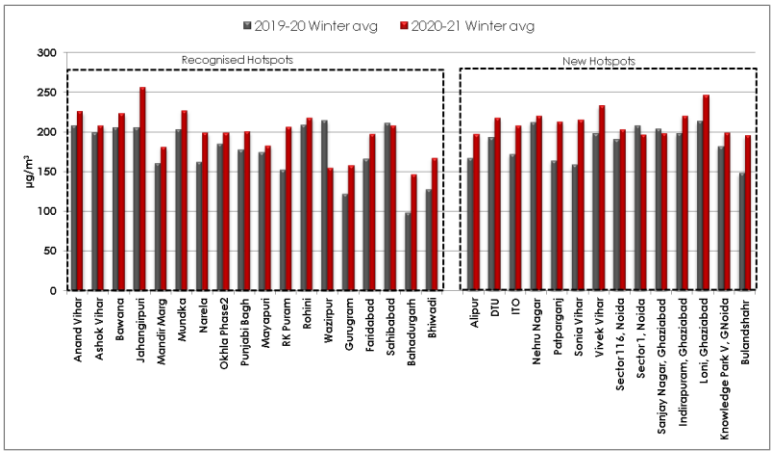
Earlier in the winter 16 of 18 recognized hotspot registered worsening of air (See Graph 10: Winter pollution at hotspots). Two hotspots that showed improvement were Wazirpur and Sahibabad.

Graph 9: Pollution at hotspots during monsoon



Note: Average $PM_{2.5}$ concentration is based on mean of daily values recorded at the CAAQM stations given it has adequate data for the monsoon. Mayapuri and Sahibabad don't have a CAAQM station, therefore nearest station to them (Pusa DPCC and Vasundhara respectively) is used to represent their air quality. Gurugram and Faridabad are represented by their oldest station- Vikas Sadan and Sector 16A respectively.
Source: CSE analysis of CPCB's real time air quality data

Graph 10: Winter pollution at hotspots



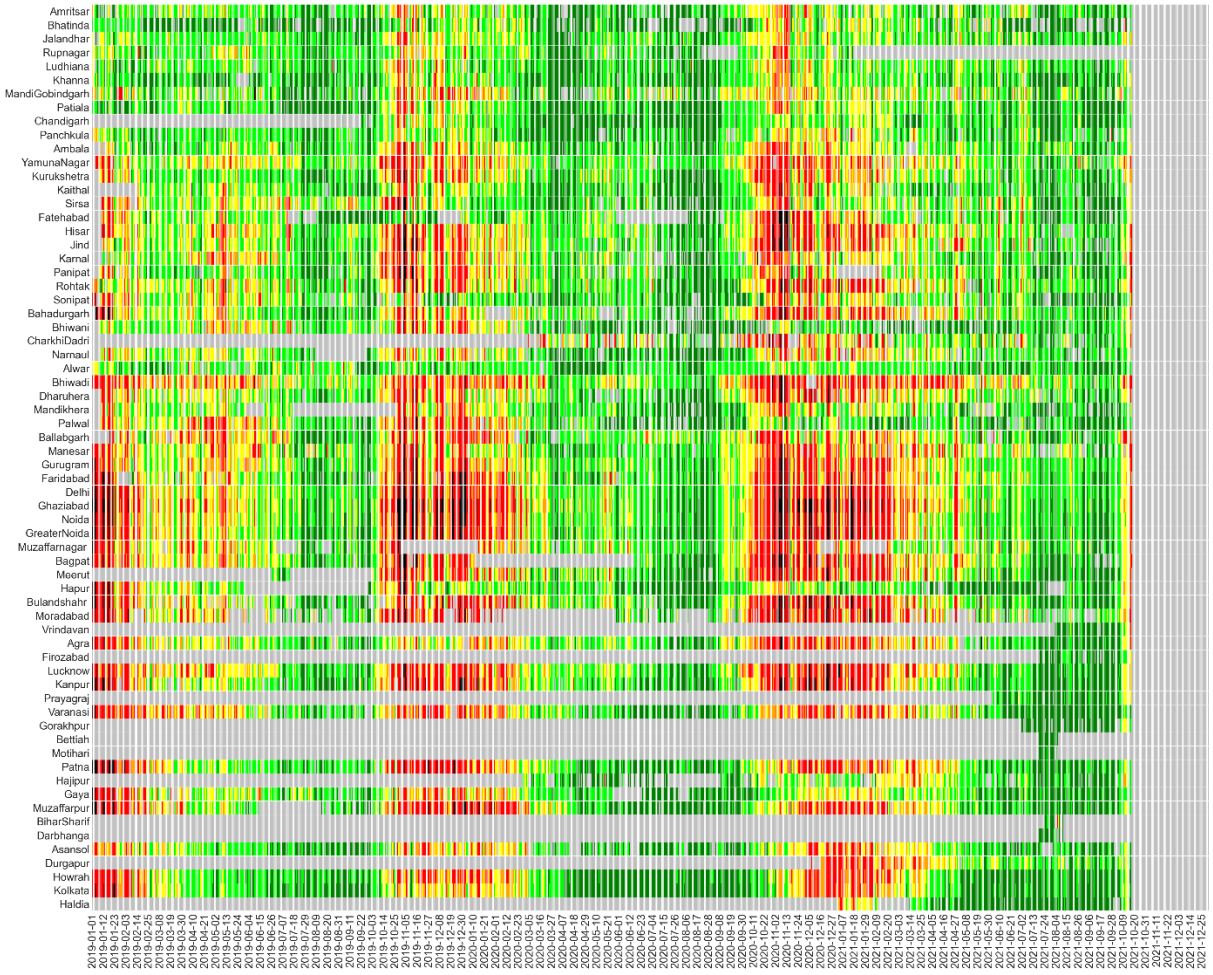
Note: Average $PM_{2.5}$ concentration is based on mean of daily values recorded at the CAAQM stations given it has adequate data for the winter. . Mayapuri and Sahibabad don't have a CAAQM station, therefore nearest station to them (Pusa DPCC and Vasundhara respectively) is used to represent their air quality. Gurugram and Faridabad are represented by their oldest station- Vikas Sadan and Sector 16A respectively.
Source: CSE analysis of CPCB's real time air quality data

Trend in $PM_{2.5}$ concentration in Indo Gangetic plain

Indo Gangetic plain (IGP) wide phenomena: Winter is problematic throughout the IGP. Tracking all the 67 monitored cities in the region makes it very clear that air quality dips to poor and worse categories as the monsoon retreats. For most of the northern plains from Punjab to central UP, the start of bad air quality days is almost perfectly synchronized. Eastern plains witness the onset of pollution almost 3-4 weeks later. It is interesting to note that air cleans up in Punjab much earlier than rest of IGP, while pollution lingers on longer in NCR and adjoining western UP.

In the lower IGP (Bihar and West Bengal) cleaning of air starts earlier than NCR. General observation form the data is that Northern Plains (up till central UP) are much severely impacted farm stubble fire smoke during the start of winter season but high levels seen later in the season are due to inversion and local pollution. Meanwhile, winter build-up in eastern plains is driven almost exclusively by inversion and local pollution with limited impact of farm stubble fires. (See *Graph 11: Heatmap of air quality in IGP cities (1.1.2019 to 15.10.2021)*).

Graph 11: Heatmap of air quality in IGP cities (1.1.2019 to 15.10.2021)



Note: Average $PM_{2.5}$ concentration is based on mean of daily values recorded at all CAAQM stations in the city. Cell colour is based on the official colour-scheme of AQI sub-categories.
Source: CSE analysis of CPCB's real time air quality data

Monsoon season average is a good indicator of extent of local pollution among cities. The weather conditions actively wash down pollution. Therefore, cities reporting higher seasonal averages ought to have bigger local pollution problem. Therefore, it is no a surprise that industrial towns of Bhiwadi, Moradabad, and Yumuna Nagar are at the bottom of the list of least polluted cities in IGP during this monsoon season. It is interesting to note that cities in Delhi-NCR and its adjoining region are also concentrated at the bottom third of the list, indicating problem of local pollution. In fact, within Delhi there are locations like Anand Vihar that report as bad air as Bhiwadi the worst city on the list (See *Annexure 1: Seasonal $PM_{2.5}$ averages of IGP cities*).

Bhatinda and Haldia were the cleanest cities in IGP during this monsoon season.

Also despite the heavier than usual monsoon many cities in IGP actually recorded increase in PM2.5 level this monsoon compared to last monsoon. Bhiwani (16 per cent), Narnaul (14 per cent), Rohtak (10 per cent), Kolkata (9 per cent), Gaya (6 per cent), and Sirsa (5 per cent) saw increase of over 5 per cent.

Most improvement was noted in Charkhi Dadri (25 per cent), Mandi Gobindgarh (20 per cent), Agra (20 per cent), Fatehabad (17 per cent), Lucknow (17 per cent), Meerut (16 per cent), Bulandshahr (13 per cent) and Bagpat (12 per cent). (See annex 1: Seasonal PM2.5 averages of IGP cities).

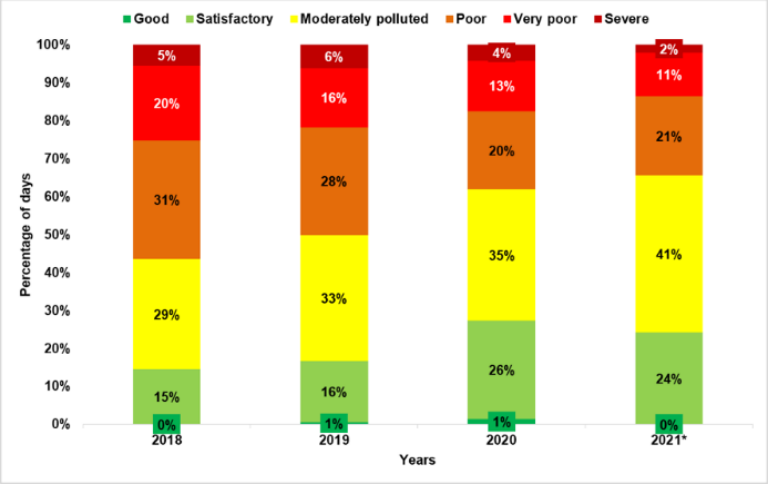
What is composite Air Quality Index (AQI) signaling in Delhi

In addition to the analysis of $PM_{2.5}$ concentration as a key indicator of change in air quality, an additional effort has also been made to understand the trend in the daily reporting of Air Quality Index (AQI) in Delhi. The general public follows the AQI as this is a tool for communication of air quality status. It translates complex air quality data (concentrations) of various pollutants into a single number (index value), nomenclature and colour. This classifies the air quality as Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. Each category is decided based on ambient concentration values of air pollutants and their likely health impacts. AQI for each pollutant type is computed independently, and these are called sub-index. The highest AQI among all the pollutant types becomes the main AQI and the pollutant type associated with it is labelled as predominant pollutant at the location. The sub-index are expected to consider all regulated pollutants (PM_{10}, $PM_{2.5}$, NO_2, SO_2, CO, O_3, NH_3, and Pb (upto 24-hours and 8-hours for CO and O_3). The daily AQI is reported based on the lead pollutant of the day with highest sub-index. This kind of represents the composite air quality of the city.

However, all the eight pollutants may not be monitored at all the locations. Therefore, the overall AQI is calculated only if data is available for a minimum of three pollutants, out of which one should necessarily be either $PM_{2.5}$ or PM_{10}. Else, data is considered insufficient for calculating AQI. Similarly, a minimum of 16 hours of data is considered necessary for calculating the sub-index. AQI thus reflects the composite air quality of the city.

CSE's analysis of the daily AQI for the period 2018-2021 (until October 15th) shows that number of 'good' days are still very negligible in Delhi. From zero good days in 2018 about three days in 2019 and five days in 2020 have been recorded. There are none so far in 2021. However, there has been a steady increase in the number of 'satisfactory' and 'moderately polluted' days. On the other hand, the number of days in 'very poor' and 'severe' categories, have somewhat decreased over the past four years indicating stabilization and even bending of the curve. The data for the year 2021 is till 15 October, so the worst days are yet to come (See *Graph 12: Categorization of Air Quality Index for a period of four years 2018-2021*).

Graph 12: Categorization of Air Quality Index for a period of four years 2018-2021



Note: Data for 2021 is till 15 October
Source: CSE's analysis based on CPCB AQI data

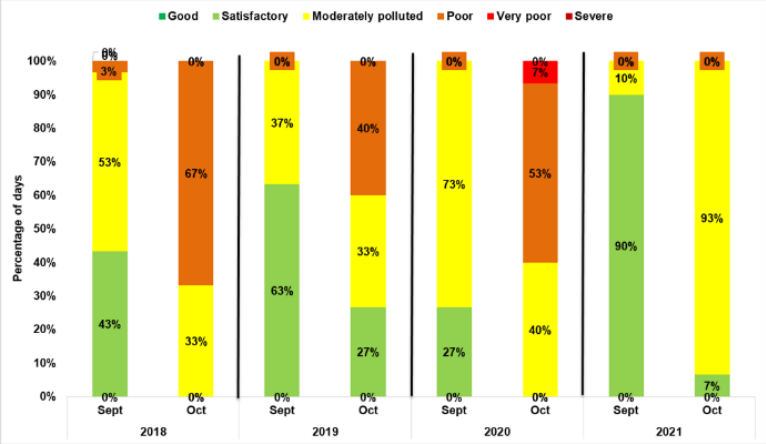
The AQI during pre-winter months and the changing pattern of lead pollutant: The months of September and October which is the transition period from monsoon to winter show that the number of days in 'satisfactory' category has increased from 43 per cent in 2018 to 90 per cent in 2021. In 2020 however, this came down to 27 per cent. A similar pattern is seen in the 'moderately polluted' category.

In September 2021 has not recorded any 'poor' day. In October, 2021, the number of days in 'poor' category has reduced from 67 per cent in 2018 to zero per cent in 2021. In 2020, there was a slight increase with 53 per cent of days in 'poor' category. (See *Graph 13: Month-wise categorization of Air Quality Index for September and October (till 15th) from 2018–2021*)

Normally particulate pollution dominate the daily pollution in Delhi. However, during pre-winter months primarily due to the wash out effect of rains, other gaseous pollutants have often became the lead pollutants along with particulate pollution of the day. In 2021, out of the 45 days (September 1 –October 15), division of the days based on the prominent pollutant are as follow.

- PM_{10} = 5 days
- $PM_{2.5}$ + PM_{10} = 10 days
- PM_{10} + O_3 = 1 day
- PM_{10} + CO = 15 days
- PM_{10} + CO + O_3 = 5 days
- PM_{10} + $PM_{2.5}$ + O_3 = 4 days
- PM_{10} + $PM_{2.5}$ + CO = 4 days
- $PM_{2.5}$ + CO + O_3 = 1 day

Graph 13: Month-wise categorization of Air Quality Index for September and October (till 15th) from 2018–2021



Note: Data for 2021 is till 15 October
Source: CSE's analysis based on CPCB AQI data

Act now

Delhi and the larger region will require urgent action to prevent severe smog episodes as well as speed up deeper reforms to sustain the gains. Reduce traffic volume, eliminate waste burning, eliminate dirty industrial fuels, and implement stringent dust control measures especially in construction sector.

Annexure

Annexure 1: Seasonal $PM_{2.5}$ averages of IGP cities

Rank	City	Monsoon 2021	Summer 2021	Winter 2020
1	Bhatinda	15	43	71
2	Haldia	18	23	85
3	Gorakhpur	20	-	-
4	Siliguri	21	71	106
5	Varanasi	23	62	125
6	Howrah	24	48	109
7	Kolkata	25	45	103
8	Firozabad	25	-	-
9	Prayagraj	25	29	
10	Sonipat	26	51	91
11	Patiala	26	43	73
12	Vrindavan	27	-	-
13	Muzaffarpur	27	60	123
14	Patna	27	68	127
15	Chandigarh	28	36	58

Rank	City	Monsoon 2021	Summer 2021	Winter 2020
16	Mandikhera	28	50	84
17	Agra	28	74	149
18	Gaya	28	44	70
19	Meerut	28	69	161
20	Asansol	29	54	98
21	Palwal	29	36	49
22	Kanpur	29	55	166
23	Fatehabad	30	53	147
24	Alwar	30	40	56
25	Hapur	31	27	63
26	Khanna	31	42	66
27	Bulandshahr	32	75	198
28	Hajipur	32	63	58
29	Kaithal	33	37	100
30	Sirsa	33	57	82
31	Bagpat	34	80	177
32	Lucknow	35	69	168
33	Greater Noida	35	72	204
34	Noida	36	70	203
35	Karnal	36	50	96
36	Panipat	36	57	101
37	Bhiwani	36	24	45
38	Amritsar	37	46	73
39	Panchkula	37	42	77
40	Narnaul	37	61	102
41	Jalandhar	38	49	69
42	Ludhiana	38	49	71
43	Kurukshetra	39	55	122
44	Bahadurgarh	40	80	151
45	Ghaziabad	41	88	229
46	Ambala	41	48	92
47	Delhi	41	78	192
48	Charkhi Dadri	42	61	125
49	Faridabad	42	78	160
50	Muzaffarnagar	42	57	141
51	Dharuhera	43	70	155
52	Hisar	43	77	156
53	Jind	43	74	156
54	Mandi Gobindgarh	43	64	83
55	Ballabgarh	44	67	112
56	Durgapur	44	75	136
57	Gurugram	44	73	157
58	Rohtak	47	72	154
59	Manesar	51	91	128
60	Yamuna Nagar	52	68	133
61	Moradabad	53	93	183
62	Bhiwadi	56	119	168
-	Rupnagar	-	-	72

Note: Seasonal value is based on average of 24hr averages in the season. Minimum 75 per cent data completeness is required in each season to assign a valid seasonal value. Cities with multiple monitoring station, average of all stations meeting the data completeness requirements in all three season is used to represent the city. Monsoon 2021 is 1.7,2021 to 14.10.2021; Summer 2021 is 16.2.2021 to 30.6.2021; Winter 2020 is 15.10.2020 to 15.2.2021.
Source: CSE analysis of CPCB's real time air quality data