

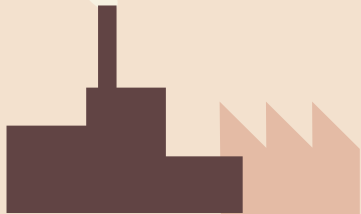
The background features a stylized illustration of air pollution. On the left, two orange smokestacks emit thick, dark grey smoke that rises into the air. On the right, a single orange smokestack emits a similar plume of smoke. In the background, there are silhouettes of buildings and a large, semi-circular shape with diagonal hatching, possibly representing a sun or moon. The overall color palette is muted, with earthy tones and greys.

Air Pollution in Delhi during lockdown

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01. introduction

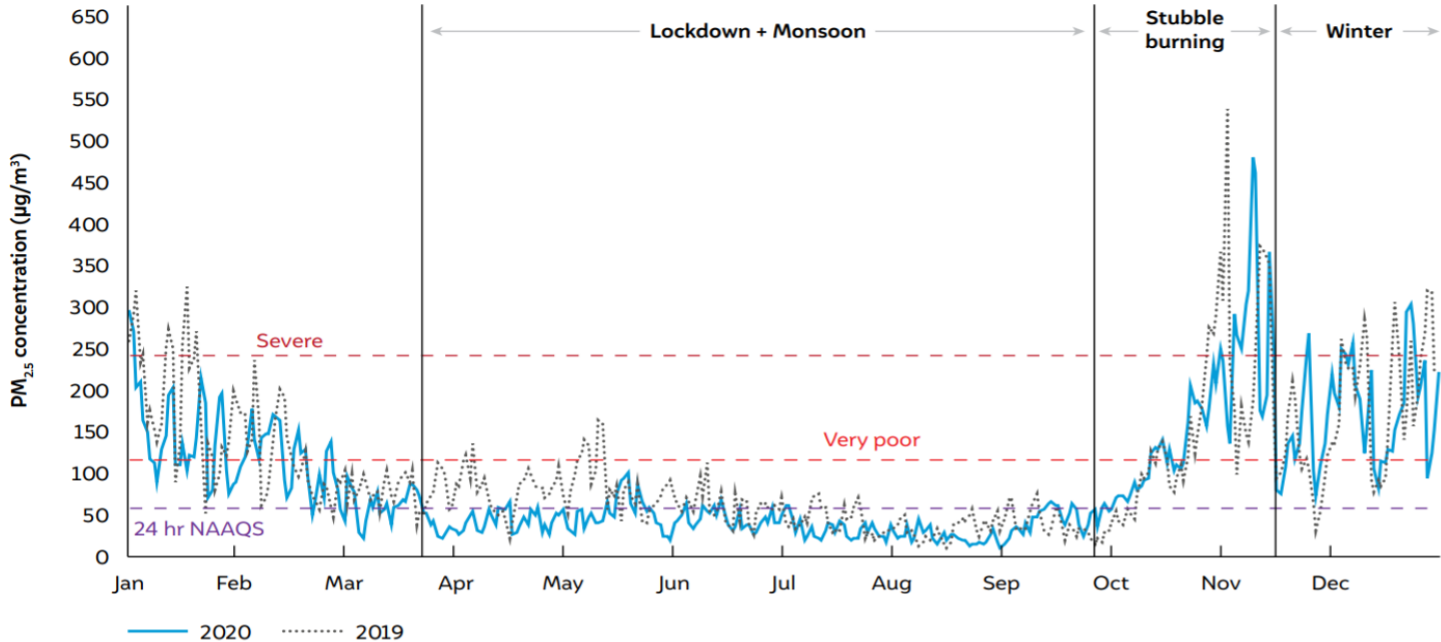


Delhi is among the most polluted cities in the world (IQ Air 2021). In 2019 alone, air pollution caused over 17,000 premature deaths and an economic loss of 1,207 million USD in the national capital (Pandey et al. 2021). With regards to air quality, 2020 was an aberration. The pandemic-induced lockdown measures provided temporary respite from the year-round poor air quality

Despite the lockdown, Delhi's annual average PM_{2.5} in 2020 was more than 2-times its permissible limit

Barring a few days in April and May, Delhi experienced National Ambient Air Quality Standard (NAAQS)¹ compliant air quality on most days during the lockdown. Yet, the annual average PM_{2.5} concentration in 2020 was 93 µg/m³, which is more than twice the permissible limit for PM_{2.5} in India. Despite low activity levels for close to eight months (March to November) in 2020, Delhi residents were exposed to NAAQS non-compliant air for more than half of the year.

Air quality gains made from lockdown were lost in winter with the unlock



In this brief, we analyse and compare winter particulate matter concentrations in 2020 with 2019 levels to understand how this winter was, if at all, different in the circumstances and polluting activity in so far as the NCR region is concerned. To this end, we analyse source activity levels, and contributions to establish primary drivers of pollution during different phases of the winter season.



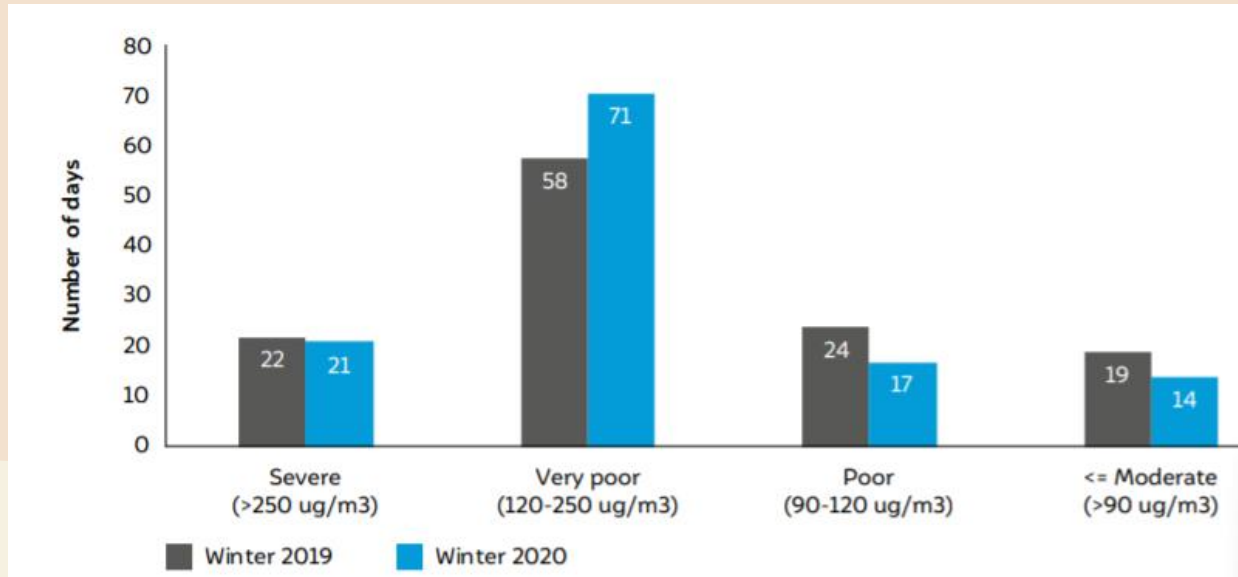
Results and discussion

| 02 |



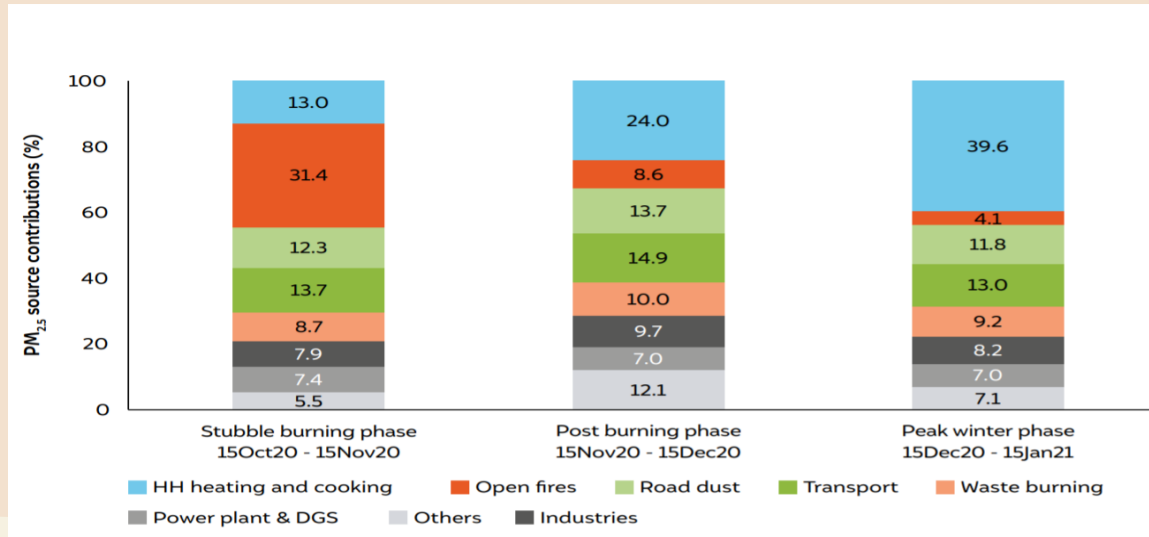
Air quality in winter 2020 was worse than winter 2019

Delhi observed 92 severe and very poor air quality days in the winter of 2020 compared to 80 such days in 2019. Compared to an average PM_{2.5} concentration of 161 $\mu\text{g}/\text{m}^3$ in 2019, between October and November 2020, this value was 172 $\mu\text{g}/\text{m}^3$. It further shot up to an average level of 192 $\mu\text{g}/\text{m}^3$ in the period between December 2020 to January 2021 compared to 178 $\mu\text{g}/\text{m}^3$ during the same period previous year.

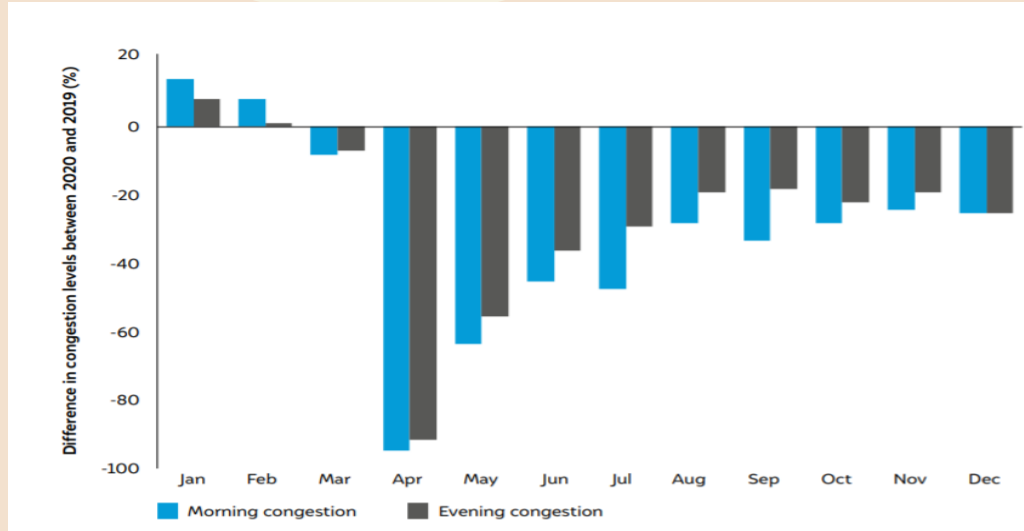


Contributions from stubble burning and household emissions from cooking and space heating were significant fractions of the pollution pie

Modelled source contribution estimates of particulate matter (PM_{2.5}) by Urban Emissions suggest that relative contribution from farm fires was the highest (~30 per cent) in the period between 15 October and 15 November 2020s. In the following months, contribution from household emissions (including domestic cooking, space heating, water heating, and lighting) primarily drove poor air quality in Delhi. It is worth highlighting that these values are modelled estimates and are subject to the sector-specific assumptions used in the model.



Average contribution of emissions from vehicles was 14% between October 2020 and January 2021



Vehicular emissions contribute 17–28 per cent to Delhi’s PM_{2.5} levels (TERI and ARAI 2018). The initial phases of the lockdown brought about a significant decline in traffic volume. We use a metric that captures ‘congestion level’ from TomTom International BV (TomTom 2020) and is indirectly an indicator for on-road traffic volumes. We observe that congestion levels were almost 92 per cent lower in April 2020 compared to the same period last year. As lockdown began to be relaxed and as economic activity resumed in the later half of the year, congestion levels were only 20–25 per cent lower between August and December 2020 than the corresponding congestion levels in 2019 (Figure 13). The lower congestion levels are representative of the reduced traffic volumes and vehicular emissions this 2020

Number of CAAQMS with $PM_{2.5}$ records

Pre-Diwali 0 hr 1 hr 2 hr 3 hr 4 hr 5 hr 6 hr 7 hr 8 hr 9 hr 10 hr 11 hr 12 hr 13 hr 14 hr 15 hr 16 hr 17 hr 18 hr 19 hr 20 hr 21 hr 22 hr 23 hr

Diwali 0 hr 1 hr 2 hr 3 hr 4 hr 5 hr 6 hr 7 hr 8 hr 9 hr 10 hr 11 hr 12 hr 13 hr 14 hr 15 hr 16 hr 17 hr 18 hr 19 hr 20 hr 21 hr 22 hr 23 hr

Post-Diwali 0 hr 1 hr 2 hr 3 hr 4 hr 5 hr 6 hr 7 hr 8 hr 9 hr 10 hr 11 hr 12 hr 13 hr 14 hr 15 hr 16 hr 17 hr 18 hr 19 hr 20 hr 21 hr 22 hr 23 hr

— Diwali'20 (14 Nov 2020) - - - Diwali'19 (27 Oct 2019) Diwali'18 (7 Nov 2018)

Despite a National Green Tribunal (NGT) ban on the sale of all kinds of firecrackers in Delhi NCR, pollution levels during Diwali 2020 reached the maximum values in the last four years (CPCB 2020b; NGT 2020). On the night of 14 November 2020 (Diwali), several continuous monitoring stations in Delhi reported a sharp jump in PM_{2.5} levels from 250 µg/m³ to 500+ µg/m³ at 10 p.m., indicating a significant share of emissions from firecrackers. In less than an hour, most stations stopped reporting. This typically happens when the concentration exceeds the standard range (0–1,000 µg/m³) of a beta attenuation mass monitor² (BAM) (Ecotech 2012). As observed in 2018 and 2019, less than 10 out of 37 continuous monitoring stations in Delhi reported values between midnight and 3 a.m. on the Diwali night in 2020

conclusion

Our analysis compared the anthropogenic activity levels in 2020 with those in 2019. We also explain how these factors influenced air quality in the winter of 2020. We find that air quality in the winter of 2020 was worse than in the winter of 2019. Lower vehicular congestion and power generation levels in October and November 2020 are indicative of reduced emissions from these two activities. A relatively longer stubble burning period, colder and drier winter conditions, and calmer winds in October and November 2020 were primarily responsible for the worsening Delhi's air quality that year. As the winter season progressed, most anthropogenic activities such as power generation and vehicular levels bounced back to previous year's levels. Household heating and cooking contributed to a significant share (40 per cent) to the pollution burden in December 2020 and January 2021

THANKYOU

