AQLI Air Quality Life Index®

Delhi Air Pollution:

8 Things You Should Know

Delhi ranks as the most polluted city globally, based on satellite-derived $PM_{2.5}$ data[1]. While 24-hour average $PM_{2.5}$ concentrations in Delhi can be higher than 250 $\mu g/m^3$ on some days during the winter months, the city's annual-average $PM_{2.5}$ concentration is over sixteen times the WHO guideline of 5 $\mu g/m^3$ and double India's national annual-standard of 40 $\mu g/m^3$.[2] If $PM_{2.5}$ levels in Delhi were permanently reduced to meet the WHO guideline, the average life expectancy in the city could increase by 7.8 years.[3]

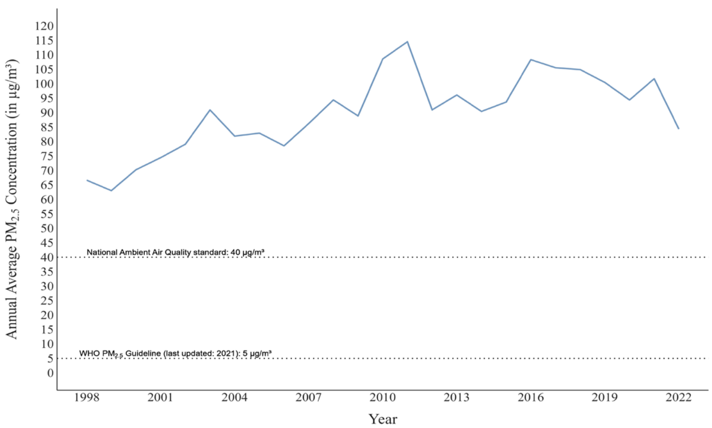
How Polluted is Delhi?

1. **Annual-average $PM_{2.5}$ concentrations in Delhi are more than twice India's standard.** In 2022, the annual-average $PM_{2.5}$ concentration in Delhi was 84.3 $\mu g/m^3$ [4] - more than twice of India's own national standard of 40 $\mu g/m^3$. If $PM_{2.5}$ concentrations in Delhi were brought down to meet the country's standard - an average resident of Delhi could gain 3.4 years of life expectancy.
2. **People in Delhi could live 3 years longer, if Delhi met the NCAP reduction target.** Delhi is among the 131 cities identified by the National Clean Air Programme (NCAP), India's flagship programme on air quality management. If $PM_{2.5}$ concentrations in Delhi are reduced by 40 percent, NCAP's particulate reduction target, average life expectancy in the city could go up 3.3 years.
3. **Delhi's $PM_{2.5}$ concentrations have increased by over 20 percent in the last two decades.** Longer-term trends suggest that Delhi's average annual $PM_{2.5}$ concentrations have increased by 26 percent from 1998 to 2022, reducing life expectancy by 1.7 years (Figure 1).

What's Polluting Delhi?

4. **Stubble burning is only a seasonal contributor to Delhi's $PM_{2.5}$ concentrations.** In the weeks preceding winter, the contribution of stubble burning has been estimated to be about 30 percent[5], but on an annual-basis the contribution of stubble fires to Delhi's $PM_{2.5}$ concentrations is less than 3 percent[6]. Biomass burning from waste on the other hand, can contribute to upto to 15 percent of Delhi's $PM_{2.5}$ concentration annually.

Figure 1.
Annual average $PM_{2.5}$ concentration in Delhi, 1998-2022



1 Air Quality Life Index (AQLI) data Available at: https://aqli.epic.uchicago.edu/the-index/ and Atmospheric Composition Analysis Group (ACAG) data Available at: https://sites.wustl.edu/acag/datasets/surface-pm2-5/

2 CPCB.2009. "National Ambient Air Quality Standards" Notification at: https://cpcb.nic.in/uploads/National_Ambient_Air_Quality_Standards.pdf

3 Air Quality Life Index 2024. "Annual Update" at: https://aqli.epic.uchicago.edu/wp-content/uploads/2024/08/AQLI-2024-Report_India-View.pdf

4 Air Quality Life Index (AQLI) data Available at: https://aqli.epic.uchicago.edu/the-index/

5 Council on Energy,, Environment and Water (CEEW).2021." Bending Delhi's Air Pollution Curve" Available at: https://www.ceew.in/sites/default/files/ceew-study-on-controlling-delhi-air-pollution-2021.pdf

6 Guttikunda, Sarath K., Sai Krishna Dammalapati, Gautam Pradhan, Bhargav Krishna, Hiren T. Jethva, and Puja Jawahar. 2023. "What Is Polluting Delhi's Air? A Review from 1990 to 2022" Sustainability 15(5) : 4209. https://www.mdpi.com/2071-1050/15/5/4209#B9-sustainability-15-04209

Figure 2: Impact of source control on life expectancy[1]

Source	Contribution to $PM_{2.5}$ concentration (percent)[2]	Potential gain in life expectancy under various source reduction scenarios (in years)*		
		10 percent	30 percent	50 percent
Vehicles	20	0.17	0.50	0.83
Dust (Road + construction)	20	0.17	0.50	0.83
Biomass (Crop residue)	3	0.02	0.07	0.12
Biomass (open waste)	10	0.08	0.25	0.41
Industries	20	0.17	0.50	0.83

*Example statistics from this figure can be interpreted as: "Vehicles contribute to 20 percent of Delhi's pollution. A sustained 30 percent reduction in vehicle emissions would result in increasing average life expectancy by half of a year."

1 For calculations in this table, Delhi's $PM_{2.5}$ concentration has been considered as 84.3 µg/m3 which was Delhi's satellite-derived $PM_{2.5}$ concentration in 2022.

2 Refer to footnotes 5 and 6 for information on source contribution to Delhi's $PM_{2.5}$ concentration

5. **Vehicles and dust constitute a major fraction of Delhi's pollution load share.** Annually, vehicular pollution and dust from road and construction sites contributes to up to 40 percent of Delhi's $PM_{2.5}$ concentration. [7]
6. **People in Delhi can live 2 years longer, if Delhi were to eliminate its local pollution sources.** If pollution from vehicles, dust from road and construction sites and biomass burning were addressed and their contributions reduced by as much as 50 percent - average life expectancy in the city can go up by 2.1 years (Figure 2).

What has been the policy response to air pollution in Delhi?

7. **Delhi has both Comprehensive and Emergency Action Plans for tacking air pollution.** Policy response to air pollution in Delhi has been in the form of a Clean Air Plan [8] which guides air pollution control actions throughout the year and an emergency response plan called the Graded Response Action Plan (GRAP) [9] which is triggered when daily-$PM_{2.5}$ concentrations in Delhi exceed the 90 µg/m³ mark. The measures in the GRAP get progressively stricter with increasing $PM_{2.5}$ concentrations.
8. **Stricter measures like bans come into effect only when pollution breaches the severe mark.** The emergency measures for when $PM_{2.5}$ concentrations are between 90 µg/m³ and 250 µg/m³ call for stricter enforcement of dust control measures and encouraging public transport. It is only when $PM_{2.5}$ concentrations exceed 250 µg/m³ that stricter measures like bans on construction activities (with certain exemptions), operations of stone crushers and mining operations and movement of certain categories of vehicles come into effect.

7 Refer to footnote 6

8 Delhi Clean Air Plan https://cpcb.nic.in/Actionplan/Delhi.pdf

9 Commission for Air Quality Management (CAQM). 2022. "Revised Graded Response Action Plan (GRAP) For NCR" Available at: https://caqm.nic.in/WriteReadData/LINKS/a7fd9448-99e6-48db-b01f-f14a019664f4.pdf

ABOUT THE AIR QUALITY LIFE INDEX (AQLI)

The AQLI is a pollution index that translates particulate air pollution into perhaps the most important metric that exists: its impact on life expectancy. Developed by the University of Chicago's Milton Friedman Distinguished Service Professor in Economics Michael Greenstone and his team at the Energy Policy Institute at the University of Chicago (EPIC), the AQLI is rooted in recent research that quantifies the causal relationship between long-term human exposure to air pollution and life expectancy. The Index then combines this research with hyper-localized, global particulate measurements, yielding unprecedented insight into the true cost of particulate pollution in communities around the world. The Index also illustrates how air pollution policies can increase life expectancy when they meet the World Health Organization's guideline for what is considered a safe level of exposure, existing national air quality standards, or user-defined air quality levels. This information can help to inform local communities and policymakers about the importance of air pollution policies in concrete terms.

Methodology: The life expectancy calculations made by the AQLI are based on a pair of peer-reviewed studies, Chen et al. (2013) and Ebenstein et al. (2017), co-authored by Michael Greenstone, that exploit a unique natural experiment in China. By comparing two subgroups of the population that experienced prolonged exposure to different levels of particulate air pollution, the studies were able to plausibly isolate the effect of particulate air pollution from other factors that affect health. The more recent of the two studies found that sustained exposure to an additional 10 µg/m3 of PM_{10} reduces life expectancy by 0.64 years. In terms of $PM_{2.5}$, this translates to the relationship that an additional 10 µg/m3 of $PM_{2.5}$ reduces life expectancy by 0.98 years. All AQLI annual average $PM_{2.5}$ values are population- weighted and AQLI's source of population data is https://landscan.ornl.gov/. We are grateful to the Atmospheric Composition Analysis Group, based at the Washington University in St. Louis for providing us with the sea-salt and mineral dust removed satellite-derived $PM_{2.5}$ data. Thus, our data can be interpreted as concentrations stemming primarily from human activity. The original dataset can be found here: https://sites.wustl.edu/acag/datasets/surface-pm2-5/. To learn more deeply about the methodology used by the AQLI, visit: aqli.epic.uchicago.edu/about/methodology.