AQLI Air Quality Life Index®

North India Fact Sheet

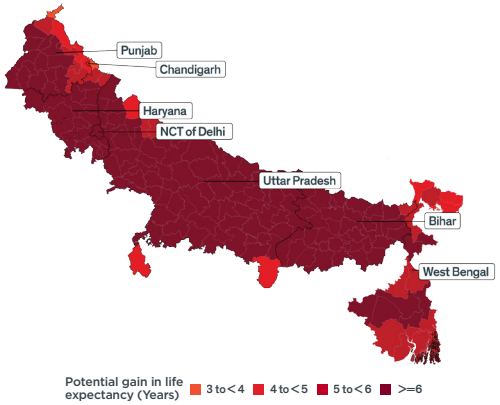
The world's 50 most polluted regions all belong to the Northern Plains of India.[1] The seven states and union territories comprising the majority of this region—Bihar, Chandigarh, Delhi, Haryana, Punjab, Uttar Pradesh, and West Bengal face the greatest health burden due to particulate pollution in India. Fine particulate air pollution ($PM_{2.5}$) shortens an average Indian's life expectancy by 5.3 years, relative to what it would be if the World Health Organization (WHO) guideline of 5 µg/m^3 was met.[2] In North India, it shortens lives by 8 years—underscoring the outsized benefits effective pollution policy would have, allowing residents of North India to gain 4.2 billion life years in total.

KEY TAKEAWAYS

- Practically all of the Northern Plains' 521.2 million people, 38.9 percent of India's population, live in areas where the annual average particulate pollution level is 17.3 times higher than the WHO guideline.
- Particulate pollution has increased over time. From 1998 to 2021, average annual particulate pollution increased by 61 percent, further reducing life expectancy by 3.2 years.
- In the most polluted region of the Northern Plains—the NCT of Delhi—18 million residents are on track to lose 11.9 years of life expectancy on average relative to the WHO guideline and 8.5 years relative to the national guideline if current pollution levels persist. Delhi, the capital and most populous city, is the most polluted city in India and the world. Yet, even in the least polluted district in the region—Pathankot in the state of Punjab—particulate pollution is more than 7 times the WHO guideline, taking 3.1 years off life expectancy if current levels persist.
- Though the Northern Plains' particulate pollution is exacerbated by geologic and meteorological factors, the AQLI's dust and sea salt-removed $PM_{2.5}$ data imply that human activity plays a key role in generating the severe particulate pollution that these residents face. That is likely due to the fact that the region's population density is nearly three times that of the rest of the country, meaning more pollution from vehicular, residential and agricultural sources. A denser population also means more human lives are impacted by each pollution source.

Figure 1 · States and union territories in the Northern Plains of India

Figure 2 · Potential gain in life expectancy from permanently reducing $PM_{2.5}$ from 2021 concentration to the WHO guideline



1 We define the Northern Plains of India as the following seven states and union territories: Bihar, Chandigarh, Delhi, Haryana, Punjab, Uttar Pradesh, and West Bengal. In this analysis, Northern Plains of India is synonymous with North India, Northern India, and the North Indian Belt.

2 This data is based on the AQLI 2021 dataset. All annual average $PM_{2.5}$ values (measured in micrograms per cubic meter: µg/m^3) are population weighted.

POLICY IMPACTS

In 2019, India declared a "war against pollution" and launched its National Clean Air Programme (NCAP), signaling its desire to reduce particulate pollution. NCAP originally aimed to reduce particulate pollution by 20-30 percent nationally relative to 2017 levels by 2024 and focused on 102 cities that were not meeting India's national annual average $PM_{2.5}$ standard, termed "non-attainment cities." In 2022, the Indian Government announced its revamped particulate pollution reduction target for NCAP, setting no national goal but increasing its ambition at the city level. The new goal aims for a 40 percent reduction relative to 2017 levels for an expanded number of 131 non-attainment cities by 2025-26. If the ambition of the revised target is met, these cities' overall annual average $PM_{2.5}$ exposure would be 21.9 µg/m³ lower than 2017 levels. This results in a life expectancy gain of 2.1 years for an average citizen living in these specific 131 cities and increases the life expectancy of an average Indian in the country by 7.9 months; 38 of these 131 targeted cities (almost 30 percent) belong to the Northern Plains of India.

Figure 3 · Potential gain in life expectancy from reducing $PM_{2.5}$ concentrations from 2021 levels to the WHO guideline in the 10 most populous districts of the Northern Plains of India

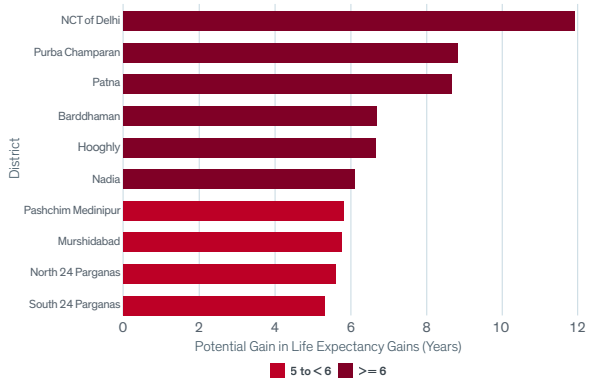
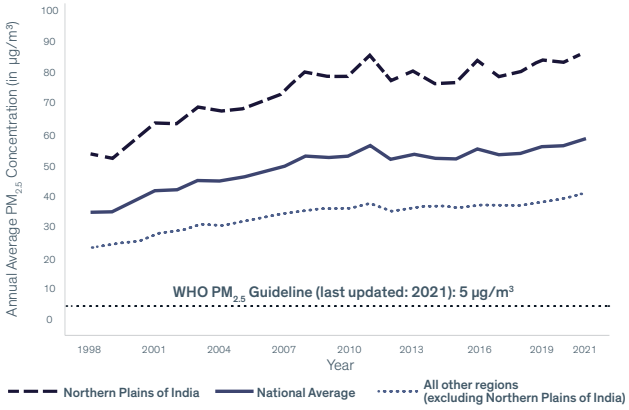


Figure 4 · Annual average $PM_{2.5}$ concentrations in the Northern Plains of India and other regions of India, 1998-2021



Potential life expectancy impacts of particulate pollution reductions in four most populous districts of each state/UT of the Northern Plains of India[3]

State	District	Population (in millions)	Annual average $PM_{2.5}$ in 2021 (in µg/m³)	Life expectancy gains from reducing $PM_{2.5}$ concentrations from 2021 concentration to WHO Guideline of 5 µg/m³ (years)	Life expectancy gains from reducing $PM_{2.5}$ concentrations from 2021 concentration to national guideline of 40 µg/m³ (years)
Bihar	Patna	6.7	93.4	8.7	5.2
Bihar	Purba Champaran	5.8	94.8	8.8	5.4
Bihar	Muzaffarpur	5.5	98.3	9.2	5.7
Bihar	Madhubani	5.2	82.3	7.6	4.2
Chandigarh	Chandigarh	1.2	48.6	4.3	0.8
Haryana	Faridabad	2.4	115.6	10.8	7.4
Haryana	Hisar	1.9	83.6	7.7	4.3
Haryana	Gurugram	1.7	119.5	11.2	7.8
Haryana	Karnal	1.7	80.9	7.4	4
NCT of Delhi	NCT of Delhi	18	126.5	11.9	8.5
Punjab	Ludhiana	3.7	74.4	6.8	3.4
Punjab	Amritsar	2.6	78.6	7.2	3.8
Punjab	Jalandhar	2.4	70.8	6.4	3
Punjab	Patiala	2	65.7	5.9	2.5
Uttar Pradesh	Prayagraj	5.4	94.8	8.8	5.4
Uttar Pradesh	Lucknow	5.2	104.4	9.7	6.3
Uttar Pradesh	Kanpur Nagar	5.1	104.2	9.7	6.3
Uttar Pradesh	Jaunpur	5.1	107.9	10.1	6.7
West Bengal	North 24 Parganas	11.1	62.2	5.6	2.2
West Bengal	South 24 Parganas	8.8	59.3	5.3	1.9
West Bengal	Barddhaman	8.3	73.2	6.7	3.3
West Bengal	Murshidabad	7.7	63.9	5.8	2.3

3 The union territories of NCT of Delhi and Chandigarh contain only one district, which is of the same name as the UT itself. Given this, the appendix table provides data on a total of 22 districts across these 7 states/UTs.

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 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, satellite measurements of global particulate matter ($PM_{2.5}$), yielding unprecedented insight into the true cost of 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. Ebenstein et al. (2017) 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. This metric is then combined with sea-salt and mineral dust removed satellite-derived $PM_{2.5}$ data. All 2021 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 satellite data. 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.