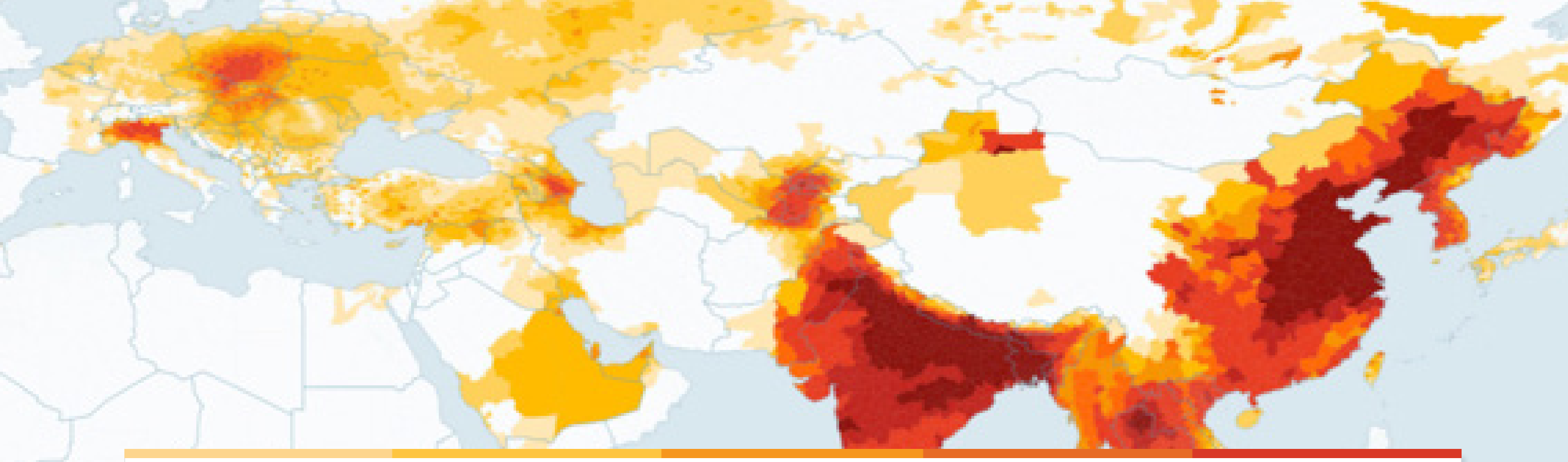
AQLI Air Quality Life Index®

AIR QUALITY LIFE INDEX® | UPDATE JANUARY 2019

India's 'War Against Pollution': An Opportunity for Longer Lives

By Michael Greenstone and Qing (Claire) Fan



SUMMARY

In 2019, India declared a "war against pollution" and launched its National Clean Air Programme (NCAP), signaling its desire to reduce particulate air pollution—the greatest threat to human health on the planet. The Programme, which aims to reduce particulate pollution by 20-30 percent nationally, will be implemented over the next five years. If successful in meeting its goals and sustaining the reduced pollution levels, the NCAP would produce substantial benefits, extending the life expectancy of the average Indian by about 1.3 years. People breathing the most polluted air—namely those in Delhi and parts of Uttar Pradesh—could live up to 3 years longer. Further, the NCAP highlighted 102 cities containing about one quarter of the country's population that fell short of India's air standards. If all the cities permanently reduced particulate pollution by 25 percent (the midpoint of NCAP's goal), their residents would gain 1.4 years. Though achieving the NCAP's goals would be an important step toward reversing India's 69 percent increase in fine particulate pollution ($PM_{2.5}$) concentrations since 1998, India could achieve further gains in life expectancy for its citizens through additional pollution reductions that bring the country into compliance with its own official air quality standards or the World Health Organization's (WHO) guidelines for $PM_{2.5}$ concentrations.

"The payoffs from the successful implementation of NCAP could be substantial, with people in the most polluted areas — like Delhi — living almost three years longer."

Michael Greenstone, Milton Friedman Distinguished Service Professor in Economics, the College and the Harris School; Director, EPIC

INTRODUCTION

India's 'War Against Pollution'

On January 10, 2019, India's Environment Minister Harsh Vardhan declared a "war against pollution" as he launched the National Clean Air Programme (NCAP). The Programme aims to reduce particulate pollution by 20-30 percent from 2017 levels by 2024. The five-year action plan, with funding of Rs 300 crore (about $42 million) for the first two years, will begin immediately and be implemented through city-specific pollution reduction plans along with national initiatives. Nationwide, it aims to meet this target by strengthening mitigation, monitoring and transparency, and building institutional capacity to address pollution. In addition, NCAP targets 102 cities throughout the country that do not meet national pollution standards. These cities are tasked with formulating local action plans for air pollution reduction.

The NCAP was introduced as India experienced some of its highest concentrations of particulate pollution. Just the week prior, particulate pollution in India's capital city of New Delhi surged to "emergency" levels, according to the Central Pollution Control Board's air quality index, with daily $PM_{2.5}$ levels hitting 440 micrograms per cubic meter—17 times the WHO guideline for a relatively safe level of $PM_{2.5}$ exposure within a 24-hour period, and 7 times the country's own National Ambient Air Quality Standard (NAAQS). The annual average pollution concentration in the city was 113 micrograms per cubic meter in 2016. If those levels remain unchanged, life expectancy there would be 7 years lower than if the city were in compliance with the national standard (40 µg/m³). India has the world's second-most polluted air, slightly trailing only Nepal. In 2016, the last year for which concentrations for the entire country are available, the $PM_{2.5}$ concentration was 54 µg/m³. This is a 69 percent increase from the concentration of 32 µg/m³ in 1998, which is the first year that such data are available. If the 2016 concentrations continue, the Air Quality Life Index (AQLI) indicates that the average person in India's life expectancy would be shortened by more than 4 years relative to what it would be if the WHO guideline was met, or about 2 years relative to India's standard. This is up from about 2 years relative to the WHO guideline, and a half year, relative to the national standard, in 1998.

Concentrations in India's northern states—where the NCAP targets its ambitions—are substantially higher. In 1998, Delhi and the north Indian states of Uttar Pradesh, Haryana and Bihar already suffered from particulate concentrations exceeding India's national standard. Over the ensuing two decades, pollution in these regions increased to over twice the national standard, leading to up to 8 years of loss in average life expectancy in some districts, relative to if the regions complied with the national standard.

RESULTS

Potential Impacts

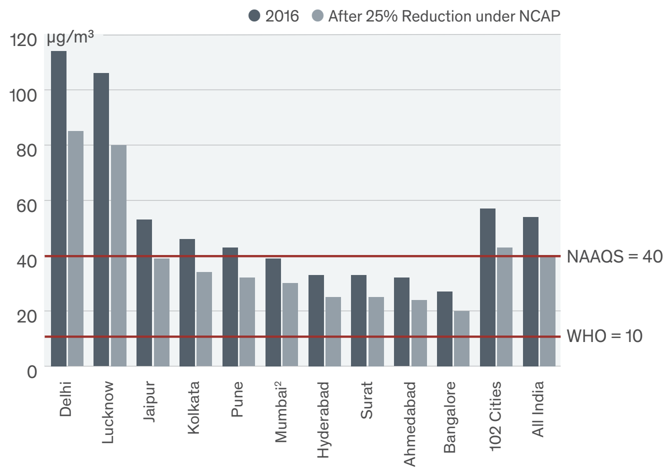
The NCAP's 20-30 percent pollution reduction target, according to the AQLI's calculations, represents a significant opportunity for India to improve its residents' health. Currently, satellite-derived air pollution data are not yet available for 2017, the baseline year for the NCAP target. Using 2016 levels as the baseline, a $PM_{2.5}$ reduction of 25 percent— the midpoint of the target range of 20-30 percent—will mean a nationwide average reduction of 13 µg/m³. This will bring the national annual average $PM_{2.5}$ to 40 µg/m³, which is India's national standard. The reduction would translate to a national average life expectancy increase of 1.3 years. This would take the country about 30 percent of the way to having all Indians breathe clean air based on the WHO guideline of 10 µg/m³.

The 102 cities singled out by the NCAP have higher pollution levels than the national average, so they stand to gain more if they follow through with their pollution reduction action plans.

METHODOLOGY

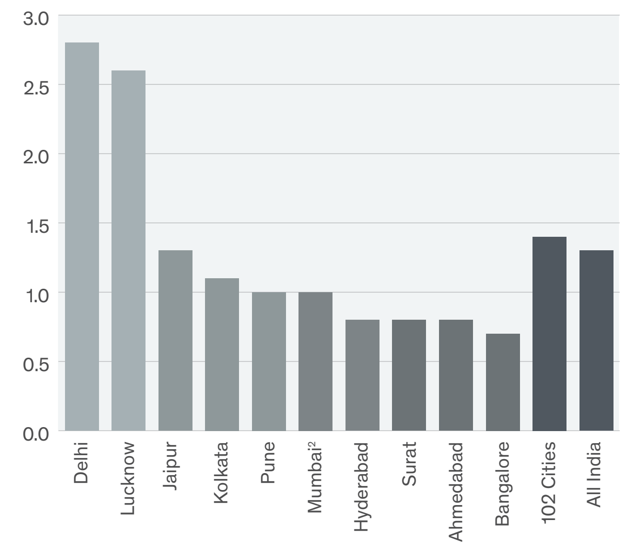
The life expectancy calculations made by the AQLI are based on a pair of peer-reviewed studies, Chen et al. (2013) and Ebenstein et al. (2017), co-authored by Michael Greenstone, that exploit a unique natural experiment in China. By comparing two subgroups of the population that experienced prolonged exposure to different levels of particulate air pollution, the studies were able to plausibly isolate the effect of particulates 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. The AQLI applied this finding to the projected declines in $PM_{2.5}$ from the NCAP using satellite-derived particulate pollution measurements to determine the life expectancy changes. To learn more about the methodology used by the AQLI, visit: aqli.epic.uchicago.edu/about/methodology

Figure 1 · PM$_{2.5}$ Concentrations in 10 Largest Non-Attainment Cities and All of India



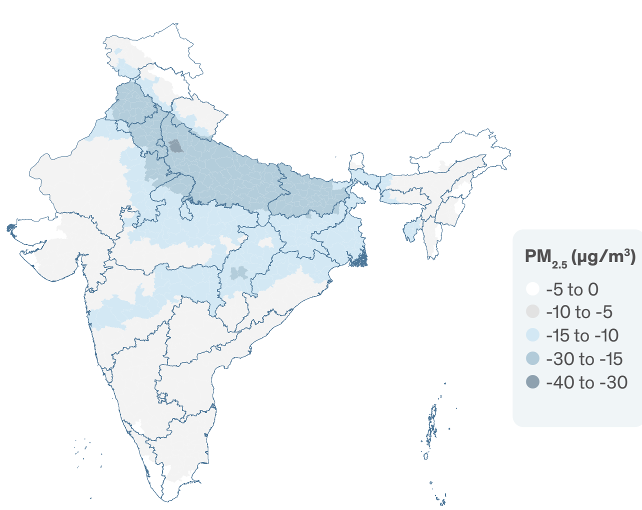
Note: A 25% PM$_{2.5}$ reduction is the midpoint of the NCAP's 20-30% target range. The cities in this graph are the 10 largest by population (2011 Census) of the 102 non-attainment cities singled out by the NCAP. Since the AQLI's data is at the district-level, the statistics shown are those associated with the districts containing the cities. Mumbai statistics are the population-weighted average of the statistics for the Mumbai City and Mumbai Suburban districts.

Figure 2 · Life Expectancy Gain From Achieving 25% PM$_{2.5}$ Reduction Under NCAP, in 10 Largest Non-Attainment Cities and All of India



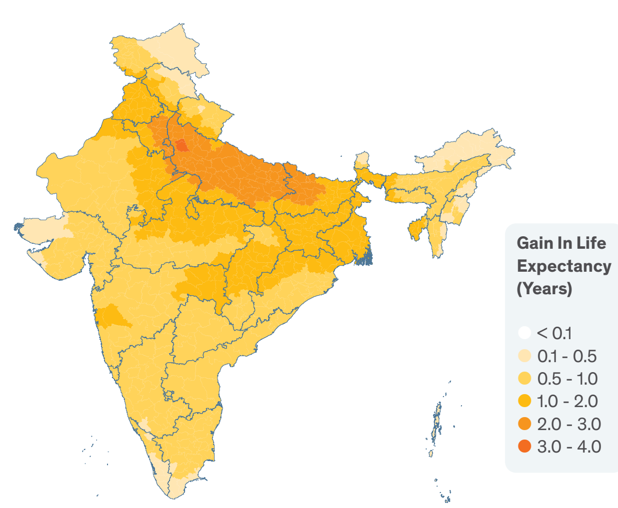
Note: A 25% PM$_{2.5}$ reduction is the midpoint of the NCAP's 20-30% target range. The cities in this graph are the 10 largest by population (2011 Census) of the 102 non-attainment cities singled out by the NCAP. Since the AQLI's data is at the district-level, the statistics shown are those associated with the districts containing the cities. Mumbai statistics are the population-weighted average of the statistics for the Mumbai City and Mumbai Suburban districts.

Figure 3 · Change in PM$_{2.5}$ From Achieving 25% PM$_{2.5}$ Reduction Target Under NCAP



Note: A 25% PM$_{2.5}$ reduction is the midpoint of the NCAP's 20-30% target range.

Figure 4 · Life Expectancy Gain From Achieving 25% PM$_{2.5}$ Reduction Target Under NCAP



Note: A 25% PM$_{2.5}$ reduction is the midpoint of the NCAP's 20-30% target range.

If all of the 102 cities reduced particulate pollution by 25 percent, their aggregate annual average PM2.5 exposure would be 14 µg/m³ lower than 2016 levels. This would translate to an average gain in life expectancy of 1.4 years. Among the 102 cities, a 25 percent pollution reduction would translate to a 2-3 year gain in life expectancy for the residents of 13 cities in Uttar Pradesh, two in Bihar, and Delhi. In Delhi, reducing the annual average PM2.5 by 25 percent, or 29 µg/m³, would translate to a gain in life expectancy of roughly 2.8 years for the average resident.[1]

CONCLUSION

The National Clean Air Programme (NCAP) aims for a future of cleaner air for India and healthier, longer lives for its citizens. The AQLI reveals that the NCAP could offer substantial benefits to India's citizens. If its targets are achieved and sustained, the average person in India would live 1.3 years longer. These are real and meaningful benefits that can justify the costs likely to be associated with achieving these pollution targets.

Significant progress is possible with ongoing political commitment. China, for example, announced its own "War on Pollution" in 2014. Since then, ground level monitors indicate that it has achieved reductions in PM$_{2.5}$ that are comparable to those that the NCAP proposes (Is China Winning its War on Pollution?, March 2018), with concomitant benefits for life expectancy there.

In the decades to come, NCAP may well be seen a watershed—the moment in India's history when clean air became an urgent priority. The AQLI indicates that the rewards for doing so will be large. Bringing the entire country into compliance with India's standards or the WHO guideline would increase the average Indian's life expectancy by 1.8 and 4.3 years respectively. Reaching the NCAP's targets will be an important first step.

1 The AQLI's data for India is at the district-level rather than the municipal level. Thus, throughout this report, pollution and life expectancy statistics associated with cities reflect the districts that contain the cities. However, since AQLI's district-level data is aggregated from finer-resolution data using population weights, more densely-populated urban areas are given more weight in the calculations. Therefore, the district-level data should be close to what municipality-specific numbers would be in cases where the city constitute a significant proportion of its district's population.

Appendix Table | Impact of Meeting NCAP Target on 102 Non-Attainment Cities

City	State	Population (Millions)	$PM_{2.5}$ Concentrations (µg/m³) 2016	$PM_{2.5}$ Concentrations (µg/m³) After 25% Reduction	Life Expectancy Gain (Years) from 25% $PM_{2.5}$ Reduction
Delhi	NCT of Delhi	16.9	114	85	2.8
Pune	Maharashtra	9.9	43	32	1.0
Bangalore	Karnataka	9.9	27	20	0.7
Thane (Badlapur, Ulhasnagar)	Maharashtra	9.3	40	30	1.0
Mumbai Suburban	Maharashtra	8.9	39	29	1.0
Jaipur	Rajasthan	7.5	53	39	1.3
Ahmadabad	Gujarat	7.3	32	24	0.8
Nashik	Maharashtra	6.3	35	26	0.8
Patna	Bihar	6.2	88	66	2.2
Surat	Gujarat	6.2	33	25	0.8
Kanpur Nagar	Uttar Pradesh	5.4	98	73	2.4
Muzaffarpur	Bihar	5.1	95	71	2.3
Guntur	Andhra Pradesh	5.0	33	25	0.8
Nagpur	Maharashtra	4.8	44	33	1.1
Allahabad	Uttar Pradesh	4.8	82	62	2.0
Lucknow	Uttar Pradesh	4.8	106	80	2.6
Krishna (Vijayawada)	Andhra Pradesh	4.7	33	25	0.8
Bareilly	Uttar Pradesh	4.6	102	76	2.5
Bulandshahr (Khurja)	Uttar Pradesh	4.5	124	93	3.0
Kolkata	West Bengal	4.5	46	34	1.1
Agra	Uttar Pradesh	4.5	101	76	2.5
Solapur	Maharashtra	4.4	37	28	0.9
Gaya	Bihar	4.4	73	55	1.8
Visakhapatnam	Andhra Pradesh	4.4	33	24	0.8
Jalgaon	Maharashtra	4.3	38	29	0.9
Kurnool	Andhra Pradesh	4.2	29	22	0.7
Hyderabad	Telangana	4.1	33	25	0.8
Kolhapur	Maharashtra	3.8	32	24	0.8
Alwar	Rajasthan	3.8	69	52	1.7
Jodhpur	Rajasthan	3.8	27	20	0.7
Nalgonda	Telangana	3.6	33	24	0.8
Ludhiana (Ludhiana, Khanna)	Punjab	3.5	70	53	1.7
Mumbai City (Mumbai, Navi Mumbai)	Maharashtra	3.5	40	30	1.0
Indore	Madhya Pradesh	3.4	40	30	1.0
Varanasi	Uttar Pradesh	3.4	87	65	2.1
Cuttack	Odisha	3.2	39	29	1.0
Medak (Patancheru)	Telangana	3.1	35	26	0.9
Nellore	Andhra Pradesh	3.1	27	21	0.7
Tirunelveli (Tuticorin)	Tamil Nadu	3.1	13	10	0.3
Sangli	Maharashtra	3.1	34	25	0.8
Firozabad	Uttar Pradesh	3.0	107	81	2.6
Amravati	Maharashtra	2.9	40	30	1.0
Nagaon	Assam	2.9	32	24	0.8
Gautam Buddha Nagar (Noida)	Uttar Pradesh	2.9	119	89	2.9
Udaipur	Rajasthan	2.9	31	23	0.8
Gulbarga	Karnataka	2.9	34	26	0.8
Moradabad	Uttar Pradesh	2.8	100	75	2.5
Latur	Maharashtra	2.7	39	29	1.0
Khordha (Bhubaneshwar)	Odisha	2.7	37	28	0.9

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Baleshwar	Odisha	2.5	43	32	1.0
Aurangabad	Maharashtra	2.5	75	57	1.8
Amritsar	Punjab	2.5	65	49	1.6
Rae Bareli	Uttar Pradesh	2.4	98	73	2.4
Sagar	Madhya Pradesh	2.4	44	33	1.1
Bhopal	Madhya Pradesh	2.4	42	32	1.0
Amroha (Gajraula)	Uttar Pradesh	2.4	110	82	2.7
Davanagere	Karnataka	2.4	24	18	0.6
Jalandhar	Punjab	2.3	68	51	1.7
Jammu	Jammu and Kashmir	2.3	51	38	1.2
Chandrapur	Maharashtra	2.3	43	32	1.1
Raipur	Chhattisgarh	2.3	60	45	1.5
Kota	Rajasthan	2.2	47	35	1.1
Sundargarh (Raurkela)	Odisha	2.2	46	34	1.1
Durg (Bhillai)	Chhattisgarh	2.1	62	46	1.5
Jhansi	Uttar Pradesh	2.1	63	48	1.6
Ujjain	Madhya Pradesh	2.0	41	31	1.0
Ghaziabad	Uttar Pradesh	2.0	120	90	2.9
Jalna	Maharashtra	2.0	40	30	1.0
Dhanbad	Jharkhand	2.0	58	44	1.4
Gwalior	Madhya Pradesh	2.0	73	55	1.8
Cachar (Silchar)	Assam	2.0	33	24	0.8
Akola	Maharashtra	1.9	41	31	1.0
Sonbhadra (Anpara)	Uttar Pradesh	1.9	57	43	1.4
Patiala	Punjab	1.9	80	60	1.9
Udham Singh Nagar (Kashipur)	Uttarakhand	1.9	73	55	1.8
Dehradun (Rishikesh)	Uttarakhand	1.8	52	39	1.3
Dharwad	Karnataka	1.8	25	18	0.6
Korba	Chhattisgarh	1.6	47	35	1.2
Kangra (Damtal)	Himachal Pradesh	1.6	48	36	1.2
Dewas	Madhya Pradesh	1.6	40	30	1.0
Hoshiarpur (Pathankot)	Punjab	1.5	64	48	1.6
Angul (Angul, Talcher)	Odisha	1.5	39	29	1.0
Kamrup Metropolitan (Guwahati)	Assam	1.5	34	26	0.8
Chandigarh	Chandigarh	1.4	71	53	1.7
Srinagar	Jammu and Kashmir	1.2	38	29	0.9
Sivasagar	Assam	1.2	24	18	0.6
Nalbari	Assam	1.1	37	28	0.9
Mandi (Sundar Nagar)	Himachal Pradesh	1.1	36	27	0.9
Rupnagar (Naya Nangal)	Punjab	0.9	65	49	1.6
Sahibzada Ajit Singh Nagar (Dera Bassi)	Punjab	0.8	72	54	1.8
Solan (Baddi, Parwanoo, Nalagarh)	Himachal Pradesh	0.6	49	37	1.2
Fatehgarh Sahib (Gobindgarh)	Punjab	0.5	75	56	1.8
Sirmaur (Kala Amb, Paonta Sahib)	Himachal Pradesh	0.5	46	34	1.1
Dimapur	Nagaland	0.4	26	19	0.6
Kohima	Nagaland	0.2	20	15	0.5
Ri Bhoi (Byrnihat)	Meghalaya	0.2	29	22	0.7

Note: The AQLI's data is at the district level. Where a city lies inside a district of a different name, and where a district contains multiple non-attainment cities, the city names are listed in parentheses.

ABOUT THE AIR QUALITY LIFE INDEX®

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 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.

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ABOUT EPIC

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