

Indian air pollution: loaded dice

India is once again at the centre of heated discussions due to its toxic air and the disproportionately high mortality and disease burden this is causing.



In November, the air in Delhi, India's capital, was so noxious that authorities declared a public health emergency and ordered the closure of schools in the city and surrounding suburbs for several days. All dirty fuel-based industries—ie, those powered by coal and diesel—were also ordered to be closed by the Supreme Court mandated Environment Pollution Prevention and Control Authority.

Delhi's toxic air, choked with smoke, partly from farm fires in neighbouring states, industrial and vehicular pollution, and road dust, is familiar to all those who live in the city. The toxicity shoots up every winter due to several factors, including lower wind speeds, festival fireworks and crop residue burning by farmers in neighbouring states.

Despite the well-documented health impacts, the situation has not improved.

A recent study showed that India's toxic air—particulate matter and household air pollution—claimed 1.24 million lives in 2017. That is 12.5% of the deaths recorded that year in India. Delhi was shown to have the highest level of annual population-weighted mean $PM_{2.5}$ (particulate matter of diameter $<2.5 \mu m$) pollution in 2017, followed by Uttar Pradesh, Bihar, and Haryana in north India, all with mean values greater than $125 \mu g/m^3$.

Delhi's toxic air regularly makes front page news, but the problem is much more widespread. For example, a 2018 report on the world's most polluted cities noted that "of the cities included in South Asia... although Delhi typically receives most media coverage as one of the world's 'pollution capitals'... [it] 'only' ranks 10th for annual $PM_{2.5}$ concentration. Other cities across Northern India and Pakistan have a

higher recorded annual $PM_{2.5}$ level, with nearby Gurugram narrowly resulting in the highest annual concentration of any global city recorded during 2018." In 2018, the average air pollution level in Gurugram was over 13 times the WHO guidelines.

Differential impacts

Polluted air does not impact everyone equally; the poor and those forced to work outdoors suffer more. A 2011 paper which investigated the human health impacts from urban air pollution in India concluded that such pollution is especially harmful to poor people. "About 74% of the population with low income is exposed to annual 24-hourly average PM_{10} concentration levels above $150 \mu g/m^3$, compared to about 58% each for those with medium or high income. The safe level standards for residential areas are up to $60 \mu g/m^3$ ", the paper noted.

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More affluent Indians are now seeking to protect themselves by installing air purifiers, remaining indoors in more "protected air" and venturing outdoors with masks on. In contrast, a cycle-rickshaw ride through the Rajendra Nagar Industrial area in Ghaziabad, adjacent to Delhi, gave a glimpse of the risks faced by extremely poor Indians, working outdoors, with few other work choices and no protection.

Vijay Singh, around 40, knows it is a tough life pedalling a rickshaw through some of the most polluted patches of the city.

"Yes, I have breathing problems. It is getting worse. I cough a lot. I don't

go to a doctor unless I feel really bad. I can't afford to take time off. I don't feel comfortable wearing a mask when I cycle. I know the air is very polluted here, but what can I do?" Singh told *The Lancet Planetary Health*.

Dr Arvind Kumar, a chest surgeon at Delhi's Ganga Ram Hospital and chairperson of the NGO the Lung Care Foundation, explains that "Air pollution affects anyone and everyone who breathes. Prime Minister Narendra Modi, and a sweeper on the street, both breathe about 25 000 times a day. However, the economic difference allows one to control the quality of air that goes into one's lungs. An economically deprived person living in a shack or by the roadside has no access to any technology device which can in any way influence the quality of air."

"Air purifiers can help some people, to some extent but at a heavy cost and no one can remain locked up in air purified rooms 24/7. Air purifiers have mechanical filters which need to be replaced if the ambient air is too dirty. This is expensive and furthermore, domestic air purifiers can't deal with noxious gases, only particulate matter", says Kumar.

In cities with clean air, cycling is healthy. But not so in polluted cities. Rahul Goel, lead author of a 2015 study concerned with on-road $PM_{2.5}$ pollution exposure in Delhi, says "We found that a person who is cycling or in an auto rickshaw is exposed to 2.5 times more particulate matter ($PM_{2.5}$) pollution than someone who is in an air conditioned car with the windows rolled up or someone who is travelling in an air conditioned train. It gets worse if you factor in the physical exertion involved in cycling, for example. When you are cycling, you inhale up to three times more air. So, for the same distance travelled,



For the full GBD study see **Articles** *Lancet Planetary Health* 2019; 3: e26–39

For the full IQAir AirVisual world air quality report 2018 see <https://www.airvisual.com/world-most-polluted-cities?continent=&country=&state=&page=1&perPage=50&cities=>

For the full paper on the health impacts from urban air pollution in India see <https://www.sciencedirect.com/science/article/pii/S0305750X1100060X>

For the full study on On-road $PM_{2.5}$ pollution exposure in Delhi see www.urbanemissions.info/wp-content/uploads/docs/2015-12-AE-Delhi-On-Road-Exposures.pdf

For more on environmentalist's response to the air purifiers proposal see <https://thewire.in/environment/new-delhi-air-pollution-stubble-burning-supreme-court-industry-smog-towers-outdoor-air-purifiers>

a cyclist inhales a total dose of polluted air eight times more than someone in an air conditioned car.”

“Location of residence also plays an important role” explains Giridhar Babu, Professor of Lifecourse Epidemiology, at the Indian Institute of Public Health, Public Health Foundation (PHFI). Urban dwelling poor communities usually live in close proximity to highly industrialised or commercial locations resulting in greater exposure to industrial pollution at home as well as at work.

“Air pollution in India is restricted neither to Delhi, nor winters, nor even cities. Over 99% of the population lives in regions above the WHO recommended annual level of $10 \mu\text{g}/\text{m}^3$ of $\text{PM}_{2.5}$. This figure drops to 83% when seen from the Indian national standards of $40 \mu\text{g}/\text{m}^3$. The Indo Gangetic plain in Northern India is particularly badly affected, with 98% of the population living in areas above the national standard”, according to Dr Santosh Harish, a Research Fellow at the Centre for Policy Research.

“Protective approaches are put into use only during spikes and when pollution becomes visible. We are now exposed to bad air almost throughout the year and hence exposure levels across the society tend to be the same. The middle class and the rich may be able to delay the impact but cannot prevent it”, added Dr Gunjan Taneja, National Technical Lead in the USAID-supported VRIDDHI programme which addresses Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCH+A).

Data gaps in villages and homes

There are multiple sources of air pollution: household combustion of polluting fuels (for cooking primarily, but also for space and water heating and lamps), power plants and industry, vehicles, waste burning, road and construction dust and episodic sources like crop residue burning. From satellite data and chemical transport modelling-derived estimates of

pollutant concentrations, it is known that rural areas also experience high levels of pollution. However, there is negligible monitoring of air quality levels in rural areas.

Unequal exposure to polluted air happens at various levels, both indoors and outdoors.

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“Household air pollution is a complex interplay of gender, poverty, energy access and traditional preferences”, points out CPR’s Harish. “The end result is that rural women and young children face particularly high levels of exposure indoors, especially those from poor households. Then there is occupational exposure: labourers on construction sites, in industries, drivers, road cleaners. The homeless population is especially badly affected.”

Gunjan Taneja adds “Children and older adults, individuals with pre-existing cardiovascular or respiratory diseases, or genetic polymorphisms are at increased risk of air pollution-related health effects. The differential impact is also due to the type of pollutant one is exposed to. For instance, exposure to particulate matter and ground level ozone is more dangerous. Children are at greatest risk from exposure to ozone because their lungs are still developing and they are more likely to be active outdoors when ozone levels are high.”

Biomass combustion, fugitive emissions from unpaved roads, agriculture crop residue burning (ACRB), and brick kilns are the main causes of air pollution in rural India. During ACRB periods, diurnal averaged ambient $\text{PM}_{2.5}$ levels in rural India were reported to go up to around $125 \mu\text{g}/\text{m}^3$, which is more than twice the $60 \mu\text{g}/\text{m}^3$ limit

prescribed by India’s Central Pollution Control Board.

What should be done?

India’s Supreme Court stepped in to tackle air pollution and set up a committee of experts with the power to order the closure of factories, schools and so on, in a graded manner. That is an emergency response, like state governments imposing fines on a few farms caught burning rice straw. While everyone talks of the need for more systemic solutions, coal-fired power plants—mostly state-owned—keep telling the Supreme Court that they need more time to install pollution control equipment.

Central and state governments have tried to introduce and educate farmers about best practices in agricultural waste management. “Particularly in the states of Rajasthan, Uttar Pradesh, Haryana, and Punjab, stringent measures have been taken by the National Green Tribunal (NGT) to limit the crop residue burning”, says Babu. But the burning goes on.

The Supreme Court is now looking at a government proposal to install large air purifiers in Delhi—the so-called smog towers—though they have been found to be of very limited use in cities such as Beijing. Many environmentalists are against the proposal.

Rahul Goel of the University of Cambridge said, “What we need is strict vehicle emission norms like the Bharat Stage VI-fuel (BS-VI) which has been rolled out in the National Capital Region recently. But this is not a transport problem alone. To reduce high levels of exposure to pollution on the roads, we need multi-sectoral reductions in emissions. Introduction of stricter emission norms brings more sustained reductions in emissions than knee-jerk decisions of banning certain types of vehicles.”

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