Scientific approaches to air pollution are helping us save lives

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Long before people measured air quality, they were aware of the menace posed by air pollution. Hippocrates, the father of modern medicine, observed in 400 BCE that different kinds of illnesses were caused by bad air quality. Seneca referred to the detrimental health effects of smoke in the 1st century. Emperor Justinian declared clean air a birthright in 535 CE. Despite understanding the threat to human life posed by harmful pollutants, pollution continued unabated and even dramatically increased during the industrial revolution in the 18th century. Polluted air is, therefore, not a recent phenomenon. What has changed now is the development of air pollution science.

The science of air pollution

Intermittent measurements of air pollutants began during the 19th century. These efforts were led mainly by chemists trying to understand the components of the atmosphere. The Donora Smog in 1948 that killed 20 people led to the US government establishing laws to reduce pollution. In the UK, London's notorious pollution and filth went unchecked until (and for a few years after) the Great London Smog of 1952, which is estimated to have killed at least 4,000 people over the span of a week.

The World Health Organisation (WHO) published its first technical paper on air pollution in 1958. In the late 1970s and early 1980s, WHO set air quality guidelines and standards for policymakers. In 1993, Harvard published its *6 Cities Study*, a study involving 8,000 citizens in the US, attempting to understand the link between fine particulate matter and mortality. The researchers found that people who lived in polluted areas died approximately two years earlier than those who lived in areas with cleaner air.

It has been a slow journey, but the pace of air pollution studies is now picking up, and with it, our ability to save lives. Several nations have established standards to monitor air pollution and ensure that it remains within limits. Scientific understanding of various pollutants and their effect on human health has helped us develop ideal standards for safer and good quality air. In 2021, WHO revised the standards for pollution levels after research suggested that even small amounts of pollutants were detrimental to our health. Over the last 150 years, science has helped shape the narrative on air pollution and its health risks.

India saw a turning point in 1981 when it introduced the Air Prevention and Control of Pollution Act. This was followed by the Environment Protection Act in 1986, which many consider a response to the infamous Bhopal gas tragedy in 1984**.** Today, a major concern for policymakers is crop residue burning in Punjab and Haryana, which chokes Delhi's lungs in the winter. Black carbon deposits from anthropogenic activities are causing the Himalayan ice to melt, not to mention rising pollution in metropolitan cities and rural areas. India's first comprehensive policy on air pollution—the National Clean Air Programme launched in 2019—puts science at the heart of action plans to check air pollution, encouraging the use of alternative methods to expand our understanding of pollution and use them to develop achievable clean air action plans for non-attainment cities. Data, with the help of various technologies, is helping us to see beyond what is immediately visible.

Technology enables better data, more information, and prioritised action

There is a popular saying that ‘In God, we trust, for everything else bring data’. Data is the key to managing problems, especially something as challenging as air pollution. Without the advancement of modern technology to measure and monitor air pollution, the unavailability of reliable data would have prevented effective action. Technology to monitor air pollution has come a long way. From simple measurements such as rain gauges, Ringelmann charts, and deposit gauges, we now have beta attenuation and ozone monitors, satellite and mobile monitoring, low-cost sensors, and methods for conducting source apportionment and emission inventory studies, giving us important information on air quality. While a few years ago, the cost of monitoring and measurement was a major obstacle, today, many low-cost applications are available, helping us study air pollution in real time and informing citizens across the world to take real-time protective action.

At the 10th World Urban Forum, UNEP launched the world’s largest air quality data platform, built on IQAir’s technology. It validates and calibrates air quality, and data that was restricted to individually run platforms (such as websites and apps) is now shared publicly. AI models trained using the available air quality data from the past can now predict how ozone behaves under various meteorological conditions. Uganda used networks of low-cost sensors, costing $150 each, to tackle air pollution even in extreme conditions. Data was shared with the public via a smartphone app developed for the project. Data from on-board sensors in satellites allow us to monitor air pollution across the globe and identify hotspots for targeted action.

Accurate data is crucial in building effective policies to curb air pollution. A scientific approach to tackling the issue makes it possible to gather data that can be recorded, quantified, and shared. The scientific approach to air pollution renews the hope that clean air will be a *birthright* one day.

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