



The Economic Cost of Air Pollution in India

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Abstract

Air pollution is a growing concern from social, economic and ecological point of society. Air pollution already affects human health, agriculture and leads to a wide range of other impacts. These impacts are expected to become much more severe in the coming years. The rise in emissions of air pollutants is projected to lead to higher concentrations of particulate matter (PM2.5) and ground level ozone. The primary purpose of this paper is to add another aspect to our understanding of air pollution: its impact on businesses and various sections of the economy. The ultimate aim is to motivate businesses and policymakers to become more active advocates for clean air by showing how much the economy and society stands to gain. Policies to limit air pollution emissions would lead to an improvement in air quality, reduce risks of very severe health impacts, and, if properly implemented, generate considerable climate co-benefits.

Key words: air pollution, economic cost, clean air, health, agricultural productivity, tourism

Introduction

Air pollution poses a major threat to human health in the 21st century. The World Health Organization estimates that only 1 in 10 people globally live in areas where air pollution is below the recommended levels and that air pollution is responsible for 7 million deaths in a year – that is one in eight deaths globally. Air pollution stands first in all other major avoidable causes of death which includes drugs, smoking, alcohol consumption, road accidents and transmissible diseases such as AIDS, malaria, and tuberculosis. Since air



pollution continues to rise at an alarming rate worldwide, especially in low- and middle-income countries, these numbers may multiple larger in the years to come (OECD, 2016).

Air pollution has a huge impact on human health in India. It is the second highest risk factor for disease, and the economic cost of air pollution is estimated to exceed 7 lakh crore (US 95 billion dollars) annually. The major sources of air pollution in India include industrial waste, biomass combustion for cooking, vehicular emissions, power generation, the construction sector, and episodic events like crop burning. The consequences of air pollution on human health have led to the introduction of strict environmental regulations around the world (Botta and Koźluk, 2014)

The poor air quality leads to direct reductions in economic activity because it negatively impacts both cognitive or physical ability of a person. For example, air pollution has been shown to decrease workers 'productivity at a large farm of California (Graff-Zivin and Neidell, 2012), at a garment manufacturing facility in India (Adhvaryu et al., 2014) or at a Chinese call centre (Chang et al., 2016). There is also evidence that pollution affects productivity in high-skill tasks, such as student performance in standardised high-school examinations (Ebenstein et al., 2016) or if we talk about investors 'performance Stock Exchange in New York(Heyes et al., 2016).

Research Objective

The objective of this paper is to inform about impact of air pollution on economic activity, using data from across India. We shall also analyze the various methods that can be used to learn about the financial impact of air pollution on an individual and the country as a whole.

Research Methodology

The method of research is exploratory, and existing research on the impact of air pollution on economies and businesses globally have been synthesized and extrapolated it to the Indian business context.

The remaining paper is structured as follows. Section 2 discusses various pollutants and their concentration in the air. Section 3 briefly discusses the various approaches that can be used to measure the economic cost of air pollution. Section 4 discusses the factors to be considered while measuring air pollution and the Section 5 provides the impact of air pollution on various sectors of the economy. The subsequent sections include the policies that are being followed and the concluding remarks.

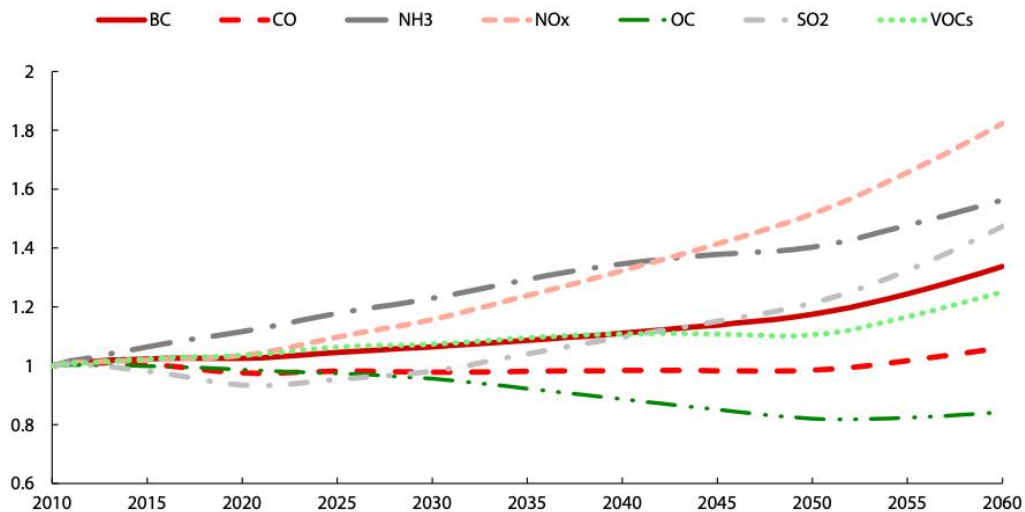


Emissions and concentrations of air pollutants

Out of all the air pollutants, whose emissions are projected to increase in the coming years (Figure 1) emissions of nitrogen oxides (NO_x) and ammonia (NH₃) are projected to increase the most. These large changes are accounted by the projected increase in the demand for agricultural products and energy (incl. transport and power generation). Emissions of black carbon (BC), carbon monoxide (CO), and volatile organic compounds (VOCs) are also expected to increase. Emissions of Sulphur dioxide (SO₂) are projected to decrease initially but increase again after 2030 this is so because according to current policies even developing countries requires flue gas desulphurization but is likely to be offset by the continuing increase in energy demand, which eventually leads to higher emissions. Emissions of BC and OC directly contribute to PM_{2.5}, while other gases such as NH₃, NO_x, SO₂ form PM_{2.5} through chemical reactions in the atmosphere. Ozone is formed in the atmosphere as a consequence of chemical and photochemical reactions between gases such as NO_x, VOCs and methane (CH₄).

Figure 1: Projections of emission factors based on GAINS model

Figure 1



Source: ENV-Linkages model, based on projections of emission factors from the GAINS model.

Approaches to measure the Economic Costs of Air Pollution



The socio-economic burden of any disease is measured in terms of both the financial and non-financial costs incurred by individuals. However, in this paper our focus is on the financial aspects of air pollution explained by the direct treatment cost and indirect cost of loss employment(absenteeism).

Three approaches are adopted in literature for measuring the economic costs of air pollution. These are discussed in detail as follows:

- **The Cost of Illness Approach**

‘Cost of illness ’method is primarily common in medical literature, which identify and measure the costs associated with a particular disease. These costs include direct, indirect, and intangible costs associated with any illness. The health care costs are associated to estimation of the medical care expenditures for diagnosis and treatment, the non-health costs include those incurred on transportation, household expenditures, and other informal care(nurse). The goal of a cost of illness analysis is to evaluate the economic burden that illnesses impose on society as a whole (Jo, 2014).

- **Productivity Loss Approach**

Productivity loss does not focus necessarily on a loss of income to the individuals but loss to the economy as whole. This includes workers missing out on the days at work due to health-related disabilities and the associated loss of income. Productivity loss can be incorporated into economic evaluations. This approach assumes that individuals have the potential to produce a certain value of outputs over their working lives, which is likely to be reduced due to illness. The work time lost is then valued at the market wage rate reflecting the value to the society (Pearce, 2016).

- **Welfare Loss Approach**

Economic valuations are primarily undertaken with an objective of cost-benefit analyses in mind, which helps the government to measure the social costs of any policy that may not be reflected in the existing markets and prices but are still crucial to populations well-being.

Measuring the economic cost of air pollution

The cost of air pollution occurs in 6 ways – lowering of labor productivity, reduction in consumer footfall, premature mortality, lowering of asset productivity, increase in health

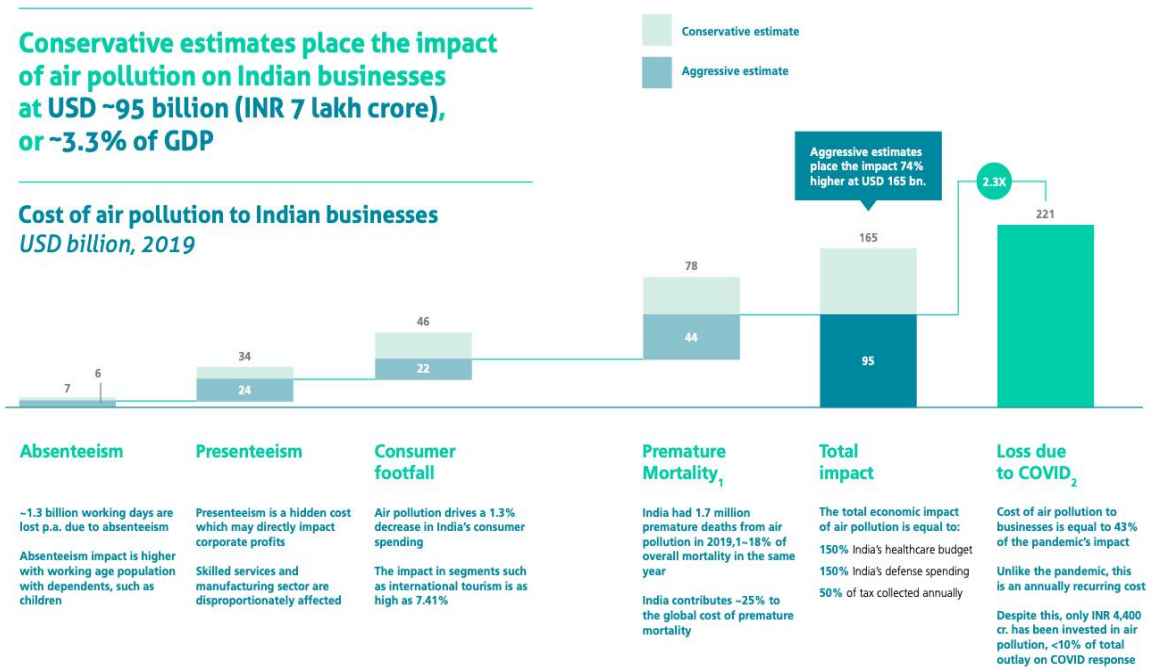


expenses and welfare losses. Out of these, the three major costs primarily employee productivity, consumer footfall and premature mortality impact businesses directly.

- **Labor Productivity (Absenteeism):** Air pollution leads to loss costing 600 crores due to absenteeism in India. As air pollution rises, employees fall sick themselves or have to stay at home to take care of dependents such as children and the elderly, who are more vulnerable to air pollution. 98% of this cost is borne by northern and eastern parts of India, where AQI levels cross 300+ frequently. The survey conducted as part of this study revealed that this cost to be is still much lower than what it should be, as even sick employees come to work, in order to earn bread and support the financial needs of the families.
- **Labor Productivity (Presentism):** Employees 'physical and cognitive performance falls due to air pollution. Business top personnel projected that employee productivity decreased by 8-10% on high pollution days, costing 2400 crores. Workers often have to make up for these by working long hours. As employees work overtime to cover up for their lost productivity, the cost continues to exist but in the forms of burnout, attrition, and increased problems for HR managers to attract talent. This has a higher impact on cognition-intensive sectors such as investment banking, software development, sectors where the dependency on complex mental tasks for output is highest.
- **Consumer Footfall:** Air pollution diminishes India's strength of being a large consumer economy by reducing consumer spending by 1.3%, costing 2200 crores. As quality of air decreases, consumers avoid exposing themselves to pollutants, same as it was observed during the scenario of COVID-19 pandemic. Apparel and food (including restaurants) bear ~50% of the overall cost. Reduced consumer footfall impacts the revenue potential of businesses. For example, an analysis of credit card transaction data was conducted in Spain which showed that for every 10% increase in particulate matter in the atmosphere, consumers in Spain spent between EUR20-30 million less per day.

Figure 2: Impact of air pollution on Indian Businesses

Figure 2



Source: <https://www.cleanairfund.org/resource/air-pollution-in-india-and-the-impact-on-business/>

- Premature Mortality:** Air pollution contributes to 18% of all deaths in India. Not only premature mortality effects our current workforce, but also the workforce, with children under the age of 1 contributing to 34% of the total impact. As India's population's middle age increases from 27 in 2019 to 32 in 2032, its sensitivity to air pollution is more likely to increase, raising the question of a sub-optimal workforce.

Impact of air pollution on various economic sectors:

- Health:** With the current trends of increasing concentrations of PM2.5 and ozone the cases of illness are likely to increase manifolds in coming years, which means more people being admitted to hospital, health expenditures and sick or restricted activity days, which ultimately lead to labour productivity losses (Table 1). The number of cases of bronchitis is projected to increase significantly, going from 12 to 36 million new cases per year for children between the age group 6 to 12, and from 3.5 to 10 million cases for adults. Also, the cases of Asthma are likely to rise. These increasing



cases have been expressed in the form of hospital admissions which are projected to increase to 11 million in 2060.

Table 1. Projected health impacts at global level

	2010	2060
Respiratory diseases (million number of cases)		
Bronchitis in children aged 6 to 12	12	36
Chronic bronchitis (adults, cases)	4	10
Asthma symptom days (million number of days)		
Asthma symptom days (children aged 5 to 19)	118	360
Healthcare costs (million number of admissions)		
Hospital admissions	4	11
Restricted activity days (million number of days)		
Lost working days	1 240	3 750
Restricted activity days	4 930	14 900
Minor restricted activity days (asthma symptom days)	630	2 580

Source: OECD

- **Agriculture:** India is an agriculture intensive country. High concentration of pollutants, and particularly of ozone, impacts the crop yields and thus affect agricultural productivity. According to the TM5-FASST calculations, and in line with the existing literature, crop yields are expected to be negatively affected in all regions, with wheat and oil seeds being more affected than the other crops.
- **Tourism:** Air pollution directly impacts revenues caused by reduced consumer footfall. Poor air quality discourages shoppers to move out of their homes and this shows up in the account books, especially for businesses that have a direct consumer interface. At present, higher incidences of air pollution led to a decrease of 1.3 per cent in consumer spending. The numbers are especially worse for the tourism industry, with the impact being as high as 7.4 per cent and with losses of approximately \$1.7 billion every year. The recurring high pollution leads to a short-term revenue loss, and a risk of long-term reputation loss. The common concern among international tourists is that of air pollution, which make them reconsider their plans to travel to India. This has led to close to 820,000 jobs lost in tourism and allied sectors. In a survey that was conducted



among 39 major tourism and hospitality businesses, it revealed that 64 per cent of them see air pollution as a major contributing factor in declining tourism activities. Further, operational costs have increased, especially in case of business travel as some corporations now choose hotels which has air purifiers in each room.

- **Energy:** There is credible evidence to prove that air pollution reduces the efficiency and lifespans of solar panels. A decrease in solar panels 'productivity was observed by solar rooftop companies on the days that had poor air quality. This would have impact on the market viability of solar panels in India in the coming future, particularly in the residential sector. It is found that for every 100-unit increase in PM2.5 levels, there was a 13 percent decrease in solar panel productivity. Talking of the industrial level, there has been an increase in energy production costs from Rs 2.61 per kilowatt hour to Rs 2.91 per kWh. This increase is alarming as it offsets 67 per cent of the cost advantage associated with solar panels over coal.
- **IT sector:** IT sector lost USD 1.3 billion or 0.7% of its GDP to air pollution. On bad air days attendance decreases by 10%, productivity is reduced by 3% and there are almost 28% higher hiring challenges. These effects impact growth. An Indian IT company in Delhi lost 33% of its competitive advantage over a company in the Philippines only because of air pollution.

Policies to reduce air pollution

From Indian point of view stringent policies that avoid premature deaths and illnesses is very important. However, there is no one-size-fits-all solution for reducing the impacts of air pollution as there is a large difference among countries in terms of prevalent pollutants and sources. The implementation of policies that reduce pollution levels will certainly tackle and reduce the biophysical and the economic costs of air pollution.

These can include adoption of end-of-pipe technologies that can reduce pollution or of cleaner technologies, especially for energy combustion, along with this implementing air quality standards, fuel quality standards, automobile emission standards and emission taxes, among others.

As the air pollution varies from region to region there is a need for effective local policies, which aim to reduce pollution levels in highly populated areas. Even though air pollution has local and regional consequences, it is more or less a global problem. Most of pollutants and small particles such as PM can be transported via winds and have impacts in areas and



countries other than the ones where they are being emitted. Further, air quality is being deteriorated in almost all major regions of the world, and international linkages between countries, through international trade, has changed the consumption patterns in one country leading to a change in emission levels in others. Global solutions are also needed in order to develop fewer polluting technologies, and a global transformation of the energy system is an essential part of any cost-effective policy response.

Furthermore, there are strong relation between a wide variety of other policy domains. Policies that increase energy efficiency reduce emissions of air pollutants and greenhouse gases. Implementing air pollution policies would lead to immediate benefits thanks to an improved air quality and even stronger benefits in the long term, with the addition of reduced impacts from climate change.

India has already made strides in its commitment to the Paris Agreement on climate change and its commitment to the overall health of the environment. With the USD 95 billion of cost figure attached to pollution, Business advocacy and support will be a must for India to tackle this head-on.

Recommendations

In order to control the Impact of Air Pollution in India on Businesses Private and Public sector can:

- **Fiscal Response and Financial Architecture:** The Indian government needs to develop a robust, coherent, and coordinated fiscal strategy to address air pollution. Financial mechanisms should be established to attract private investment in clean-air initiatives. Prioritize investment in green sectors such as clean energy and electric mobility to drive solutions for improving air quality.
- **Investment Fund for Green Industries:** Create a specialized fund focused on supporting green industries that can lead to significant improvements in air quality. For Example, IKEA launched a collection in 2019 using rice straws, a crop residue, as raw material. This initiative addresses the problem of stubble burning in Northwest India, where 39 million tons of rice straw are burned annually, contributing up to 45% of the toxic smog in Delhi. By repurposing this waste product, IKEA not only reduces air pollution but also creates an economically viable resource.
- **Corporate Social Responsibility (CSR):** Companies with a net worth of US\$ 68.5 million, revenue of US\$ 137 million, or net profit of US\$ 700,000 are mandated to



spend 2% of their average profit over the last three years on social development activities, including environmental sustainability. Businesses can channel CSR funds to address air pollution and related climate change challenges. For Instance, Cummins India Limited's Initiative- The "Creating Oxygen Hubs" project in Pune, Maharashtra, involved planting over 35,000 trees. Cummins collaborated with NGOs, civic authorities, the Maharashtra Forest department, the defense department, and local volunteers. This initiative not only enhances green cover but also helps in absorbing pollutants, thereby improving air quality.

- **Public-Private Collaboration:** Businesses should work with the public sector and other stakeholders to increase awareness about the impact of air pollution and the importance of sustainability. Companies should measure and disclose the air pollution footprint of their products in sustainability reports, promoting transparency and accountability. By disclosing the air pollution footprint, businesses can help consumers make informed choices and drive demand for cleaner products.
- **Community-Based Solutions:** Implement solutions that directly engage and benefit local communities, especially those most vulnerable to air pollution. Utilize academic research to find innovative solutions for urban planning and pollution management. Researchers at Banaras Hindu University identified tree species that can withstand high levels of particulate matter and gaseous pollutants like nitrous oxide, sulfur dioxide, and ozone. Urban planners can use this research to manage urban forests effectively, creating green spaces that help mitigate the impact of air pollution in urban areas.

By adopting these recommendations, businesses can play a crucial role in combating air pollution in India, benefiting both the environment and the economy.

Conclusion

Initially, air pollution was seen as an inevitable cost of any developing economy and also as a public health burden that must, be taken care of by society as a whole to the large extend. However, in this paper we have tried to show that air pollution is more of a profitability issue; that is clean air is a precondition is a business wants to thrive – and for India to accomplish its vision of becoming a USD 5 trillion economy by 2025.

The results show that higher levels of air pollution, as measured by PM2.5 concentration (the pollutant with by far the largest estimated impacts on mortality and



health outcomes), exert a direct burden on the economy by impacting the output per worker and reducing it and also increasing the expenses on healthcare facilities. This means that reducing air pollution could yield a large economic dividend along the well-established health system

Thus, going forward, industry leaders need to take more ownership and become the advocates in the movement for cleaner air. While there is much to be thought of and done here, business solutions to this business crisis include "greening" business operations and supply chains, adopting renewable sources of energy in technology, managing emissions through CSR activities, and working for more strict pollution control policies. If the public and private sectors collaborate and work together clean blue skies and a healthier economy can become reality of India.

Solving air pollution in India would not just improve the internal operations of businesses, it would also directly boost consumer spending. The analysis shows that when pollution levels spike, consumers tend to stay indoors to preserve their health. Discretionary categories, such as apparel and restaurants, stand to benefit most from cleaner air, as consumers are most likely to forego such purchases entirely rather than postponing them.

Most significantly, bringing air quality to safe levels would lead to 1.7 million fewer premature deaths, thereby preventing 18% of all deaths within India. The corresponding potential benefit to the Indian economy amounts to \$44 billion. As average age in India rises from 27 in 2019 to 32 in 2030, the Indian population's sensitivity to pollution will keep on increasing, leading to higher potential profit from controlling air pollution.

While the individual benefits of clean air, such as through lower absenteeism and higher consumer footfall are encouraging, their overall impact on cities and sectors is even more so. Delhi faces 275 days of unhealthy air. A study on a pharmacy chain in Delhi revealed that the sale of respiratory medicines increases six-fold when PM_{2.5} levels cross 250ug/m². A survey conducted in Delhi in the year 2019 reveals that 40% of the 17,000 respondents of Delhi would prefer to leave the city in order to prevent illness caused by bad air quality.

This whole analysis shows that clean air is not only a back bone of society but there are huge economic gains to be unlocked by solving it. Businesses would also do well to take note of what they stand to gain when they mobilize their resources to solving air



pollution in India. After all, the analysis presents a compelling picture of how solving air pollution is healthy for the environment as well as the business as a whole.

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