HPNLU JOURNAL OF Environment and Disaster Management
VOLUME V: 2024

CONTENTS

SACRED AIR, POLLUTED REALITY: ANCIENT RELIGIOUS WISDOM MEETS MODERN ENVIRONMENTAL CRISIS

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Abstract

Air pollution, a pressing global issue, has severe implications for health and ecosystems, yet ancient Vedic texts revered air (Vayu) as a sacred and life-sustaining element, emphasizing its purity and vital role in existence. Modern studies link rising pollution levels—driven by industrialization, vehicular emissions, and deforestation—to increased respiratory diseases, climate change, and biodiversity loss. The Vedas' ecological wisdom, advocating harmony with nature, aligns with contemporary solutions such as renewable energy, afforestation, and emission controls. This research examines Vedic insights on air, analyzes current pollution trends and causes, and proposes integrated remedies combining traditional sustainability principles with modern scientific strategies to mitigate environmental degradation and promote public health.

Keywords: *Air pollution, Vedic perspective, Vayu, PM2.5, sustainable solutions, environmental health.*

I

Introduction

Environmental quality plays a crucial role in maintaining human health. When the environment deteriorates, it negatively affects people's well-being and hinders progress toward sustainable development.[1] Overexploiting natural resources beyond their limits to meet excessive human demands disrupts vital ecological functions, including clean air, water, soil fertility, and biodiversity. Given that the global population is expected to rise to 9 billion by 2050- up from the current 6 billion—the potential harm to the environment is significant and requires immediate action.

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[1]World Health Organization, *Health Aspects of Air Pollution with Particulate Matter, Ozone, and Nitrogen Dioxide* (WHO Regional Office for Europe, Copenhagen, 2003) at 18.

Air pollution is a key example of environmental degradation. It occurs when harmful substances contaminate the air due to human activities, making it unsafe for living beings. This issue arises as a negative consequence of industrial emissions linked to the production and consumption of goods.[2] From an economic perspective, exposure to hazardous air pollutants leads to unaccounted societal costs, such as health problems, increased illness, and higher mortality rates.[3] However, these costs are often ignored in market transactions, creating a failure in properly valuing environmental resources. Economists argue that environmental decline stems from externalities—unintended side effects of economic activities that markets fail to regulate effectively.

Coase (1960) describes externalities as the "problem of social cost," referring to the broader impact of economic activities beyond just private expenses. Social cost encompasses not only the expenses incurred by individuals or businesses but also the wider consequences imposed on society. These include the costs of repairing past harm, preventing future damage, and addressing current environmental degradation. Environmental externalities arise when production or consumption activities generate unaccounted costs or benefits for others, without compensation.

To address these negative externalities, it is essential to measure the true cost of environmental harm. Pollution degrades living conditions, reduces productivity, and increases healthcare expenses. According to the World Health Organization (2007), environmental degradation contributes to 25% of global health problems, highlighting its significant role in overall well-being. This suggests that a clean and healthy environment is even more critical for a high quality of life than socio-economic factors alone.[4]

The Sacred Concept of Vāyu in Vedic Literature

The Vedas hold profound reverence for Vāyu (air/wind), recognizing it not merely as a physical element but as a divine, life-sustaining force. The Rigveda, the oldest of the Vedas, invokes Vāyu in hymns such as:

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[2] Maureen L. Cropper & Wallace E. Oates, *Environmental Economics: A Survey*, 30(2) *Journal of Economic Literature* 675 (1992) at 78.

[3]R. Kerry Turner, David Pearce & Ian Bateman, *Environmental Economics: An Elementary Introduction* (Harvester Wheatsheaf, London, 1994) at 54.

"वायवा याहि दर्शत." (Rigveda 1.134.4)

"O radiant Vāyu, come to us! These pressed Soma juices are offered to you—may our songs reach you."[5]

This verse highlights Vāyu's sanctity and its role in Vedic rituals, where clean, pure air was considered essential for spiritual and physical well-being.

"वायो सेन् घं हि व्यायंस्तक्ष्वे यरु वेहि" (Rigveda 10.168.4)

"The essence of air permeates the earth and atmosphere; *Vāyu* consumes impurities to sustain life."[6]

The Atharvaveda further elevates *Vāyu* as a healer:

"वायुर्वेनाहि षाव्ताक्षाव् पहि व्य अष्णङ्क्षार् पद": (Atharvaveda 4.33.6)

"Vāyu, the divine physician, the swift steed of the gods, breathes upon Earth, granting life."[7]

The Yajurveda describes *Vāyu's*cosmic role:

"वायुश्मात् नि सय् ह्मा" (Yajurveda 23.50)

"I am Vāyu, the charioteer of cosmic balance."[8]

This metaphor positions air as a regulator of natural order, emphasizing its indispensable role in maintaining harmony.

Vedic Warnings Against Environmental Degradation

The TaittirīyaUpaniṣad cautions:

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[5]R.T.H. Griffith, *The Hymns of the Rigveda*, 2nd ed. (E.J. Lazarus & Co., Benares, 1889) at 42 (original work published 1886).
[6]H.H. Wilson, *Rig-Veda-Sanhitā: A Collection of Ancient Hindu Hymns*, Vol. 6 (Trübner& Co., London, 1857) at 101.
[7]M. Bloomfield, *Hymns of the Atharva-Veda* (Clarendon Press, Oxford, 1897) at 58.
[8]D. Chand, *The Yajurveda*, 3rd ed. (MunshiramManoharlal Publishers, New Delhi, 1980) at 67.

"[illegible]" (TaittirīyaUpaniṣad

1.11.1) "Do not greedily exploit nature's

wealth."[9]

This ethical injunction warns against reckless exploitation of natural resources, including air—a teaching that aligns with modern sustainability principles.

Ayurveda's Insight on Air Pollution & Purification

The Charaka Samhita, an ancient Ayurvedic text, identifies polluted air ("दुष्टवायु") as a cause of disease and prescribes herbal fumigation (dhūpa) for purification. This reflects an early recognition of air quality's impact on health and methods to mitigate contamination.[10]

In Quran as well we have references of Air:

Quran 15:22 (Surah Al-Hijr)

"وَأَرْسَلْنَا الرِّيَاحَ لَوَاقِحَ فَأَنزَلْنَا مِنَ السَّمَاءِ مَاءً فَأَسْقَيْنَاكُمُوهُ وَمَا أَنتُمْ لَهُ بِخَازِنِينَ"

"And We send the fertilizing winds, then send down water from the sky providing it for you, and you are not its retainers."[11]

The Quran describes winds as "fertilizing (لَوَاقِحَ)," highlighting their role in cloud formation, pollination and rainfall—an early recognition of ecological interdependence. Implies that clean air is a divine gift, and its corruption disrupts natural systems.

Quran 7:57 (Surah Al-A'raf)

"

وَهُوَ الَّذِي يُرْسِلُ الرِّيَاحَ بُشْرًا بَيْنَ يَدَيْ رَحْمَتِهِ حَتَّىٰ إِذَا أَقَلَّتْ سَحَابًا ثِقَالًا سُقْنَاهُ لِبَلَدٍ مَّيِّتٍ فَأَنزَلْنَا بِهِ الْمَاءَ فَأَخْرَجْنَا بِهِ مِن كُلِّ الثَّمَرَاتِ "

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[9]S. Radhakrishnan, *The Principal Upaniṣads* (Harper & Brothers, New York, 1953) at 139.

[10]P.V. Sharma, *Caraka-Samhitā: Text with English Translation*, Vol. 1 (Chaukhambha Orientalia, Varanasi, 1981) at 25.

[11]A.F. Ibn Kathir, *Tafsir Ibn Kathir*, Vol. 5 (Darussalam Publishers, Riyadh, 2000) at 77 (original work composed in the 14th century).

"And it is He who sends the winds as good tidings before His mercy [rain]. Till when they have carried heavy clouds, We drive them to a dead land and send down rain, producing fruits of every kind."[12]

Quran 17:69 (Surah Al-Isra)

"أَمْ أَمِنتُمْ أَن يُعِيدَكُمْ فِيهِ تَارَةً أُخْرَىٰ فَيُرْسِلَ عَلَيْكُمْ قَاصِفًا مِّنَ الرِّيحِ فَيُغْرِقَكُم بِمَا كَفَرْتُمْ"

"Or do you feel secure that He will not send you back into [the sea] another time and send upon you a hurricane of wind and drown you for your disbelief?"[13]

New Testament: Wind as the Holy Spirit

John 3:8

"The wind (πνεῦμα pneuma) blows wherever it pleases. You hear its sound, but you cannot tell where it comes from or where it is going. So it is with everyone born of the Spirit."[14]

Acts 2:2 (Pentecost)

"Suddenly a sound like a mighty rushing wind (πνοήpnoē) came from heaven.

Wind as a Symbol of God's Power

Exodus 10:13,19

"So Moses stretched out his staff over Egypt, and the Lord made an east wind blow across the land all that day and all that night... and the wind brought locusts... Then the Lord changed the wind to a very strong west wind, which caught up the locusts."[15]

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[12]M.A. Al-Qurtubi, *Al-Jami' li-Ahkam al-Quran*, Vol. 7 (Dar al-Kotob al-Ilmiyah, Beirut, 2003) at 113 (original work composed in the 13th century).
[13]S. Qutb, *Fi Zilal al-Quran [In the Shade of the Quran]* (Dar al-Shuruq, Cairo, 1967) at 114.
[14]R. Bultmann, *The Gospel of John: A Commentary*, G.R. Beasley-Murray ed. (Westminster Press, Philadelphia, 1971) at 129.
[15]R. Alter, *The Five Books of Moses: A Translation with Commentary* (W.W. Norton & Company, New York, 2004) at 95.

Significance:

God uses wind (ח eר ruach) for both judgment (plagues) and deliverance (parting the Red Sea, Exodus 14:21).

II

Urban Air Pollution

The urban air pollution is the byproduct of rapid urbanization, high demand for fossil fuel and exponential growth of vehicles. The United Nations Environment Programme (UNEP) has estimated that globally 1.1 billion people breathe unhealthy air (UNEP 2002). Epidemiological studies also show that, the concentration of pollutants like Particulate matter (PM), oxides of nitrogen (NOx), ozone (O3) etc., are associated with a wide range of health effects on human, especially on the cardiorespiratory system.[16] The urban air pollution is responsible for 800,000 deaths and 4.6 million losses of life years each year around the globe.[17] The burden of disease attributable to outdoor air pollution causes 39 percent of loss of life years in South-East Asia and 20 percent in other Asian countries.[18]

With the increase in air pollution, the society is incurring high environmental cost in the form of environmental management and pollution control. The estimation of economic cost in the form of ill health, loss of productivity, depleted natural resources and reduced recreation of nature will help to determine the most efficient way to impose urban air quality standards and also to compare the cost of environmental damage to the cost of mitigation.[19]

Air Pollutants

[16]Bart Ostro, Jonathan Hurley & David P. Maliekal, Benefit Transfer in the Context of Air Pollution Valuation: Empirical Estimates from Jakarta (World Bank Policy Research Working Paper No. 1419, 1995).

[17]World Health Organization, *Health Aspects of Air Pollution with Particulate Matter, Ozone, and Nitrogen Dioxide* (WHO Regional Office for Europe, Copenhagen, 2003).

[18]World Health Organization, *Health Aspects of Air Pollution: Results from the WHO Project "Systematic Review of Health Aspects of Air Pollution in Europe"* (WHO Regional Office for Europe, 2004), available at http://www.euro.who.int/_data/assets/pdf_file/0003/74730/E83080.pdf.

[19]World Bank, *Greening Industry: New Roles for Communities, Markets, and Governments* (World Bank, Washington D.C., 2000) at 40.

Air pollutants are defined as ―the presence of one or more contaminants in the atmosphere, in such concentration and for such duration as it is injurious, or tend to be injurious, to human health or welfare, animal or plant life.[20] When compared to other air pollutants, high levels of suspended particulate matter (SPM) cause significant health impact, both as individual, as well as in the combined state.[21]

The SPM refers to the mixture of solid and liquid particles in the ambient air. These dust particles vary in size, composition, origin and represent a complex mixture of organic and inorganic substances. They are classified based on their aerodynamic properties such as transport and removal of particles from the air, their deposition within the respiratory system and association with chemical composition and sources.[22]

The SPM is classified as primary if it is in the same chemical form in which it is emitted into the atmosphere or secondary if it is formed by chemical reactions in the atmosphere.[23]Mass and composition of these particles are divided into coarse and fine particles based on the particle size. The distinction between these two fractions of particles lies on the particle size of 1 μm and 2.5 μm1. The detailed classification of air pollutants by sources and usage of fuel is given in the Table 1:

Table: 1 Principal Sources of Urban Air Pollutants

No.	**Source**	**Fuel**	**Air Pollutant**
1.	Domestic Heating & Cooking	1. Wood, Biomass	SPM, Carbon Monoxide (CO),

[20] Central Pollution Control Board (CPCB), *Air Quality Status and Trends in India* (Ministry of Environment and Forests, Government of India, New Delhi, 2000) at 9.

[21]World Health Organization, *Health Aspects of Air Pollution with Particulate Matter, Ozone, and Nitrogen Dioxide* (WHO Regional Office for Europe, Copenhagen, 2003) at 19.

[22] Central Pollution Control Board (CPCB), *Air Quality Status and Trends in India* (Ministry of Environment and Forests, Government of India, New Delhi, 2000) at 5.

[23]A. Gupta, *Environmental Pollution and Control* (APH Publishing Corporation, New Delhi, 2006) at 147.

		2. Coal 3. Kerosene, LPG, Light Oil	Nitrogen Oxides (NO_x) SPM, Sulfur Dioxide (SO_2), CO, NO_x SO_2, Carbon Dioxide(CO_2), NO_x
2.	Industrial Boilers & Power Plants	Coal, Diesel, Furnace Oil	SPM, SO_2, CO_2, NO_x
3.	Industrial Manufacturing Processes	Process-Specific	• Oil Refineries: SO_2, NO_x, Mercaptans • Smelters: Heavy Metals • Cement Industry: PM, Dust • Aluminum Smelters: Fluorides
4.	Transportation	Gasoline, LPG, CNG	SO_2, CO, NO_x, Hydrocarbons (HC), Ozone (O_3), Lead (Pb)
5.	Transportation(Diesel Vehicles)	Petrol/Diesel	SPM, SO_2, NO_x, CO_2, Odor
6.	Community Services (Incinerators, Fossil Fuel Burning)	Varies	SPM, SO_2, NO_x, CO, VOCs, Pb

Source: Central Pollution Control Board (CPCB). (2000). Air quality monitoring and emission source apportionment studies. Government of India. http://cpcb.nic.in.

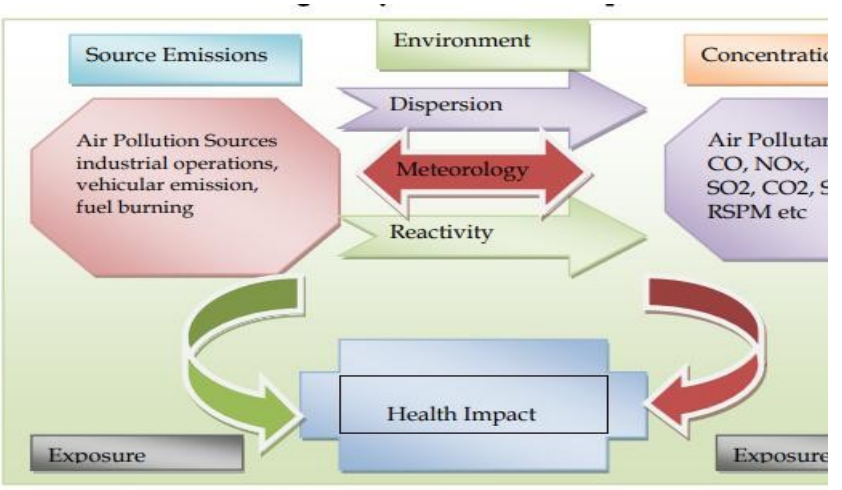
Ambient Air Quality: Temporal and Spatial Variations

Ambient air quality is a dynamic and complex environmental phenomenon influenced by meteorological and topographical conditions, leading to variations across time and space.[24] The atmosphere serves as the medium through which air pollutants are transported from their sources. The concentration of pollutants at a given location depends on factors such as

[24]*Ibid.*

exposure duration, frequency, and the concentration levels experienced by receptors.[25]

Air pollutants are emitted from various human activities in gaseous or aerosol forms. These pollutants disperse due to atmospheric turbulence, primarily within the mixing layer—approximately 1 km above ground level. While some pollutants are removed through processes like rain, wet deposition, absorption, and adsorption, those that persist can cause direct or indirect harm to human health, ecosystems, and infrastructure.Studies indicate that around 80% of coarse particulate matter settles within 150 meters of the emission source, approximately 40% between 200–270 meters, and about 20% at distances up to 1500 meters.[i] Since many pollutants are released at breathing height, human exposure to higher concentrations is more likely.[26]The climatology of air pollutants in the atmosphere and their impact is shown in the figure given below:



Source: Modified from Mohan raj et al., 2004

III

Air Pollution Control Laws in India

[25]World Health Organization, *Health Aspects of Air Pollution with Particulate Matter, Ozone, and Nitrogen Dioxide* (WHO Regional Office for Europe, Copenhagen, 2003) at 6.

[26]M. Mohan, A. Kandya& P. Batra, "Analysis of the Particulate Matter Dispersion in Urban Environments," 38(15) *Atmospheric Environment* 2343–2351 (2004), available at https://doi.org/10.1016/j.atmosenv.2004.01.012.

India has implemented several key legislative measures to regulate and mitigate air pollution. Alongside the Motor Vehicle Act (1938), two major laws—the Air (Prevention and Control of Pollution) Act, 1981 and the Environment (Protection) Act, 1986—play a crucial role in safeguarding ambient air quality. The Air Act (1981) aims to prevent, control, and reduce air pollution, while the Environment (Protection) Act (1986) focuses on broader environmental protection and improvement.[27]

Under the Air Act (1981), Section 17(g) empowers regulatory bodies to set emission standards for industries, automobiles, and other pollution sources (excluding ships and aircraft). Additionally, Section 20 authorizes vehicle registration authorities to enforce compliance with emission norms. Municipal laws further regulate pollution from waste burning, road dust, and construction activities.[28] Beyond these acts, several other laws contribute to air pollution control, either directly or indirectly. These include:

- Indian Forest Act (1865)
- Bengal Smoke Nuisance Act (1905)
- Bombay Smoke Nuisance Act (1912)
- Motor Vehicle Act (1938, amended 1988)
- Ambient Air Quality Standards (1986, amended 2009)
- Public Liability Insurance Act (1991)
- Environmental Audit Notification (1992)
- Environmental Impact Assessment Notification (1994, amended 2006, 2009, 2010, 2012)

The Central Pollution Control Board (CPCB) has monitored air quality nationwide since 1984. It has established National Ambient Air Quality Standards (NAAQS) to regulate pollutant levels in industrial, residential, rural, and ecologically sensitive zones.[29]Table 2 below gives NAAQ standard (Notified on 18.11.2009) for different air pollutants.

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[27]Ministry of Environment, Forest and Climate Change (MoEFCC), *The Environment (Protection) Act, 1986* (Government of India, New Delhi, 1986).
[28]Ministry of Environment, Forest and Climate Change (MoEFCC), *The Air (Prevention and Control of Pollution) Act, 1981* (Government of India, New Delhi, 1981).

[29] Central Pollution Control Board (CPCB), *National Ambient Air Quality Standards* (CPCB, New Delhi, 2009).

Table: 2 National Ambient Air Quality Standards (India)

Sr. no.	Pollutant	Time Weighted Average	Concentration in Ambient Air ($\mu g/m^3$)	
			Industrial/Residential/Rural Areas	Ecologically Sensitive Areas
1	SO_2	Annual* 24-hour#	50 80	20 80
2	NO_2	Annual* 24-hour#	40 80	30 80
3	PM_{10}	Annual* 24-hour#	60 100	60 100
4	$PM_{2.5}$	Annual* 24-hour#	40 60	40 60
5	Lead	Annual* 24-hour#	0.5 1.0	0.5 1.0
6	Ammonia	Annual* 24-hour#	100 400	100 400
7	Ozone (O_3)	8-hour# 1-hour#	100 180	100 180
8	CO	8-hour# 1-hour#	2 4	2 4
9	Benzene	Annual*	5	5
10	Benzo(a)Pyrene	Annual*	1	1
11	Arsenic	Annual*	6	6
12	Nickel	Annual*	20	20

Source: Central Pollution Control Board (CPCB), 2009. National Ambient Air Quality Standards. Government of India.

The NAAQ (National Ambient Air Quality) standards serve as the foundation for safeguarding human health, vegetation, wildlife, and national heritage from the adverse effects of air pollution. Ambient air quality conditions are categorized into four levels—low (L), moderate (M), high (H), and critical (C)—for industrial, residential, rural, and other regions, as well as for ecologically sensitive areas designated by the central government.[30] Legal and administrative frameworks to enforce these standards are outlined in the

[30] *Ibid.*

National Conservation Strategy and Policy Statement on Environment and Development. Additionally, measures for reducing air pollution are detailed in the Policy Statement for Abatement of Air Pollution, as presented in the accompanying table (Table:3):

Table 3: Air Pollution Management Policy in India

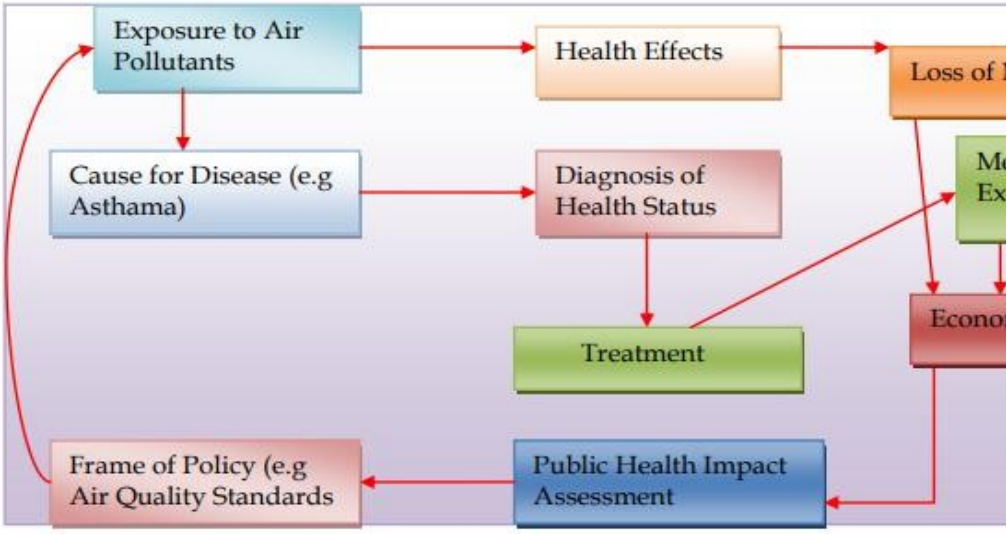
No	Policy	Measures	
1	Technological Measures	Use of clean fuels (e.g., natural gas, renewables) and advanced technologies (e.g., scrubbers, electrostatic precipitators). ● Incentives for energy-efficient devices and pollution control systems. ● Promotion of circular economy practices (recycling, waste-to-energy).	World (WHO, Energy 2020).
2	Zoning Strategy	● Source-specific air quality standards (e.g., $PM_{2.5}$ limits for industrial zones). ● Industrial siting guided by environmental impact assessments (EIAs). ● Green belts with pollution-tolerant vegetation. ● Industrial symbiosis (waste reuse between co-located industries).	United Environ (UNEP, Environ 2019).
3	Fiscal/Economic Instruments	Subsidies for clean technology adoption. ● "Polluter Pays Principle" enforcement (e.g., ● Mandatory public liability insurance for high-risk industries. ● Integration of environmental costs into project budgets (e.g., pollution offset funds).	OECD ((2021).
4.	Command and Control	Strict enforcement of pollution laws tailored to industry-specific risks (e.g., monitoring of highly polluting sectors). ● Mandatory environmental audits for industries. ● Environmental Impact Assessments (EIAs) for project planning and site selection. ● MoEF clearance for large-scale projects in ecologically sensitive areas.	Central Board (C

Source: Compiled from CPCB (2009), WHO, OECD, and UNEP reports, with modifications by the author.

IV

Health Effects of Urban Air Pollution

Prolonged or chronic exposure to air pollutants can lead to respiratory diseases and other health complications. The severity of health impacts depends on the duration of exposure—whether it is a single short-term incident (such as an accidental chemical release), frequent short-term exposures, continuous long-term exposure, or a combination of these factors. Assessing these health impacts is crucial for shaping policies aimed at reducing air pollution and enhancing public health. Additionally, the interconnected effects of urban air pollution on health and economic losses are depicted in fig. below:



Source: Author

Urban air pollution has significant and multifaceted effects on human health, as demonstrated by various studies. Research indicates that rising levels of air pollutants are linked to adverse health outcomes and decreased productivity. Vulnerable groups, particularly those with pre-existing respiratory conditions, face a higher risk of severe illness and even premature mortality due to prolonged exposure. Beyond health consequences, air pollution also imposes economic costs, including healthcare expenditures and productivity losses from absenteeism and reduced work efficiency. The key pollutants, their sources, and associated health risks are outlined in the accompanying table.

Major Air Pollutants, their sources and health effects

Sr. No.	**Pollutant**	**Sources**	**Health effects**
1.	Carbon dioxide (CO_2)	Burning of fossil fuels (coal, oil) in power plants, industries.	Respiratory problems, greenhouse effect, global warming.
2.	Carbon monoxide (CO)	Automobiles, industrial furnaces, open fires, forest fires, domestic fuel.	Breathing difficulty, headaches, mucous membrane irritation, death.
3.	Sulfur dioxide (SO_2)	Fossil fuel combustion, industries, automobiles.	Worsens lung diseases (bronchitis, wheezing), coughing, shortness of breath.
4.	Hydrogen sulfide (H_2S)	Decaying organic matter, volcanic eruptions, and sewage plants.	Headaches, nausea, collapse, coma, death.
5.	Nitrogen oxides (NO_x)	Industries (e.g., HNO_3 production), vehicle exhaust.	Alveoli irritation, lung infections, respiratory damage, death.
6.	Ozone (O_3)	Vehicle emissions, industrial processes.	Skin cancer, cataracts, weakened immunity, aquatic/vegetation
7.	Hydrocarbons (HC)	Motor vehicles, industrial activities.	Lung carcinogen; eye/nose/throat irritation; respiratory distress.
8.	Particulate matter (PM_{10}, $PM_{2.5}$)	Fuel combustion, road dust, agriculture, construction.	Tuberculosis, cancer, lung/heart damage, heart attacks, premature death.
9.	Benzene	Vehicles, industrial operations.	Dizziness, headaches, anemia, immune damage, blood/clotting disorders.
10.	Lead	Industrial activities.	Brain damage, nervous

			system impairment.

Source: World Health Organization. (2021). WHO global air quality guidelines: Particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide.

Economic Cost of Air Pollution in India

Air pollution imposes a staggering economic burden on India, with far-reaching consequences for public health and productivity. According to the World Bank (2022), India loses approximately $95 billion annually (equivalent to 1.4% of its GDP) due to pollution-related healthcare expenditures and lost labor productivity. These costs stem from increased hospital admissions for respiratory and cardiovascular diseases, premature mortality, and reduced workforce efficiency. For instance, a study by the Lancet Planetary Health (2023) estimated that 1.67 million deaths in India in 2019 were attributable to air pollution, resulting in 3.6% of the country's GDP loss.[31] Delhi, one of the world's most polluted cities, faces acute economic challenges during its winter pollution crisis. The Energy and Resources Institute (TERI, 2023) reported that Delhi incurs nearly ₹7,000 crore annually in health expenses linked to air pollution. These costs include:

- Hospitalization and medication for asthma, chronic obstructive pulmonary disease (COPD), and lung cancer.
- Lost wages due to illness and absenteeism, particularly among outdoor workers.
- Reduced tourism revenue as pollution deters visitors.

The World Bank (2022) further highlights that low-income populations are disproportionately affected, spending 8–10% of their household income on pollution-related health issues. Additionally, prolonged exposure to pollutants like $PM_{2.5}$ and ozone reduces labor productivity by 2–6% in high-risk sectors such as construction and agriculture.

V

Legal Loopholes in India's Pollution Control Enforcement

[31]World Bank, *The Cost of Air Pollution: Strengthening the Economic Case for Action* (World Bank Group, 2016), available at https://openknowledge.worldbank.org/handle/10986/25013.

India's environmental protection efforts face significant challenges due to systemic weaknesses in enforcement mechanisms. A 2023 study by the Centre for Science and Environment (CSE) revealed that 74% of industries violating Central Pollution Control Board (CPCB) norms receive penalties below ₹25,000 - an amount negligible for most polluting units. These inadequate fines fail to deter violations, as they often amount to less than 0.1% of annual profits for large corporations.[32]

The pollution control system suffers from widespread corruption, particularly in vehicle emissions testing. The Comptroller and Auditor General's (CAG) 2022 audit exposed that 43% of Pollution under Control (PUC) certificates in Delhi were issued fraudulently without proper testing.[33] Bribery networks between testing centers and vehicle owners have rendered the PUC system ineffective, allowing high-emission vehicles to remain on roads. Other critical gaps include:

- Delayed justice: Environmental cases take 5-7 years to resolve in National Green Tribunal
- Staff shortages: Only 35% of required technical staff at state pollution boards
- Political interference: 68% of closure notices to polluting units get stayed after lobbying

These systemic failures demand urgent reforms including higher penalties linked to turnover, block chain-based PUC systems, and fast-track environmental courts to ensure actual compliance.

VI

Solutions to Combat Air Pollution

Air pollution requires urgent, multi-level solutions combining government policies, technological innovations, and public participation. At the policy level, stricter enforcement of emission standards for industries and vehicles is

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[32]Centre for Science and Environment, *State of India's Environmental Compliance* (CSE Publications, New Delhi, 2023) at 33.

[33]Comptroller and Auditor General of India, *Audit Report on Vehicular Pollution Control in Delhi (Report No. 17) at 18* (2022), available at https://cag.gov.in.

crucial. India's Bharat Stage VI norms for vehicles and mandates for pollution control equipment in factories have shown promising results in reducing harmful emissions. Transitioning to renewable energy sources like solar and wind power can significantly cut down dependence on fossil fuels. The government's target of achieving 500 GW of renewable energy capacity by 2030 is a step in the right direction.

Urban planning plays a vital role in reducing pollution. Expanding green spaces, such as urban forests with air-purifying plants like neem and peepal, can improve air quality. Investing in efficient public transport systems, including metros and electric buses, can reduce vehicular emissions. Electric vehicles (EVs) should be promoted through subsidies and better charging infrastructure to accelerate their adoption.

Technological solutions, such as smog towers and AI-based air quality monitoring systems, can help manage pollution hotspots. Community participation is equally important—public awareness campaigns can encourage practices like reducing fireworks during festivals and proper waste management to minimize burning. In rural areas, promoting alternatives to stubble burning, such as happy seeder machines can curb seasonal pollution.

A collective effort involving governments, industries, and citizens is essential to achieve cleaner air. By implementing these measures, we can reduce pollution levels and safeguard public health for future generations.

VII

Conclusion: Towards Cleaner Air through Collective Action

The challenge of air pollution demands urgent, multi-dimensional solutions that combine policy reforms, technological innovation, and community participation. While government initiatives like the National Clean Air Programme mark important progress, persistent enforcement gaps - including inadequate penalties and systemic corruption in pollution monitoring - continue to undermine these efforts. Strengthening legal frameworks with stricter compliance mechanisms and transparent monitoring systems remains crucial.

Equally important is harnessing India's cultural and spiritual capital for environmental protection. Inspiring examples like Punjab's gurudwaras utilizing crop residue for community kitchens (SGPC, 2022) and Kanpur's Sankat Mochan Temple maintaining a 10,000-plant purification zone

demonstrate how religious institutions can drive grassroots change. These initiatives not only reduce pollution directly but also raise ecological awareness among millions of devotees. The path forward requires:

- Policy rigor: Implementing deterrent penalties and corruption-proof systems
- Green technology: Scaling renewable energy and emission control solutions
- Cultural mobilization: Engaging religious and community leaders as environmental stewards

By combining regulatory strength with India's rich tradition of environmental consciousness, we can clear the air for future generations. The solution lies not just in government action, but in every citizen and institution recognizing clean air as both a fundamental right and shared responsibility.