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# Air Pollution Control Through Technology: Effects On Human Health And Legal Systems

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**Abstract**

This paper examines the various health risks associated with air pollution. Particulate matter (PM2.5 and PM10) and gases such as $CO_2$, $SO_2$, and $NO_2$, primarily emitted from industrial activities, transportation and agriculture are major air pollutants that also contribute to the greenhouse effect. These pollutants are linked to environmental issues like acid rain and health problems, including respiratory infections, cardiopulmonary diseases, bronchitis and asthma, affecting individuals across all age groups. Lead emissions from sources like batteries, kerosene and industries pose additional health risks, including anaemia, kidney damage and neurotoxicity. To combat air pollution, India has implemented several policies and initiatives, such as the Air (Prevention and Control of Pollution) Act, 1981, the National Clean Air Programme, the National Air Quality Index, the Pradhan Mantri Ujjwala Yojana and the National Air Quality Monitoring Programme. Advanced technological solutions like wet scrubbers, absorption techniques, carbon sequestration and cloud seeding are crucial for effective mitigation.

***Keywords:*** Wet Scrubbers, Particulate Matter, Cloud Seeding, Carbon Sequestration, Carbon Monoxide.

## Introduction

For developing nations like India, air pollution—currently one of the largest environmental problems—has grown to be a serious health risk. Air pollution emission concerns are linked to numerous industries, including but not limited to power, transportation, industry, construction, and agriculture. Away from the source, air pollution also affects other locations. Therefore, in addition to multi-sectoral synchronization, regional-level activities through inter-state and inter-city coordination are required[1].

Ambient air pollution is defined by the World Health Organization (WHO) as possible air pollutants released by homes, businesses, and

automobiles. Particulate matter (PM) and gaseous air pollutants are examples of these air pollutants.

Human health is severely impacted by the fine particulate matter released by burning fossil fuels in homes, businesses, power plants, cars and biomass burning. Ambient air pollution increases public health spending quickly, lowers labour productivity, and lowers agricultural yields, all of which represent serious, multifaceted hazards to India's chances of meeting its development objectives.

A group of undesirable compounds that are present in the ambient air at high concentrations and have a negative impact on the environment and human health are referred to as air pollutants. Furthermore, greenhouse gases (GHGs) are responsible for climate change and global warming because they trap heat in the atmosphere. Climate change and air pollution are intimately related. The combustion of fuel in transportation, electricity generation, household activities, industries and the burning of crops and municipal garbage are the same sources of air pollution and greenhouse gases. Nonetheless, there is a noticeable distinction in the spatial dimensions of greenhouse gases and air pollution.

The average lifetime of ambient air pollutants in the atmosphere is a few days or weeks, whereas greenhouse gases (GHGs) like CO2 and CH4 have a lifespan of about 150 years and 12 years respectively. There are several direct and indirect effects on human health and the environment at the local, regional, and global levels as a result of the interaction between air pollutants and greenhouse gas emissions in the atmosphere. While greenhouse gases (GHGs) cause climate change which has indirect effects on the ecosystem and human health, air pollution has direct affects.

Methane, hydrofluorocarbons, and black carbon are examples of gases that are classified as short-lived climate pollutants (SLCPs). These are distinct from the conventional meanings of greenhouse gases and air pollutants. SLCPs are potent climate drivers even though they reside in the atmosphere for a far shorter amount of time than carbon dioxide (CO2). They have a far larger capacity to warm the atmosphere. A few SLCPs have negative effects on ecosystems, agriculture and human health as well as being air pollutants. There are significant financial savings in public health and fewer hazards to ecosystems when integrated solutions are offered to address climate change and air quality[2].

## RESEARCH METHODOLOGY

Here my study will be of doctrinal form and I have relied on secondary source of data.

### *Air pollution sources*

The industries involved in manufacturing and electricity production, construction, burning of garbage and biomass in agriculture, oil, coal, and

biomass combustion in homes as well as the usage of cars and road dust are the most frequently reported sources.
An increase in air pollution results in higher costs for health infrastructure as well as lower labour and agricultural production. Tiny particles that enter the human body from air pollution are the cause of illness and death. The microscopic particles, known as particulate matter or PM, are distributed throughout the atmosphere and transported by the wind, where they cluster in hotspots and worsen the local air quality.

***Main air pollutants and their effects***

The main pollutants affecting air quality are particulate matters (PM1, PM2.5, PM10), NOX, SOx, CO, Ozone and lead among others. In terms of the percentage contribution from various sources of pollution, the share of these contaminants varies.
It is a significant issue for policy makers to reduce the emission levels of PM2.5 and PM10, which are the main pollutants that are reported to be above the National Ambient Air Quality Standard (NAAQS) throughout the nation, particularly in metropolitan regions of the Indo-Gangetic Plain.

**Table:** Showing main air pollutants, there sources and there effects

| **Air Pollution** | **Sources** | | |
|---|---|---|---|
| | **Natural** | **Anthropogenic** | |
| $SO_2$ (Sulphur Dioxide) | Eruptions from volcanoes | i)Fossil fuel combustion (coal, heavy fuel, factories); ii)Fossil fuels excavation and distribution. refining of petroleum, diesel combustion process and natural gas in vehicles | i)Illness of the respiratory system, reduced vision, and exacerbation of pre-existing lung and heart conditions; ii)Acid rain |
| $NO_2$ (Nitrogen Dioxide) | i)Activity of bacteria in soil; ii)Fires in forest; iii)Lightning in sky | i)Combustion at high temperature (engines combustion, power stations which are fossil fuel fired); | i)To respiratory infections increases susceptibility and nose and throat irritation |

| | | | |
|---|---|---|---|
| | | ii)Fossil fuels and bio-mass burning | |
| $PM_{10}$ (Particulate Matter) | i)Dust generated by wind, including those from roads, fly ash, soot, and agricultural processes; ii)Surface abrasion, grinding and crushing are physical processes; iii)substances released by burning fossil fuels that are not combustible. | i)The emissions from road traffic, especially from diesel automobiles; ii) Some public power generation facilities and industrial combustion plants; iii) Commercial and residential combustion; iv) Non-combustion procedures, such as quarrying activities related to agriculture | i)Cardiopulmonary issues, bronchitis, asthma and pneumonia in elderly individuals |
| $PM_{2.5}$ (Particulate Matter) | i)Created through nucleation, the first step that turns a gas into a particle; ii) Reach a maximum size of 1 μm by coagulation, condensation, or further gas condensing. | i)Emission by vehicles; ii)Combustion plants of industries; ii)Combustion by commercial and residential activity. | i)People with heart or lung disease have premature death; ii)Cardio-pulmonary disorder and irregular heartbeat; iii)Increase in asthmatic condition and decreased lung function; iv)Airways irritation, breathing difficulty and coughing. |
| CO (Carbon Monoxide) | i)Produced in low amount during normal animal metabolism and had a use in signalling molecule; ii)Fires of forest and bushfires | i)Carbon fuels burning; ii)In waste incarceration organic combustion; iii)Internal combustion engines | i)Heart disease patients are more susceptible to CO poisoning and may feel pain in their chests; ii) Unfavourable consequences for a |

| | | | |
|---|---|---|---|
| | | exhaustion particularly with petrol engines;<br>iv)Smelting of iron;<br>v)Crop residue burning | pregnant woman's foetus;<br>iii) People with respiratory illnesses, the elderly, and infants are also especially vulnerable |
| Pb (Lead) | i)Plants absorbed lead through their food | i)Vehicle exhaust;<br>ii)Lead acid batteries, paints, kerosene burning, industrial effluents | i)Negative impacts on the kidneys, immunological system, cardiovascular system, and central nervous system;<br>ii) Leads to disorders in blood such as anaemia and high blood pressure;<br>iii) Potential neurotoxic that builds up in soft tissues and bones;<br>iv) Results in nephropathy and pain in the abdomen resembling colic;<br>v) Weakness in ankles, wrists or fingers;<br>vi)Discontinuity and decreased male fertility, delayed female puberty;<br>vii) Permanently impair children's cognitive abilities |

***Policy for fighting air pollution***

India has undertaken a number of programs and initiatives to address the problem of air pollution. These programs' effectiveness and success have depended, like any other policy action, on cooperation and coordination amongst numerous stakeholders. For air-pollution mitigation and clean air the major policies are-

i)The Air (Prevention and Control of Pollution) Act,1981

ii)The National Clean Air Programme (NCAP) which was one of the most recent initiatives to combat air pollution, having been introduced in the year 2019. The NCAP requires 122 Indian cities to create city-level clean air plans in order to put mitigation plans for ambient PM concentrations into action. The goal of the NCAP is to offer the Union and State governments a comprehensive plan for fighting air pollution. With 2017 serving as the base year, it has a target of lowering major air pollutants PM10 and PM2.5 by 20–30 percent by 2024. The goal of this five-year action plan is to raise public awareness and establish a network for monitoring air quality throughout all of India.

iii)For control and mitigation of air pollution in Delhi and Delhi NCR the National Air Quality Index (AQI) Comprehensive Action Plan (CAP) in 2018 has came. In order to inform the public on the state of the air quality, the AQI is a tool for converting complicated data on the concentration of different pollutants in the air into a single number.

iv)Pradhan Mantri Ujjwala Yojana (PMUY) The Pradhan Mantri Ujwala Yojana (PMUY), a liquefied petroleum gas (LPG) subsidy initiative for impoverished households, was introduced by the Ministry of Petroleum and Natural Gas (MoPNG) in 2016 with the goal of providing cleaner fuel that maintains air quality and public health. These homes are eligible for a free LPG hookup under the PMUY.

v) National Air Quality Monitoring Programme (NAMP) The government is conducting the National Air Quality Monitoring Programme (NAMP), a nationwide initiative that was launched in 1984, to ascertain the prevalence of ambient air quality exposed to three distinct air pollutants, SO2, NO2, and PM10, at all places. The Central Pollution Control Board, the National Environmental Engineering Research Institute (NERRI), the State Pollution Control Boards (SPCBs) and the Pollution Control Committee (PCC) are assisting with this effort. These organizations continuously supply the technical and financial assistance needed to keep the monitoring stations running.

vi) National Ambient Air Quality Standards (NAAQS) For the wellness of lives it specifies the essential air quality levels and the air quality margins.

***Engagement of vulnerable communities***

Children's growth and development can be negatively impacted by the level of environmental pollution, particularly when they engage in outside activities. The 9% of deaths globally in 2016 resulting from the combined impacts of ambient and home air pollution were of children. High pollution exposure impairs lung function and puts kids at risk for respiratory issues as adults. Air pollution exposure ranks among the world's leading causes of death for children under five years old, accounting for almost half of all Acute Lower Respiratory Tract Infection (ALRI) deaths in low and middle-income countries. Prematurity, severe respiratory infections and intrapartum problems (including birth asphyxia) are the top five causes of death for children under five worldwide.

Women are particularly susceptible to the negative impacts of air pollution. Women spend more time indoors than males do because of the pervasive gender gap, their low percentage of labour force involvement and their limited access to public spaces. As a result, they are more vulnerable to indoor air pollution. The inefficient burning of biomass (firewood, coal and dung cakes) in rural Indian households is linked to indoor air pollution because of improper processing. Solid biomass fuels are used for cooking in about 20% of urban homes and 83 percent of rural households. Because enclosed and small places allow pollutants to accumulate more than open spaces, this impacts women and girls on a daily basis. Major health problems like lung, heart and pulmonary illness as well as strokes are brought on by this prolonged exposure. Young women and girls lose out on jobs and education as a result of the opportunity cost of gathering firewood, which is viewed as their responsibility. Researchers have highlighted that 40 percent of the illness burden is attributable to residential air pollution, which is the primary cause of more deaths than outdoor pollution.

The increasing detrimental effects of air pollution on vulnerable areas can be lessened by implementing a variety of community-based solutions. It is possible to leverage the expertise of academics to generate creative solutions. For instance, researchers at Banaras Hindu University (BHU) have identified the types of trees that can withstand the attack of particulate matter gaseous pollutants (nitrous oxide, sulphur dioxide and ozone) in urban areas of the city. Urban planners can manage urban forests with the use of these insights[3].

***Measures to reduce air pollution***

1)FROM TRANSPORT

A multitude of factors, including the fuel type, quality, technology employed in fuel combustion, land use and vehicle use, influence the amount of pollutants emitted by motor vehicles. Each of these elements needs to be taken into consideration in order to regulate or lower the

emissions from motor vehicles. The humans can accomplish this by carrying out the following actions:

i)enhanced standards and technology for emissions;

ii)Enhanced fuel economy;

iii)Upgraded transportation planning and management of traffic;

iv)Enhanced inspection and maintenance

v) Convert to public transportation and encourage walking and cycling as non-motorized forms of active transportation.

2)FROM INDUSTRY

A. ZONING AND LAND USE PLANNING

i)New industries should be located with consideration for planning restrictions. As part of city planning, appropriate industrial zones or districts should also be constructed. ii) Environmental impact assessments should be required of all new industries. iii) moving currently operating industry out of the way of sensitive land uses like residential areas.

B. INDUSTRY-WIDE EMISSION REDUCTION

i) stressing the need for cleaner fuels;

ii) emphasizing the need for the use of the best technology available for particular industrial processes and offering an action plan for doing so. iii) Mandatory accident reporting;

iv) Strict licensing of specific polluting activities;

v) Adherence to mandatory emission regulations and a plan for enforcing them; and vi) Imposing severe fines for exceeding emission requirements

C.ENCOURAGING THE USE OF CLEANER PRODUCTION METHODS

i) boosting industrial process efficiency;

ii) to employ cleaner fuels, such as natural gas or enhance the quality of fuels (like those with lower sulphur content);

iii) adopting innovative technology

3.FROM URBAN AREAS

Pollution from various local sources is a problem for urban areas. Some of these may result from man-made activities like burning biomass, open burning of rubbish, dust from roads and building sites and natural events like forest fires and dust storms that cause dust to settle on the land. The following actions could be taken to reduce these emissions:

i)enforcing laws prohibiting the burning of waste or materials;

ii)encouraging the development of alternatives to burning waste.

iii)Better trash management and monitoring.

INDIAN LAWS AND REGULATIONS PERTAINING TO AIR POLLUTION

Since before independence, several laws have been passed in India to address air pollution. Bengal introduced the nation's first law intended to reduce air pollution. Later, it was implemented in Bombay (now Mumbai). The Bengal Smoke Nuisance Act, 1905, aims to get rid of annoyances brought on by smoke from fireplaces and furnaces in Howrah and Kolkata's towns and suburbs. Similarly, the Bombay Smoke Nuisance Act of 1912 was developed to address same issues in the state of Maharashtra. Following this, in 1939 the Motor Vehicles Act was passed, which contained regulations pertaining to the control of vehicle pollution. The most recent version of the Motor Vehicles (Amendment) Bill, 2019 gives the government the authority to recall vehicles when a flaw is discovered that could endanger the environment or other drivers. The vehicle's maker will have to do one of two things: (i) reimburse the buyer for the full purchase price, or (ii) swap out the damaged vehicle for one that satisfies the same or higher standards. The Factory Act, 1947 was subsequently passed, addressing each of these industrial issues. The management of operations involving dust and odours from industrial complexes was included in this national act.

India saw a turning point in the discussion of environmental issues following the June 1972 United Nations Conference on the Human Environment in Stockholm. The Water (Prevention and Control of Pollution) Act of 1974's Section 3 authorized the establishment of the CPCB in 1974 with the goal of monitoring and preventing water pollution. Later on, though, the Board's authority was expanded to include air pollution prevention and control. In order to control and lessen air pollution, the Air (Prevention and Control of Air Pollution) Act (Air Act, 1981) was passed in 1981. Additionally, in 1987, the Air Act of 1981 was modified to grant the central and state pollution control boards the power to handle emergencies involving extreme air pollution. The Central Pollution Control Board (CPCB), a statutory body under the Ministry of Environment, Forests, and Climate Change, is one of the government's major stake holders. It also actively participates in the generation, gathering, and collation of data, the provision of scientific information, the technical assistance for the creation of national policies and programs, the training and development of human resources, and the public awareness-raising campaigns at various governmental and non-governmental levels[4].

The Environment (Protection) Act (EPA) was passed in 1986 and serves as a general statute for both environmental prevention and preservation. The nationwide program for prevention, control, and abatement is improved and strengthened by EPA, 1986. Regulations in these domains may be issued by the Central Government and published in

the Official Gazette. Another global plea to protect the environment came from the 1992 Rio de Janeiro United Nations Conference on Environment and Development (UNCED). The conference called on national legislation pertaining to compensation for victims of environmental damage and accountability of polluters. As a result, the National Environment Tribunal Act (NETA), 1995 established the National Environment Tribunal, whose duty it is to determine strict culpability for damages resulting from accidents involving the handling of dangerous substances. In order to handle complaints regarding environmental clearances within limited zones, the National Environment Appellate Authority (NEAA) Act was passed into law in 1997. Afterwards, the National Green Tribunal (NGT) Act, 2010 effectively repealed the previous two statutes by defining the right to live in a clean and safe environment under Article 21 of the Indian Constitution. The Tribunal was established under the NGT Act in order to expedite the resolution of environmental complaints.

***Some provisions of the air (prevention and control of pollution) Act,1981 for regulating vehicular pollution***

i)Clause(g) of Subsection (1) of Section 17 "establish... standards for the release of air pollutants into the atmosphere from motor vehicles and industrial facilities." Additionally, this must be carried out in accordance with the Central Board's established requirements for air quality and in consultation with them. ii)Subsection (1) of Section 20 provides for "Authority to issue directives for ensuring vehicle emission standards" It says, "The State Government shall, in consultation with the State Board, give such instructions to the concerned authority in charge of registration of motor vehicles under the Motor Vehicles Act, 1939 with a view to ensuring that the standards for emission of air pollutants from automobiles are complied with." It continues, saying that "such authority shall be bound to comply with such instructions, notwithstanding anything contained in that Act or the rules made there under[5]."

iii)Section 21 provides for limitations on using specific industrial plants that no one may construct or run an industrial plant in an area subject to air pollution management without first obtaining permission from the State Board. iv)Subsection (1) of Section 22A provides for restraining a person from causing air pollution the power of board to make application it says “If the Board determines that someone operating an industrial plant or another activity in an area subject to air pollution control is likely to release any air pollutants beyond the limits set by the State Board under clause (g) of sub-section (1) of section 17, the Board may apply to a court for a restraining order which should not be inferior to that of a Metropolitan Magistrate or a Judicial Magistrate of the first class to prevent the release of any air pollutants[6].

V)Sub-section (1) of Section 37 provides for a penalty of not less than ten thousand rupees that may be extended to fifteen lakh rupees if any industry etc. present in any air pollution control area emit air pollutants in excess of what has been permitted by State Board(Section 22).

***Executive action in curbing air pollution***

The following executive actions, in addition to court interventions, have been critical in reducing the causes of air pollution:

i)Policy of Auto Fuel: Since vehicle emissions are the primary cause of air pollution in India, prompt remedial action is necessary. For four-wheeled light-duty and heavy-duty vehicles, India has been implementing European emission and fuel rules since 2000. ii) Infrastructure for Alternative Fuels: In order to increase the production of alternative fuels while reducing reliance on fossil fuels, the government is stressing the significance of a comprehensive and inclusive policy on alternative fuels, with a particular emphasis on options like CNG, LPG/LNG, bio-diesel and biofuels. iii) The government of India has implemented an executive measure known as Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME), which involves providing subsidies for the purchase of electric vehicles (EVs)[7] and it has been allocated Rupees ten thousand crores.

***Technology for minimising air pollution***

Fine particulate matter was predicted to be responsible for 25% of fatalities from lung cancer, 8% of deaths from chronic obstructive pulmonary disease (COPD), and 15% of deaths from stroke. These particles have the potential to lodge deeply in the lungs, causing heart conditions, chronic bronchitis, and a reduction in lung function. Consequently, the development of instrument measurement and monitoring systems for ambient air quality is an inevitable method to controlling and evaluating the emission of ambient air pollutants.

i)Broadly speaking, the instruments are capable of measuring and providing real-time analysis for essential regulatory air pollutants, including PM (PM10 and PM2.5), SOx, NOx, ozone (O3), CO and volatile organic compounds (VOCs). Inertial weighing tapered element oscillating microbalance (TEOM), laser scanning and gravimetric sampling are a few examples of industrially proven PM technologies that are used to routinely monitor the aerosols and dust at the designated region. Options for monitoring ambient air pollution at a particular workplace include personal and portable instruments. The establishment of air pollution data for the general public, the application of air quality standards, the assessment of efficient air pollution control, the creation of predictive air quality models and long-term research on the effects of air pollution on health are among

the requirements of ambient air monitoring strategies, according to the U.S. EPA (Environmental Protection Agency)[8].

ii) Wet Scrubbers

Wet scrubbers are devices that use a spray of water or another liquid to directly contact and capture suspended particles. The numerous tiny droplets in the spray act as a scrubber, effectively washing the particulates out of the contaminated airstream when they collide with them.

iii) Absorption

Absorption is the process of moving a gaseous pollutant from the air into a contacting liquid, like water in the context of controlling air pollution. The liquid needs to have the ability to either react chemically with the pollution to trap it or function as a solvent for it.

iv) Carbon Sequestration

The long-term storage of carbon dioxide underground and in Earth's oceans and forests is known as carbon sequestration. Natural processes like forest growth are necessary for the sequestration of carbon in forests and oceans. However, natural carbon sequestration is reduced by ocean pollution, forest removal for agriculture and other uses. Under development, subterranean carbon dioxide storage, also known as geosequestration or carbon capture and storage, entails directly injecting the gas into subterranean geologic "reservoir" strata. This would necessitate the expensive procedure of separating carbon dioxide from power plant flue gases (the substance released into the air during the burning of fossil fuels like coal, oil, natural gas, or wood to generate heat or electricity. These fuels may include pollutants like sulphur dioxide, carbon dioxide, and particulates. Nonetheless, nitrogen oxides make up the majority of flue gas)9.

v) Cloud seeding

It is a process of inducing artificial rain in any high air pollution prone area. It is a weather modification technique where silver iodide (AgI) was released into the atmosphere which aid in the ice crystal formation and ability of cloud to create rain get improved[10].

**DISCUSSION**

**i)**The biggest health risk of today's time is air pollution. As the stewards of the environment, it is not only our responsibility to ensure that our children have access to clean air, but also to ensure that they continue to view and paint the sky blue. September 7 mark the International Day of Clean Air for Blue Skies. To address air pollution issues in selected cities, the national clean air program employs a thorough, coordinated and cooperative strategy. It is implemented by relevant Central Ministries, State Governments and local entities through a cooperative, multi-scale, and cross-sectoral coordination strategy. In 2022, the government initiated the Swachh Vayu Survekshan under NCAP with the aim of ranking the 131 cities according to their efforts towards reducing air pollution. The initiative's goals are to increase public knowledge of air pollution, inspire residents, encourage city competition and push them to improve on Clean Air for All. But we as a people have to become environmentally conscious as without it no technocentric approach will clean the air or environment.

**ii)**Significant reductions in air pollution can be achieved by encouraging increased use of public transportation, increasing car fuel efficiency, building appropriate highways and roads etc. One of the main causes of the significant rise in air pollution is the increase in number of cars. India enacted several new regulations and guidelines to lower the amount of pollution coming from the transportation industry. In 2020, the Bharat Standard (BS-VI) regulations for fuel and vehicle emissions were approved. These bring about a decrease of 40% in PM and 43% in NOx emissions from car engines over the previous BS-IV regulations, as well as cleaner gasoline with an ultra-low sulphur content (10 ppm) instead of the 50 ppm allowed limit under BS-IV standards. So the public can help the government in reducing air pollution by car pooling by adopting electric vehicles for short distance travel.

**iii)**In 2018 the National Policy on Biofuels had been announced which aims to achieve 5% blending of biodiesel in diesel and 20% blending of ethanol in petrol by 2030.One significant source of emissions of Black Carbon (BC), a powerful greenhouse gas, is diesel vehicle exhaust. According to studies, HDVs (Heavy-duty diesel vehicle) are to blame for 78% of BC's roadside emissions. Reducing BC emissions from older diesel engines will be essential to preventing a 0.5℃ increase in global warming over the next 25 years, as these pollutants have a negative impact on the climate.

**iv)** The importance of the Central Pollution Control Board and State Pollution Control Board operating at maximum capacity was emphasized by the Supreme Court.Recently the Supreme Court said that "With roughly one-third of jobs empty, these authorities will be rendered toothless. These

authorities perform highly significant legislative functions under the Environment Protection Act, Air Act, Water Act, etc". So the vacancies in CPCB and SPCB should be filled up so that these agencies can implement the rules and regulations of the act properly.

## Conclusion

With significant effects on human health and legal frameworks, the nexus of technology and air pollution control represents a crucial frontier in environmental management. Technological developments have greatly improved our capacity to track, evaluate and reduce air pollution, but these advantages are closely related to changing legislative and regulatory responses. New technology for emissions control and monitoring must be incorporated into regulations to guarantee that businesses and local governments use cutting edge pollution control systems. Through rewards and funding for research and development, policies should promote the creation and application of innovative technology. Encouraging innovation and scaling up successful ideas can be greatly aided by public-private collaborations.

Technology and regulatory frameworks working together will be essential as India continues to face serious air quality issues. It is recommended that future endeavours concentrate on fortifying the incorporation of technology innovations into regulatory procedures, augmenting the precision and comprehensibility of data and cultivating cooperation among relevant parties. India can enhance air pollution control, safeguard public health and progress towards sustainable environmental stewardship by harmonizing technical advancements with all-encompassing and adaptable legal guidelines

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