Chapter-1
Introduction

Government of India enacted (March 1981) the Air (Prevention and Control of Pollution) Act, 1981 (The Air Act) for prevention, control, and abatement of air pollution. The Air Act defines air pollution as "presence in the atmosphere of any air pollutant" where air pollutant is defined as any solid, liquid or gaseous substance including noise[1] present in the atmosphere in such a concentration which tends to be injurious to human beings, other living organisms, plants, property[2] or environment. Air pollution is an invisible transboundary phenomenon.

1.1 Air pollutants and sources of air pollution

Air pollutants can be divided into two main groups-particulate and gaseous. Particulates include solid airborne pollutants such as dust, fly ash, smoke, fog, soot, and fumes. Gaseous pollutants include Carbon Monoxide, hydrocarbons and oxides of Sulphur and Nitrogen. These pollutants are known as primary air pollutants which interact with one another to form secondary air pollutants such as ozone[3] and other reactive materials. These secondary air pollutants also react with natural chemicals in the atmosphere.

The substances that are generally recognized as air pollutants are Particulate Matter (PM_{10} and $PM_{2.5}$), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Ozone (O_3), Lead (Pb), Ammonia (NH_3) and Volatile Organic Compounds (VOC). The concentration of pollutants in the air is measured in microgram per cubic meter ($\mu g/m^3$). Particulate Matter (PM) is a complex mixture of extremely small particles and liquid droplets, made up of several components including nitrates, sulphates, organic chemicals, metals, soil, or dust. The size of the particles is directly linked to their potential for causing health problems. PM is categorized into two groups.

(i) PM_{10} or inhalable coarse particles, such as those found near roads, dusty locations, and industries. These are less than 10 micrometres in diameter.

(ii) $PM_{2.5}$ or fine particles such as those found in smoke and haze. These are less than 2.5 micrometres in diameter.

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1 Inserted by Act 47 of 1987: Air (Prevention and Control of pollution) Amendment Act, 1987 with effect from 01 April 1988.

2 For example: impact on beauty of the Taj Mahal is due to emission from the Mathura Refinery.

3 Ozone is a natural as well as man-made product that occurs in the earth's upper atmosphere and lower atmosphere and affects life on earth in either good or bad ways. Ozone at upper atmosphere is good and it is bad at lower atmosphere. Ozone at lower atmosphere is formed primarily from photochemical reactions between two major classes of air pollutants, volatile organic compounds and nitrogen oxides.

Chart-1: Visual presentation of particles as compared to human hair

Chart-1 represents the visual presentation of PM_{10} and $PM_{2.5}$ as compared to human hair to show its size.

$PM_{2.5}$ particles upon inhalation, can be easily absorbed deep into the bloodstream and can cause far-reaching health effects like asthma, lung cancer and heart disease due to the microscopic size of these particles.

The sources of air pollution are natural and man-made. Natural sources of air pollution include forest fire, windblown dust such as road dust, soot, physical processes of crushing, grinding and abrasion of surfaces, volcanoes, lightning, *etc.* Man-made sources of air pollution comprise burning of fossil fuels (households, thermal power plants and combustion engines), smelting of metals, emissions from vehicles, quarrying, agricultural activities, burning of crop residues, emissions due to chemical, pharmaceutical, cement, petrochemicals, refineries and fertilizer industries, fly ash, *etc*.

Further, air pollution may be caused indoor due to household activities and outdoor due to industries and automobiles.

1.2 Impact of air pollution on human health

Air pollution is responsible for many Non–Communicable Diseases (NCD) and respiratory dysfunctions in humans and other living organisms. It also causes constant depletion of the ozone layer which results in global warming. Thus, air pollution is dangerous to the health of living organisms and the ecosystem.

The Lancet[4] published (January 2021) an article on "Health and economic impact of air pollution in the states of India: The Global Burden of Disease Study 2019', in which it was estimated that in India, the number of deaths due to air pollution in 2019 was 16.70 lakh, an increase of 4.29 lakh in comparison to 2017[5].

[4] The Lancet is an independent, international weekly medical journal published since 1823.
[5] In 2017, the Lancet reported 12.41 lakh death due to air pollution in India.

The impact of different types of air pollutants on human health is shown in **Table 1** below:

Table 1: - Impact of pollutants on human health

Pollutants	Sources	Impact
Particulate Matter ($PM_{2.5}$, PM_{10})	Motor vehicles, industries, domestic fuel burning, road dust	Cardiovascular and respiratory diseases, lung cancer, acute lower respiratory infections.
Sulphur Dioxide	Burning of Sulphur-containing fuels for heating, power generation and motor vehicles.	Affects respiratory system and lung functions, coughing, mucus secretion, asthma, and chronic bronchitis. Causes acid rain.
Nitrogen Oxides (NOx)	Combustion processes (heating, power generation, and vehicles) i.e., burning of fossil fuels.	Bronchitis in asthmatic children. Reduces lung function growth.
Carbon Monoxide	Incomplete fuel combustion (as in motor vehicles)	Reduces the oxygen-carrying capacity of the blood, causes headaches, nausea, and dizziness. Can lead to death at high levels.
Ozone	Formed by the reaction of NOx and VOCs in sunlight	Breathing problems, asthma, reduced lung function. Ozone is one of the most damaging pollutants for plants.
Lead	Petrol and specific industries (such as smelting, paint, colour).	Affects the intellectual development of children and very high concentrations can result in poisoning, brain damage and organ damage.
Volatile Organic Compounds	Combustion & distribution-of petroleum products as they contain traces of Benzene, Toluene and Xylene (BTX).	Exposure to the high level of BTX causes neuro-toxic symptoms and persistent exposure to BTX may cause injury to human bone marrow, DNA damage in mammalian cells and damage to the immune system.

(Source- State of Environment Report, 2012 Government of Gujarat)

1.3 Impact of air pollution on business and economy

According to an independent report[6] on "Air Pollution and its impact on business- the silent pandemic" commissioned by the Clean Air Fund (November 2020-March 2021), Air pollution costs Indian businesses about $95 billion every fiscal year. This is around three *per cent* of India's GDP. The cost is equal to 50 *per cent* of all taxes collected annually or 150 *per cent* of India's healthcare budget.

The report had identified the following six ways in which this cost manifests: (i) lower labour productivity (ii) lower consumer footfall (iii) premature mortality (iv) lower asset productivity (v) increased health expenses and (vi) welfare losses. Of these, employee productivity, consumer footfall and premature mortality impact businesses directly. The report had also identified

[6] https://www.cleanairfund.org/wp-content/uploads/2021/04/01042021_Business-Cost-of-Air-Pollution_Long-Form-Report.pdf.

other more physical consequences like fall in tourism and reduced visibility. In 2019, due to reduced visibility, 13 *per cent* of total flights were delayed which adversely affected shipping and cargo handling services.

1.4 Air Quality Index - an indicator of air pollution

The Ministry of Environment, Forests & Climate Change launched (October 2014) The National Air Quality Index (AQI) outlined as 'One Number- One Colour-One Description' for the common man to judge the air quality within his vicinity. The formulation of the index was a continuation of the initiatives under the Swachh Bharat Mission.

AQI is a numerical value based on short-term[7] air quality data of PM_{10} and $PM_{2.5}$, SO_2, NO_2, CO, O_3, NH_3 and Pb. The AQI values are divided into six categories namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. Based on the measured ambient air quality concentrations, corresponding standards and likely health impact, a sub-index is calculated for each pollutant. The worst sub-index reflects overall AQI. The numerical values of AQI, corresponding ambient air quality, colour code and associated likely health impact are shown in **Table 2** below:

Table 2: - Levels of AQI and associated impact on health

Numerical Value of AQI	Categories of AQI	Possible associated health impact
0 to 50	Good	Minimal
51 to 100	Satisfactory	Minor breathing discomfort to sensitive people
101 to 200	Moderately polluted	Breathing discomfort with lungs, asthma, and heart disease
201 to 300	Poor	Breathing discomfort to most people on prolonged exposure
301 to 400	Very Poor	Respiratory illness on prolonged exposure
>400	Severe	Respiratory impact even on healthy people and seriously impacts those with existing lung/ heart diseases

(Source: National Air Quality Index Report 2014-15 of CPCB, Ministry of Environment, Forests, and Climate Change)

1.5 Status of air pollution in Gujarat

Gujarat is one of the highly industrialized states in India. The major industry groups/sectors in Gujarat are petrochemicals, chemicals, textiles, cement, paints, pulp and paper, pharmaceuticals, and ceramics. Further, there are coal-based thermal power plants that cause significant emissions[8] and generate fly ash. In addition, the legacy solid waste and construction and demolition activities in urban areas also contribute to poor air quality. The average annual

[7] 24-hourly averaging period.

[8] 67 *per cent* of the total power generation in Gujarat is from fossil fuels (October 2019 report of Central Electricity Authority).

growth rate of vehicles in urban areas of Gujarat is also very significant. In 1999-2000, the total registered vehicles in Gujarat were 51.90 lakh. These increased by 385 *per cent* in 2018-19 to 2.52 crore[9], contributing significantly to the poor ambient air quality. Moreover, less forest cover (7.57 *per cent* compared to national forest cover of 21.67 *per cent*)[10], mining activities, major ports, railways and road infrastructure activities causing extensive vehicular movement also contribute to air pollution.

The status of air pollution in Gujarat can be gauged from the fact that based on the Comprehensive Environmental Pollution Index (CEPI)[11], the Ministry of Environment, Forest and Climate Change (Ministry) had declared (January 2010) six major industrial areas of Gujarat, *viz.*Vapi, Ankleshwar, Vatva, Ahmedabad (Odhav and Naroda), Bhavnagar and Junagadh as Critically Polluted Areas[12] (CPA) and imposed moratorium on setting up of new industries and expansion of existing industries in these areas. As per the latest CEPI score submitted (July 2019) by the Central Pollution Control Board (CPCB) to the National Green Tribunal (NGT), three new cities Vadodara, Surat and Rajkot have been added to the CPA list while Ahmedabad (Odhav and Naroda), Bhavnagar and Junagadh were removed from the list.

The Ministry, finalized and launched (January 2019) the National Clean Air Programme (NCAP) as a time-bound national-level strategy to tackle air pollution comprehensively. Under the programme, Ministry had identified 102 cities as non-attainment cities which failed to meet the prescribed standards of air pollution. Ahmedabad and Surat were among the non-attainment cities in Gujarat. Further as per the Source Apportionment Studies (SAS) of Ahmedabad and Surat cities conducted by the Gujarat Energy Management Institute (GEMI)[13] and The Energy and Resources Institute (TERI)[14], respectively the prominent sources of emission were domestic fuel, construction, road dust, industries, and vehicles.

In pursuance of the NGT order of October 2018, all the states and union territories having non-attainment cities were required to constitute the Air Quality Monitoring Committee (AQMC) and the AQMC was required to prepare an appropriate action plan.

CPCB approved (April 2019) the Air Action Plan for Ahmedabad and Surat which was in progress (January 2022). GoG constituted (June 2019), Steering Committee, Monitoring Committee and Implementation Committee for Ahmedabad and Surat for implementation of NCAP.

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9 Data provided by the Commissioner of Transport and its webpage.
10 India State of Forest Report 2019, Forest Survey of India.
11 CEPI is a rational number between 0 and 100, assigned to a given location to characterize the environmental quality following the algorithm of source, pathway and receptor.
12 CEPI score more than 70.
13 GEMI, set up in February 1999, is an autonomous institute under the aegis of Forest and Environment Department, Government of Gujarat to provide all kind of environment solutions required to ensure sustainable development.
14 TERI, established in 1974, is a research institute that specializes in the fields of energy, environment, and sustainable development.

Conclusion

The legal provisions for the regulation of air pollution have evolved over time. Backed by these legal provisions and keeping in view the need for desired interventions, the Government of India has launched NCAP in January 2019.