



# Air pollution: the top risk factor of public health globally

Sisodia Kamlesh

Professor -Zoology, Department of Zoology, M.S.J. Government P.G. College, Bharatpur, Rajasthan, India.

Corresponding Author's Email ID: mailmedrkamlesh@gmail.com

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## ABSTRACT

Pollution is unwanted, undesired, showcase in all sorts of ecosystems. Air pollution is a familiar environmental health hazard. The polluted air appears as a brown or brown-black haze setting over an area. Pollution may be seen as a bad change in physical, chemical, biological component of the biosphere. It affects life of all living organisms from small to huge or plant to animal. Hence, when nature gets affected by undesirable elements, we say it is polluted. From many different types of pollution, most important ones are pollution of air, water and land. This study focuses on air pollution and highlights the risk factor for humans' health. Air Pollution is the result of unwanted amounts of suspended particulate matter (SPM)-checked for AQI and air pollutants like Nitrogen Oxides, Sulfur Oxides, Carbon Oxides, Ozone, volatile organic compounds, smog etc. produced and released in pure air through various activities performed in routine by Man in waywardness to prove himself a super creature. Such pollution has led us in a pool of life-threatening diseases like cancer, T.B., Respiratory and cardiovascular diseases. The air pollution has become the second topmost level risk of life followed by tobacco generated diseases which are the first topmost health hazards. Besides strict execution of Acts and policies to control air pollution, there is continuous need of research and collaborations of various organizations to improve modeling of global air pollution and quantification of health hazards. There are suggestive measures like use of air filters, GRAP, Various government Policies and Acts that can help to curb this menace.

**Keywords:** Pollution, SPM, Health Hazards, Air filters, GRAP, AQI, Act

## INTRODUCTION

Pollution is an unwanted and undesired showcase of any ecosystem existing in our environment. Air pollution can be visualized as brown or black shades of haze settling over an area, exhaust billows across a busy highway or as a plume that rises as smokestack contains lots of air pollutants like smog, Oxides of Sulfur, Nitrogen, Carbon, Ozone, Particulate Matter, or volatile organic compounds affect our vital organs like brain, heart, liver, nose, and skin quite a lot. Air Pollution is contamination of the indoor or outdoor environment by any chemical, physical, or biological agent that modifies the natural characteristics of the atmosphere. Air Pollution may be defined as the presence of one or more contaminants or their combinations in air in such quantities as may

tend to be injurious to human, animal or plant lives, or physical property or construction.

According to The AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981 (ACT No. 14 of 1981) "Air Pollution" means the presence of any air pollutant in the atmosphere. Then we ask-What is Air Pollutant? Any solid, liquid, or gaseous substance concentration as may/tend to be injurious to harm plants /animals /any ecosystem /environment is an air pollutant.

Examples: Oxides of N, S, smoke, CO, CO<sup>2</sup>, Ozone, particles of Pb, Hg, Co, Zn, Cu, Brass, Asbestos...

WHO data show that almost all the global population (99%) breathe air that exceeds WHO guideline limits and contain high levels of pollutants, with low and middle income countries suffering from the highest exposures. It is associated with climate change and ecosystems globally. Many of the drivers of air pollution are sources of Greenhouse Gas Emissions.

The Modeling levels of air pollution and quantification of health impacts can be used to monitor and report on progress towards air pollution related indicators such as mortality rate and affected populated areas. Air Pollution is an observance in almost all countries of the world. The global air pollution crisis has reached alarming levels, with numerous countries experiencing significant air quality deterioration. Consistently, the most polluted cities in world and according to AQI Ranking in the world, 2024 (Pranaair.com reports, 2024), are Dhaka -Bangladesh (AQI Rank-1 and average AQI of 140), Karachi Pakistan (AQI Rank-2 and average AQI of 115), Delhi -India (AQI Rank-3 and average AQI of 111), Bahrain (AQI Rank-4 and average AQI of 103), Kathmandu-Nepal (AQI Rank-5 and average AQI of 100), and so on. Other countries in the same sequence of high AQI ranking from 6-10 are Egypt, United Arab Emirates, Kuwait, Tajikistan, Kyrgyzstan.

### TRIPLE PLANETARY CRISES

- UNEP-United Nations Environmental Program, leading environmental authority in UN system uses its expertise to strengthen environmental standards and practices at country, regional and global levels.
- The UN system has adopted International Frameworks for Environmental Issues - The three key issues are:

1. Climate Change- observance is in form of long term shifts in temperatures and weather patterns, rising sea levels, oceans turning warmer
2. Biodiversity loss of numbers and habitats.
3. Pollution -affecting the biota and their health. We are relating to Human health hazards here.

### AIR POLLUTION AS HEALTH HAZARD

Air Pollution is widely recognized threat to human health, ecosystems and even global economy (Shaddick et al., 2020). WHO reported (2016) of 4.2 million deaths annually could be attributed to ambient (outdoor) air pollution. This pollution generally considers fine particulate matter PM<sub>2.5</sub>, Ozone, and Nitrogen Oxides [report from 1990-2021, published by the core mission of the Health Effects institute, a US based non-profit research Organization in partnership with UNICEF gives State of Global Air (SoGA )Report]]. It says globally air pollution accounted for second highest/ largest risk factor of death (8.1 million deaths) in 2021, after High blood pressure. 99% of world's population lives in places with unhealthy levels of PM<sub>2.5</sub> pollution. Population from low and middle income countries are exposed to 1.3 to 4 times higher levels of ambient PM 2.5 People living in top polluted countries and exposed to high AQI values may face shortened life expectancy by several years. Air pollution also worsened the COVID-19 outcomes by compromising immune systems, causing inflammation and Oxidative stress in lungs etc. Nearly 50% of all Chronic Obstructive Pulmonary Disorder (COPD) deaths were from India in 2021.

### AIR QUALITY ANALYSIS

Various human activities and demands to comply needs of growing population have compromised in quality of air from bad to worst levels which is generally ranked as poor, very poor, and to severe levels through AQI-Air Quality Index indicators. Based on AQI numbers, orders of graded response action plan-GRAP are implied. Air Pollution is the second most risked factor, a major threat to public health, first being tobacco generated. Air Pollutants within our body land us in a pool of life-threatening diseases like cancer and bad health of lungs, respiratory and cardiovascular systems. According to WHO's PM 2.5 guidelines, Bangladesh's average of 75micrograms per meter cube value of PM 2.5 far exceeds the recommended limit of 10 micrograms per meter cube

value, further highlighting the health risks its citizens face (Web sources). People exposed to this value may face shortened life expectancy by several years

#### **AIR POLLUTANTS AND SOURCES OF AIR POLLUTION**

There are lot of substances and allergens that lead to air pollution and ill effects thus related to it.

- Health risking Air Pollutants comprise of smog, Industrial Pollution (45%).
- Carbon Particles , Carbon Monoxide, Volatile Organic Compounds , Non Carbon particles, Ozone Particles, Particulate Matter, etc. are chief air pollutants.
- Smoke rising from Crop, stubble & waste burning (17%),
- Vehicular Pollution Small, mid or heavy vehicles all add to pollution. (14%),
- Diesel generators –Diesel combustion leads to respiratory problems amongst children and women more than man (9%),
- Domestic cooking -The different substances that add flavors to foods and tempering methods adds lots of fumes mixed with spices which may enter lungs and harm the body (7%)
- Other sources like building /construction, demolition etc. (8%) also add to air pollutants.

#### **Common Pollutants regulated by National Ambient Air Quality Standards (NAAQS)**

- PM-Particulate Matter, Ozone, Nitrogen Oxides, Sulfur Oxides, Carbon Monoxides and Lead
- Other regulated pollutants are---- Soot/smoke/dust/Ar./Ni.
- Photochemical oxidants-Ozone, Benzene, Per-Oxy Acetyl Nitrate(PAN), Per-Oxy Benzol Nitrates,
- Aerosols/ Acid Droplets of Sulfuric /Nitric acids
- Agrochemicals like biocides & fertilizers
- SPM- Suspended Particulate Matter -PM2.5
- RSPM- Respirable Suspended Particulate Matter or PM10 (Thoracic Fraction). PM10 is the largest particle in RSPM, with a diameter of 10 micrograms. Minute particles reach PM 2.5 size and 0.1 size as well.

#### **Effect of Air Pollutants on Human Health**

Some of the Organs Affected by Air Pollution and Diseases developed by air pollution are - Brain, Eyes, Heart, Liver, Pancreas, Lungs, Nose and Skin. Effects are noticeable as bad functioning of organs which may lead to stroke,

dementia, dry eyes, blepharitis, cataracts, hypertension, Congestive heart failure, hepatic steatosis, hepatocellular carcinoma, diabetes aggravation, allergic rhinitis, Atopic skin disease, skin aging, urticaria, Seborrhea, Dermographism, acne etc.

Other badly affected body parts include Lungs, which result in Chronic Obstructive Pulmonary Disease (COPD), asthma, Lung cancer, Chronic Laryngitis, Acute and Chronic bronchitis.

Urinogenital system is effected as well and symptomatic cases are seen in form of bladder cancer, kidney cancer, prostate hyperplasia. Besides this, blood leukemia, ntravascular coagulation, anaemia, sickle cell pain crises, metabolic syndrome of fat, obesity, osteoporosis are also observed as health hazards. The various pollutants enter mouth, trachea, bronchioles, alveoli and blood capillaries. These pollutants are studied as Oxides of Sulfur, Nitrogen Oxides, Particulate Matter, Ozone, lead,CO, Ammonia , and other chemicals.

**Oxides of Sulphur-** Generally, there are natural ways or man-made ways for pollutants to get added to air. Volcanic eruptions and its dust may add up to 67% pollution while 33% of Sulphur Oxides are added through man-made sources- through thermal plants, paper industry, smelting or combustion. These are seen to be damaging aesthetic beauty of buildings as well. These pollutants cause respiratory illness, visibility impairment, and they also aggravate existing heart and lung diseases.

**Oxides of Nitrogen-** Natural lightening, thunder, forest fires, bacterial activity of soil produce various oxides of Nitrogen. The electricity power station, buildings, burning of biomass and fossil fuels produce Nitrogen Oxides in man-made sources. In environment, the Nitrate aerosols and Ozone precursors are formed. These Oxides cause irritations of nose and throat and also increases susceptibility to respiratory infections.

**Thoracic fraction or RSPM-** Respirable Suspended Particulate Matter in nature are the coarse particles produced by mechanical break up of large solid particles, wind blows, photochemical abrasions, urban haze, pollens and spores and observed as brown-black haze. The road traffic emissions, industrial commercial, residential

combustion, quarrying and agriculture are some man-made ways adding to RSPM pollutants. The RSPM generally means PM size less than or equal to  $10\text{ }\mu\text{g}/\text{m}^3$  which can easily settle in lungs and bronchii to create cardiopulmonary health problems.

#### **Particulate Matter size less than or equal to $2.5\mu\text{g}/\text{m}^3$**

can penetrate into regions of gaseous exchange of size area less than or equal to 100 nanometers. Their size enters bloodstream and causes cardiovascular damages. Health hazards are observed as Oxidative stress, Irritation of airways, cough, chronic bronchitis, irregular heartbeat, cardiopulmonary disorders, pre-mature deaths.

#### **Ozone**

Ozone is a **secondary pollutant** of air formed by reaction between oxides of Nitrogen, and volatile organic compounds in presence of sunlight. Ozone is present in stratosphere (10-50 km. above Troposphere in which we inhale and live) as a pale blue gas, soluble in water and non-polar solvents with specific sharp odour resembling Chlorine bleach. It is presumed for health hazard like lung Function deficits, respiratory illness, premature deaths, asthma, bronchitis, heart attack and other cardiopulmonary problems.

#### **Lead**

It is added to air as pollutant from vehicular emissions and combustion of fuels. The bright silvery, soft, dense, ductile, highly malleable, bluish white metal has poor electrical conductivity and is resistant to corrosion. It gets absorbed by plants and gets in to food/ crop produces. It has very dangerous effects on human health as it can enter bloodstream which damages immunity of a person and make him prone to other diseases as well. It affects the cardiovascular system, increases blood pressure and also causes anaemia by damaging RBCs. It affects Central nervous system and causes reduction in cognitive ability of children. It also causes colic-like abdominal pain and affects kidneys to cause nephropathy. It also causes reduction of fertility in males, delayed puberty in girls, and miscarriages. Accumulation of lead leads to soft tissues and bones, weak fingers, wrist or ankles.

#### **Carbonmonoxide or Carbonous Oxide**

It is colourless, tasteless, toxic gas which is lighter than air and is mainly formed by incomplete combustion of Carbon

containing fuels. This gas enters bloodstream through inhaled air and combines with haemoglobin to form carboxyhaemoglobin. This condition is diagnosed as anoxemia- inhibition of blood's carrying capacity to organs and tissues. Person observes chest pain and growing foetus has adverse effects due to this gas.

Other air pollutants such as Ammonia, Benzene, Poly aromatic hydrocarbons, Arsenic, Nickel, Chloro-fluorocarbons also have dangerous impacts on human health.

#### **What Cost We Pay Due To Air Pollution?**

- Our natural resources get depleted and in longer duration we completely lose them.
- Health hazards of respiratory, neurons, nephrons, reproductive and cardiovascular systems develop which need medical care.
- Diseases like Tuberculosis, typhoid, lung cancer etc. develop.
- Manpower and money required to develop control devices.
- Damage to Agriculture, soiling of residences, commercial buildings, aesthetics of historical monuments.
- Corrosion of metals like Fe, steel, Ni, Zn also observed

#### **Recommendations**

- Use of air filters –Air filters of various brands and rates are seen to provide pollution free air as they suck the air pollutants to the minutest level of 0.1 micron size as well. The High Efficiency Particulate Air (HEPA) is a specific class of filters designed to trap 99.97% of 0.3 micron sized particles and allergens. H13 filters are said to be more effective with trapping of 0.2 Micron sized particles and more suitable for vulnerable class such as allergy sufferers, patients in hospitals, ambulances etc. so as to reduce air contamination to minimum or almost nil. These can reduce the risk of infections during operations in surgery, neo-natal wards, Companies also say about 99.995% capturing of allergens by H14 filters-the medical grade filters. These medical grade filters undergo rigorous testing and scrutiny and hence are highly sought after for medical-care settings. These are said to meet required standards set by Department of Energy (DoE). The air filters can be used in hospitals, microbe-related work

culture laboratories and homes where people are allergy prone.

- Punishment on Violation of CAQM Act- The adoption and implementation of policies and acts should be excised.

The penalty given for violation of this act is imprisonment for up to 5 years or a fine of ten billion (one crore) or both and it should be executed strictly-for all people of any caste or creed. The Commission for Air Quality Management (CAQM) in National Capital Region (NCR) and adjoining areas keeps revising and imposes strict regulations depending on AQI-Air Quality Index. Invocation and revocation of actions under different stages of GRAP-Graded Action Response Plan from mild to strict are imposed depending on AQI.

- Clean transport, energy efficient homes, power generation, Industrial and better Municipal Management would reduce outdoor air pollution. Use of clean technologies in industry, Improving management of urban and agricultural waste, Shifting to clean modes of power generation, Improving energy efficiency of buildings and Ensuring access to clean household energy solutions,
- Energy-efficient housing & Municipal Waste Management can reduce climate pollutants and serve as a catalyst for local economic development and the promotion of Healthy Lifestyles.
- Policies & investments supporting affordable and sustainable access to clean energy, cleaner transport & power generation. Cooperation across sectors and at different levels- Urban, regional, National, International is crucial.
- The momentum behind the air pollution and climate change agendas, and the synergies between them, together with SDGs provide opportunities to address air pollution and the related burden of disease.
- Modeling levels (mathematical models that make us understand and predict how pollutants behave in atmosphere) should be shared with possibilities of future resolution to prevailing situation of air pollution.
- Research work is further required. Collaboration and sharing of good practice between Organizations like WHO, Environmentalists, Scientists & World Meteorological organization, to improve modeling of global air pollution and the assessment of its impact on health. The new Air Quality Guidelines (WHO-AQG) are

ambitious & reflect the large impact that air pollution has on global health (Jan, 2024).

These are based on scientific evidence from multiple countries. WHO is rolling out Breath Life, a global communications campaign to increase public awareness of air pollution as a major health and climate risk. Breath Life is led by WHO in partnership with the UNEP-hosted Climate and Clean Air Coalition to Reduce Short-lived Climate Pollutants. The campaign stresses both the practical policy measures that the cities can implement (such as better housing, transport, waste, and energy systems) and measures people can take as communities or individuals (for example, to stop waste burning, promote green spaces and walking/ cycling)to improve our air. The air quality database is updated every 2-3 years. Agencies recommend aiming for annual mean concentrations of PM10 & PM2.5 not exceeding 10 & 05  $\mu\text{g}/\text{m}^3$  respectively, and the peak season mean 8-hour. Ozone concentration not exceeding 100  $\mu\text{g}/\text{m}^3$  for mean 8 hour; NO<sub>2</sub>-10  $\mu\text{g}/\text{m}^3$  annual average; For 24 hour mean permissible concentration in NO<sub>2</sub>, SO<sub>2</sub>, CO: 25  $\mu\text{g}/\text{m}^3$ , 40  $\mu\text{g}/\text{m}^3$ , 07  $\mu\text{g}/\text{m}^3$  respectively.

#### **Key sources of ambient air pollution and results of Impacts of air Pollution on health must be made public.**

Modeling levels of air pollution and quantification of health impacts can be used to monitor and report on progress towards the air pollution related indicators of :

- SDG 3.9.1(mortality rate attributed to household and ambient pollution)
  - SDG 7.1.2(proportion of population with primary reliance on clean fuels & technology)
  - SDG11.6.2 (annual mean levels of fine particulate matter viz.PM2.5,PM10 in cities-Population weighted)
- Effective& Interesting Tackling Measures AQI-Adaptable, Quick, Ideas for India
- PM Ujjwala Yojana –most impactful air pollution Intervention in last decade.
  - Clean heating fuel-only electrical appliances to be used to fight winter/cold
  - End Stubble burning
  - Strengthen National Clean Air Programs.
  - Creating Awareness regarding health Hazards and economic losses in person and Nation's GDP
  - Educating Masses because Air Pollution Also occurs by filthy/dirty talks and bad cognitive analysis.

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**Correspondence** and requests for materials should be addressed to  
**Sisodia Kamlesh**

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