Air Pollution

Vidhi Gupta*   **Sukritee Raizada****

Clean Air is a vital need to encourage a healthy eco system. Air Pollution is the one of major concerns all over the world. It affects all age groups but, its affects are quite different from region to region.More than 95 percent of the world's population is breathing polluted, unsafe air and the worst hit areas are in Africa and Asia. A major study of global air pollution has found, urban areas, which are home to a bigger percentage of the world's population, are exposing hundreds of millions to air that is filled with pollution from automobiles and factories. In many rural areas, the burning of solid fuels such as wood, charcoal and coal, is also a threat. The main sources of Air pollution are Ambient Air pollution and Household Air Pollution.. Regions with the highest concentration of pollution include countries in North and West Africa, as well as South Asia.Countries have been recommended to limit their average annual air pollution levels to 10 micrograms of PM 2.5 for every cubic metre of air. Greenhouse gases also trap the heat in the earth's atmosphere which results in warming of the planet. There are various types air pollution which include; lead, nitrogen oxide, ozone, particulate matter,carbon dioxide, and sulfur dioxides. Air Pollution is hazardous to human health and has severe effects on lungs, cardiovascular health, fertility,immune system damage.

INTRODUCTION

Air pollution

Air Pollution is the presence of toxic chemicals or compounds (including those of biological origin) in the air, at levels that pose a health risk. Air pollution is the presence of chemicals or compounds in the air which are usually not present and which degrade the quality of the air or cause calamitous changes to the quality of life (such as the destroying of the ozone layer or causing global warming). Many a times, it is caused by industrial activities such as mining, construction, transportation, industrial work, etc. Also, natural processes including volcanic eruptions and wildfires may also pollute the air, but their occurrence is rare and they mostly have a local effect, unlike human activities that is the leading cause of air pollution and contribute to the global deterioration in the quality of Air.

Some facts about Air Pollution:

1. The lower the levels of air pollution, lead to better cardiovascular and respiratory health both in the long term and short term.

2. The WHO Air Quality Guidelines: Global Update 2005 provides an analysis of health effects of air pollution and benchmarks for health-harmful pollution levels.

3. In 2016, 91% of the world population was living in places where the harmful level of pollutants in the air exceeded the benchmarks provided by WHO.

4. Ambient (outdoor air pollution) in both cities and rural areas caused about 4.2 million premature deaths worldwide in 2016.

5. Some 91% of such premature deaths struck the low- and middle-income countries, and the largest number occurred in the South-East Asia and Western Pacific regions as per WHO.

6. The primary steps to reduce air pollution include policies and investments that support cleaner transport, energy-efficient homes, power generation, industry and effective municipal waste management.

7. Additionally, indoor smoke is a grave health risk for about 3 billion people who resort to cooking and heating their homes with biomass, kerosene fuels and coal.

8. Air pollution is responsible for1.7 million child deaths a year

* Executive Finance, Helpage India
** Sukritee Raizada, Income Tax Trainee at O.P. Bagla & Co.

Main Sources of Air Pollution:

Ambient Air Pollution:

Ambient or outdoor air pollution in both cities and rural areas of low and middle income countries was forecasted to cause 91% of 4.2 million premature deaths per year in 2016.The given mortality estimate is due to exposure to minute PM of 2.5 microns or less in diameter. PM is a common proxy measure for air pollution. It holds the highest adverse impact. The main components of PM are sulfate, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water. It consists of a composite mixture of solid and liquid particles of organic and of organic and inorganic substances slinging in the air. While particles with a diameter of 10 microns or less, ($\leq$ PM10) can pierce and get deposited deep inside the lungs, the even more harmful particles are those with a diameter of 2.5 microns or less, ($\leq$ PM2.5). PM2.5 can gore the walls of lungs and reach our blood system. Persistent exposure to particles leads to the risk of developing cardiovascular diseases, respiratory diseases, and lung cancer. Air quality measurements are primarily measured in terms of either daily or annual mean concentrations of PM10 particles per cubic meter of air volume (m3).

Everyday, air quality measurements evaluate such PM concentrations in terms of micrograms per cubic meter ($\mu g/m3$). If sufficient measurement tools are available, concentrations of fine particles (PM 2.5 or smaller), are also reported.

Household Air Pollution:

Around3 billion population cooks polluting open fires or simple stoves fuelled by biomass, (wood, animal dung and crop waste), coal and kerosene. Each year, close to 3.8 million people die untimely from problems coming from household air pollution from unsuitable cooking practices which use polluting stoves along with solid fuels kerosene. Household air pollution leads to non-communicable diseases. Present data reveals stroke, ischaemic heart disease, chronic obstructive pulmonary disease (COPD) and lung cancer are the consequences of air pollution. Children below the age of 5 years are particularly affected because of particulate matter or soor inhaled from household Pollution. . Among these 3.8 million deaths:

1. 27% due pneumonia

2. 18% attributable to stroke

3. 27% result from ischaemic heart disease

4. 20% come from chronic obstructive pulmonary disease (COPD)

5. 8% come from lunch Cancer

The Main types of Air Pollution

Ozone (O$_3$)

Ozone is the primary factor which contributes to asthma, morbidity and mortality. The current guiding value is 100 $\mu g/m3$ 8-hour mean which was reduced from the earlier level of 120 $\mu g/m3$ based on daily mortality and lower ozone concentrations. Ozone at ground level and top atmosphere are different. It's formed as a result of reaction of pollutants such as nitrogen oxides from vehicle and industry emission and volatile organic compounds.

Nitrogen dioxide (NO$_2$)

Guideline values

40$\mu g/m3$ annual mean

200$\mu g/m3$ 1-hour mean.

NO2 is the primary source of nitrate aerosols, which in turn is an important part of PM2.5 and in the presence of ultraviolet light of ozone. The chief sources of anthropogenic emissions of NO2 are a result of combustion processes such as power generation, heating and engines in vehicles and ships. The present WHO guideline value has been set to40 $\mu g/m3$ (annual mean).Concentrations exceeding 200 $\mu g/m3$, are considered toxic and can cause significant inflammation of the airways.

Sulfur dioxide (SO$_2$)

It's a colorless gas with a sharp odor. It's the result of the burning of fossil fuels like coal and oil for domestic heating, power generation and motor vehicles, and the smelting of mineral ores containing sulfur. The chief anthropogenic source of SO2 is the burning of sulfur-containing fossil fuels for domestic heating, power generation and motor vehicles. SO2 benchmark value is20 $\mu g/m3$ 24-hour mean and 500 $\mu g/m3$ 10-minute mean as per WHO.

Carbon oxides

Carbon Dioxide includes both carbon monoxide (CO) and carbon dioxide (CO2). These are colorless, odorless gases. CO has toxic affects on both plants and animals. CO and CO2 are greenhouse gases.

Particulate Matter

These are minute particles of liquid or solid suspended in a gas. Some are man-made and some are natural. Natural ones originate from dust

storms, volcanoes, forest, grassland fires, seaspray, living vegetation. Human activities such burning of fossil fuels and industrial processes generate aerosols. Aerosols are both gas and particles together.
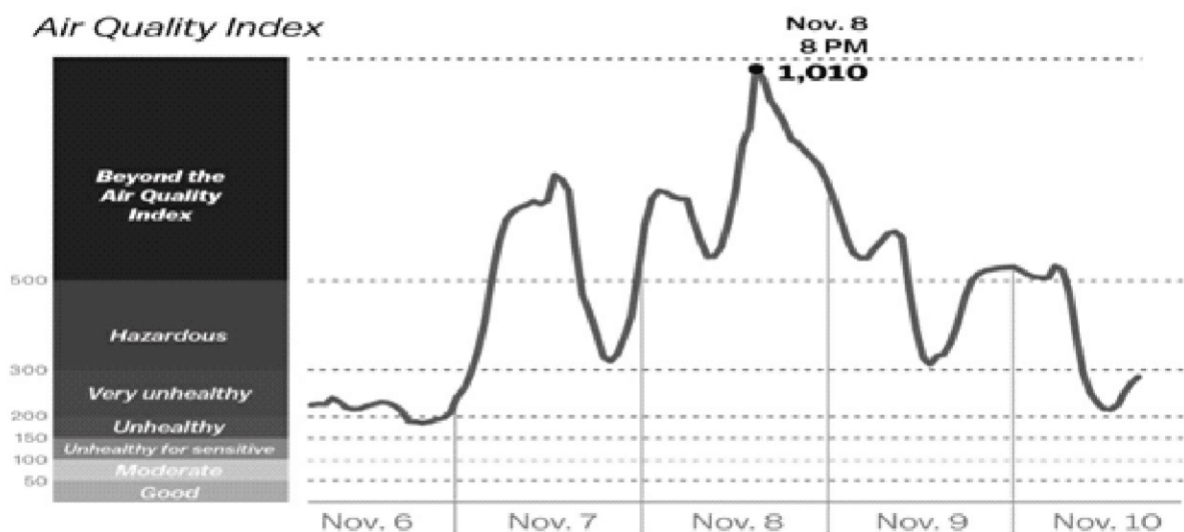
Lead

Lead comes from metal refineries and combustion and mining activities.

Delhi Air pollution

Delhi has been experiencing exacerbating affects of Air pollution. November 8,2017 is marked as the Red Letter Day in the history of Delhi as the whole Capital came to a stand still. AQI levels indicated 999 which was way above the worst AQI category. The safe limits for PM 2.5 is 60 AQI and for PM 10 it is AQI 100. AQI over 150 is unhealthy and anything over 300 is considered perilous. Medical Experts compared the pollution levels to smoking 50 cigarettes a day. There was an altitudinous increase in the number of people complaining of respiratory problems and hospitals raised a health emergency. The Air quality was so bad that it resulted in dropping cricket Test Match because both Indian and Sri Lankan Teams found it difficult to play. Moreover, this was the first time a cricket match had been stalled for these reasons. It led to increased accidents on the highway. However, Union Environment Minister Harsh Vardhan attributed the dust coming in from the Gulf and stubble burning as the major reason behind an air pollution crisis here in November.

Primary Causes:

Burning of Crops

Burning of crops by the farmers of neighboring states of Haryana and Uttar Pradesh. Farmers burn rice stubbles at the end of the kharif season before planting crops for Rabi season. The smog in Delhi trapped the pollutants making it difficult to breathe.

Traffic Pollution

Delhi has a good number of environment friendly CNG buses. Even then the air pollution level in Delhi is tremendous, which is also due to number of vehicles in Delhi per household. Due to mighty growth of real estate, the green cover over Delhi has declined.

Onset of Winter

The winter air is cold and dense and dust particles get trapped into it. And Absence of wind current mostly aggravated the situation.

Construction Activity

Construction activity also leads of increased circulation of dense dust particles.

Dumping and Burning of Garbage from industries also contributes to it.

Western disturbances

Dust storm from the Gulf contributed to 40% of pollution, stubble burning in neighbouring states attributed for 25% pollution, the local reasons had only 35% contribution.

Case Study 1

When Delhi became the most polluted city on Earth

Source: US State Department

Vox

Lastly, the crackers wreaked havoc over the already hazardous AQI in Delhi.

Measures issued by National Disaster Management Authority:

1. People were advised not to step out of the house and avoiding areas with dust. If it was urgent, they were advised to set up when the sun started shining brightly.

2. Immediately resorting to medical help

3. Ensuring children remain indoors.

4. Drinking lots of water and eating foods high in Vitamin C, Magnesium and omega fatty acids.

5. Avoiding strenuous activities

6. Nasal filter and Air purifiers were suggested to be purchased at homes

7. Indoor Plants like Aloe Vera should be installed for better air quality.

Measures taken by government:

A prohibitory order regarding burning of crops, industrial waste were issued. There was a ban on use of Generator sets and prohibition on burning of open Garbage. Increased frequency of metros and mechanical sweeping of roads. Sprinkling of Water of water on roads was instructed. Government also issued an order to shut schools and colleges temporarily. Bulky Vehicles were probhited.

Case study 2

Around 1.6 million people in China die each year from heart, lung and stroke problems which come from polluted Air. China experienced Airpocalypse in December,2015. From Nov 28,an expanse of toxic air had spread over China. By Nov 30,2015 Beijing Air contained hazardous level of PM 2.5, almost 40% more than the benchmark set by WHO. AQI(Air Quality Index) reached it's maximum at 500. Beijing had created a four tier response system for Air pollution Levels in October 2013. It stated that a red alert must be issued during the periods Air Quality Index is expected to surpass 200 for three consecutive days. Inspite of the chronic situation, China had initially issued an Orange Alert which was met with heavy criticism.
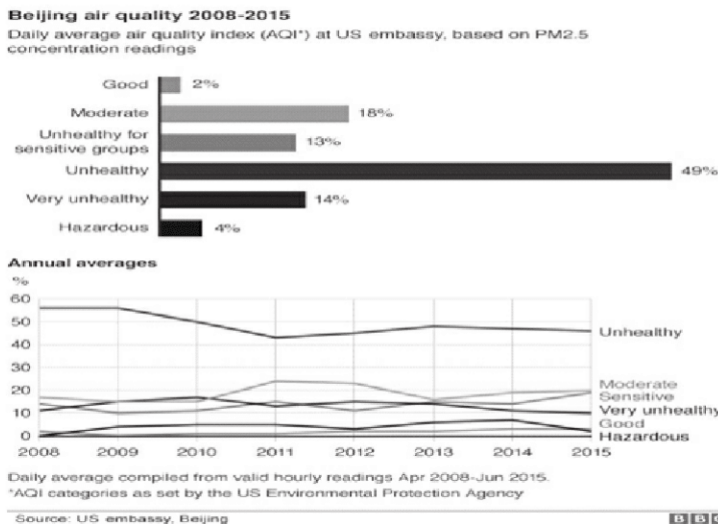
Pursuant to the criticism, and the alarming situation being continued it finally issued a red alert.

Causes

1. Industrial Coal Burning

2. Motor Vehicle emission

3. Neighbouring regions particularly Industrialised and one of the 10 most polluted areas like Hebei Province

Measures Taken:

1. The city's emergency management headquarters advised kindergartens, primary and high schools to shut classes, outdoor operations on construction sites were banned and some industrial plants were required stop production.

2. Schools designed specific set of activities for children to keep students fit.

3. Vehicle use was limited as odd and even number plates were allowed on alternate days. 30% Government Cars were banned. 21000-25000 buses were added as a result out of which

Beijing air quality 2008-2015
Daily average air quality index (AQI*) at US embassy, based on PM2.5 concentration readings

Good — 2%
Moderate — 18%
Unhealthy for sensitive groups — 13%
Unhealthy — 49%
Very unhealthy — 14%
Hazardous — 4%

Annual averages

Daily average compiled from valid hourly readings Apr 2008-Jun 2015.
*AQI categories as set by the US Environmental Protection Agency
Source: US embassy, Beijing

The key Health Problems caused by Air Pollution

Asthma   Cancer   Respiratory problems   Heart disease

Birth defects   Intellectual disorders   Tuberculosis   Immune system damage

about 8000were clean energy buses.

4. The neighboring provinces of Hebei and Shandong and Tianjin Municipality took emergency measures as well to lessen the affect on Beijing. A joint Law enforcement Action plan was formulated.

5. Use of desulfurizing equipment and Inspectors were assigned duties to overlook implementation of action plan.

6. Strict Punishment and penalties on Agencies and Personnel failing to implement emercency plans.

Conclusion: Both India and China are dealing with alarming levels of air pollution. While China is effectively taking steps and working on its air quality India still lacks the basic framework, technology, strict policies and guidelines to address the problem. Also, the government efforts are not enough, participation of people at individual levels will have an indisputable effect in Air Pollution.

The cost of Air Pollution:

Pneumonia

Pneumonia attributes to 45% of all pneumonia deaths in children less than 5 years old. Household air pollution is also risk for acute lower respiratory infections (pneumonia) in adults, and is responsible for 28% of all adult deaths.

Chronic obstructive pulmonary disease

25% of untimely deaths are a result of chronic obstructive pulmonary disease (COPD) in adults in low- and middle-income countries because of exposure to household air pollution. Women who are exposed to high levels of indoor smoke are more than twice as likely to suffer from COPD than women who use cleaner fuels and technologies. Among men (who already have a heightened risk of COPD courtesy their smoking habits), exposure to household air pollution doubles that risk.

Stroke

12% of all early deaths due to stroke can be pursuant to the everyday exposure to household air pollution which arise from cooking with solid fuels and kerosene.

Ischaemic heart disease

Nearly 11% of all deaths due to ischaemic heart disease, which accounts to 1 million death yearly,are a result of exposure to household air pollution.

Lung cancer

Nearly 17% of premature lung cancer deaths in adults are a resul of exposure to carcinogens from household air pollution emitted from cooking with kerosene or solid fuels like wood, charcoal or coal. The risk for women is higher, due to greater participation in food preparation.

Other health impacts and risks

Small particulate matter and other pollutants in indoor smoke lead to swollen airways and lungs, damaging immune response and reducing the oxygen-carrying capacity of the blood.There is also evidence of connection between household air pollution and low birth weight, tuberculosis, cataract, nasopharyngeal and laryngeal cancers.

Note: For lung cancer and chronic obstructive pulmonary disease, active smoking and second-hand tobacco smoke are also main risk factors.

The use of kerosene is the major cause of childhood poisonings.

The lack of access to electricity for 1 billion people exposes households to very high levels of fine particulate matter. The use of lighting fuels introduces other health risks, such as burns, injuries.

Fuel gathering increases the risk of musculoskeletal damage, consumes considerable time for women and children.

Both short and long-term exposure to ambient air pollution may lead to reduced lung function, respiratory infections and severe asthma. Maternal exposure to ambient air pollution is related to adverse birth outcomes, such as low birth weight, pre-term birth and small gestational age births. Emerging research also proposes that ambient air pollution may lead to diabetes and affect neurological development in children.

Role of WHO

WHO Member States data adopted a resolution (2015) and a road map in 2016 for a more high reaching global response to the hazardous health effects of air pollution.WHO is responsible for developing and producing air quality guidelines and thereby providing exposure limits to key air pollutants (indoor and outdoor).WHO creates health related assessment of the effect of different types of pollutants as mentioned above. It has created Airo+,Health Economic Assessment Tool to assess walking and cycling interventions,Green+ tool, Sustainable Transport Health assessment

tool(STHAT) and Integrated Transport and Health Impact Modelling Tool. It is developing Clean Household Energy Solutions Toolkit(CHEST) to guide countries with tools needed to make policies for clean household energy access.The WHO has co-sponsored Pan European Programme on Transport Health and Environment (PEP), and built a model of regional, Member State, and multi-sectoral cooperation for reducing the effects of air pollution and other health impacts in the transport sector.

Some Solutions to combat Air Pollution:

As seen from the above data air pollution attributes to cardiovascular illnesses, Respitory diseases and causes premature deaths.

1. Industry: Clean technologies which reduce industrial smokestack emissions need to be implemented. Improved management of agriculture and industrial waste, including capturing of methane gas emitted from waste sites as an alternative to incineration.;

2. Energy: Providing ways to budget friendly clean household energy solutions for cooking, heating and lighting. Black carbon and methane emissions by inefficient stove combustion are hazardous climate change pollutants

3. Transport: There is a need to shift to energy efficient and cleaner resources of power generation. More environment friendly vehicles need to developed, walking and cycling networks in cities should be encouraged. Moving to environment friendly heavy duty diesel vehicles and low-emissions vehicles and fuels, including fuels with reduced sulfur content.Netherlands wants to ban the further sale of petrol and diesel cars from 2025 and make way for electric and hydrogen vehicles.

4. Urban planning: Building should become more energy efficient and shouldn't destroy forest cover and cities should have more green spaces, new policies for conservation of forest spaces need to be set up. Freiburg in Germany has 500km of bike routes, tramways, Copenhagen gives preference to bikes over cars and consequently has more cycles than people. Oslo is planning to

5. halve its climate emissions by 2020 and suggests a large no-car zone, the building of 40 miles of new bike lanes, steep congestion charges, a rush-hour fee for motorists, and the removal of many parking spaces.

6. Power generation: There's a dire need to use low-emissions fuels and renewable combustion-free power sources which are available in abundance like solar, wind or hydropower.

7. Municipal and agricultural waste management: Strategies to reduce waste, separate waste, recycle, reuse or waste reprocessing. Efficient methods of biological waste management such

as anaerobic waste digestion to produce biogas, are feasible, low cost alternatives to the open

8. Burning of solid waste. Where it is inexorable, then combustion technologies with strict emission controls are necessary.

The Concept Skyscraper Trees is gaining popularity. Full size trees, thousands of shrubs and plants scale the sides of the building. Bosco Verticale in Milan is being constructed. Liuzhou Forest City is the most ambitious project undertaken by China. It will be a new town with homes for 30,000 people, wherein buildings will be covered by 40,000 trees and 1 million plants. Similar projects have been enrolled for Lausanne in Switzerland, Utrecht in the Netherlands.

At individual Level we can contribute by keeping a regular check on the pollution emitted by our vehicles, conserving energy by switching off lights and computers when not in use. Opt for carpooling with your colleagues and friends. Avoid excessive idling of your vehicle during red lights. Use energy efficient equipments and use indoor plants to curb Air Pollution levels. Buy products that say low 'VOC'. Plant more trees in your neighbouring areas.

SOURCES:

Down To Earth Article named Through the thick Air https://www.downtoearth.org.in/coverage/delhi-air-pollution-56180

Article about burning of crops in North India by Scroll.in https://scroll.in/article/887787/crop-burning-in-the-north-is-spreading-pollution-not-just-to-delhi-but-even-indias-south

The Economist article on how China cut its Air Pollution https://www.economist.com/the-economist-explains/2018/01/25/how-china-cut-its-air-pollution

Bloomberg Article on how china is winning its war on air Pollution https://www.bloomberg.com/news/articles/2018-01-11/china-is-winning-its-war-on-air-pollution-at-least-in-beijing

BBC news online article on red alert In China https://www.bbc.com/news/world-asia-china-35026363

World Economic Forum Article on Milan is growing trees on skyscrapers https://www.weforum.org/agenda/2017/10/milan-s-tree-covered-skyscrapers-are-inspiring-the-world/

Love to Know Website Article by Ecologist VijaylaxmiKinhal https://greenliving.lovetoknow.com/Types_of_Air_Pollution

The Guardian's Article on Air Pollution in Chinahttps://www.theguardian.com/world/2015/aug/14/air-pollution-in-china-is-killing-4000-people-every-day-a-new-study-finds

Kitchen Arena Case Study on Delhi's Air Pollution by VS Chaitanya https://www.kitchenarena.in/delhi-air-pollution/

NDTV online article on Delhi's air pollution https://www.ndtv.com/delhi-news/delhi-air-pollution-updates-how-the-national-capital-is-battling-smog-toxic-fumes-1776576

BBC online article on First red alert in Beijing, China https://www.bbc.com/news/world-asia-china-35026363

CK-12 Foundation Online on the types of Air Pollution https://www.ck12.org/earth-science/Types-of-Air-Pollution/lesson/Types-of-Air-Pollution-HS-ES/

Your Article library article on types,sources,effects of Air Pollution http://www.yourarticlelibrary.com/environment/air-pollutants-types-sources-effects-and-control-of-air-pollutants/9964

The Guardian Article on how city's are tackling Air Pollution https://www.theguardian.com/environment/2016/may/17/how-are-cities-around-the-world-tackling-air-pollution

WHO Website information on health impacts of ambient Air Pollution http://www.who.int/airpollution/ambient/health-impacts/en/