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Impact of Air and Water on Human Health As Well As Environment

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Abstract
Quality of air and water are essential elements and they play vital role in every point of human life. Integrated air and water management is a key in environmental balance and sustainable economic development. With growing population and heavy industrialization in developed nations are facing huge threat from deteriorating quality of air and water caused by pollutants becoming an alarming situation and throwing many challenges to find new methods and policies to improve quality management methods. Besides air pollutant emissions by anthropogenic (stationary, mobile, organic & inorganic, fumes, waste deposition) and natural (dust, methane, radioactive decay, smoke, etc) sources are becoming unstoppable due to modern life style of humans. Such pollutants are having impacts on human health need to understand very well to treat and manage the quality of air and water.
*This paper analyzes quality indicators of air (Particulate Matter, Ozone, Nitrogen Diozide, Sulfur Dioxide, Carbon Monoxide, etc) and water (dissolved solids, oxygen, ph, fecal coliform, etc) that has major impacts on environment and human health. Also an attempt made to recommend the possible methods of controlling quality of air and water. It also examines various existing systems and research by scholars and organizations to find the real scenario on air and water pollution. The results of this study reveal various factors that have the "**impact of air and water pollution on health of humans as well as environment"**.*
Keywords: *Air and Water Quality, Air Pollution, Water Pollution, Types of Air Pollutions, Types of Water Pollutions, Air Quality Index, Water Quality Index, Public Health in India, Pollution and Public Health.*

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I. Introduction

Air and water pollution is considered as growing risk and mainly developed nations are the more suffering destinations, and its dynamics depend on a broad range of factors. Rapid growth in technology, increasing economic activity and energy demand will lead significant increase in global emissions of air pollutants in the coming decades. A comparative analysis by world health organization showed that 7 per cent increase during 2017-19. *"Air pollution threatens us all, but the poorest and most marginalized people bear the brunt of the burden,"* Trdros Adhanom Ghebreyesus in an article "**Poverty and Pollution go Hand in Hand**", said the WHO's director general[1], in context to pollutant emission indicators of air and water are cook stoves, heating fuel, and kerosene lighting are all common sources of pollution in cities in developing countries.

Since many reasons have been noticed for emissions of air and water pollutant indicators, there is an interesting observation of decline in CO_2emission in the air by Robin Meyers[2] stated in *"The Atlantic"* historically the rise in carbon emissions almost equaled global economy growth of 3 per cent with 2.7 per cent, but it is only 0.6 per cent increase predicted in 2019. The collapse of western coal industry which by shutting down around 500 coal based power plants in United States witnessed slow growth in carbon emissionsdue to 5 per cent decline in usage of coal in North America and Europe every year expected, which is a glimmer of hope. But significantly alternative power industries are being born such as thermal, wind and solar power industries even though they have the lower power production capacity when compared with coal based power industries. But even 2 per cent growth in natural gas is a more energy gain due to its larger base.

Mainly air pollutants are categorized into primary (organic) and secondary germinated from various sources, which are called stationary, mobile and natural. Primary pollutants are organic and they evolve from natural and mechanical processes such as volcanic eruption, forest fire, vehicle and industrial emissions. Particulate matter (PM) and ground level ozone are formed when vehicle and industrial emission exposed to sunlight also the combustion of fossil fuel will form secondary pollutants.

Air pollution from urbanization and industrialization often causes acid rains is another source for surface water contamination a major cause for pollution victimization of urban and rural population. Rain water is a gift to humankind that will wash and clean pollution from atmosphere, the same rain can also pollute majority of surface and ground water due to acid rains that will combine with lakes, rivers and ocean. But major sources of water pollution are disposal of human waste, industrial waste, river dumping,and ocean dumping,alsoan excessive usage of plastics.

As a result, emission of particulate and biological molecules in air and water pollution damages living organisms of human beings and causes death. According to 2012 statistical data of world health organization[3]reveals that 23 per cent of deaths linked to environmental pollutions causing 3.8 million deaths from household air pollution and 4.2 million deaths from ambient pollution. If not death many short time and long term pollution connected health diseases are escalating, which causes damaging socio economic status of lower and middle income classes of population.

The economic growth is closely relative with air and water pollution, which is a key to effective control of pollutant emission based on industrial structure, laid a gap in regional economic growth patterns[4]– a comparison between China and South Korea by Min Jiang, Euijune Kim and Youngjin Woo. Despite global economic policies and key indicators, the increasing climatic risks are for many developing and developed nations drawing immediate attention to change economic policies to mix climate with politics to break the connection between greenhouse gas emissions to cease global warming[5] an estimated 10 year low per cent of 2.3 by United Nations.

Besides many climatic conditions, the global agricultural production badly affected by emission of pollutants with usage of chemical fertilizers, pesticide abd irrigation systems that uses polluted water resources of both ground and surface. The Indian government has spent around three thousand crores in the name of ***NamamiGanje***to clean river Ganga, which serves agriculture and drinking water needs of almost 40 per cent of Indian population**.** Surprisingly the **Covid 19** pandemic situation with lockdown has reduced the pollution and started repairing pollution damages both air and water pollution including Ozone layer. According to studies on **Ozone** layer by scientists revealed surprising fact that it heals by itself due to corona lockdown.

II. Types Of Air Pollutants

Harmful substances in the air causing pollution basically categorized into primary and secondary. The primary pollutants like ash from volcanic eruption, carbon monoxide and sulfur dioxide from vehicle and industrial emissions, which are originated as outcome of a direct process from human activities. Particulate Matter ($PM_{2.5}$ and PM_{10}), Nitrogen dioxide (NO_2), Carbon monoxide, Carbon dioxide (CO_2), Sulfur dioxide(SO_2), Ground level Ozone and volatile organic compounds.

Table 1:*Source of data:* https://aqicn.org/city/delhi/

Sample Air Quality Index (AQI)			
Air Quality Indicators			
Name	Type		Value
	Primary	Secondary	
PH		PM	65
TDS (mg/l)		PM	25
Hardness (mg/l)	Chemical		18
Chloride (mg/l)	Chemical		13
Sulphate (mg/l)	Chemical		11

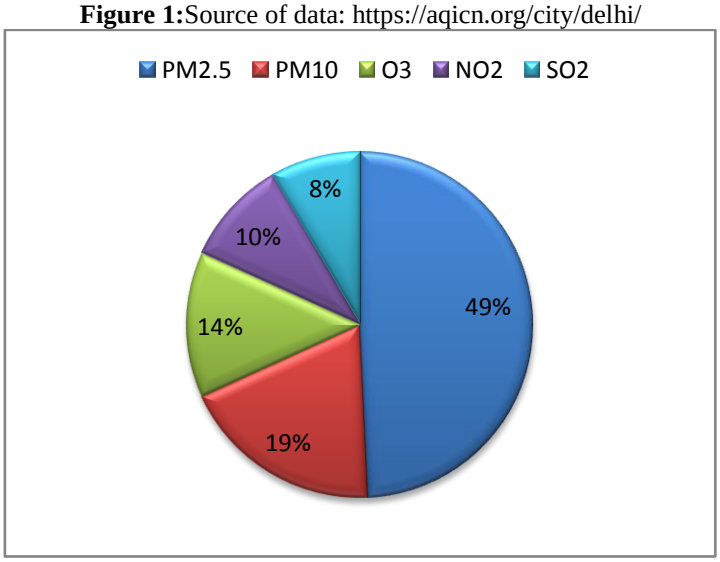
AQI Color Code
Good (0 - 50)
Moderate (51-100)
Unhealtty for sensitive groups (101 - 200)
Unhealth (201 - 300)
Very unhealthy (301 - 401)
Hazardious (401 - 500)

Particulate Matter (PM)

Particulate matter is a mix of solids and liquids, including carbon, complex organic chemicals, sulfates, nitrates, mineral dust, and water suspended in air. Two categories of PM are $PM_{2.5}$ and PM_{10} which is a 2.5 and 10 microns in size i.e., 100 times smaller than millimeter are fine particles[6]. Main sources of PM are mobile pollutants like dust particles from construction and mining sites, carbon and other complex organic chemical emissions from vehicle and industrial discharge can enter lungs and ultrafine particles enter blood streams using human airway which causes long term health problems like respiratory dieses and cancers. Live data of pollution status of Delhi showing from **Table 1** $PM_{2.5}$ is the major pollutant emission occupies 46 per cent from

mobile pollution seen in urban atmosphere rest of the chemical pollutants including PH_{10} occupies 54 per cent with values $PM_{2.5}$, PM_{10}, O_3, NO_2, SO_2 are 19, 14, 10 and 8 per cent respectively.

Figure 1: Source of data: https://aqicn.org/city/delhi/



Ground level Ozone

Atmosphere is covered with two layers of Ozone one at ground level (troposphere ozone) and the second is at higher level(stratospheric ozone)that forms a layer to protect from ultraviolet rays release from sun. The ground level ozone is a place where most of the weather conditions take place. It contains 75 per cent of atmosphere's mass and 99 per cent of the total mass of water vapor and aerosols.

When concentration levels increase in Ozone over 70 to 75 ppb (particle per billion is measurement used to calculate)where as in some countries 50 ppb (is safe to breathable according to WHO guidelines) in the air can cause effects on human health such as ***eye irritation, respiratory tract, lowering the function of lungs and difficulty in breathing***[7]also causes global warming and many studies predict there will be will be increase of 11 per cent by 2050.

Organic Pollutants

Nitrogen Dioxide (NO^2) causes acid rain that will pollute both air and water (ground and surface). Human activities are the main source of nitrogen dioxide with combustion of fossil fuels like coal, gas and oil. Increasing Nitrogen Dioxide concentrations in air affect human health causing respiratory and lung disorders that will have high impact on children below 15 years, asthmatic of all age groups and adults with respiratory and cardio vascular diseases. Concentration over 120 µg/m3 will ignite toxic reaction on plants reduces the growth. When sulfur dioxide and ozone are present, its effect on vegetation will become worse. In addition along with sulfur dioxide, nitrogen dioxide can cause acid rain which will pollute both ground water and surface water will have its overall impacts on environment and human health.Cultivation of agriculture using organic farming has gained global attention but also recommends proper treatment of irrigations systems to prevent bad impact of nitrogen on plants.

Sulfur Dioxide (SO^2) derived from the combustion of fossil fuels like coal, oil and gas. Usage of coal in large quantities for industrial and domestic combustion in urban areas will cause increase of Sulfur Dioxide in air pollution. As a result of its occurrence in air above 500µg concentrated toxin may absorb into nose and upper respiratory tract dissolves 45 volumes of sulfur dioxide at 15^0C where the absorption is dependent with 85 per cent at 4-6 µg/m^3 and above 99 per cent. If concentration exceeds 28.6 µg/m^3 (10 ppm) causes serious respiratory problems such as bronchitis, irritate nose, throat and lungs. In result it causes coughing, wheezing, phlegm and asthma attacks. The effects are worse when you are exercising. Sulfur Dioxide has been linked to cardiovascular disease.

Occurrence of pollutants like Carbon monoxide, lead and other also has adverse effects on human health and environment. Emissions of these pollutants found majorly in urban area with heavy industrialization, miningand transportation.

III. TYPES OF WATER POLLUTANTS

Water pollutants are more active in post monsoon and its quality is measured using mean water quality index (WQI). The water quality is determined using quality parameters depend on permissible levels as per guide lines of Indian Counsel of Medical Research (ICMR, 1975). For evaluating quality indicators, a rating scale of 0 to 100 is used where less value is having high risk and values grows on the scale will have low risk means more purity of the water. Following models of evaluation of quality indicators:

The calculation WQI is based on the weightage of parameter WQI = Wi x Vr where Wi = (K/Vi : K = Constant of proportionately) and Vi = Permissible value. Wi is proportional to 1/Vi where K=1/ Σ1/Vi and Σ1/Vi = 1/v (pH) + 1/V (TDS) + ….. n parameters is a mathematical way of calculating WQI.

Table 2: *Source IMCR*

S.NO	Parameter	Vi (ICMR Standard)	Wi (Unit Weights)
1	pH	7 - 8.5	0.530
2	TDS	500 mg/l	0.008
3	Hardness	300 mg/l	0.014
4	Chloride	250 mg/l	0.016
5	Sulphate	200 mg/l	0.021

Different types of pollutants emerge from various sources mainly originates from human waste, industrial waste and other sources like agriculture, radioactive, marine dumping and etc. On the whole five pollutants are choosen each from air and water to find the categorical causes of pollution effects on human health and environment as shown in table 1 and 2 with their permissible values. These pollutants mainly categorized into organic, pathogens, nutrients, suspended solids and sediments, inorganic, thermal and radioactive pollutants.

pH

Natural waters contain acid-base equilibrium and pH of water is a measure and it is controlled by carbon dioxide-bicarbonate-carbonate equili-brium system. An increased concentration of carbon dioxide will lower the pH. Another reason to affect equilibria in pH is temperature. Decrease of pH in water at about 0.45 will raise the temperature by 25^0C. The common range of pH in most of the waters lies in between 6.5 to 8.5.

The pH is main measure to determine corrosivity[8] of water and it can cause lead and copper pipes leach into drinking water. The lower level of pH in water causes high in corrosion. Exposure to pH values greater than 11 can trigger health problems humans such as irritation to eyes, skin, and mucous membranes. pH level below 4 has the reported occurrence of redness and irritation of eyes and below 2.5 damage to epithelium is irreversible and extensive.

TDS (Total Dissolved Solids)

Minerals, salts, metals, cations or anions dissolved in water refers to total dissolved solids (TDS) comprises both organic and inorganic salts like calcium, magnesium, potassium, sodium, bicarbonates, chlorsides and sulfates. Since drinking water originates from different sources like sewage, urban run-off, industrial wastewater, agriculture run-off, chemical used in the water treatment process, and etc. Existence of high levels of TDS in water causes several diseases in humans like nausea, lung irritation, rashes, vomiting, dizziness, etc. Drinking water with elevated TDS levels for longer periods will expose human body to various chemicals and toxins will lead to chronic health problems like cancer, liver, kidney failures, nervous system disorders, weaken immunity and may also cause genetic disorders in new born.

Contribution of TDS among other indicators are relatively high in 56 per cent causing liver and kidney diseases when compared with other health problems and causes by other water quality indicators.

Hardness in water

Hardness occurs when calcium and magnesium dissolved in water may not cause health problems in humans but when arsenic also seen it could cause some serious health problem. Some statistical studies showed some percentage in mortality of cardio vascular diseases, but recommended to conduct more studies for accurate results on this regard. According to Brian Oram, 2018[9] water could be a major contributor of calcium and magnesium to the diet. But when high levels of arsenic found it could cause symptoms of thickening and discoloration of the skin, stomach pain, nausea, vomiting, diarrhea, numbness in hands and feet, partial paralysis, and blindness. But it only appears in ground water contamination when surface arsenic related pollutants enter the ground water system by gradually moving with the flow of ground water from rains, melting

of snow, etc. Since arsenic does not have the noticeable taste, odor or color in water, it is recommended to conduct proper test of the water particularly when ground level water below 100ft is used as drinking water.

Sodium and chloride

Sodium chloride also called road salt when it comes to water pollution and the chloride is completely soluble and very mobile. Chloride is toxic to aquatic life and impacts vegetation and wild life. Chloride contaminant cannot be reversed, broke, metabolized or remove from environment. One of the main sources of chloride and sodium are road saltand can have impacts on both environment and human health. Sodium in drinking water may lead to hypertension and it is suggested to restrict 20mg of sodium per liter of water. The concentration of chloride exceeds 250 mg/l results odor and taste but not toxic to human health at low levels.

IV. IMPACTS ON HUMAN HEALTH

Both air and water pollution hastheir impact on human health due to exposure to many sources of pollutant emissions majorly causing common respiratory tract infections, skin and eye irritation, cardio vascular diseases, lungs and kidney disorders, bone and nervous system, cancers, and etcvia consumption of air and water pollutants such as ***$PM_{2.5}$, PM_{10}, O_3, NO_2, SO_3 and pH, TDS, Arsenic, Chloride, Sodium and others***.

Respiratory tract and cardiovascular problems

Chronic Obstructive Pulmonary Disease (COPD), asthma, lung cancer even combination with stroke and heart diseases[10]mainly caused by air pollution. Whereas a small amount of 8 per cent water pollution linked to coronary heart disease that will buildup calcium and other materials like fat with the coronary artery(By Kevin Wood, Vice President Sales & Marketing at Camfil, USA)[11] this lead to blockages which prevent blood from reaching the heart and other areas of body. In addition particulate air pollution also involves strokes and when it becomes chronic it will cut off blood supply to the brain lead to brain damage or death. COPD is a multiple respiratory tract diseases mainly triggered by raising levels in air pollutants which will make the breathing difficult. Diseases like bronchitis and emphysema are seen mostly in metro cities causing breathing ailments vulnerable to all age groups and more impact on children. The percentage of respiratory tract diseases is 12 per cent higher when compared to cardiovascular diseases.

Ozone in upper atmosphere protects earth from release of ultraviolet radiation from Sun but it becomes harmful chemical when its concentration grows at ground level can trigger cough, throat irritation, chest pain and airway inflammation. It can also have its effect increased on bronchitis, emphysema and asthma.

Sulfur dioxide and nitrogen dioxide are color no color gas emissions by combustion of fossil fuels or by industrial process. Both can trigger increased harm to cardiovascular and respiratory diseases. Nitrogen dioxide in air pollution increases asthmatic attacks in humans by 7 per cent.

Impacts on Nervous System and Brain

Air pollutants like lead, ozone, particulate matter, nitrogen dioxide, carbon monoxide, and sulfur dioxide are most damage to human health.

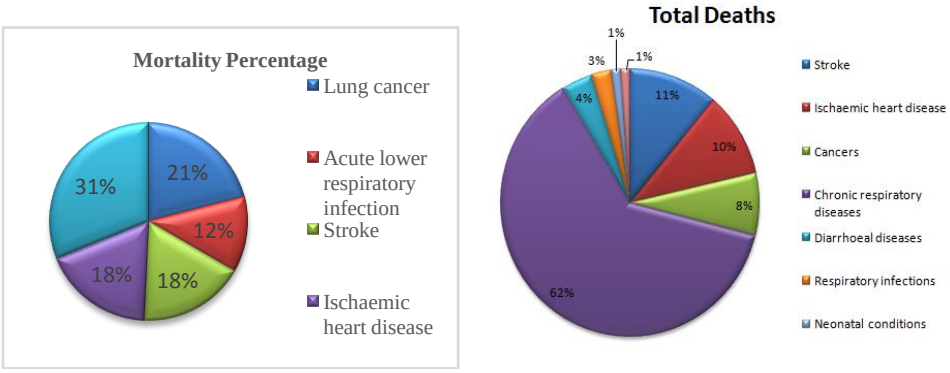
Increase of lead in air can damage nervous system, kidneys and brain. Recent studies reveal that United States successful in reducing the led in air by 98 per cent in 2017[12]. Its existence in environment can result in decreased growth of reproductive growth of plants and animals and neurological effects in vertebrates.

Impact on Global Mortality

World Health Organizationrevels its observations in 2013 on impact of air pollutants PM (2.5 and 10), Ozone (O_3), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2) in children and adults exposure to ambient air pollution reduced lung function, respiratory infections and aggravated asthma are both short-term and long-term.

Global Ambient Air Quality Database of WHO, 2018 shows the mortality percentage of diseases with 29 per cent of lung cancer, 17 per cent of acute lower respiratory infection, 24 per cent of stroke, 25 per cent of ischaemic heart disease and 43 per cent of COPD.

Figure 3 ***Source:*** Deaths caused by Water: Global Data - WHO



V. CONCLUSION

Major impact of environment pollution by air and water on human health causes increase of death rate affected by various diseases caused by air and water pollutants shows maximum deaths occurred for respiratory tract infections at 62 per cent (14 million)[13] is a major concern and air pollutants causes more than 40 per cent ofdeaths when compared to water pollutants due to air is the fastest transportation medium and difficult to control it. Whereas the major source of water pollution is human waste disposal, river dumping, marine dumping and usage of road salts for large scale cleaning process of removal of ice and dirt gathered on public places by storms and cyclones.

Both types of pollutants causes common diseases like skin infections, eyes irritation and rashes, respiratory tract infections, kidney and lungs are almost equal and air pollutants elevates greater health risks for when compared with water pollutants by almost 30 per cent.

In addition air and water pollution is a global problem affects environment largely have its impacts on social and economic conditions of smaller income groups caused by natural disasters occurred frequently. There is a need to for more studies to find out common factors and control them with proper management and new technology even though many advanced systems are already available. In addition there is an emergency to implement machine learning and artificial methods to develop smart self-learning solution system and build efficient warning systems to control and prevent pollution.

To face day to day growing challenges to control pollution and environment imbalances that will spoil the cycle of natural resources for agriculture, production of one time used products, less pollution generation electronic goods, bio fertilizers and pesticides, electric and bio fuel, etc are recommended.

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