Recent Challenges in Environmental Pollution and its Impact on Living Beings

Dr. Arvind Mishra
Department of Botany, M.D.P.G. College, Pratapgarh

Dr. Govind Krishna Mishra
Department of Chemistry, B.S.N.V.P.G. College, Lucknow

Abstract

Environmental pollution is not a new phenomenon, yet it remains the world's greatest problem facing humanity, and the leading environmental causes of morbidity and mortality. Man's activities through urbanization, industrialization, mining, and exploration are at the forefront of global environmental pollution. Both developed and developing nations share this burden together, though awareness and stricter laws in developed countries have contributed to a larger extent in protecting their environment. Despite the global attention towards pollution, the impact is still being felt due to its severe long-term consequences. Present study deals with the types of pollution—air, water, and soil; the causes and effects of pollution; and proffers solutions in combating pollution for sustainable environment and health.

Keywords: *Environmental pollution, sustainability, environmental health, global challenge, remedies.*

Introduction:

Environment is the surroundings in which we live, but the contamination of our environment by pollutants is environmental pollution. The current stage of the earth that we are seeing is the cause of centuries of exploitation of earth and its resources. Moreover, the earth cannot restore its balance because of environmental pollution. The human force has created and destroyed life on earth. Humans play a vital role in the degradation of the environment. The environmental pollution, directly and indirectly, affects the lives of humans and other species. These living beings co-existed on the earth with human from centuries.

Effect of pollution on Air

Carbon and dust particles string up with the air in the form of smog, damaging respiratory system, haze, and smoke. These are caused by the emission of industrial and manufacturing units by burning of fossil fuels, vehicle combustion of carbon fumes. These factors affect the immune system of birds which become a carrier of viruses and infections. Besides, it also affects the body system and body organs.

Effect on Land, Soil, and Food

Human's organic and chemical both waste harm the land and soil with its decomposition. Also, it introduces some chemical in the soil and water. Land and soil pollution mainly caused by the use of pesticides, fertilizers, soil erosion, and crop residues.

Effect on Water

Water gets contaminated easily with any pollutant whether it is human waste or chemical discharge from factories. Also, we

use this water for irrigation of crops and drinking. But, because of infection they become contaminated too. Besides, an animal dies because they drink this same contaminated water. Around 80% of pollutants of land such as chemical, industrial and agricultural waste end up in the water bodies. Besides, these water bodies ultimately connect to the sea which means it indirectly pollutes the biodiversity of the sea.

Effect on Food

Because of contaminated soil and water, the crop or agricultural produce also get toxic. Furthermore, this contaminated food effect our health and organs. From the beginning of their life, these crops are laced with chemical components that reach a mass level until the time of harvest.

Effect on Climate

Climate change is also a cause of environmental pollution. Also, it affects the physical and biological components of the ecosystem. Ozone depletion, greenhouse gases, global warming all these climate changes are a cause of environmental pollution. Their effect can be fatal for our upcoming generations. The irregular extreme cold and hot climate affect the ecological system of the earth. Furthermore, some unstable climate changes are earthquakes, famine, smog, carbon particles, shallow rain or snow, thunderstorms, volcanic eruption, and avalanches are all because of climate change that happens all because of environmental pollution. Thus we can say that man has exploited the wealth of nature at the cost of his and environments health. Also, the effect that is now emerging rapidly is all because of the activities of humans for hundreds or thousands of years. Above all, if we wish to survive and continue our life on earth then we have to take measures. These measures will help in securing our as well as our next generation future.

Environmental Pollutants

The World Health Organization (WHO) reports on six major air pollutants, namely particle pollution, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. Air pollution can have a disastrous effect on all components of the environment, including groundwater, soil, and air. Additionally, it poses a serious threat to living organisms. In this vein, our interest is mainly to focus on these pollutants, as they are related to more extensive and severe problems in human health and environmental impact. Acid rain, global warming, the greenhouse effect, and climate changes have an important ecological impact on air pollution.

Particulate Matter (PM) and Health

Studies have shown a relationship between particulate matter (PM) and adverse health effects, focusing on either short-term (acute) or long-term (chronic) PM exposure. Particulate matter (PM) is usually formed in the atmosphere as a result of chemical reactions between the different pollutants. The penetration of particles is closely dependent on their size. Particulate Matter (PM) was defined as a term for particles by the United States Environmental Protection Agency. Particulate matter (PM) pollution includes particles with diameters of 10 micrometers (μm) or smaller, called PM_{10}, and extremely fine particles with diameters that are generally 2.5 micrometers (μm) and smaller.

Particulate matter contains tiny liquid or solid droplets that can be inhaled and cause serious health effects. Particles <10 μm in diameter (PM_{10}) after inhalation can invade the lungs and even reach the bloodstream. Fine particles, $PM_{2.5}$, pose a greater risk to health (Table 1).

TABLE 1

Particle size **Penetration degree in human respiratory system**
>11μm Passage into nostrils and upper respiratory tract
7–11μm Passage into nasal cavity
4.7–7μm Passage into larynx
3.3–4.7μm Passage into trachea-bronchial area
2.1–3.3μm Secondary bronchial area passage
1.1–2.1μm Terminal bronchial area passage
0.65–1.1μm Bronchioles penetrability
0.43–0.65μm Alveolar penetrability

Table 1: Penetrability according to particle size.

Multiple epidemiological studies have been performed on the health effects of PM. A positive relation was shown between both short-term and long-term exposures of $PM_{2.5}$ and acute nasopharyngitis. In addition, long-term exposure to PM for years was found to be related to cardiovascular diseases and infant mortality.

Those studies depend on $PM_{2.5}$ monitors and are restricted in terms of study area or city area due to a lack of spatially resolved daily $PM_{2.5}$ concentration data and, in this way, are not representative of the entire population. Following a recent epidemiological study by the Department of Environmental Health at Harvard School of Public Health (Boston, MA), it was reported that, as $PM_{2.5}$ concentrations vary spatially, an exposure error (Berkson error) seems to be produced, and the relative magnitudes of the short- and long-term effects are not yet completely elucidated. The team developed a $PM_{2.5}$ exposure model based on remote sensing data for assessing short- and long-term human exposures. This model permits spatial resolution in short-term effects plus the assessment of long-term effects in the whole population.

Moreover, respiratory diseases and affection of the immune system are registered as long-term chronic effects. It is worth noting that people with asthma, pneumonia, diabetes, and respiratory and cardiovascular diseases are especially susceptible and vulnerable to the effects of PM. $PM_{2.5}$, followed by PM_{10}, are strongly associated with diverse respiratory system diseases, as their size permits them to pierce interior spaces. The particles produce toxic effects according to their chemical and physical properties. The components of PM_{10} and $PM_{2.5}$ can be organic (polycyclic aromatic hydrocarbons, dioxins, benzene, 1-3 butadiene) or inorganic (carbon, chlorides, nitrates, sulfates, metals) in nature. Particulate Matter (PM) is divided into four main categories according to type and size (Table 2).

TABLE 2

Type	PM diameter (μm)
Particulate contaminants Smog	0.01–1
Soot	0.01–0.8
Tobacco smoke	0.01–1
Fly ash	1–100
Cement Dust	8–100
Biological Contaminants	
Bacteria and bacterial spores	0.7–10
Viruses	0.01–1
Fungi and molds	2–12
Allergens	0.1–100
Types of Dust Atmospheric dust	0.01–1
Heavy dust	100–1000
Settling dust	1–100
Gases gaseous contaminants	0.0001–0.01

Table 2. Types and sizes of particulate Matter (PM).

Gas contaminants include PM in aerial masses.Particulate contaminants include contaminants such as smog, soot, tobacco smoke, oil smoke, fly ash, and cement dust. Biological Contaminants are microorganisms (bacteria, viruses, fungi, mold, and bacterial spores), cat allergens, house dust and allergens, and pollen. Types of Dust include suspended atmospheric dust, settling dust, and heavy dust. Another fact is that the half-lives of PM_{10} and $PM_{2.5}$ particles in the atmosphere is extended due to their tiny dimensions; this permits their long-lasting suspension in the atmosphere and even their transfer and spread to distant destinations where people and the environment may be exposed to the same magnitude of pollution. They are able to change the nutrient balance in watery ecosystems, damage forests and crops, and acidify water bodies. As stated, $PM_{2.5}$, due to their tiny size, are causing more serious health effects. These aforementioned fine particles are the main cause of the "haze" formation in different metropolitan areas.

Ozone Impact in the Atmosphere

Ozone (O_3) is a gas formed from oxygen under high voltage electric discharge. It is a strong oxidant, 52% stronger than chlorine. It arises in the stratosphere, but it could also arise following chain reactions of photochemical smog in the troposphere.

Ozone can travel to distant areas from its initial source, moving with air masses. It is surprising that ozone levels over cities are low in contrast to the increased amounts occuring in urban areas, which could become harmful for cultures, forests, and vegetation as it is reducing carbon assimilation. Ozone reduces growth and yield and affects the plant microflora due to its antimicrobial capacity. In this regard, ozone acts upon other natural ecosystems, with microflora and animal species changing their species composition. Ozone increases DNA damage in epidermal keratinocytes and leads to impaired cellular function. Ground-level ozone (GLO) is generated through a chemical reaction between oxides of nitrogen and VOCs emitted from natural sources and/or following anthropogenic activities. Ozone uptake usually occurs by inhalation. Ozone affects the upper layers of the skin and the tear ducts. A study of short-term exposure of mice to high levels of ozone showed malondialdehyde formation in the upper skin (epidermis) but also depletion in vitamins C and E. It is likely that ozone levels are not interfering with the skin barrier function and integrity to predispose to skin disease. Due to the low water-

solubility of ozone, inhaled ozone has the capacity to penetrate deeply into the lungs.

Toxic effects induced by ozone are registered in urban areas all over the world, causing biochemical, morphologic, functional, and immunological disorders. The European project (APHEA2) focuses on the acute effects of ambient ozone concentrations on mortality. Daily ozone concentrations compared to the daily number of deaths were reported from different European cities for a 3-year period. During the warm period of the year, an observed increase in ozone concentration was associated with an increase in the daily number of deaths (0.33%), in the number of respiratory deaths (1.13%), and in the number of cardiovascular deaths (0.45%). No effect was observed during wintertime.

Carbon Monoxide (CO)

Carbon monoxide is produced by fossil fuel when combustion is incomplete. The symptoms of poisoning due to inhaling carbon monoxide include headache, dizziness, weakness, nausea, vomiting, and, finally, loss of consciousness. The affinity of carbon monoxide to hemoglobin is much greater than that of oxygen. In this vein, serious poisoning may occur in people exposed to high levels of carbon monoxide for a long period of time. Due to the loss of oxygen as a result of the competitive binding of carbon monoxide, hypoxia, ischemia, and cardiovascular disease are observed. Carbon monoxide affects the greenhouses gases that are tightly connected to global warming and climate. This should lead to an increase in soil and water temperatures, and extreme weather conditions or storms may occur. However, in laboratory and field experiments, it has been seen to produce increased plant growth.

Nitrogen Oxide (NO_2)

Nitrogen oxide is a traffic-related pollutant, as it is emitted from automobile motor engines. It is an irritant of the respiratory system as it penetrates deep in the lung, inducing respiratory diseases, coughing, wheezing, dyspnea, bronchospasm, and even pulmonary edema when inhaled at high levels. It seems that concentrations over 0.2 ppm produce these adverse effects in humans, while concentrations higher than 2.0 ppm affect T-lymphocytes, particularly the CD8+ cells and NK cells that produce our immune response.It is reported that long-term exposure to high levels of nitrogen dioxide can be responsible for chronic lung disease. Long-term exposure to NO_2 can impair the sense of smell.

However, systems other than respiratory ones can be involved, as symptoms such as eye, throat, and nose irritation have been registered. High levels of nitrogen dioxide are deleterious to crops and vegetation, as they have been observed to reduce crop yield and plant growth efficiency. Moreover, NO_2 can reduce visibility and discolor fabrics.

Sulfur Dioxide (SO_2)

Sulfur dioxide is a harmful gas that is emitted mainly from fossil fuel consumption or industrial activities. The annual standard for SO_2 is 0.03 ppm. It affects human, animal, and plant life. Susceptible people as those with lung disease, old people, and children, who present a higher risk of damage. The major health problems associated with sulfur

dioxide emissions in industrialized areas are respiratory irritation, bronchitis, mucus production, and bronchospasm, as it is a sensory irritant and penetrates deep into the lung converted into bisulfite and interacting with sensory receptors, causing bronchoconstriction. Moreover, skin redness, damage to the eyes (lacrimation and corneal opacity) and mucous membranes, and worsening of pre-existing cardiovascular disease have been observed. Environmental adverse effects, such as acidification of soil and acid rain, seem to be associated with sulfur dioxide emissions.

Lead

Lead is a heavy metal used in different industrial plants and emitted from some petrol motor engines, batteries, radiators, waste incinerators, and waste waters. Major sources of lead pollution in the air are metals, ore, and piston-engine aircraft. Lead poisoning is a threat to public health due to its deleterious effects upon humans, animals, and the environment, especially in the developing countries. Exposure to lead can occur through inhalation, ingestion, and dermal absorption. Trans- placental transport of lead was also reported, as lead passes through the placenta unencumbered. The younger the fetus is, the more harmful the toxic effects. Lead toxicity affects the fetal nervous system; edema or swelling of the brain is observed. Lead, when inhaled, accumulates in the blood, soft tissue, liver, lung, bones, and cardiovascular, nervous, and reproductive systems. Moreover, loss of concentration and memory, as well as muscle and joint pain, were observed in adults. Children and newborns are extremely susceptible even to minimal doses of lead, as it is a neurotoxicant and causes learning disabilities, impairment of memory, hyperactivity, and even mental retardation. Elevated amounts of lead in the environment are harmful to plants and crop growth. Neurological effects are observed in vertebrates and animals in association with high lead levels.

Polycyclic Aromatic Hydrocarbons (PAHs)

The distribution of PAHs is ubiquitous in the environment, as the atmosphere is the most important means of their dispersal. They are found in coal and in tar sediments. Moreover, they are generated through incomplete combustion of organic matter as in the cases of forest fires, incineration, and engines. PAH compounds, such as benzopyrene, acenaphthylene, anthracene, and fluoranthene are recognized as toxic, mutagenic, and carcinogenic substances. They are an important risk factor for lung cancer.

Volatile Organic Compounds (VOCs)

Volatile organic compounds (VOCs), such as toluene, benzene, ethylbenzene, and xylene, have been found to be associated with cancer in humans. The use of new products and materials has actually resulted in increased concentrations of VOCs. VOCs pollute indoor air and may have adverse effects on human health. Short-term and long-term adverse effects on human health are observed. VOCs are responsible for indoor air smells. Short-term exposure is found to cause irritation of eyes, nose, throat, and mucosal membranes, while those of long duration exposure include toxic reactions. Predictable assessment of the toxic effects of complex VOC mixtures is difficult to

estimate, as these pollutants can have synergic, antagonistic, or indifferent effects.

Dioxins

Dioxins originate from industrial processes but also come from natural processes, such as forest fires and volcanic eruptions. They accumulate in foods such as meat and dairy products, fish and shellfish, and especially in the fatty tissue of animals. Short-period exhibition to high dioxin concentrations may result in dark spots and lesions on the skin. Long-term exposure to dioxins can cause developmental problems, impairment of the immune, endocrine and nervous systems, reproductive infertility, and cancer (16). Without any doubt, fossil fuel consumption is responsible for a sizeable part of air contamination. This contamination may be anthropogenic, as in agricultural and industrial processes or transportation, while contamination from natural sources is also possible. Interestingly, it is of note that the air quality standards established through the European Air Quality Directive are somewhat looser than the WHO guidelines, which are stricter.

Environmental impact of air pollution:

Air pollution is harming not only human health but also the environment in which we live. The most important environmental effects are as follows. Acid rain is wet (rain, fog, snow) or dry (particulates and gas) precipitation containing toxic amounts of nitric and sulfuric acids. They are able to acidify the water and soil environments, damage trees and plantations, and even damage buildings and outdoor sculptures, constructions, and statues. Haze is produced when fine particles are dispersed in the air and reduce the transparency of the atmosphere. It is caused by gas emissions in the air coming from industrial facilities, power plants, automobiles, and trucks. Ozone, as discussed previously, occurs s both at ground level and in the upper level (stratosphere) of the Earth's atmosphere. Stratospheric ozone is protecting us from the Sun's harmful ultraviolet (UV) rays. Global climate change is an important issue that concerns mankind. As is known, the "greenhouse effect" keeps the Earth's temperature stable. Unhappily, anthropogenic activities have destroyed this protecting temperature effect by producing large amounts of greenhouse gases, and global warming is mounting, with harmful effects on human health, animals, forests, wildlife, agriculture, and the water environment.

Discission

Undoubtedly, all the living beings are vulnerable to air pollution, especially during their development. Air pollution has adverse effects on our lives in many different respects. Diseases associated with air pollution have not only an important economic impact but also a societal impact due to absences from productive work and school. Despite the difficulty of eradicating the problem of anthropogenic environmental pollution, a successful solution could be envisaged as a tight collaboration of authorities, bodies, and doctors to regularize the situation. Governments should spread sufficient information and educate people and should involve professionals in these issues so as to control the emergence of the problem successfully.

At this point, international cooperation in terms of research, development, administration policy, monitoring, and politics is vital for effective pollution control. Legislation concerning air pollution must be aligned and updated, and policy makers should propose the design of a powerful tool of environmental and health protection. As a result, the main proposal of this study is that we should focus on fostering local structures to promote experience and practice and extrapolate these to the international level through developing effective policies for sustainable management of ecosystems.

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