ENVIRONMENTAL POLLUTION

ABSTRACT

Environmental pollution is one of the most pressing global challenges of the modern era. It refers to the contamination of natural resources, including air, water, soil, and ecosystems, due to the introduction of harmful substances or pollutants. These pollutants, often resulting from industrial activities, agricultural practices, waste disposal, and urbanization, pose significant threats to both human health and the environment. Environmental pollution has far-reaching consequences, affecting biodiversity, climate stability, and the health of all living organisms. This chapter explores the type, causes, health effects and prevention of pollution.

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I. INTRODUCTION

Environmental pollution (contamination of air, water, and soil by human activity) is the major subject of global concern for climate change and human health. The problem is no doubt greater in developing countries, where conventional sources such as industrial and automobile emissions, burning garbage, poor sanitation, emissions from volcanic eruption, contaminated drinking water etc affect large number of populations. According to WHO 2015, It is estimated that 9 million premature deaths, or more than three times the number of deaths from malaria, AIDS and tuberculosis were due to ill health caused by pollution.Pollution of the environment is generally higher in middle and low-income nations than in industrialized nations, as a result of a lack of resources, weak laws, and a lack of awareness of the different types of pollution.People most likely face pollution regularly without realizing it,Unlikely as it may seem, ignorance of the types of pollution leads to human actions creating pollutants in amounts and forms that the environment can no longer neutralize without severely altering its structure. Examples of activities that lead to pollution of the air, land, and water include deforestation, bush burning, disposing of household and agricultural waste in water bodies, using chemicals to harvest aquatic species, and improper disposal of technological waste. More specifically, human activities grow together with an increase in the impact on the environment as human population density rises. In addition to humans, other aquatic and terrestrial animals are also affected, including microbes, which are more likely to sustain their biological role due to their diversity and abundance. In addition to mining, exploration, urbanization, and population increase, other factors that contribute to environmental pollution include the transboundary migration of pollutants from developed to developing nations and vice versa. (1-3)

II. AIR POLLUTION

Air pollution is basically the admittance of harmful chemicals or substances into the atmosphere, possibly causing damage to human life, wildlife, vegetation, and buildings. These substances, mostly not naturally part of the air, contribute to the deterioration of air quality. Moreover, air pollution is also contributing to global warming and the depletion of the ozone layer, further deteriorating the wholesome state of life on Earth. [4-5]

Air Pollutants

Pollutants have different properties that determine their dispersion and consequences, depending on the source, form, and conditions in which they are created. Sulfur oxides, nitrogen oxides, volatile organic compounds (VOCs), and carbon monoxide (CO) are common gaseous pollutants.

Categories of Air Pollutants

There is major two categories for gaseous pollutants:

- Primary air pollutants
- Secondary air pollutants.

The primary pollutants are the ones directly emitted into the atmosphere, like CO, CO2, NH3, and volatile organic compounds; secondary pollutants, which form under the chemical transformation of the primary ones, include nitrogen oxides, sulfur compounds, and ozone from ammonium nitrate aerosols, sulfuric acid, and hydrocarbons. Main sources are domestic, industrial processes, and transport.[20]

Health Effects of Different Air Pollutants

Cancer: Living close to busy roads may put a woman at higher risk of developing breast cancer, according to a study including over 57,000 women.Exposure to benzene at work, an industrial chemical found in gasoline, has been linked to non-Hodgkin's lymphoma and can induce leukemia.An extended investigation conducted between 2000 and 2016 discovered a correlation between the prevalence of lung cancer and a greater reliance on coal for energy production.PM2.5 and NO_2 increase the risks of colorectal and prostate cancers.[15]

Cardiovascular Disease: Particulate pollution with fine particles can accelerate artery calcification and affect blood vessel function. In post-menopausal women, short-term daily exposure to nitrogen oxides is linked to a higher risk of hemorrhagic stroke. Additionally, exposure to TRAP (traffic-related air pollution) raises risk of hypertensive disorder in pregnant woman.[15]

Respiratory Disease: Air pollution can affect lung development and is linked to the development of diseases like emphysema, asthma, and other respiratory diseases, which include COPD. Chronic bronchitis is known to be caused by exposure to particulate matter (PM2.5, PM10) and nitrogen dioxide in large amounts over a long period. Carbon monoxide or CO is colorless, odorless, highly soluble, and non-irritating and has a greater affinity for hemoglobin compared to oxygen. This reduces the oxygen-carrying capacity of red blood cells, which could have harmful health implications.[15]

Global Warming: Global warming is defined as a gradual increase in the average temperature of Earth's surface, resulting from human activities, mainly because of the wider emission of greenhouse gases, including carbon dioxide and methane. These gases trap heat in the atmosphere and contribute to the effects of climate change: rising sea levels, extreme weather conditions, and shift in ecosystems. Mitigation of global warming involves reducing the use of fossil fuel, enhancing energy efficiency, and shifting to renewable sources of energy. The mitigation of global warming is central to environmental sustainability and public health. [18-20]

Air Pollution Prevention and Control: It involves strategies and technologies to reduce release of number of pollutants into the atmosphere. Some of the useful approaches to this include:

Use of Public Transport: The primary source of air pollution is the combustion of fossil fuels. When the majority of people use public transportation, then there are fewer cars and other vehicles on the road, which will be helpful to reduce release of global warming gaseous.

Avoid Plastic Bags: Plastic bags have become a nuisance in the environment. Burning them releases poisonous gases. A sustainable alternative to plastic bags is using paper or cloth bags, which are biodegradable and less damaging to the ecosystem.

Planting Trees: Plants help enhance air quality by absorbing much carbon dioxide and releasing oxygen through photosynthesis. They may considerably contribute to changing the situation with global warming if the number of trees grows.

Use Filters in Chimneys

Smoke from chimneys contain a lot of pollutants that degrade air quality. In case filters are installed at the top of the chimney, it will reduce the number of harmful substances released into the atmosphere.

III. WATER POLLUTION

The presence of dangerous chemical substances in the water at any amounts that may harm aqueous environment is known as water pollution. Water pollution can be natural or man made. Naturally existing ore are rich in harmful metals may contaminate underground water sources. Pollutants from livestock operations, food processing waste, insecticides, herbicides, heavy metals from electronic, chemical, and medical wastes, and volatile organic compounds (VOCs) are examples of anthropogenic elements that cause water pollution.[14] Other organic contaminants are also introduced into surface water by airborne pollutants such as PM. Typhoid, vomiting, diarrhea, and stomach aches are just a few of the health issues that these pollutants can cause in people. Pesticides, hydrocarbons, POPs, heavy metals, and other chemicals can have serious negative impacts on health, including cancer, hormone imbalances, reproductive problems, and serious liver and kidney damage.

Eutrophication

This is a process where aquatic bodies become enriched with nutrients, mostly causing excessive growth of algae and aquatic plants due to runoff from agricultural fertilizers, sewage, and industrial discharges that introduce nitrogen and phosphorus into lakes, rivers, and coastal waters.[17]

Consequences of Eutrophication

Algal Blooms: These will lead to fast growth and forming complex layers on the water surface. Such a situation will reduce sunlight input for photosynthetic activities.

Oxygen Depletion: With the death and decomposition of algae, oxygen is depleted in the water; this leads to hypoxic or anoxic conditions that have worsen effect on aquatic life.

Decline Water Quality: Eutrophication can lead to foul odors, toxic algae blooms, and low levels of recreational opportunities.[20]

Biochemical Oxygen Demand

Biochemical Oxygen Demand (BOD) is the amount of dissolved oxygen needed by microbes for decomposing organic waste in water. It is an indicator of pollution in water bodies. High BOD indicates microbial growth & low oxygen availability in water. [21]

BOD increase = water polluted

Health Effects of Different Water Pollutants

Water pollution from various contaminants threatens human health. Contaminated water contains life threating pathogens that transmits infectious diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid and polio.

IV. SOIL POLLUTION

The presence of dangerous chemical substances in the soil at any amounts that have adverse effects on the ecosystem, human health and agricultural productivity is called soil pollution. The primary causes of soil contamination, aside from disasters like earthquakes and erosion, are household and industrial pollutants. Heavy metals, hydrocarbons, and inorganic and organic solvents are a few examples of soil contaminants. The main causes of soil contamination are garbage burning, open-air trash dumping, and inadequate landfills. Fossil fuels from power stations, petrochemical facilities, and petroleum refineries also contribute to soil pollution. Soil pollution is a common consequence of petroleum discovery, processing, and distribution via road transportation. Healthy soils harbor biodiversity in various ecosystems that provide basic human life-sustaining services like pollination, storages, and waters that avoid flood risks, with resultant averted water-borne diseases. They do have other uses, as is generally observed, while sequestering a remarkable portion of carbon to contribute in controlling global warming.

Effects of Soil Pollution

Soil Pollution affects soil's ability to yield crop. Deforestation generates airborne dust &leads soil erosion. Toxic soil pollutants like heavy metals and pesticides contaminate soil frequently. Some heavy metals & metalloids like cadmium, lead, arsenic etc causes cardiac disorders. Cadmium accumulation causes endothelial dysfunction, atherosclerosis and vascular malformations like inhibition of NO-mediated vasodilatation. Chemical soil pollutants like

polybrominated diphenyl ethers, polychlorinated biphenyls (e.g. dioxins), perfluorocarboxylic acids etc originate from industries. These compounds have adverse health effects. All of them are known to increase risk of cancer, atherosclerosis, endothelial dysfunction obesity and other complications. Pesticides used in agricultural work are also associated with an increased risk of developing short-term problems (e.g. nausea, skin irritation, headache etc) & other chronic metabolic conditions such asischaemic heart disease diabetes, cancer and respiratory symptoms.[19]

V. CONCLUSION

An overview of pollution, its sources, impacts, and mitigation strategies have been provided in this chapter. Of all the pollution categories, air pollution appears to have been researched extensively and given more attention. This might be the outcome of higher rates of sickness and early mortality linked to air pollution. Pollution affects both developed and developing countries equally, but it is the latter that bear the brunt of it because of insufficient laws, low public awareness, and extreme poverty. In low- and middle-income countries, the most vulnerable populations are disproportionately impacted by pollution. Pollution poses serious risks, and everyone should work together to prevent behaviors that contribute to pollution in the environment so that areas that have already been impacted by pollution can be remedied. Biological remediation techniques that employ microorganisms have been deemed environmentally and economically viable, as well as safe for human and environmental use.

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