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Environmental Pollution: Causes, Controlling Measures and Public Awareness

Dr. S. Anil Kumar

M.A., MBA., M.Phil., PhD., D.I.R.P.M., H.D.C.S., C.C.C.S., C.CM.G

Assistant Professor, Department of Political Sciences,

S.G.S. Arts College, TTD, Tirupati, AP, India. 517 502

Abstract: *Pollution is defined as almost any human action that causes the natural environment to decline or degrade in quality. Environmental pollution is not a recent phenomenon, but it continues to be the biggest threat to humanity and the main factor in environmental illness and mortality. Premature fatalities from pollution were estimated to account for 9 million deaths in 2015, more than three times the amount of deaths from malaria, AIDS, and tuberculosis combined. Generally speaking, environmental pollution is worse in middle- and low-income countries than it is in developed ones. This may be because to factors like poverty, shoddy laws, and a lack of awareness of pollution sources.*

Key Words: *Global, pollution, temperature, warning*

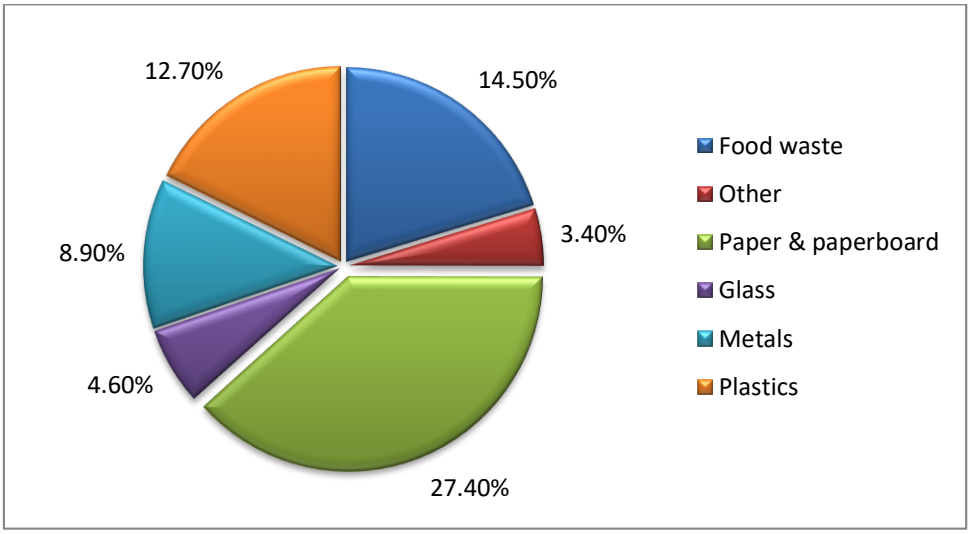
Key Words: *Xyzdf*

INTRODUCTION

People probably encounter pollution on a regular basis without realising it, or perhaps our fast-paced lives have made us immune to it. As implausible as it may seem, ignorance about pollution causes humans to engage in activities that produce harmful byproducts in amounts and forms that the environment is no longer able to fight without utter system deformation (1). For instance, incorrect electronic waste disposal, burning of bushes, dumping of household and agricultural trash into waterways, using chemicals to harvest aquatic life, and deforestation all contribute to air, land, and water pollution. More specifically, as the density of people grows so do human activities and their corresponding effects on the environment (2).

The effects extend beyond people to include other aquatic and terrestrial species, including microorganisms. These organisms, due of their diversity and abundance, tend to continue performing the biogeochemical processes required for maintaining the ecosystem. The causes of environmental pollution include Trans boundary flow of pollutants from developed to developing countries, or vice versa (3). These factors include industrialization, urbanisation, population increase, exploration, and mining. Pollution has continued to be a problem on a worldwide scale in part because of transboundary pollution. No country can afford to be oblivious to pollution since it can spread through several channels, principally the air and water, and cause devastation in other nations (4).

FIGURE 1: TYPES OF POLLUTANTS



Additionally, the transboundary transfer of defective electrical and electronic equipment (EEE) from industrialised to developing nations under the pretence of closing the digital gap is a significant contributor to the contamination of the air, water, and soil with harmful metals. In addition, harmful substances like gaseous pollutants, toxic metals, and particulate matter (PM) are released into the atmosphere, along with sewage, industrial effluents, agricultural runoff, and electronic waste (5). Environmental pollution is also brought on by soil-polluting activities like mining, deforestation, and illegal trash dumping. It is typical to deny that human activities have caused the natural environment to become unstable in order to continue engaging in harmful behaviours that can lead to major illnesses or even death.

Because of weak laws, lax enforcement of fines, or a lack of concern for the effects of such activities on health and the environment, several human activities that have been shown to be harmful to the environment are nonetheless practised in middle- and low-income nations. Alarmingly, low-income individuals (6), children, elderly people, and other vulnerable groups are disproportionately affected by environmental pollution, especially air pollution, in emerging nations. Environmental pollution's sources and effects must be understood, yet taking no action can cost you dearly. Various physical and chemical methods have been used to eliminate pollution, but the majority of them are costly and contribute to new environmental issues. Environmentally friendly and economically sensible methods that produce fewer secondary byproducts are being studied in the literature as a way to effectively combat the pollution brought on by persistent pollutants that keep on developing. Microbial bioremediation is one of these methods that has drawn attention from all around the world, presumably because it is an effective and environmentally beneficial way to restore the environment. There are many different types of pollution, but the three main types—air, water, and soil/land pollution—would be taken into account (7), (8).

POLLUTION TYPES

Air pollution

The presence of dangerous chemical substances in the atmosphere at concentrations that could be harmful to people, animals, plants, and a structure is known as air pollution. In general, air pollution denotes the existence of chemical substances in the atmosphere that were not there at first but have led to a decline in air quality. Pollutants have different characteristics depending on their origin, form, and environment, which make their spread and impacts varied. Volatile organic compounds (VOCs), sulphur oxides (particularly SO2), nitrogen oxides (including NO and NO2), and carbon monoxide are typical gaseous pollutants (CO). Primary and secondary pollutants are two categories for these gaseous pollutants (9).

Water pollution

Both naturally occurring and man-made factors can cause water contamination. Ores with a high concentration of hazardous substances may naturally linger in underground water sources, creating contamination. Similar ores are associated to instances of significant arsenic and lead impurities in groundwater sources. Additionally, as mentioned by Ewuzie et al. (2020), the geological configurations of various regions greatly influence the fundamental compositions of the water bodies (10).

Soil pollution

The primary causes of soil contamination, aside from earthquakes, erosion, and other natural calamities that have a tendency to harm the soil, are industrial and domestic wastes. Heavy metals, hydrocarbons, and inorganic and organic solvents are a few examples of soil contaminants. The three main causes of soil contamination are open-air trash disposal, waste burning, and inadequate landfills. Soil contamination is also supported by fossil fuels from petrochemical plants, oil refineries, and power plants (11).

CAUSES OF POLLUTIONS

Urbanization and industrialization

Man has been introducing dangerous elements into the environment at an alarming rate ever since the industrial revolution. A combination of positive and negative effects link industrialization, urbanisation, economic growth, and the environment. Urbanization and rapid economic growth typically occur in many nations where it has been seen that populations are moving from villages to cities and towns. One of the effects of unchecked urbanisation in developing countries is environmental deterioration. This happens very quickly, leading to a wide range of associated issues such excessive air pollution, contaminated water, more difficult waste disposal concerns, and barren farmland. Most likely, environmental pollution is caused by industrialization, modernization, and the quickening of urbanisation worldwide (12), (13), but it is more pronounced in developing countries.

Water resources are already in decline, and as the population grows, there is a chance that they will go even further downhill or possibly run out entirely as a result of disregard for water conservation and wasteful water use. In addition, there are a lot of waste discharges into land and water due to industrialization. Massive amounts of wastewater, heavy metals, toxic sludge, and solvents enter streams and rivers as a result of urbanisation and industrialisation, polluting them. Urbanization has accelerated the proliferation of cars and other motorised vehicles, which is a major cause for worry over air pollution. Last but not least, industrialization causes severe habitat degradation by chopping down trees for their lumber and building homes, all of which help to destroy ecosystems and cause the extinction of some animal and plant species (14).

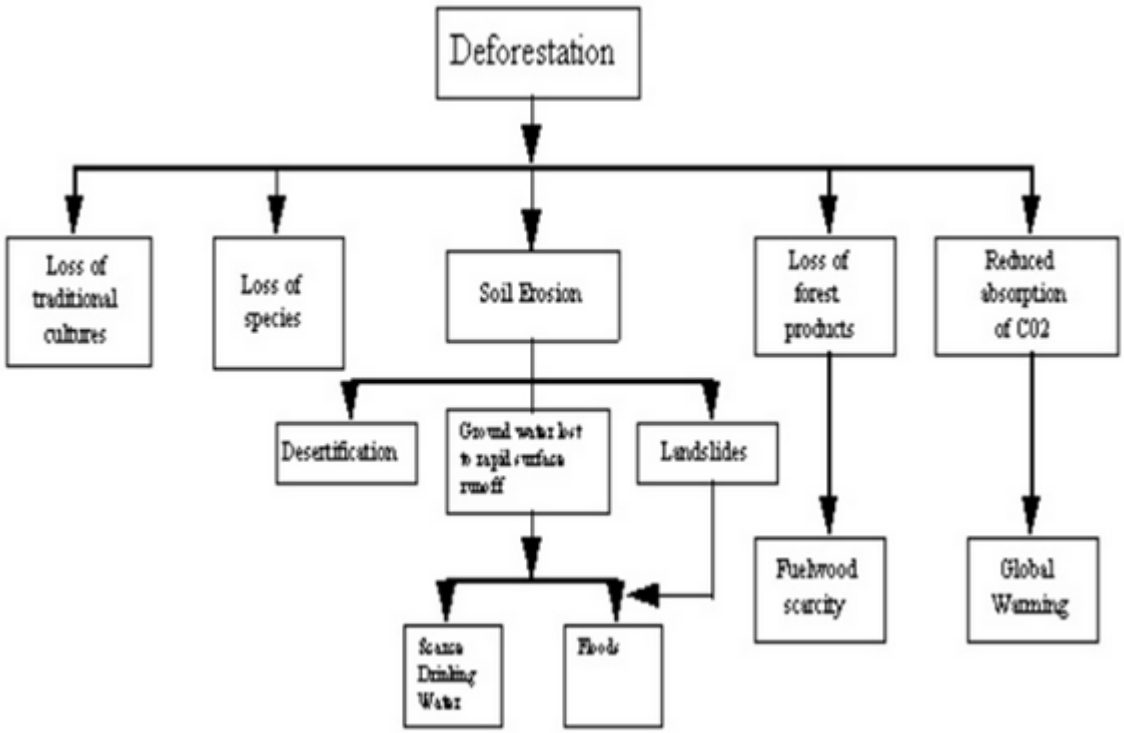
Mining and exploration

Different levels of pollution are produced during the mining and exploration process, which has an impact on the quality of the air, water, and land. The phase and scope of the work being done at the site determines the level of pollution. Excavation of the mine site alone could result in waste production, sinkhole formation, and habitat loss. Other harmful materials like lead (Pb) could erupt during the extraction of a certain precious substance, such as gold mine, and contaminate the soil and water. The various phases of large-scale exploration may cause more severe soil, water, and air pollution, even though mineral exploration may only cause minor contamination. When limestone, petroleum, and rocks are exploited on a huge scale for use in various construction projects, the pollution is considerably worse. Vandals have started illegally blowing up oil pipelines in most oil-producing states in African nations, and they also steal oil to refine in unauthorised refineries. Security organisations most frequently set fire to these illegal refineries with the intention of ending bunkering. However, this burning activity generates massive amounts of harmful metals, organic pollutants, sulphur compounds, and carbon compounds that have a negative impact on both terrestrial and marine life as well as the environment. For instance, acid rain is seen, the intensity of the heat rises because of greenhouse gases, and fish and other aquatic life in surface waters perish. Large amounts of dust may be released into the air by mining operations at limestone quarry sites and cement manufacturing facilities, which aggravates already existing environmental degradation (15).

Agricultural activities

Any nation may thrive economically by turning to agriculture to support people's livelihoods. Despite these significant functions, agriculture nonetheless contributes to pollution, which poses a range of threats to human health and the environment. Certain farming practises that have a tendency to harm, taint, and degrade the environment and ecosystem can lead to agricultural pollution. Burning waste products from agricultural processes like clearing land, adding more fertiliser than plants actually need, and using nonbiodegradable pesticides are all sources of pollution in agriculture. Following these processes, certain chemicals enter the food chain, smoke and particulate matter is produced, and ecosystems become unstable. Additionally, nitrates generated by agricultural operations are well-known chemical contaminants in aquifers of groundwater.

FIGURE 2: EFFECTS OF DEFORESTATION



Fertilizers that are administered in higher quantities than necessary for plant absorption are frequently linked to eutrophication, which happens when there are too many nutrients in water bodies. Through runoffs, excess nitrogen and phosphates can contaminate groundwater or surface waters. Environmental pollution also results from farming and from raising land-based or aquatic animals. For instance, uneaten animal feeds or animal excrement may emit strong scents that could have a negative impact on health. More specifically, the need to boost agricultural production in order to feed an expanding population has stimulated the use of antifouling agents, antibiotics, and fungicides in farming, which worsens ecosystem degradation. Despite the fact that agriculture is a basic human need and is necessary to feed the world's population, pollution caused by agricultural practises should be a top priority (8).

Burning of fossil fuels

Long before they are burned, dangerous air pollutants may be released by fossil fuels. Air pollutants are released when fossil fuels are burned, causing environmental degradation and the ensuing damage of the ecosystem. We burn oil, coal, and gas to meet our energy needs, which is what, is causing the current global warming issue. Fossil fuel combustion releases a range of primary and secondary pollutants, such as airborne particles, SO2, CO2, CO, hydrocarbons, organic compounds, chemicals, and nitrogen oxides (NOx). The main greenhouse gases, such as carbon dioxide, methane (CH4), nitrous oxide, and fluorinated gases, are all present in the emissions from fossil fuels. As a result, these activities cause air pollution that not only threatens air quality but also contributes to climate change and global warming (2), (5).

Particulate matter

PM plays a crucial role in the composition of the atmosphere. PM can come from both natural and artificial sources. Numerous natural sources release tonnes of PM into the atmosphere every year. There are several of them, such as volcanic eruption, wind and dust storms, forest fires, salt spray, rock debris, interactions between gaseous emissions, and soil erosion. The combustion of fuels, industrial processes, the steel and cement industries, petroleum foundries, smelting and mining operations, fly-ash emissions from power plants, coal burning, and the disposal of agricultural waste are all examples of man-made activities that contribute to PM in the atmosphere (8).

Plastics

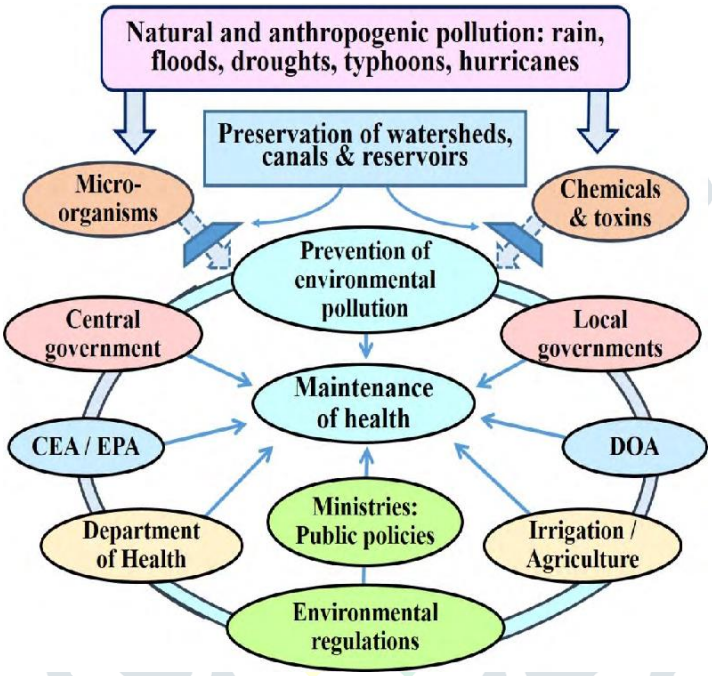
People are starting to realise how much plastic pollution has affected the environment. Polypropylene, polyethylene, polystyrene, polyamides, and polyester are a few plastic kinds that can be found in the natural world. Because of their durability and affordability, plastic bags are frequently employed in underdeveloped nations for shopping and food storage. Additionally, the majority of beverages that were once offered in glass bottles are now packaged in plastic bottles. However, in certain locations, drinks are drunk in these plastic bottles, and the bottles are carelessly thrown out, adding to the abundance of plastics in the environment. Although plastics can be broken down into macro- or microplastics, they are primarily nonbiodegradable. According to a survey, between 1960 and 2013, the United States' rise in the production of municipal solid garbage was 188%, compared to the growth in the production of plastics, which was 8238%. (12). However, the production of plastic garbage increased at the same time that glass and metal waste production decreased. Microplastics (MPs) are small plastic particles that are primarily found in consumer goods like paint, cosmetics, and synthetic fabric fibres. Secondary MPs are produced when bigger plastic waste breaks down (2).

CONTROLLING MEASURES

Most developing nations, which are the worst affected by pollution, have not yet adequately reported on its consequences. This is due in part to unreliable database management systems and a lack of knowledge about the negative effects that pollution may have on the environment and human health. For example, in some regions of Africa, specific health issues like birth deformities, miscarriage, cancer, stunted growth, and untimely death are entirely attributed to bad luck and "act of the gods," which diverts attention away from pollution and its associated impacts. It is well established that public preferences for environmental protection are strongly correlated with social determinants of health, such as income and education levels.

Because of this, pollution and its impacts worsen in low-income countries where people are more concerned with food and shelter than with their health and the environment. Because the environment usually always suffers the greatest losses as a result of an increase in pollution, it is known as environmental pollution. The environment is made up of the biosphere, air, water, and land and serves as a holding area for all pollutants. The impacts on the land include the discoloration of vehicles and automobiles, death of wildlife species, destruction of roofing materials, soil infertility leading to poor plant yields, strewing of waste across the land surfaces (resulting in an offensive odour and diminished aesthetics), damage to trees, and death of wildlife species.

FIGURE 3: PREVENTION



According to (6), continuous mining specifically destroys vegetation/soil systems and lowers soil productivity and fertility. Other human activities also harm the environment by causing habitat destruction, soil erosion, animal extinction, and the loss of resources like wetlands and coastal ecosystems (13). All of these directly or indirectly cause food shortages for both people and other animals, which can result in famine and even death. Additionally, since land and water are in direct contact, it is simpler for pollutants to spread between the areas. Pollution frequently alters the chemical, microbiological, and physical characteristics of water bodies. Examples include eutrophication, higher salinity from drilling with NaCl, increased amounts of harmful metals, and increased water temperature due to increased heat from the sun. Oil in exploration locations also covers the water's surface and blocks sunlight and oxygen.

These modifications lead to excessive plant and nutrient growth, a drop in water oxygen, a loss in biodiversity, the dissolution of the bionetwork, and a decline in both the amount and quality of water. Due to the entry of sulfur- and nitrogen-containing compounds and other anaerobic activities as a result of pollution, water bodies become odiferous and repellent, lose their aesthetic value, and are abandoned. Multiple contaminants are known to be transported by atmospheric air and left behind on land and in water. The purity of colour and the shapes of things are obscured by haze, which arises when sunlight interacts with certain pollutants like PM and gases. Investigating how MPs affect the soil and aquatic habitats. However, MPs could include dangerous additives and chemicals that can get into the soil ecology and build up in soil invertebrate species. Earthworms' immune system response, biomass, growth, and even reproduction can be affected by such buildup. All of these negative environmental effects of pollution have a direct or indirect connection to both human and animal health (15).

PUBLIC AWARNESS

Sub lethal health effects on both wildlife and marine organisms are caused by oil spills that occur during exploration, refining, and transportation on land, through pipelines, and/or maritime vessels. These species' digestive, respiratory, and circulatory systems suffer when they breathe in or consume petroleum products that contain dangerous chemicals. Oil slicks pose a threat to seabirds and other marine mammals because they tend to contaminate their skin or feathers, slowing their movement, making it difficult for them to find enough food, and making it impossible for them to flee

from predators, all of which can result in death. Studies have showed that oil-fouling is killing birds. Although some oil-fouled birds are discovered and reported when they pass away, there are many deaths from oil spills that go unreported.

Recent times have seen more conversation on the problems caused by plastics in the environment. The lives of largely birds, fish, crabs, turtles, and other marine animals could ultimately be impacted, as well as the ecosystems and biodiversity. Plastics cause direct or indirect harm to animals. Internal damage, lacerations, sores, choking and entanglement of aquatic species, delayed growth and photosynthesis in primary producers of the food chain like algae, and effects on development and reproduction in crustaceans are all examples of direct hazards. Again, in addition to imminent death, an animal may sustain injuries or have movement restrictions, which may cause malnutrition or make it harder for it to flee from predators. Furthermore, certain plastic additives like plasticizers and other organic contaminants that alter metabolic processes and behaviours have an indirect effect on these creatures. Additionally, genetic diversity and biodiversity in the natural population are impacted by pollution. According to studies, the ribosomal sequences in the genomes of fish living in contaminated environments are extremely complicated. It is shown that, in reaction to changes in the environment, there is a regular rise in the number of ribosomal DNA copies. This occurs as a result of the fact that these sequences play a major role in maintaining genomic integrity (1). It has been suggested to use biological, chemical, and physical remediation techniques.

However, attention should be paid to ways to prevent pollution so that rehabilitation of the already harmed ecosystem would be quick and practical. The physicochemical characteristics of the contaminants deposited in the environment that needs to be cleaned are unaffected by physical methods of soil reclamation. On the other hand, chemical treatments lower the ecological risk of the pollutants by degrading them and further altering their physicochemical characteristics. The 2030 Agenda for Sustainable Development, also known as Agenda 2030, is advised to be put into action. This will give us a framework for creating a more sustainable future for humanity and for using the natural resources we rely on sustainably (3).

Additionally, recent studies have identified specific areas for research and innovation, such as comprehending and lowering plastics use, cleaning up beaches and oceans, developing substitute materials, and comprehending the effects on human and animal health (4). Briefly stated, public education about how to manage and enhance the relationship between human society and the environment in an integrated and sustainable manner can be accomplished through workshops, conferences, seminars, and use of the media (16).

CONCLUSION

Air pollution appears to be the sort of pollution that has been studied the most and gotten the most attention. This may be due to increased premature mortality and morbidity rates linked to air pollution. The burden of pollution is shared by developed and developing countries, but the latter are more affected than the former because of lax regulations, a lack of awareness, and poverty. In middle- and low-income countries, the most vulnerable individuals are disproportionately impacted by pollution. To make it possible to remediate an already damaged ecosystem, awareness of the dangers of pollution must be increased, and all hands must be on deck to halt actions that cause environmental pollution. Among the numerous remediation techniques, biological techniques utilising microorganisms have been deemed economical and environmentally beneficial.

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