

Environmental Pollution

- Environmental pollution (Air, water, soil, thermal, and noise): causes, effects, and Controls; Primary and secondary air pollutants; Air and water quality standards
 - Nuclear hazards and human health risks
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Environmental pollution:

Pollution is the introduction of contaminants into the natural environment that causes adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants.

Environmental pollution is one of the most serious problems facing humanity and other life forms on our planet today. “Environmental pollution is defined as “the contamination of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected.” Pollutants can be naturally occurring substances or energies, but they are considered contaminants when in excess of natural levels. Any use of natural resources at a rate higher than nature’s capacity to restore itself can result in pollution of air, water, and land.

Environmental pollution is of different types namely air, water, soil, noise and light-weight. These cause damage to the living system. How pollution interacts with public health, environmental medicine and the environment has undergone dramatic change.

Air pollution:

Air pollution is a mixture of solid particles and gases in the air. Car emissions, chemicals from factories, dust, and pollen and mold spores may be suspended as particles. Ozone, a gas, is a major part of air pollution in cities. When ozone forms air pollution, it's also called smog. Some air pollutants are poisonous.

“Air pollution occurs when harmful or excessive quantities of substances are introduced into Earth's atmosphere. Sources of air pollution include gases, particulates, and biological molecules.”

“Air pollution refers to the release of pollutants into the air that are detrimental to human health and the planet as a whole.”

Primary and secondary air pollutants:

A primary pollutant is an air pollutant emitted directly from a source. A secondary pollutant is not directly emitted as such, but forms when other pollutants (primary pollutants) react in the atmosphere.

Primary air pollutants:

The primary pollutants are “directly” emitted from the processes such as fossil fuel consumption, volcanic eruption and factories.

The major primary pollutants are Oxides of Sulphur, Oxides of Nitrogen, Oxides of Carbon, Particulate Matter, Methane, Ammonia, Chlorofluorocarbons, Toxic metals etc.

Examples of Primary Pollutants:

1. Car exhaust, smokestacks (CO, SO₂, NO)
2. Particulate material (soot, ash)
3. Toxic metals (lead, mercury)
4. Volatile organic compounds (VOCs) (methane, propane, CFCs, etc.)

Secondary air pollutants:

The secondary pollutants are not emitted directly. The secondary pollutants form when the primary pollutants react with themselves or other components of the atmosphere. Most important secondary level Air Pollutants are Ground Level Ozone, Smog and POPs (Persistent Organic Pollutants).

Causes of air pollution:

The burning of fossil fuels Sulfur dioxide emitted from the combustion of fossil fuels like coal, petroleum and other factory combustibles are one the major cause of air pollution. But, their overuse is killing our environment as dangerous gases are polluting the environment

➤ **Burning of Fossil Fuels:**

The combustion of fossil fuels emits a large amount of sulphur dioxide. Carbon monoxide released by incomplete combustion of fossil fuels also results in air pollution.

➤ **Automobiles:**

The gases emitted from vehicles such as jeeps, trucks, cars, buses, etc. pollute the environment. These are the major sources of greenhouse gases and also result in diseases among individuals.

➤ **Agricultural Activities:**

Ammonia is one of the most hazardous gases emitted during agricultural activities. The insecticides, pesticides and fertilizers emit harmful chemicals in the atmosphere and contaminate it.

➤ **Factories and Industries:**

Factories and industries are the main source of carbon monoxide, organic compounds, hydrocarbons, and chemicals. These are released into the air degrading its quality.

➤ **Mining Activities:**

In the mining process, the minerals below the earth are extracted using large pieces of equipment. The dust and chemicals released during the process not only pollute the air but also deteriorate the health of the workers and people living in the nearby areas.

➤ **Domestic Sources:**

The household cleaning products and paints contain toxic chemicals that are released in the air. The smell from the newly painted walls is the smell of the chemicals present in the paints. It not only pollutes the air but also affects breathing.

Effects of Air Pollution:

The hazardous effects of air pollution on the environment include:

➤ Diseases:

Air pollution has resulted in several respiratory disorders and heart diseases among humans. The cases of lung cancer have increased in the last few decades. Children living near polluted areas are more prone to pneumonia and asthma.

➤ Global Warming:

Due to the emission of greenhouse gases, there is an imbalance in the gaseous composition of the air. This has led to an increase in the temperature of the earth. This increase in earth's temperature is known as global warming.

➤ Acid Rain:

The burning of fossil fuels releases harmful gases such as nitrogen oxides and sulphur oxides in the air. The water droplets combine with these pollutants, become acidic, and fall as acid rain which damages human, animal and plant life.

➤ Ozone Layer Depletion:

The release of chlorofluorocarbons (CFC), halons, and hydrochlorofluorocarbons in the atmosphere is the major cause of depletion of the ozone layer. The depleting ozone layer does not prevent the harmful ultraviolet rays coming from the sun and causes skin diseases and eye problems among individuals.

➤ Effect on Animals:

The air pollutants suspend on the water bodies and affect the aquatic life. Pollution also compels the animals to leave their habitat and shift to a new place.

Air Pollution Control:

Following are the measures one should adopt to control air pollution:

➤ Avoid Using Vehicles:

People should avoid using vehicles for shorter distances. Rather they should prefer public modes of transport to travel from one place to another. This not only prevents pollution but also conserves energy.

➤ Energy Conservation:

A large number of fossil fuels are burnt to generate electricity. Therefore, do not forget to switch off the electrical appliances when not in use. Thus, you can save the environment at the individual level. Use of energy-efficient devices such CFLs also controls pollution to a greater level.

➤ **Use of Energy efficient appliances:**

Whether at the domestic level or at the industrial level, we must push for appliances that use energy efficiently, which result in complete combustion of fuel, as incomplete combustion causes air pollution.

➤ **Shifting industries:**

Another possible solution to reduce the harmful effects of air pollution is to shift the manufacturing plants, factories and industries to remote areas with a low level of population.

➤ **Using Modern Techniques:**

With technology making great advancements, there are now technologies available that can help reduce the release of pollutants in the air. Air filters, scrubbers, precipitators are just a few examples.

➤ **Shifting to Natural Gasses:**

Instead of using and exhausting fossil fuels, shifting to greener options is a no-brainer. For example, using CNG (compressed natural gas) instead of petrol or diesel is a great option.

Water pollution:

Water pollution is the contamination of water bodies, usually as a result of human activities. Water bodies include for example lakes, rivers, oceans, aquifers and groundwater. Water pollution results when contaminants are introduced into the natural environment.

“Water is essential to life. It need not be spelt out exactly how important it is. Yet water pollution is one of the most serious ecological threats we face today.”

Water pollution happens when toxic substances enter water bodies such as lakes, rivers, oceans and so on, getting dissolved in them, lying suspended in the water or depositing on the bed. This degrades the quality of water. Not only does this spell disaster for aquatic ecosystems, the pollutants also seep through and reach the groundwater, which might end up in our households as contaminated water we use in our daily activities, including drinking.

Sources of Water Pollution:

Point and non-point sources:

1. When pollutants are discharged from a specific location such as a drain pipe carrying industrial effluents discharged directly into a water body it represents point source pollution
2. In contrast, non-point sources include discharge of pollutants from diffused sources or from a larger area such as runoff from agricultural fields, grazing lands, construction site, abandoned mines and pits, etc.

Causes of Water Pollution:

The causes of water pollution vary and may be both natural and anthropogenic. However, the most common causes of water pollution are the anthropogenic ones, including:

Agrochemicals:

Agrochemicals like fertilizers (containing nitrates and phosphates) and pesticides (insecticides, fungicides, herbicides etc.) washed by rain-water and surface runoff pollute water.

Storm water runoff:

Carrying various oils, petroleum products, and other contaminants from urban and rural areas (ditches). These usually forms sheens on the water surface.

Sewage:

Emptying the drains and sewers in fresh water bodies causes water pollution. The problem is severe in cities.

Mining activities:

Mining activities involve crushing rocks that usually contain many trace metals and sulfides. The leftover material from mining activities may easily generate sulfuric acid in the presence of precipitation water.

Industrial Effluents:

Industrial wastes containing toxic chemicals, acids, alkalis, metallic salts, phenols, cyanides, ammonia, radioactive substances, etc., are sources of water pollution. They also cause thermal (heat) pollution of water.

Burning of fossil fuels:

the emitted ash particles usually contain toxic metals (such as As or Pb). Burning will also add a series of oxides including carbon dioxide to air and, respectively, water bodies.

Leaking landfills:

May pollute the groundwater below the landfill with a large variety of contaminants (whatever is stored by the landfill).

Animal waste:

Contribute to the biological pollution of water streams. Think of it this way: anything that can cause air pollution or soil pollution may also affect water bodies and cause innumerable ecological and human health issues

Effects of water pollution:

The effects of water pollution are varied. They include poisonous drinking water, poisonous food animals (due to these organisms having bioaccumulated toxins from the environment over their life spans), unbalanced river and lake ecosystems that can no longer support full biological diversity, deforestation from acid rain, and many other effects. These effects are, of course, specific to the various contaminants.

1. Water bodies in the vicinity of urban areas are extremely polluted. This is the result of dumping garbage and toxic chemicals by industrial and commercial establishments.
2. Water pollution drastically affects aquatic life. It affects their metabolism, behavior, causes illness and eventual death. Dioxin is a chemical that causes a lot of problems from reproduction to uncontrolled cell growth or cancer. This chemical is bioaccumulated in fish, chicken and meat. Chemicals such as this travel up the food chain before entering the human body.
3. The effect of water pollution can have a huge impact on the food chain. It disrupts the food-chain. Cadmium and lead are some toxic substances, these pollutants upon entering the food chain through animals (fish when consumed by animals, humans) can continue to disrupt at higher levels.
4. Humans are affected by pollution and can contract diseases such as hepatitis through faecal matter in water sources. Poor drinking water treatment and unfit water can always cause an outbreak of infectious diseases such as cholera etc.
5. The ecosystem can be critically affected, modified and destructured because of water pollution.

Control of Water Pollution:

Water pollution, to a larger extent, can be controlled by a variety of methods. Rather than releasing sewage waste into water bodies, it is better to treat them before discharge. Practicing this can reduce the initial toxicity and the remaining substances can be degraded and rendered harmless by the water body itself. If the secondary treatment of water has been carried out, then this can be reused in sanitary systems and agricultural fields.

A very special plant, the Water Hyacinth can absorb dissolved toxic chemicals such as cadmium and other such elements. Establishing these in regions prone to such kinds of pollutants will reduce the adverse effects to a large extent. Some chemical methods that help in the control of water pollution are precipitation, the ion exchange process, reverse, and coagulation. As an individual, reusing, reducing, and recycling wherever possible will advance a long way in overcoming the effects of water pollution.

Soil Pollution:

Soil contamination or soil pollution as part of land degradation is caused by the presence of xenon biotic chemicals or other alteration in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals or improper disposal of waste.

Definition of Soil pollution:

“Soil pollution refers to the contamination of soil with anomalous concentrations of toxic substances. It is a serious environmental concern since it harbors many health hazards.”

“Soil pollution refers to anything that causes contamination of soil and degrades the soil quality. It occurs when the pollutants causing the pollution reduce the quality of the soil and convert the soil inhabitable for microorganisms and macro organisms living in the soil.”

Causes of Soil Pollution:

Soil pollution can be natural or due to human activity. However, it mostly boils down to the activities of the human that causes the majority of soil pollution such as heavy industries, or pesticides in agriculture.

Industrial activities including mining, smelting and manufacturing; domestic, livestock and municipal wastes; pesticides, herbicides, fertilizers used in agriculture; petroleum-derived products that are released into or break-down in the environment; fumes generated by transportation all contribute to the problem. These include pharmaceuticals, endocrine disruptors, hormones and biological pollutants; "e-waste" from old electronics; and the plastics that are nowadays used in almost every human endeavor.

Natural Pollution of Soil:

In some extremely rare processes, some pollutants are naturally accumulated in soils. This can occur due to the differential deposition of soil by the atmosphere. Another manner in which this type of soil pollution can occur is via the transportation of soil pollutants with precipitation water.

Anthropogenic Soil Pollution:

Almost all cases of soil pollution are anthropogenic in nature. A variety of human activities can lead to the contamination of soil.

Pesticides:

Before World War II, the chemical nicotine chemical present in the tobacco plants was used as the pest controlling substance in agricultural practices. However, DDT was found to be extremely useful for malaria control and as pest control of many insects during World War II.

Inorganic Fertilizers:

Excessive use of inorganic nitrogen fertilizers leads to acidification of soil and contaminate the agricultural soil.

Industrial Pollution:

The incorrect way of chemical waste disposal from different types of industries can cause contamination of soil. Human activities like this have led to acidification of soil and contamination due to the disposal of industrial waste, heavy metals, toxic chemicals, dumping oil and fuel, etc.

Heavy Metals:

The presence of heavy metals (such as lead and mercury, in abnormally high concentrations) in soils can cause it to become highly toxic to human beings.

Effects of Soil Pollution:

Soil pollution affects plants, animals and humans alike. While anyone is susceptible to soil pollution, soil pollution effects may vary based on age, general health status and other factors, such as the type of pollutant or contaminant inhaled or ingested. However, children are usually more susceptible to exposure to contaminants, because they come in close contact with the soil by playing in the ground; combined with lower thresholds for disease, (headaches, nausea, and vomiting, coughing, pain in the chest, and wheezing) this triggers higher risks than for adults. Therefore, it is always important to test the soil before allowing your kids to play there, especially if you live in a highly industrialized area.

Control of Soil Pollution:

Several technologies have been developed to tackle soil remediation. Some important strategies followed for the decontamination of polluted soil are listed below.

1. Excavation and subsequent transportation of polluted soils to remote, uninhabited locations.
2. Extraction of pollutants via thermal remediation – the temperature is raised in order to force the contaminants into the vapor phase, after which they can be collected through vapors extraction.
3. Bioremediation or phytoremediation involves the use of microorganisms and plants for the decontamination of soil.
4. Mycoremediation involves the use of fungi for the accumulation of heavy metal contaminants.

Thermal pollution:

Thermal pollution, sometimes called "thermal enrichment," is the degradation of water quality by any process that changes ambient water temperature. A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers. Other causes of thermal pollution include soil erosion.

Cause of Thermal Pollution:

Many human and natural factors contribute to the problem of thermal pollution. The single biggest cause of thermal pollution is probably cooling for industrial machinery and power plants. Water is an excellent, and free, cooling agent. This is why many industrial operations pull in relatively cool water to cool their machinery and let the relatively warm water flow back into the river or lake or sea.

Thermal pollution also has some natural causes. Geothermal vents and hot springs introduce excess heat into bodies of water. Soil erosion, deforestation, and runoff from paved areas are other artificial sources of hot water. Deforestation eliminates shade, which exposes the water to sunlight. Water on hot paved surfaces gets hot, then runs off into nearby bodies of water, raising the water temperature. Retention ponds can also be a source of thermal shock because the relatively small and shallow bodies of water can absorb quite a bit of heat energy from the sun. Pumping that water directly into a river, lake, or bay causes a significant temperature increase, just like pouring a hot pitcher of water into a bathtub full of water causes the water to jump a few degrees Fahrenheit.

Effects of Thermal Pollution:

The effects of thermal pollution are diverse, but in short, thermal pollution damages water ecosystems and reduces animal populations. Plant species, algae, bacteria, and multi-celled animals all respond differently to significant temperature changes. Organisms that cannot adapt can die of various causes or can be forced out of the area. Reproductive problems can further reduce the diversity of life in the polluted area.

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1. Decreased Dissolved Oxygen:

Warm water holds less oxygen than cool water. If the oxygen level drops animals that cannot move to another area may begin to die. In deeper bodies of water, the injection of warm water can keep oxygen from dispersing into deep water, which is potentially good for bacteria but dangerous for aquatic animals. The decreased oxygen can cause algae blooms that pose a threat to aquatic plants and animals. This algae bloom problem is probably the most common and best-known side effect of thermal pollution.

2. Loss of Biodiversity:

The sudden heating can kill off vulnerable organisms or drive them away. This is one of many serious issues for threatened and endangered animal species. This loss can come from organisms dying from the hot water, being unable to reproduce as effectively as before, or simply leaving the area. We usually think of animals as casualties of water pollution, but multi-celled aquatic plants are also at risk when thermal pollution changes the local aquatic ecosystem.

3. Ecological Impacts:

The local aquatic ecosystem can be damaged by thermal pollution, especially if it is dramatic, as in copious amounts of warm water being dumped into a chilly pond or bay or river. “Thermal shock” can kill off insects, fish, and amphibians.

4. Migration:

Fish and amphibians may move away from the warm water to a more-suitable location, disrupting the ecosystem for animals that remain. Birds may also be forced to leave in search of areas with more food.

5. Increased Toxins:

Toxins in the water are more a side effect of dumping waste water than a direct effect of thermal pollution. Chemical pollution is an almost inevitable side effect of using water for cooling. Solvents, fuel oil, and dissolved heavy metals end up in the lake or river where the cooling water gets dumped.

Nuclear hazards and human health risks:

These can be both beneficial and harmful, depending on the way in which they are used. We routinely use X-rays to examine bones for fractures, treat cancer with radiation and diagnose diseases with the help of radioactive isotopes. About 17% of the electrical energy generated in the world comes from nuclear power plants.

Radioactive substances when released into the environment are either dispersed or become concentrated in living organisms through the food chain. Other than naturally occurring radioisotopes, significant amounts are generated by human activity, including the operation of nuclear power plants, the manufacture of nuclear weapons, and atomic bomb testing. For example, strontium 90 behaves like calcium and is easily deposited and replaces calcium in the bone tissues. It could be passed to human beings through ingestion of strontium-contaminated milk. Again another example is tritium, which is radioactive hydrogen. The amount of tritium released from nuclear power plants to the atmosphere have reached as high as tens of thousands of curies in one year, and releases to bodies of water have measured as high as tens of millions of picocuries per litre.

Nuclear accidents impact health:

Apart from the damage caused by fires and explosions, accidents also release radioactive materials which can cause radiation sickness. Radiation exposure above a certain threshold, usually only received by workers and emergency teams in a stricken plant, causes acute radiation syndrome within hours of exposure. Depending on the dose of radiation this ranges from skin rashes, vomiting and diarrhoea, to coma and death.

Radiation damages DNA, especially as it assembles in dividing cells. That means tissues which contain many dividing cells, such as the gut lining, skin and bone marrow, are most at risk of damage. High enough doses also damage brain cells and such doses are invariably fatal.