

Unit 3 Environmental Pollution

Definition

- Pollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings.
- Pollutants include solid, liquid or gaseous substances present in greater than natural abundance produced due to human activity, which have a detrimental effect on our environment.

From an ecological perspective pollutants can be classified as follows:

- Degradable or non-persistent pollutants: These can be rapidly broken down by natural processes. Eg: domestic sewage, discarded vegetables, etc.
- Slowly degradable or persistent pollutants: Pollutants that remain in the environment for many years in an unchanged condition and take decades or longer to degrade. Eg: DDT and most plastics.
- Non-degradable pollutants: These cannot be degraded by natural processes. Once they are released into the environment they are difficult to eradicate and continue to accumulate. Eg: toxic elements like lead or mercury.

Air Pollution

- Air pollution began to increase in the beginning of the twentieth century with the development of the transportation systems and large-scale use of petrol and diesel.
- The Air Pollution Control Act in India was passed in 1981 and the Motor Vehicle Act 1988 (published in 1989)

Types and sources of Air Pollution

- What is air pollution?
- Air pollution occurs due to the presence of undesirable solid or gaseous particles in the air in quantities that are harmful to human health and the environment.
- Air may get polluted by natural causes such as volcanoes, which release ash, dust, sulphur and other gases, or by forest fires that are occasionally naturally caused by lightning. However, unlike pollutants from human activity, naturally occurring pollutants tend to remain in the atmosphere for a short time and do not lead to permanent atmospheric change.

Types and sources of Air Pollution

- Pollutants that are emitted directly from identifiable sources are produced both by natural events (for example, dust storms and volcanic eruptions) and human activities (emission from vehicles, industries, etc.). These are called primary pollutants. There are five primary pollutants that together contribute about 90 percent of the global air pollution. These are carbon oxides (CO and CO₂), nitrogen oxides, sulfur oxides, volatile organic compounds (mostly hydrocarbons) and suspended particulate matter.
- Pollutants that are produced in the atmosphere when certain chemical reactions take place among the primary pollutants are called secondary pollutants. Eg: sulfuric acid, nitric acid, carbonic acid, etc.

Types and sources of Air Pollution

- Carbon monoxide is a colourless, odorless and toxic gas produced when organic materials such as natural gas, coal or wood are incompletely burnt. Vehicular exhausts are the single largest source of carbon monoxide.
- Sulfur oxides are produced when sulfur containing fossil fuels are burnt.
- Nitrogen oxides are found in vehicular exhausts. Nitrogen oxides are significant, as they are involved in the production of secondary air pollutants such as ozone.
- Hydrocarbons are a group of compounds consisting of carbon and hydrogen atoms. They either evaporate from fuel supplies or are remnants of fuel that did not burn completely.
- Hydrocarbons are washed out of the air when it rains and run into surface water.

Types and sources of Air Pollution

- Particulates are small pieces of solid material (for example, smoke particles from fires, bits of asbestos, dust particles and ash from industries) dispersed into the atmosphere.
- Lead is a major air pollutant that remains largely unmonitored and is emitted by vehicles. High lead levels have been reported in the ambient air in metropolitan cities. Leaded petrol is the primary source of airborne lead emissions in Indian cities.

Effects of air pollution on living organisms

- When the upper respiratory system is irritated by pollutants sneezing and coughing expel contaminated air and mucus. Prolonged smoking or exposure to air pollutants can overload or breakdown these natural defenses causing or contributing to diseases such as lung cancer, asthma, chronic bronchitis and emphysema (a disease of the lungs that usually develops after many years of smoking).
- Cigarette smoking is responsible for the greatest exposure to carbon monoxide.
- Sulfur dioxide irritates respiratory tissues.
- Nitrogen oxides especially NO₂ can irritate the lungs, aggravate asthma or chronic bronchitis and also increase susceptibility to respiratory infections such as influenza or common colds.
- When some gaseous pollutants enter leaf pores they damage the leaves of crop plants.
- At a higher concentration of sulphur dioxide majority of the flower buds become stiff and hard.

Effects of air pollution on living organisms

- Air pollutants break down exterior paint on cars and houses. All around the world air pollutants have discoloured irreplaceable monuments, historic buildings, marble statues, etc.

Control measures for air pollution

- Air pollution can be controlled by two fundamental approaches: preventive techniques and effluent control. One of the effective means of controlling air pollution is to have proper equipment in place. This includes devices for removal of pollutants from the flue gases through scrubbers, closed collection recovery systems through which it is possible to collect the pollutants before they escape, use of dry and wet collectors, filters, electrostatic precipitators, etc.

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Air quality monitoring in India

- The Central Pollution Control Board (CPCB) initiated its own national Ambient Air Quality Monitoring (NAAQM) program in 1985.
- Data to the NAAQM is supplied by the respective state pollution control boards, which is then transmitted to the CPCB.

Water Pollution

- When the quality or composition of water changes directly or indirectly as a result of man's activities such that it becomes unfit for any purpose it is said to be polluted.
- **Point sources of pollution:** When a source of pollution can be readily identified because it has a definite source and place where it enters the water it is said to come from a point source. E.g. Municipal and Industrial Discharge Pipes.
- **non-point sources of pollution:** When a source of pollution cannot be readily identified, such as agricultural runoff, acid rain, etc, they are said to be non-point sources of pollution. E.g. agricultural runoff, acid rain,

Causes of water pollution

- disease-causing agents : bacteria, viruses, protozoa and parasitic worms that enter water from domestic sewage and untreated human and animal wastes.
- oxygen depleting wastes: The amount of oxygen required to break down a certain amount of organic matter is called the biological oxygen demand (BOD). The amount of BOD in the water is an indicator of the level of pollution. If too much organic matter is added to the water all the available oxygen is used up. This causes fish and other forms of oxygen dependent aquatic life to die.
- inorganic plant nutrients: These are water soluble nitrates and phosphates that cause excessive growth of algae and other aquatic plants.
- Water soluble inorganic chemicals: acids, salts and compounds of toxic metals such as mercury and lead.
- organic chemicals: oil, gasoline, plastics, pesticides, cleaning solvents, detergent and many other chemicals

Control measures for preventing water pollution

- While the foremost necessity is prevention, setting up effluent treatment plants and treating waste through these can reduce the pollution load in the recipient water.
- A few years ago a new technology called the Root Zone Process has been developed by Thermax. This system involves running contaminated water through the root zones of specially designed reed (grass) beds.

Soil Pollution

- Soil is a thin covering over the land consisting of a mixture of minerals, organic material, living organisms, air and water that together support the growth of plant life. Soils vary in their content of clay (very fine particles), silt (fine particles), sand (medium size particles) and gravel (coarse to very coarse particles).
- Causes of soil degradation: Erosion, Excess use of fertilizers, Problems with pesticide use
- It is better for us to adopt sustainable farming practices so as to prevent the degradation of soil.

Marine pollution

- Marine pollution can be defined as the introduction of substances to the marine environment directly or indirectly by man resulting in adverse effects such as hazards to human health, obstruction of marine activities and lowering the quality of sea water.
- Specific causes that pollute marine waters:
- Very often municipal waste and sewage from residences and hotels in coastal towns are directly discharged into the sea.
- Pesticides and fertilizers from agriculture which are washed off the land by rain, enter water courses and eventually reach the sea.
- Petroleum and oils washed off from the roads normally enter the sewage system but stormwater overflows carry these materials into rivers and eventually into the seas.

Marine pollution

- Ships carry many toxic substances such as oil, liquefied natural gas, pesticides, industrial chemicals, etc. in huge quantities sometimes to the capacity of 350,000 tonnes. Ship accidents and accidental spillages at sea therefore can be very damaging to the marine environment.
- Offshore oil exploration and extraction also pollute the seawater to a large extent.
- Pollution due to organic wastes

Control measures

- One way of reducing the pollution load on marine waters is through the introduction of sewage treatment plants. This will reduce the biological oxygen demand (BOD) of the final product before it is discharged to the receiving waters.

Effects of marine pollution

- When liquid oil is spilled on the sea it spreads over the surface of the water to form a thin film called an oil slick. Oil slicks damage marine life to a large extent.

Noise Pollution

- Noise may not seem as harmful as the contamination of air or water but it is a pollution problem that affects human health and can contribute to a general deterioration of environmental quality. Sound is measured in a unit called the 'Decibel'. There are several sources of noise pollution that contribute to both indoor and outdoor noise pollution. Noise emanating from factories, vehicles, playing of loudspeakers during various festivals can contribute to outdoor noise pollution while loudly played radio or music systems, and other electronic gadgets can contribute to indoor noise pollution. The permitted noise level is 125 decibels, as per the Environment (Protection) (second amendment) Rules, 1999.

Effects of noise pollution

- on physical health:
- physical damage to the ear and the temporary or permanent hearing loss often called a temporary threshold shift (TTS).
- on mental health:
- Noise can also cause emotional or psychological effects such as irritability, anxiety and stress. Lack of concentration and mental fatigue are significant health effects of noise.

Noise Control techniques

- There are four fundamental ways in which noise can be controlled: Reduce noise at the source, block the path of noise, increase the path length and protect the recipient.

Thermal Pollution

- Sources: The discharge of warm water into a river is usually called a thermal pollution. It occurs when an industry removes water from a source, uses the water for cooling purposes and then returns the heated water to its source. Power plants heat water to convert it into steam, to drive the turbines that generate electricity. For efficient functioning of the steam turbines, the steam is condensed into water after it leaves the turbines. This condensation is done by taking water from a water body to absorb the heat. This heated water, which is at least 15C higher than the normal is discharged back into the water body.

Thermal Pollution

- Effects: The warmer temperature decreases the solubility of oxygen and increases the metabolism of fish. This changes the ecological balance of the river. Tropical marine animals are generally unable to withstand a temperature increase of 2 to 3 C and most sponges, mollusks and crustaceans are eliminated at temperatures above 37 C.
- Control measures: Thermal pollution can be controlled by passing the heated water through a cooling pond or a cooling tower after it leaves the condenser. The heat is dissipated into the air and the water can then be discharged into the river or pumped back to the plant for reuse as cooling water. There are several ways in which thermal pollution can be reduced. One method is to construct a large shallow pond. A second method is to use a coolintower. The disadvantage in both these methods is however that large amounts of water are lost by evaporation.

Nuclear Hazards

- Nuclear energy can be both beneficial and harmful depending on the way in which it is used. The radioactive wastes from nuclear energy have caused serious environmental damage.
- Radiation can also cause mutations which are changes in the genetic makeup of the cells. Mutations can occur in the ovaries or the testes leading to the formation of mutated eggs or sperms which in turn can lead to abnormal offspring. Mutations can also occur in the tissues of the body and may manifest themselves as abnormal tissue growths known as cancer. Two common cancers that are linked to increased radiation exposure are leukemia and breast cancer.

Solid waste Management

- The term municipal solid waste (MSW) is generally used to describe most of the non-hazardous solid waste from a city, town or village that requires routine collection and transport to a processing or disposal site. Sources of MSW include private homes, commercial establishments and institutions as well as industrial facilities.
- Municipal solid waste contains a wide variety of materials. It can contain food waste such as vegetable and meat material, left over food, egg shells, etc which is classified as wet garbage as well as paper, plastic, tetrapacks, plastic cans, newspaper, glass bottles, cardboard boxes, aluminum foil, metal items, wood pieces, etc. Which is classified as dry garbage.

Solid waste Management

- Control measures of urban and industrial wastes:
 1. Source reduction
 2. Recycling
 3. Disposal
- Disposal of solid waste is done most commonly through a sanitary landfill or through incineration.
- Hazardous wastes: Wastes are normally classified as hazardous waste when they cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of.

Solid waste Management

- Types of hazardous wastes:
- Toxic wastes are those substances that are poisonous even in very small or trace amounts.
- Reactive wastes are those that have a tendency to react vigorously with air or water, are unstable to shock or heat, generate toxic gases or explode during routine management. For example, gunpowder, nitroglycerine, etc.
- Ignitable wastes are those that burn at relatively low temperatures (less than 60 C) and are capable of spontaneous combustion during storage, transport or disposal. For example, gasoline, paint thinners, and alcohol.
- Corrosive wastes are those that destroy materials and living tissue by chemical reaction. For example, acids and bases.
- Infectious wastes include human tissue from surgery, used bandages and hypodermic needles, microbiological materials, etc.
- Radioactive waste is basically an output from the nuclear power plants and can persist in the environment for thousands of years before it decays appreciably.
- Lead, mercury and arsenic are hazardous substances which are often referred to as heavy metals.

POLLUTION CASE STUDIES

- A case study of groundwater pollution in India
- A case study of pesticide pollution in India
- A case study of river pollution in India

DISASTER MANAGEMENT: FLOODS, EARTHQUAKES, CYCLONES, LANDSLIDES

- Disaster management is a multidisciplinary area in which a wide range of issues that range from forecasting, warning, evacuation, search and rescue, relief, reconstruction and rehabilitation are included. It is also multi-sectoral as it involves administrators, scientists, planners, volunteers and communities.
- These roles and activities span the pre-disaster, during disaster and post disaster plans.
- The main elements of a mitigation strategy are as follows:
 - Risk assessment and Vulnerability analysis
 - Applied research and technology transfer
 - Public awareness and training

DISASTER MANAGEMENT: FLOODS, EARTHQUAKES, CYCLONES, LANDSLIDES

- Institutional mechanisms
- Incentives and resources for mitigation
- Landuse planning and regulations
- Hazard resistant design and construction
- Structural and Constructional reinforcement of existing buildings