B.Sc. Semester – 6

Effects of Air, Water and Soil Pollution on Vegetation

By

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Pollution - Definition

- According to Odum:

- **“Pollution is an undesirable change in the physical, chemical or biological characteristics of air, land and water that is likely to harmfully affect human life and other species including raw material resources”**

Pollutants - Definition

- **Substances added into the atmosphere that affect the normal functioning of the ecosystem and cause pollution**

Eg. Smoke, dust, CO, CO_2, H_2S, detergents, heavy metals, pesticides, weedicides, fungicides, fertilizers, radioactive substances, sewage, etc.

Classification of Pollutants

- **Biodegradable pollutants : that can be decomposed by natural processes**

  eg.: sewage, domestic waste, agriculture residues, cattle dung, etc.

- **Non-biodegradable pollutants : that can not be decomposed by natural processes. Once they contaminate the atmosphere, it becomes almost impossible to remove these.**

  eg. DDT (Dichlorodiphenyltrichloroethane) , BHC (Benzene Hexa Chloride), plastic bottles, polythene bags, soft drink cans, insecticides, pesticides, etc.

Classification of Pollutants

Biodegradable Materials	Non Biodegradable
They get decomposed easily by natural methods	The do not get easily decomposed by natural methods
Example - • Peels of vegetables and fruits - 1 to 2 weeks • **Paper** - 10-30 days • **Cotton cloth** - 2 to 5 Months • **Wood** - 10 to 15 years • **Woolen Clothes** - About a year	**Example** • **Tin, aluminium, and other metal cans** - 100 to 500 years • **Plastic bags** - Several years

Classification of Pollutants

Type of Waste	Approximate Time taken to Degenerate	Nature of Material
Peels of vegetable and fruits, leftover foodstuff, etc.	1 to 2 weeks	Biodegradable
Paper	10 to 30 days	Biodegradable
Cotton cloth	2 to 5 months	Biodegradable
Wood	10 to15 years	Biodegradable
Woollen clothes	About a year	Biodegradable
Tin, aluminium, and other metal cans	100 to 500 years	Non-biodegradable
Plastic bags	Several years	Non-biodegradable

Air Pollution

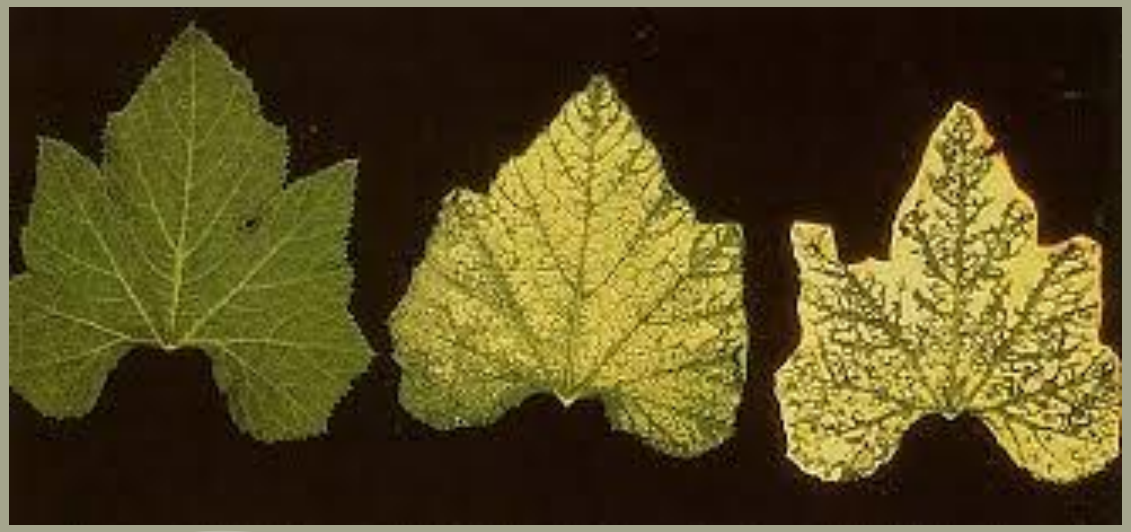
- Any contamination of the atmosphere that causes damage to living organisms and the environment.

- Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere (WHO).

Air Pollution

Effects of Air pollution on vegetation:

- **Chlorosis**: Presence of SO_2 and fluorides in the air causes insufficient production of chlorophyll in leaves – known as chlorosis.

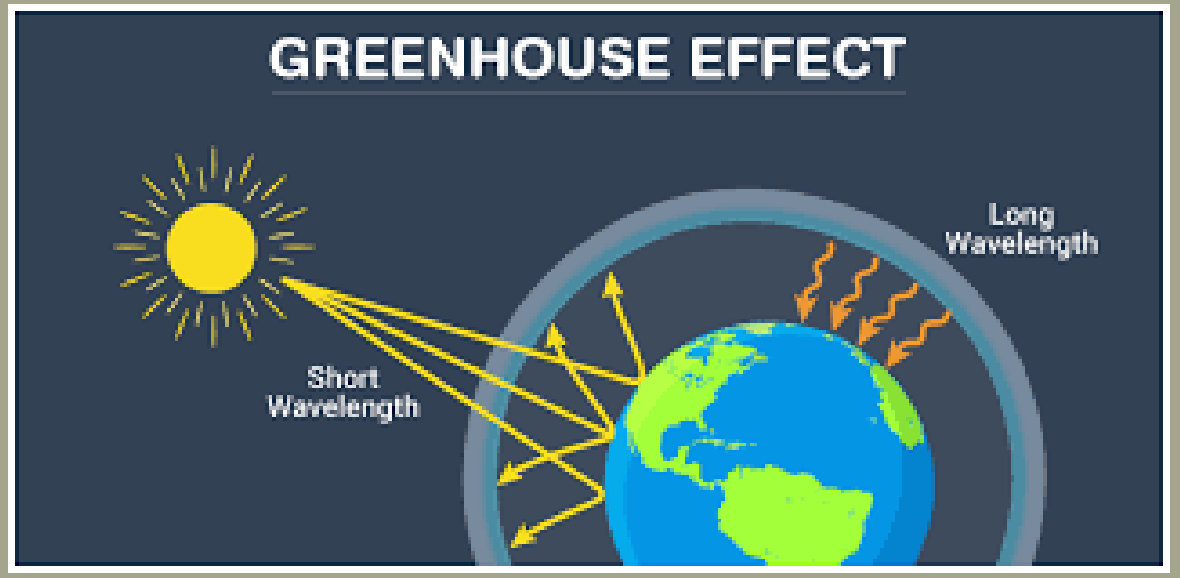


Air Pollution

- **Necrosis** : The breaking down of cells due to the presence of SO_2, NO_2, ozone and fluorides

Air Pollution

- **Greenhouse effect** : Concentration of greenhouse gases like CO_2, CH_4, N_2O and CFCs in the atmosphere increases the temperature of the earth slowly and gradually. These gases absorb infrared radiations but do not allow these radiations to reflect and return back to the earth – the greenhouse effect – thus causing global warming. The rise in temperature will bring about a fall in agricultural produce.



Air Pollution

- The greenhouse effect refers to circumstances where the short wavelengths of visible light from the sun pass through a transparent medium and are absorbed, but the longer wavelengths of the infrared re-radiation from the heated objects are unable to pass through that medium. The trapping of the long wavelength radiation leads to more heating and a higher resultant temperature. Besides the heating of an automobile by sunlight through the windshield and the namesake example of heating the greenhouse by sunlight passing through sealed, transparent windows, the greenhouse effect has been widely used to describe the trapping of excess heat by the rising concentration of carbon dioxide in the atmosphere. The carbon dioxide strongly absorbs infrared and does not allow as much of it to escape into space.

Air Pollution

- **Destruction of crops : Smog** – Combination of smoke and fog causes heavy damage to crops such as leafy vegetables, cereals, textile crops, ornamental plants, fruits and forest trees, resulting in heavy agricultural losses.
- **Depletion of the ozone umbrella :** Freon and chlorofluorocarbons that are being used in aerosol packages and foam plastics, destroy O_3 molecules in the ozone umbrella and pierce holes in it. UV radiations enter the earth through the pierced holes and cause skin cancer and other diseases. Ozone damages plants by entering leaf openings called stomata and oxidizing (burning) plant tissue during respiration.

Air Pollution

- **Acid rains :** In industrial areas a large amount of N_2O (nitrous oxide), NO (nitric oxide) and SO_2 (Sulphur dioxide) is discharged in the air. These gases get absorbed by rain water from the atmosphere and are poured back down on the earth in the form of acid rain.

Acid rain not only destroys vegetation but is injurious to aquatic animals in water bodies such as lakes, ponds, etc.

Air Pollution

- When some gaseous pollutants enter leaf pores they damage the leaves of crop plants.
- Chronic exposure of leaves to air pollutants can breakdown the waxy coating that helps prevent excessive water loss and leads to damage from disease, pests, drought and frost.
- Such exposure interferes with photosynthesis and plant growth, reduces nutrient uptake and causes leaves to turn yellow, brown or drop off altogether.

Air Pollution

- At higher concentration of SO_2 majority of the flower buds become stiff and hard. They eventually fall off from the plans, as they are unable to flower.

- Prolonged exposure to high levels of several air pollutants from smelters (installation for smelting a metal from its ore), coal burning power plants and industrial units as well as from cars and trucks can damage trees and other plants.

Water Pollution - Definition

Any contamination in water bodies such as lakes, rivers, seas, etc., which may harmfully affect humans, domesticated species including organisms that live in water.

Water Pollution - Causes

- **Domestic sewage :** contains human excreta, urine, unclean used water from households, etc. Several pathogenic microbes breed in contaminated water.
- **Industrial effluents :** organic and inorganic waste of industries contain heavy metals such as Hg, Cu, Zn and Pb along with detergents, petroleum, phenols, carbonates, alcohol, cyanides and arsenic.
- **Agriculture :** The use of fertilizers and pesticides such as DDT, BHC, endrin, etc.

Water Pollution - Causes

- **Radioactive waste :** Water currents carry liquid radioactive material released into the sea around most nuclear plants in the world.
- **Marine transports :** Ship accidents and wastage of oils while loading and discharge during marine transports.
- **Coir manufacturing :** Decaying of coconut husk releases H_2S into the water bodies.

Water Pollution

Effects of water pollution on vegetation :

- **Toxic compounds :** involve heavy metals, biocides, fungicides, cyanides, pesticides and other organic and inorganic compounds that are harmful to aquatic life. These toxic compounds are non-biodegradable in nature. DDT, aldrin and dieldrin are toxic compounds that are banned.

Water Pollution

- **Biochemical Oxygen Demand or Biological Oxygen Demand (BOD) : The amount of oxygen required by the micro-organisms in water is known as BOD. It is higher in polluted water (sewage) and lesser in drinking water. The contents of dissolved O_2 in water are lowered with the increase in BOD. It causes suffocation and death of aquatic flora and fauna.**

Water Pollution

- **Red tide:** When coastal water gets dumped with sewage, dinoflagellates multiply rapidly and form blooms. These blooms release a toxic metabolic byproduct that can kill fishes and aquatic plants.
- **Eutrophication :** The water becomes nutrient enriched when sewage and fertilizers are added into the freshwater system, hence phytoplanktons and algae grow well in water. The increased productivity of lakes and ponds brought about by nutrient enrichment is called eutrophication.

Eutrophication also has negative effects

Soil/land Pollution

- **Soil** – topmost layer of the earth, produced by weathering of rocks. It is a mixture of minerals and organic constituents that are in solid, gaseous and aqueous state.

- Harmful changes in soil cause severe irreversible damages to the quality of soil which in turn lead to unwanted changes in soil adversely affecting agricultural activities.

Soil/land Pollution - Causes

- Biocides that remain in the soil for a longer period of time.
- Industries release SO_2 and N_2O into the air. These gases get absorbed by the rainwater and fall on the earth in the form of acid rain.

  They act as pollutant in the soil.
- Domestic waste, sewage and sludge act as major sources of soil pollution in urban areas.

Soil/land Pollution - Causes

- Explosive radioactive substances and waste discharged from industries and laboratories, etc. also enter the soil causing pollution.
- Industrial waste consists of biodegradable and non-biodegradable substances such as metals, toxic substances, paint, plastic, heavy metals, etc.
- Chemicals released into the air such as radioactive substances, sulphur, minerals and lead finally accumulate on the ground and pollute the soil.

Soil/land Pollution - Causes

Effects of soil pollution on vegetation:

- The physical, chemical and biological properties of soil change due to these soil pollutants.
- Fertilizers containing phosphorus and nitrogen are the major cause of eutrophication.
- May alter plant metabolism and reduce crop yields.
- Trees and plants may absorb soil contaminants and pass them up the food chain.

Soil/land Pollution - Causes

- Fluorides combine with Mg^{2+} of chlorophyll and hence inhibit photosynthesis, cause leaf abscission and of fruit.
- Nitrogen fertilizers (nitrates+nitrites) : Toxic concentration in leaves and fruits enters into food chain
- Weedicides : They are usually metabolic inhibitors which stop photosynthesis and other metabolic activities killing the plant. Some causes death due to proliferation of phloem cells to block transport of organic food.

Soil/land Pollution - Causes

- Plants are mostly unable to adapt to the change in the Chemistry of the soil in short time period.
- Fertility of the soil decreases due to soil pollution making it unsuitable for agriculture and local vegetation to survive.
- **pH** : Acidic deposition into the soil can hamper its ability to buffer changes in the soil pH, causing plants to die off due to inhospitable conditions.

Thanks