Environment Sustainability

Ecosystem

What is an Ecosystem?

An Ecosystem is a structural and functional unit of ecology where the living organism interact with each and the surrounding environment. In other words, an ecosystem is a chain of interaction between organism and their environment. The term "Ecosystem" was first coined by A.G. Tansley, an English botanist in 1935.

Read on to explore the structure, components, types and function of the ecosystem in the notes provided below:

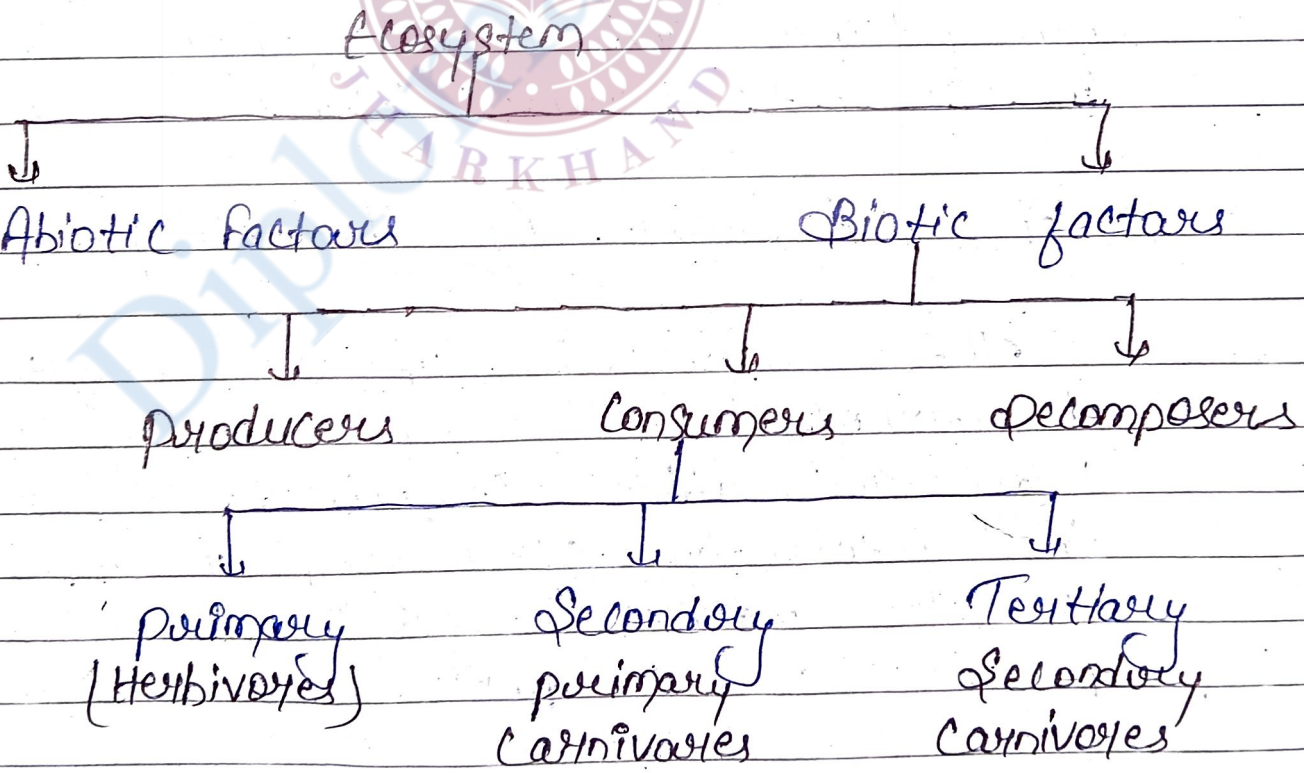
* Structure of the Ecosystem:

The structure of an ecosystem is characterised by the organisation of both biotic and abiotic components. These include the distribution of energy in our environment. It also includes the climatic condition prevailing in that particular environment.

The structure of an ecosystem can be split into two main components, namely:-

- Biotic components.
- Abiotic components.

The biotic and abiotic components are interrelated in an ecosystem. It is an open system where the energy and components can flow throughout the boundaries.



* Biotic Components

Biotic components refer to all living components in an ecosystem. Based on nutrition, biotic components can be categorised into autograph, heterotrophs and saprotrophs (or decomposers).

- producers :-

It includes all autotrophs such as plant. They are called autotrophs as they can produce food through the process of photosynthesis. Consequently, all other organism higher up on the food chain rely on producer for food.

- Consumers

It includes the organism that depend on other organism for food. Consumers are further classified into primary consumers, secondary consumers and tertiary consumers.

- primary consumers :-

primary consumers are always herbivores as they rely on producers for food.

- Secondary Consumers:-

It depends on primary consumers for energy. They can either be carnivores or omnivores.

- Tertiary Consumers:-

The organisms that depend on Secondary Consumers for food. Tertiary Consumer can also be Carnivores or omnivores.

- Quaternary Consumers:-

Quaternary Consumers are present in some food chains. These organism prey on tertiary Consumers for energy. Furthermore, they are usually at the top of food chains as they have no natural predators.

* Decomposers

Decomposers includes saprophytes such as fungi and bacteria. They directly thrive on the dead and decaying organic matter. Decomposer are essential for the ecosystem as they help in recycling nutrient to be needed by plants.

* Abiotic Components

Abiotic components are the non-living component of an ecosystem. It includes air, water, soil, minerals, sunlight, temperature, nutrients, wind, altitude, turbidity etc.

* function of Ecosystem

1. It regulates the essential ecological processes, supports life system and renders stability.
2. It is also responsible for the cycl of nutrients between biotic and abiotic components.
3. It maintains a balance among the vari trophs levels in the ecosystem.
4. It cycles the minerals through the ~~biosphere~~. biosphere.
5. The abiotic components help in the synthesis of organic components that involve the exchange of energy.

So the functional units of an ecosystem are functional component that work together in an ecosystem are:-

- Productivity:-
  It refers to the rate of biomass production.

- Energy flow:- It is the sequential process through which energy flows from one trophic level to another. The energy captured from the sun flows from producers to consumers and then to decomposers and finally back to the environment.

- Decomposition:-
  It is the process of breakdown of dead organic material. The top-soil is the major site for decomposition.

- Nutrient cycling:-
  In an ecosystem nutrient are consumed and recycled back in various forms

Types of Ecosystem

An Ecosystem can be small as an oasis in a desert, or as big as an ocean, spanning thousand of miles. There are two types of ecosystem:-

- Terrestorial Ecosystem
- Aquatic Ecosystem.

* Terrestorial Ecosystem

Terrestorial Ecosystem are exclusively land based ecosystem. There are different types of terrestorial ecosystem distributed around various geological Zones.

They are follows:-

1. Forest Ecosystem
2. Grassland Ecosystem
3. Tundra Ecosystem
4. Desert Ecosystem

- Forest Ecosystem

A Forest Ecosystem consists of several plants particularly trees, animals and microorganism that live in coordination

with the abiotic factors of the environment
- Forests help in maintaining the temperature of the earth and are the major carbon sink.

Grassland Ecosystem
In a grassland ecosystem, the vegetation is dominated by grasses and herbs. Temperate grassland and tropical or Savanna grasslands are examples of grasslands ecosystem.

Tundra ecosystem
Tundra ecosystem are devoid of trees and are found in cold climates or where rainfall is scare
- These are covered with snow for most of the year. Tundra type of ecosystem is found in the arctic or mountain tops.

Desert Ecosystem.
Desert are found throughout the world. These are regions with little rainfall and scare vegetation. The

days are hot and the nights are cold.

* Aquatic Ecosystem

Aquatic ecosystem are ecosystem present in a body of water. These can be further divided into two types, namely :-

1. Freshwater Ecosystem
2. Marine Ecosystem

* Freshwater Ecosystem

The freshwater ecosystem is an aquatic ecosystem that includes lakes, ponds, rivers, stream and wetlands. These have no salt content in contrast with the marine ecosystem.

* Marine Ecosystem

The marine ecosystem includes seas and oceans. These have a more substantial salt content and greater biodiversity in comparision to the freshwater ecosystem.

Global Warming (Cause and effects)

Global warming refers to the long-term increase in earth average surface temperature due to human activities, primarily the emmision of greenhouse gases into the atmosphere. These gases, such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases.

The main cause of global warming include:-

1. Burning fossil fuels:- The combustion of fossil fuels like coal, oil and natural gas for energy production, transportation and industrial process release large amount of CO_2 into the atmosphere.

2. Deforestation:- The clearing of forests for agriculture, urbanisation, and logging reduces the number of trees available to absorb CO_2 through photosynthesis, contributing to higher atmospheric CO_2 level.

3. Industrial process:-

Certain industrial activities release greenhouse gases, such as methane and nitrous oxide.

4. Agricultural practices:-

Livestock farming, rice cultivation, and the use of fertilizers release methane and nitrous oxide.

The effect of global warming are widespread and can have significant impacts on the environment, ecosystem and human societies including.

1. Rising Temperatures:-

Average global temperature have been increasing leading to heatwaves, melting glaciers and ice caps.

2. Extreme weather Events:-

Global warming contributes to more frequent and intense extreme weather events, including hurricanes, droughts, floods, and ~~wildfire~~ wildfire.

3. Sea level Rise:-
melting ice sheets and thermal expansion of seawater result in rising sea levels, threating coastal communities ecosystem, and infrastructure.

4. Ocean Acidification:-
Increased Co2 levels in the atmosphere lead to higher levels of Co2 dissolve in the oceans, causing ocean acidification, which can harm marine life.

Impact on agriculture:-

5. ~~loss of Biodiversity~~:- Changes in temperature and precipation patterns affect agricultural productivity, leading to crop failure food shortage and economic loses.

6. Health Risks:-
Heatwaves air pollution, vector-borne diseases and food and water insecurity. pose health risk to human population, particularly in ~~urban~~ vulnerable regions.

* Green house effect:-

The green house effect is a natural process that ~~Sun heat in the ear~~ occurs where gases trap the sun heat in the earth atmosphere. This process make the earth much warmer to support life.

→ The green house effect is the natural mechanism.

* Ozone depletion

The decrease in concentration of ozone present in statosphere due to some chemicals is called depletion of ozone layer.

Cause of ozone depletion

- Emmision of large quantities of CFC- into the atmosphere from refrigerators, Air conditioners
- NO (nitric oxide) released from jet planes.
- Chlorine gas.

Effects

Due to depletion of ozone layer, the UV rays are coming to earth directly and it causes.

- Skin Cancer
- Damage the eye by the formation of Cataracts.
- It decrease photosynthesis in plants.
- It increase spreading of diseases by bacteria and virus due to damage of Immue system.

Control Measures.

- Don't buy or use aerosal product with cfc
- minimise the use of vehicles.
- use eco-friendly cleaning products.
- Reduce the use of ozone depleting substance.

Unit- 02

Air and pollution

Air pollution

- Air pollution is the presence of harmful substances in the air, such as particulate matter, gases, and chemicals. These pollutants can come from natural source like wildlife and volcanic eruption, as well as human activities such as transportation industry and agriculture.

- Air pollution can have serious effects on human health, including respiratory and cardiovascular diseases and can also harm the environment, leading to issues like acid rain, smog, and climate change.

To reduce air pollution, it's important to use cleaner fuels, improve vehicle emission and promote renewable energy sources.

✳ Natural sources of air pollution.

Natural sources of air pollution include:-

1. Volcanic Eruptions:-

Volcanic eruptions release ash, sulphur dioxide and other gases into the atmosphere, which can contribute to air pollution.

2. Wildfires:-

Natural wildfires can release large amounts of smoke, particulate matter, and other pollutants into the air.

3. Dust and Sandstones:-

Wind can carry dust and sand particles over long distances, creating temporary episode of air pollution.

4. Biogenic Sources:-

Natural process such as the decay of organic matter and emissions from plants, can release

volatile organic compound (VOCs) into the air.

Man made Sources of Air pollution

1. Transportation:- Vehicles especially those running on fossil fuels, emit pollutant like nitrogen oxide (NOx), carbon monoxide (CO) and particulate matter (PM).

2. Industry:-
Factories and power plants emit various pollutant, including sulphur dioxide, nitrogen oxides and particulate matter as well as volatile organic compound.

3. Agriculture:-
Agriculture activities such as the use of fertilizers and pesticides, can release ammonia (NH_3) and other pollutant into air.

4. Burning of fossil fuel:-
Burning coal, oil natural gas for energy production release pollutant such as sulphur dioxide, nitrogen oxides and carbon dioxide (CO_2) into the air.

5. Waste Disposal:—
Open burning of waste material, as well as poorly managed landfills can release pollutant into the air.

* Air pollutant and Types

Air pollutant can be broadly classified into several types:-

1. particulate matter (PM):—
These are the tiny particles suspended in the air, including dust, dirt, soot, and liquid droplet.

2. Nitrogen oxides (NOx):—
These are a group of gases that include nitrogen dioxide (NO_2) and nitric oxide (NO). They are produced during combustion processes.

3. Sulphur dioxide:—
This gas is produced by the burning of fossil fuels that

contain sulphur such as coal and oil.

4. Carbon monoxide (CO):-
This colourless, odourless gas is produce by the incomplete combustion of carbon containing fuels. Co ~~be~~ can be harmful when inhale as it reduced the blood's ability to carry oxygen.

5. Ozone (O3):-
while ozone in the upper atmosphere (stratosphere) is beneficial as it protects us from the sun's ultraviolet rays, ground-level-zone is harmful pollutant.

6. Volatile organic compounds (VOCs):-
These are organic chemicals that easily evaporate into the air. They are emitted by a wide array of products including paints, cleaning agents and fuels.

7. Heavy metals:-
This category includes metals such as lead mercury and arsenic which can be released into the air from various industrial processes and can have toxic effects on human health and environme

* Effect of particulate pollutant and control by cyclone seperatory

Here are the effect of some common pollutant and how a cycle seperatory can help control them:-

1. Particulate matter (PM):-
PM can irritate the respiratory system, worsen asthma, and cause cardiovascular issue. A cyclone seperatory can be used to remove large particle from the air stream.

2. Nitrogen oxide (Nox):-
Nox can contribute to the formation of smog and acid rain, leading to respiratory issues and environmental damage.

3. Sulphur dioxide (So2):- So2 can react in the atmosphere to form particles and contribute to acid rain. Cyclone seperatory can help remove solid particles containing sulphur compounds.

4. Carbon Monoxide (Co):-

Co can reduce the blood ability to carry oxygen, leading to symptom like headache, dizzines and nausea

5. Volatile Organic Compounds (Vocs):-

Vocs can contribute to the formation of ground level ozone and smog, which ca cause respiratory issues.

* Cyclone seperators work by using centrifugal force to separate particles from a gas stream. As the gas stream enters the cyclone, it is forced into a swirling motion, causing the heavier particles to be thrown outward and collected at the wall of the cyclone.

* Effect of particulate pollutant control by electrostatic preciptor.

- particulate matter (PM) pollution can have various health effects, depending on the size and composition of the particles.

An electrostatic preciptor (ESP) is a devi used to control particulate pollution

by charging particles and then collecting them using electrostatic forces.

Here how its works:-

1. Charging:-
The gas stream containing particulate matter enters the ESP, where it passes through a series of high-voltage wires or plates.
These wires or plates are charged with a high voltage, creating a corona discharge.

2. particle charging:-
As the gas stream passes through the charged wires or plates the particles in the gas becomes charged through a process called ionization.
The charged particles then move towards a collection surface, such as plates or tubes, which are oppositely charged.

3. particle collection:-
The charged particles are attracted to and deposited on the

collection surface. Where they accumulate as a layer of dust of can be removed periodically.

4. Clean Gas outlet:—

The cleaned gas with reduced particulate content, exist the ESP through an outlet.

To improve the control of particulate pollution using an electrostatic precipitator you can:—

- Optimize the design and operation of the ESP to maximize particle charging and collection efficiency.

- Ensure proper maintenance and cleaning of the ESP to prevent particle build up and maintain optimal performance.

- Monitor and control the voltage and current settings of the ESP to achieve the desired efficiency while minimizing energy consumption.

* Air (prevention and control of pollution) Act 1981

[29th march, 1981].

An act to provide for the prevention, control and abatement of air pollution, for the establishment with a view to carrying out the aforesaid purposes, of Boards, for conferring on and assigning to such Boards powers and function relating and for matters connected there with.

The air (prevention and control of pollution) Act, 1981 is a significant environmental legislation enacted in India to combat air pollution.
Here's an overview of its key provision and objectives.

1. Objective:-
The primary aim of the Act is to prevent, control and abate air pollution in India by regulating

and monitoring industrial emissions and other sources of air pollution.

2. Regulatory Authority :—
The act establishes the central pollution control Board (CPCB) at the central level and state pollution control Boards (SPCBs) at the state level to enforce the provision of the Act and oversee pollution control measure.

3. pollution control measures :—
The act empowers the central and state pollution control boards to prescribe standard for emissions from industries, automobiles, and other sources of air pollution. It set limit on the release pollutant such as sulphur dioxide (SO_2), nitrogen oxides (NOx), particulate matter (PM) and volatile organic compound. (VOC)

4. monitoring and Enforcement :—
The CPCB and SPCBs are responsible for monitoring air quality, conducting inspections and enforcing compliance with pollution control standards.

5. pollution control Zones:-

The Act provides for the declaration of air pollution control areas where stricter regulations may be enforced to mitigate pollution levels.

6. public participation.

The act encourages public participation in pollution control effect by allowing individual and organisation to file complaints, petitions and legal actions against polluters.

7. Penalties and offenses:-

It prescribe penalties for noncompliance with pollution control measure, including fines and imprisonment for offenders.

8. Amendments:-

over the years, the act has been amended to strengthen pollution control measure and address emerging environmental challanges.

The Air (prevention and Control of pollution) Act 1981, along with other environmental laws and regulations, plays a crucial role in safeguarding public health, promoting sustainable development, and protecting the environment from the adverse effect of air pollution in India.