ENVIRONMENTAL GEOGRAPHY -18MAG14E

Syllabus, Unit – II: Ecosystem: Concepts - Structure – Classification – Functions – Biomes and types – Food Chain - Food Web – Food Pyramid – Nutrient Cycle – Natural disruptions of the Ecosystem – Human interferences: Population growth and its impact - Biodiversity

The term ecosystem was first used by A.G. Tansley in 1935. Ecosystem vary greatly in size and elements but each is a functioning unit of nature. Everything that lives in an ecosystem is dependent on the other species and elements that are also part of that ecological community. For thousands of years, people have interacted with ecosystems. Many cultures developed around nearby ecosystems. The whole surface of Earth is a series of connected ecosystems. If one part of an ecosystem is damaged or disappears, it has an impact on everything else.

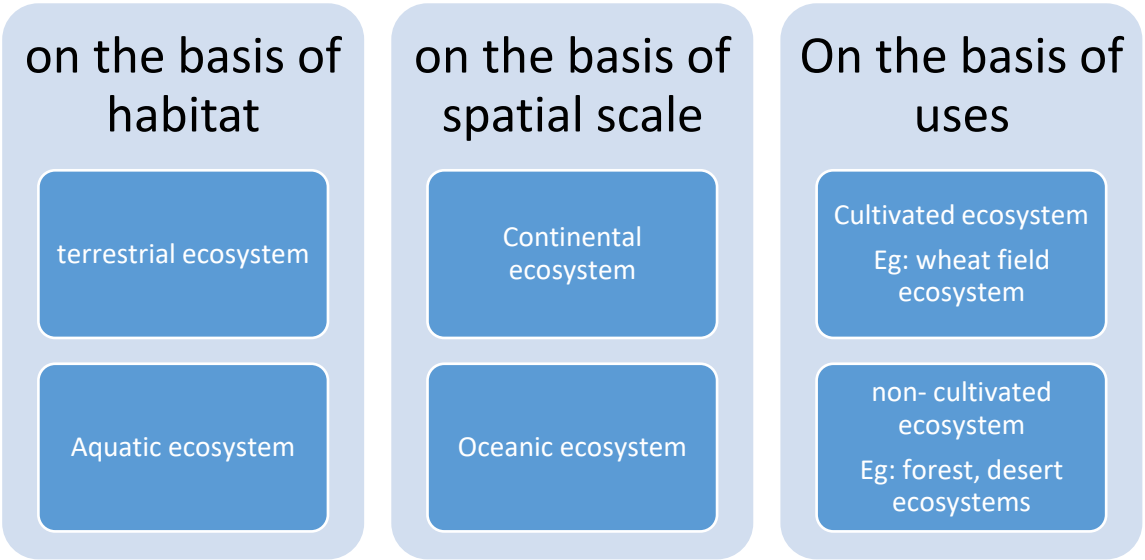
Ecosystem: Concept

- An ecosystem is defined as a structural and functional unit of biosphere.
- It consists of community of living beings and physical environment, both interacting and exchanging materials between them.
- It includes plants, animals, micro-organisms, water, soil, and people.

Ecosystem: Definitions

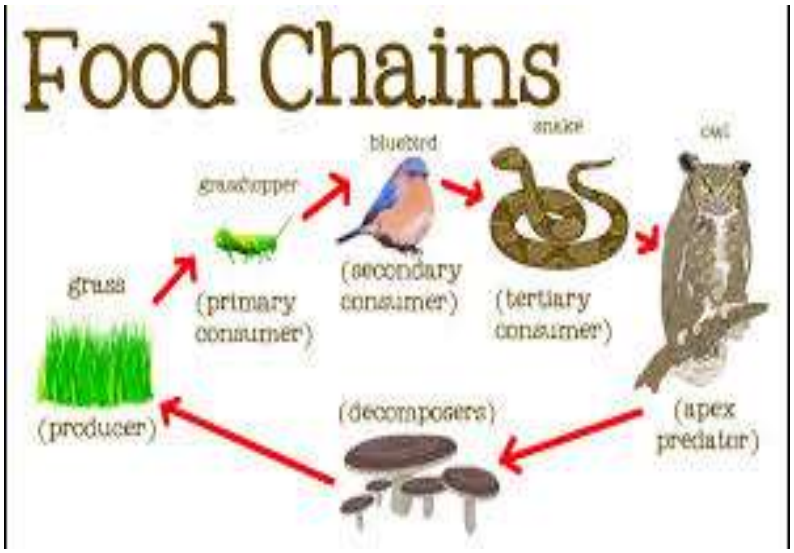
- A.G. Tansley: Ecosystem is a particular category of physical systems, consisting of organisms and inorganic components in a relatively stable equilibrium, open and of various sizes and kinds.
- F.R. Forsberg: Ecosystem is a functioning, interacting system composed of one or more living organisms and their effective environment, both physical and biological.
- R.L. Linderman: Ecosystem applies to any system composed of physical-chemical-biological processes, within a space- time unit of magnitude.
- A.N. Strahler and A.H. Strahler: the total assemblage of components interacting with a group of organisms is known as ecosystem.

TYPES OF ECOSYSTEM



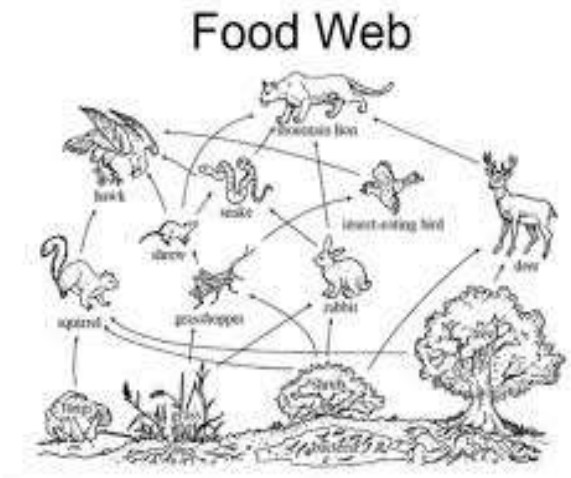
Food Chain

A food chain refers to the order of events in an ecosystem, where one living organism eats another organism, and later that organism is consumed by another larger organism. The flow of nutrients and energy from one organism to another at different trophic levels forms a food chain. The food chain also explains the feeding pattern or relationship between living organisms. Trophic level refers to the sequential stages in a food chain, starting with producers at the bottom, followed by primary, secondary and tertiary consumers. Every level in a food chain is known as a trophic level.



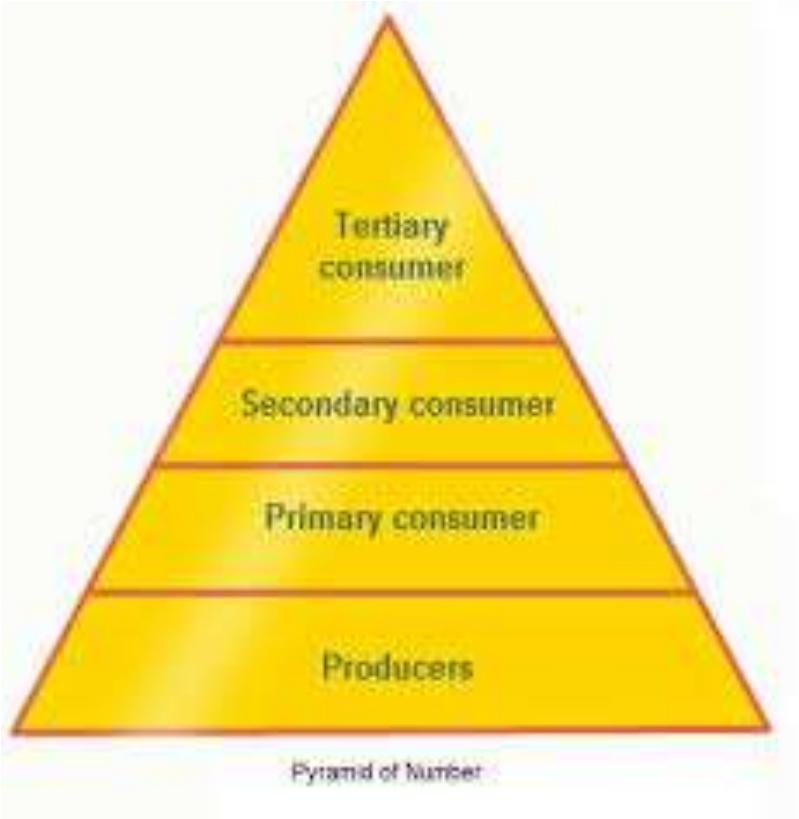
Food web

Several interconnected food chains form a food web. A food web is similar to a food chain but the food web is comparatively larger than a food chain. Occasionally, a single organism is consumed by many predators or it consumes several other organisms. Due to this, many trophic levels get interconnected, and the food chain fails to showcase the flow of energy in the right way. But the food web is able to show the proper representation of energy flow, as it displays the interactions between different organisms. When there are more cross interactions between different food chains, the food web gets more complex. This complexity in a food web leads to a more sustainable ecosystem.



Ecological pyramid

An ecological pyramid is a graphical representation of the relationship between different organisms in an ecosystem. Each of the bars that make up the pyramid represents a different trophic level, and their order, which is based on who eats whom, represents the flow of energy.

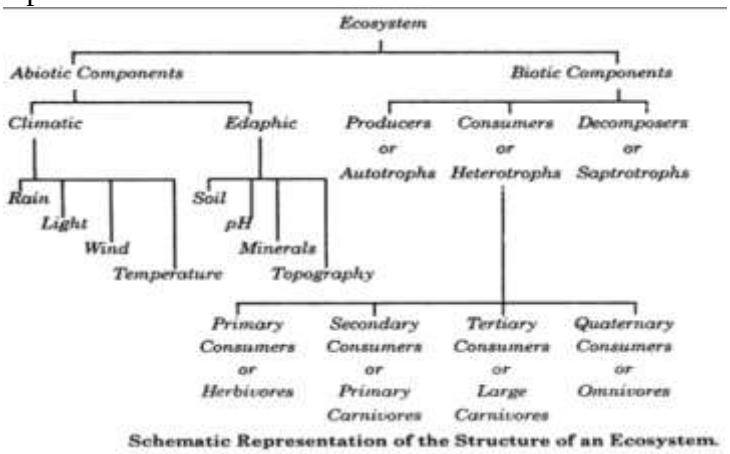


Structure of Ecosystem

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

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

- Biotic Components
- Abiotic Components



Schematic Representation of the Structure of an Ecosystem.

Abiotic Components:

Abiotic components are the inorganic and non-living parts which act as major limiting factors.

Light

- The spectral quality of solar radiation is important for life.
- The UV component of the spectrum is harmful to many organisms

Rainfall

- Majority of biochemical reactions take place in an aqueous medium.

Temperature

- A few organisms can tolerate and thrive in a wide range of temperatures (they are called eurythermal).
- A vast majority of them are restricted to a narrow range of temperatures (stenothermal).

Atmosphere

- 21% oxygen helps in the survival of many organisms; 78% nitrogen prevents spontaneous combustion and 0.038% carbon dioxide helps primary producers in the synthesis of carbohydrates

Organic compounds

- Proteins, carbohydrates, lipids etc. are essential for energy transfer in the living world.

Inorganic compound

- Carbon, carbon dioxide, water, sulphur, nitrates, phosphates, and ions of various metals are essential for organisms to survive.

Altitude

- Vertical zonation of vegetation is caused due to altitude.
- Change in temperature with altitude is a limiting factor.

Buffering capacity of the earth

- A neutral pH (pH of 7) is maintained in the soil and water bodies due to the buffering capacity of earth.
- The neutral pH is conducive for the survival and sustenance of living organisms.

Salinity

- Some organisms are tolerant of a wide range of salinities (euryhaline).
- Others are restricted to a narrow range of salinities (stenohaline).

Biotic Components

Primary producers or Autotrophs (self-nourishing)

- Primary producers are green plants, certain bacteria and algae that carry out photosynthesis.
- In the aquatic ecosystem, microscopic algae (plankton) are the primary producers.

Consumers or Heterotrophs or Phagotrophs (other nourishing)

- Consumers are incapable of producing their own food.
- They depend on organic food derived from plants, animals or both.
- Consumers can be divided into two broad groups namely micro and macro consumers.

Macro consumers

- Herbivores are primary consumers which feed mainly on plants. E.g. sheep, rabbit, etc.
- Secondary consumers feed on primary consumers. E.g. wolves, dogs, snake, etc.
- Carnivores which feed on both primary and secondary consumers are called tertiary consumers. E.g. lion (can eat wolves), snakes etc.
- Omnivores are organisms which consume both plants and animals. E.g. man, bear, pig, etc.

Micro consumers or Saprotrophs (decomposers or osmotrophs)

- They are bacteria and fungi which obtain energy and nutrients from dead organic substances (detritus).
- Earthworm and certain soil organisms (such as nematodes, and arthropods) are detritus feeders and help in the decomposition of organic matter and are called detrivores.

Every factor in an ecosystem depends on every other factor, either directly or indirectly. A change in the temperature of an ecosystem will often affect what plants will grow there, for instance. Animals that depend on plants for food and shelter will have to adapt to the changes, move to another ecosystem, or perish. As human populations have grown, however, people have overtaken many ecosystems. Ecosystems can recover from destruction, however. Individual people, cultures, and governments are working to preserve ecosystems that are important to them. The so-called Rights of Nature says Nature or *Pachamama* [Earth], where life is reproduced and exists, has the right to exist, persist, maintain and regenerate its vital cycles, structure, functions and its processes in evolution.

ECOSYSTEM

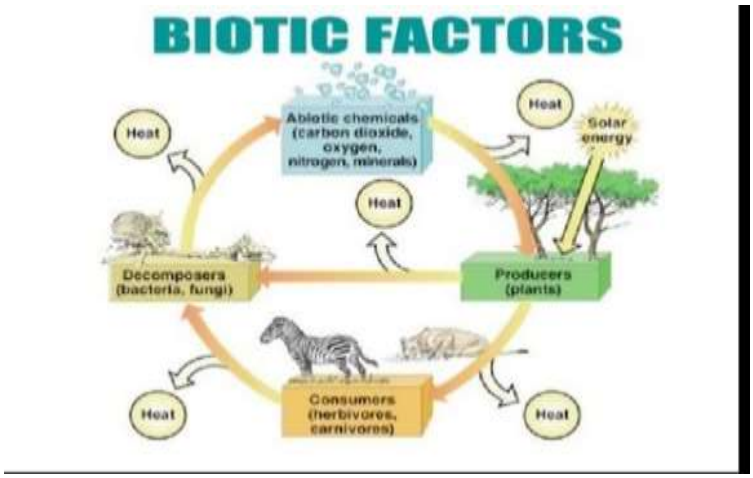
Large community of living organisms in a particular area is called ecosystem .They area complex interacting system of living and non-living components and their physical environment acting as an ecological unit .The concept of ecosystem was postulated by A.G.TANSLEY in 1935.Ecosystem consist of biotic and abiotic components.

COMPONENTS OF ECOSYSTEM

All ecosystem consist of BIOTIC AND ABIOTIC COMPONENTS.

Biotic Components :

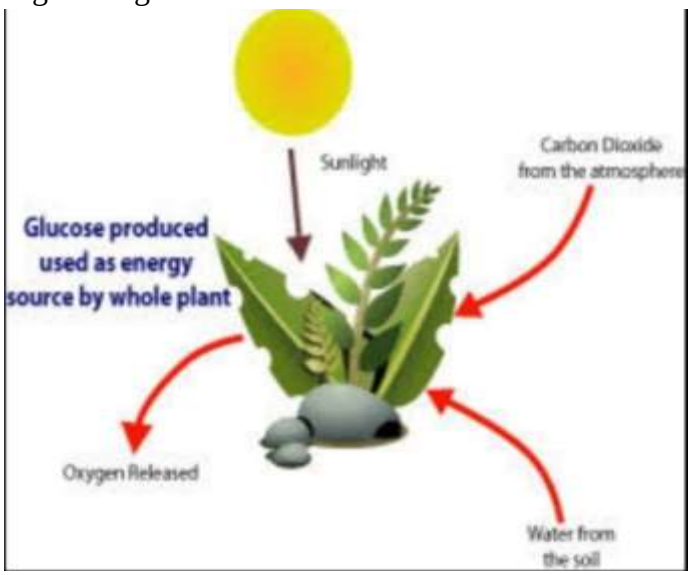
The biotic components include all living organisms present in the environmental systems .



The biotic components are:

I. Producers

They are also called autotrophs .they are organisms which manufacture their own food from inorganic substances with the help of solar energy.
Eg: green plants, blue green algae etc.



II Consumers

They are also called hetrotrophs .those living members of ecosystems which consume the food produced by producers are called consumers .

Eg : all animals. there are different classes of consumers such as

- ❖ Primary consumers:

These are purely herbivorous animals that are depend for their food on producers

Eg: insects, rabbit, deer etc.

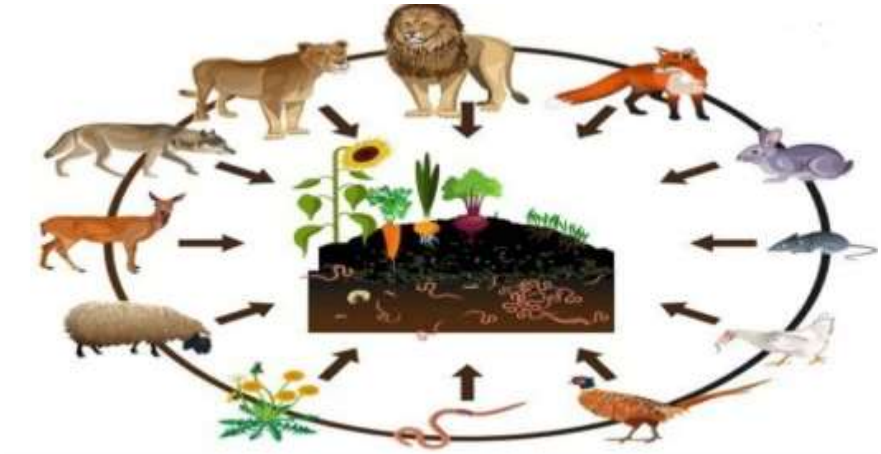
- ❖ Secondary consumers:

These are carnivores which feed on herbivores .

Eg: fox, dogs, cats etc.

- ❖ Tertiary consumers: These are the top carnivores which prey upon other carnivores , omnivores and herbivores.

Eg :lion ,tiger ,hawk etc.



III Decomposers:

They are organisms that decompose are dead plant and animal tissues and absorb the products of decomposition.

Eg: bacteria and fungi.

2. ABIOTIC COMPONENTS

The non-living organisms called abiotic components.
Eg: soil, water, air etc.

Classification of *ecosystem*

Ecosystem have been classified into two types; Natural Ecosystem And Artificial Ecosystem.

Natural Ecosystem
The natural ecosystem is classified into two: Aquatic and Terrestrial ecosystem.

a. **Aquatic ecosystem**: they are operated on the aquatic habitats. on the basis of salt content in water aquatic ecosystem are divided into two:

- Fresh water ecosystem -pond, lake, river are fresh water ecosystem.
- Marine water ecosystem-oceans, estuaries are salt water ecosystem.

b. **Terrestrial ecosystem**: they are found only on landforms .

- Forest ecosystem-it consist not only living components [trees, animals plants] but also non-living components [soil, water air].coniferous trees, hardwood trees etc are seen.
  Eg : lichens , various mosses etc, are plants and animals like coyotes , deer etc.
- Grassland ecosystem-it is an area where the vegetation is dominated by grasses and other plants.
  Eg: temperate grassland, savana grassland etc.
- Desert ecosystem: study of interactions between both biotic and abiotic components of desert environment. E.g.: cacti, acacia euphorbia are common desert plants,camel wood rat etc. are desert animals.

Artificial ecosystem

It is a human made system of plants, animals and people living in an area together with their surroundings.
Eg: garden,zoo etc.

Functions of Ecosystem

- Exchange of energy that take place in various plants and animal communities.
- All living beings interacting and influencing each other and the environment surrounding them.
- Ecological succession or development.
- Helps to keep the components parts running together.
- Decomposers carry out the function of breaking down complex organic materials into simple inorganic product which can be used by producers.
- Helps to maintain and development of ecosystem.

Biome

Biome, also called major life zone, the largest geographic biotic unit, a major community of plants and animals with similar life forms and environmental conditions. It includes various communities and is named for the dominant type of vegetation, such as grassland or coniferous forest. Several similar biomes constitute a biome type—for example, the temperate deciduous forest biome type includes the deciduous forest biomes of Asia, Europe, and North America. “Major life zone” is the European phrase for the North American biome concept.

Biome Types

World biomes are divided variously on differ end bases like climate, vegetation, soil-water condition, heat, growth form of plants. Basically worked-biomes are divided into the following two broad categories on the basis of the nature of the habitats

- Land biomes, and
- Aquatic biomes.

Land Biomes

On the Basis of Climate and Vegetation Though there is variation in the evolutionary stages of plants and animals over lands and in aquatic environments but on an average there is close relationship between the world distributional patterns of plants and animals and the present climatic types of the world. Thus based on relationships between the distributional patterns of plants and animals and world climates the world biomes have been divided into the following 3 broad categories

- Tundra biome,
- Temperate biome, and
- Tropical biome.

Since the vegetation is the most dominant component of the biomes and the vegetation and climates are very intimately related and hence the world is divided into different biome types on the basis of major world climates and vegetation types. Thus biomes are divided into second order and third order biomes on the basis of vegetation types and characteristics as shown in table

Biomes of the First Order (based on climatic zones)	Biomes of the Second Order (based on vegetation)	Biomes of the Third Order (based on vegetation)

1. TUNDRA BIOME	(¡)Arctic Tundra Biome (ii) Alpine Tundra Biome	
2. TEMPERATE BIOMB	(i)Boreal Forest Biome (Taiga Forest Biome) (ii) Temperate Deciduous Forest Biome (iii) Temperate Grassland Biome iv) Mediterranean Biome (v)Warm Temperate Biome	(a) North American Biome (b)-Asiatic Biome (c) Mountain Forest Biome (a) North American Biome (b) European Biome (a) Eurasian Steppe Biome (b) North American Prairie Biome (c) Pampa Biome (d) Australian Grassland Biome (a) Northern Hemispheric Biome (b) Southern Hemispheric Biome
3. TROPICAL BIOME	(i) Tropical Forest Biome (ii) Savanna Biome (ii) Desert Biome	(a) Evergreen Rainforest Biome (b) Semi-evergreen Forest Biome (c) Deciduous Forest Biome (d) Semi-deciduos Forest Biome () Montane Forest Biome () Swamp Forest Biome (a) Savanna Forest Biome (b) Savanna Grassland Biome (a) Dry or arid Desert Biome (b) Semi-arid Biome

On the Basis of Soll-Water and Heat Aallablity a rowin of Plants

The land biomes are determined and divided into the following 3 major types and 13 sub-tyeps:

(A) Optimum land biome

Those land biomes become optimum biomes which are characterized by constant supply of soil water and neat throughout ten year and the plants grow in all seasons of the year.

(1) **Tropical evergreen rainforest biome** represents the equatorial forest zones which are warm and wet throughout the year because of vertical sun's rays all year round and daily rainfall. There is water surplus throughout the year and the vegetation grows constantly in all seasons of the year

(B) Biomes with seasonal climates

There are at least two seasons in a year when there is marked variation in temperature and humidity. At least one season 1s characterized by deficiency in either heat or humidity. There are seven types of biomes under this major class of biomes with seasonal climates as follows

(2) Monsoon forest biome includes the open forest of tropical areas. One season is cool and dry while the other is warm and moist. There is deficiency of moisture during dry season and hence the plants shed their leaves at the end of winter season to conserve moisture. Thus the trees of this biome are deciduous in character.

(3) Temperate deciduous forest biome represents broadleaf deciduous forests of middle latitudes or of temperate regions. Plants shed their leaves during winter season. There is surplus so1l water in this biome because of lesser evaporation due to relatively lower temperature than the tropical monsoon deciduous forest biome.

(4) Coniferous forest biome includes coniferous trees of the temperate climatic zones of high 1atitudes.These are evergreen forests. Winters are 1ong and exceptionally cold and therefore there is deficiency of heat during cold months.

(5) Mediterranean forest biome represents the evergreen forests having stiff and hard leaves(sclerophyll forest) and very hard barks. Summers arc dry but winters are wet. Thus there is deficiency of soil-water during dry summer months but the plants have been endowed with several typical characteristics to cope with dry summer months.

(6) Savanna biome is, in fact, tropical grassland having scattered trees, characterized by tropical climate with long dry season and short, wet monsoon season.

(7) Tall-grass prairie biome represents the region of mid-latitudes having dense and tall grasses and herbs and sub-humid climate.

(8) Short-grass steppe biome represents the steppe region of the Eurasia which is characterized by short and sparse grasses of semiarid plains of mid-latitudes and moderate soil-water deficit.

(C) Biomes with permanent deficiency In heatand/or water

On the basis of permanent deficiency in heat and or water world biomes are divided into the Following 5 sub-types:

[1] Semi-arid biome,
[2] Warm arid biome,
[3] Temperate arid biome,
[4] Arctic tundra biome, and
[5] Alpine mountainous tundra biome.

Aquatic Biomes

Aquatic biomes are divided into 3 major categories and 8 sub-types as follows:

Warm water biome

Continental shelf biome

A continental shelf is a portion of a continent that is submerged under an area of relatively shallow water known as a shelf sea. Much of these shelves has been exposed during glacial periods and interglacial periods. The shelf surrounding an island is known as an insular shelf.

Open sea biome

The open ocean biome is the largest of all the biomes and consists of many different ecosystems. Seaweed is the main plant found in the open ocean biome, but there are also hundreds of plant-like organisms known as algae. Ninety percent of marine life lives in the upper zone of the ocean that receives sunlight.

Cold water biome

Upwelling water biome

Temperate Upwelling regions are continental margins characterized by the consistent welling up of nutrient rich bottom waters to the surface. These regions are remarkably productive and are associated with large fisheries and correspondingly large populations of seabirds.

Continental shelf biome

A continental shelf is a portion of a continent that is submerged under an area of relatively shallow water known as a shelf sea. Much of these shelves has been exposed during glacial periods and interglacial periods. The shelf surrounding an island is known as an insular shelf

Open ocean biome

Fresh water biome

Riverine biome (river biome)

Freshwater biomes include lakes and ponds(standing water) as well as rivers and streams (flowing water). They also include wetlands. Humans rely on freshwater biomes to provide aquatic resources for drinking water, crop irrigation, sanitation, and industry.

Lacustrine biome (lake biome)

It is naturally occurring water on Earths surface. The water of ice sheets, ice caps, glaciers, icebergs, bogs, ponds, lakes, rivers and streams, and groundwater are freshwater because these water bodies characterised by having a low concentration of salt and other dissolved solids.

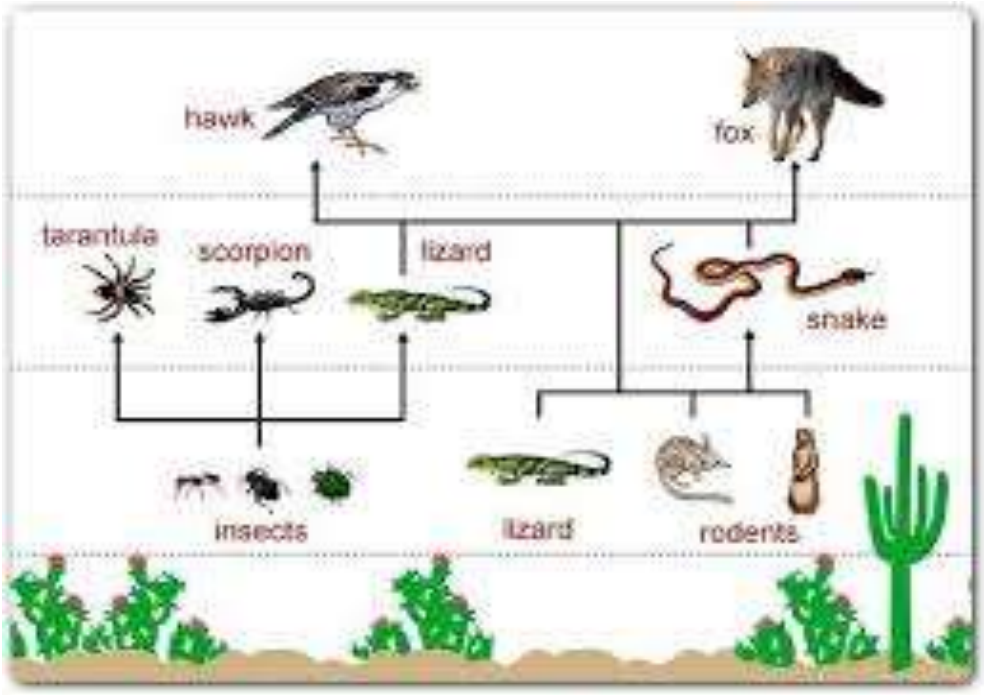
Pond biome

A fresh water biome is defined as water with a salt concentration below 1 percent.... Major freshwater biomes include ponds, lakes streams, wetlands, and rivers.

Food chain and Food web

Food chain:

Food chain, in ecology, the sequence of transfers of matter and energy in the form of food from organism to organism. A food chain shows the feeding relationships for a single chain of producers and consumers.



A food chain is a linear network of links in a food web starting from producer organisms (such as grass or trees which use radiation from the Sun to make their food) and ending at apex predator species (like grizzly bears or killer whales), detritivores (like earthworms or woodlice), or decomposer species (such as fungi or bacteria). A food chain also shows how the organisms are related with each other by the food they eat. Each level of a food chain represents a different tropic level. A food chain differs from a food web, because the complex network of different animals' feeding relations are aggregated and the chain only follows a direct, linear pathway of one animal at a time. Natural interconnections between food chains make it a food web.

Types of Consumers:

Different types of consumers have different food sources.

- Herbivores: such as the rabbit above, are organisms that eat only plants.
- Carnivores: such as the hawk above, are organisms that eat only animals.
- Omnivores: are organisms that eat both plants and animals. Most humans are omnivores.
- Detritivores: are organisms that eat dead plant and animal matter. Earthworms, for example, are detritivores.

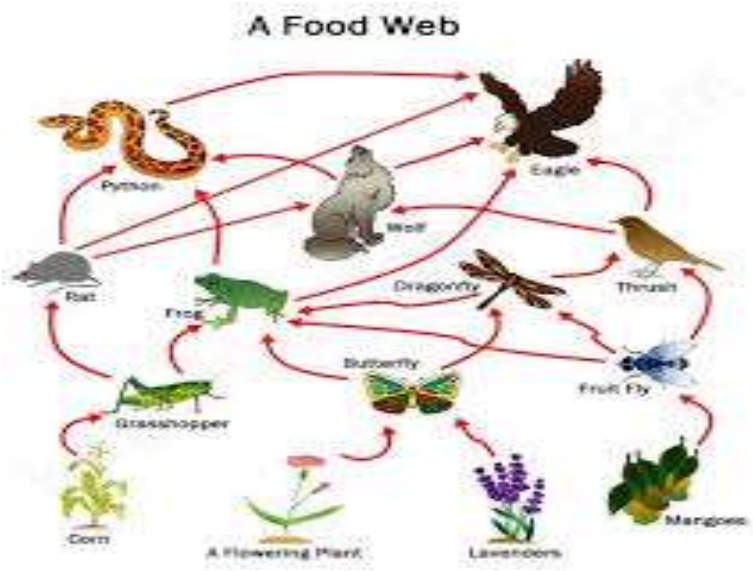
- Decomposers: are detritivores that break down plant and animal matter into simpler compounds. Fungi, for example, are decomposers. Decomposers return nutrients to the ecosystem.

a food chain as a level of feeding, or a tropic level. Energy flows up the food chain from the lowest tropic level to the highest. Producers are the first, or bottom, trophic level. The next tropic level is made of primary consumers—herbivores that eat producers. The next tropic level is made of secondary consumers—carnivores that eat herbivores.

Continuing up the food chain, tertiary consumers are carnivores that eat secondary consumers. Omnivores, such as most humans, can be listed at different trophic levels in different food chains. A person is at the level of primary consumer when eating vegetables. A person is at the level of secondary consumer when eating beef or chicken.

Food web:

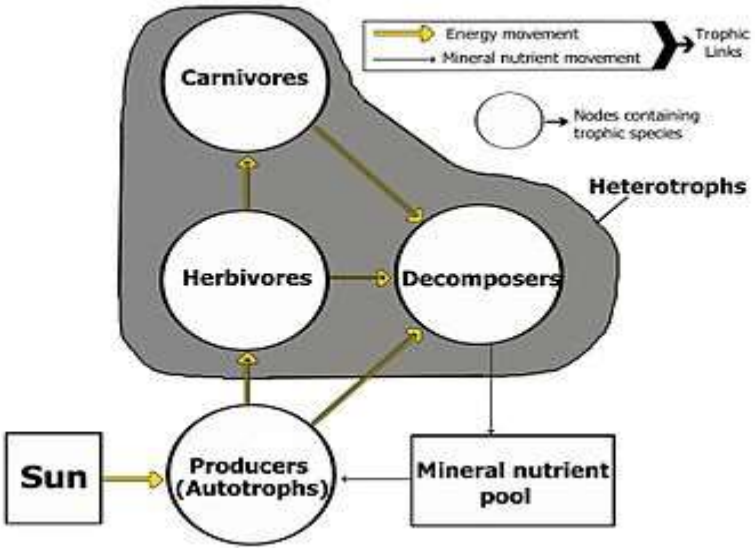
A food chain shows a simple sequence of feeding relationships. But most feeding relationships are not very simple. This complex network of feeding relationships and the related flow of energy can be represented by a food web.



A food web (or food cycle) is the natural interconnection of food chains and a graphical representation of what-eats-what in an ecological community. Another name for food web is consumer-resource system. Ecologists can broadly lump all life forms into one of two categories called tropic levels:

1) The autotrophs, and
2) The heterotrophs.

To maintain their bodies, grow, develop, and to reproduce, autotrophs produce organic matter from inorganic substances, including both minerals and gases such as carbon dioxide. These chemical reactions require energy, which mainly comes from the Sun and largely by photosynthesis, although a very small amount comes from bio electrogenesis in wetlands, and mineral electron donors in hydrothermal vents and hot springs.

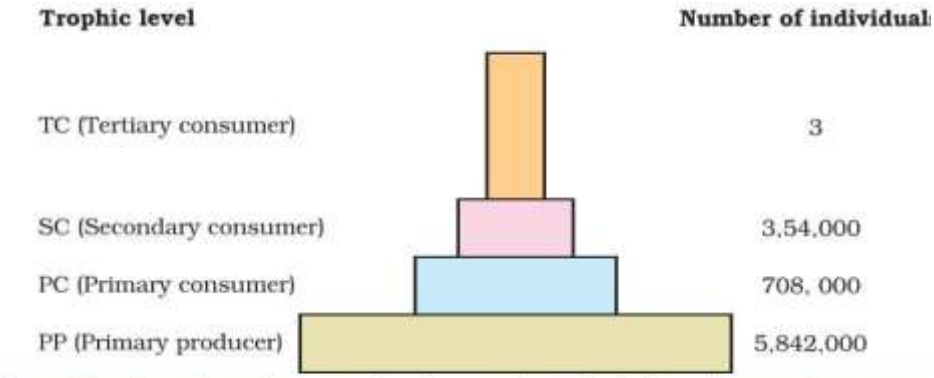


Ecological Pyramids

- The pyramidal representation of trophic levels of different organisms based on their ecological position (producer to final consumer) is called as an ecological pyramid.
- The pyramid consists of a number of horizontal bars depicting specific trophic levels. The length of each bar represents the total number of individuals or biomass or energy at each trophic level in an ecosystem.
- The food producer forms the base of the pyramid and the top carnivore forms the tip. Other consumer trophic levels are in between.
- The ecological pyramids are of three categories:

1. Pyramid of numbers,
2. Pyramid of biomass, and
3. Pyramid of energy or productivity.

Pyramid of Numbers



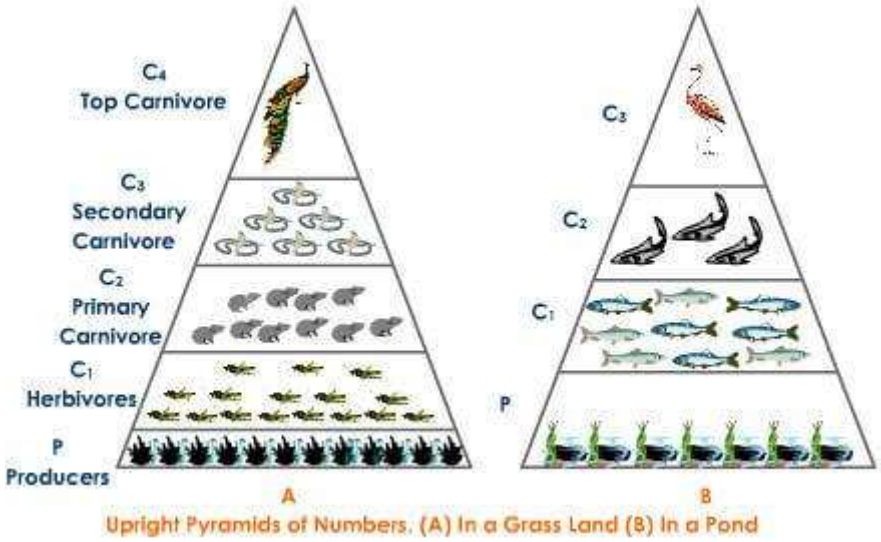
Pyramid of numbers in a grassland ecosystem. Only three top-carnivores are supported in an ecosystem based on production of nearly 6 millions plants

- Pyramid of numbers represents the total number of individuals of different species (population) at each trophic level.

- Depending upon the size, the pyramid of numbers may not always be upright, and may even be completely inverted.
- It is very difficult to count all the organisms, in a pyramid of numbers and so the pyramid of number does not completely define the trophic structure for an ecosystem.

Pyramid of numbers – upright

- In this pyramid, the number of individuals is decreased from lower level to higher trophic level.

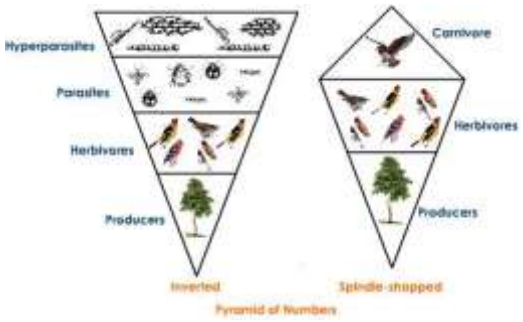


Upright Pyramids of Numbers. (A) In a Grass Land (B) In a Pond

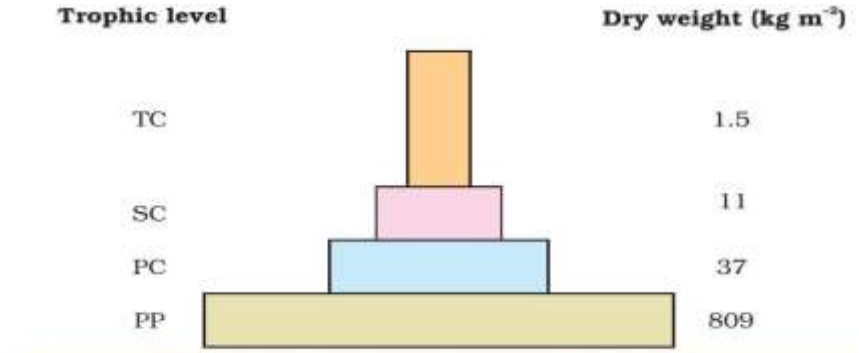
- This type of pyramid can be seen in the grassland ecosystem and pond ecosystem.
- The grasses occupy the lowest trophic level (base) because of their abundance.
- The next higher trophic level is primary consumer – herbivores like a grasshopper.
- The individual number of grasshoppers is less than that of grass.
- The next energy level is a primary carnivore like rats.
- The number of rats is less than grasshoppers, because, they feed on grasshoppers.
- The next higher trophic level is secondary carnivore like snakes. They feed on rats.
- The next higher trophic level is the top carnivore like Hawk.
- With each higher trophic level, the number of individual decreases.

Pyramid of numbers – inverted

- In this pyramid, the number of individuals is increased from lower level to higher trophic level. E.g. Tree ecosystem.



Pyramid of Biomass

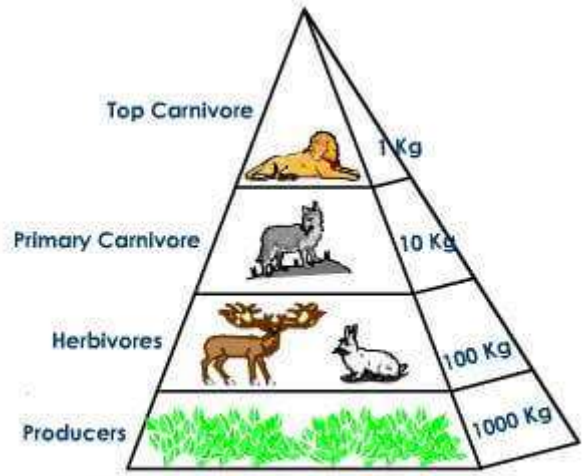


Pyramid of biomass shows a sharp decrease in biomass at higher trophic levels

- Pyramid of biomass is usually determined by collecting all organisms occupying each trophic level separately and measuring their dry weight.
- This overcomes the size difference problem because all kinds of organisms at a trophic level are weighed.
- Each trophic level has a certain mass of living material at a particular time called the standing crop.
- The standing crop is measured as the mass of living organisms (biomass) or the number in a unit area.

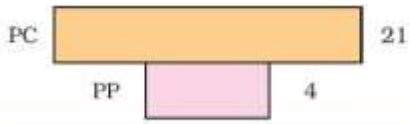
Pyramid of Biomass – upright

- For most ecosystems on land, the pyramid of biomass has a large base of primary producers with a smaller trophic level perched on top.
- The biomass of producers (autotrophs) is at the maximum. The biomass of next trophic level i.e. primary consumers is less than the producers. The biomass of next higher trophic level i.e. secondary consumers is less than the primary consumers. The top, high trophic level has very less amount of biomass.



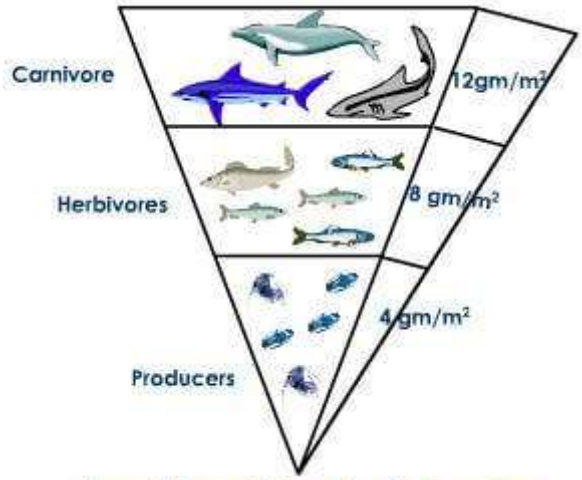
Upright Pyramid of biomass in a Terrestrial Ecosystem

Pyramid of Biomass – Inverted



Inverted pyramid of biomass-small standing crop of phytoplankton supports large standing crop of zooplankton

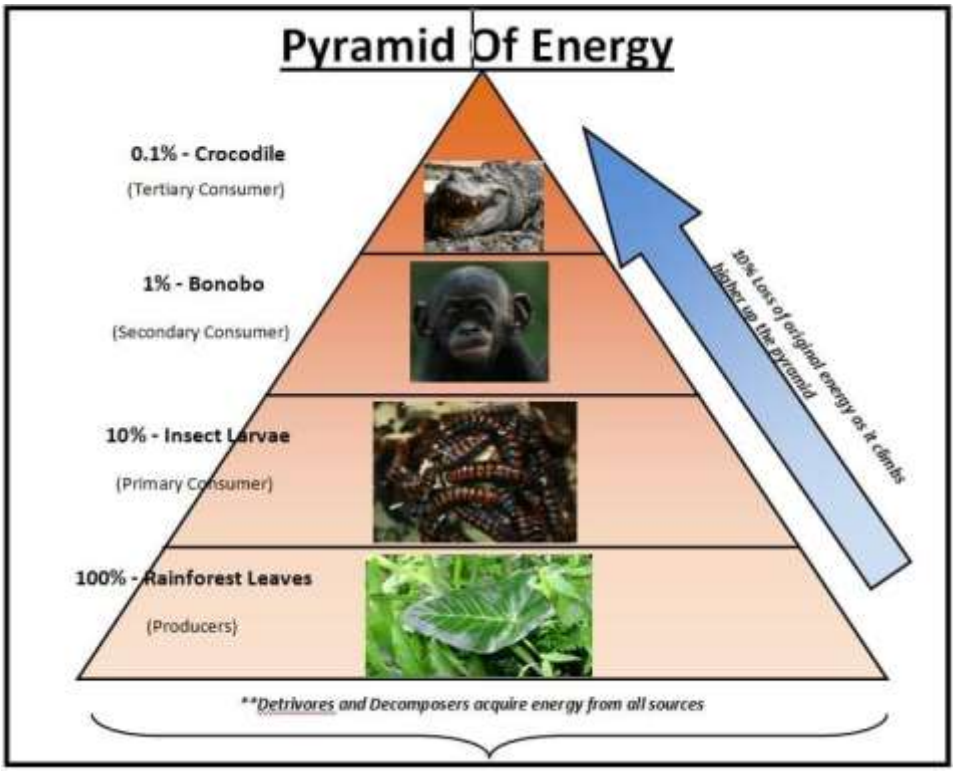
- In contrast, in many aquatic ecosystems, the pyramid of biomass may assume an inverted form. (In contrast, a pyramid of numbers for the aquatic ecosystem is upright)
- This is because the producers are tiny phytoplankton that grows and reproduces rapidly.
- Here, the pyramid of biomass has a small base, with the consumer biomass at any instant exceeding the producer biomass and the pyramid assumes an inverted shape.



Inverted Pyramid in an Aquatic Ecosystem

Pyramid of Energy

- To compare the functional roles of the trophic levels in an ecosystem, an energy pyramid is most suitable.
- An energy pyramid represents the amount of energy at each trophic level and loss of energy at each transfer to another trophic level. Hence the pyramid is always upward, with a large energy base at the bottom.



- Suppose an ecosystem receives 1000 calories of light energy in a given day. Most of the energy is not absorbed; some is reflected to space; of the energy absorbed only a small portion is utilized by green plants, out of which the plant uses up some for respiration and of the 1000 calories; therefore only 100 calories are stored as energy-rich materials.
- Now suppose an animal, say a deer, eats the plant containing 100 calories of food energy. The deer use some of it for its metabolism and stores only 10 calories as food energy. A lion that eats the deer gets an even smaller amount of energy. Thus, usable energy decreases from sunlight to producer to herbivore to carnivore. Therefore, the energy pyramid will always be upright.
- Energy pyramid concept helps to explain the phenomenon of biological magnification – the tendency for toxic substances to increase in concentration progressively with higher trophic levels.

Nutrient Cycle Definition

- A nutrient cycle is defined as the cyclic pathway by which nutrients pass-through, in order to be recycled and reutilised. The pathway comprises cells, organisms, community and ecosystem.
- In the process, nutrients get absorbed, transferred, released and reabsorbed. It is a natural recycling system of mineral nutrients.
- Nutrients consumed by plants and animals are returned to the environment after death and decomposition and the cycle continues.
- Soil microbes play an important role in nutrient recycling. They decompose organic matter to release nutrients. They are also important to trap and transform nutrients into the soil, which can be taken up by plant roots.
- Nutrient cycling rate depends on various biotic, physical and chemical factors.
- Example of nutrient cycles: carbon cycle, nitrogen cycle, water cycle, oxygen cycle, etc.

Energy Flow and Nutrient Cycle

- The energy flow refers to the transfer of energy from one trophic level to another in the food chain and food web. It is unidirectional and energy is lost from one trophic level to another in the form of heat. Sunlight is the ultimate energy source.
- Nutrient cycling is a cyclic process that encompasses the movement of nutrients from the physical environment to living organisms and back to the environment. Nutrients are present on the earth where they are recycled, transformed into different forms and reutilized.

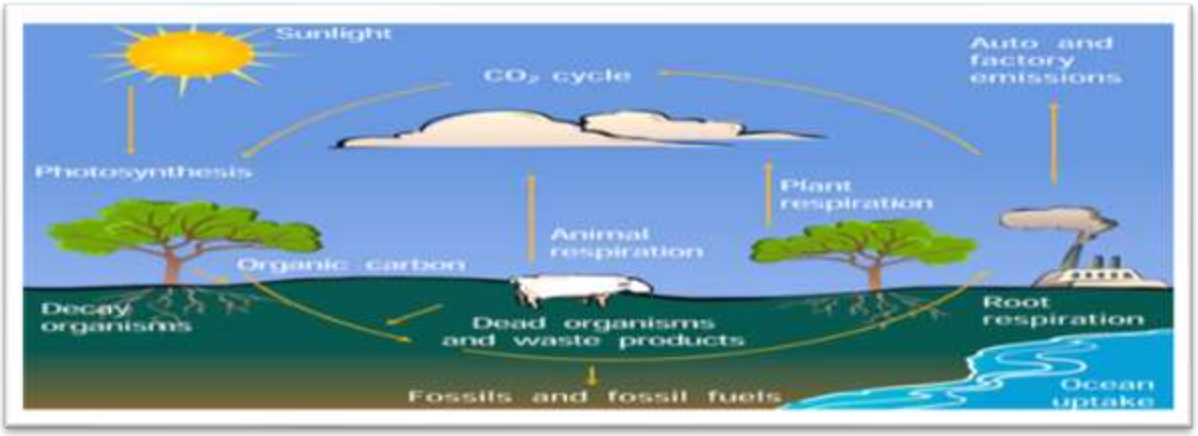
Nutrient Cycles Examples

- Nutrient recycling involves both biotic and abiotic components. The main abiotic components are air, water, soil.
- Recycling of Carbon, Hydrogen, Nitrogen and Oxygen occurs in water, air and soil, whereas calcium, phosphorus, potassium, etc. are recycled mainly in soil and are available locally.

The 4 main nutrient cycles are:

1.Carbon Cycle

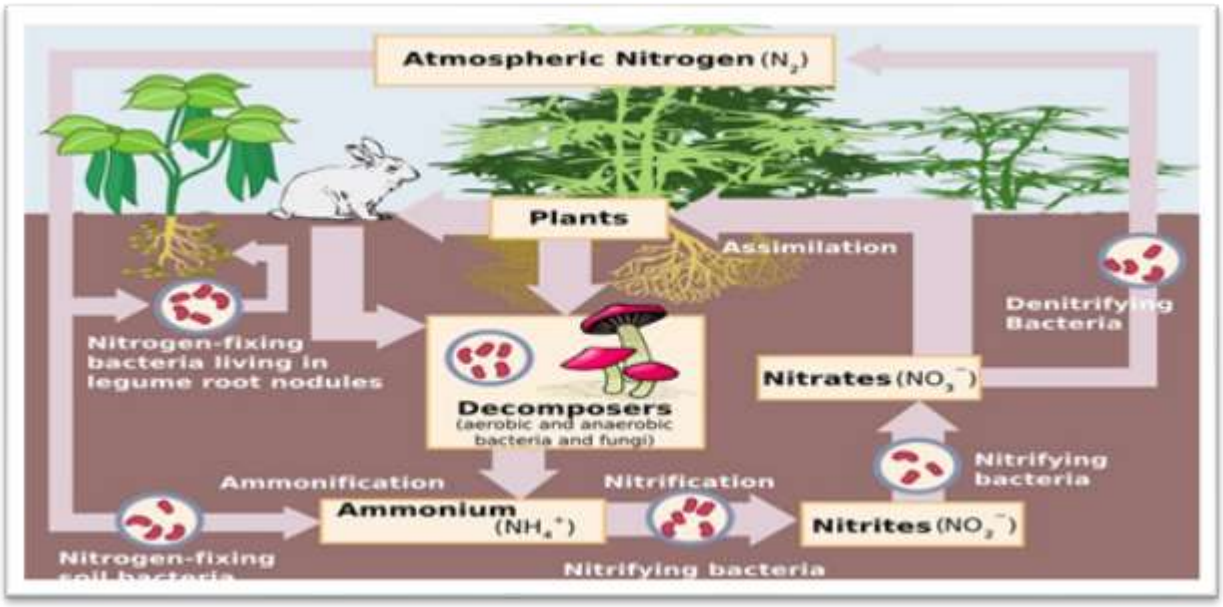
Carbon is the main constituent of all the living cells. All the organic matter and biomolecules contain carbon.



- Carbon is present mainly as carbon dioxide and methane in the atmosphere
- There is a continuous exchange of carbon between biotic and abiotic components by the process of photosynthesis and respiration
- Atmospheric carbon dioxide is fixed by plants in the process of photosynthesis
- All the living organisms release carbon dioxide during respiration
- Carbon is released into the atmosphere by burning of fossil fuels and auto emissions
- Organic carbon from dead and decaying organisms and waste products is released into the atmosphere after decomposition

2. Nitrogen Cycle

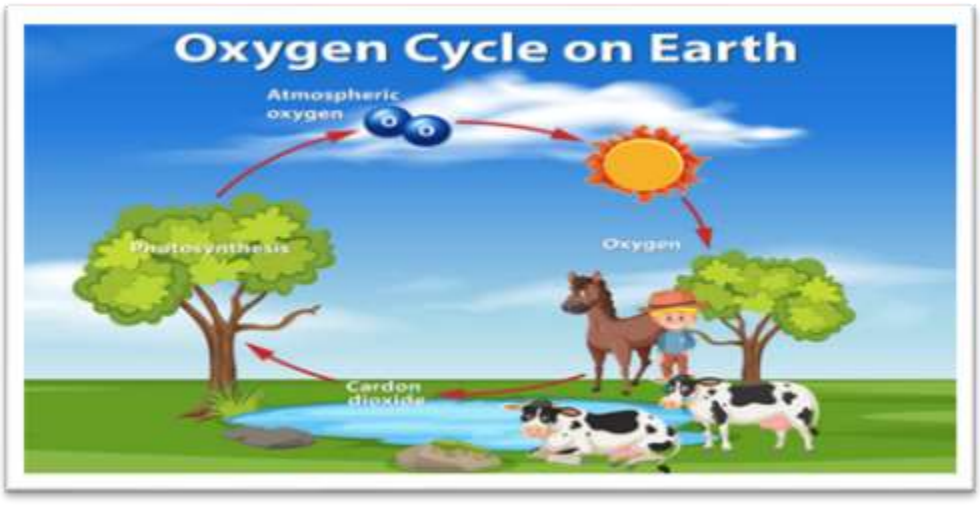
Nitrogen is also an essential component of life. Nitrogen cannot be directly utilised by living organisms and has to be converted to other forms.



- By the process of nitrogen fixation, nitrogen-fixing bacteria fix atmospheric nitrogen to ammonia and nitrifying bacteria convert ammonia to nitrate. It is then taken up by plants
- Atmospheric nitrogen is converted to nitrates directly by lightning and assimilated by plants
- Decomposers break down proteins and amino acids of dead and decaying organic matters and waste product
- Denitrifying bacteria convert ammonia and nitrates to nitrogen and nitrous oxide by the process of denitrification. In this way, nitrogen is released back into the atmosphere

3. Oxygen Cycle

Oxygen is essential for life. Aquatic organisms are dependent on oxygen dissolved in water. Oxygen is required for decomposition of biodegradable waste products.



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- Photosynthesis is the main source of oxygen present in the atmosphere
- Atmospheric oxygen is taken up by living organisms in the process of respiration and release carbon dioxide which is used for photosynthesis by plants

4. Hydrologic or Water Cycle

Water is an essential element for life to exist on earth.

- Water from oceans, lakes, rivers and other reservoirs is continuously converted to vapour by the process of evaporation and transpiration from the surface of plants
- Water vapours get condensed and return by precipitation and the cycle continues
- The water falling on the ground is absorbed and stored as groundwater

Importance of Nutrient Cycling

All living organisms, biomolecules and cells are made up of carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorus. These elements are essential for life. It is important to recycle and continuously replenish nutrients into the environment for life to exist.

Nutrient cycling is important for:

- It is required for the transformation of nutrients from one form to another so that it can be readily utilised by different organisms, e.g. plants cannot take atmospheric nitrogen and it has to be fixed and converted to ammonium and nitrate for uptake.
- Transfer of nutrients from one place to another for utilisation, e.g. air to soil or water
- Nutrient cycles keep the ecosystem in equilibrium and help in storing nutrients for future uptake
- Through nutrient cycling, living organisms interact with the abiotic components of their surroundings

Human Disruption of The Ecosystem

- Ecosystem is a community of organisms that interact with each other and their environment.
- Ecosystems change over time. Sudden disruptions such as volcanoes, floods, or fires can affect which species will thrive in an environment. Other disruptions are caused by human activities.
- Some disruptions can be devastating for an individual species and may even cause an entire species to permanently disappear in a process called extinction.
- . As species become extinct, the variety of species in the biosphere decreases, which decreases biodiversity, or the variety of life.
- Every organism plays an important role in the ecosystem to which it belongs. Whenever one species is removed, other species in the food chain are affected. These changes influence a community's biodiversity and can disrupt an entire ecosystem.
- Natural disruptions have causes, such as weather, geological forces, or biological changes, also caused by diseases , storms ,insects, volcanic activity, earthquakes, droughts ,and long term freezing etc..

Balance in an Ecosystem

- An **ecosystem** consists of the living and non-living things that interact with one another in a particular location.
- Example, the fish and plants both live in the water, plants provide oxygen for the fish and rocks provide them with shelter, and the fish nibble at the plants and prevent overgrowth.
- All of the elements of the ecosystem you have created are in harmony. When this type of stability exists in an ecosystem, we call it a **balanced ecosystem**

Major natural disruptions are:

Wildfires

- Fire is a common disruption to ecosystems that can be caused by nature or by human behavior. Natural wildfires can both help and harm an ecosystem.
- Example, wildfires kill many small animals and displace others that flee to safety. Animals looking to return after the fire will find their homes and much of their food supply destroyed. Also, bare soil that remains after a wildfire is particularly susceptible to soil erosion because the soil is no longer held in place by roots.

Flooding

- Flooding can occur after a storm and may be disruptive to an ecosystem, depending on the extent of the flooding and how long the water stays.
- Flooding can result in saturated soils, or soils that are filled with water. Plant roots require oxygen, so saturated soils can kill plants by drowning the plant roots. Flooding may also cause water and nutrients to run off across land surfaces.
- Rushing water can cause soil to wash away, particularly bare soil. Burrows, dens, and nests can be destroyed, forcing surviving animals to relocate.

- Some ecosystems, called flood plains, are made up of species that have adapted to occasional flooding. Flood plains are flat areas along rivers that flood when the river rises above its banks. The flooding deposits nutrient rich sediment along stream banks. Adaptations of flood-plain species allow them to thrive in their ecosystem.

Volcanic Eruptions

- On 4 November, 2020, thermal changes under Barren island contributed to a tremendous volcanic eruption.
- The north face of the mountain slid away in avalanche, rock-filled gas, smoke that ripped up the trees in its path. Subsequently, slower flows of gas and rock destroyed trees and living organisms in the soil.
- Mature forests were turned into ash covered wasteland. The plants attract herbivores that drop seeds from other plants in their dung.
- The steady progression of species change and replacement in an ecosystem over time, as occurred after the eruption in Barren Island, is called ecological succession.

Human Effects on Ecosystems

- Humans impact the natural world more than any other species. Without limits on human activity, humans can damage the environment in many ways.
- As the human population grows, it requires more resources to keep its members healthy and comfortable.
- Each new family needs a place to live, food, water, clothing, medicine, and tools.

HUMAN DISRUPTIONS

Habitat destruction occurs when a habitat is removed and replaced with some other type of habitat.

- No matter how careful the plan, land used to grow crops or build houses is no longer suitable for some of the organisms that once lived there. As a result, the organisms living at the site must move or be destroyed.
- Habitat destruction is the most important reason species are threatened with extinction today. Habitat destruction can have harmful effects on humans, too.

1. Habitat destruction (urbanization, mini, deforestation)
2. Invasive species (kudzu)
3. Pollution (water, air, soil, noise, light)
4. Population (more people need more resources)
5. Climate changes (overuse of fossils fuels)
6. Overexploitation (overfishing, overhunting)
7. Habitat Destruction

Introduced Species

- Wherever humans go, they take animals, plants, and microorganisms with them. Tulips-as well as most crop plants and many other highly-valued garden plants - are not native to the India but rather are introduced species.

- Introduced species are an important part of the economy and of society. Some introduced species, however, can be disruptive to an ecosystem. An introduced species that has negative effects in its new ecosystem is called an invasive species.
- Invasive species can have serious effects on an ecosystem and on the human population. For example, tea and coffee plantations in hilly areas like NILGIRI hill ranges and Western Ghats etc…

Overhunting

- Throughout history, humans have hunted or kill animals for several reasons. They obtained food and necessary materials from animals and eliminated competition for crops and prey.
- They protected livestock by trapping or hunting animals such as wolves. Many species were driven to extinction by hunting thousands of years ago.
- As the human population grew, more and more species of animals were threatened with extinction from overhunting.
- Laws were passed to limit hunting and to ban the killing of endangered species. Nevertheless, poaching, or illegal hunting, continues to threaten many populations.

Pollution and Environmental Change

- The human population has grown exponentially over the last few centuries. This population growth was a result of increasing resources and new technology to feed and provide for the growing population.
- Human activities cause pollution-the release of harmful substances into the environment-including air pollution, water pollution, and the production of hazardous waste. Air pollution in the form of carbon dioxide has contributed to global warming.
- One effect of today's heavy use of fossil fuels-including coal, oil, and gas-is air pollution. Air pollution includes noxious compounds and particulate matter. Air pollution can result in respiratory trouble and other human sickness.

Human Population Growth

- Sources of water pollution include the runoff of fertilizer from lawns and agricultural fields, as well as runoff from oil and other urban pollutants.
- Water pollution is also caused by oil spills, in addition to smoke from power plants. Fertilizers introduce excess nutrients and result in major changes in water ecosystems, including changing the pH of the water, causing algae blooms, and reducing the oxygen in the water.
- Rainwater can wash all pollutants on Earth's surface into rivers, lakes, and the ocean. Oil spills kill animals and can affect several different food webs.
- Air pollution can lead to water pollution by causing acid rain that can damage-and even kill-living things. Water pollution can also occur when people do not properly dispose of toxic household or industrial materials.

Global Climate Change

Earth's climate has changed over geological time for many reasons.

a. Changes in orbit and earth's rotation
b. Solar energy
c. Greenhouses gases

- Climate change can involve global warming, a slow rise in Earth's average temperature.
- While global temperatures have changed over time, most scientists agree that the release of carbon dioxide into the air from the burning of fossil fuels contributes to this rise in temperature.
- An increasing rise in temperatures could affect ecosystems around the globe.
- For example, rising temperatures can speed up the melting of glaciers and ice caps disrupting or destroying habitats along shorelines as waters rise.
- Climate change can also affect precipitation patterns resulting in droughts or floods. Climate change can also alter ecosystems as populations unable to survive warmer temperatures migrate to cooler regions

BIODIVERSITY

Biodiversity describes the richness and variety of life on earth. It is the most complex and important feature of our planet. Without biodiversity, life would not sustain.

The term biodiversity was coined in 1985. It is important in natural as well as artificial ecosystems. It deals with nature's variety, the biosphere. It refers to variabilities among plants, animals and microorganism species.

Biodiversity includes the number of different organisms and their relative frequencies in an ecosystem. It also reflects the organization of organisms at different levels.

Biodiversity holds ecological and economic significance. It provides us with nourishment, housing, fuel, clothing and several other resources. It also extracts monetary benefits through tourism. Therefore, it is very important to have a good knowledge of biodiversity for a sustainable livelihood.

Types of Biodiversity

There are the following three different types of biodiversity:

- Genetic Biodiversity
- Species Biodiversity
- Ecological Biodiversity

Subject Name: Environmental Geography
Subject Code : 18MAG14E
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