

# EVS

Nature → Organisms

→ Environment

Reciprocal relation b/w organisms & environment

→ Ecology

The word 'ecology' was introduced by Ernest Haeckel. It was derived from two German words, Oikos (place to live) and Logos (study).

Environment .

→ Environment is the sum of all social, economical, biological, physical or chemical factors which constitute the surroundings of man who is both creator and moulder of his environment.

→ Refers to the sum total of conditions which surrounded man at a given point in space and time .

Microclimate .

→ Climate of a small region .

## Weather And Climate

- The weather refers to the short term properties of atmosphere (temperature, pressure, humidity, rainfall, sunshine, cloud cover, wind etc) at a given place and time.
- The average weather of an area including general patterns of atmospheric conditions, seasonal variations and weather extremes over a long period of time.

## Climatic Zones

1. Tropical region ( $0\text{--}20^\circ$  latitude)
2. Sub-tropical region ( $20\text{--}40^\circ$  latitude)
3. Temperate region ( $40\text{--}60^\circ$  latitude)
4. Arctic & Antarctic region ( $60\text{--}80^\circ$  latitude)

## Types of Environment

### 1. Natural

- Environment that came into existence without human interference

→ It operates through homeostatic mechanism  
(self regulating)

## 2. Manmade (Anthropogenic)

### Environment Ethics

1. Protection of renewable natural resources
2. Conservation of non-renewable resources
3. Optimum resource use by nations
4. Avoid consumerism
5. Adopt sustainability as a way of life
6. Joining environment and economics to eradicate poverty
7. Link environment with peace and security

### Components of Environment

- Biotic
  - Producers → Consumers → Decomposers
- Abiotic
  - Climatic factors

→ Temperature, Water, light, Humidity, Wind, Mineral.

- Edaphic Factors .

→ Soil, substratum .

## Natural Resources

Inexhaustible	Exhaustible
<ul style="list-style-type: none"><li>• Solar energy .</li><li>• Wind energy .</li><li>• Rainfall</li><li>• Power of Tides</li><li>• Hydropower .</li></ul>	<p><u>Renewable</u></p> <ul style="list-style-type: none"><li>• Water .</li><li>• Soil fertility</li><li>• Natural vegetation .</li><li>• Wild life .</li><li>• Aquatic animals</li><li>• Humans .</li></ul> <p><u>Non Renewable</u></p> <ul style="list-style-type: none"><li>• Biological species</li><li>• Minerals .</li></ul>

### Inexhaustible

→ Present in unlimited quantity and they

are not likely to be exhausted by human activities.

→ Some inexhaustible resources remain unaffected by human activities, while many others may show some changes in their quality.

→ Some resource may sometimes be affected locally by human activities.

Eg: air quality.

### Exhaustible Resources

→ limited supply on the earth and are therefore liable to be exhausted if used indiscriminately.

① Renewable - have the capacity to reappear/replenish themselves by quick recycling reproduction and replacement within a reasonable time.

- Soil, water, living beings.

- If the consumption of resources continues to exceed their rate of renewal, not only

their quality become affected, they may even totally exhausted.

### Non Renewable

→ Many abiotic resources are non renewable.

Fossil fuels and metals once extracted cannot be regenerated at the place of extraction.

→ Some biotic resources are also non-renewable.

### Principle Natural Resources And Importance

#### I. Forest Resources

##### → Productive function

- Timber, Bamboos, food and wide variety of compounds such as resins, alkaloids, essential oils, latex, pharmaceuticals etc.

##### → Protective function

- Conservation of soil and water.
- Prevention of drought and protection against wind, cold, radiation, noise etc.
- Control the flow of water in streams &

rivers

- Prevent the erosion of soil

→ Regulative Function

- Absorption, storage and releases of gases

( $\text{CO}_2$  and  $\text{O}_2$ ), water, minerals and radiant

energy

- Floods, drought and global biochemical

cycle

- Improve atmospheric temperature conditions

and enhances the economical and environmental

value of the landscape

### The forest area in India - Short note .

India is a country that is blessed with different varieties of forests such as rainforests, grasslands, mangroves etc. Due to the varying altitudes and climatic conditions we can find a diversity of flora and fauna. From snow leopards of the Himalayas to the camels of Rajasthan,

the neverending list of these wonderful species grab the attention of people from around the world. But this is a sad reality that the percentage of forest area in India is rapidly decreasing due to which many species are in the threat of extinction. Our national animal, the Indian tiger is itself vanishing. Our past generation including the Bishnois that gave up their life to save the forest cover. So the conservation of our threatened forest is of utmost concern to us and the government are implemented it through various programs such as the Chipko Movement, Forest Act etc.

### Deforestation

1. Shifting Cultivation (Jhum Cultivation)

→ Agroforestry system

→ Widely practiced in Northeast India

2. Over Population

3. Demand of wood for industries

4. Construction of Roads

→ Along mountains which cover nearly 30,000 km  
in ecologically fragile areas is the main cause  
of deforestation.

5. Mining Operations

→ Mining of mica, coal, manganese, limestone  
etc cause the large area of forests are  
cleared and laid barren.

6. Overgrazing

7. Pests

8. Weather

9. Forest fires

10. Dams and hydro electric projects

### Effects of Deforestation

→ Amount of runoff water flowing into rivers  
and ~~rivers and~~ streams increases frequent  
flood.

- Increased soil erosion and decreased soil fertility leads to formation of deserts .
- Extinction of forest dwelling plants and animals and microbial species resulting into loss of irreplaceable genetic resources .
- It threatens tribal people whose culture and physical survival depend upon the forest .
- Increases the regional and global climate change . It become warmer due to lack of humidity .
- Pattern of rainfall has changed .
- Global warming .

## II. Water Resources

- About  $\frac{3}{4}$ th of earth is occupied by oceans .
  - 97.5% - Strongly saline .
  - 2.5% - fresh water .
- Polar glaciers .
- Remaining fresh water occurs as ground water .

→ Water in lakes and river (0.02 %).

→ Soil - 0.01 %.

→ Atmosphere - 0.0001 %.

Water is present in different forms in environment.

### Ground Water

→ Aquifers : It is a highly permeable layer of sediment or rock containing water.

→ Layers of sand and gravel are good aquifers while the clay and crystalline rocks having poor permeability are not good aquifer.

Aquifer  
↳ Unconfined  
↳ Confined

→ Unconfined : Covered by permeable earth materials and recharged by seeping down of water from rainfall and snow melts.

→ Confined Aquifers : Present between two impermeable layers of rock and are recharged only in those areas where the aquifer meets the land surface.

→ The recharging area may be several kms

away from the location of the well.

### Effects of overuse of ground water

1. Lowering of water table and drying of wells.
  - effect on agriculture.
2. Ground subsidence.
  - If ground water withdrawal is more than its recharge rate, the sediments in the aquifer become compacted.
3. Causes damage of buildings, destroys water supply, reverse the flow of sewers and canals and tidal flooding.

### Surface Water

#### Water use and Problems

- About 70% of total consumption of water resources are for agriculture.
- Only 1.1% is used for domestic and municipal supplier and the rest is used by various industries.

## Problems

- 40% of world's population lives in arid/semi-arid region. They are struggling for obtaining water for domestic and agriculture.
- Drying up of near by wetlands.
- Saline intrusion

## Conservation & Management Of Water

- Reducing the water wastage in agriculture fields by adopting sprinkle, drip irrigation etc.
- Recycling of used water in industries.
- Reduction in domestic water usage by constructing waste water treatment plants and recycling the treated water.
- Harvesting of rainwater by storing of rainwater and recharging.
- Protection of watersheds and afforestation to improve water economy.
- Desalination of sea-water and saline ground water

to make it fit for human consumption and other purposes.

- Diversion of water bodies through canals to increase water supply in drier areas.
- Regular dredging and desilting of rivers, streams, and other water bodies.

## Mineral Resources

- Exhaustible, non-renewable resources found in earth's crust.
- A no. of minerals such as Ag, Cu, tungsten, Au etc. are now in short supply and likely to be exhausted within next 20-100 years.
- Metallic and non-metallic.

## Mining

### 1. Surface mining

- Mineral deposit occur at or near the surface

of the earth

m

i) Open Mining - Extracted out by making pits by removing the over-burden

- Cu, Fe, gravel, limestone, sandstone, granite etc.

ii) Dredging - In this method, chained buckets and draglines are used to scrap out the minerals from under water mineral deposit.

iii) Strip Mining - In this method, the ores are stripped off by using bulldozers, powershovels and strip wheels.  
- Phosphate

## 2. Subsurface Mining

→ When the mineral deposit lies deep beneath the earth's surface.

→ Petroleum products

## Effects

- The top soil is removed from the mining area that causes to destruction of soil fertility.
- Ground subsidence → tilting of buildings, cracks in buildings, buckling of roads, bending in rail tracks, leaking of gas from cracked pipelines etc
- Disturbs natural hydrological process and also pollutes water as well as surface water.
- Extraction and processing of ores emits enormous quantities of air pollutants such as  $\text{SO}_2$  PM leading to environmental hazards.
- Miners often suffer from serious respiratory and skin diseases like asbestosis, silicosis, black lung diseases.

## Remedial Measures

- Reclaimed / restored to a semi natural condition

by revegetation, gradual restoration of flora etc

- Prevention of drainage discharge and <sup>mining</sup> confining to standards of air emissions.
- The adverse impact of mining can be minimised by adopting eco-friendly mining technology like microbial leaching technique for extraction of gold with the help of bacterium *Thiobacillus ferri oxidans*.

### Conservation of Minerals

- Reduce
- Reuse
- Recycling
- Substitution
- Decreased Consumption
- Use of waste

### Energy Resources

#### 1. Non-renewable

##### i) Fossil fuels

- Are found inside the earth's crust, where they have been formed

through heat and compression on forest and other organic matter buried under due to earth quake, land slide, lava etc

→ Solid - Coal, Peat

→ Liquid - Petroleum

→ Gaseous - Natural gases

→ Coal is the most abundant fossil fuel on earth. It contains C, H<sub>2</sub>O, S and N

There are 3 types of coal.

- Anthracite / hard coal - 90% of C

- Bituminous / soft coal - 80% of C

- Lignite / brown coal - 70% of C

## ii) Nuclear Energy.

## 2. Renewable

### i) Solar Energy

a) Direct Solar Energy.

→ Radiant energy

→ Photo voltaic cells convert direct solar energy into electricity - Photo voltaic conversion

b) Indirect Solar Energy .

→ It is the energy obtained from materials that have previously incorporated the sun's variant energy .

→ Biomass .

→ All materials originating from photosynthesis include plant materials and dried residues , fresh water and marine algae , agricultural and forest residues .

Biomass fuel .

→ It is burned to release energy in 3 ways .

Solid .

Wood, charcoal ,  
animal dung

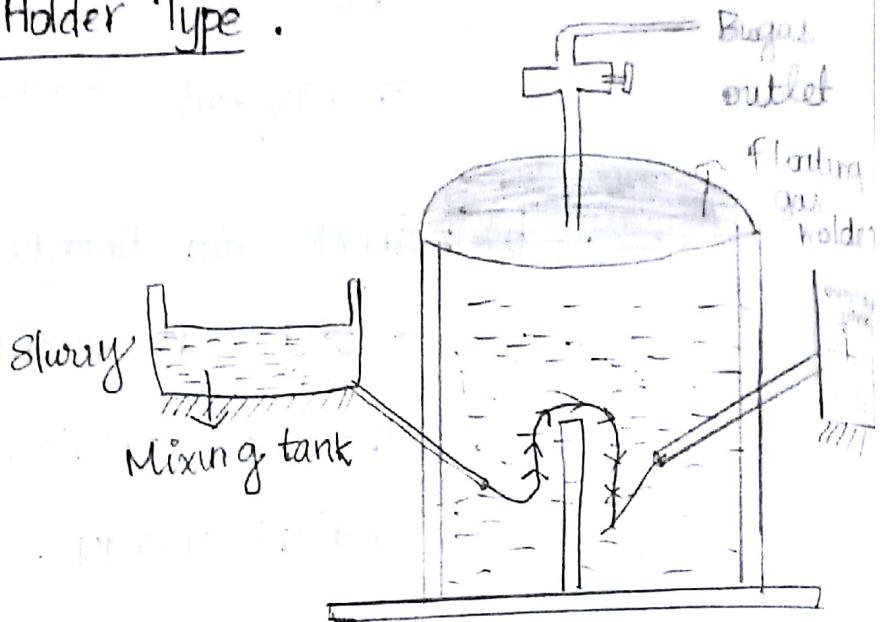
Liquid

Methanol,  
Ethanol

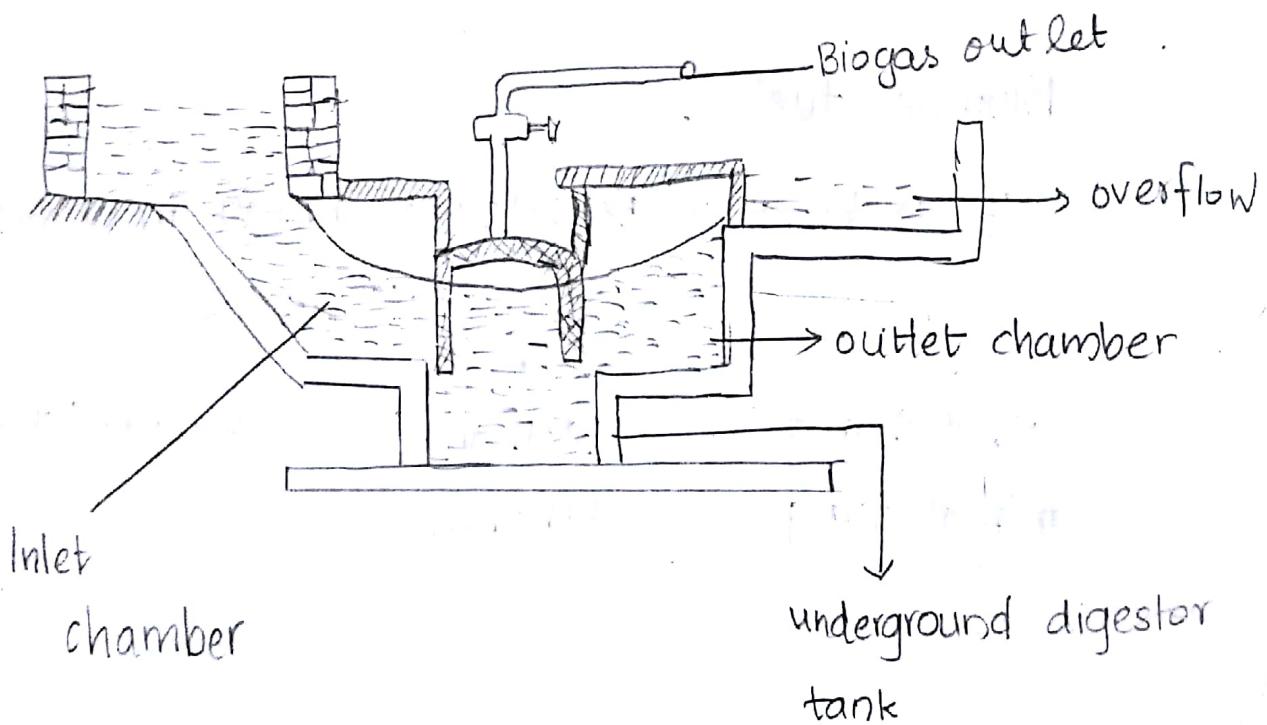
Gas .

Biogas ( $\text{CH}_4$  &  $\text{CO}_2$ )

## 1. Floating Gas Holder Type .



## 2. Fixed Dome Type .



b) Hydropower

c) Geothermal energy

d) Wind power

e) Tidal energy

## Ecosystem

Structural and functional unit of biosphere  
segment of nature consisting community of living  
beings and the physical environment both,  
interacting and exchanging materials between them  
→ holocoenosis :- relation between biotic components  
and physical environment .

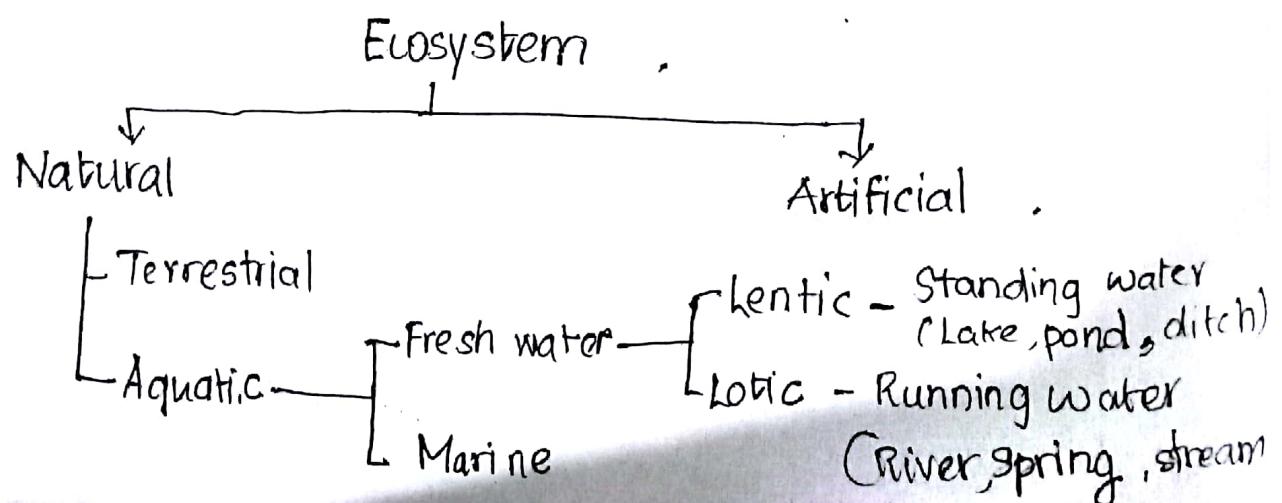
Types

- Natural
- Manmade

→ Temporary or Permanent .

↓                          ↓  
rain fed pond            lake , forest etc

→ Aquatic water   Terrestrial



## Components

→ Biotic and abiotic

↓  
all living  
org

↓

autotrophs & heterotrophs

Consumers (herbivores & carnivores)  
Decomposers

## Biotic Components

### 1. Producers

→ Chlorophyll bearing autotrophic (self nourishing) organism

Inorganic raw materials  $\xrightarrow{\text{sunlight}}$  Organic materials

photosynthesis

Solar Energy → Chemical bond energy of organic compounds

Convertors / transducers

Autotrophs → / rooted plants

ie, herbs, shrubs and trees

## Deep Aquatic Ecosystem

→ Floating plants/ phytoplankton

Shallow water - rooted plants

Macrophytes

### Consumers

Phagotrophs (to eat)/other feeding organisms

2 types → ① Herbivores      ② Carnivores

1. Herbivores → 1<sup>st</sup> Order Consumers

Feed directly on plants

Eg:

Aquatic ecosystem → protozoans, molluscs, crustaceans

→ Key industry animals

→ 1° consumers convert the plant material to animal material.

2. Carnivores

→ Feed or prey upon other animals

→ 1° Carnivores → Feed up on herbivores

→ 2° Consumers

Eg: birds, frogs etc

### 3° Consumers

Feed upon 1° carnivores .

Eg : Owl , tiger , lion .

→ 2° carnivores are preyed upon by some larger carnivores → 3° carnivores .

→ The larger animal : like lion , tiger which cannot be preyed upon further they occupied top position in food chain - top carnivores

### 3. Decomposers

→ Saprophytic micro-organisms

→ bacteria & fungi

→ dead organic material

→ Micro-consumers

→ Reducers

→ Decomposers secrete some digestive enzyme in the surrounding medium to digest the organic material . They absorb a part of the

decomposition products for their own nourishment  
The remaining substances add materials and  
minerals to the substratum

### - Mineralization .

## Abiotic Components .

### 1) Climatic Regions .

Precipitation , temperature , light & physical  
factors .

### 2) Inorganic substances

C , N , H , O , P , S .

### 3) Organic Substance .

Carbohydrates , Protein , lipids , humic substances .

## Biogeochemical Cycle .

## Structure & Function of Ecosystem .

### Structure .

Features are

1) Species composition .

2) Stratification

3) Trophic Organization

4) Nutrients .

### 1. Species Composition

Each ecosystem has its own type of species composition . A great variety of species is found in forest ecosystem whereas a few species occurs in a desert ecosystem

### 2. Stratification

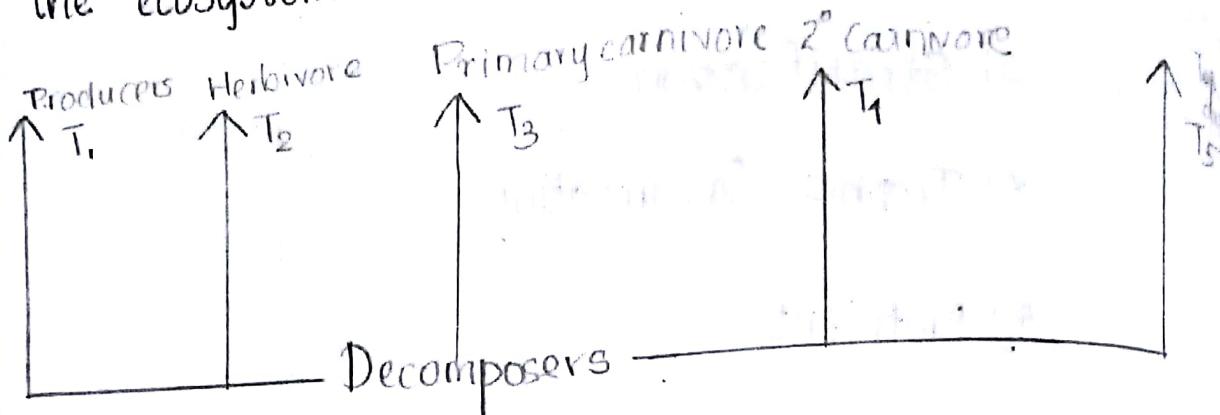
The organisms in each ecosystem are found in one or more layers/strata comprising the population of particular kind of species .

### 3. Trophic Organization

→ Relationships of producers and consumers and maintain the ecosystem structure

→ Based on the existence of several T levels in

the ecosystem.



→ Decomposers form ultimate/detritus trophic level.

→ Parasite feed up on the organisms of all T level.

Therefore, they do not have a fixed T level.

Similarly, there is no fixed T level for omnivorous organisms like human beings.

→ In an ecosystem there can be only 4-5 successive T level.

i) All the food available at one T level is not eaten by the animals of next T level. Some of the food energy is lost in this manner.

ii) All the food eaten by an animal is not useful, thus a good deal of energy containing food is passed out as waste.

iii) Large amount of energy is lost in respiration to derive organisms, metabolism and thus there is not much energy left to support high level.

- T structure may also be described in terms of the amount of living materials present in different T levels.
- Standing Crop
- Biomass of organism/unit area

#### 4. Nutrients

N, P and Ca present in the soil at any given time

- Standing state

→ Different ecosystem have different standing state of nutrients

→ It may vary at different time even the same ecosystem

#### Functions

i) Productivity

ii) Energy flow

iii) Nutrient Cycling

iv) Development & Stabilization

i) Productivity .

Rate of organic matter/biomass production

2 types — i) Primary -

ii) Secondary .

Primary Productivity .

→ Rate at which radiant energy is captured by the producers for the synthesis of organic compound through photosynthesis .

→ per g/~~year~~ m/year

→ kcal /m<sup>2</sup>/ year .

→ The 1° productivity is further distinguished as

- Gross Primary Productivity (GPP and

- Net Primary Productivity (NPP)

- The rate of total capture of energy / the total production of organic matter or biomass by producers / unit area and time is GPP
- The rate at which energy / org matter stored by the producers after respiration and maintenance / unit area and time is NPP .

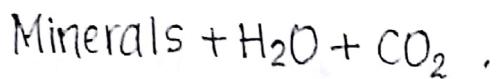
$$NPP = GPP - \text{Loss due to respiration \& maintenance} .$$

## Secondary Productivity.

The rate of increase in the biomass of consumers per unit area and time

## Decomposition

- Mineralization .



## Energy Flow

- The functioning of ecosystem depends on the flow of energy through matter .

- Energy enters the ecosystem from solar radiations and is converted into chemical form by producers

• Energy flow is governed by two laws  
• 1<sup>st</sup> law of Thermodynamics .

Energy can neither be created nor be destroyed . It can be transformed from one form to other .

• 2<sup>nd</sup> law of Thermodynamics .

Energy transformation / transfer of energy is accompanied by dispersion . 100% of transformation of

energy from one form to the other / transfer ;  
one org. to other is not possible .

2 aspects of Energy flow

i) There is unidirectional / one way flow of energy  
the ecosystem .

ie, Producers → Herbivores → Carnivores .

ii) The amount of energy flow decreases with successive  
trophic level .

### Food Chain

→ The transfer of food energy from the source in plants through a series of organisms with repeated eating and being eaten is referred to as food chain .

1) Grazing food chain → Producers through herbivores →

2) Detritus food chain .

### Terrestrial Food Chain

i) Veg → Grasshopper → Shrew → Hawk .

ii) Veg → Frog → Snake → Peacock .

iii) Plant → Butterfly → Frog → Snake → Hawk .

iv) Veg → Rabbit → Fox → Wolf → Tiger .

### Aquatic .

i) Phytoplanktons → Zooplanktons → Small crustaceans →  
Predator insects → Small fish → Large fish  
→ Stork / king fisher .

ii) Phytoplanktons → Zooplankton → Small fish →  
Large fish → Shark .

iii) Phytoplanktons → Zooplankton → Fish → Crane →  
Hawk .

### ii) Detritus Food Chain

It starts with dead org matter and passes through detritus feeding organism in soil to organisms feeding on detritus feeders and their predators .

Eg. leaves → Detritus → Microorganisms → Crabs

and Shrimp → Small fish → Large fish .

## Food Web

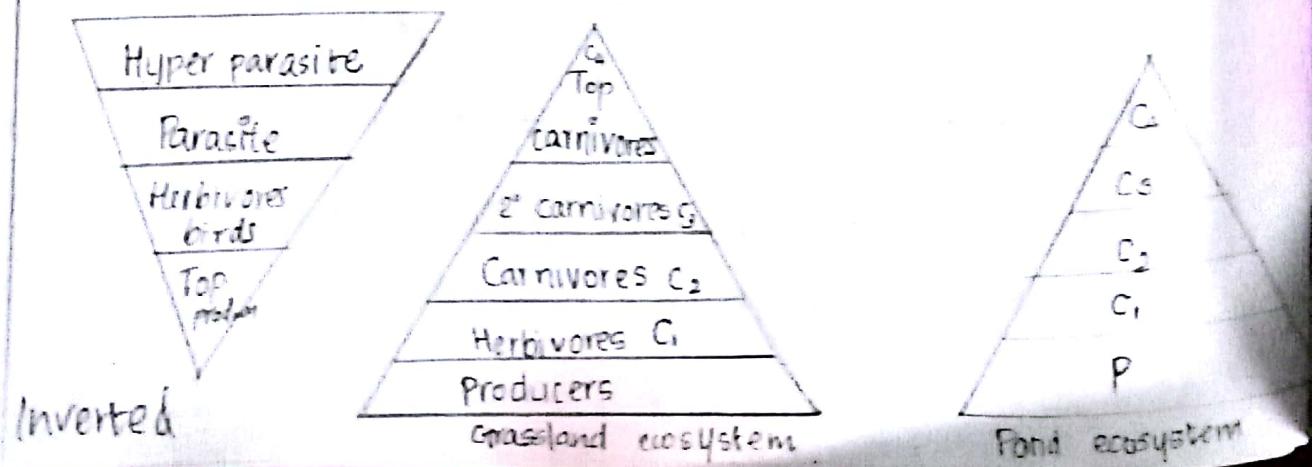
A network of food chains which are interacted at various T levels so as to form a no. of feeding connections amongst different organisms of a bio-community is called food web.

## Ecological Pyramid

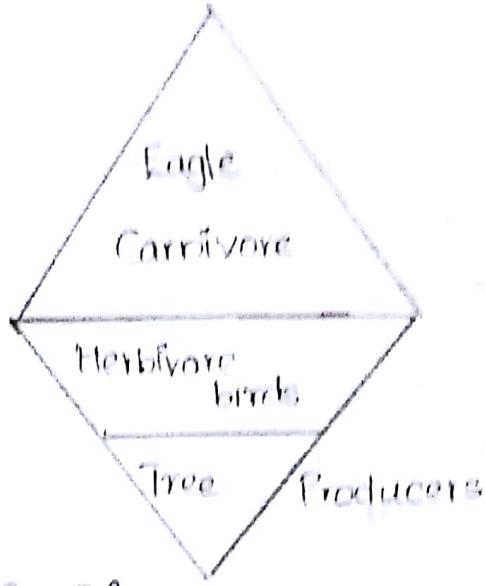
- No. of individuals / Amount of biomass / amount of energy
- Charles Elton / Eltonian Pyramid
  - i) Pyramid of number
  - ii) Pyramid of biomass
  - iii) Pyramid of energy

### Pyramid of Number

- No. of individuals / unit area of various trophic level  
→ Upright

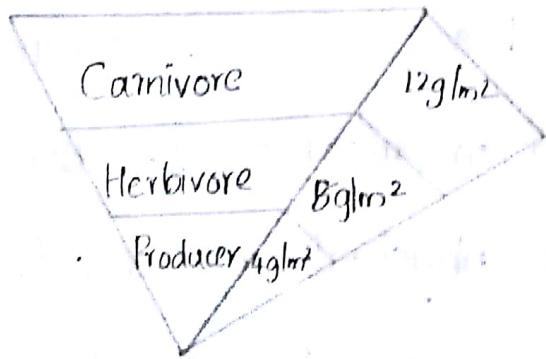
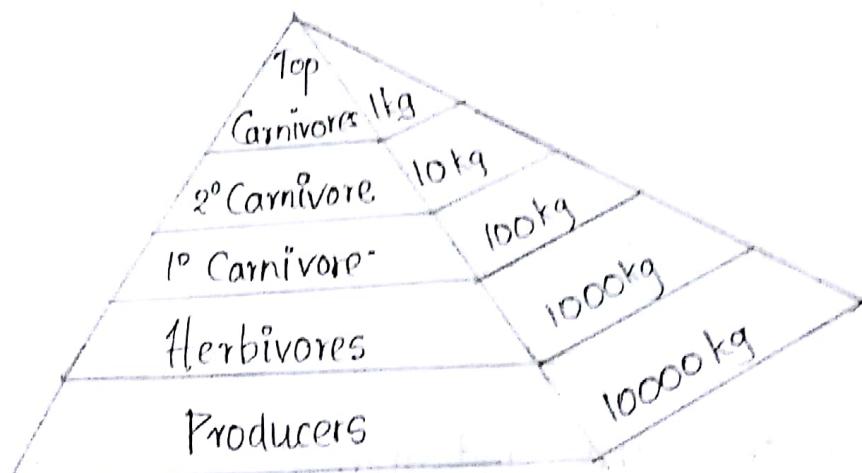


Spindle



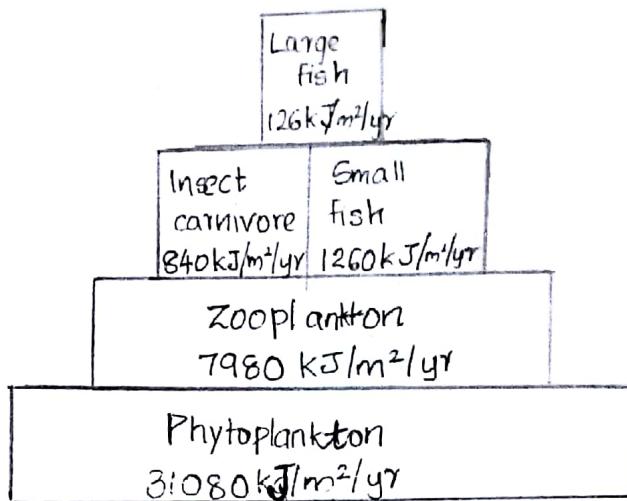
Pyramid of Biomass

Amount of living/organic matter/unit area



Pyramid of Energy

Amount of energy trapped/unit time and area



## Ecological Succession

→ Pioneer Community :- 1<sup>st</sup> community

Eg: Lichens

→ Climax Community (last/stable)

Eg: Forest.

Change of plant and animal communities in an orderly sequence in an area, resulting in establishment of stable or climax community.

The interacting organisms of the community slowly change the physical and chemical nature of the substratum as well as the factors of the environment → reaction.

→ Weathering of rocky substratum

- Binding of soil particles
  - Holding of water
  - Decreasing the effect of wind and keeping the substratum moist and cool in summer and warm in winter.
- 
- 1<sup>st</sup> community which inhabit a bare area - pioneer community
  - It has the little diversity and takes longest time to change the environment for invasion of next community.
  - The last and stable → climax community.
    - ↓
    - Perfect harmony with the physical envt. → climatic climax community.
  - Intermediate pioneer - climax → seral / transitional → sere.
  - Hydrarch → succession beginning in watery habitat.
    - ↓
    - hydrosere.
  - Xerarch
    - ↓
    - xerosere → Lithosere → sequence of successional stages

on bare rock .

Psammosere → sequence of successional stages on a land .

Characteristics .

- It tends to progress from unstable to stable community .
- So regular and directional .
- In successive several stages , there is tendency towards increase in the species diversity , total biomass , humus of the soil .
- Tends to progress from simple food chains to complex food chain .
- Habitat tends to modify from aquatic to dry condition or to mesic .
- Succession of plant and animal occurs side by side .

## Types

1. Primary → Occurs on a substratum devoid of earlier life, i.e., bare rock, ice, sediments, new islands, newly formed pond/lake etc.
  - i) Presere → long period of time.

## 2. Secondary Succession

→ Occurs in an area which have become bare due to destruction of previously existing biotic community by fire, drought, land slide etc.

Subsere - much less time to reach climax community.

## Mechanism of Succession

### I. Nudation

- Development of a bare area.

### II. Migration

- The seeds, spores or other propagules of organisms reach the bare area.

- Air, wind, animal.

### III. Ecesis (establishment)

- Successful establishment of a species

#### IV : Aggregation

The increase in the no. of colonizing individuals

#### V. Invasion

Migration does not end with the establishment of pioneer from time to time. Pioneers of new species continue to reach the area under colonization.

If they are able to establish in new area.

Invasion, new organism - invaders

#### VI . Competition and Co-action

Space, food etc.

→ Affect each other's life - Coaction

#### VII. Reaction

Change brought about by colonisers

#### VIII . Stabilisation (climax)

Continuous competition, invasion and reaction give rise to continuous changes in the environment and the structure of vegetation.

After a long period of time, some individuals

arise which are in complete harmony with the climate of the area.

Become dominant and create conditions favourable for the growth of other plants below them.

## Biodiversity

→ Totality of genes, species and ecosystem.

→ Variety and variability among living organisms and ecological complexes in which they occur.

### i) Genetic diversity

Within the species

→ Alleles (different variants of same gene) in entire genes or chromosomal structure.

### ii) Species diversity

→ A species with more genetic diversity can adapt better to the changed environmental conditions.

→ Low genetic diversity - uniformity.

### iii) Species diversity

Diversity of species within a region.

→ Diversity of species in the region from microorganism

→ Full range of species in the region from microorganisms to multicellular plant and animals -

- It is measured on the basis of species richness and equitability/evenness
- No. of species/unit area
- Increases with the area
- higher species richness represents greater species diversity.

### Equitability/Evenness

- Evenness in the no. of individuals of a species
- Evenness of species represents higher species diversity.

### iii) Community & Ecosystem diversity.

- Variation in the biological communities in which species live

- i) Alpha    ii) Beta    iii) Gamma

#### i) Alpha

- Indicates within the community

- Diversity of organisms sharing the same community habitat

#### ii) Beta

- Diversity between the communities

→ Species frequency change, when habitat/community changes

→ There are differences in species composition of communities along environmental gradient.

### iii) Gamma:

→ Diversity of the habitats over the total landscape or geographical area.

→ Ecosystem diversity represents to the variation in the structure and function of ecosystem.

→ It has focus on various biotic interactions and role and function of keystone species (species determining the ability of large no. of other species to persist in the community.)

→ Endemic species - Species found exclusively in a particular region.

### Benefits of Biodiversity:

a) Source of food and improved varieties.

a) As a source of new crops.

b) As a source of material for breeding

improved varieties

c) As a source of biodegradable pesticides.

There are 1000 species of edible plant but only 20 species is cultivated 85% world's food and the rest 15% is produced by animals.

### Drugs and Medicines

→ Morphine : analgesic medicine  
*papaver somniferum*

→ Quinine : Malaria  
*chinchona ledgerian*

→ Taxol : Cancer  
bark of yew tree (*Taxus baccata* and *T. breviflora*)

→ Several plants species are used for manufacture of innumerable synthetic products. Such plant based synthetic products are called botanical chemicals.

## Aesthetic and Cultural Benefits

Ecotourism, bird watching, wild life pet keeping, gardening, etc.

- Related to our cultural and religious belief.
- Plants and animals are considered to be the symbols of national pride and cultural heritage.
- Many plants and several birds, animals and even snakes are considered sacred and worshipped.

## Ecosystem Services

- a) Maintenance of gaseous composition of the atmosphere.
- b) Climate control by forest and oceanic systems.
- c) Natural pest control.
- d) Formation and protection of soil.
- e) Conservation & purification of water.
- f) Nutrient cycling.

## Threats to Biodiversity.

### 1. Habitat destruction.

→ Natural habitats converted into human settlements, harbours, dams, reservoirs, crop/grazing grounds, mining sites etc.

- Population of many species

→ Declines reproductive capacity of wild animals

→ Affected migratory animals because of the disturbance in their routes.

### 2. Habitat Fragmentation.

→ Limit disposal and colonisation of potential species foraging ability (searching food).

### 3 Disturbance & Pollution

→ Polln →

→ Eutrophication

### 4. Introduction of Exotic species

New species

## 5. Hunting and Overexploitation

## 6. Poaching

Killing of prohibited wild animals for illegal trading of wild plant and animal products

Extinct in wild

Globally extinct.

Ecologically, extinct → if it persist at such reduced numbers that its effects on other species in the community.

i) Natural extinction.

ii) Mass extinction.

iii) Anthropogenic extinction.

i) Natural - Extinction of species slowly from the earth due to change in environmental conditions.  
Also called background extinction.

ii) Mass - Catastrophe

iii) Anthropogenic - due to manmade

- Large body size → Eg. Bengal tiger, lion, elephant
- Small population size and low reproductive potential.  
Eg.: blue whale, giant panda.
- Feeding at high T level → Eg: Bengal tiger, Black eagle.
- Fixed migratory routes & habitat - Blue whale, whooping crane.
- localized and narrow range of distribution .