

# Unit–1: Topic-1: Introduction to Environment and Environmental Studies

## Introduction to Environment and Environmental Studies:

- Definition and Components of Environment,
- Relationship between the different components of Environment,
- Man and Environment relationship,
- Impact of technology on Environment,
- Environmental Degradation,
- Multidisciplinary nature of the Environment studies, its scope and importance in the present day Education System

TOPIC:1 Definition and Components of Environment,(GTU- 208,2009,2010,2011,2012)

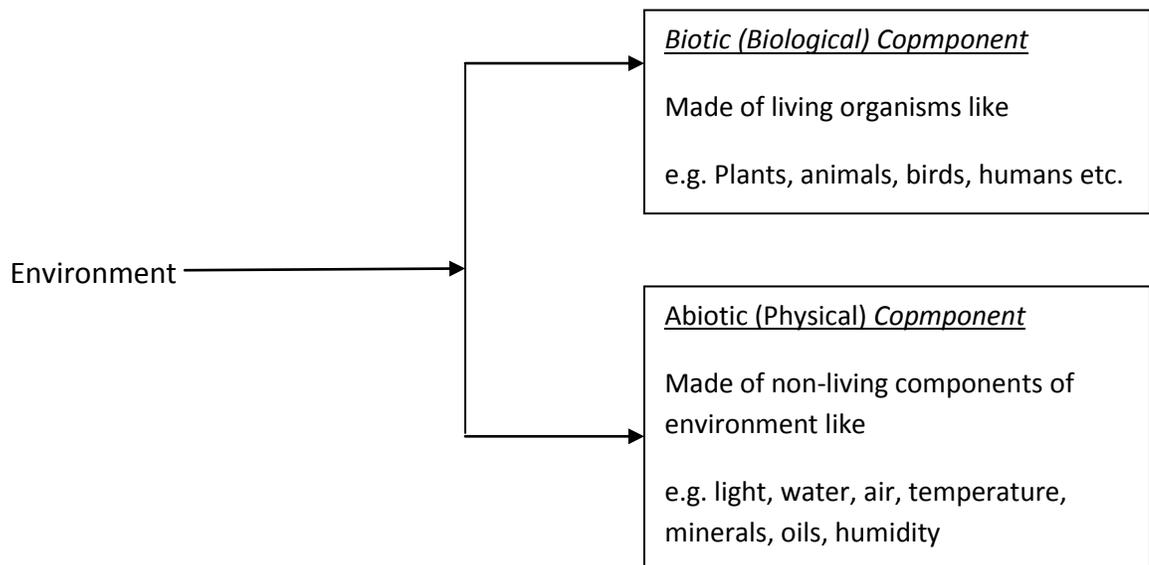
## Definitions:

### Environment:

“External surroundings and conditions which directly or indirectly affects the living organism.

is known as Environments”

Environment is divided in two parts as under.

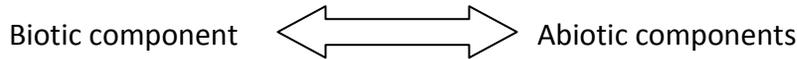


**Ecology:**

Ecology is the study of inter-relationship between living and non-living organisms

Or

Ecology is the study of inter-relationship between biotic and abiotic components of environment



**Environment Science:**

“ Environment Science is a scientific study of Earth, air, water, living organisms and man with its effect on environment”

Or

“Environment Science is a scientific study of biotic and abiotic components and its effect on environment”

**Environment Engineering:.**

“Environment Engineering is the application of engineering to enhance, to protect, to improve the quality of environment”

**Environment Studies:**

“its concerned with environment issues, which related with scientifically as well as social aspects of environment so each people can understand the importance of environment”

Or

It’s a study of environment issues with respect to scientific as well as social aspects so every people get aware of it”

**QUESTION:Explain the Components of Environment:**

Environment is divided in four different components.

1. Atmosphere
2. Hydrosphere
3. Lithosphere
4. Biosphere

(1) Atmosphere:

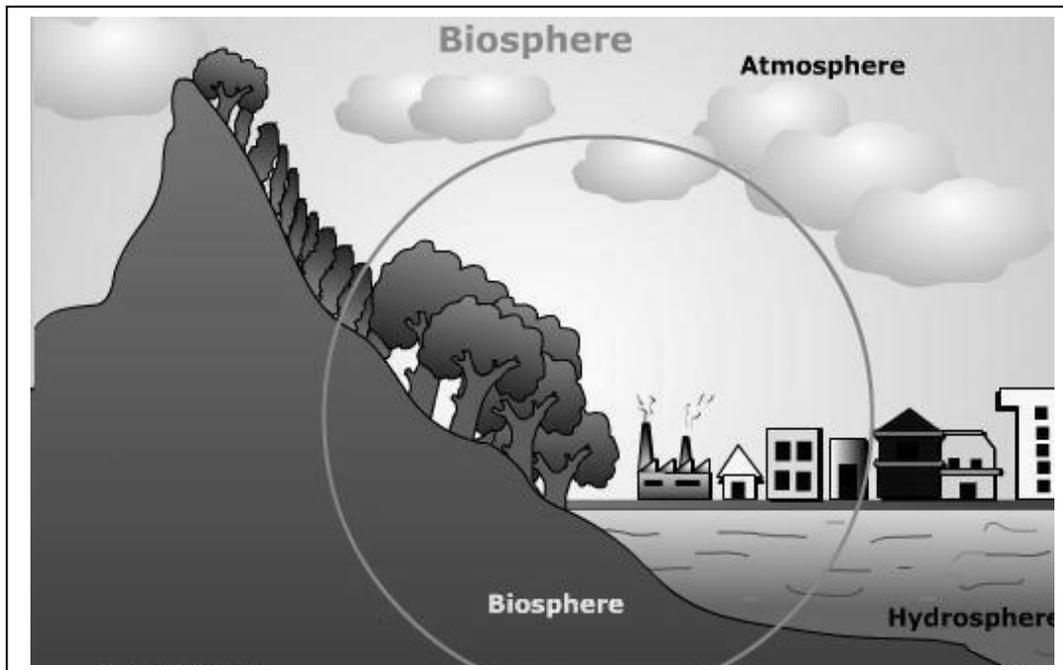
- Atmosphere is a protective layer for the earth, which is made of three basic elements i.e. gases, water, vapor and dust particles
- The living being i.e. the bio sphere is developed due to the presence of atmosphere

Extra Note:

Earth's average temperature is about 15°C because of atmosphere

where as for moon its totally different variation of temperature is from 100°C to more than -100°C so living being are not able to grow in moon.

- Human life, food, shelter(home) etc. are influenced by the atmosphere.
- The Gases includes Nitrogen Oxygen, Argon, Carbon Dioxide and traces of Carbon monoxide, oxide of sulphur, nitrogen and hydrocarbon etc., with changing concentration of which decreases with increases in altitude



- The major gases in pollution free dry air are
  - (1) Nitrogen 78%
  - (2) Oxygen 21%
  - (3) Argon 0.9%
- The minor gases in free dry air are

(1) Water vapor	0.1%
(2) Carbon Monoxide	0.032%
(3) Neon(Ne)	0.0018%
(4) Methane (CH <sub>4</sub> )	0.0002%

➤ The Trace gases( Gases which are less than 1% of total gas on earth)

Ozone (O<sub>3</sub>), CO, H<sub>2</sub>, NH<sub>3</sub>, NO, NO<sub>2</sub> Gases having concentration less than **0.000006%**

### **Structure of Atmosphere:**

Dependent on various parameter like temperature, pressure, density of atmosphere, it is divided in five different layers.

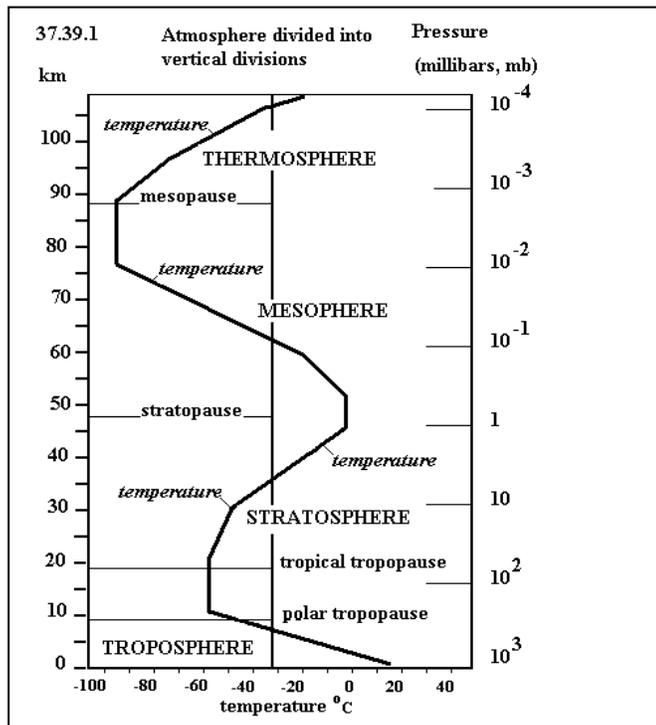
(a) Troposphere

(b) Stratosphere

(c) Mesosphere

(d) Thermosphere

(e) Exosphere



**(a) Troposphere: ( Origin word Greek : Tropa = Change or Turning)**

- Lower most layer of atmosphere, where living organisms exist.
- It extends up to 8 km at poles and 16 at equator which contains 70% of the atmospheric mass and extends up to 10-12 Km distance
- Density of this layer decreases with altitude
- Temperature decreases with altitude
- Boundary between Troposphere and Stratosphere is know as tropopause.

**(b) Stratosphere:.....(Strato = a class of cloud)**

- Next layer to the troposphere is stratosphere, which extends up to 50-55 km above the earth surface
- Near about 20 km temperature remain constant then increases with increase in height due to ozone(O<sub>3</sub>) layer which is available between 20 to 30 km of height.(highest at 25Km)
- Ozone layer protects the living organisms from high energy ultraviolet radiation and absorbs the radiation that's why temperature in this layer rises as shown in figure 2.

**(c) Mesosphere:**

- It exists above the stratosphere
- Extends up to 80-85 km
- In this layer temperature decreases with altitude about -93 °C (180 K) which is the coldest part of the atmosphere.

**(d) Thermosphere**

- After mesosphere, thermosphere extends up to 500 km above earth surface
- Temperature increases with altitude
- It is also known as ionosphere, because nitrogen and oxygen atoms get ionized and release lots of heat. So the temperature of this layer is very high.
- This is the hottest part of the atmosphere. Within the thermosphere charged particles are there therefore it is also known as ionosphere.

**(e) Exosphere**

- The uppermost layer of the atmosphere is called exosphere.
- Individual atoms can escape from the Earth's gravitational attraction therefore this region is called exosphere

**(2) Hydrosphere:**

- All water resources e.g. oceans, seas, rivers, lakes, ponds, polar ice caps, glaciers, ground water, water vapors are collectively known as a hydrosphere
- Very important part of Earth's surface, about 70% of total area is covered with water.
- Northern Hemisphere is dominated by lithosphere, whereas Southern Hemisphere is dominated by Hydrosphere

- 97% of Hydrosphere is in oceans and Seas, remaining 2% of water is in Glaciers and Ice Caps and Only 1% of water is available as a Fresh water.
- Fresh water is most necessary for existence of each and every living being, so its very important to use
- Hydrosphere is divided in two part Fresh water and Marine water.
- Fresh Water e.g. Rivers, Streams, lake, pond etc.
- Marine Water e.g. Oceans, Seas, Salty lake etc

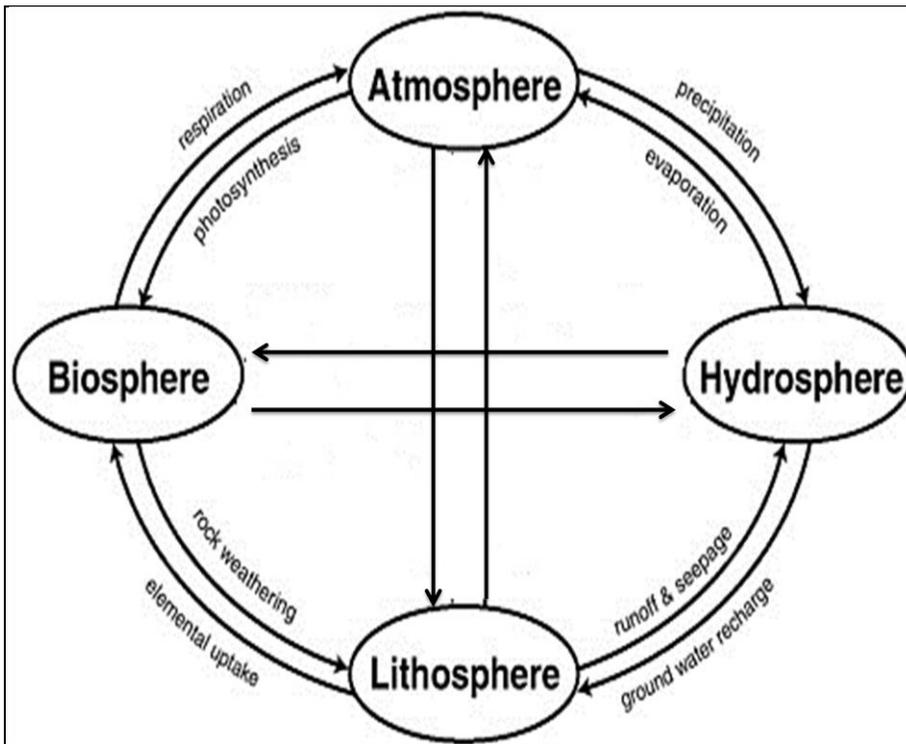
### (3) Lithosphere

- The upper most layer of earth's crust is called the lithosphere, which is made up of Soil, minerals, rocks and other organic and inorganic matter.
- It plays an important role in growth of living organisms like humans, plant, animals, rocks and other organic and inorganic matter.
- It provides a platform for the decomposition of organic wastes by micro and macro Decomposers (विघटको).
- Even the existence (अस्तित्व) Biosphere as well as Hydrosphere is possible because of present of lithospher.

### (4) Biosphere.

- Part of Earth, where all life exists is known as a biosphere.
- Biosphere is a biological environment where living organisms interact with physical environment
- Biosphere is a place where biotic and abiotic part of environment interact with each other
- It extends from lowest sea bed up to about 24km above earth surface.
- So biosphere is consist all components of atmosphere like Hydrosphere, Lithosphere, and Atmosphere.
- Biosphere is able to decompose the waste and make it useful once again by the next generation.
- Because of lots human activities like pollution we are degrading the quality of our biosphere, so biosphere is in stress.

**QUESTION::Relationship between different components of the environment:**



Environment is divided in two parts

(1) Abiotic Component.

- Atmosphere
- Lithosphere
- Hydrosphere

(2) Biotic Component.

- Biosphere

- Above figure shows a relationship between four environmental components.
- Circles represents the sphere and Curved arrows indicates the flow of matter from one sphere to another sphere.
- All sphere have two way transfer of matter, one is within itself and another one is with other sphere.
- All components of environment are interrelated to each others, any change in one components may effects other component also.

- E.g. change in the abiotic component like Temperature may raise serious issue, change in temperature will rise a rate of evaporation and it will increase the humidity of atmosphere.
- And after the saturation( संतृप्त) of humidity rainfall take place, so it directly or indirectly change in temperature is going to affect Lithosphere and ultimately to Biosphere.( in from of heavy rainfall and flood may raise the erosion on earth surface.)
- E.g. Lithosphere is almost static component of environment while atmosphere and hydrosphere are dynamic components of environment. Different types of movements in air due to wind and storms and movements of river water as well as ocean water cause changes on the land surface and thus affect the lithosphere.
- Same way each sphere is connected with different sphere by various effects like precipitation, evaporation, photosynthesis, rock weathering, respiration etc.

### **QUESTION:::Man and Environment Relationship:**

- Man is a biotic component of environment and man's daily life is dependent on various abiotic components of it.
  - e.g. for breathing, growth, water, food, etc.
  - we are mainly dependent on abiotic components of environment, Thus, we are dependent on environment for our survival.
- In ancient time we had good relationship between man and environment, we used to worship nature like sun, water, air, soil, plants and animals.
- As per Indian tradition, bodies of plants, animals and human beings are made up of five essential elements (water, air, earth, akash and fire) and after death and decay, these bodies again converted to those five essential elements.
- We have worshipped their natural resources in the form of God. For example, Sun as Surya dev, Water as Varun dev, Air as Pawan dev, Soil as Pruthvi devi, Trees as Van dev, Fire as Agni dev and Cow as Mata, which is showing a strong relationship between man and invironemnt.
- But With the increase in population, man started interfering with the environment in various ways like,
  - Grass lands were converted to crop fields and it's converted in non agriculture land.
  - Forests were cut down for fuel and building materials.
  - Irrigation systems were built to transport water.
  - Inhabitant of some species were destroyed leading to their extinction.

- Higher level of pollution
- Higher uses of fertilizers and pesticides etc.
- Some animals and birds were hunted to extinction.
- Due to more and advanced development of technology it disturbs the balance between environment and man.
- An activity done by human being are directly or indirectly affects the environment.
  - e.g. Development of Residential zone
  - Development of industrial zone
  - Urbanization
  - Growth of agriculture sector
  - Over population
  - Growth of slum area
  - Transportation
  - Civil works, Religious festivals. Etc.....

### ***Impact of Technology on Environment:***

- Because of growth of technology and new discovery we are living in a modern world, with lots of facilities which are making our life comfortable,
  - e.g. medical, agriculture, transportation, construction, electronic equipments, communication devices like mobile internet etc.
- Our development of technology is also producing a lots of problem to environment, The impact of technology on environment can be observed in many ways.
- Here we have shown a effect of technology on various field

#### (1) Agriculture

- Soil erosion,
- Eutrophication,
- Heavy uses of pesticides, fertilizers, insecticides,
- Water pollution
- Stress on natural resources.

#### (2) Water Resources Projects (Dams, Reservoirs, Canals)

- Deforestation,
- Water logging problems,
- Evacuation of village people.

(3) Construction

- Cutting of forest,
- Decrease agriculture land,
- Stress on natural Resources,
- Cutting Forests

(4) Transportation

- Deforestation,
- Disturbance in wild life habitats,
- Air, Noise pollution.

(5) Mining

- Soil erosion,
- Deforestation,
- Air pollution,
- Water Pollution.

(6) Power Generation

- Radioactive pollution,
- Air Pollution,
- Water Pollution,
- Deforestation,
- Global warming.

(7) Urbanization

- Air Pollution,
- Water Pollution,
- Electricity Consumption,
- Slum area development.

Etc.....

- Many more fields are available in which development of technology is responsible for the disturbance quality of environment.

**Impact Equation – IPAT:**

- Famous physicist John Holdren and biologist Paul Ehrlich studied environmental degradation and pollution in detail. They developed a model using three factors to assess the impact (I) on the environment which is called IPAT equation.

- It was one of the earliest attempts to describe the role of three multiple factors, viz. Population (P), Affluence (A) and Technology (T), in determining environmental degradation.

$$I = P \cdot A \cdot T$$

Where,  
I = Environmental impact  
P = size of human population  
A = Affluence – refers to the level of consumption by population  
T = Technology - refers to the processes used to obtain resources and transform them into useful goods and wastes.

- In developing countries like India, basically population, poverty and pollution are three key factors responsible for rapid environmental degradation which is called as P<sup>3</sup> syndrome.
- In developed countries, use of natural resources with very high rate is the main reason of environmental degradation.

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### ***Environmental degradation:***

Definition:

The deterioration of the environmental quality due to different activities of living beings that pollute the key elements like air, water and soil is called Environmental Degradation.

Environmental degradation can occur naturally or through human activities.

The factors of environmental degradation are (1) Natural factors, (2) Man made factors.

1. Natural factors:

- Draughts.
- Storms and floods.
- Earthquakes.
- Volcanic eruptions.
- Tsunami etc.

2. Man made factors:

- Urbanization.
- Industrialization.
- Deforestation etc.

The environment is degraded because of the following reasons.

1. Over population and poverty.
2. Over uses of natural resources
3. Wasteful use of natural resources.
4. Deforestation.
5. High use of fossil fuels like oil and coal.
6. Heavy industrialization leads to air, water and noise pollution.
7. Heavy Uses of fertilizers, pesticides and insecticides
8. Soil erosion.

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***Multidisciplinary nature of the Environmental Studies:***

- ✓ Environmental study is the scientific study of our environment.
- ✓ Environmental study is the study of earth, air, water, living organisms and the man with his impact on environment.
- ✓ It is highly multidisciplinary interacting disciplines of physical, chemical, biological sciences, geology, mathematics, sociology etc.
- ✓ Branches of Biology like Botany, Zoology, Microbiology, Genetics, Biochemistry and Biotechnology helps in understanding the biotic components and their interactions.
- ✓ Basics of Physics, Chemistry, Geology, Atmospheric sciences and Oceanography help us to understand the physical and chemical structure of tea biotic components and energy transfer and its flow.
- ✓ Mathematics, statics and computer sciences serves as effective tools in environmental modeling and management.
- ✓ Sociology and Economics helps us to understand socio – economic aspects associated with various developmental activities.
- ✓ Environmental study is therefore a multidisciplinary subject where different aspects are dealt with a holistic approach.

## ***Scope of the Environmental Studies and its importance in present day Education System:***

Scope of the environmental studies is very wide and it includes a large number of areas and aspects. Few basic aspects are as follows.

1. Natural resources – their conservation and management.
2. Ecology and biodiversity.
3. Environmental pollution and control.
4. Social issues in relation to development and environment.
5. Human population and environment.

Environmental studies can be highly specialized also which may concentrate on more technical aspects like Environmental Science, Environmental Engineering, Environmental Management etc.

Environment belongs to all and is thus important for all. Whatever be the occupation or age of a person, he or she will be affected by environment by his or her deeds. Thus environment is one subject that is actually global in nature.

Environmental studies is also very important since it deals with the most basic or routine issues like safe and clean drinking water, hygienic living conditions, clean and fresh air, fertile land, healthy food and development that is sustainable.

Environmental studies helps to solve biggest environmental problems like acid rain, global warming, ozone depletion and resources depletion.

## Unit–1: Topic-2: Ecology and Ecosystem

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### **Objectives of Ecology:**

The main objectives of ecology are...

1. To study the inter-relationship between organisms in population and diverse communities.
  2. To study the behavior of different organisms (species) in natural environment.
  3. To study the effect of temporal changes (seasonal, annual and successional) in the occurrence of organisms.
  4. To study the adjustment of species (structurally and functionally) with change in physical environment.
  5. To study development in the course of evolution.
  6. To study biological productivity, energy and material flow in the natural system.
  7. To develop mathematical models to relate interaction of parameters and to predict the effects.
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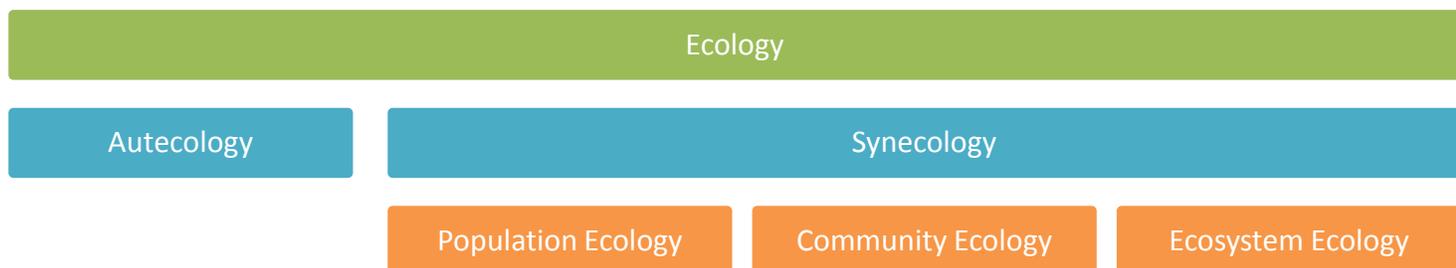
### **Classification of Ecology:**

Depending on various aspects/criteria, there are various classifications of Ecology.

1. Based on study area or level of organization:

Based on this ecology is divided into two main part (1) Autecology, (2) Synecology.

- (1) Autecology: It deals with the study of an individual species of organisms and its population. The Ecologist studies the behavior and adaptations of particular species to the environmental condition of every stage of that individual's life cycle. It is also called the Species Ecology.
- (2) Synecology: It deals with the study of group of organisms which are associated together as a unit, i.e., communities, their compositions, their behavior and relation to environment. It is also called as ecology of communities. It is further divided into 3 types. (a) Population Ecology, (b) Community Ecology, (c) Ecosystem Ecology.

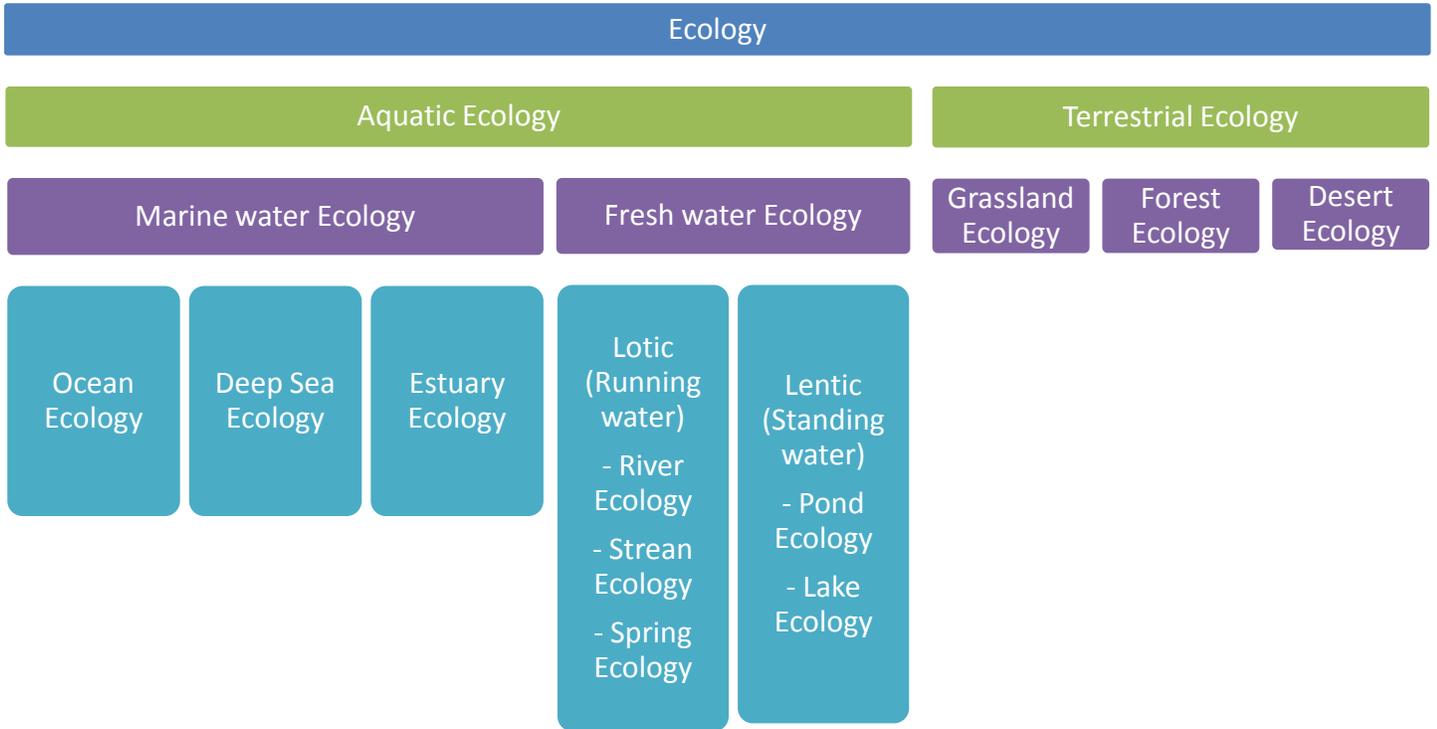


2. Based on environment or habitat:

Based on this ecology is classified as,

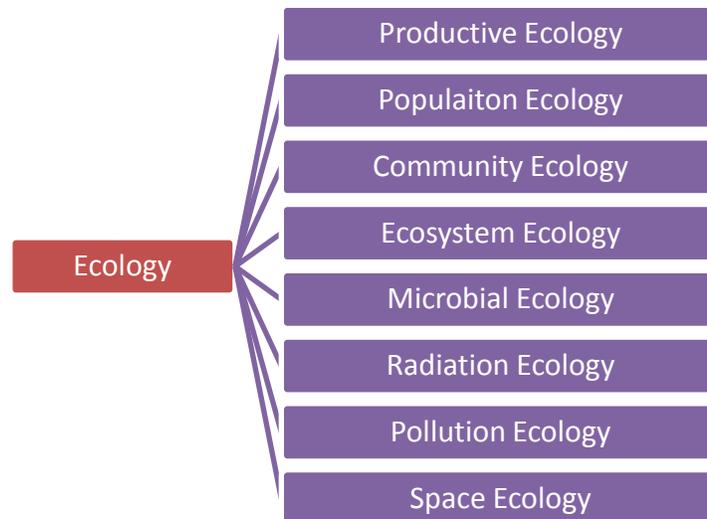
- (1) Aquatic Ecology: Study of interaction of organisms in water.
- (2) Terrestrial Ecology: Study of interaction of organisms on land.

Ecology may be sub divided as per habitat as following.



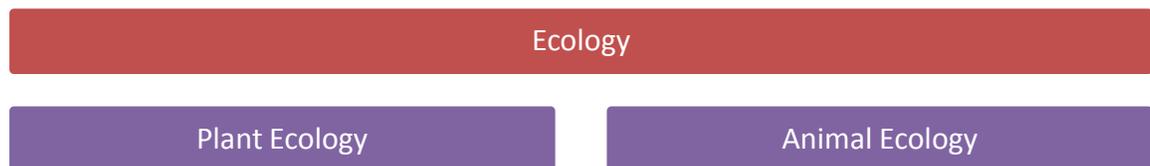
3. Based on Advancement in the field of Ecology:

Nowadays with advancing trends in the fields ecology may be divided into following branches:



4. Based on taxonomy:

Based on this (principles of classifying plants and animals) ecology may be classified as following.



**Concept of Ecosystem:**

Ecosystem:

It is made up of two words 'eco' and 'system'. Eco means environment and system means an interacting and interdependent complex.

Definitions of ecosystem:

There are number of definitions of ecosystem.

1. The organism of any community besides interacting among themselves, always have functional relationship with the environment. This structural and functional system of communities and environment is called ecological system or ecosystem.

2. It is a community of interdependent organisms together with the environment.

Examples of ecosystem:

An ecosystem may be as small as a drop of water or as large as ocean. It may be of temporary nature, for example a fresh pool or a field of cultivated crops, or permanent for example a forest or an ocean. An aquarium can be called as artificially established self sustained ecosystem. Earth itself is a vast ecosystem (biosphere) where biotic and abiotic components are constantly acting and reacting upon each other. The biosphere has various smaller ecosystems for example forest, desert, cropland, freshwater, marine etc.

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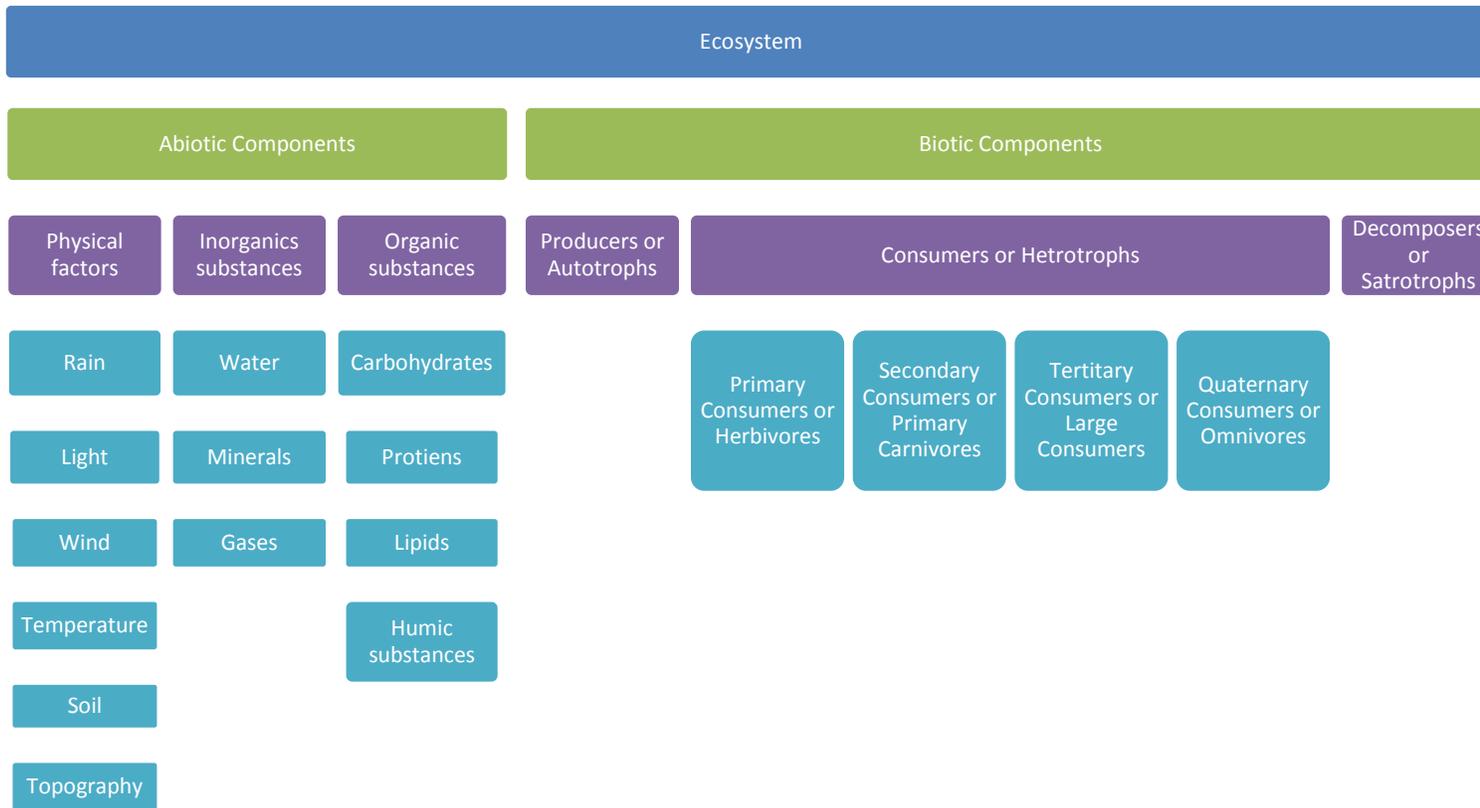
### ***Components of Ecosystem:***

#### ***(1) Structural Components:***

All ecosystems, whether terrestrial, freshwater, marine or man-engineered, have two major components.

1. Abiotic components (Non living)
2. Biotic components (Living)

The whole structure of ecosystem is given in the flow chart.



### 1. Abiotic Components:

The non-living factors or the physical environment prevailing in an ecosystem form the abiotic components. They have a strong influence on the structure, distribution, behavior and interrelationship of organisms.

Abiotic components are mainly divided into 3 main categories:

- (1) **Physical:** Includes climatic factors like rain, temperature, light, wind, humidity, precipitation etc. and Edaphic factors which include soil, pH, topography etc.
- (2) **Inorganic substances:** They include water, minerals and gases. These organic substances are required for synthesis of organic substance and are called biogenetic substance. They play an important role in biogeochemical cycle.
- (3) **Organic substances:** This includes carbohydrates, proteins, lipids and humic substances that link the abiotic components with the biotic components.

### 2. Biotic components:

The living organisms including plants, animals and micro-organisms (bacteria and fungi) that are present in an ecosystem are included in biotic components.

On the basis of their role in the ecosystem the biotic components can be classified into three main groups: (1) Producers, (2) Consumers and (3) Decomposers or Reducers.

(1) Producers:

The green plants have chlorophyll with the help of which they trap solar energy and change it into chemical energy of carbohydrates using simple inorganic compounds namely water and carbon dioxide. This process is known as photosynthesis. As the green plants manufacture their own food they are known as **Autotrophs** (auto means self and trophos means feeder).

The chemical energy stored by the producers is utilized partly by the producers for their own growth and survival and the remaining is stored in the plant parts for their future use.

(2) Consumers:

The animals which lacks chlorophyll are unable to synthesis their own food. Therefore, they depends on the producers for their food. They are known as **Hetrotrophs** (i.e. hetros means other and trophos means feeder).

The consumers are of four types.

(a) Primary consumers or first order consumer or herbivores:

These are the animals which feed on plants or the producers. They are called herbivores. Examples are rabbit, deer, goat, cattle etc.

(b) Secondary consumers or second order consumers or primary carnivores:

The animals which feed on the herbivores are called the primary carnivores. Examples are cats, foxes, snakes etc.

(c) Tertiary consumers or third order consumers:

These are the large carnivores which feed on the secondary consumers. Examples are wolves.

(d) Quaternary consumers or fourth order consumers or omnivores:

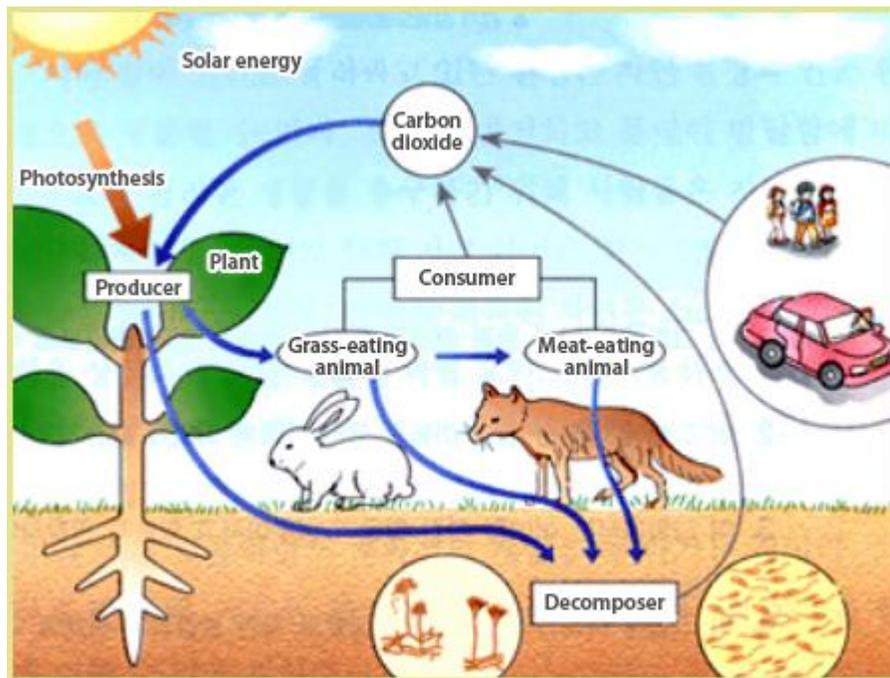
These are the largest carnivore which feed on the tertiary consumers and are not eaten up by any other animals. Examples are lions and tigers.

(3) Decomposers or Reducers:

Bacteria and fungi belong to this category. They breakdown the dead organics materials of producers (plants) and consumers (animals) for their food and release to the environment, the simple inorganic and organic substances produced as byproducts of their metabolisms.

These simple substances are reused by the producers resulting in a cyclic exchange of materials between the biotic community and the abiotic environment of the ecosystem. The decomposers are also known as Saprotrophs (i.e. sapos means rotten or decomposed and trophos means feeder).

Fig.- Components of Ecosystem.



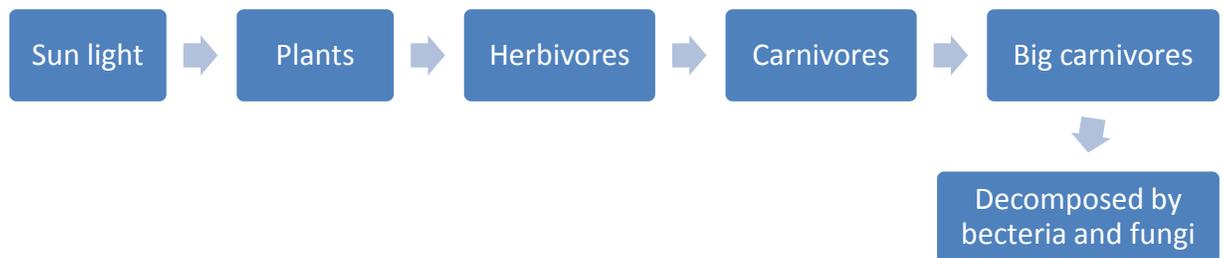
**(2) Functional components of ecosystem:**

The functional components of ecosystem comprises of (1) Food chain, (2) Food web and (3) Bio- Geo chemical cycle.

1. Food chain:

The transfer of food energy from the producers through a series of organisms (herbivores, carnivores and decomposers) with repeated eating and being eaten is known as food chain.

In the ecosystem green plants contain chlorophyll with the help of which they convert solar energy to food which is being taken by different heterotrophs (consumers). Heterotrophs cannot produce food for themselves. The food which is produce by autotrophs (producers) is eaten by herbivores (cow, goats, rabbits etc.) which are eaten by small carnivores which in turn become food for bigger carnivores and the process continues. Ultimately after the life cycle, the dead organism is decomposed by decomposers like bacteria and fungi. The figure is shown below.



**Fig.: Movement of food and energy in food chain.**

Types of food chain:

All ecosystems possess two types of food chains, (a) Grazing food chain and (b) Detritus food chain.

(a) Grazing food chain:

It starts from green plants (producers) and passes through herbivores to carnivores. It is again divided into two parts, (i) Terrestrial food chain and (ii) Aquatic food chain.

(i) Terrestrial food chain:

A food chain showing interconnections of living organisms in terrestrial ecosystem is called terrestrial food chain.

Example-1:



Example-2:



(ii) Aquatic food chain:

A food chain showing interconnections of living organisms in aquatic ecosystem is called aquatic food chain.

Example-1:



Example-2:



(b) Detritus food chain:

The food chain in which micro-organisms such as fungi and bacteria break down and metabolize dead organic matter and act as producer is called detritus food chain.

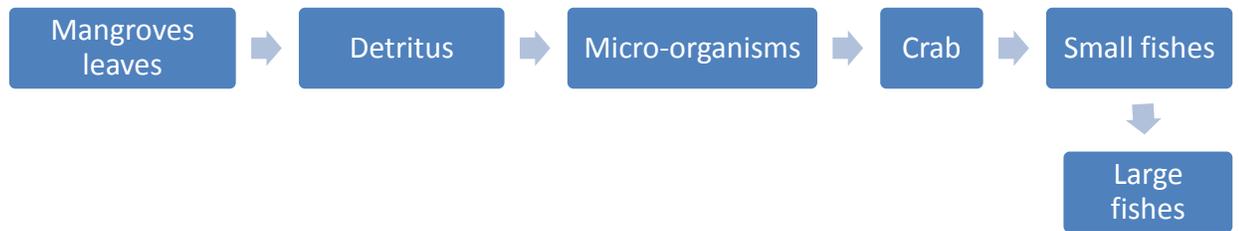
Detritus means dead organic matter.

The detritus food chain starts from dead organic matter which is eaten by micro-organisms (detritivores) which are then eaten by other organisms. In fact, such food chains are less dependent upon the direct solar energy and mainly depend on the supply of organic matter.

The best example of detritus food chain is seen in mangrove ecosystem.

The leaves of mangroves trees fall into the warm shallow waters. The fallen leaf fragments are eaten by detritivores like crabs. The detritivores are eaten by small fishes, which in turn, eaten by large fishes.

Example-1:



Example-2:



References:

1. Environmental Studies by R. Rajagopalan (Oxford University Press)
2. Basics of Environmental Studies by B.R.Shah & Ms.Snehal Popli (Mahajan Publishing House)
3. Environmental Studies by Dr.R.P.Rethaliya & Falguni Patel (Atul Prakashan)

## The Four Spheres

The atmosphere is best envisioned as a transport-conveyor compartment that moves substances from atmospheric sources to receptors. Its storage capacity for matter is small compared to the other spheres, but it has an immense capability for spatially redistributing matter.

The hydrosphere may be envisioned as two compartments: a conveyor, a river system, that collects the substances within the water shed and delivers them to the second hydrologic compartment, oceans.

The lithosphere is the solid shell of inorganic materials at the surface of the Earth. It is composed of soil particles and the underlying rocks down to a depth of 50km. The soil layer is also referred to as the pedosphere, a mixture of inorganic and organic solid matter, air, water and microorganisms. Within the soil, biochemical reactions by microorganisms are responsible for most of the chemical changes of matter. However, soil and rock are mainly storage compartments for deposited matter.

The biosphere is the thin shell of organic matter on the Earth's surface. It occupies the least volume of all of the spheres but it is the heart, or the chemical pump, of much of the flow of matter through nature. Weathering through the hydrological cycle, blowing wind, and volcanic releases are the other mobilizing agents. The biosphere is responsible for the grand scale recycling of energy and matter on Earth. The mobilization of matter by biota is by no means restricted to small geographic regions. The periodic burning of forests and savannas, for example, not only change the chemical form of matter, but also result in long-range atmospheric transport and deposition. Some of the biologically released chemicals, including carbon, nitrogen, and sulfur have long atmospheric residence times, resulting in continental and global-scale redistribution.