**Subject-** Environmental Studies

# Unit 2

## Ecosystems

## Definition and concept of Ecosystem

In nature several communities of organisms live together and interact with each other as well as with their physical environment as an ecological unit. We call it an **ecosystem**. The term 'ecosystem' was coined by **A.G. Tansley** in 1935. **An ecosystem is a functional unit of nature encompassing complex interaction between its biotic (living) and abiotic (non-living) components.** For example- a pond is a good example of ecosystem, shown below.

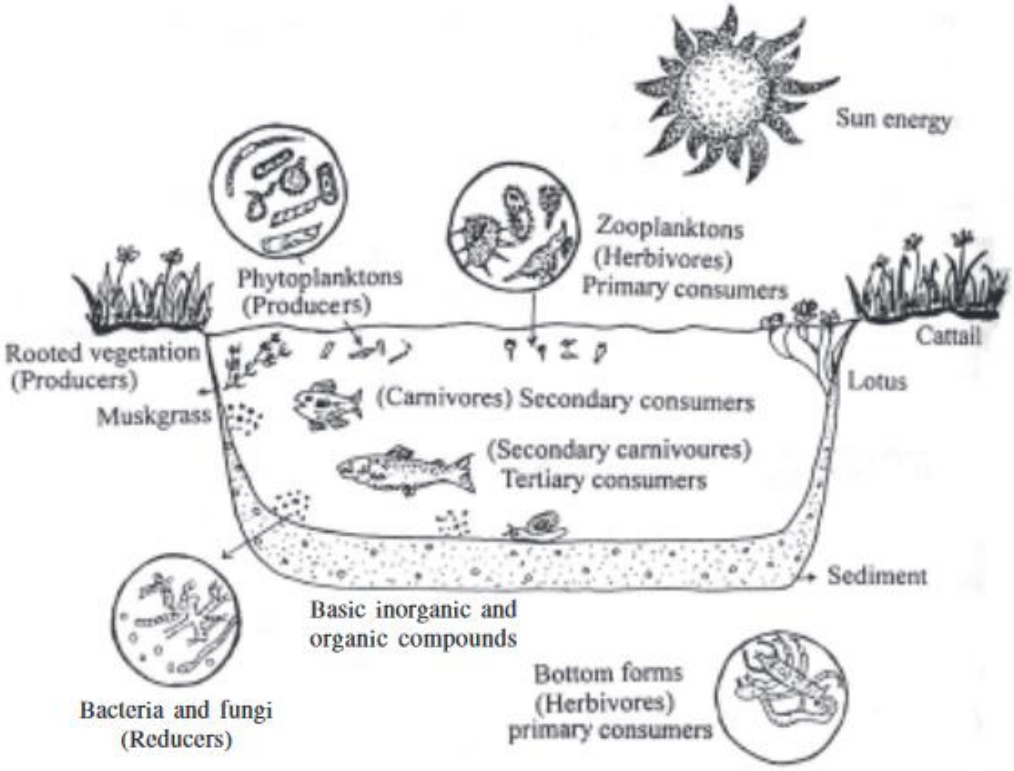
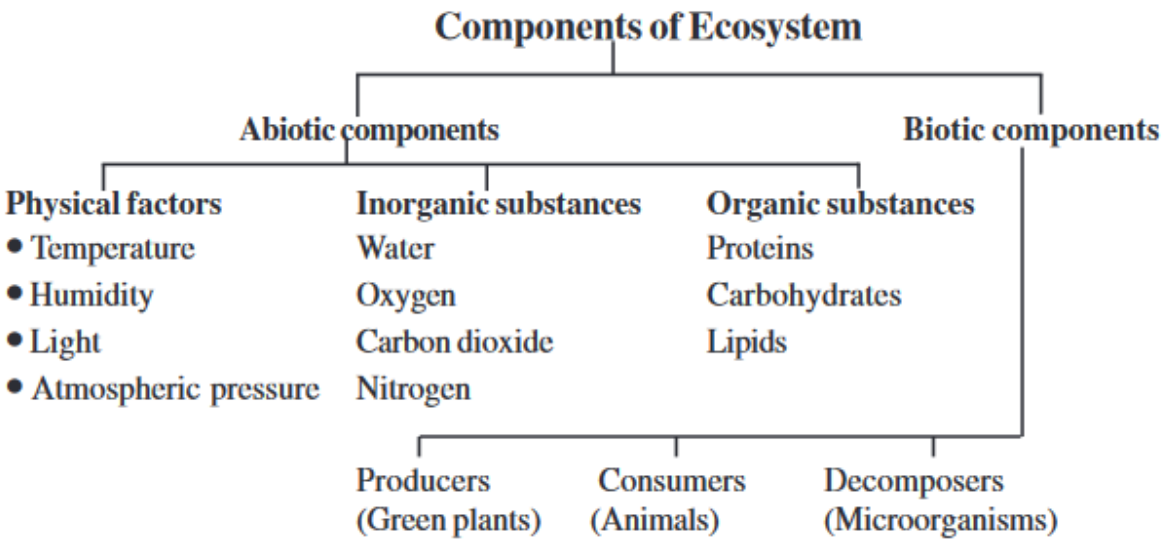



**Fig. Pond Ecosystem**

## Structure of ecosystem (biotic and abiotic components)




## Functions of ecosystem

Ecosystems are complex dynamic system. They perform certain functions. These are:-

(i) Energy flow through food chain

(ii) Nutrient cycling (biogeochemical cycles)

(iii) Ecological succession or ecosystem development

(iv) Homeostasis (or cybernetic) or feedback control mechanisms

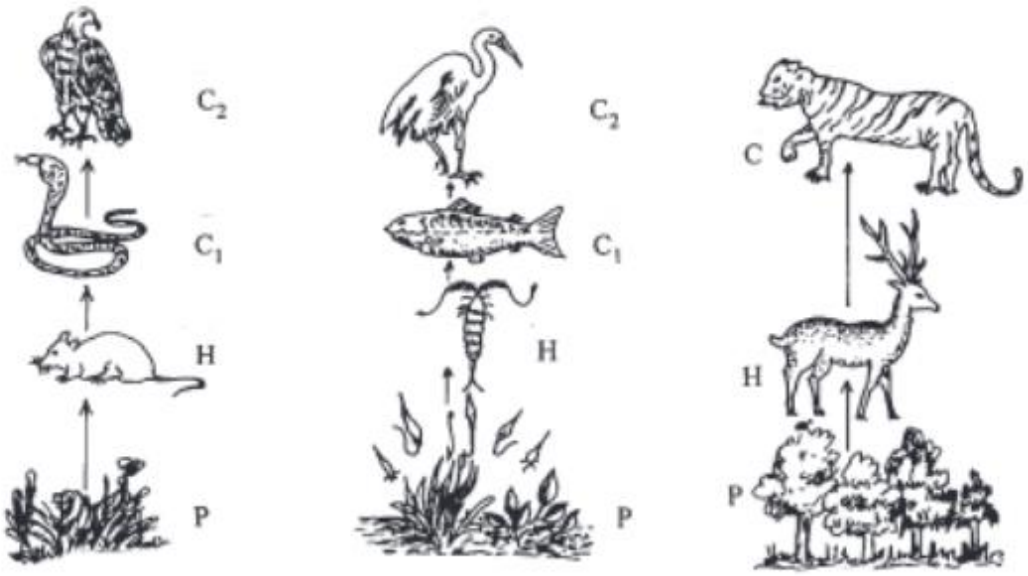
**Food Chain**

Transfer of food energy from green plants (producers) through a series of organisms with repeated eating and being eaten is called a food chain.

**Grasses → Grasshopper → Frog → Snake → Hawk/Eagle**

Each step in the food chain is called **trophic level**. In the above example grasses are 1st, and eagle represents the 5th trophic level.

During this process of transfer of energy some energy (90 per cent) is lost into the system as heat energy and is not available to the next trophic level. **Therefore, the number of steps are limited in a chain to 4 or 5.**




P = Producer, H = Herbivore, C = Carnivore, $C_1$ = First level carnivore, $C_2$ = Top Carnivore

**Autotrophs:** They are the producers of food for all other organisms of the ecosystem. They are largely green plants and convert inorganic material in the presence of solar energy by the process of photosynthesis into the chemical energy (food).

**Herbivores:** The animals which eat the plants directly are called primary consumers or herbivores e.g. insects, birds, rodents and ruminants.

**Carnivores:** They are secondary consumers if they feed on herbivores and tertiary consumers if they use carnivores as their food. For e.g. frog, dog, cat and tiger.

**Omnivores:** Animals that eat both plant and animals e.g. pig, bear and man

**Decomposers:** They take care of the dead remains of organisms at each trophic level and help in recycling of the nutrients e.g. bacteria and fungi.

There are two types of food chains:

(i) **Grazing food chains:** which starts from the green plants that make food for herbivores and herbivores in turn for the carnivores.

(ii) **Detritus food chains:** start from the dead organic matter to the detrivore organisms which in turn make food for protozoan to carnivores etc.

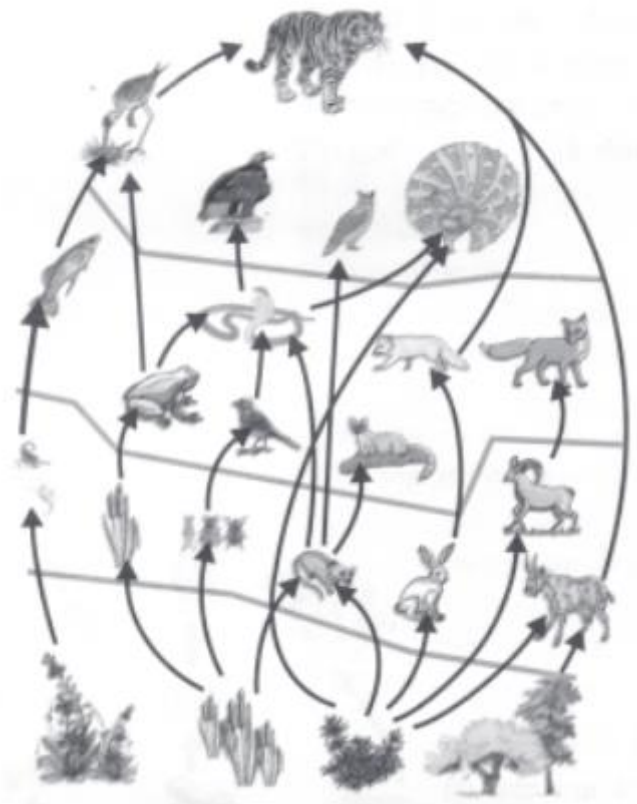
In an ecosystem the two chains are interconnected and make y-shaped food chain. These two types of food chains are: -

(i) Producers → Herbivores → Carnivores

(ii) Producers → Detritus Feeders → Carnivores

**Food web**

Trophic levels in an ecosystem are not linear rather they are interconnected and make a food web. Thus food web is a network interconnected food chains existing in an ecosystem.



**Flow of energy in an ecosystem**

The flow of energy in an ecosystem is always linear or one way (unidirectional). The quantity of energy lowing through the successive trophic levels decreases as shown by the reduced sizes of boxes in fig. below. At every step in a food chain or web the energy received by the organism is used to sustain itself and the left over is passed on to the next trophic level.

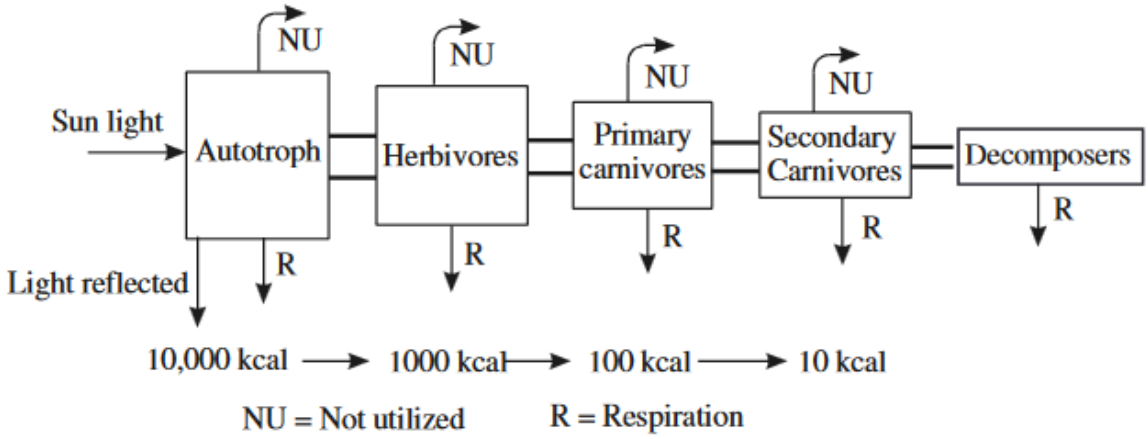



Figure: Model of energy flow through an ecosystem. Boxes indicate the standing crop biomass and pipes indicate the energy flowing. (NU = Not utilized, R =Respiration)

**Significance of studying food chains**

1. It helps in understanding the feeding relations and interactions among different organisms of an ecosystem.

2. It explain the flow of energy and circulation of materials in ecosystems.

3. It help in understanding the concept of biomagnification in ecosystems

**Ecological pyramid**

Ecological pyramids are the graphic representations of trophic levels in an ecosystem. They are pyramidal in shape and they are of three types.

The producers make the base of the pyramid and the subsequent tiers of the pyramid represent herbivore, carnivore and top carnivore levels.

**Pyramid of number:** This represents the number of organisms at each trophic level.

**Pyramid of biomass:** This represents the total standing crop biomass at each trophic level.

**Pyramid of energy:** This pyramid represents the total amount of energy at each trophic level.

**BIOGEOCHEMICAL CYCLES**

**Recycling of the nutrients is called biogeochemical or nutrient cycle (Bio = living, geo = rock, chemical = element).**

In ecosystems flow of energy is linear but that of nutrients is cyclical.

The nutrients cycle from dead remains of organisms released back into the soil by detritivores which are absorbed again i.e. nutrient absorbed from soil by the root of green plants are passed on to herbivores and then carnivores. The nutrients locked in the dead remains of organisms and released back into the soil by detritivores and decomposers.

There are two important components of a biogeochemical cycle-

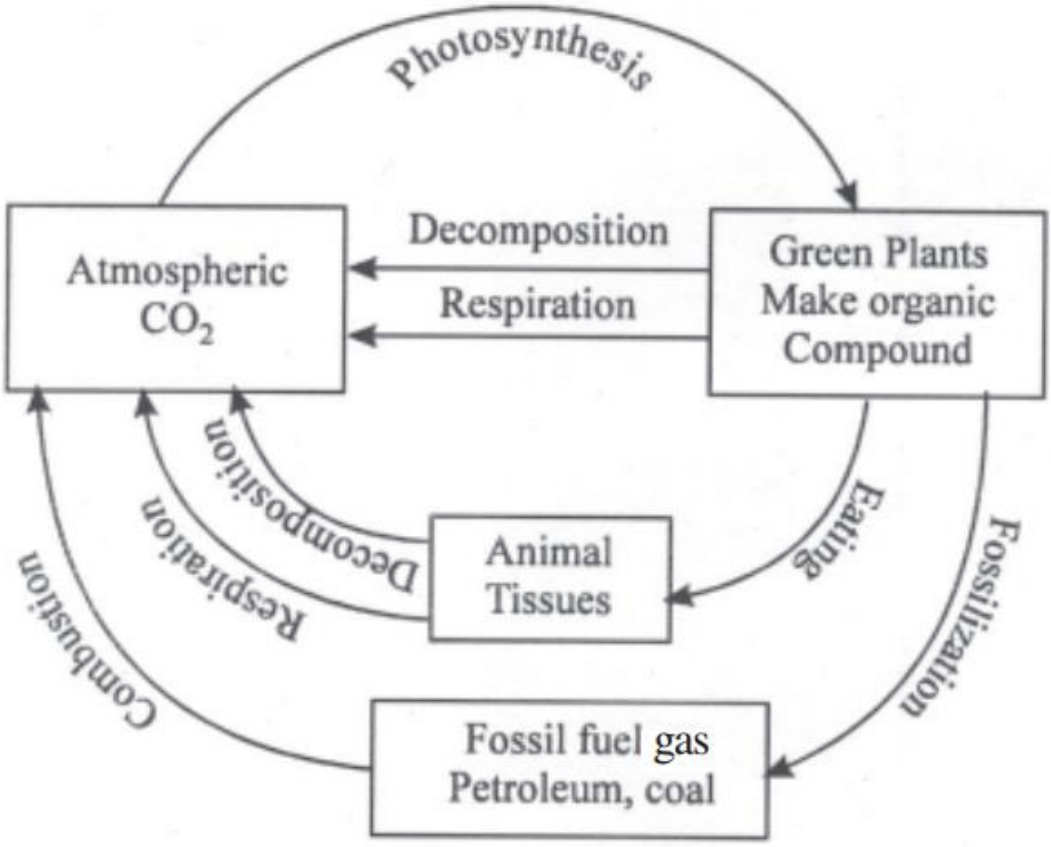
(1) **Reservoir pool**- atmosphere or rock, which stores large amounts of nutrients.

(2) **Cycling pool or compartments of cycle-** They are relatively short storages of carbon in the form of plants and animals.

**Carbon cycle**

**The global carbon cycle consists of following steps-**

- **Photosynthesis**
- **Respiration**
- **Decomposition**
- **Combustion**
- **Impact of human activities**




**Nitrogen cycle**

(a) **Nitrogen fixation:** This process involves conversion of gaseous nitrogen into Ammonia, a form in which it can be used by plants. Atmospheric nitrogen can be fixed by the following three methods:-

(i) Atmospheric fixation: Lightening, combustion and volcanic activity help in the fixation of nitrogen.

(ii) Industrial fixation: At high temperature (400$^{o}$C) and high pressure (200 atm.), molecular nitrogen is broken into atomic nitrogen which then combines with hydrogen to form ammonia.

(iii) Bacterial fixation: There are two types of bacteria-

(i) Symbiotic bacteria e.g. Rhizobium in the root nodules of leguminous plants.

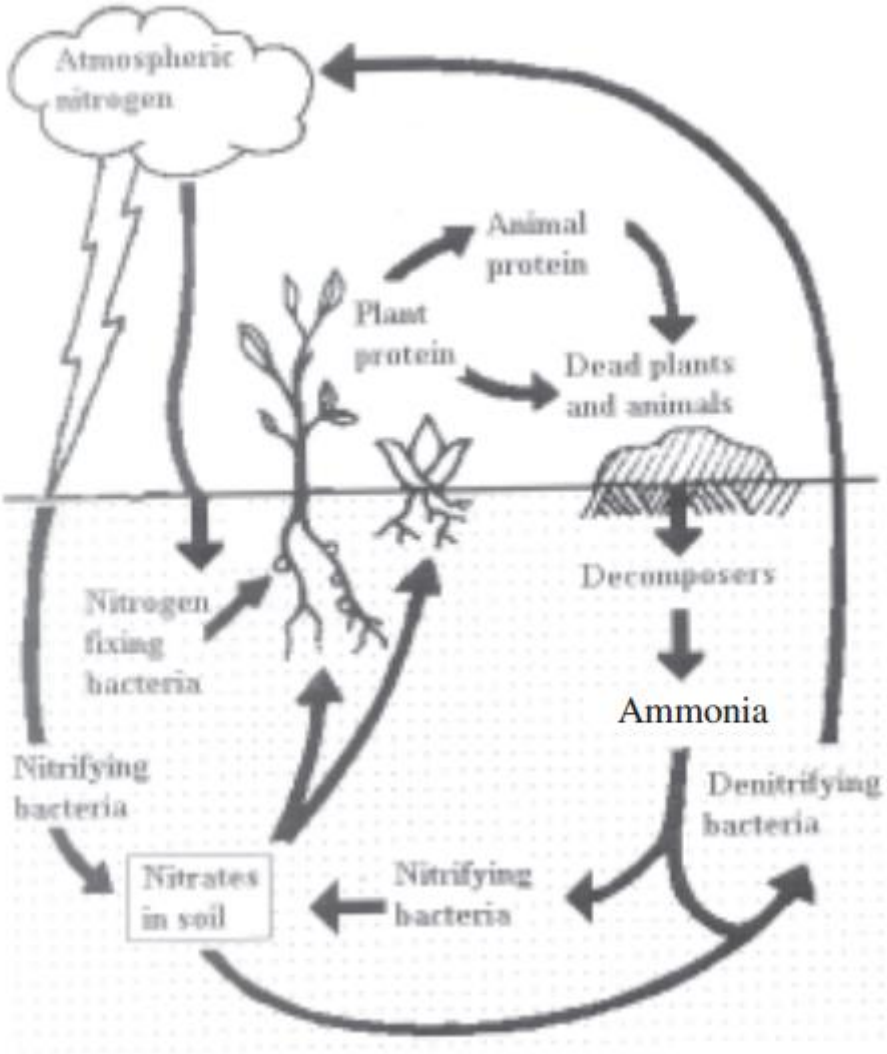
(ii) Free living e.g. Nostoc, Azotobacter, and Cyanobacteria can combine atmospheric or dissolved nitrogen with hydrogen to form ammonia.

**(b) Nitrification:** It is a process by which ammonia is converted into nitrates or nitrites by Nitrosomonas and Nitrococcus bacteria respectively. Another soil bacteria Nitrobacter can covert nitrate into nitrite.

**(c) Assimilation:** In this process nitrogen fixed by plants is converted into organic molecules such as proteins, DNA, RNA etc. These molecules make the plant and animal tissue.

**(d) Ammonification:** Living organisms produce nitrogenous waste products such as urea and uric acid. These waste products as well as dead remains of organisms are converted back into inorganic ammonia by the bacteria. This process is called ammonification. Ammonifying bacteria help in this process.

**(e) Denitrification:** Conversion of nitrates back into gaseous nitrogen is called denitrification. Denitrifying bacteria live deep in soil near the water table as they like to live in oxygen free medium. Denitrification is reverse of nitrogen fixation.


Atmospheric nitrogen
Animal protein
Plant protein
Dead plants and animals
Decomposers
Nitrogen fixing bacteria
Ammonia
Nitrifying bacteria
Denitrifying bacteria
Nitrates in soil
Nitrifying bacteria