UNIT – 4
ECO SYSTEM

Lesson Structure

4.0 Objective:

The basic objective of this unit is to provide comprehensive information to students about the concept, structure and function of Ecosystem. Furthermore, students will also be able to know about the energy flow, forest and pond ecosystem etc.

4.1 Introduction :

The term ecosytem was first coined by A.G. Tansley in 1935 and it was derived from two greek words 'eco' and the 'system' where eco means environment and system means interaction or interdependent. According to 'Tansley'–Ecosytem is the system resulting from the integration of abiotic and biotic componets of an environment. in other words, an ecosystem is a community of living organism in conjunction with the non-living components of their environments interacting as a system. These biotic and abiotic componets are regarded as linked together through nutrient cycles and energy flows.

4.2 Concept of Ecosytem :

Living organisms cannot live isolated from their non-living environment because the latter provides materials and energy for the survival of the former i.e., there is interaction between a biotic community and its environment to produce a stable system: a natural self-sufficeint unit which is known as an ecosystem.

An ecosystem is, therefore, defined as a natural functional ecological unit comprising of living organisms (biotic community) and their non-living (abiotic or physio chemical) environment that

interact to form a stable self-supporting system, A pond, lake, desert, grass land, meadow, forest etc. are common examples of ecosystems.

4.3 Strucutre and Function of Ecosystem :

Each ecosytem has two main components.

1. Abiotic

2. Biotic

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, behaviour and interrelationship of organisms.

Abiotic components are mainly of two types :

(a) **Climatic factors–**Which include rain, temperature, light, wind, humidity etc.

(b) Edaptic factors–which include soil, pH. topography minerals etc.

The functions of important factors in abiotic components are given below :

Soils are much more complex than simple sediments. They contain a mixture of weathered rock fragments, highly altered soil mineral particles, organic matter and living organism. Soil provide nutrients, water, a home and a structural growing medium for organism. The vegetation found growing on top of a soil is closely linked to this component of an ecosystem through nutrient cycle.

The atmosphere provides organisms found within ecosytem with carbon-dioxide for photo-synthesis and oxygen for respiration. The process of evaporation, transpiration and precipitation, cycle water between the atmosphere and the earth's surface. Solar radiation is used in ecosystem to heat the atmosphere and to evaporate and transpire water into the atmosphere. Sun light is also necessary for photosyntesis. Phtosynthhesis provides the energy for plant growth and metabolism, and the organic food for other forms of life.

Most living tissue is composed of a very high percentage of water, up to end even exceeding 90%. The protoplasm of a very few cells can survive if their water content drops below 10%, and most are killed if it is less than 30-50%

Water is the medium by which mineral nutrients enter and are trans-located in plants. It is also necessary for the maintenance of leaf turgidity and is required for phtosyntheitc chemical reaction. Plants and animals receive their water from the Earth's surface and soil. The original source of this water is precipitation from the atmosphere.

2. Biotic Compnents–The living organisms including plants, animals and micro-organisms (Bacteria and fungi) that are present in an ecosystem form the biotic components.

On the basis of their role in the ecosystem the biotic components can be classified into three main groups–

(i) Producers

(ii) Consumers

(iii) Decomposers

(i) 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 compunds namely water and carbon-dioxide. This process is known as photosynthesis. As the green plants manufacture their own food they are known as Autotrophs (i.e. auto = Self, trophos = feeder).

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

(ii) Consumers–The animals lack chlorphyll and are unable to synthesise their own food. Therefore, they depend on the producers for their food. They are known as heterotrophs (i.e. heteros = other, trophos = feeder)

The consumers are of four types, namely :

(a) Primary consumers or first order consumers or Herbivores :

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

(b) Secondary Consumers or Second order consumers or primary carnivores :

The animal 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 Carnivones which feed on the secondary consumers. Examples are wolves.

(d) Quaternary Consumers or Fourth order consumers or Ominivores :

These are the largest carnivores which feed on the tertiary consumers and are not eaten up by any other animal. Examples are Lions and Tigers.

(iii) Decomposers–Bacteria and Fungi belong to this category. They breakdown the dead organic materials of producers (plants) and consumers (animals) for their food and release to the environment, the simple inorganic and organic substances produced as by–products of their metabolism.

These simple substances are reused by the producers resulting in a cyclic exchange of materials between the biotic community and the a biotic environment of the ecosystem. The decomposers are known as saprotrophs (i.e., Sapros = rotten, trophs = feeder).

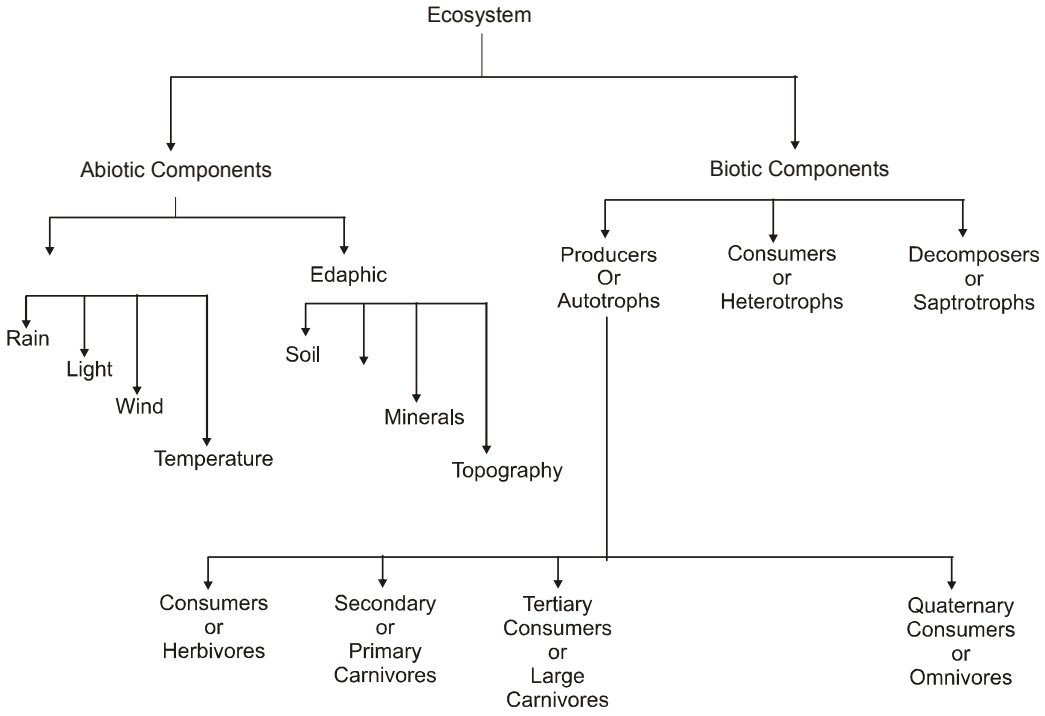


Fig. Structure of an Ecosystem

4.4 Energy Flow :

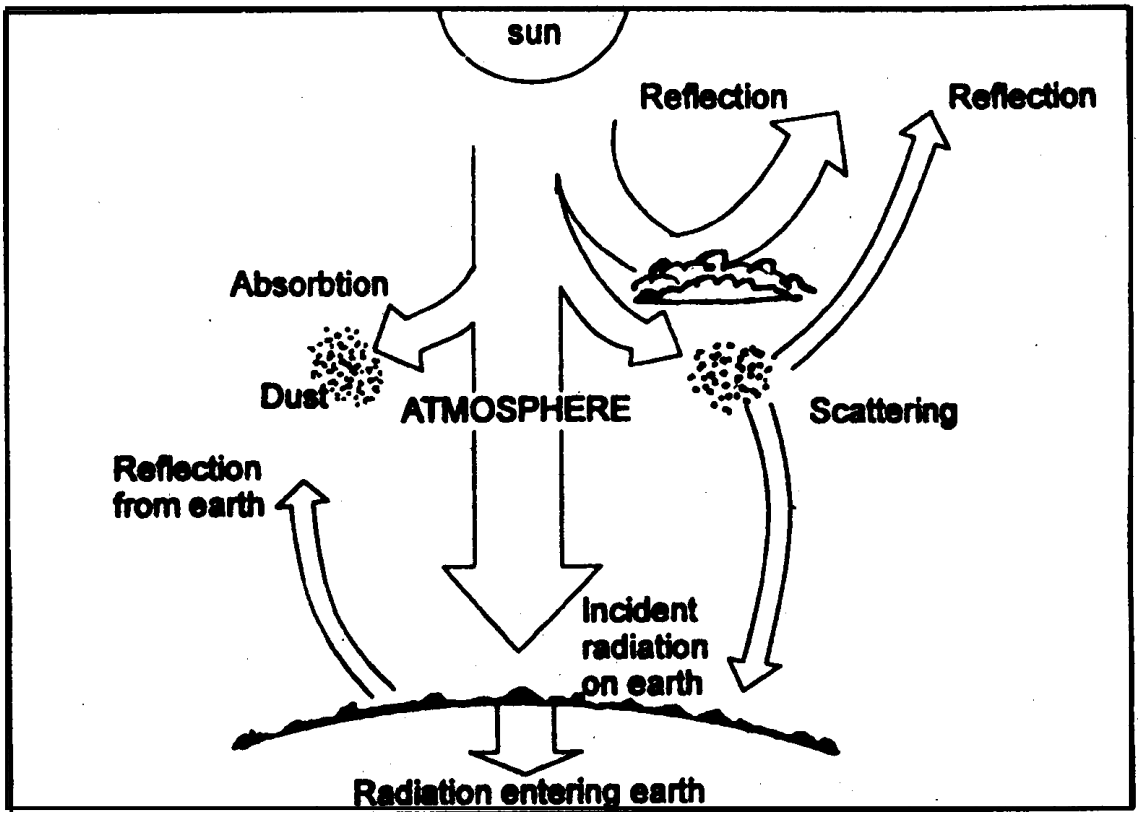
Energy is defined as the ability to do work and is the essence of life. Without energy transfers, there could be no life and no ecological system. The energy used for all the life processes is derived from solar radiant energy. The behaviour of energy is described by the laws of thermodynanics–

(i) Energy may be transformed from one type into another but is never created or distroyed, and

(ii) no process involving an energy transformation will spontaneously occur unless there is a degradation of the energy from a concentrated form into a dispersed form etc.

The radiant energy produced in the sun travels through space in the form of waves, but only a small fraction of solar radiation reaches the earth to provide energy for the biotic components of the ecosystem. Following figure indicates the fate of radiant energy reaching the earth's atmosphere. It becomes clear from the figure that most of the radiation is lost in space by proceses of reflection, abosrption as well as through scattering. Its energy is greatly altered as it passes through cloud cover water and vegetation. The daily imput of sunlight to autotrophic layer in ecosystem varies mostly between 100 and 800 to 300-400 I cal per cm^2 (= 3000 to 4000 K cal per m^2) in the temperate zone. The total radiation flux within different strata of the ecosystem varies from season to season as well as with nature of the earth's surface, thus controlling the distribution and response of organisms accordingly.

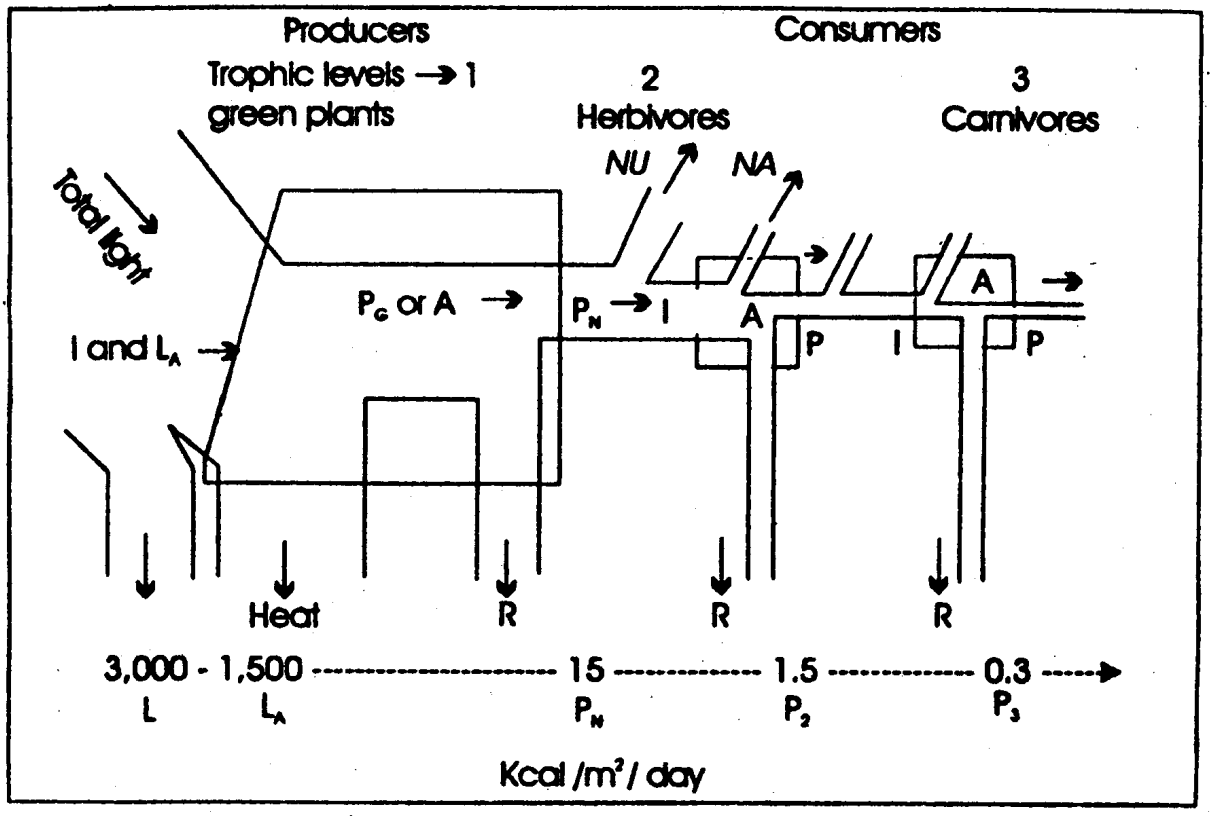
Radiant Energy Reaching Earth's Atmosphere



The energy reaching the earth's surface is transformed and/or abserved by plants and other organisms. It is used by the green plants during photosyntesis by converting the light energy to chemical energy and making it available to other organisms as food. Such energy transfers along the food chain were studied for the first time by Lindman in 1942. He stated that all the functions of an ecosystem could be explained in terms of energy by the knowledge of two attributes of each trophic level the level of energy storage and the efficiency of energy transfer.

The process of energy flow in an ecosystem has been depicted by Odum in a simplified diagram as shown in following figure, where the 'boxes' represent the trophic levels and the 'pipes' depict the energy flow in and out of each level. It becomes clear from his simplified models that the energy flow is greatly reduced at each excessive trophic level from producers to herbivores and then to carnivores.

Energy Flow in a Food Chain



4.5 Forest and Pond Ecosystem :

Forest Ecosystem–About 30% of the land area of the earth is under forest cover, but due to man's intervention this area is gradually becoming smaller. But still forest ecosystem is very important. The coniferous forest stretch as broad belts across, North America and Euresia. On the other hand temperate deciduous forests occupy areas in eastern North America, Parts of Europe, Japan and also in Australia. Among forests the tropical ever green forests are found in the tropical regions.

In the forest ecosystem, the biotic components are the organic substances present in the soil and atmosphere and also minerals present in dead organic debris. The producers are trees of different species. The primary consumers are animals of various types, while secondary consumers include carnivores like lions, tigers, snakes, birds, lizards, foxes etc. The forest ecosystems are of great concern

from the environmental point of view.The rate of explioitation of forest by man is growing day by day. Thus causing a great concern to all nations of the world because of its impact over global climate and on several animal species.

Pond Ecosystem–A pond is a good example of fresh water ecosystem, which exhibits a self-sufficient, self-regulating system. A pond is a place where living organisms not only live but interact with abiotic and biotic components, thus forming an ecosystem which is different from other systems. Similarly, lakes, swampy regions and delta regions of rivers have their own ecosystems in which producers, consumers and decomposers interact and are responsible for the unique ecosystem of each.

4.6 Summary :

An 'ecosystem' is system formed by the interactions of a variety of individual organisms with each other and with their physical environment. Ecosystems are nearly self-contained so that the exchange of nutrients with in the system is much greater than exchange with other system. An ecosystem, thus, is not entirely a biological entity. Any complete description of an ecosystem must include the physical environment as well as the biological compoents and the interactions between the two.

Ecosystems are of diverse types-mostly natural, but there are a few which are man-made or modified by man's activity.

4.7 Questions for Exercise :

1. What is Ecosystem ? Discuss it on the basis of concept of ecosystem.
2. Define Ecosystem? Discuss the structure and function of Ecosystem.
3. Write and essay on Energy flow in Ecosystem?
4. Describe the forest and pond Ecosystem.

4.8 Suggested Readings :

- Smith, L.R. : Man and Environment : An Ecosystem Approach
- Santra, S.C. : Environmental Science
- Saxena, H.M. : Environmental Geogrraphy

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