

Module – III

Environment: Introduction, Multidisciplinary nature of environmental studies- Definition, scope and importance, Need for public awareness.

Ecosystem: Concept, Energy flow, Structure and function of an ecosystem, Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems, Ecological succession.

➤ Environment

Definition

Environmental studies deals with every issue that affects an organism. It is essentially a multidisciplinary approach that brings about an appreciation of our natural world and human impacts on its integrity. It is an applied science as it seeks practical answers to making human civilization sustainable on the earth's finite resources.

• Scope

As our surroundings were originally natural landscapes such as a forest, a river, a mountain, a desert, or a combination of these elements. Most of us live in landscapes that have been heavily modified by human beings, in villages, towns or cities. But even who live in cities get our food supply from surrounding villages and these in turn are dependent on natural landscapes such as forests, grasslands, rivers, seashores, for resources such as water for agriculture, fuel wood, fodder, and fish. Thus our daily lives are linked with our surroundings and inevitably affects them. All peoples are using water to drink and for other day-to-day activities. Air for breath, use resources for food, depends on the community of living plants and animals which form a web of life, of which we are also a part.

Our dependence on nature is so great that we cannot continue to live without protecting the earth's environmental resources. Thus most traditions refer to our environment as 'Mother Nature' and most traditional societies have learned that respecting nature is vital for their livelihoods. This has led to many cultural practices that helped traditional societies protect and preserve their natural resources.

• Importance

Environment is not a single subject. It is an integration of several subjects that include both Science and Social Studies.

In a world natural resources are limited. Water, air, soil, minerals, oil, the products are get from forests, grasslands, oceans and from agriculture and livestock, are all a part of our life support systems. Without them, life itself would be impossible. As keep increasing in numbers and the quantity of resources uses also increases, the earth's resource base must inevitably shrink. The earth cannot be expected to sustain this expanding level of utilization of resources. Added to this is misuse of resources. Wasting or polluting large amounts of nature's clean water, Creating more and more material like plastic that discard after a single use and wasting colossal amounts of food,

which is discarded as garbage is polluting the environment. Manufacturing processes create solid waste by products that are discarded, as well as chemicals that flow out as liquid waste and pollute water, and gases that pollute the air. Increasing amounts of waste cannot be managed by natural processes. These accumulate in our environment, leading to a variety of diseases and other adverse environmental impacts now seriously affecting all our lives. Air pollution leads to respiratory diseases, water pollution to gastro-intestinal diseases, and many pollutants are known to cause cancer.

Improving this situation will only happen if each of us begins to take actions in our daily lives that will help preserve our environmental resources. Cannot expect Governments alone to manage the safeguarding of the environment, nor expect other people to prevent environmental damage.

➤ **NEED FOR PUBLIC AWARENESS**

As the earth's natural resources are diminishing gradually and environment is being increasingly degraded by human activities, it is evident that something needs to be done to save environment. Along with government support also needed to save environment. It is the prevention of environment degradation in which all take part that must become a part of all our lives. Just as for any disease, prevention is better than cure. To prevent ill-effects on our environment by our actions is economically more viable than cleaning up the environment once it is damaged. Individually play a major role in environment management. Reduce wasting natural resources and act as watchdogs that inform the Government about sources that lead to pollution and degradation of our environment.

This can only be made possible through mass public awareness. Mass media such as newspapers, radio, television, strongly influence public opinion. However, someone has to bring this about. If each of us feels strongly about the environment, the press and media will add to our efforts. Politicians in a democracy always respond positively to a strong publicly supported movement. Thus if you join an NGO that supports conservation, politicians will make green policies.

• **Institutions in Environment**

There have been several Government and Nongovernment organizations that have led to environmental protection in our country. They have led to a growing interest in environmental protection and conservation of nature and natural resources. The traditional conservation practices that were part of ancient India's culture have however gradually disappeared. Public awareness is thus a critical need to further environmental protection. Among the large number of institutions that deal with environmental protection and conservation, a few well-known organizations include government organizations such as the BSI and ZSI, and NGOs such as BNHS, WWF-I, etc.

• **People in Environment**

There are several internationally known environmental thinkers. Among those who have made landmarks, the names that are usually mentioned are Charles Darwin, Ralph Emerson, Henry Thoreau, John Muir, Aldo Leopold, Rachel Carson and EO Wilson. Each of these thinkers looked at the environment from a completely different perspective.

➤ **Ecosystem**

An 'Ecosystem' is a region with a specific and recognizable landscape form such as forest, grassland, desert, wetland or coastal area. The nature of the ecosystem is based on its geographical features such as hills, mountains, plains, rivers, lakes, coastal areas or islands. It is also controlled by climatic conditions such as the amount of sunlight, the temperature and the rainfall in the region. The geographical, climatic and soil characteristics form its non-living (abiotic) component. These features create conditions that support a community of plants and animals that evolution has produced to live in these specific conditions. The living part of the ecosystem is referred to as its biotic component.

The living community of plants and animals in any area together with the non-living components of the environment such as soil, air and water, constitute the ecosystem.

Understanding ecosystems

Natural ecosystems include the forests, grasslands, deserts, and aquatic ecosystems such as ponds, rivers, lakes, and the sea. Man modified ecosystems include agricultural land and urban or industrial land use patterns.

- **Ecosystem degradation**

Ecosystems are the basis of life itself. The natural ecosystems in the wilderness provide a variety of products and are regions in which a number of vital ecological processes are present, without human civilization would not be able to exist.

Ecosystems are however frequently disrupted by human actions which lead to the extinction of species of plants and animals that can live only in the different natural ecosystems. Some species if eliminated seriously affect the ecosystem.

These are called 'keystone' species. Extinction occurs due to changes in land use. Forests are deforested for timber, wetlands are drained to create more agricultural land and semi arid grasslands that are used as pastures are changed into irrigated fields. Pollution from industry and waste from urban settings can also lead to extinction of several species.

The reason for the depletion of natural resources is twofold – our rapidly exploding population that needs to sustain itself on resources, and the growth of affluent societies, which consume and waste a very large proportion of resources and energy. Increasing extraction of resources is at the cost of natural ecosystems, leading to a derangement of their important functions. Each of us in our daily lives uses a variety of resources.

If tracked back to their source, one finds that the resources were originally obtained from nature and natural ecosystems. Our insensitivity to using resources carefully has produced societies that nature can no longer sustain. If one thinks before wasting resources such as water, reusing and recycling paper, using less plastic that are non-degradable, ruminatively this can have positive implications on the integrity of our natural resource base and conserve the resources that nature provides.

- **Resource utilization**

Most traditional societies used their environment sustainably. Though inequality in resource utilization has existed in every society, the number of individuals that used a large proportion of

resources was extremely limited. In recent times the proportion of 'rich' people in affluent societies, grew rapidly. Inequality thus became a serious problem. Whereas in the past many resources such as timber and fuel wood from the forest were extracted sustainably, this pattern has drastically changed during the last century.

The economically better off sections began to use greater amounts of forest products, while those people who lived in the forest became increasingly poor. Similarly the building of large irrigation projects led to wealth in those areas that had canals, while those who had to remain dependent on a constant supply of water from the river itself, found it difficult to survive.

➤ **STRUCTURE AND FUNCTIONS OF AN ECOSYSTEM**

Structural aspects

Components that make up the structural aspects of an ecosystem include:

- 1) Inorganic aspects – C, N, CO₂, H₂O.
- 2) Organic compounds – Protein, Carbohydrates, Lipids – link abiotic to biotic aspects.
- 3) Climatic regimes – Temperature, Moisture, Light & Topography.
- 4) Producers – Plants.
- 5) Macro consumers – Phagotrophs – Large animals.
- 6) Micro consumers – Saprotrophs, absorbers fungi.

Functional aspects

- 1) Energy cycles.
- 2) Food chains.
- 3) Diversity-inter linkages between organisms.
- 4) Nutrient cycles-biogeochemical cycles.
- 5) Evolution.

Since each ecosystem has a non-living and a living part that are linked to each other, one needs to look around us and observe this closely. This is an important aspect that is a vital part of our lives. The non-living components of an ecosystem are the amount of water, the various inorganic substances and organic compounds, and climatic conditions such as rainfall and temperature, which depend on geographical conditions and location which is also related to the amount of sunlight. The living organisms in an ecosystem are inseparable from their habitat.

The living component of plant life ranges from extremely small bacteria, which live in air, water and soil, algae which live in fresh and salt water, to the terrestrial plants which range from grasses and herbs that grow after the monsoon every year, to the giant long-lived trees of the forest. The plants convert energy from sunlight into organic matter for their growth. They thus function as producers in the ecosystem. The living component of the animal world ranges from microscopic animals, to small insects and the larger animals such as fish, amphibia, reptiles, birds and mammals. Man is just one of the 1.8 million species of plants and animals that inhabit the earth.

➤ **ENERGY FLOW IN THE ECOSYSTEM**

Every ecosystem has several interrelated mechanisms that affect human life. These are the water cycle, the carbon cycle, the oxygen cycle, the nitrogen cycle and the energy cycle. While every

ecosystem is controlled by these cycles, in each ecosystem its abiotic and biotic features are distinct from each other.

All the functions of the ecosystem are in some way related to the growth and regeneration of its plant and animal species. These linked processes can be depicted as the various cycles. These processes depend on energy from sunlight.

During photosynthesis carbon dioxide is taken up by plants and oxygen is released. Animals depend on this oxygen for their respiration.

The water cycle depends on the rainfall, which is necessary for plants and animals to live. The energy cycle recycles nutrients into the soil on which plant life grows. Our own lives are closely linked to the proper functioning of these cycles of life. If human activities go on altering them, humanity cannot survive on our earth.

- **The Water Cycle**

When it rains, the water runs along the ground and flows into rivers or falls directly into the sea. A part of the rainwater that falls on land percolates into the ground. This is stored underground throughout the rest of the year. Water is drawn up from the ground by plants along with the nutrients from the soil. The water is transpired from the leaves as water vapour and returned to the atmosphere. As it is lighter than air, water vapour rises and forms clouds. Winds blow the clouds for long distances and when the clouds rise higher, the vapour condenses and changes into droplets, which fall on the land as rain. Though this is an endless cycle on which life depends, man's activities are making drastic changes in the atmosphere through pollution which is altering rainfall patterns. This is leading to prolonged drought periods extending over years in countries such as Africa, while causing floods in countries such as the US. El Nino storms due to these effects have devastated many places in the last few years.

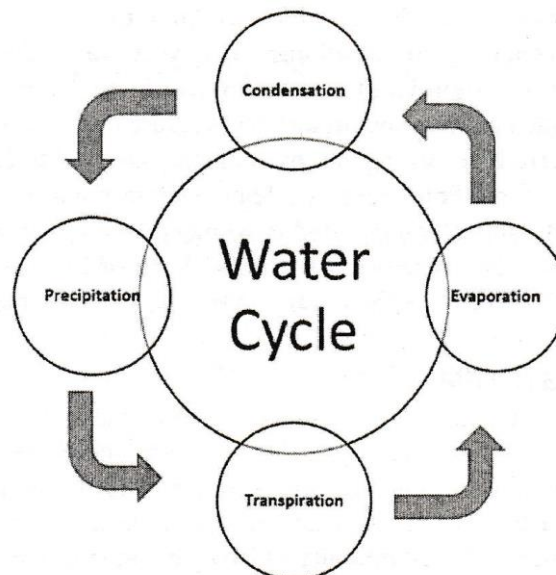


Fig: Water Cycle

- **The Carbon cycle**

The carbon, which occurs in organic compounds, is included in both the abiotic and biotic parts of the ecosystem.

Carbon is a building block of both plant and animal tissues.

In the atmosphere, carbon occurs as carbon dioxide (CO_2). In the presence of sunlight, plants take up carbon dioxide from the atmosphere through their leaves. The plants combine carbon dioxide with water, which is absorbed by their roots from the soil. In the presence of sunlight they are able to form carbohydrates that contain carbon.

This process is known as photosynthesis. Plants use this complex mechanism for their growth and development. In this process, plants release oxygen into the atmosphere on which animals depend for their respiration. Plants therefore help in regulating and monitoring the percentage of Oxygen and Carbon dioxide in the earth's atmosphere. All of mankind thus depends on the oxygen generated through this cycle. It also keeps the CO_2 at acceptable levels.

Herbivorous animals feed on plant material, which is used by them for energy and for their growth. Both plants and animals release carbon dioxide during respiration. They also return fixed carbon to the soil in the waste they exerted.

When plants and animals die they return their carbon to the soil. These processes complete the carbon cycle.

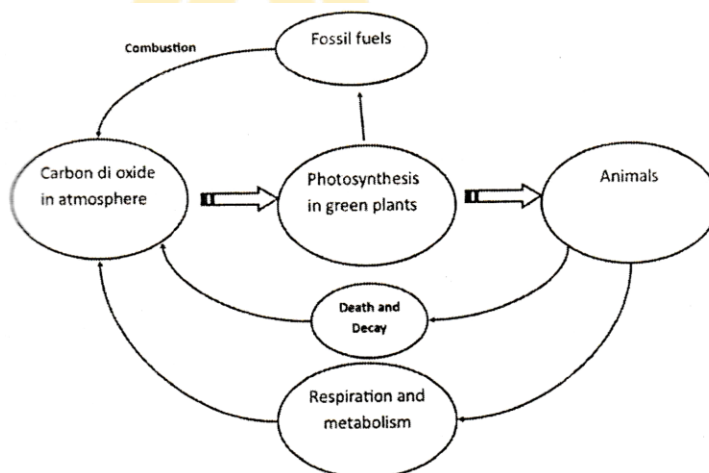


Fig: Carbon Cycle

- **The Nitrogen Cycle**

Carnivorous animals feed on herbivorous animals that live on plants. When animals defecate, this waste material is broken down by worms and insects mostly beetles and ants. These small 'soil animals' break the waste material into smaller bits on which microscopic bacteria and fungi can act. This material is thus broken down further into nutrients that plants can absorb and use for their growth. Thus nutrients are recycled back from animals to plants. Similarly the bodies of dead animals are also broken down into nutrients that are used by the plants for their growth. Thus the nitrogen cycle on which life is dependent is completed.

Nitrogen fixing bacteria and fungi in soil gives this important element to plants, which absorb it as nitrates. The nitrates are a part of the plant's metabolism, which help in forming new plant proteins.

This is used by animals that feed on the plants. The nitrogen is then transferred to carnivorous animals when they feed on the herbivores. Thus our own lives are closely interlinked to soil animals, fungi and even bacteria in the soil. When we think of food webs, we usually think of the large mammals and other large forms of life. But we need to understand that it is the unseen small animals, plants and microscopic forms of life that are of great value for the functioning of the ecosystem.

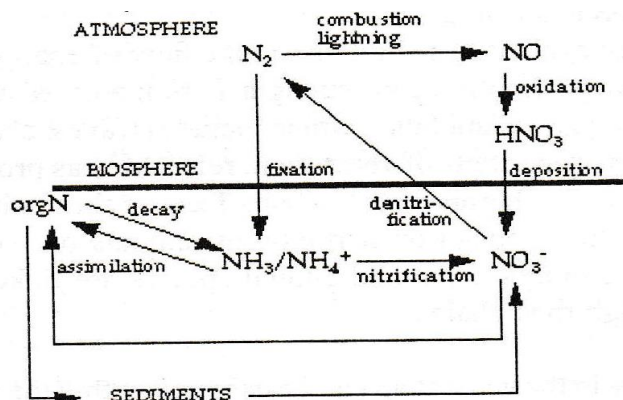


Fig: Nitrogen Cycle

- **The Oxygen Cycle**

Oxygen is taken up by plants and animals from the air during respiration. The plants return oxygen to the atmosphere during photosynthesis. This links the Oxygen Cycle to the Carbon Cycle. Deforestation is likely to gradually reduce the oxygen levels in our atmosphere. Thus plant life plays an important role in our lives which we frequently do not appreciate. This is an important reason to participate in afforestation programs.

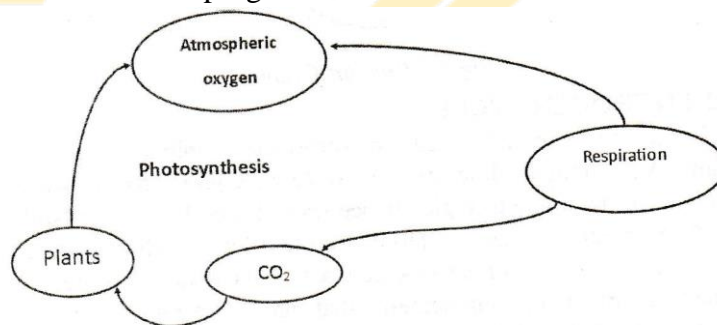


Fig: Oxygen Cycle

- **The Energy Cycle**

The energy cycle is based on the flow of energy through the ecosystem. Energy from sunlight is converted by plants themselves into growing new plant material which includes leaves, flowers, fruit, branches, trunks and roots of plants.

Since plants can grow by converting the sun's energy directly into their tissues, they are known as producers in the ecosystem. The plants are used by herbivorous animals as food, which gives them energy. A large part of this energy is used up for day to day functions of these animals such as breathing, digesting food, supporting growth of tissues, maintaining blood flow and body

temperature. Energy is also used for activities such as looking for food, finding shelter, breeding and bringing up young ones. The carnivores in turn depend on herbivorous animals on which they feed. Thus the different plant and animal species are linked to one another through food chains. Each food chain has three or four links. However as each plant or animal can be linked to several other plants or animals through many different linkages and these inter-linked chains can be depicted as a complex food web. This is thus called the 'web of life' that shows that there are thousands of interrelationships in nature.

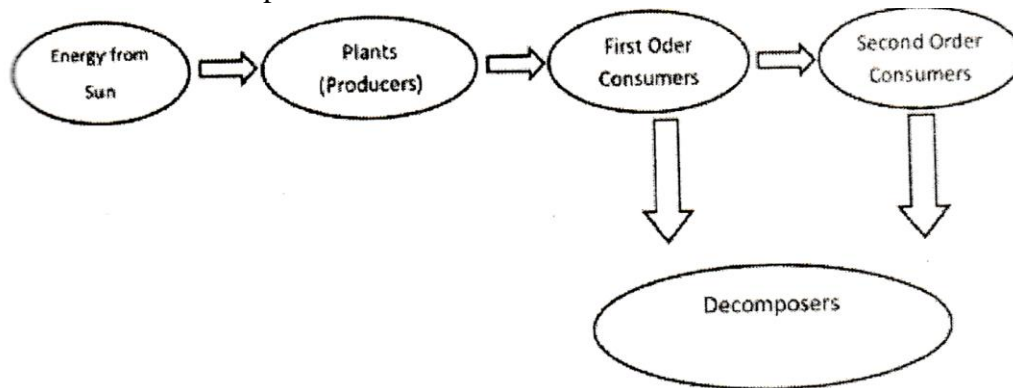


Fig: Energy Cycle

- **Integration of cycles in Nature**

These cycles are a part of global life processes.

These bio geochemical cycles have specific features in each of the ecosystems. These cycles are however linked to those of adjacent ecosystems.

Their characteristics are specific to the plant and animal communities in the region. This is related to the geographical features of the area, the climate and the chemical composition of the soil. Together the cycles are responsible for maintaining life on earth. If mankind disturbs these cycles beyond the limits that nature can sustain, they will eventually break down and lead to a degraded earth on which man will not be able to survive.

- **The food chains**

The transfer of energy from source in plants through a series of organisms by eating and being eaten constitutes **food chain**.

The most obvious aspect of nature is that energy must pass from one living organism to another. When herbivorous animals feed on plants, energy is transferred from plants to animals. In an ecosystem, some of the animals feed on other living organisms, while some feed on dead organic matter. At each linkage in the chain, a major part of the energy from the food is lost for daily activities.

Each chain usually has only four to five such links. However a single species may be linked to a large number of species.

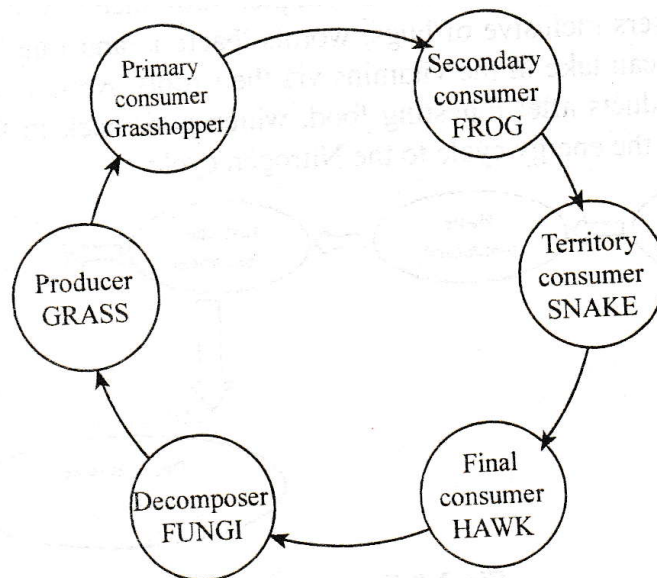


Fig: Food Chain

➤ The food webs

These food chain are not isolated sequences, but are interconnected with each other. This interlocking pattern is called as **food web**.

In an ecosystem there are a very large number of interlinked chains. This forms a food web. If the linkages in the chains that make up the web of life are disrupted due to human activities that lead to the loss or extinction of species, the web breaks down.

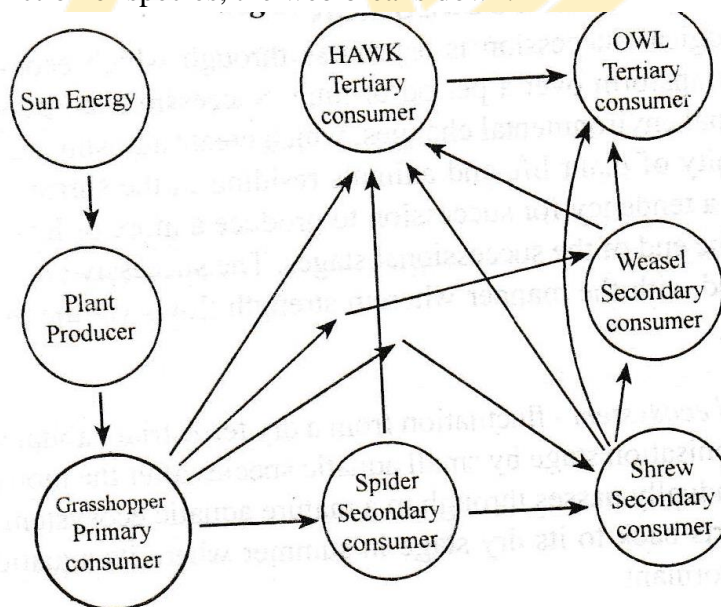


Fig: Food Web

➤ The ecological pyramids

Each step of the food web is called a trophic level. These trophic level together form the **ecological pyramid**.

In an ecosystem, green plants – the producers, utilize energy directly from sunlight and convert it into matter. A large number of these organisms form the most basic, or first ‘trophic level’ of the food pyramid. The herbivorous animals that eat plants are at the second trophic level and are called primary consumers. The predators that feed on them form the third trophic level and are known as secondary consumers.

Only a few animals form the third trophic level consisting of carnivores at the apex of the food pyramid. This is how energy is used by living creatures and flows through the ecosystem from its base to the apex. Much of the energy is used up in activities of each living organism.

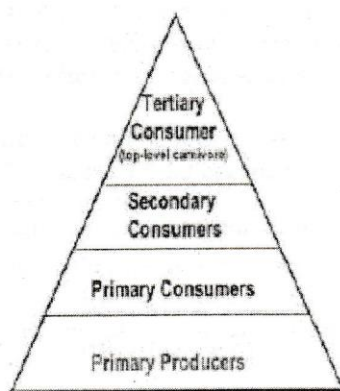


Fig : Energy pyramid

➤ **ECOSYSTEMS**

➤ **Forest ecosystem**

Forests are formed by a community of plants which is predominantly structurally defined by its trees, shrubs, climbers and ground cover.

Natural vegetation looks vastly different from a group of planted trees, which are in orderly rows. The most ‘natural’ undisturbed forests are located mainly in our National Parks and Wildlife Sanctuaries. The landscapes that make up various types of forests look very different from each other. Their distinctive appearance is a fascinating aspect of nature. Each forest type forms a habitat for a specific community of animals that are adapted to live in it.

The non-living or abiotic aspects of the forest:

The type of forest depends upon the abiotic conditions at the site. Forests on mountains and hills differ from those along river valleys. Vegetation is specific to the amount of rainfall and the local temperature which varies according to latitude and altitude. Forests also vary in their plant communities in response to the type of soil.

The living or the biotic aspects of the forest:

The plants and animals form communities that are specific to each forest type.

For instance coniferous trees occur in the Himalayas. Mangrove trees occur in river deltas. Thorn trees grow in arid areas. The snow leopard lives in the Himalayas while the leopard and tiger live

in the forests of the rest of India. Wild sheep and goats live high up in the Himalayas. Many of the birds of the Himalayan forests are different from the rest of India. Evergreen forests of the Western Ghats and North East India are most rich in plant and animal species.

- **Types of forest ecosystem**

Forests in India can be broadly divided into Coniferous forests and Broad leaved forests.

Coniferous forests: Grow in the Himalayan mountain region, where the temperatures are low. These forests have tall stately trees with needle like leaves and downward sloping branches so that the snow can slip off the branches.

Broadleaved forests: They have several types, such as evergreen forests, deciduous forests, thorn forests, and mangrove forests. Broadleaved forests have large leaves of various shapes.

Evergreen forests grow in the high rainfall areas of the Western Ghats and North East India and the Andaman and Nicobar Islands. These forests grow in areas where the monsoon lasts for several months. There is no dry leafless phase as in a deciduous forest. An evergreen forest thus looks green throughout the year. The trees overlap with each other to form a continuous canopy. Thus very little light penetrates down to the forest floor.

Deciduous forests are found in regions with a moderate amount of seasonal rainfall that lasts for only a few months. The deciduous trees shed their leaves during the winter and hot summer months. The forest frequently has a thick undergrowth as light can penetrate easily onto the forest floor.

Thorn forests are found in the semi-arid regions of India. The trees, which are sparsely distributed, are surrounded by open grassy areas. Thorny plants are able to conserve water.

Mangrove forests grow along the coast especially in the river deltas. These plants are able to grow in a mix of saline and fresh water. They grow luxuriantly in muddy areas covered with silt that the rivers have brought down. The mangrove trees have breathing roots that emerge from the mud banks.

Conservation of forest ecosystem: The forests can be conserved only when its resources are used carefully. This can be done by using alternate sources of energy instead of fuelwood. There is a need to grow more trees than are cut down from forests every year for timber. Afforestation needs to be done continuously from which fuelwood and timber can be judiciously used. The natural forests with all their diverse species must be protected as National Parks and wildlife sanctuaries where all the plants and animals can be preserved.

- **Forest types in India**

The forest type depends upon the abiotic factors such as climate and soil characteristics of a region. Forests in India can be broadly divided into Coniferous forests and Broadleaved forests.

They can also be classified according to the nature of their tree species – evergreen, deciduous, xerophytic or thorn trees, mangroves, etc.

They can also be classified according to the most abundant species of trees such as Sal or Teak forests. In many cases a forest is named after the first three or four most abundant tree species.

Coniferous forests grow in the Himalayan mountain region, where the temperatures are low.

These forests have tall stately trees with needlelike leaves and downward sloping branches so that the snow can slip off the branches. They have cones instead of seeds and are called gymnosperms.

Broadleaved forests have several types, such as evergreen forests, deciduous forests, thorn forests, and mangrove forests. Broadleaved forests have large leaves of various shapes.

Evergreen forests grow in the high rainfall areas of the Western Ghats, North Eastern India and the Andaman and Nicobar Islands. These forests grow in areas where the monsoon lasts for several months. Some even get two monsoons, such as in Southern India.

Evergreen plants shed a few of their leaves throughout the year.

There is no dry leafless phase as in a deciduous forest. An evergreen forest thus looks green throughout the year. The trees overlap with each other to form a continuous canopy.

Thus very little light penetrates down to the forest floor. Only a few shade loving plants can grow in the ground layer in areas where some light filters down from the closed canopy.

The forest is rich in orchids and ferns.

The barks of the trees are covered in moss. The forest abounds in animal life and is most rich in insect life.

Deciduous forests are found in regions with a moderate amount of seasonal rainfall that lasts for only a few months.

Most of the forests in which Teak trees grow are of this type. The deciduous trees shed their leaves during the winter and hot summer months. In March or April they regain their fresh leaves just before the monsoon, when they grow vigorously in response to the rains. Thus there are periods of leaf fall and canopy regrowth. The forest frequently has a thick undergrowth as light can penetrate easily onto the forest floor.

Thorn forests are found in the semi- arid regions of India. The trees, which are sparsely distributed, are surrounded by open grassy areas. Thorny plants are called xerophytic species and are able to conserve water. Some of these trees have small leaves, while other species have thick, waxy leaves to reduce water losses during transpiration. Thorn forest trees have long or fibrous roots to reach water at great depths. Many of these plants have thorns, which reduce water loss and protect them from herbivores.

Mangrove forests grow along the coast especially in the river deltas.

These plants are able to grow in a mix of saline and fresh water. They grow luxuriantly in muddy areas covered with silt that the rivers have brought down. The mangrove trees have breathing roots that emerge from the mudbanks.

➤ **Grassland ecosystems**

A wide range of landscapes in which the vegetation is mainly formed by grasses and small annual plants are adapted to India's various climatic conditions. These form a variety of grassland ecosystems with their specific plants and animals.

Grasslands cover areas where rainfall is usually low and/or the soil depth and quality is poor.

The low rainfall prevents the growth of a large number of trees and shrubs, but is sufficient to support the growth of grass cover during the monsoon. Many of the grasses and other small herbs become dry and the part above the ground dies during the summer months. In the next monsoon the grass cover grows back from the root stock and the seeds of the previous year. This change

gives grasslands a highly seasonal appearance with periods of increased growth followed by a dormant phase.

A variety of grasses, herbs, and several species of insects, birds and mammals have evolved so that they are adapted to these wide-open grass covered areas. These animals are able to live in conditions where food is plentiful after the rains, so that they can store this as fat that they use during the dry period when there is very little to eat. Man began to use these grasslands as pastures to feed his livestock when he began to domesticate animals and became a pastoralist in ancient times.

TYPES OF GRASSLANDS

The Himalayan -pasture belt: It extends upto the snowline. The grasslands at a lower level form patches along with coniferous or broadleaved forests. These Himalayan pastures have a large variety of grasses and herbs. There are also a large number of medicinal plants.

The Terai: This consists of patches of tall grasslands interspersed with a Sal forest ecosystem. The patches of tall elephant grass are located in the low-lying waterlogged areas. The Sal forest patches cover the elevated region and the Himalayan foothills. The Terai also includes marshes in low-lying depressions. This ecosystem extends as a belt south of the Himalayan foothills.

The Semi-arid plains: This is located in Western India. Central India and the Deccan are covered by grass land tracts with patches of thorn forest and are covered with seasonal grasses and herbs on which its fauna is dependent.

The Shola grasslands: It consists of patches on hillslopes along with the Shola forests on the western Ghats, Nilgiri and Annamalai ranges. This forms a patchwork of grassland on the slopes and forest habitats along the streams and low lying areas.

➤ Desert ecosystem

Desert and semi arid lands are highly specialized and sensitive ecosystems that are easily destroyed by human activities. The species of these dry areas can live only in this specialised habitat.

Deserts and semi arid areas are located in Western India and the Deccan Plateau. The climate in these vast tracts is extremely dry. There are also cold deserts such as in Ladakh, which are located in the high plateaus of the Himalayas.

The most typical desert landscape that is seen in Rajasthan is in the Thar Desert. This has sand dunes. There are also areas covered with sparse grasses and a few shrubs, which grow if it rains. In most areas of the Thar the rainfall is scanty and sporadic. In an area it may rain only once every few years. In the adjoining semi arid tract the vegetation consists of a few shrubs and thorny trees such as khair and babul.

The Great and Little Rann of Kutch are highly specialised arid ecosystems. In the summers they are similar to a desert landscape. However as these are low-lying areas near the sea, they get converted to salt marshes during the monsoons.

During this period they attract an enormous number of aquatic birds such as ducks, geese, cranes, storks, etc. The Great Rann is famous, as it is the only known breeding colony of the Greater and

Lesser Flamingos in our country. The Little Rann of Kutch is the only home of the wild ass in India. Desert and semi arid regions have a number of highly specialized insects and reptiles. The rare animals include the Indian wolf, desert cat, desert fox and birds such as the Great Indian Bustard and the Florican. Some of the commoner birds include partridges, quails and sand grouse.

➤ **Aquatic ecosystems**

The aquatic ecosystems constitute the marine environments of the seas and the fresh water systems in lakes, rivers, ponds and wetlands. These ecosystems provide human beings with a wealth of natural resources. The aquatic ecosystems are classified into freshwater, brackish and marine ecosystems, which are based on the salinity levels.

The fresh water ecosystems: They have running water are streams and rivers. Ponds, tanks and lakes are ecosystems where

water does not flow and have expanses of shallow water with aquatic vegetation, which forms an ideal habitat for fish, crustacean and water birds.

Marine ecosystems are highly saline, while brackish areas have less saline water such as in river delta.

Brackish water ecosystems in river deltas are covered by mangrove forests and are among the world's most productive ecosystems in terms of biomass production. The largest mangrove swamps are in the Sundarbans in the delta of the Ganges.

➤ **ECOLOGICAL SUCCESSION**

Ecological succession is a process through which ecosystems tend to change over a period of time. Succession can be related to seasonal environmental changes, which create changes in the community of plants and animals living in the ecosystem. Other successional events may take much longer periods of time extending to several decades. If a forest is cleared, it is initially colonized by a certain group of species of plants and animals, which gradually change through an orderly process of community development.

One can predict that an open area will gradually be converted into a grassland, a shrubland and finally a woodland and a forest if permitted to do so without human interference.

There is a tendency for succession to produce a more or less stable state at the end of the successional stages. Developmental stages in the ecosystem thus consist of a pioneer stage, a series of changes known as several stages, and finally a climax stage. The successive stages are related to the way in which energy flows through the biological system. The most frequent example of successional changes occur in a pond ecosystem where it fluctuates from a dry terrestrial habitat to the early colonization stage by small aquatic species after the monsoon, which gradually passes through to a mature aquatic ecosystem, and then reverts back to its dry stage in summer where its aquatic life remains dormant.

Theory Questions

1. **Enumerate the utilization of carbon in ecosystem.** *(December 2017)*
2. **Describe grassland ecosystem. What are its types? How conservation of grassland can be made.** *(December 2017)*

3. Discuss how oxygen cycle utilized in the eco system. *(December 2015)*
4. Define environment. Mention its scope. Discuss the need for public awareness. *(December 2015)*
5. What is an eco system? Discuss Forest ecosystem. Explain how conservation of forest can be done. *(December 2015)*
6. Discuss how oxygen cycle is utilized in the ecosystems. *(December 2015)*
7. Write a short note on
 - i. Ecological succession
 - ii. Food chain, food web and ecological pyramid. *(June 2015)*
8. Elaborate how the nitrogen cycle ecosystem operates. *(June 2015)*

