

the stability of a natural ecosystem due to more protection available to the members of the community against external environmental change.

Modern ecologists, however, disagree with the viewpoint that species diversity contributes to dynamic equilibrium in ecosystems. The assertion seemed reasonable so long as the disturbance in an ecosystem was not too severe. Recent discoveries about the inability of the most diverse of all ecosystems, tropical rain forests, to recover from deforestation, suggest that ecosystems vary in their response to stress and that factors other than diversity, and not yet identified or understood may contribute significantly to dynamic equilibrium. Most ecologists now believe that there is no simple relationship between diversity and dynamic equilibrium. Because each ecosystem has evolved to fit a particular physical environment, less complex systems may be just as stable and capable of recovering from disturbance as complex systems.

Major Ecosystems

The biosphere is the biggest ecosystem which combines all the ecosystems of the world. Each system has a different set of physiography, climate, natural vegetation, soil, water bodies etc. and, as such, differs in respect of its species composition and rate of production etc. The major ecosystems are described as under :

1. Pond Ecosystem

A pond is a good example of a fresh water ecosystem. A pond exhibits a self-sufficient, self-regulating system. It is a place where living organisms live and interact with biotic as well as abiotic components. The chief features of the pond ecosystem include the following :

Abiotic Component

The chief substances are heat, light, pH value of water, and the basic inorganic and organic compounds, such as water itself, carbon dioxide gas, oxygen gas, calcium, nitrogen, phosphates, amino acids, humic acid, etc.

Biotic Component

1. **Producers** : These are autotrophic green plants and some photosynthetic bacteria. The producers fix radiant energy with the help of minerals derived from the water and mud, they manufacture complex organic substances as carbohydrates, proteins, lipids, etc. Producers include the following :
 - (a) **Macrophytes** : These are mainly rooted larger plants which include partly or completely submerged, floating and emergent hydrophytes.
 - (b) **Phytoplanktons** : These are minute, floating or suspended lower plants. Majority of them are filamentous algae, and some chloro coccals, diatoms and flagellates.
2. **Consumers** : They are heterotrophs which depend for their nutrition on organic food manufactured by producers, the green plants. Most of the consumers are herbivores, a few insects and some large fish are carnivores. The consumers in a pond include the following :
 - (a) **Primary Consumers (herbivores)** : Also known as primary macro-consumers, these herbivores feed directly on living plants or plant remains. The herbivores are further differentiated as :

- (i) **Benthos** : These are animals associated with living plants and those bottom forms which feed upon plant remains lying at the bottom of pond. These are known as detritivores. Benthic populations include fish, insect larvae, beetles, mites, molluscs, crustaceans, etc.
- (ii) **Zooplanktons** : These are chiefly the rotifers, while some are protozoans and crustaceans. They chiefly feed on phytoplanktons.
- (b) **Secondary Consumers (Carnivores)** : They feed on the primary consumers (herbivores) and include chiefly insects and fish. Most insects feed on zooplankton.
- (c) **Tertiary Consumers (Carnivores)** : They are some large fish as game fish that feed on the smaller fish.
3. **Decomposers** : They are also known as micro consumers. They bring about the decomposition of complex dead organic matter of both-producers (plants) as well as the macro consumers (animals) to simple forms. They play an important role in the return of minerals elements again to the medium of the pond. They are chiefly bacteria, actinomycetes and fungi.

2. Marine Ecosystem

The marine ecosystem is different from fresh water ecosystem mainly because of its salty water which is in continuous circulation. Marine environments, as compared with fresh water, appear to be more stable in their chemical composition due to being saline. Moreover, other physico-chemical properties as dissolved oxygen content, light and temperature are also different.

Biotic Component

1. **Producers** : These are autotrophs, also designated as primary producers. Producers are mainly phytoplanktons, such as diatoms, dinoflagellates and some microscopic algae. Besides them a number of macroscopic sea weeds, as brown and red algae, also contribute significantly to primary production. These organisms show a distinct zonation at different depths of water in the sea.
2. **Consumers** : These are heterotrophic macro-consumers, being dependent for their nutrition on the primary producers. These are :
 - (a) **Primary Consumers** : The herbivores, that feed directly on producers, and are chiefly crustaceans, molluscs, fish, etc.
 - (b) **Secondary Consumers** : These are carnivorous fish, as Herring, Shad, Mackerel, etc, feeding on herbivores.
 - (c) **Tertiary Consumers** : There are other carnivorous fishes like cod, haddock, halibut, etc. that feed on the other carnivores of the secondary consumer level.
3. **Decomposers** : The microbes active in the decay of dead organic matter of producers and macro consumers are chiefly bacteria and some fungi.

3. Grassland Ecosystem

This is a terrestrial ecosystem. Grasslands occupy roughly 19% of the earth's surface. The various components of a grassland ecosystem include the following :

Biotic Component

1. **Producers** : These are mainly grasses of different species. Besides them, a few forbs and shrubs also contribute to primary production.
2. **Consumers** : These occur in the following sequence :
 - (a) **Primary Consumers** : The herbivores feeding on grasses include grazing animals such as cows, buffaloes, deers, sheep, rabbit, mouse, etc. Besides them, there occur insects, termites, and millipeds, etc. that feed on the leaves of grasses.
 - (b) **Secondary Consumers** : These are the carnivores feeding on herbivores, and include animals like fox, jackals, snakes, frogs, lizards, birds, etc. Sometimes the hawks feed on the secondary consumers, thus occupying tertiary consumers level in the food chain.
3. **Decomposers** : The microbes active in the decay of dead organic matter of different forms of higher life are fungi, some bacteria and actinomycetes. They bring about the minerals back to the soil, thus making them available to the producers.

Abiotic Component

These are nutrients present in soil and the aerial environment. Thus, the elements like C, H, O, N, P, S etc. are supplied by carbon dioxide water, nitrates, phosphates and sulfates etc. present in air and soil of the area. Some trace elements are also present in soil.

4. Forest Ecosystem

Forests occupy nearly 30% of the land area of the earth. But due to man's interference, this are is gradually shrinking. Yet forest ecosystem is very important and varied. The coniferous forests stretch as broad belts across North America and Eurasia. On the other hand, temperate deciduous forests occupy eastern North America, parts of Europe, Japan, Australia etc. Tropical evergreen as well as tropical deciduous are found in the tropical regions.

Abiotic Component

These conclude inorganic as well as organic substances present in the soil and the atmosphere. In addition to the minerals present in forests, we find the dead organic debris—the litter accumulation, chiefly in temperate climate. The light conditions vary due to complex stratification in the plant communities.

Biotic Component

The living organisms present in the food chain occur in the following sequence :

1. **Producers** : These are mainly trees that show much species diversity and greater degree of stratification especially in tropical moist deciduous forests. Besides trees, there also exist shrubs and a ground vegetation. In temperate coniferous forests, shrubs and ground flora are insignificant.
2. **Consumers** : These include :
 - (a) **Primary Consumers** : These are herbivores that include the animals feeding on tree leaves, as ants, flies, beetles, leaf hoppers, bugs, spiders, etc. and larger animals grazing on shoots and/or fruits of the producers, e.g. elephants, deer, nilgai, moles, squirrel, shrews, flying foxes, fruit bats, mongoose etc.

- (b) **Secondary Consumers** : These are the carnivores like snakes, birds, lizards, fox etc. feeding on the herbivores.
- (c) **Tertiary Consumers** : These include top carnivores like lion, tiger, etc. that eat carnivores of secondary consumer level.
3. **Decomposers** : These are wide variety of micro-organisms including fungi, bacteria and actinomycetes. Rate of decomposition in tropical and subtropical forests is more rapid than that in the temperate forests.

5. Desert Ecosystem

Desert occupy nearly 17% of the land, occurring in regions with an annual rainfall of less than 25 cm. The species composition of such ecosystem is much more varied and typical due to extremes of both temperature and water factors. The biotic components include :

1. **Producers** : These include shrubs, especially bushes, some grasses, and a few trees. The shrubs have widespread branched root system with their stems and branches variously modified. A few succulents like cacti are also present which store water. The lower plants like lichens and xerophytic mosses may also be present.
2. **Consumers** : The most common animals are reptiles and insects, able to live under xeric conditions. In addition to them, there also exist nocturnal rodents and birds, camels feed on tender shoots of the plants.
3. **Decomposers** : These are very few, as due to poor vegetation, the amount of dead organic matter is less. They are some fungi and bacteria, most of which are thermophilic.

6. Cropland Ecosystems

Contrary to natural ecosystems, cropland ecosystems are artificial or man-engineered where man becomes responsible for the replacement of natural systems. To secure maximum production man makes much planned manipulations in the physico-chemical environment. These include addition to fertilisers to soil, use of chemicals for disease control, proper irrigation practices, etc. Thus, a cropland ecosystem is an artificial system aimed primarily to grow a single species of one's choice. There are ecosystems of dominant species like wheat, maize, jowar, rice, sugarcane, vegetables, coffee, tea, etc.

The abiotic component of this ecosystem includes climatic conditions and mineral contents of the soil. The various types of food grains, pulses and commercial crops are grown in these croplands, which provide food and fodder to man and animals respectively. In the fields, several types of animals like birds, rats, rabbits, reptiles, insects etc. also survive. The decomposition of dead organic matter of plants and animals make the minerals available again.

Major Ecosystems of India

India exhibits a variety of physiography which also controls climate, natural vegetation, soil and man's adaptation to nature. As such, the following major ecosystems may be recognised in India :

- (1) Himalayan or mountain ecosystem, (2) Plain ecosystem, (3) Desert ecosystem, (4) Plateau ecosystem, (5) Coastal ecosystem, (6) Plain-plateau transitional ecosystem, and (7) Island ecosystem.

1. The Himalayan or Mountain Ecosystem

Altitude, slope, extent of river valleys, direction of mountains and inequalities of rainfall have made the environment of this region multi-dimensional. Explicitly two types of environmental influences are observed here : horizontal, and vertical. Inequal distribution is responsible for the horizontal impact, while temperature differences due to altitudinal variation cause the vertical impact. Direction of mountains influence both temperature and rainfall. Due to all these factors, the Himalayan ecosystem may be divided into several sections. The Eastern Himalayas, due to lesser elevation and more rainfall, are densely forested, dominated by broad leafed evergreen trees, bamboo, etc. These dense forests provide natural habitat for animals ranging from elephants to very small animals. Biomass of this region is more than that of any other region in India. Besides, this, several tribal groups live here. Temperate forests which are less dense, are found at higher elevations, (upto 2500 m), beyond which the alpine grasslands and coniferous trees are dominant. In this region, biomass decreases with increasing altitude.

Western Himalayas are less dense because of lesser amount of rainfall. The dense Terai forests have been cut clear to make room for agricultural farms. Deciduous forests occur upto an altitude of 1500 m, with a moderate biomass. Mixed forests are found upto 4000 m, with a relatively more biomass. Temperate forests occur between 4000-5000 m, with a moderate biomass. Indiscriminate felling of trees have caused the maximum destruction of forests. The diversity of the Himalayan ecosystem has always been attractive for animals and human beings alike. Ecological degradation is a matter of great concern here. Deforestation is the biggest problem, which has given rise to the 'Chipko Movement'. This movement is assuming global dimension.

2. Plain Ecosystem

The Great Northern plain is a riverine alluvial plain bounded on the north by the Himalayas and on the south by the Peninsular Plateau. The plain is covered with fertile alluvium, and extends over 700,000 sq. km. area. Sloping from north-west to south-east, the plain has width of 145-480 km., and a length of 2400 km. From the sea level, it rises upto 150 m. This plain is divided into three segments : western, central, and eastern. All the three segments differ from each other in their climatic characteristics, mainly the amount of rainfall, which decreases from east to west. Due to seasonal characteristic of rainfall, the vegetation is dominated by deciduous forests. Earlier, the region was heavily forested, but by the expansion of arable land and settlement has caused so much deforestation that hardly 7% of the region now remains under forests. However, planted crops dominate the vegetation. The cultivation of crops, dense, settlement and domesticated animals have lent a typical character to the ecosystem of the region. The region has been the cradle of human civilization and culture for the last 5 or 6 thousand years, and as such, man-made (cultural) landscape is dominant here. The ever-increasing population has led to over exploitation of natural resources such as soil, water, vegetation and animals, which has resulted in the ecological imbalance. Deforestation has caused problems like climatic imbalances, soil erosion, floods, droughts, water-logging, etc. Excessive use of chemical fertilizers to increase soil productivity has adversely affected the quality of soils. River water has become polluted, and several animal species have become extinct. Thus, the ecology of the plains is under severe strain.

3. Hot Desert Ecosystem

The Thar Desert in India extends over nearly 100,000 sq. km. It is characterised by high temperature and scanty rainfall. Lack of moisture supports a sparse vegetation only, characterised by small plants. Human needs have destructed even this sparse vegetation cover. The entire region has been converted into a vast expanse of sand dunes, and bare rocks. Animal life is restricted to a few animals. Camel is the most important animal of the desert. Among other domesticated animals, cattle are dominant. Scarcity of water is the biggest problem here. Small animals and xerophytic vegetation are typical of the desert ecosystem. Canals and availability of ground water resources have turned the areas green.

4. Plateau Ecosystem

The Peninsular Plateau of India represents an ancient landmass. It extends from the Vindhyan ranges in the north to Kanyakumari in the south, and from Eastern Ghats in the east to Western Ghats in the west, covering nearly 1.6 million sq. km. The region has a unique structure, relief, soils, drainage and climate. The vegetation ranges from dense forests to thorny vegetation, while the animals include large animals e.g. tiger, lion, elephants and many small animals. The plateau is interspersed with several ranges and river valleys. It is highly dissected and has a rolling relief. Major part of the plateau is covered by lava soils. The region has extensive forest cover and a great mineral wealth. The ecosystem of the region is quite different from others. Pockets of fertile soils, water resources and mineral wealth are densely populated. The region supports a large number of tribal groups who live amidst nature. This ecosystem is more balanced than any other ecosystem.

5. Coastal Ecosystem

The east coastal plains of India are more extensive and open than the west coastal plains. This region (or narrow belt) represents a transition between the Ganga plain and the Sea coast. Due to the maritime influence, the ecosystem of coastal plains is different from that of the Ganga plain. Here, the climate is moist. The ingress of sea-water has favoured the growth of animals and vegetation that can withstand salinity. A dense population has caused much destruction of forests. Natural vegetation is confined to areas unsuitable for cultivation. Intensive farming is practised here. Fishing is a dominant activity in the coastal areas.

6. Plain-Plateau Transitional Ecosystem

Due to the peculiar physiography of India, this transitional zone occurs in the Peninsular plateau region in several patches. The Aravallis, the Vindhya-Satpuras, the Western Ghats, the Eastern Ghats, etc. exhibit this ecosystem. The mixed influence of plains, plateau and hills have created a transitional ecosystem in these areas. The physiography is dominated by a highly dissected terrain, with numerous rivers and streams forming waterfalls. Open to dense forests of various types (depending on the amount of rainfall, mainly) provide natural habitat to a rich animal life. However, human interference in the form of several dams and hydro electric plants rivers, mining activities, and construction of roads and railway lines, etc. has created many ecological problems in these areas.

7. Island Ecosystem

Two major group of islands of India are located in the Bay of Bengal and the Arabian Sea. Both groups are different in their origin, structure, physiography, flora and fauna. The Andaman and Nicobar group of Islands are located in the Bay of Bengal and have a volcanic mountainous origin. They are associated with the Himalayan orogeny. As such, they have a high relief, a dense cover of tropical evergreen forests, and a rich wild life. They support a tribal life belonging to the rare stock of the oldest races of the world, which is on the verge of extinction.

Lakshadweep Islands are located in the Arabian Sea. They are of mainly coral origin. Palm trees on the sandy surface are the dominant vegetation here.

