



UNIT IV

Biodiversity and Conservation

Biodiversity, or Biological Diversity, is the sum of all the different species of plants, animals, fungi and microbial organisms that live on Earth, including the various ecosystems in which they live on. Biodiversity also includes the genetic information that these organisms contain.

Types of Biodiversity

Biodiversity further classifies into three major types. They are:

- Genetic Diversity
- Species Diversity
- Ecological Diversity

Genetic Diversity

- It is basically the variety of species expressed at the genetic level by each individual in a species. No two individuals belonging to the same species are exactly similar. For example, in the species of human beings, each human shows a lot of diversity in comparison to another human. People living in different regions show a great level of variation.

Species Diversity

- It is the biodiversity observed within a community. It stands for the number and distribution of species. The number of species in a region varies widely depending upon the varied environmental conditions. For example, it is usually observed that civilizations residing beside water bodies show more species than the one compared to the areas away from water bodies.

Ecosystem diversity

It defines the diversity observed among the ecosystems in a particular region. Different ecosystems like mangroves, rainforests, deserts, etc., show a great variety of life forms residing in them.

All these diversities help in maintaining the correct balance of nature. But, gradually over the years, there has been a major loss in the biodiversity across the globe. The loss of biodiversity could adversely affect our environment as the balance is lost and the natural food web is disturbed.

Biogeographic zones of India

- Biogeographic classification of India is the division of India according to biogeographic characteristics.
- Biogeography is the study of the distribution of species (biology), organisms, and ecosystems in geographic space and through geological time.
- There are ten biogeographic zones in India.
 1. Trans Himalayan zone.
 2. Himalayan zone
 3. Desert zone.
 4. Semiarid zone.
 5. Western ghat zone.
 6. Deccan plateau zone.
 7. Gangetic plain zone.
 8. North east zone.
 9. Coastal zone.
 10. Islands present near the shore line.

Trans- Himalayan Region

- The Trans Himalayan regions of the states of Jammu and Kashmir and Himachal Pradesh are a moonscape land – an arid high altitude desert unlike any other part of the Indian subcontinent.
- The stark landscape is a panorama of high snow capped peaks and bare multi hued hills sculpted by the forces of nature. The high dusty valleys strewn with rock have altitudes ranging from 2,500m to 4,500m.

Himalayan Zone

- The Himalayas consist of the youngest and loftiest mountain chains in the world.
- The Himalayas have attained a unique personality owing to their high altitude, steep gradient and rich temperate flora. The forests are very dense with extensive growth of grass and evergreen tall trees. Oak, chestnut, conifer, ash, pine, deodar are abundant in Himalayas.
- There is no vegetation above the snowline. Several interesting animals live in the Himalayan ranges. Chief species include wild sheep, mountain goats, ibex, shrew, and tapir. Panda and snow leopard are also found here.

Semi-Arid Areas

- Adjoining the desert are the semi-arid areas, a transitional zone between the desert and the denser forests of the Western Ghats. The natural vegetation is thorn forest.
- This region is characterized by discontinuous vegetation cover with open areas of bare soil and soil-water deficit throughout the year. Thorny shrubs, grasses and some bamboos are present in some regions.
- A few species of xerophytic herbs and some ephemeral herbs are found in this semi-arid tract. Birds, jackals, leopards, eagles, snakes, fox, buffaloes are found in this region.

Western Ghats

- The mountains along the west coast of peninsular India are the Western Ghats, which constitute one of the unique biological regions of the world.
- The Western Ghats extend from the southern tip of the peninsula (8°N) northwards about 1600 km to the mouth of the river Tapti (21°N).
- The mountains rise to average altitudes between 900 and 1500 m above sea level, intercepting monsoon winds from the southwest and creating a rain shadow in the region to their East.

North-West Desert Regions

- This region consists of parts of Rajasthan, Kutch, Delhi and parts of Gujarat. The climate is characterized by very hot and dry summer and cold winter. Rainfall is less than 70 cm.
- The plants are mostly xerophytic. Babul, Kikar, wild palm grows in areas of moderate rainfall. Indian Bustard, a highly endangered bird is found here. Camels, wild asses, foxes, and snakes are found in hot and arid sex positions.

Deccan Plateau

- Beyond the Ghats is Deccan Plateau, a semi-arid region lying in the rain shadow of the Western Ghats. This is the largest unit of the Peninsular Plateau of India.
- The highlands of the plateau are covered with different types of forests, which provide a large variety of forest products.
- The Deccan plateau includes the region lying south of the Satpura range. It extends up to the southern tip of peninsular India. Anaimudi is the highest peak of this region.

- The Deccan plateau is surrounded by the western and the eastern ghats. These ghats meet each other at the Nilgiri Hills.

Gangetic Plain

- In the North is the Gangetic plain extending up to the Himalayan foothills. This is the largest unit of the Great Plain of India.
- Ganga is the main river after whose name this plain is named.
- The aggradational Great Plains cover about 72.4mha area with the Ganga and the Brahmaputra forming the main drainage axes in the major portion.

North-East India

- North-east India is one of the richest flora regions in the country. It has several species of orchids, bamboos, ferns and other plants.
- Here the wild relatives of cultivated plants such as banana, mango, citrus and pepper can be grown

Islands

- The two groups of islands, i.e., the Arabian Sea islands and Bay Islands differ significantly in origin and physical characteristics.
- The Arabian Sea Islands (Laccadive, Minicoy, etc.) are the foundered remnants of the old land mass and subsequent coral formations.
- On the other hand, the Bay Islands lay only about 220 km. Away from the nearest point on the main land mass and extend about 590 km.
- With a maximum width of 58 km the island forests of Lakshadweep in the Arabian Sea have some of the best-preserved evergreen forests of India.
- Some of the islands are fringed with coral reefs. Many of them are covered with thick forests and some are highly dissected.

Coasts

- India has a coastline extending over 5,500 km.
- The Indian coasts vary in their characteristics and structures.
- The west coast is narrow except around the Gulf of Cambay and the Gulf of Kutch. In the extreme south, however, it is somewhat wider along the South Sahyadri.
- The backwaters are the characteristic features of this coast. The east coast plains, in contrast are broader due to depositional activities of the east-flowing rivers owing to the change in their base levels.

Global Biodiversity Hotspots

- Biodiversity hotspots are defined as regions “where exceptional concentrations of endemic species are undergoing an exceptional loss of habitat”.
- These hotspots are important because Biodiversity underpins all life on Earth. Without species, there would be no air to breathe, no food to eat, no water to drink.
- There would be no human society at all. And as the places on Earth, where the most biodiversity is under the most threat, hotspots are critical to human survival.

A region must meet two strict criteria to qualify as a biodiversity hotspot which is given below:

1. It must have at least **1,500 vascular plants** as endemics which are to say, it must have a high percentage of plant life found nowhere else on the planet. A hotspot, in other words, is irreplaceable.
2. It must have **30% or less of its original natural vegetation**. In other words, it must be threatened.

Biodiversity Hotspots of the World

- These hotspots regions support a rich biodiversity because of geologic formations and endemic flora and fauna and also exhibit exceptional scientific interest.
- It is important ecosystem in the world and the habitat of endemic species.
- The Biodiversity Hotspots of the World are given below:

Africa

1. Eastern Afro-Montane
2. The Guinean forests of Western Africa
3. Horn of Africa
4. Madagascar and the Indian Ocean Islands
5. Maputoland, Podoland, Albany hotspot
6. Succulent Karou
7. East Malanesian islands
8. South Africa's Cape floristic hotspot
9. Coastal forests of Eastern Africa

Asia and Australia

1. Himalayan hotspot
2. The Eastern Himalayas
3. Japan biodiversity hotspot
4. Mountains of South-West China
5. New Caledonia
6. New Zealand biodiversity hotspot
7. Philippine biodiversity hotspot
8. Western Sunda (Indonesia, Malas and Brunei)
9. Wallace (Eastern Indonesia)
10. The Western Ghats of India and Islands of Sri Lanka
11. Polynesia and Micronesian Islands Complex including Hawaii
12. South-Western Australia

North and Central America

1. California Floristic Province
2. Caribbean islands hotspot
3. Modrean pine-oak wood lands of the USA and Mexico border
4. The Mesoamerican forests

South America

1. Brazil's Cerrado
2. Chilean winter rainfall (Valdivian) Forests
3. Tumbes-Choco-Magdalena
4. Tropical Andes
5. Atlantic forest

Europe and Central Asia

1. Caucasus region
2. Iran-Anatolia region
3. The Mediterranean basin and its Eastern Coastal region
4. Mountains of Central Asia

Above Biodiversity Hotspot regions are blessed with a variety of exceptional plant species and habitat, but facing endemism and serious habitat loss.

Hence, it is our duty to protect and conserve the endemic species and their habitat.

We can conserve biodiversity in two ways- first is in-situ and second is ex-situ. In-situ conservation involves in the maintenance of bio-diversity rich area in its natural form, whereas in ex-situ conservation, the endangered species are kept in a specially protected area which is separated from its natural habitat region.

India as a mega diversity nation

- India, the largest democratic republic of the world, has the seventh largest area (328.73 million ha) and second largest human population (more than 1 billion).
- With about 2.5% of the world's geographical and 1.8% of the forest area, the country at present is supporting 16% of the world's population and 18% of the domestic cattle population, amounting to about 500 million.
- India is one of the richest countries in the world in terms of biodiversity. This natural variation in life is also reflected in the demography of the land.
- Although the causes behind biodiversity and demographic diversity are different, the human population of the land has depended on the biodiversity in many ways for a long time.
- At the same time, today, the excessive human population of India is leading to a survival pressure on the biodiversity.
- Thus, it is important to know and appreciate the diversity in both - human population and flora and fauna.
- India ratified the International Convention on Biodiversity (CBD) on 18 Feb. 1994 and became Party to the Convention in May 1994.
- The CBD is an international legal instruments for promoting conservation and sustainable use of biological diversity taking into account the need to share cost and benefit between developed and developing countries and ways and means to support innovation by local people.

Endangered and Endemic Species of India

- **Endangered species of India**

A plant, animal or microorganism that is in immediate risk of biological extinction is called endangered species or threatened species.

In India, 450 plant species have been identified as endangered species. 100 mammals and 150 birds are estimated to be endangered.

India's biodiversity is threatened primarily due to:

1. Habitat destruction
2. Degradation and
3. Over exploitation of resources

Some of the rarest animals found in India are:

1. Asiatic cheetah
2. Asiatic Lion
3. Asiatic Wild Ass
4. Bengal Fox
5. Gaur
6. Indian Elephant
7. Indian Rhinoceros
8. Marbled Cat
9. Markhor

Endemic species of India

Species that are found only in a particular region are known as endemic species. Almost 60% the endemic species in India are found in Himalayas and the Western Ghats.

Endemic species are mainly concentrated in:

1. North-East India
2. North-West Himalayas
3. Western Ghats and
4. Andaman & Nicobar Islands.

Examples of endemic Flora species are

1. SapriaHimalayana
2. Ovaria Lurida
3. Nepenthiskhasianaetc

Endemic fauna of significance in the western ghats are:

1. Lion tailed macaque
2. Nilgiri langur
3. Brown palm civet and
4. Nilgiritahr

Factors affecting endemic species:

1. Habitat loss and fragmentation due to draining and filling of inland wetlands.
2. Pollution also plays an important role.

Threats to Biodiversity

1. Habitat loss and deforestation

- The dramatic alteration of habitats directly threatens biodiversity.
- When such habitats are lost due to deforestation and other anthropogenic activities such as mining, the respective environments are unable to provide shelter, food, water, or breeding grounds for the living organisms.

2. Climate Change

- The global climatic changes throughout the history of the plant have definitely modified life and ecosystems in the planet.
- As an outcome, crucial habitats have been destroyed and a number of species have gone extinct with a huge majority at the verge of extinction.
- It therefore means that if the global temperatures continue to change drastically, especially due to anthropogenic activities that accelerate the process, the threats to biodiversity will continue to expand as ecosystems and species will not be able to adapt.

3. Over Exploitation of Resources

- On the account of the ever rising human population, there has been a correlation increase in demand for manufactured products, essential goods and services.
- The high demands of these things have resulted in overfishing, overhunting, over-harvesting and excessive mineral resource extraction which has highly contributed to biodiversity loss.
- Mineral extraction, poaching, excessive logging and other forms of resource exploitation for profit has heightened the risks of species extinction.
- It has also altered natural habits therefore destroying food chains and interfering with the ecological balance.

4. Nutrient Loading

- As the agricultural sector continue to expand and serve towards attaining the world's food security, it has also more than doubled dependence on the use of fertilizers on a profitable scale.
- Accordingly, the use of fertilizers beyond limits has contributed to increased level of nitrogen and phosphorous nutrients in the natural ecosystems.

- As much as the nutrients exist naturally in all ecosystems, the manufacturing of artificial fertilizer with reactive nitrogen and phosphorus nutrients to increase crop productivity has altered the ecological balance over time thereby threatening the survival of ecosystems.
- Particularly, the survival of species that flourish in phosphorous or nitrogen-poor environments are increasingly threatened.
- Furthermore, leaches and entry into water systems have resulted in increased eutrophication.

5. Environmental Pollution

- Pollution has continued to harm the biosphere by releasing and depositing toxic chemicals into the atmospheric, terrestrial and marine systems.
- With the high levels of pollution every year, it is gradually disrupting the Earth's ecosystems as the chemicals released potentially influence species' habits and ecosystems.
- Pollution has also depleted ozone levels, created dead zones in marine habitats due to toxicity and acid rains, altered species feeding and breeding habits, and even caused the death of many species due to oil spills or the consumption of plastic and other toxic substances.

6. Invasive Species

- Invasive species are the non-native species that invade normal and healthy ecosystems and threaten the survival of the native species either by attacking them or competing for the habitat's resources.
- Accordingly, they upset the native biota and ecosystems thereby causing extinctions and massive threats to biodiversity.

7. Man Animal Conflict

- It refers to the interaction between wild animals and people and the resultant negative impact on people or their resources, or wild animals or their habitat.
- It occurs when wildlife needs overlap with those of human populations, creating costs to residents and wild animals.

8. Poaching of Wildlife

- Poaching of wildlife for trade and commercial activities has been on the rise for the last many decades. It has been a significant cause of the extinction of hundreds of species and the endangerment of many more, such as whales and many African large mammals, Asian tigers, etc.
- Most extinction over the past several hundred years is mainly due to overharvesting for food, fashion, and profit.
- Illicit trade in wildlife in current times is driving many species of wild animals and plants to extinction.
- Elephants are poached for ivory; tigers and leopards for their skin; pangolins for meat and scales; and rare timber is targeted for hardwood furniture.

Conservation of Biodiversity

- We all need to conserve biodiversity, as it leads to the conservation of essential ecological diversity to preserve the continuity of food chains.
- In-situ and Ex-situ conservation are the two strategies practiced for the preservation of a variety of living species globally.

In-situ and Ex-situ conservation of Biodiversity

In-situ Conservation

- In-situ conservation is the on-site conservation of genetic resources in natural populations of plant or animal species.
- In India, ecologically unique and biodiversity-rich regions are legally protected as biosphere reserves, national parks, sanctuaries, reserved forests, protected forests and nature reserves.
- India now has 18 biosphere reserves, 104 national parks and 500 wildlife sanctuaries.
- Plantation, cultivation, grazing, felling trees, hunting and poaching are prohibited in biosphere reserves, national parks and sanctuaries.

Protected Area Network in India

- National Board for Wildlife (NBWL), chaired by the Prime Minister of India provides for policy framework for wildlife conservation in the country.
- The National Wildlife Action Plan (2002-2016) was adopted in 2002, emphasizing the people's participation and their support for wildlife conservation.

Ex-situ Conservation

- In this approach, threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care.
- **Zoological parks, botanical gardens, wildlife safari parks and seed banks** serve this purpose.
- There are many animals that have become extinct in the wild but continue to be maintained in zoological parks.
- In recent years ex-situ conservation has advanced beyond keeping threatened species.
- Now **gametes** of threatened species can be preserved in viable and fertile condition for long periods using cryopreservation techniques.
- Eggs can be fertilized in vitro, and plants can be propagated using tissue culture methods.
- Seeds of different genetic strains of commercially important plants can be kept for long periods in **seed banks**.
- The national gene bank at **National Bureau of Plant Genetic Resources (NBPGR), Delhi** is primarily responsible for conservation of unique accessions on long-term basis, as base collections for posterity, predominantly in the form of seeds.

Historic Citizen Movements to Conserve Biodiversity

Chipko Movement

- It is a social-ecological movement that practiced the **Gandhian methods of satyagraha** and nonviolent resistance, through the **act of hugging trees to protect them from falling**.
- The modern Chipko movement started in the early 1970s in the **Garhwal Himalayas** of Uttarakhand, with growing awareness towards rapid deforestation.
- The landmark event in this struggle took place on March 26, **1974**, when a group of peasant women in Reni village, Hemwalghati, in Chamoli district, Uttarakhand, India, acted to prevent the cutting of trees and **reclaim their traditional forest rights** that were threatened by the contractor system of the state Forest Department.
- Their actions inspired hundreds of such actions at the grassroots level throughout the region.
- By the 1980s the movement had spread throughout India and led to formulation of people-sensitive forest policies, which put a stop to the open felling of trees in regions as far reaching as Vindhyas and the Western Ghats.

- The first recorded event of Chipko however, took place in village Khejarli, Jodhpur district, in 1730 AD, when 363 Bishnois, led by Amrita Devi sacrificed their lives while protecting green Khejri trees, considered sacred by the community, by hugging them.

Appiko Movement

- Appiko movement was a revolutionary movement based on environmental conservation in India.
- The Chipko movement in Uttarakhand in the Himalayas inspired the villagers of the district of Karnataka province in southern India to launch a similar movement to save their forests.
- In September 1983, men, women and children of Salkani ‘hugged the trees’ in Kalase forest. (The local term for ‘hugging’ in Kannada is appiko.)
- Appiko movement gave birth to a new awareness all over southern India.

Ecosystem and biodiversity Services

- The earth is a home to millions of species. Every organism depends on one or another organism for energy, survival, and other life processes.
- This dependence of organisms on one another and their surroundings forge an interacting system called ecosystems. The interactions among different components of ecosystems are fundamental for a well-defined environment.
- As a part of an ecosystem, humans derive lots of benefits from the biotic and abiotic components. These benefits are collectively termed as ecosystem services.
- Life and biodiversity on earth depend on these services. Ecosystem services are classified into four services:

Provisioning Services:

- This includes the products/raw materials or energy outputs like food, water, medicines and other resources from ecosystems.
- Ecosystems are a source of food, water, medicines, wood, biofuels, etc. Also, they provide conditions for these resources to grow.

Regulating Services:

- This includes the services which regulate the ecological balance.
- For example, terrestrial environs like forest purify and regulates air quality, prevent soil erosion, and control greenhouse gases. Biotic components such as birds, rats, frogs, act as natural controllers and thus help in pest and disease control. Hence, ecosystems act as regulators.

Supporting services:

- Supporting services form the basis for other services. They provide habitat for different life forms, retain biodiversity, nutrient cycling, and other services for supporting life on the earth.

Cultural services:

- It includes tourism; provides recreational, aesthetic, cultural and spiritual services, etc. Most natural elements such as landscapes, mountains, caves, are used as a place for cultural and artistic purposes. Even few of them are considered sacred. Moreover, ecosystems provide enormous economic benefits in the name of tourism.
