

## Biodiversity

In simple terms, biodiversity is the number and variety of living organisms present in a specific geographical region. It includes various plants, animals and microorganisms, the genes they have and the ecosystems formed by them. It relates to the diversity among living organisms on the earth, including the diversity within and between the species and that within and between the ecosystems they form.

### IMPORTANCE OF BIODIVERSITY

Biodiversity has contributed a lot to the development of human culture and, in turn, human communities have played an important role in shaping the biodiversity at the genetic, species and ecological levels. Biodiversity is important in the following ways:

- **Ecological role:** Species of many kinds perform some of the other functions in an ecosystem. Every organism, besides fulfilling its own needs, also contributes something useful to different other organisms in the environment. Species capture, store and utilise energy, produce and decompose organic materials, are part of cycles of water and nutrients throughout the ecosystem, fix gases in the atmosphere and also help regulate the climate. Thus, they help in soil formation, reducing pollution, protection of land, water and air resources. These functions of biodiversity are important for ecosystem functions and stability.
- **Ecosystem services:** Biodiversity underpins the basis of all the ecosystem services on the planet.
- **Provisioning Services:** Various plants, animals and microorganisms which form the biodiversity, provide us with foods such as cereals, fishes etc. , fibre for our clothes such as cotton, wool etc., fuelwood for survival as well as pharmaceutical products such as neem, tulsi etc.
- **Regulating services:** Biodiversity regulates the local as well as global climate, manages the global levels of oxygen, carbon dioxide and other gases, maintain freshwater quality by vegetation slowing runoff, absorbs carbon by acting as carbon sinks etc. Thus biodiversity regulates the life and life processes on the planet.
- **Supporting services:** Biodiversity helps in pollination, nutrient cycling as well as recycling, greenhouse gas reduction by sequestration.
- **Social and cultural services:** Biodiversity provides us with aesthetic pleasure. It provides is recreational avenues and rich biological diversity encourages tourism in the region. Many communities and cultures have co-evolved with the surroundings and the resources provided by a biologically diverse environment. Hence, it performs an important social role as well. Important services which are provided by biodiversity are:
  - Recreation and relaxation
  - Tourism especially ecotourism
  - Art, Design and inspiration
  - Spiritual experiences and a sense of place
- **Food web maintenance:** Biodiversity helps in maintaining food webs as higher the diversity of an ecosystem, more complex is going to be the food webs because there are so many options to eat. Therefore, higher chances of survival of every species are there. This results in more stable food chains and food webs.
- **Scientific role:** Biodiversity help in scientific research, education and monitoring. For example, research about new genetic materials with the help of gene pools. Biodiversity, thus, helps in understanding

functioning of life and the role that each species plays in sustaining ecosystems of which we humans are also a part.

## TYPES OF BIODIVERSITY

Based on the three elements of biodiversity, that is, genes, species and ecosystems, biodiversity is considered to be of **three types**:

- **Genetic diversity:** It can be understood as the diversity of genes within a particular species. This diversity ensures that some species can survive disruptions. Thus, genetic diversity gives us beautiful butterflies, roses, corals and fruits in myriad hues, sizes and shapes.
- **Species diversity:** It refers to the variety of species within a particular geographical region. Species which are different from one another do not interbreed naturally. However, closely associated species can have a lot of similarity in their hereditary characteristics. For example, humans and chimpanzees have about 98.4 per cent genes which are same. Species diversity is measured by species richness, which means the number of different species per unit area in a region, and species evenness of species equitably, which refers to the relative abundance of individuals of different species in an area.
- **Ecosystem or Community diversity:** It refers to the diversity of different biological communities or ecosystems like forests, deserts, lakes, corals etc. In a region or on the earth. As the ecosystem changes, species best adapted to that particular ecosystem becomes predominant. Thus, biodiversity also depends on the nature of the ecosystems.

## MEASUREMENT OF BIODIVERSITY

Measurement of biodiversity was done by **Whittaker**. Biodiversity can be measured by two major components: **Species Richness** and **Species Evenness**

- **Species Richness:** It refers to the measure of a number of species found in per unit area of a region or community. It has three components:
  1. **Alpha diversity:** It refers to the diversity of species found in a particular area or ecosystem, and is usually expressed by the number of species in that ecosystem.
  2. **Beta diversity:** It refers to the comparison of the diversity of species between two or more ecosystems, usually measured as the change in the number of species between the ecosystems.
  3. **Gamma diversity:** It is the measure of the overall diversity for the different ecosystems in a region. It is highly subjective because of different perceptions about the boundaries of the region.
- **Species Evenness:** It is the measure of relative abundance of individuals of different species in a given region. Low evenness in general, means that a few species dominate the region or ecosystem.

## LOSS OF BIODIVERSITY

The loss of species, ecosystems or genes is termed as a loss of biodiversity. The biological wealth of the planet is declining rapidly. The IUCN Red List documents the extinction of 784 species ( including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years. In the last 20 years alone, we have witnessed the loss of more than 30 species. As per the Living Planet report:

- The present rate of extinction of species is up to 100 to 1000 species extinction per 10,000 species in a duration of 100 years. This is almost 1000 times more than the natural rate of extinction.
- The living planet index, which measures the biodiversity abundance levels, is showing a persistent downward trend. On average, monitored species population has declined by 58% since the year 1970.
- In tropical forests, there has been a 40% decline of species since the year 1970.
- Whereas in temperate grasslands, species population has declined by 18% and in freshwater habitat, species population has declined by 81% since the year 1970.

## Reasons for loss of Biodiversity

- **Habitat loss and fragmentation:** This is a primary cause which drives animals and plants to extinction. The habitat loss and fragmentation have been through changes of land use, in particular, the conversion of natural ecosystems to cropland, development of infrastructure projects like rails and roadways, increasing urbanisation and mining activities.
  - As per the Living Planet report, there have been about 30% decline in wetlands in the last 40 years. Wetlands have been primarily reclaimed for agriculture and urbanisation. Also, about 50% of the tropical and subtropical forests and 45% of the temperate grasslands have been converted for human use.
  - Besides total loss, the degradation of many habitats by pollution also threatens the survival of many species. When large habitats are broken up into smaller fragments because of different human activities, mammals and birds which require large territories and certain animals with migratory habits are adversely affected, causing a decline in their population.
- **Over-exploitation of species:** Unsustainable use of ecosystems and over-exploitation of biodiversity are a major reason behind biodiversity loss. Over-hunting or poaching of species, overfishing and over-harvesting of plant products can quickly lead to a decline in biodiversity. Changing consumption patterns of humans is often cited as the key reason for this unsustainable exploitation of natural resources. Many species which got extinct in the past 5 centuries, like Steller's sea cow, passenger pigeon, were subject to over-exploitation by humans.
- **Introduction of alien species:** Plants, animals and microorganisms transported deliberately or unintentionally from an outside geographical region can cause great damage to native species by competing with them for food and shelter, spreading diseases unknown to them, causing genetic changes through the process of interbreeding with native species, and disrupting various aspects of their food chains and the physical environment. For example, in India Water hyacinth was introduced by the British for beautification. But over time, it has become an invasive species, clogging rivers, lakes and other water bodies, thus not allowing any aquatic life to grow and survive.
- **Environmental pollution:** The accumulation of Pollution such phosphorus and nitrogen largely from excess fertilizers running off farmland, harmful chemicals from urban and suburban runoff, industrial effluents etc. which are discharged into the natural water bodies. For example, oil spill off the port of Ennore in Chennai in 2017. Similarly, plastic pollution causes the death of animals. Also, air pollution from industries and vehicles has resulted in the death of many bird species in urban areas.
- **Global climate change:** Climate change is projected to become a progressively more significant threat to biodiversity in the coming decades. Already, changes in the flowering and migration patterns as well as in the distribution of various species have been observed throughout the world. These changes have altered food chains and create mismatches within ecosystems where different species have evolved synchronised inter-dependence.

- **Co-extinctions:** When a particular species becomes extinct, the plants and animals associated with it in an obligatory way also come under the danger of becoming extinct. For example, When a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate.
- **Natural causes:** Like floods, earthquakes and other natural disasters also cause loss of biodiversity.

## CONSERVATION OF BIODIVERSITY

Biodiversity is crucial for human existence. All forms of life are closely interlinked in the environment. If species of plants and animals become endangered, they can cause degradation of other components in the environment, which is bound to threaten human being's own existence in some way or the other. So, conservation of biodiversity is of utmost importance. Conservation is the protection, preservation, management, or restoration of wildlife and natural resources. It ensures maintenance of natural landscapes and their ecosystems and the species, populations, genes, and the complex interactions among themselves and between them and the environment.

Conservation can broadly be divided into two types:

- **In-situ Conservation:** It is the approach of protecting an endangered plant or animal species in its natural habitat, either by protecting it cleaning up the habitat itself or by defending the species from predators. It forms the central element of any national strategy to conserve biodiversity. It involves the creation of protected area networks such as **National Park, Wildlife Sanctuary, Biosphere Reserve, Reserved forests, Nature Reserve, wetland protection zones etc.** The principal aims of in-situ conservation include:
  - Promotion of protection, restoration and sustainable management of the protected area.
  - Development of strategies for conservation of biodiversity within the area.
  - Creation of natural corridors linking areas of biological interest to prevent further habitat fragmentation.
  - Introduction of legislation to protect the species.
  - Information dissemination, education and awareness generation.
  - Promoting sustainable tourism in sensitive areas.
- **Ex-situ Conservation:** Ex-situ conservation is the relocation of endangered or rare species from their natural habitat to protected areas equipped for their protection and preservation. It is an alternative essential strategy when in-situ conservation is inadequate. This includes genetic resource conservation and makes use of a diverse body of techniques and facilities. Some of these include:
  - Zoological parks, Botanical gardens and Wildlife Safari parks.
  - Gene banks such as seed banks, sperm banks etc.
  - Captive breeding of animals and artificial propagation of plants, and attempt to reintroduce them into the wild; and
  - Collection of living organisms for research and development purpose.