



Government of Tamilnadu

Department of Employment and Training

Course : TNPSC Group I Mains Material
Subject : Environment, Biodiversity and Disaster Management
Topic : Biodiversity: Significance and Threats

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BIODIVERSITY: SIGNIFICANCE AND THREATS

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Significance of Biodiversity – Global and India

Biodiversity is the variety of life on earth. That is, it is the number of different species of flora and fauna including microorganisms. These organisms can inhabit different ecosystems with varying conditions like the Rainforests, Coral reefs, Grasslands, Deserts, Tundra and the Polar ice caps. This variety (Biodiversity) is essential for the wellbeing of our planet and sustenance of life as a whole.

The importance of biodiversity can be viewed and measured as

- a) Ecosystem services
- b) Biological resources
- c) Social benefits of biodiversity

The organization and functioning of ecosystems world over are affected and dependent on biodiversity and its richness. The major functional attributes are:

1. Continuity of nutrient cycles or biogeochemical cycles (N_2 , C, H_2O , P, S cycles)
2. Soil formation, conditioning or maintenance of soil health (fertility) by soil microbial diversity along with the different trophic members
3. Increases ecosystem productivity and provide food resources
4. Act as water traps, filters, water flow regulators and water purifiers (forest cover and vegetation)
5. Climate stability (forests are essential for rainfall, temperature regulation, CO_2 absorption, which in turn regulate the density and type of vegetation)
6. Forest resource management and sustainable development
7. Maintaining balance between biotic components
8. Cleaning up of pollutants – microbes are the biggest degraders of molecules including many anthropogenic ones which are present in effluents, sewage, garbage and agro-chemicals.

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9. Ecological stability – the varieties and richness of species contribute to ecological stability and survival of species. Biodiverse regions are reservoirs of biological resources like food resources, gene pool, genetic resource, medicinal resources, bio-prospecting
 10. To provide unique aesthetic value and hot spots for Ecotourism. Along with forest resources and wildlife it has commercial significance
 11. An indicator of the health of the ecosystem. Endemism is a crucial indicator of richness.

Biogeographical Regions of India

As per the international 'biome' type of classification based upon climate, fauna and flora and the soil conditions, India can be divided into ten different biogeographic zones, namely:

1. Trans Himalayan Region:

An extension of the Tibetan plateau, high-altitude cold desert in Ladakh (J&K) and Lahaul Spiti (H.P) comprising 5.7% of the country's landmass. The mountains of this region have the richest wild sheep and goat community in the world, renowned for its quality wool and wool products. Other fauna includes Chiru and Black-rocked Crane.

2. Himalayas:

The entire mountain chain running from north-western to north-eastern India, comprising a diverse range of biotic provinces and biomes and covers 7.2% of the country's landmass. The common fauna of the Himalayan ranges, are the wild sheep, mountain goats, shrew, snow leopard and panda, many of which are endangered.

3. Indian Desert:

The extremely arid area west of the Aravalli hill range, comprising both the salty desert of Gujarat and the sand desert of Rajasthan. It comprises 6.9% of the country's land-mass. Wild ass is endemic to this region. It is also the habitat for the Indian Bustard, camel, foxes and snakes, many of which are endangered.



4. **Semi – Arid Zones:**

This zone is between the desert and the Deccan plateau, including the Aravalli hill range covering 15.6% of the country's landmass. Fauna found here are nilghai, blackbuck, four horned antelopes, sambhar, chital and spotted deer which are herbivores along with predators like Asiatic lion, tiger, leopard and jackal.

5. **Western Ghats:**

Western Ghats, are mountain ranges along the west coast of India, extending over almost 1,500 km from Sat Pena in south Gujarat to the southernmost tip of Kerala. The annual rainfall is about 2000 mm. This zone has large populations of Nilgiri tahr (State animal of Tamil Nadu), Nilgiri Langur, tiger, leopard, and Indian elephant. The grizzled squirrel and lion tailed macaque are endemic to this region.

6. **Deccan Peninsula:**

This covers much of the southern and south-central plateau with a predominantly deciduous vegetation and 4.3% of the country's landmass. It is known for deciduous forests, thorn forests and pockets of semi ever green forests. Fauna found here are Chital, Sambhar, Nilghai, Elephant, Sloth bear, Black buck and Barking deer. It is the catchment area of major Indian rivers like Godavari, Tapti, Narmada and Mahanadi.

7. **Gangetic Plains:**

These plains are relatively homogenously defined by the Ganges river system and occupy about 11% of the country's landmass. This region is very fertile and extends up to the Himalayan foothills. Fauna includes rhinoceros, elephant, buffalo, swamp deer, hog-deer.

8. **North-East India:**

The plains and non- Himalayan hill ranges of north eastern India are home to a wide variety of vegetation. With 5.2% of the country's landmass, this region represents the transition zone between the Indian, Indo-Malayan and Indo-Chinese biogeographical regions and is the meeting point of the Himalayan Mountains and peninsular India. The North-East is thus the biogeographical 'Gateway' for much of

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India's fauna and flora and also biodiversity hotspot (Eastern Himalaya), which includes the Indian rhinoceros, leopard and golden langur.

9. Coastal Region:

Coastal region of India with sandy beaches, mud flats, coral reefs, mangroves constitutes 2.5% of the total geographical area. The coastline from Gujarat to Sundarbans is estimated to be 5423 km long. Apart from this a total of 25 islets constitute the Lakshadweep, which are of coral origin and have a typical reef lagoon system, rich in biodiversity. The fauna includes native crabs, turtles and tunas

10. Andaman and Nicobar Islands:

The Andaman and Nicobar Islands in the Bay of Bengal have highly diverse set of biomes, constituting 0.3% of the total geographical area. They are centers of high endemism and contain some of India's finest evergreen forests and support a wide diversity of corals. Fauna includes Narcondam hornbills of the Andamans and the South Andaman Krait.

Threats To biodiversity

Even though India is one of the 17 identified mega diverse countries of the world, it faces lots of threats to its biodiversity.

The threats are:

1. Natural causes, human activities, both directly and indirectly are today's main reason for habitat loss and biodiversity loss.
2. Fragmentation and degradation due to agricultural practices,
3. Extraction of mining, fishing, logging, harvesting.
4. Development of settlements, industrial and associated infrastructures leads to habitat loss and fragmentation leads to formation of isolated, small and scattered populations and as endangered species.
5. Other threats includes specialized diet, specialized habitat requirement, large size, small population size, limited geographic distribution and high economic or commercial value.

Causes of Biodiversity Loss

The major causes for biodiversity decline are:

1. Habitat loss due to Industrialization, Urbanization, infrastructure development, Transport – Road and Shipping activity, communication towers, dam construction, unregulated tourism and monoculture are common area of specific threats
2. Fragmentation and destruction (affects about 73% of all species)
3. Pollution and pollutants (smog, pesticides, herbicides, oil slicks, GHGs)
4. Climate change
5. Introduction of alien/exotic species
6. Over exploitation of resources (poaching, indiscriminate cutting of trees, over fishing, hunting, mining)
7. Intensive agriculture and aqua cultural practices
8. Hybridization between native and non-native species and loss of native species
9. Natural disasters (Tsunami, Forest fire, Earth quake, Volcanoes)
10. Co-extinction

1. Habitat Loss

Development of human society is inevitable. Natural habitats are destroyed for the purpose of settlement, agriculture, mining, industries and construction of highways. As a result, species are forced to adapt to the changes in the environment or move to other places. If not, they become victim to predation, starvation, disease and eventually die or results in human animal conflict.

Over population, urbanization, industrialization and agricultural advancements require additional land, water and raw materials every year. This is made possible only through fragmentation or destruction of natural habitats by filling wetlands, ploughing grasslands, cutting down trees, forest, desilting rivers, constructing transport ways, caving mountains, extracting, ores, changing the course of rivers and filling of seashore. The most dramatic example of habitat loss comes from the tropical rainforests 14% of the earth's land surface once covered by these tropical forests, is not more than 6% now. The Amazon rainforest, a vast area, harbouring millions of species,

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also called “Lungs of the planet “is destroyed and being replaced for agriculture and human settlements. 90% of New Zealand’s wetlands have been destroyed and cleared for cultivating soya beans and raising grass for beef cattle. Kodaikanal and Nilgiri hills of Tamil Nadu have been destroyed rapidly for human occupancy. Loss of habitat results in annihilation of plants, microorganisms and forcing out animals from their habitats.

2.Habitat fragmentation

Habitat fragmentation is the process where a large, continuous area of habitat is both, reduced in area and divided into two or more fragments. Fragmentation of habitats like forest land into crop lands, orchard lands, plantations, urban areas, industrial estates, transport and transit systems has resulted in the destruction of complex interactions amongst species, (food chain and webs) destruction of species in the cleared regions, annihilation of species restricted to these habitats (endemic) and decreased biodiversity in the habitat fragments. Animals requiring large territories such as mammals and birds are severely affected. The elephant corridors and migratory routes are highly vulnerable. The dwindling of many well-known birds (sparrows) and animals can be attributed to this.

3.Over exploitation:

We depend on nature for our basic needs such as food and shelter. However, when the need becomes greed, it leads to over exploitation of natural resources. Excessive exploitation of a species, reduces the size of its population to such a level that it becomes vulnerable to extinction. Dodo, passenger pigeon and Steller’s sea cow have become extinct in the last 200-300 years due to over exploitation by humans. Overfishing due to population pressure leads to many marine fish (populations) declining around the world.

4.Exotic species invasion:

Exotic species (non-native; alien) are organisms often introduced unintentionally or deliberately for commercial purpose, as biological control agents and other uses. They often become invasive and drive away the local species and is considered as the second major cause for extinction of species. Exotic species have proved harmful to both aquatic and terrestrial ecosystems.

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Tilapia fish (*Jilabi kendai*) introduced from east coast of South Africa in 1952 for its high productivity into Kerala's inland waters, became invasive, due to which the native species such as *Puntius dubius* and *Labeo Kontius* face local extinction. Amazon sailfin catfish is responsible for destroying the fish population in the wetlands of Kolkata. The introduction of the Nile Perch, a predatory fish into Lake Victoria in East Africa led to the extinction of an ecologically unique assemblage of more than 200 nature species of cichlid fish in the lake. African apple snail (*Achatina fulica*) is the most invasive among all alien fauna in India. This mollusc was first reported in the Andaman and Nicobar Islands. It is now found across the country and threatens the habitat of several native species. Moreover, it is becoming a vicious pest in vegetable farms. Exotic earthworms compete for food with native varieties and deplete their population in soil. Papaya Mealy Bug (*Paracoccus marginatus*) is native of Mexico and Central America, is believed to have destroyed huge crops of papaya in Assam, West Bengal and Tamilnadu.

6.Climate changes

Industrialization is a major contributor to climate change and a major threat to biodiversity. Energy drives our industries, which is provided by burning of fossil fuels. This increases the emission of CO₂, a GHG, leading to climate change. Due to large scale deforestation, the emitted CO₂ cannot be absorbed fully, and its concentration in the air increases. Climate change increases land and ocean temperature, changes precipitation patterns and raises the sea level. This in turn results in melting of glaciers, water inundation, less predictability of weather patterns, extreme weather conditions, outbreak of squalor diseases, migration of animals and loss of trees in forest. Thus, climate change is an imminent danger to the existing biodiversity

7.Shifting or Jhum cultivation (Slash-and-burn agriculture)

In shifting cultivation, plots of natural tree vegetation are burnt away and the cleared patches are farmed for 2-3 seasons, after which their fertility reduces to a point where crop production is no longer profitable. The farmer then abandons this patch and cuts down a new patch of forest trees elsewhere for crop production. This system is practiced in north-eastern regions of India. When vast areas are cleared and burnt, it results in loss of forest cover, pollution and discharge of CO₂ which in turn attributes to

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loss of habitat and climate change which has an impact on the faunal diversity of that regions.

8.Coextinctions

Coextinction of a species is the loss of a species as a consequence of the extinction of another. (Eg. orchid bees and forest trees by cross pollination). Extinction of one will automatically cause extinction of the other. Another example for co-extinction is the connection between Calvaria tree and the extinct bird of Mauritius Island, the Dodo. The Calvaria tree is dependent on the Dodo bird for completion of its life cycle. The mutualistic association is that the tough horny endocarp of the seeds of Calvaria tree are made permeable by the actions of the large stones in birds gizzard and digestive juices thereby facilitating easier germination. The extinction of the Dodo bird led to the imminent danger of the Calvaria tree coextinction.

9.Pollution

Pollutants and pollution are a major cause for biodiversity loss. Excessive use of fertilizers, pesticides and heavy metals have polluted the land, ground and surface water bodies. There is a tendency of pesticide biomagnification which results in high concentrations at higher trophic levels which has resulted in drastic decline in the population of fish-eating birds and falcons. Run off from fertilizer rich fields causes nutrient enrichment of water bodies leading to eutrophication. Mercury, arsenic, cadmium, chromium poisoning has led to depletion of biotic resources in vulnerable ecosystems. Death of vulture population is attributed to the veterinary medicine Diclofenac, which is responsible for the thinning of the egg shells.

10.Intensive agriculture:

Spread of agriculture is sometimes at the cost of wetlands, grasslands and forests. Intensive agriculture is based on a few high yielding varieties. As a result, there is reduction in the genetic diversity. It also increases vulnerability of the crop plants to sudden attack by pathogens and pests. There are only few varieties of traditional paddy strains today due to use to hybrid varieties in Tamil Nadu.

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11.Forestry

There is a tendency to grow economically important and viable trees like Teak, Sandal, Oak, Sal in forests resulting in loss of other forest trees.

12.Natural threats

These include spontaneous jungle fires, tree fall, land slide, defoliation by insects or locust attack.

13.Loss of biodiversity

Species have been evolving and dying out (extinction) ever since the origin of life. However, species are now becoming extinct at a faster rate. This is destabilizing the ecological stability and the distribution of biological diversity on earth. Human activities greatly contribute to the loss of biodiversity. Natural resources such as land, water and organisms are indiscriminately exploited by human beings.

According to the Convention of Biological Diversity, direct and indirect human activities have a detrimental effect on biodiversity. Direct human activities like change in local land use, species introduction or removal, harvesting, pollution and climate change contribute a greater pressure on loss of biodiversity. Indirect human drivers include demographic, economic, technological, cultural and religious factors.

Even though new species are being discovered, there is little hope for adding new species through speciation into the biodiversity treasure. Monsoon failure, global warming, depletion in ozone layer, landslides in hilly states, pollution are a few indirect effects of human activities which results in the loss biodiversity. IUCN Red List (2004) documents the extinction of 784 species in the 500 years.

It is estimated that the current rate of biodiversity loss is 100 to 1000 times higher than the naturally occurring extinction rate and is still expected to grow in the future. This loss of biodiversity has an immense impact on plant animal and human life. The negative effects include dramatic influence on the food web. Even reduction in one species can adversely affect the entire food chain which further leads to an overall reduction in biodiversity. Reduced biodiversity leads to immediate danger for food security by reducing ecosystem services.

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Species is considered extinct when none of its members are alive anywhere in the world. If individuals of a species remain alive only in captivity or other human controlled conditions, the species is said to be extinct in the wild. In both of these situations, the species would be considered globally extinct. A species is considered to be locally extinct when it is no longer found in an area it once inhabited but is still found elsewhere in the wild. In the 450 million years of life on Earth, there had been 5 mass extinctions, which had eliminated at least 50% of the species of flora and fauna on the globe. The extinction of species is mainly due to drastic environmental changes and population characteristics.

There are three types of Extinctions

i. Natural extinction is a slow process of replacement of existing species with better adapted species due to changes in environmental conditions, evolutionary changes, predators and diseases. A small population can get extinct sooner than the large population due to inbreeding depression (less adaptivity and variation).

ii. Mass extinction: The earth has experienced quite a few mass extinctions due to environmental catastrophes. A mass extinction occurred about 225 million years ago during the Permian, where 90% of shallow water marine invertebrates disappeared.

iii. Anthropogenic extinctions These are abetted by human activities like hunting, habitat destruction, over exploitation, urbanization and industrialization.

Questions:

1. Explain the causes and threats of the biodiversity and its significance to the ecosystem.