

Concepts of Biodiversity and Conservation of Forests and Wildlife

Meaning of Biodiversity: Biodiversity refers to the variety and variability of living organisms found on the Earth, including plants, animals, microorganisms and the ecosystems in which they live. It represents the richness of life and the differences among living organisms in different geographical regions. Biodiversity is influenced by climatic conditions, soil, relief, water availability and other environmental factors. Tropical rainforests, wetlands, grasslands, mountains and coral reefs support different forms of biodiversity. India is one of the world's megadiverse countries because of its wide range of ecosystems and rich variety of plant and animal species. Biodiversity is essential for maintaining ecological balance, providing food and medicine, regulating climate and supporting human livelihoods.

Major Concepts of Biodiversity: The concept of biodiversity is generally explained through three major levels: genetic diversity, species diversity and ecosystem diversity. These three levels help us understand the variety of life from genes within individual species to the different ecosystems found across the world.

1. **Genetic Diversity:** Genetic diversity refers to the variation in genes among individuals of the same species. These genetic differences enable organisms to adapt to changing environmental conditions and increase their chances of survival. For example, different varieties of rice, wheat and tea possess different genetic characteristics that influence their productivity, resistance to diseases and ability to tolerate environmental stress. Genetic diversity is important for crop improvement, disease resistance and the long-term survival of species.



Fig.1 genetic diversity

2. **Species Diversity:** Species diversity refers to the variety of different species of plants, animals and microorganisms present in a particular geographical area. It includes both species richness, which refers to the number of species, and species evenness, which describes how evenly individuals are distributed among those species. For example, a tropical rainforest generally contains a greater variety of plant and animal species than a desert ecosystem. Species diversity contributes to ecological stability, food security and the proper functioning of ecosystems.



Fig.2 Species Diversity

3. **Ecosystem Diversity:** Ecosystem diversity refers to the variety of ecosystems, habitats and ecological processes found within a region. Different ecosystems support different communities of plants, animals and microorganisms. Forests, grasslands, wetlands, rivers, mountains and coastal ecosystems are examples of ecosystem diversity. In Assam, Kaziranga National Park supports a combination of grasslands, wetlands and forest habitats that provide shelter and food for numerous species. Ecosystem diversity is important because different ecosystems perform different ecological functions, such as water purification, soil formation, carbon storage and flood regulation.



Fig.3 Ecosystem Diversity

Importance of Biodiversity: Biodiversity is important for maintaining ecological balance and supporting life on Earth. Different species perform essential functions in ecosystems, such as pollination, decomposition, nutrient cycling, soil formation and pest control. Forests absorb carbon dioxide, regulate local climate and help maintain the water cycle, while wetlands provide habitats for wildlife and help reduce flood impacts. Biodiversity also provides food, fuel, fibre, timber and medicinal resources for human beings. Many rural and Indigenous communities depend on forests and other natural ecosystems for their livelihoods, traditional knowledge and cultural practices. Therefore, the conservation of biodiversity is necessary for environmental sustainability, economic development and the well-being of present and future generations.

Meaning of Biodiversity Hotspots

A biodiversity hotspot is a geographical region that contains exceptionally high levels of endemic plant life and has experienced significant habitat loss. The concept was introduced by British ecologist Norman Myers in 1988 to identify areas requiring urgent conservation attention. Biodiversity hotspots are important because they contain species that are found nowhere else in the world and face considerable threats from human activities and environmental changes.

According to the widely used criteria established by Conservation International, a region must satisfy two conditions to qualify as a biodiversity hotspot:

1. Endemic plant species: It must contain at least 1,500 species of vascular plants that are endemic to the region, meaning they occur naturally nowhere else.
2. Habitat loss: It must have lost at least 70% of its original natural vegetation, indicating a high degree of habitat destruction.

These criteria help identify regions where conservation efforts can protect a large number of unique species under serious threat.

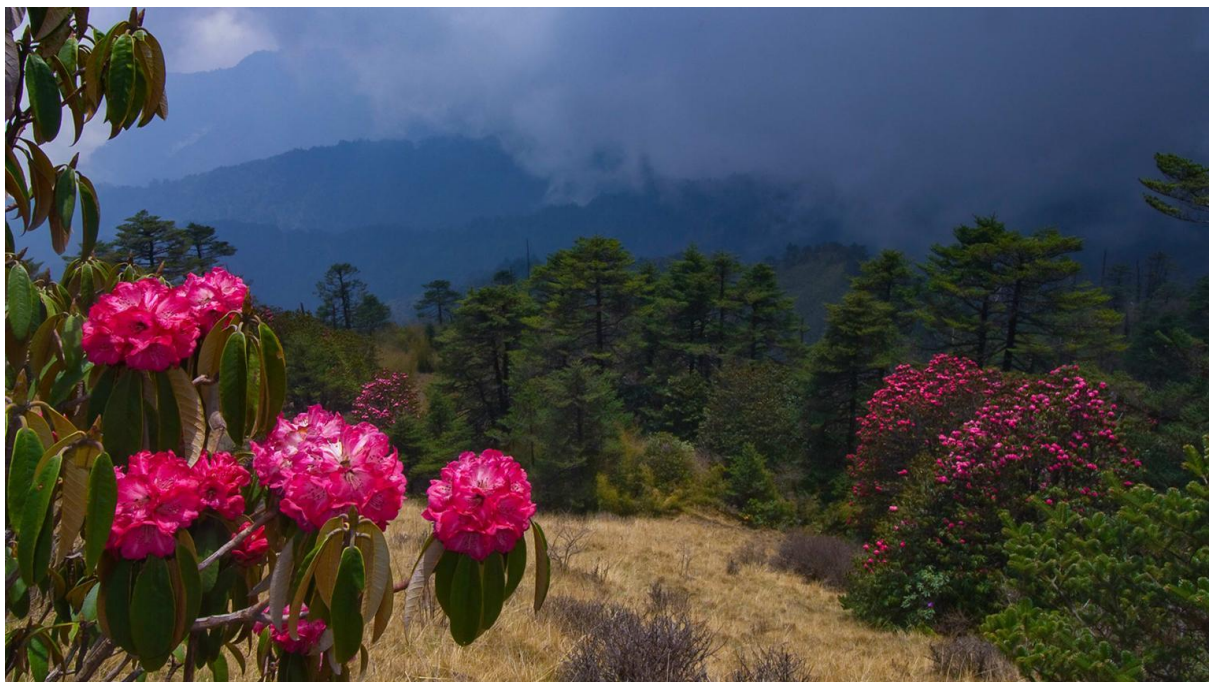
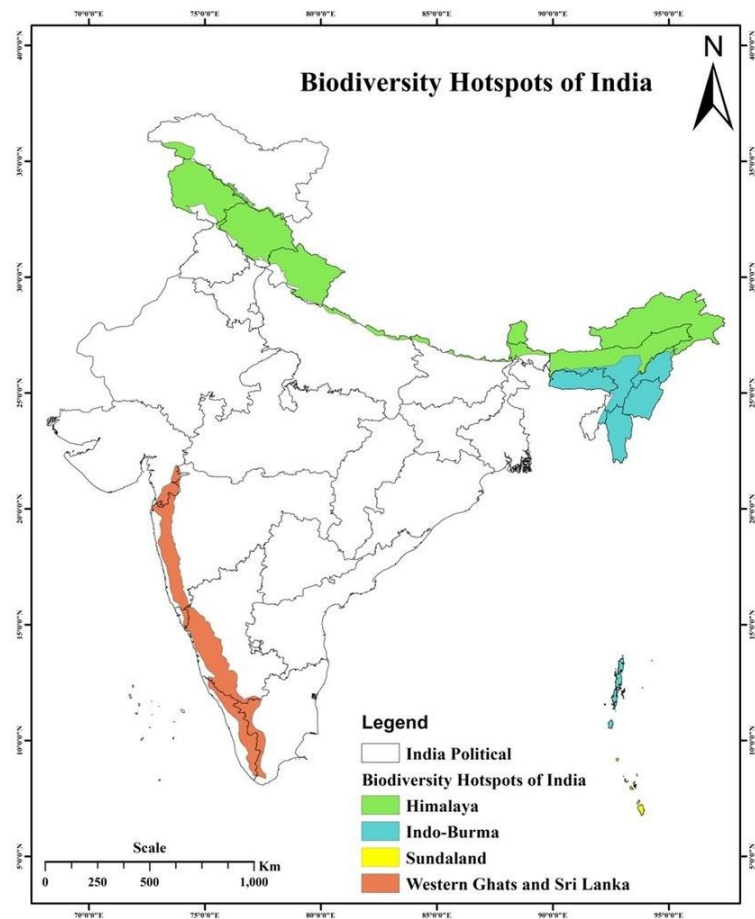
Major Biodiversity Hotspots of the World

There are currently 36 recognised biodiversity hotspots worldwide. They occur across tropical forests, mountain systems, islands and other biologically rich regions. Many hotspots are located in tropical and subtropical areas because of their high species richness and endemism. However, biodiversity hotspots are not restricted to the tropics; some temperate regions also qualify.

Examples include the Tropical Andes of South America, Madagascar and the Indian Ocean Islands, the Western Ghats and Sri Lanka, the Himalaya and Indo-Burma. These regions support unique plant and animal communities but face threats such as deforestation, agricultural expansion, urbanisation, mining, infrastructure development and climate change.

Biodiversity Hotspots of India

India falls within four internationally recognised biodiversity hotspots. These regions are important because they contain many endemic species and face considerable pressure from habitat loss and human activities.



1. Himalaya

The Himalayan hotspot extends across the mountain system of South Asia. It contains diverse ecosystems ranging from subtropical forests to alpine meadows. Important species include the red panda, snow leopard and many endemic plants. Major threats include deforestation, infrastructure development, habitat fragmentation and climate change.



2. Indo-Burma

This hotspot includes much of Northeast India, including Assam, as well as parts of Southeast Asia. It supports tropical forests, wetlands and grasslands, with rich diversity of birds, mammals, reptiles and plants. Threats include forest clearance, hunting, infrastructure expansion and conversion of natural habitats into agricultural land and plantations.



3. Western Ghats–Sri Lanka

This hotspot includes the Western Ghats of peninsular India and Sri Lanka. It is known for high levels of endemism among amphibians, reptiles, plants and other organisms. Deforestation, plantations, mining, dams and fragmentation of forest habitats are major conservation concerns.



4. Sundaland

In Indian territory, this hotspot is represented by the Nicobar Islands. It contains tropical rainforests and island ecosystems with distinctive flora and fauna. Its biodiversity is threatened by habitat destruction, invasive species, coastal development and climate-related hazards.

Significance of Biodiversity Hotspots

Biodiversity hotspots are important for conservation planning because they help identify areas where limited resources can be directed towards protecting highly threatened and unique species. They support ecosystem services such as carbon storage, water regulation, soil conservation and pollination. They also provide livelihoods and cultural resources for Indigenous peoples and local communities. Protecting hotspots can help prevent species extinction, maintain ecological stability and promote sustainable development.

Major Threats to Biodiversity Hotspots

The major threats include deforestation, habitat fragmentation, agricultural expansion, mining, urbanisation, illegal wildlife trade, pollution, invasive alien species and climate change. In Northeast India, road construction, expansion of settlements, forest degradation and the conversion of natural forests into plantations can affect wildlife habitats and disrupt ecological connectivity. Effective conservation requires protected areas, wildlife corridors, habitat restoration, community participation and sustainable land-use planning.

Conclusion

Biodiversity hotspots are regions characterised by high plant endemism and extensive loss of natural habitat. The hotspot concept provides a scientific basis for prioritising biodiversity conservation at the global and regional levels. India's four hotspots—the Himalaya, Indo-Burma, Western Ghats–Sri Lanka and Sundaland—contain globally significant biological resources. Their conservation is essential for preventing extinction, maintaining ecosystem functions and ensuring the sustainable use of natural resources.

Meaning of Forest Conservation: Forest conservation refers to the protection, management and sustainable use of forests to maintain their ecological, economic and social values. Forests are important natural resources because they provide habitats for wildlife, prevent soil erosion, regulate climate, store carbon and support the water cycle. They also provide timber, bamboo, fuelwood, medicinal plants and other resources for human use. However, deforestation, shifting land use, mining, road construction, forest fires and illegal logging threaten forest ecosystems. Forest conservation aims to prevent unnecessary destruction of forests, restore degraded areas and ensure that forest resources are used responsibly. In the hilly regions of Assam, forest conservation is particularly important for reducing soil erosion, protecting watersheds, maintaining biodiversity and supporting the livelihoods of local communities.

Methods of Forest Conservation: Forest conservation can be achieved through several methods. Afforestation involves planting trees on land that was not recently under forest cover, while reforestation involves re-establishing tree cover in areas where forests have been removed or degraded. Sustainable forest management promotes the responsible harvesting of

forest products without damaging the long-term health of the forest. The establishment of national parks, wildlife sanctuaries and other protected areas helps preserve natural habitats and restrict destructive activities. Social forestry and community forestry encourage local people to participate in tree planting and forest management. Prevention of forest fires, control of illegal logging, regulation of mining and protection of watersheds are also important conservation measures. In addition, agroforestry, awareness programmes and the use of alternative sources of fuel can reduce pressure on natural forests.

Meaning of Wildlife Conservation: Wildlife conservation refers to the protection and management of wild animals, birds and other organisms, along with their natural habitats, to ensure their continued survival. Wildlife plays an important role in maintaining ecological balance through activities such as pollination, seed dispersal, predation and nutrient cycling. However, wildlife populations are threatened by habitat destruction, poaching, illegal wildlife trade, pollution, forest fires, human-wildlife conflict and climate change. Wildlife conservation aims to protect endangered species, maintain healthy populations and preserve the habitats necessary for their survival. For example, Kaziranga National Park in Assam is internationally recognised for the conservation of the greater one-horned rhinoceros and also supports elephants, tigers, wild water buffaloes and numerous bird species.

Methods of Wildlife Conservation: Wildlife conservation involves both in-situ and ex-situ conservation. In-situ conservation means protecting species within their natural habitats through national parks, wildlife sanctuaries, biosphere reserves and wildlife corridors. This method allows organisms to survive, reproduce and interact within their natural ecosystems. Ex-situ conservation involves protecting species outside their natural habitats, such as in zoos, botanical gardens, seed banks and captive-breeding centres. Other wildlife conservation measures include preventing poaching, controlling illegal wildlife trade, restoring degraded habitats, protecting breeding grounds and reducing human-wildlife conflict. Environmental education, scientific research and community participation are also essential. In Assam, protected areas such as Kaziranga National Park and Manas National Park play important roles in wildlife conservation.

Role of Government and Communities in Conservation: Government institutions, local communities and non-governmental organisations all play important roles in biodiversity conservation. The Government of India has introduced several laws and programmes to protect forests and wildlife. The Wild Life (Protection) Act, 1972, provides a legal framework for wildlife protection, while the Biological Diversity Act, 2002, provides a framework for biodiversity conservation, sustainable use and fair and equitable sharing of benefits arising from biological resources. The Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980, as amended, provides a legal framework concerning the diversion of forest land for non-forest purposes. Local communities contribute through traditional conservation practices, community forest management, protection of sacred groves and sustainable use of forest resources. Their participation is particularly important because many communities depend directly on forests for food, livelihoods and cultural practices.

Conclusion: Biodiversity represents the variety of life at genetic, species and ecosystem levels. It maintains ecological balance and provides essential resources and services for human survival. Forest and wildlife conservation are closely connected because forests provide habitats and ecological conditions necessary for the survival of many species. Effective conservation requires habitat protection, sustainable resource use, legal measures, scientific research and active community participation. Therefore, conserving biodiversity, forests and wildlife is essential for maintaining ecological stability and achieving sustainable development.

A. One-Mark Questions (5 × 1 = 5 marks)

1. Define biodiversity.
2. What is genetic diversity?
3. What is an endemic species?
4. Define afforestation.
5. Name one wildlife sanctuary or national park in Assam.

B. Short-Answer Questions (5 Questions, 2/3 Marks Each)

1. Distinguish between genetic diversity and species diversity.
2. What is ecosystem diversity? Give two examples.
3. Mention three major threats to biodiversity.
4. State three methods of forest conservation.
5. Differentiate between in-situ and ex-situ wildlife conservation with examples.

C. Long-Answer Questions (5 Questions, 8 Marks Each)

1. Explain the meaning and major concepts of biodiversity, with suitable examples.
2. Discuss the ecological, economic and social significance of biodiversity.
3. Describe the major causes of biodiversity loss and suggest suitable conservation measures.
4. Discuss the major methods of forest conservation and explain their importance for environmental sustainability.
5. Explain the methods of wildlife conservation, highlighting the roles of protected areas, government legislation and local communities in India.