

# **Module Title: Biodiversity Conservation – Importance, Challenges & Solutions**

**Course Overview:** This course provides insights into biodiversity, its importance, threats, and conservation strategies. It is designed for students, environmental enthusiasts, and policymakers

**Format:** Text, images, videos, quizzes

**Target Audience:** High school and college students.

**Course Duration:** 10-12 hours (can be delivered over 2-3 days)

## **Learning Objectives:**

By the end of this course, learners will be able to:

- Define biodiversity and its different types.
- Explain the importance of biodiversity
- Identify major threats to biodiversity
- Understand conservation strategies at individual and global levels

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## Module 1: Introduction to Biodiversity

The term “biodiversity” is a contraction of “biological diversity” or “biotic diversity”. These terms all refer to the idea of living variation, from genes and traits, to species, and to ecosystems. The popular contraction “biodiversity” came about in the mid-1980s, heralded by a symposium in 1986 and an influential follow-up book, *Biodiversity* (Wilson 1988). These events often are interpreted as the beginning of the biodiversity story, but this mid-1980s activity actually was both a nod to important past work, and a launching of something quite new, in ways not fully anticipated.

The new term “biodiversity” energised some fundamental ideas developed over the previous decade (or longer). Precursor terms like “biotic diversity” had helped to communicate why we should be concerned about the loss of variety, arising from the species extinction crisis (later, the “biodiversity crisis”). This recognised the idea that living variation itself has current value, because it provides the opportunity for future benefits for humanity.

**Definition:** Biodiversity, the variability among living organisms from all sources, underpins all life on Earth. This includes diversity within species, between species and across ecosystems, representing the genetic makeup of plants, animals, microorganisms and the complexity of ecosystems.

This diversity exists at different scales: regional diversity, ecosystem diversity, species diversity and genetic diversity. Biodiversity is not static, but constantly changing. It is increased by genetic change and evolutionary processes and reduced by processes such as habitat degradation, population decline and extinction.

### Levels of Biodiversity: Genetic, Species, Ecosystem

1. **Genetic Diversity:** Genetic diversity refers to the variation of genes within a species. This includes differences between individuals of the same species as well as between different populations of the same species.

Biodiversity includes the genes that every individual inherits from its parents and passes on to the next generation. Genetic diversity is found everywhere, from the variety of songs and feather colors of birds to the colors, tastes, and textures of apples and other foods.

Genetic variation, which determines the extent to which individuals can adapt to their environments, is extremely important to their survival.

**Importance:**

- Enhances the adaptability and survival of species.
- Ensures species can cope with changes in the environment (e.g., disease, climate change).
- Essential for crop and livestock breeding programs.

**Example:**

- Different varieties of rice or wheat with unique traits (e.g., drought resistance).
- Wild and domestic dogs have vast genetic variation.

## **2. Species diversity**

Species diversity refers to the variety of species within a region or ecosystem. It includes the number of species (richness) and their relative abundance (evenness).

Species diversity measures the number of different species found in a given territory – a lush tropical rainforest, for example, has much higher species diversity than a sandy desert, where a select few species can survive.

This type of biodiversity is fundamental to the functioning of many of the natural systems that agriculture depends on, such as pollination, water retention and nutrient cycling. Species-rich habitats are more adaptable and can be more productive. For example, they may be more resistant to erosion and have longer growing seasons.

**Importance:**

- Maintains ecosystem resilience and functionality.
- Each species plays a unique role in the food web and ecosystem balance.
- Greater diversity means greater stability in ecological communities.

**Example:**

Indian Elephant (*Elephas maximus indicus*)

- Native to forested regions of South and Northeast India.
- Plays a key role in maintaining forest ecosystems by seed dispersal.

### 3. Ecosystem Diversity

Ecosystem diversity refers to the variety of ecosystems in a given region. It considers the range of different habitats, biological communities, and ecological processes.

Ecosystem diversity is the variety of ecosystems in a given place. An ecosystem is a community of organisms and their physical environment interacting together. An ecosystem can cover a large area, such as a whole forest, or a small area, such as a pond.

An ecosystem is a community of organisms and their physical environment interacting together. An ecosystem may be as large as the Great Barrier Reef or as small as the back of a spider crab's shell, which provides a home for plants and other animals, such as sponges, algae and worms.

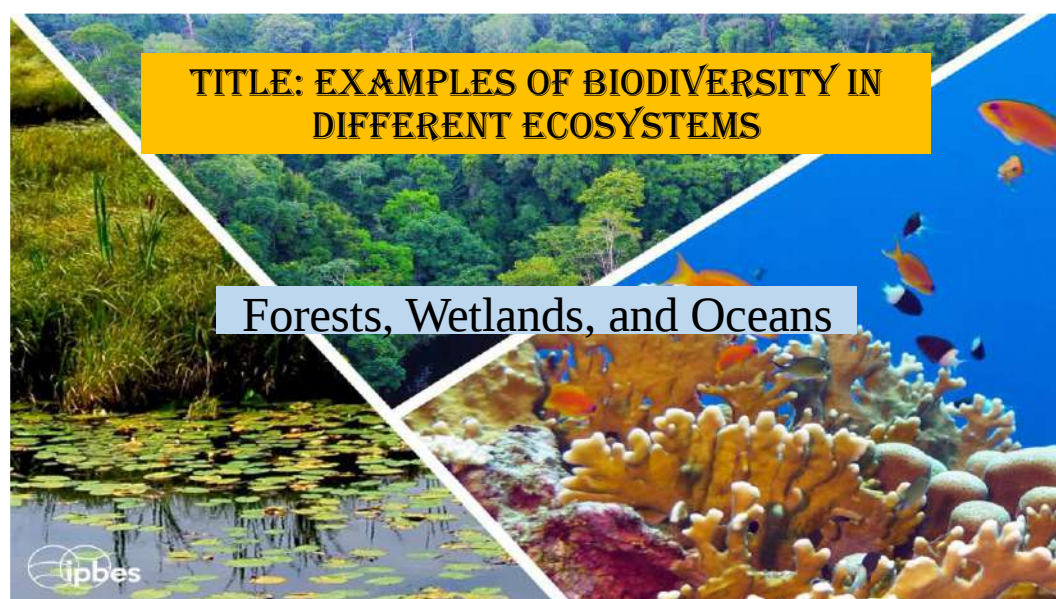
#### Importance

- Different ecosystems provide a wide array of services: water purification, pollination, climate regulation, etc.
- Supports a wider range of species and genetic diversity.

#### Example:

- Deserts, forests, wetlands, grasslands, mountains, marine zones—all represent different ecosystems.
- India has ecosystem diversity from the Himalayas to the Western Ghats to coastal mangroves.

Refer the following PowerPoint Presentation for *different types of ecosystem*



## **Importance of Biodiversity in Ecosystem Services**

Biodiversity is crucial for sustaining ecosystem services like clean water, fertile soil, and climate regulation, as diverse ecosystems are more resilient and provide a wider range of benefits to humans and the planet.

Here's a clear and detailed explanation of the Importance of Biodiversity in Ecosystem Services, suitable for your e-learning material or slides:

### **1. Provisioning Services**

These are the products we obtain from ecosystems.

Examples:

- Food: Crops, fruits, vegetables, fish, honey
- Medicines: Over 50% of modern drugs are derived from plant species (e.g., neem, turmeric)
- Raw materials: Timber, fiber, fuelwood

Biodiverse ecosystems provide a greater variety of useful products.

### **2. Regulating Services**

These are the natural processes that regulate the environment.

Examples:

- Climate regulation: Forests absorb CO<sub>2</sub> and help stabilize the climate
- Water purification: Wetlands filter pollutants
- Pollination: Bees, butterflies, and birds pollinate crops
- Pest and disease control: Natural predators reduce pests

Biodiversity ensures balanced, healthy ecosystems that regulate themselves.

### **3. Cultural Services**

Non-material benefits that contribute to cultural and spiritual well-being.

Examples:

- Recreation and tourism: Ecotourism in biodiversity hotspots (e.g., Western Ghats, Sundarbans)
- Spiritual and religious value: Sacred groves, rivers, species (e.g., Tulsi, Peepal tree)
- Aesthetic appreciation: Landscapes, flora, and fauna in art and literature

Cultural identity and inspiration are deeply connected to biodiversity.

### **4. Supporting Services**

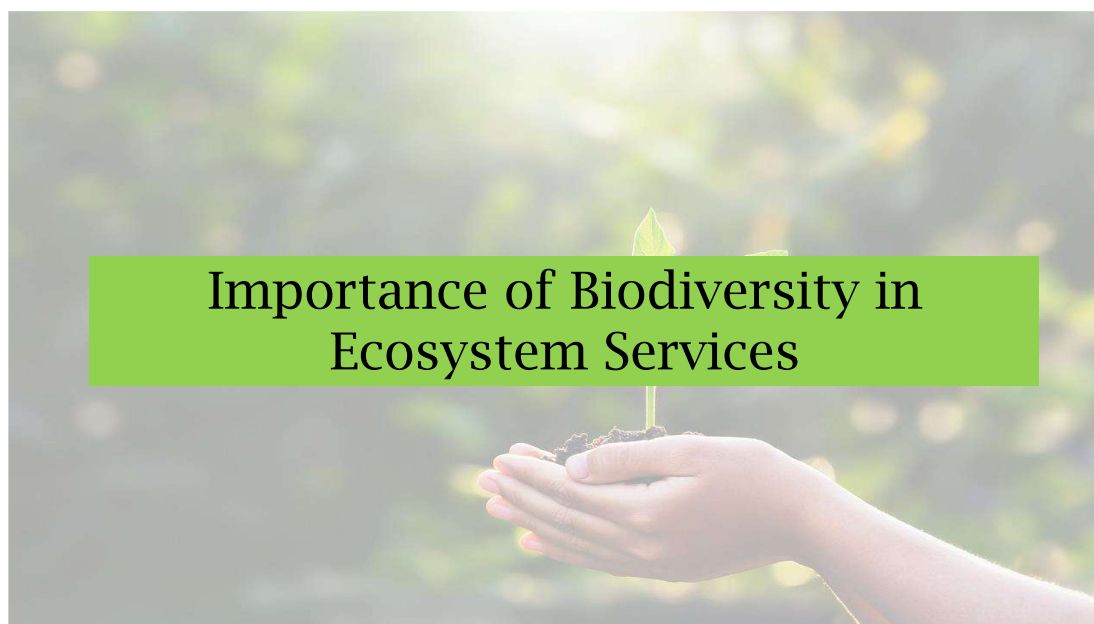
These are services that are necessary for the production of all other ecosystem services.

Examples:

- Soil formation: Decomposition by microbes and insects
- Nutrient cycling: Fungi, bacteria, and earthworms recycle nutrients
- Photosynthesis: Plants support all life by producing oxygen and food

Supporting services maintain the structure and health of ecosystems.

*“Without biodiversity, there is no foundation for clean water, food security, climate balance, or human health.”*



Types of Diversity: <https://youtu.be/rclOz8Fsbgm>

### **Importance of Biodiversity**

**Food value:** Human consumes a number of wild and semi-wild species of plant as food. Many species of marine algae and mushroom also form the source of the food. Wheat, rice and corn, the three major carbohydrate crops, yield nearly 2/3rd of the food, sustaining world's population. Livestock and wild fauna also contribute greatly to feeding humans. Staple crops, meat and fish form bulk of our diet while vegetables and fruits add variety to our diet and are indispensable source of vitamins and minerals.

**Medicinal value:** Many of the chemicals are derived from plants that had been used in the traditional medicines. Currently 25% of all prescription drugs are derived from mere 120 species of plants. Some of the plant species native to India, such as Neem and Tulsi etc.

has potential medicinal applications. In India, 3,000 plant species are still used as medicinal plants by more than 75% rural population

**Fuel value:** communities near forests obtain firewood for subsistence and income generation. Till date, the highest use of wood is as fuel. Fire wood is used for brick, pottery and bangle firing.

**Other goods value:** includes fodder for livestock, variety of natural fibers, ornamental plants etc. moreover, marine resources, freshwater and other aquatic animals provide food and goods.

**Timber value:** wood harvested from wild species, timber is a source of income generation. Many industries such as pulp and paper industry saw milling, plywood, construction poles, railway sleepers thrive on wood resources.

**Fishery value:** Fish and other fishery products have a significant place in world's food security. These resources constitute another class of commodity of great economic importance in global trade. Marine aquatic resource harvest constitutes about 80% and the remainder from inland fishery and aquaculture production. Commonly harvested marine forms include herrings, sardines and anchovies group.

**Other productive use value:** many useful micro-organisms are used to clean-up oil-spills and toxic wastes, in biofertilizers, some fungi are used to control plant diseases. A few nitrogen fixing water weeds, such as Azolla, are being used as biofertilizers. To productive use from musk deer, silk from silkworm, wool from sheep, fur from many textile, silk, leather, ivory work etc. fetch their raw materials from biological diversity.

Many non-wood products of economic value produced by wild species include medicinal herbs, gum and resin, honey beeswax, fibers, essential oils etc. form important sources of income.

**Ecosystem service value:** ecosystem service value of biodiversity refers to the service provided by the ecosystem such as prevention of soil erosion, soil formation, cycling of nutrients, fixation, waste disposal, role as carbon sink, and pollination of plants by insects and birds, climate regulation, prevention from flood and drought etc.

**Social, Cultural and Religious Service Value:** Social service value of biodiversity is associated with social life, customs, religious, and psycho-spiritual aspects of the people

in different societies. Human history reveals that people have through cultural religious beliefs. In, India leaves, flowers and fruits or other parts of plants of Tulsi, Pipal, Bargad, Neem, Mango, Khejri, Bel are used variously and their trees are planted which are considered sacred and worshiped by the people. Many animals such as birds, cow, snake, bull, peacock owl etc. have been considered sacred and find a significant place in our psycho-spiritual arena.

**Aesthetic value:** the diverse flora and fauna with innumerable species of plants and animals brings the earth to life. Biodiversity has also a great aesthetic value in ecotourism, bird watching, wildlife viewing, pet keeping, gardening etc. people from far and wide spend lot of their time and money to visit wilderness areas to enjoy the aesthetic value of biodiversity.

**Ethical value:** ethical value involves issues like all life must be preserved. We have a moral obligation to preserve species with lesser powers because extinction of some species will threaten the very existence of man. Man holds a great responsibility towards preserving and conserving other species. We have moral obligation to preserve species with lesser powers because extinction of some species will threaten the very existence of man.



### Case Study: Bishnoi Community and Sustainable Use of Natural Resources

The Bishnoi community, mainly residing in the arid regions of western Rajasthan, is one of India's most remarkable examples of grassroots-level environmental conservation. Established in the 15th century by Guru Jambheshwar (also known as Jambhoji), the community is guided by 29 principles (from where the name 'Bishnoi'—meaning twenty-nine—is derived). Several of these commandments are focused on living in harmony with nature and protecting all forms of life.

### **Sustainable Practices in Natural Resource Use**

#### **1. Forest**

The Bishnois are well-known for protecting Khejri trees (*Prosopis cineraria*), which play a crucial role in maintaining soil fertility and preventing desertification in Rajasthan.

The most iconic example is the sacrifice of 363 Bishnois in 1730 AD in Khejarli village, who laid down their lives to prevent the felling of Khejri trees by the king's men. This is considered an early version of the Chipko movement.

#### **2. Wildlife**

Bishnois strictly prohibit the hunting of animals. They protect and feed wildlife such as blackbucks, chinkaras (Indian gazelles), peacocks, and other birds. Animals are treated as part of the family, and injured wildlife is often brought into their homes for care and recovery. Their efforts have created natural safe zones for wildlife, even outside official protected areas.

#### **3. Water**

Living in a water-scarce region, Bishnois have developed efficient water conservation techniques. They construct and maintain kunds, small community water tanks that store rainwater for domestic and agricultural use. They practice judicious use of water, avoiding waste and ensuring availability during dry seasons.

#### **4. Use of Forest and Agricultural Resources**

They collect only fallen wood for fuel and avoid cutting green trees. Agricultural practices are eco-friendly, avoiding chemical fertilizers and relying on natural compost. Livestock is an integral part of their economy, and animals are cared for with great affection and respect.

### **Ecological and Social Impact**

The Bishnoi community is often referred to as India's first ecological warriors.

Their traditions have preserved biodiversity in a naturally fragile desert ecosystem.

Their example influenced environmental policies and community conservation programs in India, including aspects of the Wildlife Protection Act, 1972.

The Bishnoi community demonstrates that traditional knowledge and values can lead to effective and long-lasting environmental conservation. Their model of coexistence with nature, where every tree and animal is considered sacred, provides important lessons in sustainability and respect for ecosystems—especially in today’s context of ecological crisis.

Importance of forest: [https://www.youtube.com/watch?v=\\_dWJVHIE9S8](https://www.youtube.com/watch?v=_dWJVHIE9S8)

Amazon Rainforest : [https://youtu.be/YxyDNrTIViw?si=F2cwi\\_qUddFW0F3M](https://youtu.be/YxyDNrTIViw?si=F2cwi_qUddFW0F3M)

### Assessment test on Module-1

#### MCQs on Biodiversity and Its Importance

1. Which of the following is an example of genetic diversity?
  - A. Different species of birds in a forest
  - B. Different ecosystems in a region
  - C. Variations of rice varieties in India
  - D. A coral reef with many species of fish
 ✓ Answer: C
2. The variety of life forms in an ecosystem is referred to as:
  - A. Ecology
  - B. Ecosystem services
  - C. Biodiversity
  - D. Biome
 ✓ Answer: C
3. Which Indian region is a biodiversity hotspot?
  - A. Thar Desert
  - B. Western Ghats
  - C. Indo-Gangetic Plains
  - D. Sunderbans Delta
 ✓ Answer: B
4. Which of the following is a provisioning service of biodiversity?
  - A. Climate regulation
  - B. Pollination
  - C. Timber and medicinal plants
  - D. Soil formation
 ✓ Answer: C
5. What role does biodiversity play in pollination?
  - A. It reduces pest attacks
  - B. It supports decomposition
  - C. It helps in seed dispersion
  - D. It provides pollinators like bees and butterflies
 ✓ Answer: D
6. The Great Indian Bustard is an example of:
  - A. An exotic species
  - B. A domesticated species
  - C. An endangered species
  - D. A marine species
 ✓ Answer: C
7. Which of the following is NOT a cultural service provided by biodiversity?
  - A. Ecotourism
  - B. Religious significance
  - C. Oxygen production
  - D. Aesthetic value
 ✓ Answer: C
8. Supporting services in ecosystems include:
  - A. Providing water
  - B. Providing oxygen
  - C. Soil formation and nutrient cycling
  - D. Providing fruits
 ✓ Answer: C
9. Loss of biodiversity can affect:

## Module 2: Biogeographical regions and biodiversity hot spots

A **biogeographical region** is a large geographical area defined by its distinct climate, terrain, flora, and fauna. These regions are characterized by the natural boundaries that influence the distribution of plant and animal species. Each biogeographical region supports a unique ecosystem and biodiversity that has evolved under specific environmental conditions.

India represents almost all biogeographical regions of the world. These are:

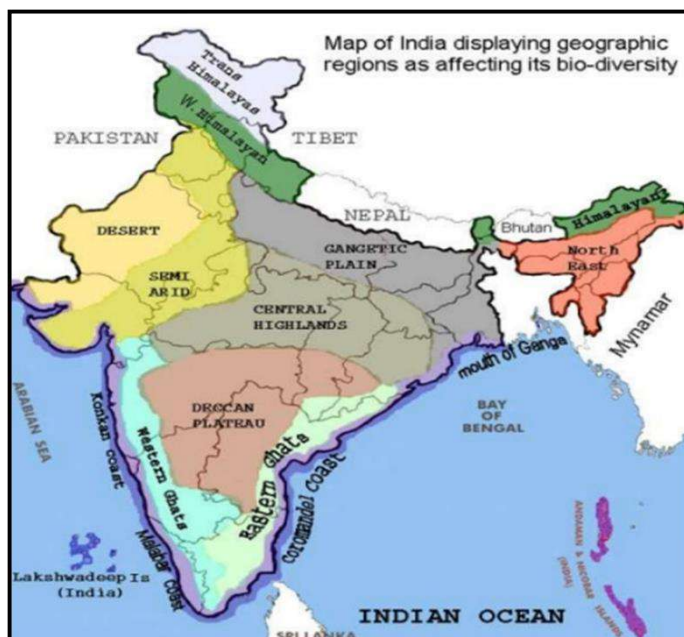
1. **Trans-Himalayan Zone (upper region):** It is an extension of Tibetan plateau including the high-altitude cold desert in Ladakh and Lahul Spiti with sparse mountain vegetation and possesses the richest wild sheep and goat community in the world. The snow-leopard and migratory black necked crane are found here.
2. **Himalayan Zone:** It comprises diverse biotic provinces and biomes. Based on altitude, there are three zones of vegetation in Himalayan range which correspond to three climatic belts: first the sub-montane or lower region (tropical and subtropical), that extends from plain to foot of hills up to 5000-6000 ft. altitude. Second the temperate or montane zone, ranging between 5,500-12,000 ft altitudes, has vegetation dominated by Pinus, chir, deodar etc. Third the alpine zone, where shrubby growth of junipers and rhododendron is found in grassy areas. At about 15000 ft. altitude and snow-line, plant growth is almost nil.
3. **Desert Zone:** This arid area, west of the Aravali hill range, comprises three biotic provinces, viz. Kutch (salt desert of Gujarat), Thar sand desert of Rajasthan and Ladakh. Kutch and Thar incorporates parts of Gujarat, Rajasthan, Haryana, and Delhi with climate which is very and dry (in summer) and very cold (in winters) and rainfall less than 700 mm. The Ladakh region, the cold desert region, on the other, hand has sparse vegetation.
4. **Semi-arid Zone:** This are, between the desert and the Deccan plateau including Aravali range, comprises Madhya Pradesh, Chhattisgarh, parts of Orissa and Gujarat. On the basis of the amount of rainfall, the forests in this region have developed into thorny, mixed deciduous and 'Sal' type.
5. **Western Ghat Zone:** This area of hill ranges and plains, running along western coastline, comprising the Malabar Coast and Western Ghat mountains of India, extends from Gujarat in the north to the Cape of Camorin in the south. This region receives heavy rainfall and has rich vegetation. The tropical moist evergreen forests are luxuriant and multistoried and have tall trees.
6. **Deccan Peninsula Zone:** This area of south and south-central plateau, south of the river Tapi. The zone is semi-arid region and lies in the rain shadow of Western Ghats. The precipitation hardly exceeds 100 mm.
7. **The Gangetic Plain:** Gangetic plain, along Ganga river system, lies in the north extending up to Himalayan foothills. This region, comprising Uttarkhand, Uttar Pradesh, Bihar and West Bengal, is the most fertile region due to alluvial soil. The major climatic factors, for the temperature and

precipitation together, are responsible for the distinctive type vegetation in the region. The vegetation is chiefly of tropical moist and dry deciduous forest type.

**8. The North-East India:** It comprises non-Himalayan hill ranges and is one of the richest florist regions in the country. This region receives the heaviest precipitation. The temperature and wetness are also very high, resulting in the dense tropical evergreen forests.

**9. The Islands:** The islands of Lakshadweep in the Arabian Sea and Andaman and Nicobar in the Bay of Bengal, have a wide range of spreading coastal vegetation like mangroves, beach forests etc.

**10. The Coast:** India has a coastline of about 7516.6 km. Mangrove vegetation is the characteristic of the estuarine tracts along the coast.



**Biodiversity hotspots** are defined as regions “where exceptional concentrations of endemic species are undergoing an exceptional loss of habitat”. The concept of biodiversity hotspots was developed by the Norman Myers in 1988 when he identified that the tropical forest losing its plants species as well as habitat. IUCN prepares ‘**Red Data Book**’. There are **34 areas** around the world which are qualified as Biodiversity hotspots. These hotspots represent only 2.3% of the total Earth's land surface. 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.

#### Criteria to qualify as a Biodiversity Hotspot

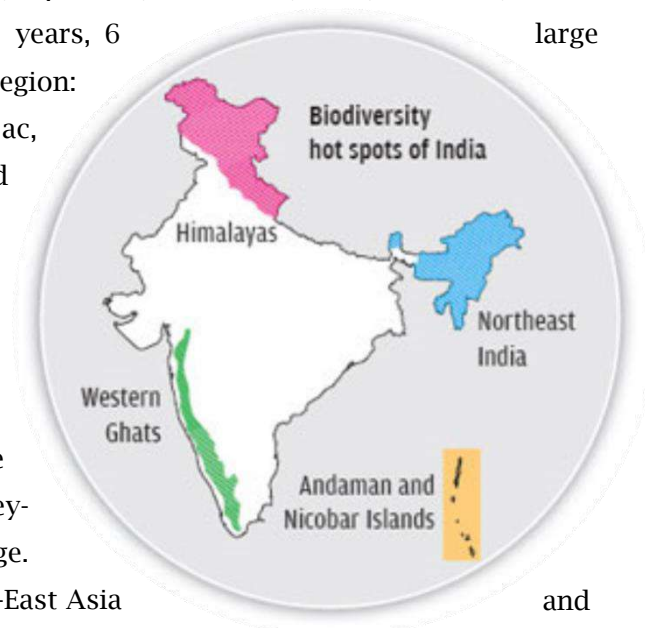
A region must meet two strict criteria to qualify as a biodiversity hotspot which is given below:

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 hot spots** are the geographical regions of the world exhibiting species richness and species diversity with flora and fauna under constant threat due to over-exploitation by humans.

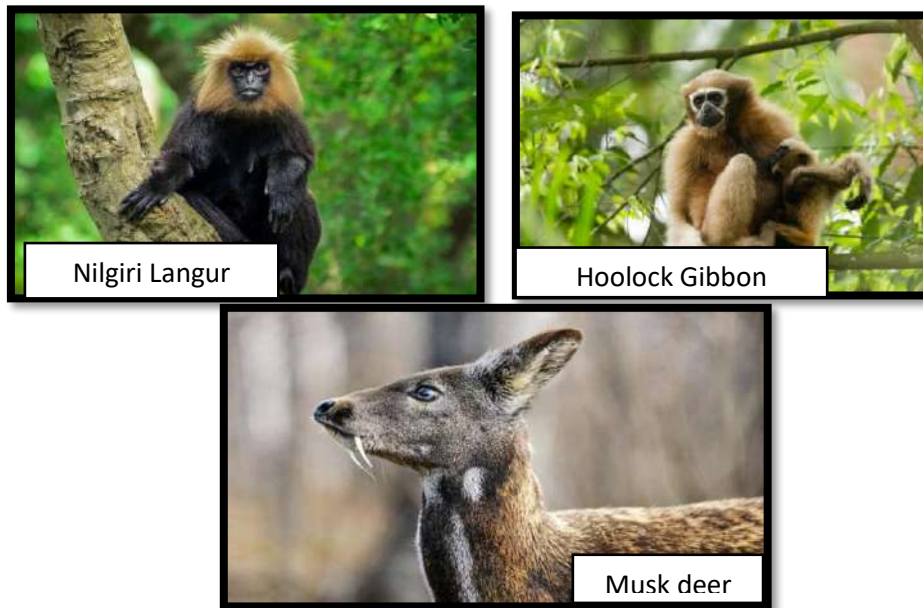
Among 35 hot spots of the world, four regions from India, namely Western Ghats and Eastern Himalayas, are included under hot spots. Both Western Ghats and eastern Himalayas show a high degree of endemism and are rich in flowering plants, also in reptiles, amphibians, shallow-tailed butterflies and some mammals.

1. **Eastern Himalayas:** eastern Himalayan hot spot comes under Indo-Burma hot spot. Being an active centre of evolution, it has rich diversity of flowering plants and is popularly known as cradle of flowering plants. Eastern Himalayas displays an ultra-varied topography that fosters deep and semi-isolated valleys found in this region which are exceptionally rich in endemic species of the plants. Some of the places exceptionally rich in biodiversity in this region are: Namdapha, Tirap, Sirohi, Dzuko, Tura, Senchal, Tale and Buxa vallies. Numerous primitive genera of flowering plants such as Mangolia, Almus, Exbuckluandia, Tetracentron, Butea, etc. are found in this region. Certain plant species like Sapria himalayana a parasitic angiosperm, was sighted only twice in the 70 years in this region.
2. **Western Ghats:** Western Ghats extends along a 16,000 km long strip of forest parallel to the western coast of Indian peninsula in Maharashtra, Karnataka, Tamil Nadu, and Kerala. Western Ghats encompasses the montane forests in southwestern parts of India and on the neighboring island of Sri Lanka. The predominant vegetation includes deciduous and tropical rain forests, montane forests and grasslands as well as scrub forests in lower, drier areas. The hot spot abodes a diverse and endemic assemblage of biological diversity. Many animal species such as Asian elephant, Indian tigers, and the endangered lion-tailed macaque, inhabit in dense forests of this region.
3. **Indo - Burma Region:** The Indo-Burma Region is stretched over a distance of 2,373,000 km<sup>2</sup>. This region spans over the North-eastern states, Myanmar, Cambodia, Laos, Thailand, Vietnam and the southern part of China. In the last 12 years, 6 large mammal species have been discovered in this region: the Large-antlered Muntjac, the Annamite Muntjac, the Grey-shanked Douc, the Annamite Striped Rabbit, the Leaf Deer, and the Saola. This hotspot is also known for the endemic freshwater turtle species, most of which are threatened with extinction, due to over-harvesting and extensive habitat loss. There are also 1,300 different bird species, including the threatened White-eared Night-heron, the Grey-crowned Crocias, and the Orange-necked Partridge.
4. **Sundaland:** The Sundaland hotspot lies in South-East Asia and covers Singapore, Thailand, Indonesia, Brunei, and Malaysia. In the year 2013, the Sundaland was declared as a World Biosphere Reserve by the United Nations. This region is famous for its rich terrestrial and marine ecosystem. Sundaland is one of the biologically richest



hotspots in the world which comprises 25,000 species of vascular plants, of which 15,000 are found only in this region. These islands are an abode to unique orchids and tropical plant species of high economic value, like oil palm, rubber, etc.

**Endangered species** are those species which have very low population and are in considerable danger of extinction and whose survival is unlikely if the causal factors continue operating, fall under this category. Endangered species included those species whose number has been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.



**Endemic species** are those species which remain confined only to a particular locality. Such species are very important from the point of view of conservation strategy because their disappearance means extinction of these species as they are not found elsewhere. Isolated mountain tops, valleys and large oceanic islands are usually areas of endemism.



### **India is considered as a megadiversity nation**

India is one of the 17 megadiversity countries of the world. India represents almost all biogeographical regions of the world. These ecosystems have rendered India 16 major climax forest types and 10 biodiversity rich zoogeographic zones. The rich heritage of biodiversity encompasses a wide spectrum of habitat from tropical rainforests to alpine vegetation and from temperate forests to coastal wetlands.

**Bio-wealth of India:** Country has 47,000 plant species and 90,000 species of animals. There are many species of animals endemic to India. 176 species of endemic birds and 214 species of reptiles are confined to India. Amphibians have the higher percentage of endemism, 60%, are restricted to India. Of the species of flowering plants found in India, about 18% are endemic. At least 166 crop species and 320 species of their wild relatives are originated in India. India ranks 6<sup>th</sup> in centers of diversity and origin as far as agro-biodiversity are concerned. India also harbours rich marine biodiversity along the coastline with exclusive economic zone supporting the most productive ecosystems such as mangroves, estuaries, lagoons and coral reefs. About 50% of the world's reef building corals and over 45 species of mangrove plants are found in India.

**Mountain as repository of biodiversity:** Country's two megadiversity hot spots, the Eastern Himalayas and the Western Ghats are the mountainous regions. Also known as water tower, mountains are the treasure houses of endemic species and repositories of genetic diversity. The North East Himalayas is a treasure house of biodiversity of the country. The Western Ghats with tropical evergreen rainforests are treasure house of species diversity and are estimated to have provided refuge to almost 1/3<sup>rd</sup> of animal species found in India.

**The Indian Deserts:** Indian deserts, extending from western part of Delhi to Rann of Kutch and parts of Rajasthan in between, harbour thorny trees, scrubs and cacti and black buck, Asiatic wild Ass, rodents etc.

**Indian Wetlands:** India has both inland wetland and coastal wetland ecosystems. Along coast, there are salt marshes, lagoons, brackish waters, estuaries, mangrove forests and coral reefs. Indian marshes are shallow water areas with abundant vegetation such as reeds, rushes, grasses, sedges etc. Inland wetlands include marshes, swamps flood plains, littoral areas (marginal zones of ponds and lakes) and rivers. The major rivers have extensive flood plains. Some of the best forests of the country are located in these flood plains.

**Indian Mangroves:** Mangrove plants are those plants which survive in high salinity, tidal streams, strong wind velocity, high temperature and muddy anaerobic soil - a combination of conditions hostile for other plants. The *pneumatophore* roots of these plants which come out of the soil are good breeding grounds and prove as nurseries for many fishes. Mangroves not only protect coastal

communities from the fury of cyclones and coastal storms, but also prevent the land from sea erosion. In addition, they provide fuel wood and medicines. They also serve the home of a wide range of flora and fauna.

In India, mangroves occur along both the east and the west coasts and represents 7% of the world's mangroves.

**Indian Coral Reefs:** coral reefs are formed by afterdeath deposition of calcareous exoskeleton of marine coelenterates called coral polyps over thousands of years. The colour of coral comes from alga *Zooxanthellae*. These tiny single - celled algae lives inside the tissue of polyp which in turn get food and oxygen produced as a result of photosynthesis from *Zooxanthellae*. The major reef formations in India are located in Gulf of Mannar, Palk Bay, Gulf of Kutch, Lakshadweep and Andaman and Nicobar islands.

**Indian lakes:** India has several large natural lakes. Wular Lake in Jammu and Kashmir is the largest natural freshwater lake. The Sāmbhar is a salt lake in the Great Indian Desert of Rajasthan. The Chilika Lake, in Coastal Orissa is the largest brackish water lagoon in Asia. Rich in Fauna, it is home to variety of residential and migratory birds, many fish species and Irrawaddy dolphin. It is recognized as biodiversity hotspot and was designated as a Ramsar site in 1981.

**The Red Data Book** is a comprehensive document maintained by national or international agencies that provides information on the conservation status of plant and animal species. It lists species that are threatened, endangered, vulnerable, rare, or extinct, helping raise awareness and guide conservation efforts.

Compiled by organizations like the International Union for Conservation of Nature (IUCN) at the global level. Lists species under categories such as:

- Extinct (EX)
- Extinct in the Wild (EW)
- Critically Endangered (CR)
- Endangered (EN)
- Vulnerable (VU)
- Near Threatened (NT)
- Least Concern (LC)

Includes details on habitat, population trends, threats, and conservation measures

#### **Types of Red Data Books:**

- International Red Data Book - by IUCN (global focus)
- National Red Data Books - prepared by individual countries (e.g., Zoological Survey of India publishes India's Red Data Book for fauna)

Examples of Species in Red Data Book (India):

Bengal Tiger – Endangered

Asiatic Lion – Endangered

Ganges River Dolphin – Endangered

Great Indian Bustard – Critically Endangered

Indian Vulture – Critically Endangered

**Purpose:**

- Helps in tracking biodiversity loss
- Assists in policy-making and conservation planning
- Promotes legal protection of listed species

Biodiversity hotspots of the India: <https://www.youtube.com/watch?v=xcHZFuq270g>

Biogeographic regions of the India: <https://www.youtube.com/watch?v=EJcqqVpZ54M>

**Multiple Choice Questions (MCQs) on Biogeographical Regions and Biodiversity Hotspots**

1. How many biogeographical regions is India divided into?

- A. 8
- B. 10
- C. 12
- D. 14

✓ Answer: B. 10

2. Which of the following is not a biogeographical region of India?

- A. Western Ghats
- B. Desert
- C. Tundra
- D. Deccan Plateau

✓ Answer: C. Tundra

3. The Trans-Himalayan biogeographic zone is known for:

- A. Tropical rainforests
- B. High-altitude cold desert ecosystems
- C. Mangrove vegetation
- D. Coral reefs

✓ Answer: B. High-altitude cold desert ecosystems

4. Which biogeographical region of India is known for high endemism and species richness?

- A. Gangetic Plain
- B. Western Ghats

C. Semi-Arid Region

D. Islands

☒ Answer: B. Western Ghats

5. What is a biodiversity hotspot?

A. Area with low human population

B. Area with only rare plants

C. Area rich in biodiversity but under threat

D. Area suitable for farming

☒ Answer: C. Area rich in biodiversity but under threat

6. How many biodiversity hotspots are found in India?

A. 2

B. 3

C. 4

D. 5

☒ Answer: C. 4

7. Which of the following is not one of the biodiversity hotspots in India?

A. Himalaya

B. Indo-Burma

C. Amazon Basin

D. Western Ghats and Sri Lanka

☒ Answer: C. Amazon Basin

8. The Eastern Himalayas are rich in:

A. Coral reefs

B. Temperate coniferous forests and endemic orchids

C. Desert vegetation

D. Coastal mangroves

☒ Answer: B. Temperate coniferous forests and endemic orchids

9. What are the criteria for an area to qualify as a biodiversity hotspot?

A. It must have at least 1,500 endemic plant species and have lost 70% of its vegetation

B. It must be untouched by humans

C. It must have tropical rainforests only

D. It must support marine biodiversity only

☒ Answer: A. It must have at least 1,500 endemic plant species and have lost 70% of its vegetation

1. What is meant by a biogeographical region?
2. How many biogeographical regions are there in India?
3. Name any four biogeographical regions of India.
4. Which biogeographical region of India is known for cold desert ecosystems?
5. Mention two unique features of the Western Ghats biogeographical region.
6. What kind of biodiversity is found in the Himalayan region?
7. Why is the Deccan Plateau considered a distinct bio-geographical zone?
8. Name any two species found in the Trans-Himalayan region.
9. Define a biodiversity hotspot.
10. How many biodiversity hotspots are located in India?
11. Name the four biodiversity hotspots found in India.
12. What are the two main criteria to classify a region as a biodiversity hotspot?
13. Why are biodiversity hotspots important for conservation?
14. Which hotspot in India includes parts of Northeast India and the Andaman Islands?
15. Name two endemic species found in the Western Ghats.
16. Mention one major threat to biodiversity hotspots.

### **Module 3: Threats to Biodiversity**

**Habitat loss and degradation:** Destruction of habitat is the primary cause for the loss of biodiversity. When people cut down trees, fill a wetland, plough grassland or burn a forest, the natural habitat of a species gets changed or destroyed resulting in killing many plants, animals and micro-organisms.

The main causes of habitat loss are agricultural activities, harvesting or extraction, mining, logging, deforestation, rapid rate of urbanization, industrial development. The ever increasing human settlements have been causing destruction of natural ecosystems to meet their requirements of food shelter and other needs.

**Habitat fragmentation:** Fragmented habitats are such as a forest patch surrounded by croplands, orchards, plantations or urban areas i.e. large continuous habitat is divided into small and scattered patches. Sometimes, the habitats, that formerly occupied wide areas, are often divided into pieces by roads, fields, towns, canals, industries, power line etc. The fragments thus formed are often isolated from one another. As a result, the population of a species gets separated into isolated groups. These isolated, small and scattered populations are increasingly vulnerable to inbreeding depressions, high infant mortality and susceptibility to environmental stresses and finally lead to extinction. With the fragmentation of a forest tract, usually the species occupying deeper parts of the forest disappear first.

**Poaching of wildlife: (Commercial hunting)** poaching refers to illegal trade of endangered and rare species of animals and plants and their products. Poaching of wildlife is threatening biodiversity worldwide. Despite ban on trade in endangered and rare species and their products, smuggling of wildlife and their products such as hide, skin, fur, antlers, meat, horn, and tusk, cosmetic, decorative and herbal products continues.

In India, rhino is hunted for its horn, tigers for its bones and skin, musk deer for musk, elephant for ivory, gharial and crocodile for their skin, whale for combs, and spiny tailed lizard for 'sanda' oil.

Surviving the Odds - Combating Illegal Wildlife Trade in India:

[https://youtu.be/K\\_logs20DeY?si=V8eJv7BC-FOKVyac](https://youtu.be/K_logs20DeY?si=V8eJv7BC-FOKVyac)

**Introduction of exotic or alien species:** exotic or alien species are the non-native newly entering species in a geographical region where they have never been. Exotic species, often called ecological cancer, have no predators, competitors, parasites or pathogens and flourish well if established in the new geographical regions. They wipe out many local species. Introduction of water hyacinth (jalkumbhi), a water weed in several tropical countries clogs rivers and lakes and lakes and threatens the survival of many aquatic species in lake and flood plain.

Pathogenic microorganisms, if introduced to new virgin areas, may cause epidemics resulting total elimination of native species. Exotic species, often called ecological cancer, have no predators, competitors, parasites or pathogens and flourish well if established in the new geographical regions.

Water Hyacinth - The Aquatic Invasion: <https://youtu.be/NA4uMg--6Bw?si=SVjMuDPpwWmpR7fx>

**Over-exploitation of bio-resources:** A particular species, if over-exploited, reduces the size of its population to an extent that it becomes vulnerable to extinct. Many fern species and gymnosperms and animal species such as frogs, earthworms, cockroaches etc. needed for laboratory teaching work are overused for study purposes. Overuse of such bio-wealth coupled with commercial over-exploitation caused their destruction. Consumption of wood of Indian wild mango trees in plywood, hunting of whale for tallow and wild medicinal plants for extraction of drugs and horticultural plants like rhododendrons and orchids, fall under the over-exploited category.

**Pollution and disturbances:** Pollution may alter natural habitats and cause reduction and elimination of population of sensitive species. Excessive use of pesticides in crop fields is causing decline in the population of birds and falcons. Toxic wastes entering the water in fresh water bodies bring about changes in the food chain.

Water pollution, due to excessive organic loading of water bodies, results eutrophication which drastically reduces biodiversity. Acid rain, global warming and ozone layer depletion affect adversely plant and animal species.



**Threats to Olive ridley Turtles:** <https://youtu.be/rm6hCUT8seQ?si=cO65HqMcI3UbFtQe>  
**Environmental issues of the Western Ghats:** <https://youtu.be/rTV-56QagQM?si=2THnsFo440DRndRa>  
**Threat to Himalayas:** <https://youtu.be/ZmlP1JlvfxU?si=mxQ69DwX9XnDsByV>

### **Case Study: Silent Valley, Kerala – A Battle Against Biodiversity Loss**

**Silent Valley** is located at Mukkali, Mannarkkad, Padavayal in Kerala, at the core of the Nilgiri Biosphere Reserve.

In 1976, Kerala State Electricity Board planned a construction of a 240 MW hydroelectric project, the Silent Valley Hydro-Electric Project (SVHEP), over the Kunthipuzha River flowing through the Palakkad and Mallapuram districts, intended to submerge 8.3 sq km of forest land. The plan for construction of the dam, announced already in 1973, attracted attention of environmentalists not only in Kerala state but also all over the globe.

Romulus Whitaker, founder of the Madras Snake Park and the Madras Crocodile Bank, was probably the first person to draw public attention to the small and remote area. Also the poet activist Sugathakumari played an important role in the Silent Valley protest and her poem "Marathinu Stuthi" ("Ode to a Tree") became a symbol for the protest from the intellectual community and was the opening song/prayer of most of the "save the Silent Valley" campaign meetings. People were concerned about the fact that the construction of the dam will submerge vast amount of land and will severely destroy the rich ecological flora and fauna of that region. People expressed their concern and it triggered a wave of protests through the different mode of protest all across the state. Many environmentalists, scientists, concerned people and common people also joined the demonstration. The protest from the Kerala state was further intensified when people from all over the country joined the protest. Soon it became India's major and perhaps the first environmental movement with a far reaching consequence.

In 1978 Indira Gandhi, Prime Minister of India, approved the project, with the condition that the state government enact legislation ensuring the necessary safeguards. Also that year IUCN (Ashkhabad, USSR, 1978) passed a resolution recommending protection of lion-tailed macaques in Silent Valley and Kalakkad and the controversy heated up. In 1979 the Government of Kerala passed legislation regarding the Silent Valley Protection Area (Protection of Ecological balance Act of 1979) and issued a notification declaring the exclusion of the hydroelectric project area from the proposed national park. In 1982, a multidisciplinary committee with Prof. M. G. K. Menon as chairman and Madhav Gadgil, Dilip K. Biswas and others as members, was created to decide if the hydroelectric project was feasible without any significant ecological damage.

Early in 1983, Prof. Menon's Committee submitted its report. After a careful study of the Menon report, the Prime Minister of India decided to abandon the Project. On September 1, 1986 Silent Valley National Park was designated as the core area of the Nilgiri Biosphere Reserve. The area is now considered as 'hot spot'. The 'Save Silent Valley' movement was a grand success for all time environmental movement in India. Beside this, it is a source of inspiration for similar agitations. The 'Narmada Bachao Andolan' and the 'Tehri Dam' protests are highly motivated by that campaign.

|                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------|
| Climate Change - A Short Film: <a href="https://youtu.be/jAa58N4Jlos?si=RE2o6mWep87A1ovQ">https://youtu.be/jAa58N4Jlos?si=RE2o6mWep87A1ovQ</a> |
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**WORKSHEET: THREATS TO BIODIVERSITY**

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Instructions: Choose the correct option and mark the answer clearly.

1. Which of the following is the greatest threat to biodiversity today?

- A. Natural disasters B. Habitat loss and fragmentation C. Evolution D. Soil erosion

Answer: \_\_\_\_\_

2. Introduction of non-native species that harm native biodiversity is called:

- A. Species extinction B. Genetic pollution C. Invasive alien species D. Ecosystem restoration

Answer: \_\_\_\_\_

3. Which of the following is an example of overexploitation?

- A. Recycling plastic B. Hunting animals for commercial gain C. Organic farming D. Controlled grazing

Answer: \_\_\_\_\_

4. Which plant is an invasive species in Indian forests?

- A. Banyan B. Mango C. Lantana camara D. Teak

Answer: \_\_\_\_\_

5. Climate change affects biodiversity by:

- A. Increasing soil fertility B. Stabilizing ecosystems
- 
- C. Altering habitats and life cycles D. Preventing migration

Answer: \_\_\_\_\_

6. Deforestation is mainly caused by:

- A. Planting native trees B. Industrialization and urban growth
- 
- C. Wildlife sanctuaries D. Monsoon rainfall

Answer: \_\_\_\_\_

7. Which of the following is not a threat to biodiversity?

- A. Poaching B. Reforestation C. Pollution D. Illegal wildlife trade

Answer: \_\_\_\_\_

8. Which act helps protect biodiversity in India?

- A. Forest Fire Prevention Act B. Wildlife Protection Act, 1972
- 
- C. Biodiversity Trade Act D. Natural Heritage Act

Answer: \_\_\_\_\_

9. What is the impact of habitat fragmentation on wildlife?

- A. Increases food availability   B. Supports breeding of all species  
C. Isolates populations and reduces gene flow   D. Helps migration

Answer: \_\_\_\_\_

10. Which of the following is a direct consequence of deforestation?

- A. Improved biodiversity   B. Increased rainfall  
C. Soil erosion and loss of species   D. Reduction in carbon dioxide

Answer: \_\_\_\_\_

11. Poaching is a threat to biodiversity because it:

- A. Promotes ecotourism   B. Helps animal population growth  
C. Leads to extinction of species   D. Increases genetic variation

Answer: \_\_\_\_\_

12. Which species has been greatly affected by illegal trade in India?

- A. House Sparrow   B. Indian Cobra   C. Bengal Tiger   D. Squirrel

Answer: \_\_\_\_\_

13. A major pollutant that threatens marine biodiversity is:

- A. Noise pollution   B. Oil spills   C. Deforestation   D. Pesticides in air

Answer: \_\_\_\_\_

14. Global warming primarily threatens biodiversity by:

- A. Increasing crop yield   B. Causing habitat shifts and species extinction  
C. Promoting forest growth   D. Reducing rainfall

Answer: \_\_\_\_\_

15. Which of the following best defines "overexploitation"?

- A. Sustainable use of resources   B. Use of renewable energy  
C. Excessive use of species beyond their recovery capacity   D. Use of rainwater for irrigation

Answer: \_\_\_\_\_

16. Which invasive species has affected grasslands and forest regeneration in India?

- A. Lotus   B. Water Hyacinth   C. Parthenium (Congress grass)   D. Neem

Answer: \_\_\_\_\_

17. Which of the following ecosystems is most affected by oil spills?

- A. Grasslands B. Forests C. Coral reefs and marine ecosystems D. Deserts

Answer: \_\_\_\_\_

18. Which factor contributes to global warming and indirectly threatens biodiversity?

- A. Nitrogen gas B. Oxygen gas C. Carbon dioxide emissions D. Drinking water usage

Answer: \_\_\_\_\_

19. The destruction of coral reefs is an example of:

- A. Overexploitation B. Habitat loss C. Invasive species D. Soil degradation

Answer: \_\_\_\_\_

20. Which of the following is a non-anthropogenic (natural) threat to biodiversity?

- A. Forest fire caused by lightning B. Deforestation  
C. Industrial waste D. Urban development

Answer: \_\_\_\_\_

21. Which of the following animals is commonly poached for its tusks?

- A. Elephant B. Deer C. Tiger D. Lion

Answer: \_\_\_\_\_

22. Genetic erosion refers to:

- A. Increase in genetic diversity B. Reduction in genetic diversity within a species  
C. Evolution of new species D. Cloning of animals

Answer: \_\_\_\_\_

23. One major effect of invasive species on native species is:

- A. They help conserve the native species B. They form symbiotic relationships  
C. They increase competition and may drive native species to extinction D. They reduce pollution

Answer: \_\_\_\_\_

24. An example of a species affected by climate change in India is:

- A. Peacock B. Olive Ridley Turtle C. Common Myna D. Wild Boar

Answer: \_\_\_\_\_

25. Monoculture in agriculture can lead to:

- A. Enhanced biodiversity B. Resistance to pests  
C. Increased genetic diversity D. Loss of biodiversity

Answer: \_\_\_\_\_

26. Which human activity has the most long-lasting negative impact on biodiversity?

- A. Controlled tourism   B. Wildlife photography  
C. Habitat destruction   D. Rainwater harvesting

Answer: \_\_\_\_\_

## **Module 4: Conservation Strategies**

Biodiversity conservation is the protection and management of biodiversity to obtain resources for sustainable development.

Biodiversity conservation has three main objectives:

- To preserve the diversity of species.
- Sustainable utilization of species and ecosystem.
- To maintain life-supporting systems and essential ecological processes

### **WHAT IS IN-SITU CONSERVATION**

**In-situ conservation** emphasizes the preservation and protection of total ecosystem at their original and natural environment.

### **ADVANTAGES AND DISADVANTAGES OF IN-SITU CONSERVATION**

In-situ conservation of wild life offers many advantages. In fact, the method involves promotion of natural system to take care of its own self.

The **advantages of in-situ conservation** can be summed up as follows:

1. In-situ conservation is a cheap and convenient way of conserving biological diversity play a supportive role only. Factors detrimental to the existence of the species concerned are eliminated and the species is allowed to grow in its natural environment in which it has growing since a long time. This reduces the cost of conservation efforts enormously.
2. In order to ensure the survival of the species we protect the entire natural habitat or the ecosystem. Thus, a large number of organisms are protected and maintained in the process. In-situ conservation offers a way to protect to a large number of organisms simultaneously known or unknown to science.
3. In a natural system organisms not only live and multiply but evolve as well. A natural ecosystem allows free play of natural agencies-like drought, storms, snow, fluctuation in temperature, excessive rains, fires, pathogens etc-which provide an opportunity to the organisms to adjust to the diverse conditions of the environment and evolve into a better adopted life form.

**Disadvantage of in-situ conservation** is that it requires large areas of earth's surface if we have to preserve the full complement of biotic diversity of a region. This involves minimizing or excluding

human activity and interference from that locality which is often difficult in the face of growing demand for space. After all humans, also need space to live.

**National Parks:** These are strictly reserved for the betterment of the wildlife and declared as places where activities such as forestry, grazing, hunting, cultivation etc. are not permitted either. No private ownership is allowed. Usually they are hitched to the habitat for specific wild animal with their boundaries circumscribed by legislation. No biotic interference is allowed except for the buffer zone where limited human activity for enjoyment through eco-tourism is allowed. For example Buxa National Park. Common fauna found are tiger, leopard, elephant, clouded leopard, Sāmbhar etc.

National parks of India: [https://youtu.be/gFCjGHmypaM?si=n\\_qll41ovvKvp\\_IP](https://youtu.be/gFCjGHmypaM?si=n_qll41ovvKvp_IP)

**Wildlife sanctuaries:** Like national parks, wildlife sanctuaries are also protected areas dedicated to protect wildlife, but they aimed at conserving animal species only. Also the boundary of a sanctuary is not limited by state legislation. Limited biotic interference is allowed in them. Private ownership rights and forestry operations are permissible to an extent that they do not affect the wildlife adversely. Visitors are not allowed to carry weapons without permission, set fire, leave any fire burning or its remnant, feed animals and use the chemicals or explosives injurious to any wildlife, e.g. Jaldapara Sanctuary. Important fauna found are Rhino, Elephant, Deer, Sāmbhar, Tiger, Leopard, Different kinds of birds.

Wildlife Sanctuaries of India: [https://youtu.be/gFVvSEuNfGA?si=\\_ycl10dNG6VdZKxD](https://youtu.be/gFVvSEuNfGA?si=_ycl10dNG6VdZKxD)

**Biosphere reserves:** are special categories of protected areas of land representing natural ecosystems with unique biological communities selected for long term in-situ conservation of species of plants and animals. In Biosphere reserve, multiple land use is permitted. A biosphere is not hitched to any one, two or three species but to the ecosystem as a whole i.e. totally of all life forms that live in it. In a biosphere reserves wild population as well as traditional life styles of tribals and various domesticated plants and animals are also protected. There are three distinct zones viz. core, buffer and transition in a biosphere reserve e.g. Sunderbans.

Biosphere reserves of India: <https://youtu.be/JiypthSRvuo?si=9MUi-g7XspDkKPpv>



## SHORTCOMINGS IN THE EXISTING SYSTEM OF PROTECTED AREAS

Though an impressive proportion of surface of our globe has been earmarked as protected areas, there exist great anomalies in the system. Many of these parks and sanctuaries simply exist on paper and in majority of cases where some efforts are undertaken to manage and protect the wild life they are hardly adequate. Major drawbacks in the existing system can be summarized as follows:

(1) In a number of countries though a large proportion of land has been set aside as protected areas for wild life, little wild life actually occurs in these places. For example, about one fifth of the total land area of Bhutan has been classified as protected area. Most of Bhutan's protected areas are high up in the Himalayas where little wild life occurs. Though there are about 7,000 protected areas spread over about 5th of earth's surface much of the biologically significant localities, which are rich in rare and endemic species and high biodiversity, are not covered in the existing system. All over the world high altitude areas have received a greater share of protection efforts whereas areas of greater biotic significance, low land forests, wetlands and aquatic system with enormous diversity of forms remain unprotected.

(2) Moreover, the size of the protected area set aside for many habitat types is awfully **insufficient to conserve the entire biodiversity** of the locality in most of the cases. We have marked nearly 5% of world's total land surface for wild life, the current system of conservation in protected areas may not forestall the extinction of many species which need large habitats and are susceptible to chance variations in climate and environmental factors.

(3) Many of the existing protected areas are simply on paper as they **lack adequate staff or budget** for their maintenance. They are simply carved out as protected areas on maps and many even lack a proper boundary so that it is difficult to demarcate them in field.

(4) A number of parks and sanctuaries **encourage profitable activities**, which are injurious to the wild life. Logging operations are carried out with Government permission in many parks of Canada, Czechoslovakia, and Indonesia etc. In many developing countries, the inefficient and corrupt administration allows logging and fuel wood collection surreptitiously, causing extensive damage to the wild life. Many of the wild life reserves in Europe and Canada are oriented primarily for tourism and recreation. Conservation of biodiversity has assumed secondary position or is often absent altogether in these areas.

(5) **Human settlements** present around or within the protected areas are often detrimental to the cause of wild life conservation. It is very difficult to find such large areas of wilderness devoid of

human settlements or interference as required for proper and adequate wild life protection efforts. Natives and indigenous people who largely depend on wild plants and animals for their subsistence usually frequent even those parts of wilderness, where modern societies, agriculture, rails and roads have not reached. Wild life conservation efforts tend to rob these people of the vital resources on which they have been living since times immemorial. This is resented. The local people do not co-operate and at times develop hostile attitude, which defeats the very purpose of the conservation efforts.

(6) Although local people and natives are fully capable of abusing land and hunting wild life to extermination, it is interesting to note that many of the world's healthiest and richest ecosystems of today occur in regions under their control. Farmers of South East Asia traditionally honour sacred groves-patches of wilderness amidst agricultural fields and rural landscape-as abodes of powerful deities. Indigenous Indians of Panama leave patches of forests as super natural parks for the refuse of the wild life and spirits. Indigenous people, their costumes and traditions, are rarely involved in wild life conservation efforts. These customs and traditions are disappearing at a fast rate. There is no harm in adapting modern scientific ways and methods but in the process healthy customs and traditions which represent the accumulated wisdom of past generations are also being forgotten.

## CONSERVATION BEYOND PARKS, SANCTUARIES AND RESERVES

Despite our efforts, halting the expansion of human activity, resource overexploitation, and environmental pollution within the limited time left seems nearly impossible. A review of the past fifty years shows minimal progress. This will have serious consequences—declining species, disruption of vital ecological services like water regulation, nutrient cycling, pest control, and climate buffering.

Humanity must act collectively to reduce biodiversity loss. While we are bound to lose some biological wealth, what truly matters is what we manage to save. The future of mankind depends on what survives this ongoing wave of extinction.

Preserving a few species in zoos, freezing germplasm, or maintaining small protected habitats is not a real solution. Even with sincere efforts and maximum resources, species will continue to vanish. The principal cause of the loss of biodiversity lies in the rapid destruction of natural habitats of species, which is in turn due to:

1. Rising **population pressure** and requirement of land for cultivation

2. Unjust and **inequitable distribution of wealth** which forces people to over exploit the natural resources

3. **Industries, logging and human settlements** etc which either encroach upon or introduce harmful wastes to the natural systems damaging an ever increasing part of wild life habitats

4. Commercial **logging operations, extraction of fuel wood and other products** for which an increasingly larger area of natural ecosystems is searched rummaged and damaged.

The burden of biodiversity conservation falls largely on poor, developing countries, which hold 50–70% of the world's species in just 6–7% of Earth's surface. These nations face poverty, malnutrition, and high population pressure. For many, forests and wildlife are essential for survival—providing food, fuel, and income. To someone struggling for a daily meal, wildlife conservation seems irrelevant. Poverty drives the overexploitation of nature; to conserve habitats. If we have to conserve natural habitats we shall have

a. **Intensify agricultural productivity** and provide the people of the area with alternatives so that further encroachments on the natural habitats are checked.

b. **Intensify forest management** and develop compensatory plantations which can provide an alternative to continued exploitation of natural forests

c. **Peruse a vigorous forest conservation policy** so that substantial areas of remaining natural habitats are protected from all types of exploitation.

d. **Developmental projects affecting wild land or natural habitats** of wild life adversely should be discouraged. In cases where they are essential, they should be accompanied by compensatory.

#### WHAT IS EX-SITU CONSERVATION

**Ex-situ conservation** involves maintaining and breeding endangered species in controlled environments like zoos, gardens, and labs. In the wild, animals face constant threats—competition, disease, injury, and lack of mates—while plants struggle with grazing, fires, and resource scarcity. Human care in ex-situ settings removes these stresses, ensuring survival and breeding.

The methods of ex-situ conservation

The practice of ex-situ conservation involves techniques, which are essentially meant to maintain, multiply or help the species to survive under natural conditions. These include

##### (1) **Long Term Captive Breeding**

Ex-situ conservation involves the long-term capture, care, and breeding of endangered species whose natural habitats are lost or unsafe due to threats like poaching or habitat destruction. Many species now depend on captive breeding for survival, including the Siberian tiger, Père David's deer, Lion-tailed macaque, European bison, Przewalski's horse, Grevy's zebra, Chinese alligator, and others, as their original habitats can no longer support them.

## **(2) Short Term Propagation and Release**

Short-term ex-situ conservation involves captive breeding and later releasing animals back into the wild once temporary threats like overhunting are removed. This method helps species recover in their natural habitats. Examples include the cheetah, wolf, red wolf, American bison, Arabian oryx, onager, Andean condor, bald eagle, peregrine, Hawaiian goose, Guam rail, European eagle owl, Galapagos giant tortoise, and land iguana.

## **(3) Animal Translocations**

Translocation involves moving animals from one location to another, often with a brief period in captivity, to aid conservation. It's used when reintroduction into their original habitat isn't viable. For example, the endangered manatee has been successfully translocated to safer waters, and golden lion tamarins were moved in 1963 to a new forest habitat where they have adapted well. While translocation may serve various purposes, its primary goal is species conservation. Translocation usually resorted to under following circumstances

1. The wild population may be threatened with prospects of extinction due to habitat destruction, uncontrollable hunting or some other reason
2. The population within a locality may have become surplus, ie, quick multiplication may have caused the number of individuals to rise beyond the capacity of the habitat to sustain them
3. There may be present apparently suitable empty habitats which can be used to accommodate the additional species which is in need of conservation. Thus threatened species may be conserved by providing it with a new home by translocation.
4. Small isolated populations decline due to continued inbreeding as the individuals have no other choice but to breed with the available mates. In such cases introduction of co-specific types through animal translocation could ensure survival of the population
5. In cases where a particular species occurs in a restricted locality, or is endemic to a particular place, its disappearance due to some local cause may result in its extinction. Successful translocation to other places could extend the range of distribution of the species and save it from prospects of extinction.

6. Translocation may be resorted to as an alternative to culling. Individuals of the species may be removed from the community to release the pressure on another species which is rarer and thus more important, or to improve the population by correcting structural imbalances, or to save healthy individuals of the population by removing the unhealthy ones.

7. Translocation may also be used if the animal populations become a nuisance to humans, threatening life, health, property or livelihood. The animal population has to suffer if man retaliates. Under such circumstances it is often in the interest of conservation to transfer the excess population to some other place where it does not come in conflict with man.

As humans convert productive habitats for agriculture and urban use, wildlife is rapidly declining. With increasing urbanization, many people may only encounter wild species in zoos and botanical gardens. These institutions now serve as living museums and are shifting from mere exhibition to active roles in breeding and conserving biodiversity. Many species in **zoos and botanical gardens** are already rare or extinct in the wild, highlighting their vital role in conservation.

**Botanical gardens:** plays a significant role in conservation of plant species beyond preservation in the wild and in supply for research and education, thereby taking pressure off of wild population of species. These botanical gardens are the living repository of thousands of trees and shrubs. These are aimed at conservation of rare and the multiplication of selected endangered plant species. Many of the botanical gardens now have seed banks, tissue culture facilities and other ex-situ technologies e.g. Lloyd Botanical Garden, Darjeeling, Indian Botanical Garden, Howrah.

**Zoos or Zoological parks:** Contribute to the conservation of animal diversity by propagating and reintroducing endangered species, they also act as centers for research to improve management of captive and wild population. Many of them have well developed captive breeding programs for restoring those species of animals whose number of surviving species is so small that there is no realistic chance of in-situ survival. As the number of individual increases in the captive breeding, they are selectively released in the wild. Apart from conservation, zoos are also aimed to inspire among visitors sympathy for wild animals and understanding and awareness about the orphaned wild animals. E.g. Padmaja Naidu Himalayan Zoological Park, Darjeeling is a center for captive breeding of snow leopards and red pandas.

India's first captive-bred endangered vultures Released into the wild

<https://youtu.be/iX1GMedAK9I?si=XgTuxGJaaGOdakjF>

Tigers in Crisis: The Dark Truth Behind Captive Breeding Programs

<https://youtu.be/HOrSCuSXfpE?si=HVtMkzZ2j7I9og00>

**Aquaria:** Botanical gardens and Zoos also play a prominent role in restoring degraded ecosystems, reintroducing species in wild and restocking of depleted population of fishes and other aquatic animals. Role of aquaria in captive propagation of threatened fresh water species is significant.

#### **CONSERVATION OF BIO-DIVERSITY IN SEED-BANKS, GENE-BANKS OR GERM PLASM RESERVES**

A large number of plant species form seed with variable periods of dormancy following which they can be germinated to yield daughter plants. Most of such plants, therefore, can be preserved in the form of their seeds in small packets for long duration. Places where the seeds are stored are known as seed-banks or gene-banks or sometimes **germ-plasm banks**. The germ plasm of a plant is any of its living organ or a part of it from which new plants can be generated.

**National Bureau of Plant Genetic Resources (NBPGR):** is a special gene bank/seed bank garden established to cryopreserve pollen, seeds etc. of agricultural and horticultural vegetative propagated crops like potato and tissue culture raised forest trees and their wild varieties by using liquid nitrogen at a temperature of  $-196^{\circ}\text{C}$ . Preserved materials can be stored for long period of time in compact and low maintenance refrigeration units.

**National Bureau of Animal Genetic Resources (NBAGR):** is a special gene bank center established in Karnal, Haryana to preserve semen of domesticated bovine animals. Ex-situ or off-site conservation is done artificially under human care and is most suited for rare species having small remaining population.

#### **Disadvantages of ex-situ conservation**

A number of disadvantages are inherent in the practice of ex-situ conservation. The wild life which we painstakingly breed, may not be exactly the same which it would have been if allowed to continue in nature. Some of these disadvantages are:

1. In order to prevent genetic drift the populations in captivity have to be larger than we have maintaining in most of the cases. We do not have provisions, space, funds and manpower to keep the required number of individuals of each species. Out of 629 species considered threatened only 20,628 specimens belonging to 140 species are kept in zoos of the world. This is too small a number to avoid genetic drift and the eventual loss of a number of useful genes
2. Animals in captivity may undergo genetic adaptation to their artificial conditions and thus become useless for the natural habitats. With time homogenization of their genetic set up occurs and captive parents are able to pass only a limited assortment of traits to their off springs which tend to become more or less carbon copies of each other. The lack of genetic diversity makes them unfit to adjust and adapt to the persistently changing conditions of the environment in nature.

3. Animals in captive population may lose their knowledge of the natural environment. This make them incapable to live in the wild to the extent that no amount of acclimatization or training can rehabilitate them in the wild.

4. The ex-sin populations may represent only a limited portion of the gene pool of the species. This is particularly true of wide ranging species with many scattered populations each of which has its own genetic makeup. To sample and breed the complete genetic spectrum, representative, specimens from many populations are required which is a difficult task.

5. Ex-situ conservation efforts require a regular supply of resources, funds and institutional support etc. any interruption in the course of which may result into considerable losses.

### **Advantages of ex-situ conservation**

Ex-situ conservation is employed for endangered species that have little to no chance of surviving in the wild. In such cases, in-situ methods prove insufficient, making human care essential. These species are bred in controlled environments to restore their population and vitality, after which they may be reintroduced into their natural habitats. This approach, though a last resort, has successfully saved species like Père David's deer, Addax, Oryx, the douc langur, and Przewalski's horse. Despite its success, ex-situ conservation faces several objections. The main objections to the practices of ex-situ conservation are:

- **Limited Scope:** Wildlife is vast and diverse, but ex-situ methods can accommodate only a small fraction of endangered species.
- **Reintroduction Challenges:** While breeding in captivity is often successful, reintroducing species into the wild frequently fails and is costly, despite occasional successes.
- **Narrow Focus:** Ex-situ efforts focus on single species, whereas in-situ conservation benefits entire ecosystems and multiple species.
- **High Costs:** Ex-situ conservation is far more expensive than in-situ methods. For instance, maintaining African elephants or black rhinos in captivity can cost 50 times more than protecting them in the wild.

Success of Conservation Programs in India

<https://youtu.be/4MSOuXP9gus?si=1yCTDgDfixrOW9jW>

### **Global Initiatives for Biodiversity Conservation**

Biodiversity, the variety of life on Earth, is essential for the stability of ecosystems and human survival. Due to increasing threats such as habitat destruction, climate change, and pollution, several global initiatives have been launched to conserve and sustainably manage biodiversity. Two

of the most significant among them are the Convention on Biological Diversity (CBD) and the Sustainable Development Goal 15 (Life on Land).

## **1. Convention on Biological Diversity (CBD)**

### Introduction

The Convention on Biological Diversity (CBD) is a legally binding international treaty adopted during the Earth Summit held in Rio de Janeiro in 1992. It is one of the most comprehensive international agreements dedicated specifically to the conservation and sustainable use of biodiversity.

### Objectives

The CBD has three main objectives:

1. Conservation of biological diversity
2. Sustainable use of the components of biodiversity
3. Fair and equitable sharing of benefits arising from the use of genetic resources (such as medicinal plants or traditional knowledge)

### Key Features

1. The treaty recognizes that biodiversity is not just a global concern, but a national responsibility, and encourages countries to develop and implement their own National Biodiversity Strategies and Action Plans (NBSAPs).
2. It promotes in-situ conservation (like protected areas and natural reserves) and ex-situ conservation (like gene banks, botanical gardens, and zoos).
3. The Nagoya Protocol (2010) under the CBD further strengthens access to genetic resources and benefit-sharing.
4. The Cartagena Protocol (2000) focuses on the safe handling of genetically modified organisms (GMOs).

### Global Impact

- As of now, 196 countries are parties to the CBD.
- It has led to the creation of thousands of protected areas across the globe and inspired policies and awareness about biodiversity at national and community levels.

#### Example – India's Efforts under CBD

- India launched its National Biodiversity Action Plan (NBAP) aligned with CBD objectives.
- The Biological Diversity Act, 2002 was enacted to promote conservation and fair benefit sharing.
- The National Biodiversity Authority (NBA) was established to oversee implementation.

## **2. Sustainable Development Goal 15 – Life on Land**

### Introduction

The Sustainable Development Goals (SDGs) are a set of 17 goals adopted by the United Nations in 2015, to be achieved by 2030. Among them, SDG 15: Life on Land is directly focused on biodiversity and terrestrial ecosystems.

#### Goal Statement

"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss."

#### Targets under SDG 15

#### **Some of the specific targets include:**

15.1: Ensure the conservation, restoration, and sustainable use of terrestrial and inland freshwater ecosystems

15.2: Promote sustainable forest management and reforestation

15.3: Combat desertification and restore degraded land

15.4: Ensure conservation of mountain ecosystems

15.5: Take urgent action to reduce degradation of natural habitats and halt biodiversity loss

15.7: End poaching and trafficking of protected species

15.9: Integrate ecosystem and biodiversity values into national and local planning

#### Progress and Challenges

1. Despite global efforts, progress remains uneven. Challenges include:
2. Continued loss of species at an alarming rate
3. Forest degradation and illegal wildlife trade
4. Lack of adequate funding and implementation capacity in developing countries

#### Example – India's Initiatives toward SDG 15

- Project Tiger and Project Elephant
- Green India Mission under the National Action Plan on Climate Change
- Eco-sensitive zones around protected areas
- Afforestation and reforestation programs

Global initiatives like the CBD and SDG 15 are critical frameworks that guide nations toward a more sustainable and biodiversity-friendly future. They emphasize the need for international cooperation, national responsibility, and community participation. While challenges remain, consistent efforts backed by scientific research, policy support, and public awareness can make biodiversity conservation a reality for future generations.

## Final Assessment

**Format: Scenario-Based MCQs**

**Duration: 45 minutes**

**Total Marks: 25**

**Passing Score: 75%**

### Question Paper

**Q1.** Which of the following provides direct benefits from biodiversity?

- A) Cultural expressions
- B) Climate regulation
- C) Food and medicine
- D) Aesthetic appreciation

**Q2.** The variety of life forms in a given ecosystem is referred to as:

- A) Geo diversity
- B) Species richness
- C) Biodiversity
- D) Ecosystem stability

**Q3.** Who coined the term “biodiversity hotspot”?

- A) Charles Elton
- B) Norman Myers
- C) E.O. Wilson
- D) Aldo Leopold

**Q4.** Which of the following is a threat to biodiversity?

- A) Reforestation
- B) Habitat loss
- C) Soil conservation
- D) Species adaptation

**Q5.** Which of these is **not** an in-situ conservation method?

- A) Wildlife sanctuary
- B) National park
- C) Seed bank
- D) Biosphere reserve

**Q6.** The Wildlife Protection Act in India was enacted in:

- A) 1965
- B) 1972
- C) 1984
- D) 1991

**Q7.** Which of the following is an example of **ex-situ** conservation?

- A) Sacred groves
- B) Marine park

- C) Zoological park
- D) Tiger reserve

**Q8.** Which is a biodiversity-rich region in India?

- A) Thar Desert
- B) Western Ghats
- C) Deccan Plateau
- D) Indo-Gangetic plain

**Q9.** The IUCN Red List classifies species based on:

- A) Population increase
- B) Economic value
- C) Risk of extinction
- D) Genetic traits

**Q10.** Which of the following organisms is a keystone species?

- A) Elephant
- B) Deer
- C) Frog
- D) Ant

**Q11.** Biodiversity ensures:

- A) Uniform genetic pool
- B) Ecosystem resilience
- C) Reduced productivity
- D) Limited ecological niches

**Q12.** Which international treaty deals with biodiversity conservation?

- A) Montreal Protocol
- B) Kyoto Protocol
- C) Convention on Biological Diversity (CBD)
- D) Basel Convention

**Q13.** Which of the following ecosystems has the highest biodiversity?

- A) Desert
- B) Grassland
- C) Tundra
- D) Tropical rainforest

**Q14.** The term "species richness" refers to:

- A) Number of rare species
- B) Genetic quality
- C) Number of species
- D) Size of the ecosystem

**Q15.** Which practice can help conserve agro-biodiversity?

- A) Monoculture
- B) Crop rotation
- C) Slash-and-burn
- D) Over-irrigation

**Q16.** What is the Red Data Book?

- A) List of cultivated species
- B) Record of endangered species
- C) Forest management guide
- D) Wildlife trade directory

**Q17.** Which is a **man-made** threat to biodiversity?

- A) Natural selection
- B) Earthquakes
- C) Pollution
- D) Evolution

**Q18.** The Western Ghats are considered a hotspot because they:

- A) Have rich soil
- B) Are industrialized
- C) Contain endemic species
- D) Are free of threats

**Q19.** Which of these is a **component of biodiversity**?

- A) Genetic diversity
- B) Atmospheric pressure
- C) Ocean salinity
- D) Wind pattern

**Q20.** What is the goal of ecosystem restoration?

- A) Increase urbanization
- B) Remove native species
- C) Return ecosystem to original state
- D) Promote monoculture

**Q21.** Which NGO is famous for wildlife conservation in India?

- A) ASHA
- B) PRS
- C) WWF India
- D) TERI

**Q22.** Biodiversity is important for ecosystem:

- A) Uniformity
- B) Degradation
- C) Services
- D) Limitation

**Q23.** The Rio Earth Summit (1992) led to the:

- A) Paris Agreement
- B) Convention on Biodiversity
- C) Kyoto Protocol
- D) Stockholm Declaration

**Q24.** Which community-based conservation method is effective in India?

- A) Mining zones

- B) Sacred groves
- C) Private sanctuaries
- D) Industrial forests

**Q25.** Which of the following is a success story in Indian conservation?

- A) Dodo preservation
- B) Project Tiger
- C) Urban farming
- D) Timber licensing

| Q.No | Ans | Q.No | Ans | Q.No | Ans | Q.No | Ans | Q.No | Ans |
|------|-----|------|-----|------|-----|------|-----|------|-----|
| 1    | C   | 6    | B   | 11   | B   | 16   | B   | 21   | C   |
| 2    | C   | 7    | C   | 12   | C   | 17   | C   | 22   | C   |
| 3    | B   | 8    | B   | 13   | D   | 18   | C   | 23   | B   |
| 4    | B   | 9    | C   | 14   | C   | 19   | A   | 24   | B   |
| 5    | C   | 10   | A   | 15   | B   | 20   | C   | 25   | B   |

## Glossary of Terms

1. **Biodiversity** – The variety of life in all its forms, including genetic, species, and ecosystem diversity.
2. **Genetic Diversity** – Variability in the genetic makeup among individuals within a species.
3. **Species Diversity** – The number and variety of species in a particular region.
4. **Ecosystem Diversity** – Variety of ecosystems in a geographical location.
5. **Endemic Species** – Species that are native and restricted to a particular geographical area.
6. **Exotic Species** – Species introduced to a new habitat where they are not native.
7. **Species Richness** – Number of different species in a given area.
8. **Species Evenness** – Relative abundance of different species in a community.
9. **Bio magnification** – Increase in concentration of toxic substances in higher trophic levels.
10. **Bio prospecting** – Exploration of biodiversity for new resources of social and commercial value.
11. **Ecosystem** – A community of organisms interacting with their physical environment.
12. **Habitat** – The natural home or environment of an organism.
13. **Niche** – The role or function of an organism in its ecosystem.
14. **Keystone Species** – A species that plays a critical role in maintaining ecosystem balance.
15. **Flagship Species** – Species selected to act as an ambassador for conservation.
16. **Indicator Species** – Species used to assess the health of an ecosystem.
17. **Biome** – A large ecological area with distinct climate, flora, and fauna.
18. **Trophic Level** – Position of an organism in a food chain.
19. **Primary Productivity** – The rate at which plants produce biomass.
20. **Carrying Capacity** – The maximum population size an environment can sustain.
21. **Habitat Loss** – Destruction or degradation of natural habitats.
22. **Deforestation** – Removal of forests for non-forest use.
23. **Desertification** – Degradation of land in arid, semi-arid areas.
24. **Invasive Species** – Non-native species that disrupt native ecosystems.
25. **Climate Change** – Long-term alteration of temperature and weather patterns.
26. **Overexploitation** – Unsustainable use of natural resources.
27. **Pollution** – Introduction of harmful substances into the environment.
28. **Poaching** – Illegal hunting or capturing of wildlife.
29. **Habitat Fragmentation** – Breaking up of a habitat into smaller pieces.
30. **Genetic Erosion** – Loss of genetic diversity in a species.
31. **In-situ Conservation** – Conservation of species in their natural habitats.
32. **Ex-situ Conservation** – Conservation outside natural habitats, like in zoos or seed banks.
33. **Biosphere Reserve** – Protected area for sustainable development and conservation.
34. **National Park** – Reserved area for wildlife where activities like hunting are prohibited.

35. **Wildlife Sanctuary** – Protected area where animals are protected but human activity may be allowed.
36. **Sacred Grove** – Patch of forest protected for religious or cultural reasons.
37. **Gene Bank** – Facility for storing genetic material of plants or animals.
38. **Cryopreservation** – Storage of cells or genetic material at very low temperatures.
39. **Captive Breeding** – Breeding of endangered species in controlled environments.
40. **Reintroduction** – Returning animals to their natural habitat from captivity.
41. **CBD (Convention on Biological Diversity)** – International treaty to sustain biodiversity.
42. **CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora.**
43. **Wildlife Protection Act (1972)** – Indian law to protect wild animals and birds.
44. **Environment Protection Act (1986)** – Umbrella legislation to protect and improve the environment.
45. **Forest Conservation Act (1980)** – Regulates deforestation and forest land use in India.
46. **Biodiversity Act (2002)** – Indian law for conservation and sustainable use of biodiversity.
47. **NBA (National Biodiversity Authority)** – Indian body implementing the Biodiversity Act.
48. **Hotspot** – Area rich in endemic species but threatened by human activity.
49. **Ramsar Site** – Wetlands of international importance.
50. **Protected Area Network** – System of reserves set up for conservation of biodiversity.
51. **Joint Forest Management (JFM)** – Collaborative forest conservation by government and communities.
52. **Eco-development** – Integrating local community development with conservation.
53. **People's Biodiversity Register (PBR)** – Documenting local biodiversity by communities.
54. **Community Reserve** – Protected area managed by local communities.
55. **UNEP** – United Nations Environment Programme, promoting global environmental action.
56. **IPBES** – Intergovernmental platform for biodiversity and ecosystem services.
57. **Sustainable Development** – Development that meets present needs without harming future generations.
58. **EIA (Environmental Impact Assessment)** – Evaluation of potential environmental effects of projects.
59. **Carbon Footprint** – Total greenhouse gas emissions caused by an individual or activity.
60. **Ecological Restoration** – Process of assisting recovery of damaged ecosystems.

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