

3. Biodiversity

- 3.1. What is Biodiversity?
- 3.2. Levels of Biodiversity
- 3.3. Values of Biodiversity
- 3.4. India as a Mega Diversity Nation
- 3.5. Threats to Biodiversity
- 3.6. Man and wildlife conflict
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Do you know?

It is interesting to know that there are more than 20,000 species of ants, 3,00,000 species of beetles, 28,000 species of fishes and nearly 20,000 species of orchids. Ecologists and evolutionary biologists have been trying to understand the significance of diversity.

- There are about 1.8 Million species known and described.
- Scientist are still identifying species that were not known in the past.

3.1 What is biodiversity?

The variety and range of life forms on the earth is termed as “Biological diversity” or “Biodiversity”. In other words, biodiversity is made up of all living species, their genetic properties and the ecosystems of a region. Biodiversity is the outcome of 3000 million years of evolution.

The biosphere constitutes a vital life supports for man. Its existence in a healthy and



Figure 3.1 : Biodiversity (a)

functional state is essential for existence of human race. This diversity of living creatures form a support-system which has been utilized by each civilization for its growth and development. The variability in nature helped in utilization of the earth’s biological wealth for the benefit of humanity and has been integral to the process of development.

Those that used this “bounty of nature” carefully survived. Those that over used or misused it disintegrated. At present we are losing accumulated heritage of millions of years at a very rapid rate. The very basis of our existence is being undermined. The onset of reduction in diversity of life forms is bound to have grave consequences for the entire living-world.

“Variation is the law of Nature.”

Observe and discuss:

Different living beings have different structures, shapes, defense mechanism, feeding habits and life cycle. Such variety is found in all forms of flora and fauna in your surroundings. Make a list.

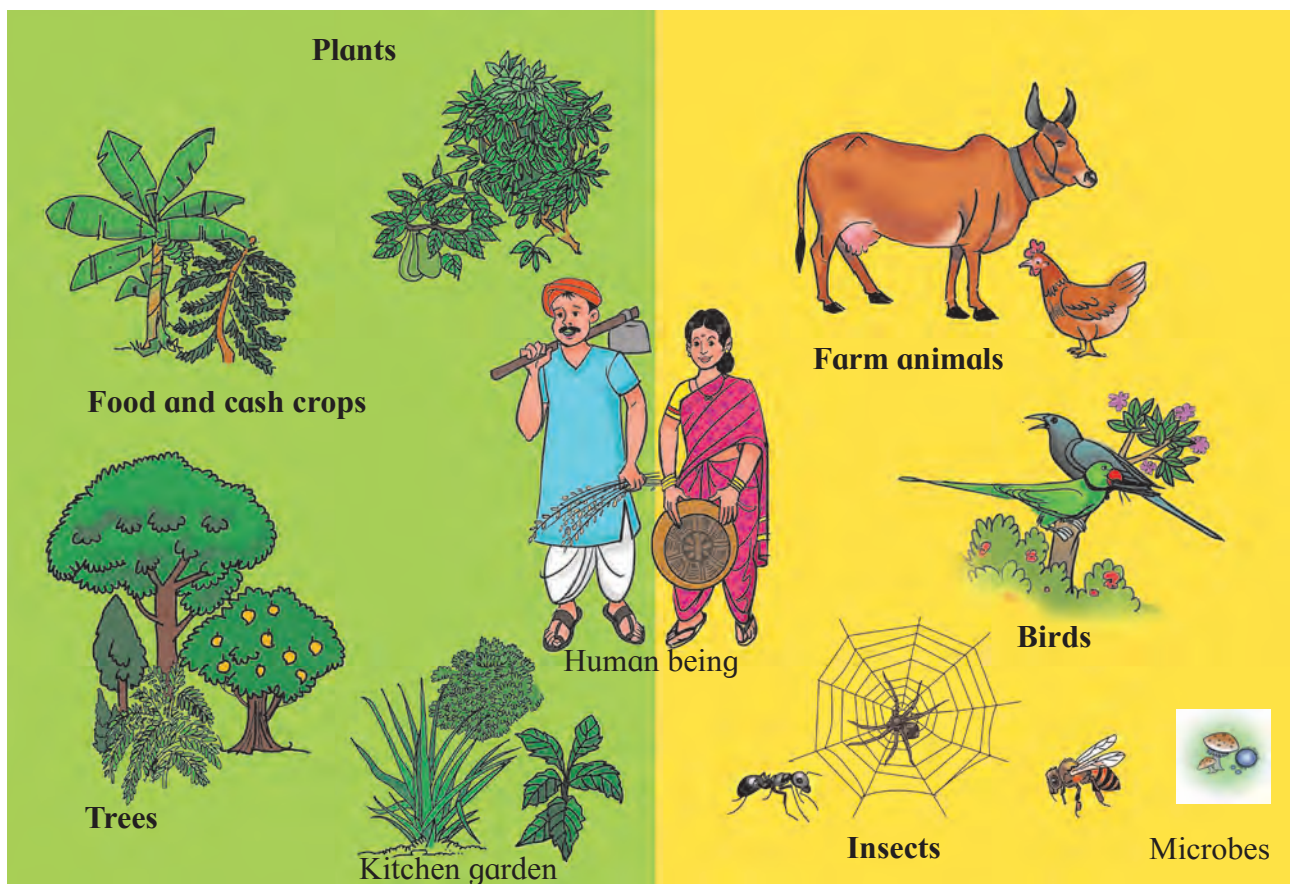


Figure 3.1 : Biodiversity (b)

3.2. Levels of Biodiversity

There are three hierarchical levels.

(a) Genetic diversity: This is the variability that is present in the individuals of a species due to differences in individuals genetic makeup.

It refers to variation of genes within species. Differences could be in entire genes or in structure of chromosomes. Genetic diversity enables a population to adapt to the environment. It is also responsible for speciation. Some variations are easy to see, such as; size, colours, taste and flavor. For example varieties of rice and wheat. Deliberate manipulation of genes by humans within a species produces new varieties of crops and new breeds of

domestic animals.

(b) Species diversity:

It is the variability in the species richness within a specified area (habitat).

It refers to the variety of species in a given region.

It is largely the result of natural evolutionary process.

(c) Ecosystem diversity :

It is the variety of ecosystems that are present on the earth. some of them include forest, grassland, pond, river, marine ecosystems etc.

This variety in ecosystems is formed because of different climatic conditions and topographical features which are present on the earth.

Do you know?

The Warlis, an Adivasi community of Maharashtra, cultivate about 15 varieties of rice. They have developed their farming systems over several generations. The different varieties of paddy they cultivate have different requirements of water and soil texture. These varieties have different resistances to insects and possess varied flavors. If the monsoon proceeds normally, their main varieties give a good yield. If it does not the other hardier varieties which though having a low yield can survive in less rainfall conditions and give adequate production. The availability of varieties for different soil, water and weather conditions helps to get some production in adverse conditions as well.

Do you know?

• Number of Species on the earth

GROUP	Number of Species (approx)
Mammals	5,513
Birds	10,425
Reptiles	10,038
Fish	32,900
Amphibians	7,302
Insects	10,00,000
plants	30,7,674
Lichens	17,000

Source : IUCN-2014

ACTIVITY: 1

Using the school /college and the local environment students should identify the three different categories of biodiversity. e.g.

- Birds, insects, trees, animals, living in the local area
- Survey the different varieties of any crop e.g. rice, jowar etc. and document names of variety.
- Identify and name the different ecosystem within a local area.

Sample observation Table on species

S.N.	Species	Number	Found where
1			
2			

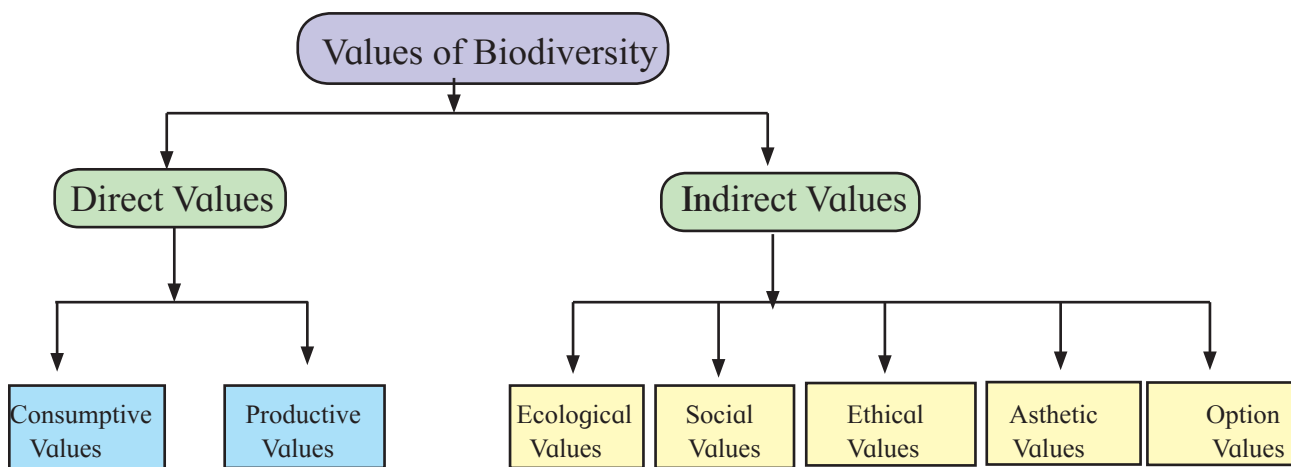
3.3. Values of Biodiversity:

The world is inhabited by myriads of life forms, animals and plants. These life forms are of great diversity, living in diverse habitat and possessing diverse qualities which in themselves make very interesting studies. Moreover, these life forms are vital to human survival as they provide food and materials for shelter, clothing, tools and medicine.

Now a days, we possess modern technologies which can utilize the different genetic qualities in a variety of ways. Wild diversity can also be incorporated into crops and contribute to world agricultural development.

Why is Biodiversity important?

All species are interconnected. They depend on one another. With less biodiversity, these connections weaken and sometimes break, harming all the species in the ecosystem. Biodiversity is important to people in many ways As biodiversity decreases, these systems break down.



A. Direct Values

1. Consumptive Values:

This is related to natural products which are consumed directly for food, fodder, timber, fuel wood etc. Human use thousands of species of plants and animals in their day to day lives. The tribal people generally depend on the forest for their daily needs.

2. Productive use values:

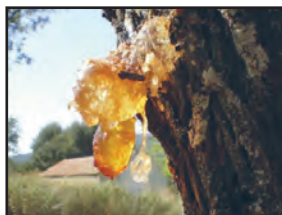
This is assigned to products that are commercially harvested and marketed like resins, gum, honey etc. Present agricultural crops have originated from wild varieties.



1. Honey comb



2. Commercial product;
Honey



3. Gum exudation from the tree bark

Figure 3.2 : Productive use values

Economics of biological diversity

People are dependent on biodiversity for meeting their basic needs of food and energy. A range of industries including pharmaceutical, agricultural, timber etc. are dependent on biodiversity for raw materials. Some of the economic uses of biodiversity are described below:

- i) **Food Value:** Approximately 80,000 edible plant species have been used at one time or another in human history, of which about 3,000 are currently used. About 150 species have been cultivated on a large scale. Of these; about 10 to 20 species provide 80-90% of the world's calorie intakes.

Apart from the above major edible plants, hundreds of other uncultivated plants are used as food.

- ii) **Medicines, Drugs, Cosmetics:** Biodiversity provides health security to humans, livestock and plants (bio-pesticides and bio-fertilizer). In the Western Ghats, about 2000 plants are being used for medicinal purposes. Across the country, some 8,000 plants and a few hundred animals are being used for their medicinal value by local communities.

A large proportion of allopathic medicines have a plant origin. Nearly 25% of all prescription drugs used in the developed world are based on plants, including various indispensable mainstream

drugs, e.g. Aspirin. Ayurvedic medicines and medicinal plants after primary processing have been exported from India for centuries. The volume of this trade has become much bigger in recent years. Medical tourism is emerging as a high value economic sector, where therapies based on indigenous Ayurveda and other oriental medical systems are provided.

iii) Fibre: Cotton, jute, flax, sisal, hemp, rattan, coconut coir, bamboo and other grasses are sources of natural fibre. These are used in both local economies and for industrial use, for making twines, ropes, cords, fabric, as building and packaging material in sacks and gunny bags, as carpet-backing etc.

iv) Biofuels: Most of the rural population of India depends on fire wood for fuel. Fuels like biogas, biodiesel and ethanol are also becoming economically important. All these fuels come from bio resources. Jatropha and Karanj are two plant species used to make biofuels. In India, scientists

are screening different varieties of Jatropha and Karanj to identify naturally high-yielding varieties. Recently scientists are working on algae as potential source of biofuel.

v) Building Materials: Housing and building materials such as bamboo, grasses, hardy plants, palm leaves and timber come from the local ecosystem. Large scale cultivation of bamboo and timber species is done in several countries. Most of the world's timber production still comes from forests.

vi) Tourism: Nature-based tourism is increasing day by day the world over. It has become a major industry supporting lakhs of people across the world. example - case of Sanjay Gandhi National Park on the outskirts of Mumbai receives more than 15 lakh tourists every year. Nature-based tourism is growing as an economic sector. Tadoba Andhari Tiger Reserve (TATR) receives more than 30 lakh tourists every year generating lakhs of rupees of revenue for the Government.

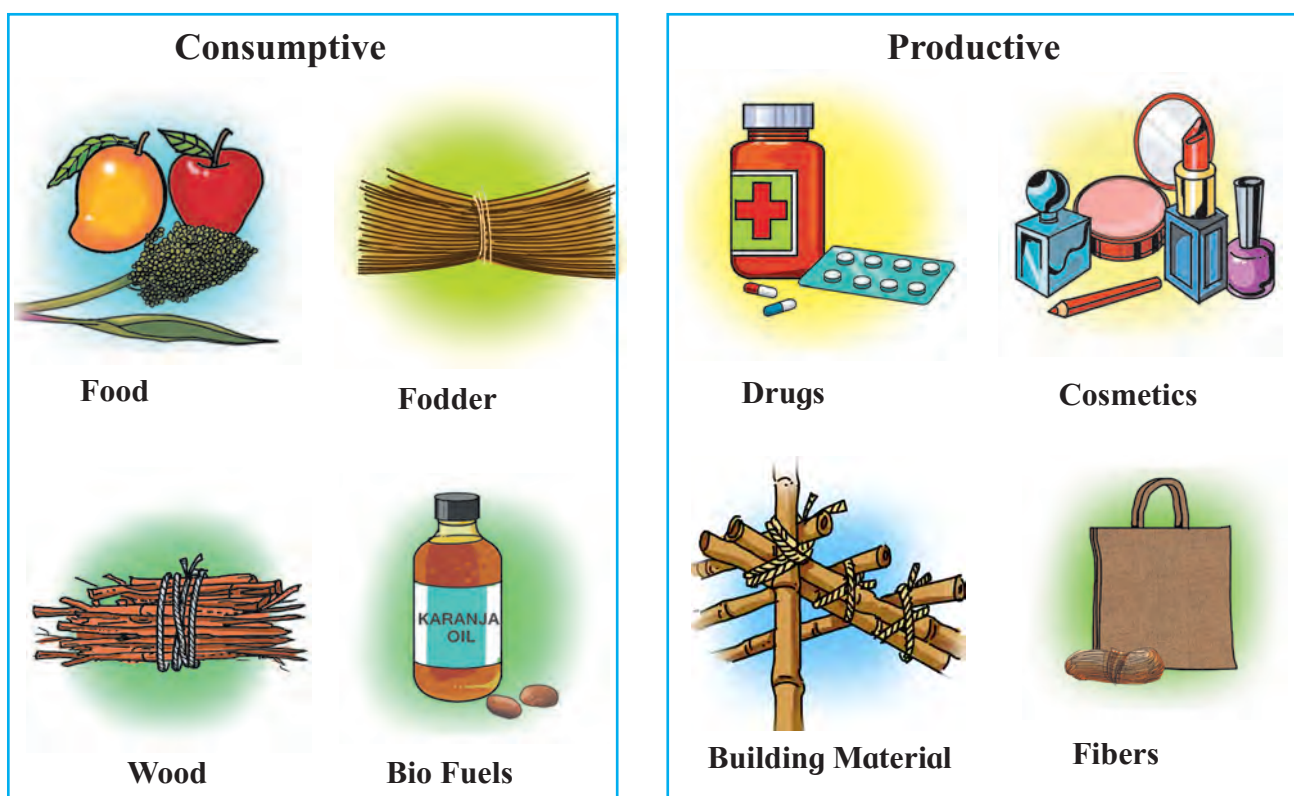


Figure 3.3 : Direct Values

Indirect values of Biodiversity

Biodiversity as a part of natural cycles:

Biodiversity provides essential ecosystem benefits. These are the methods by which biodiversity creates condition of the earth that support human survival. These include hydrological and geo-chemical cycles and climatic condition. For example- microbes convert dead organic material made up of complex compound of carbon, hydrogen, oxygen, nitrogen etc. into the constituent simpler organic compounds. In this way, biodiversity influences soil formation, reduction of soil salinity, decomposition of dead organisms and modification of minerals, nutrient cycling etc. Vegetation cover helps in air purification by absorbing atmospheric carbon dioxide. Biosphere maintains the balance of atmospheric gases and helps to stabilize the climate.

Forest and grassland help to maintain the flow of stream and river. They help to recharge ground water and reduce soil erosion. Rain water percolates into the soil when the surface is covered with vegetation. The roots help to bind the soil and prevent erosion.

A change in the balance of ecosystems or degradation of ecosystems can affect the above functions of the natural world around us. Examples of such changes are loss of soil productivity, soil, erosion, reduced water holding and recharge capacity. Toxins may build up in the environment due to reduced capacity to absorb or disperse pollutants.



Figure 3.4 : Forest helps to maintain flow of water



figure 3.5 : Roots help to bind soil and prevent erosion

1. Ecological Value of Biodiversity

Interdependence of species: Species have evolved to fill particular niches (role in ecosystem) or habitats. Many species depend on each other in intricate ways for survival, such as food chain and food webs. Besides, there are other ecological roles, such as pollination and seed dispersal. Living organisms and relationships of symbiosis, predation, food chain and food webs are aspects of biodiversity. These are important to maintain and evolve biodiversity itself.



Figure 3.6 : Natural Habitat

ACTIVITY 2:

Help students to make a note on how local biodiversity is responsible to meet our daily needs

Group: 5 to 6 students per group

Work plan:

1. Ask each group to enlist daily requirement of a household by keeping a record for 6-7 days.
2. Make different lists of things which are collected from nearby areas. e.g. Gobar, fire wood, plants, vegetables, fruits, honey, flowers etc.

In cities students can observe and note down the use of plants in their own or neighbor's gardens, collection of firewood from road side trees, use of hills for walking etc.

3. Discuss with friends and elders about what would happen if these items were not available from the surroundings in our villages or cities.
4. Note down these discussions and share within the group. Make a comprehensive report of the discussions.
5. Ask each group to present their findings in the class.

2. Social Values

The biodiversity in different parts of the world has been largely preserved by the traditional societies. The indigenous people have protected the forests for their own use. In ancient times, especially in India flora and fauna were held in high esteem.

Trees like Peepal, Banyan and Tulsi are still worshiped.

Human activities are dependent on the relationship between biological diversity and ecological processes. Loss in diversity has many unfavorable implications related to ecosystem functions such as; energy flow and biogeochemical cycles.



Banyan



Tulsi

Figure 3.7 : Social Values

3. Ethical Values

The ethics of biodiversity loss is now a major consideration for saving biodiversity, because such loss is forever and there is no way to recreate lost biodiversity. Morality and ethics teach us to preserve all forms of life and not to harm any organism unnecessarily. Some people take pleasure in the hunting of animals and sometimes degrade and pollute the environment by their unethical actions.

4. Aesthetic Values

A world without melodious birds, graceful beats and thick forest would be poorer place for humans to live in. People feel pleasure and happiness in the presence of wild life. Aesthetic value of biodiversity is described in the number of folk arts and folk songs, stories and other literature which shows its impact on the minds of the people.

5. Option Values

The potential of species to provide economic benefit to human beings in the future is called Option Value. The biotechnologists working towards generating new species to fight and cure deadly disease such as Cancer and AIDS are examples of option value.



Figure 3.8 : Techniques in Biotechnology

3.4 India as a Mega Diversity Nation

India has been recognized as one of the world's top 17 Mega Diversity Nations. In India, about 1,15,000 species of plants and animals have been identified and described.

The country boasts of 45,000 species which account for 15% of the known world plants. The North Eastern is known for being a unique treasure house of orchids in the country.

India is very rich in faunal wealth and has nearly 92,037 animal species. About 61,375 of which are insects. In animals, the rate of endemism in reptiles is 33% and in amphibians 62%. Further there is wide diversity in domestic animals. There are no clear estimates about the richness of marine biota. There is an abundance of sea weeds, fish, crustaceans, molluscs, corals, reptiles and mammals associated with marine and coastal ecosystem.

Do you know?

17 Mega Diversity Nations

- | | |
|----------------------------------|---------------------|
| 1) Mexico | 2) Colombia |
| 3) Ecuador | 4) Peru |
| 5) Brazil | 6) Papua New Guinea |
| 7) Madagascar | 8) China |
| 9) India | 10) Malaysia |
| 11) Indonesia | 12) Australia |
| 13) South Africa | 14) USA |
| 15) Philippines | 16) Venezuela |
| 17) Democratic Republic of Congo | |

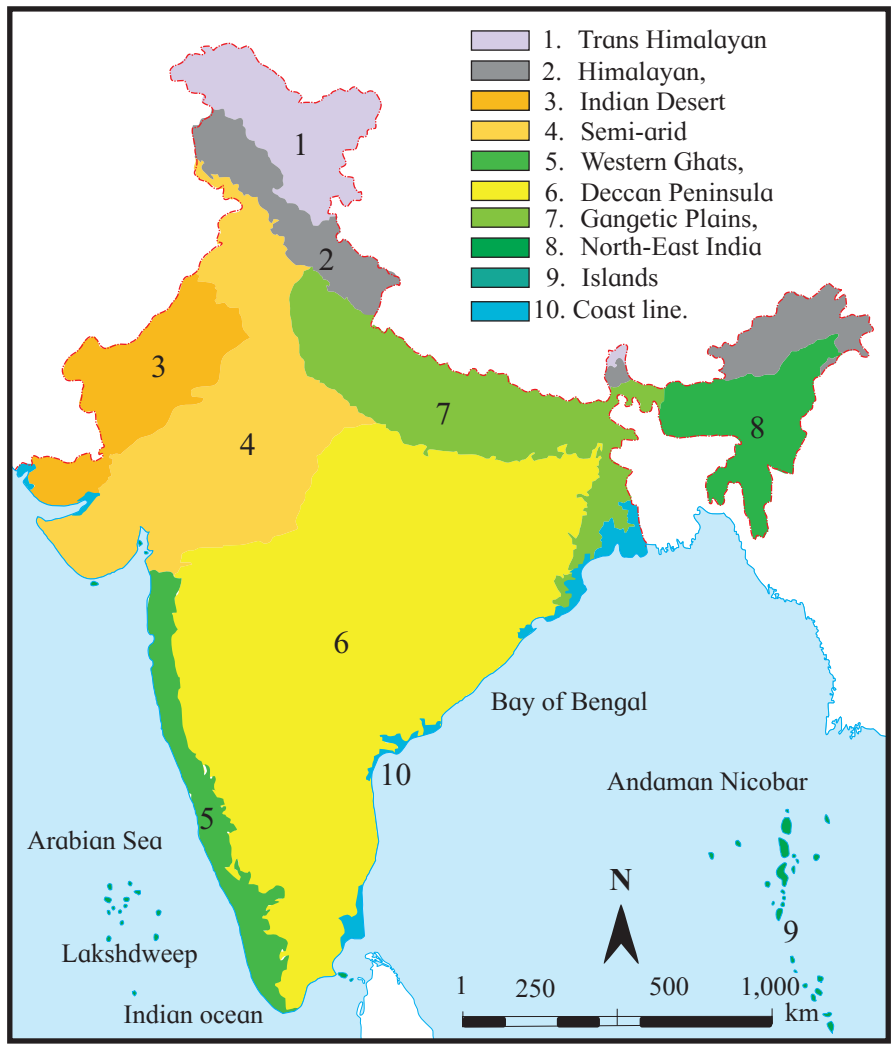
Biodiversity Hotspots

Hotspots are areas which are extremely rich in species, having high endemism and face a constant threat. There are 35 hotspots in the world. In India there exist 2 hotspots, the Western Ghats and the Eastern Himalayan.

The Indian Gene Centre is among the 17 mega diversity region of the world. More than 20 crop species were domesticated here. It is known to have more than 49,000 species of plants, 18,000 species of higher plants including major and minor crops (166) and their wild relatives (326). Around thousands of wild edible plant species are widely used by Indian local tribal communities. These include 145 species of roots and tubers, 521 of leafy vegetables/greens, 101 of buds and flowers, 647 of fruits and 118 of seeds and nuts. In addition, nearly 9,500 plant species of ethnobotanical uses have been reported from the country of which 7,500 are the ethno medicinal importance and 3,900 are multipurpose, edible species.

Biogeographic zones of India :

India is divided into 10 major Biogeographical Zones. This is based on geography which is



Map 3.1 : Biogeographic zones of India

related to climate (rainfall and temperature), soil characteristics, nature of vegetation and the diversity of its faunal species. This thus considers both abiotic and biotic aspects of nature. Human societies in India have used these biogeographic zones for agriculture, pastoralism and urbanization in ways that are specific to the biogeographic zones. This biogeography is closely linked to cultural (human) geography.

India has high Himalayan Mountains, river plains of our major rivers, semiarid lands, hilly regions and coastal areas. When viewed in a biogeographical context the plant and animal diversity of wild and cultivar species is region specific. This provides 10 distinctive biogeographical zones which given India its Megadiversity status.

1. Trans Himalayan
2. Himalayan
3. Indian Desert
4. Semi-arid
5. Western Ghats
6. Deccan Peninsula
7. Gangetic Plains
8. North-East India
9. Islands
10. Coastal line

Do you know about Western Ghats?

The Western Ghats are 1600 km long mountain range running all along the West Coast of India. Covering approximately 1, 40,000 sq. km, these mountains are home to number of endemic plants and animal species. It is one of the hotspots of the world from biodiversity point of view. Western Ghats start from the Gujarat, Maharashtra, Goa, Karnataka, Tamil-Nadu and ends in Kerala. In Maharashtra Western Ghats are locally called as Sahyadris.

3.5 Threats to Biodiversity

The wild variety of species on the earth are vital to keep the world's many ecosystems healthy, balanced and thriving. There are several major causes of biodiversity loss.

1. Fragmentation and Habitat loss

Habitat degradation overexploitation of resources, agricultural conversion and urbanization are the factors contributing to loss of biodiversity. The consequent fragmentation of habitat results in small isolated patches of land which cannot maintain populations of species in the long term.

When large habitats are broken up into small fragments due to various human activities, those mammals and birds which require large territories, decline and may become extinct. Certain animals which migrate long distances are badly affected, leading to a population decline.

2. Over exploitation

Over- hunting, over-fishing and over-harvesting contribute greatly to the loss of biodiversity.

3. Invasive species

The introduction of non-native species into an ecosystem can threaten endemic wildlife. When alien species are introduced unintentionally or deliberately for whatever purpose, some of them become invasive and cause a decline in the population or extinction of indigenous species. Threats posed to our native species by invasive weed species include *Parthenium*, *Lantana* and water Hyacinth. *Tilapia* fish introduced from South America has reduced the population of local fish species.

4. Pollution

Air pollution and acid rain destroy forests. Water pollution kills fish and other aquatic plants and animals. Toxic and

hazardous substances that are drained into water sources kill aquatic life. Oil spills kill coastal birds and aquatic plant life and other marine animals. Plastic trash affects wildlife. Pollution is a big threat to biodiversity.

5. Climate Change

Climate change is already having an impact on biodiversity, and is projected to become a progressively more significant

threat in the coming decades. Loss of Arctic sea ice threatens biodiversity across an entire biome and beyond. The related pressure of ocean acidification, resulting from higher concentration of carbon dioxide in the atmosphere, is already threaten our ecosystem. In addition to warming temperatures, increased frequency of extreme weather events, storms and changing patterns of rainfall and repeated drought well have a significant impact on biodiversity.



Deforestation



Urbanization



Industrilization



Pollution

Figure 3.9 :Threats to Biodiversity

3.6 Man and wildlife conflict

When wild animals leave their natural habitat in search of food and water, it gives rise to a conflict between man and wildlife.

In Maharashtra, at times leopards attack people in both urban and rural areas. Destruction of crops by wild boar and blackbuck are conflicts reported in the newspaper from time to time. In Central India, Sloth bear attacks are common during the season of Mahua collection.

Activity 3 :

Based on the news in newspaper articles from local newspaper write a note analyzing man –animal conflict in Maharashtra.

3.7 Conservation of Biodiversity

Conservation is the planned management of natural resources, to retain the balance in nature and retain species and habitat diversity.



Figure 3.10: Leopard entering urban areas

The main reason for this conflict is the growing human pressure on wildlife habitat which results in:

1. Fragmentation and honeycombing of animal habitat.
2. Loss of corridors and migratory routes for long-range animals such as elephants is a serious conflict issue.
3. Loss of food and water in wildlife habitats due to the shrinking of forest cover leads to crop damaged outside protected areas.

It also includes wise use of natural resources in such a way that the needs of present generation are met and at the same time leaving enough for the future generations. Conservation of biodiversity is important to:

- prevent the loss of genetic diversity of a species.
- save a species from becoming extinct.
- Prevent ecosystems damage and degradation.

Methods of biodiversity conservation

Conservation efforts can be grouped into the following two categories:

1. In-situ (on-site) conservation includes the

protection of plants and animals within their natural habitats. Protected Areas on land or in the sea which is dedicated to protect and maintain biodiversity is done through our national parks and sanctuaries.

2. Ex-situ (off-site) conservation of plants and animals is done outside their natural habitats. These include botanical gardens, zoos, gene banks, seed bank, tissue culture and cryopreservation.

1. In-situ Conservation

i) Protection of habitat: The main strategy for conservation of species is the protection of habitats in representative ecosystems. Currently, India has 104 National Parks, 551 Wildlife Sanctuaries, 18 Biosphere Reserves, 50 Tiger Reserves and 32 Elephant Reserves. 27 wetlands, 30 mangrove areas and four coral reef areas have been identified for intensive conservation and management purposes by the Ministry of Environment, Forests and climate change, Govt. of India.

• National Parks and Wildlife Sanctuaries:

Many National Parks and Wildlife Sanctuaries have been established to preserve wildlife in their natural environment. The Jim Corbett Tiger Reserve- Uttaranchal, Kanha National Park, Madhya Pradesh, Bandhavgarh National Park- Madhya Pradesh, Ranthambhor National Park- Rajasthan, Gir National Park- Gujarat etc. Some of the main protective areas in India are;

- Kaziranga National Park (Assam) – One-horned rhinoceros
- Manas National Park (Assam) – Wild buffaloes
- Gir National Park (Gujarat) – Lions, chital, sambar, wild bears
- Kolleru National Park (Andhra Pradesh) – Pelicans and marine birds
- Dachigam National Park (Jammu and Kashmir) – Kashmir stag, wild goats, and sheep.

- Bandipur National Park (Karnataka) – Indian bison, elephants, langurs, Tiger
- Periyar National Park (Kerala) – Elephants, barking deer, sambar
- Kanha National Park (Madhya Pradesh) – Tiger, leopards, wild dogs, barasingha.
- Keoledeo National Park (Rajasthan) – ducks, herons, flemingo, pelicans.
- Jim Corbett National Park (Uttaranchal) – Tigers, barking deer, sambar, bear, rhesus monkey.
- Jaldapara National Park (West Bengal) – Rhinoceros

Do You Know?

TIGER RESERVES IN MAHARASHTRA

Tiger Reserves were started by the former Prime Minister Indira Gandhi’s flagship program “**Project Tiger**”. It envisioned creating a safe heaven for tigers to flourish and receive legal protection against poachers. Melghat is the first tiger reserve to be declared in 1973-74 with Gugamal National Park as its core zone along with adjoining Melghat Wildlife Sanctuary. Subsequently, over the years, 5 additional Tiger Reserves were created.

List of Tiger Reserves in Maharashtra

Tiger Reserve	Location	Year de-clared	Core area (sq. km)	Buffer area (sq.km)
Melghat	Amravati	1974	1,500	1,268
Tadoba-Adhari	Chandrapur	1993	626	1,102
Pench	Nagpur	1999	257	484
Sahyadri	Western Ghats	2007	600	565
Nawegaon –Nagzira	Gondia	2013	654	1,241
Bor	Wardha	2014	138	678

Source : National wildlife database, WII

UNESCO

• Biosphere Reserves

The concept of Biosphere Reserves (BR) was launched in 1975 as a part of UNESCO's Man and Biosphere Programme (MAB), dealing with the conservation of ecosystems and the genetic material they contain. A Biosphere Reserve consists of core, buffer and transition zones.

- (a) The core zone is the fully protected natural area of the Biosphere Reserve which is least disturbed by human activities. It is a legally protected ecosystem in which entry is not allowed except with permission for some special purpose. Destructive sampling for scientific investigations is prohibited.
- (b) The buffer zone surrounds the core zone and is managed so that some resources can be used by local people and promotes research and educational activities.
- (c) The transition zone is the outermost part of the Biosphere Reserve. It is an area where active co-operation between the reserve management and the local people. Such as settlements, agriculture, forestry, recreation and other economic activities are in harmony with the conservation goals. There are 553 Biosphere Reserves located in 107 countries in the world.

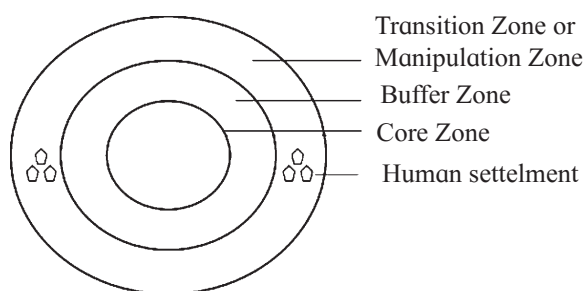


Figure 3.11 : Diagrammatic representation of Biosphere reserve

The main functions of the biosphere reserves are:

- **Conservation** : Long term conservation of representative landscapes and different types of ecosystems along with all their species and genetic resources.
- **Development** : Encourage traditional resource use and promote economic development which is culturally, socially and ecologically sustainable.
- **Scientific research, monitoring and education** : Support conservation research, monitoring, education and information exchange related to local, national and global environmental and conservation issues.

ii) Species-Oriented Projects:

Several species have been identified that need a concentrated and specifically directed effort to prevent extinction.

1. Project Tiger –

This has been success in conservation of the tiger its prey and its habitat.

Tigers which were once abundant in Indian forests declined drastically from an estimate of 40,000 at the turn of nineteenth century to 1200 by 1970. This led to initiating Project Tiger in 1973, with the objective of conserving and rescuing this species from extinction. A total ban was imposed on hunting of tigers and trading in tiger products at the national and international levels. Elaborate management plans are made for each of the tiger reserves for tiger habitat improvement and anti -poaching measures to safeguard our national animal.

2. Project Elephant

Project Elephant was launched in February, 1992 to assist states having free ranging populations of wild elephants to ensure long-term survival of identified

viable populations of elephants in their natural habitats. The project is being implemented in several states. Some of them are; Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Kerala, Karnataka, Odisha, Tamil Nadu, West Bengal etc. Recently elephants have started migrating into Maharashtra in the Kokan region (Sawantwadi) creating man-elephant conflict in the area.

3. Crocodile breeding and management project :

The project surveyed the crocodile habitats and facilitated their protection through declaration of Sanctuaries and National Parks. Captive breeding and reintroduction programs involved careful collection of eggs from the wild. Eleven Sanctuaries have been declared specially for crocodile protection including the National Chambal Sanctuary in Madhya Pradesh.

iii) Sacred forests and sacred lakes:

These are small forest patches protected by tribal communities due to their religious sanctity. These have been free from all disturbances. Sacred forests are located in several parts of India i.e. Karnataka, Maharashtra, Kerala, Meghalaya. Several water bodies for example, Khecheopalri lake in Sikkim have been declared sacred by local people, leading to the protection of their aquatic flora and fauna. Sacred groves or Devrais in the Western Ghat of Maharashtra are examples of sacred forest that have been preserved over several generations.

2. Ex-situ Conservation

i) Botanical Gardens, Zoos : To complement in-situ conservation efforts, ex-situ conservation is being undertaken through setting up botanical gardens, zoos, medicinal plant parks, etc. by

various agencies. The Indian Botanical Garden in Howrah (West Bengal) is over 200 years old. Other important botanical gardens are in Ooty, Bangalore and Lucknow.

Number of zoos have been developed in the country. They have played an important role in the conservation of endangered animal species such as the Manipur Thamin deer (*Cervus eldi eldi*) and Red panda (*Ailurus fulgens*) of Assam. Notable successful examples of captive breeding is that of Gangetic gharial (*Gavialis gangeticus*).

The main objectives of botanical gardens are –

- Ex-situ conservation and propagation of important threatened plant species.
- Serve as a Centre for Conservation, Research and training,
- Build public awareness through education on plant diversity and need for their conservation.

ii) Gene Banks : Ex-situ collection and preservation of genetic resources is done through gene banks and seed banks. The National Bureau of Plant Genetic Resources (NBPGR), New Delhi preserves seeds of wild relatives of crop plants as well as cultivated varieties; the National Bureau of Animal Genetic Resources (NBAGR) at Karnal, Haryana maintains the genetic material for domesticated animals and the National Bureau of Fish Genetic Resources (NBFGR), Lucknow for fishes.

iii) Cryopreservation: This method is particularly useful for conserving crops through vegetative propagation. Cryopreservation is the storage of material at ultra-low temperature in liquid nitrogen (-196°C). It essentially involves suspension of all metabolic processes and activities.

iv) Conservation at Molecular Level (DNA level): Germplasm conservation at molecular level is now feasible and is attracting attention. Cloned DNA and material having DNA in its native state can all be used for genetic conservation. Non-viable material representing valuable genotypes stored in gene banks can all be used as sources of DNA libraries from where a relevant gene or a combination of

genes can be recovered.

v) Legal measures: Market demand for some animal body parts like bones of tiger, rhino horns, furs, ivory, skins, musk, peacock feathers, etc. results in killing of a large number of wild animals. The Wildlife Protection Act (1972) contain provisions for penalties or punishment for offender. Thus prevents poaching and illegal trade.



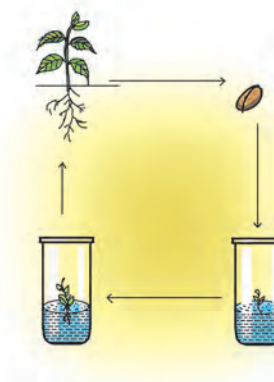
Botanical Garden



Zoo



Genetic Conservation



Tissue Culture

Figure 3.12: Ex-situ Conservation

Think on it:
How can we conserve biodiversity and why?

Exercise

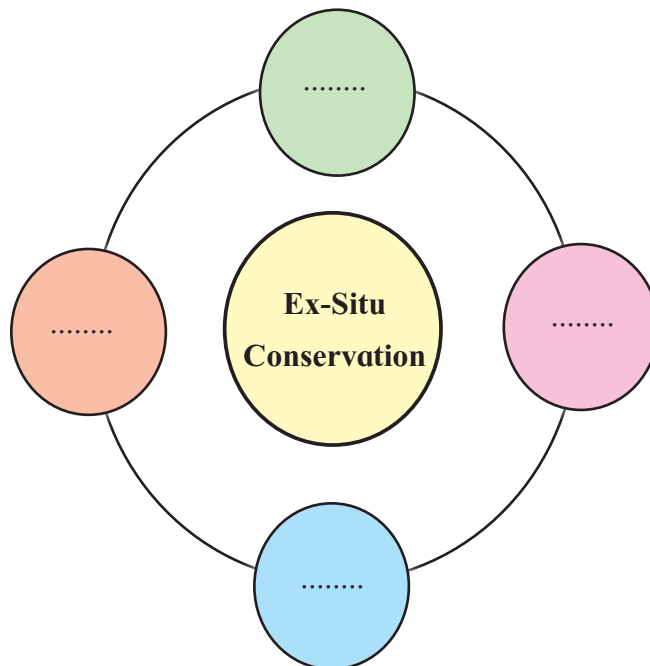
Q. 1. Fill in the blank with the help of correct option.

- 1) is one of the biodiversity Hotspots in India.
 - a) Assam
 - b) North-East India
 - c) Western Ghats
 - d) Kerala
- 2) is the indirect value of biodiversity.
 - a) Consumptive use value
 - b) Productive use value
 - c) Option value
 - d) None of these.
- 3) India has been recognized as one of the World's top mega diversity nations.
 - a) 10
 - b) 12
 - c) 17
 - d) 20
- 4) are the causes of Biological reduction
 - a) Pollution
 - b) Over-exploitation
 - c) Climate Change
 - d) All of these
- 5) Dachigam National park is located at
 - a) Jammu and Kashmir
 - b) Assam
 - c) Kerala
 - d) Karnataka.

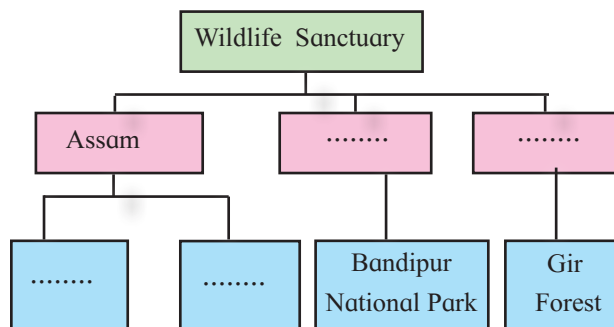
Q.2. Correlate the following pairs.

- 1) Peepal and Tulsi : Social Value Of Biodiversity :: Folk arts and songs.....
- 2) Variation of Genes: genetic biodiversity:: Variety of species :
- 3) In-situ: natural habitat :: Ex-situ :
- 4) Project Tiger: 1973 :: Project Elephant :

Q.3. Complete the Web Diagram.



Q.4. Complete the tree diagram.



Q.5) Write short answers of the following questions.

- 1) What is biodiversity?
- 2) Roots help to bind the soil and prevent erosion. give reasons.
- 3) What are the two conservation strategies of Biodiversity?
- 4) Write the importance of Biodiversity.
- 5) Explain your role in biodiversity conservation.
- 6) What is the hotspot of biodiversity?

Q.6) Write long answers of the following questions.

- 1) What are the values of Biodiversity? Describe each value.
- 2) Explain Ex-situ conservation in detail.
- 3) What are threats to Biodiversity? Write any four.
- 4) Describe any two species-oriented projects under In-situ conservation.
- 5) Write about Biosphere reserve in detail.

