BIODIVERSITY

Definition:

Biodiversity refers to the variety and variability among all groups of living organism and the ecosystem complex in which they occur.

Classification of Biodiversity

Biodiversity is generally classified into three types

1) Genetic diversity
2) Species diversity
3) Ecosystem or Community diversity

1. Genetic Diversity

- A species with different genetic characteristics is known as **genetic diversity.**
- It is the basic source of biodiversity.
- The genes found in organisms can form enormous number of combinations each of which gives rise to some variability.
- Genes are the basic units of hereditary information transmitted from one generation to other. When the genes within the same species show different versions due to new combinations, it is called **genetic variability**.
- For example, all rice varieties belong to the species Oryza sativa, but there are thousands of wild and cultivated varieties of rice which show variations at the genetic level and differ in their color, size, shape, aroma and nutrient content of the grain. This is the genetic diversity of rice.

2. Species Diversity

- The variability found between different species of a community is called as species diversity.
- It represents broadly the species richness and their abundance in a community. There are two popular indices of measuring species diversity known as Shannon-Wiener index
- The total number of living species in a range of l0 million to 50 million. Till now only about l.5 million living and 300,000 fossil species have been actually described and given scientific names.

3. **Ecosystem Diversity**

- The diversity at the ecological or habitat level is known as ecosystem diversity
- The diversity of ecological complexity showing variations in ecological niches, trophic structure, food-webs, nutrient cycling etc.
- The ecosystems also show variations with respect to physical parameters like moisture, temperature, altitude, precipitation etc.
- We may consider diversity in forest ecosystem, which is supposed to have mainly a dominance of trees. But, while considering a tropical rainforest, a tropical deciduous forest, a temperate deciduous forest and a boreal forest, the variations observed are just too many and they are mainly due to variations in the above mentioned physical factors.

VALUE OF BIODIVERSITY

Introduction

The value of biodiversity in terms of its commercial utility, ecological services, social and aesthetic value is enormous. We get benefits from other organisms in innumerable ways. Sometimes we realize and appreciate the value of the organism only after it is lost from this earth. Very small, insignificant, useless looking organism may play a crucial role in the ecological balance of the ecosystem or may be a potential source of some invaluable drug for dreaded diseases like cancer or AIDS. The multiple uses of biodiversity or biodiversity value have been classified as follows:

1) **Consumptive use value**

These are direct use values where the biodiversity product can be harvested and consumed directly e.g. fuel, food, drugs, fibre etc.

Food: A large number of wild plants are consumed by human beings as food. About 80,000 edible plant species have been reported from wild. About 90% of present day food crops have been domesti-cated from wild tropical plants. Even now our agricultural scientists make use of the existing wild species of plants that are closely related to our crop plants for developing new hardy strains. A large number of wild animals are also our sources of food.

Drugs and medicines: About 75% of the world³s population depends upon plants or plant extracts for medicines. The wonder drug Penicillin used as an antibiotic is derived from a fungus called 9eniciSSium. Likewise, we get Tetracyclin from a bacterium. Quinine, the cure for malaria is obtained from the bark of Cinchona tree, while DigitaSin is obtained from foxglove (Digitalis) which is an effective cure for heart ailments. Recently vinblastin and vincristine, two

anticancer drugs, have been obtained from Periwinkle (Catharanthus) plant, which possesses anticancer alkaloids. A large number of marine animals are supposed to possess anti-cancer properties which are yet to be explored systematically.

Fuel: Our forests have been used since ages for fuel wood. The fossil fuels coal, petroleum and natural gas are also products of fossilized biodiversity. Firewood collected by individuals is not normally marketed, but are directly consumed by tribals and local villagers, hence falls under consumptive value.

2. **Productive use values**:

- These are the commercially usable values where the product is marketed and sold. It may include lumber or wild gene resources that can be traded for use by scientists for introducing desirable traits in the crops and domesticated animals. These may include the animal products like tusks of elephants, musk from musk deer, silk from silk-worm, wool from sheep, fir of many animals, lac from lac insects etc, all of which are traded in the market
- Many industries are dependent upon the productive use values of biodiversity e.g.- the paper and pulp industry, Plywood industry, Railway sleeper industry, Silk industry, textile industry, ivory-works, leather industry, pearl industry etc.
- Despite international ban on trade in products from endangered species, smuggling of fur, hide, horns, tusks, live specimen etc. worth millions of dollars are being sold every year. Developing countries in Asia, Africa and Latin America are the richest biodiversity centers and wild life products are smuggled and marketed in large quantities to some rich western countries and also to China and Hong Kong where export of cat skins and snake skins fetches a booming business.

3. Social Value

- These are the values associated with the social life, customs, religion and psycho-spiritual aspects of the people. Many of the plants are considered holy and sacred in our country like Tulsi (holy basil), Peepal, Mango, Lotus, Bael etc.
- The leaves, fruits or flowers of these plants are used in worship or the plant itself is worshipped.
- The tribal people are very closely linked with the wild life in the forests. Their social life, songs, dances and customs are closely woven around the wildlife. Many animals like Cow, Snake, Bull, Peacock, Owl etc. also have significant place in our psycho-spiritual arena and thus hold special social importance.

- Thus biodiversity has distinct social value, attached with different societies.

4. Ethical value:

- It is also sometimes known as existence value.
- It is based on the concept of "Live and Let Live". If we want our human race to survive, then we must protect all biodiversity, because biodiversity is valuable.
- The ethical value means that we may or may not use a species, but knowing the very fact that this species exists in nature gives us pleasure.

5. Aesthetic value:

Great aesthetic value is attached to biodiversity. No one of us would like to visit vast stretches of barrenlands with no signs of visible life. People from far and wide spend a lotof time and money to visit wilderness areas where they can enjoy the aesthetic value of biodiversity and this type of tourism is now known as **eco-tourism**. The "Willingness to pay" concept on such eco-tourismgives us even a monetary estimate for aesthetic value of biodiversity.

6. Optional Value

These values include the potentials of biodiversity that are presently unknown and need to be explored. There is a possibility that we may have some potential cure for AIDS or cancer existing within the depth of a marine ecosystem.

7. Ecosystem service value:

Recently, a non-consumptive use value related to self maintenance of the ecosystem and various important ecosystem services has been recognized. It refers to the services provided by ecosystems like prevention of soil erosion, prevention of floods, maintenance of soil fertility, cycling of nutrients, fixation of nitrogen, cycling of water, their role as carbon sinks, pollutant absorption and reduction of the threat of global warming etc.

INDIA AS A MEGA-DIVERSITY NATION

Nearly 170 countries are present in the world and 12 of them contain 70% of our plant diversity. Among this India have 12 mega diversity countries in the world. It has 47000 species of plant and 81000 animal species which about 7% and 6.5% respectively of global flora and fauna.

Endemism:

The species which are restricted only to a particular area are called as **endemic species.** Our country has a rich endemic flora and fauna. About 62% amphians, 50% lizards, 33% of flowering plant, 53% of fresh water fishes and 10% mammalian are endemic species.

Centre of origin

A large no of species are known to have originated in India.

- **Plant diversity:** Nearly 5000 flowering plant and 166 crop plant species have their origin in India.
- **Agro-biodiversity**: There are crops species and wild relatives. India is considered to be the centre of origin of 30000 to 50000 varieties of rice, mango, turmeric, ginger etc.
- **Marine Biodiversity:** Along 7500KM long coastline of our country in the mangroves, estuaries, coral reefs, back water etc. There exists a rich biodiversity. More than 340 coral species of the world are found there. Several species of mangrove plants and sea grass are also found in our country.
- **Animal biodiversity:** There are 75000 animal species including 5000 insects. India is home to about nearly 200000 living organism.

A large proportion of the India biodiversity is still unexplored. There are about 93 major wetland, coral reefs and mangroves. Indian forest covers 64.01 million hectares having a rich biodiversity of plants such as Trans Himalayan, North east central, eastern Himalaya forest, Western Ghats, coast deserts etc. Due to vary diverse climate conditions there is a complete rainbow spectrum of biodiversity in our country.

HOT-SPOTS OF BIODIVESITY

Areas which exhibit high species richness as well as high species endemism are termed as hot spots of biodiversity. The terms were introduced by Myers (1988). There are 25 such hot spots of biodiversity on a global level out of which two are present in India, namely the Eastern Himalayas and Western Ghats. Two of these hotspots lie in India extending into neighboring countries namely, Indo-Burma region (covering Eastern Himalayas) and Western Ghats- Sri Lanka region. The Indian hot spots are not only rich in floral wealth and endemic species of plants but also reptiles, amphibians, swallow tailed butterflies and some mammal.

These hotspots covering less than 2% of the world's land area are found to have about 50% of the terrestrial biodiversity. According to Myers et al. (2000) an area is designated as a hotspot when it contains at least 0.5% of the terrestrial biodiversity.

About 40% of terrestrial plants and 25% of vertebrate species are endemic and found in these hotspots. After the tropical rain forests, the second highest numbers of endemic plant

species are found in the Mediterranean (Mittermeier). Broadly this hotspot is in western Amazon. Madagascar, North and East Borneo, North Eastern Australia, West Africa and Brazilian Atlantic forest. These are the areas of high diversity, endemism and area also threatened by human activities. More than 1 million peoples are live in these areas.

Reason for rich biodiversity in the tropics

The followings are the reasons for the rich biodiversity in the tropics.

1. The tropics have a more stable climate.
2. Warm temperatures and high humidity in the tropical areas provide favorable conditions.
3. No single species can dominate and thus there is an opportunity for many species to coexist.
4. Among plants, rate of out-crossing appear to be higher in tropics.

Eastern Himalayas

Geographically this area comprises Nepal, Bhutan and neighboring states of Northern India. There are 35,000 plant species found in the Himalayas, of which 30% are endemic.

The Eastern Himalayas are also rich in wild plants of economic value.

Examples: Rice, banana, citrus, ginger, chili and sugarcane.

The taxol yielding plant is also sparsely distributed in the region.

(a) 63% mammals are from Eastern Himalayas, and

(b) 60% of the Indian Birds are from North East.

(c) Huge wealth of fungi, insects, mammals, birds have been found in this region.

Western Ghats

The area comprises Maharashtra, Karnataka, Tamilnadu and Kerala. Nearly 1500 endemic, dicotyledonous plant species are found from Western Ghats. 62% amphibians and 50% lizards are endemic in Western Ghats.

It is reported that only 6.8% of the original forests are existing today while the rest has been deforested or degraded.

Some common plants: Ternstroemia Japonica, Rhododendron and Hypericum.

Some common animals: Blue bird, lizard, hawk.

THREATS TO BIODIVERSITY

Any disturbance in a natural ecosystem tends to reduce its biodiversity. The waste generated due to increase in human population and industrialization, spoils the environment and leads to more diversity in biological species. Any change in the system leads to a major imbalance and threatens the normal ecological cycle.

CAUSES FOR LOSS OF BIODIVERSITY (OR) VARIOUS THREATS TO INDIAN BIODIVERSITY

1. Habitat Loss

The loss of populations of interbreeding organisms is caused by habitat loss. Habitat loss threatened a wide range of animals and plants.

Factors Influencing Habitat Loss

1. **Deforestation:** The loss of habitat is mainly caused by deforestation activities. Forests and grasslands have been cleared for conversion into agricultural lands, or settlement areas or developmental project. The forest and grasslands are the natural homes of thousands of species, which disintegrate due to loss of their natural habitat.
2. **Destruction of wetlands:** The wetlands, estuaries and mangroves are destroyed due to draining, filling and pollution, which cause huge biodiversity loss.
3. **Habitat fragmentation**: Sometimes the habitat is divided into small and scattered patches. This phenomenon is known as habitat fragmentation. Due to this many wild animals and songbirds area vanishing.
4. **Raw material**: For the production of hybrid seeds, the wild plants are used as raw materials. As a result, many plant species become extinct.
5. **Production of drugs**: Many pharmaceutical companies collect wild plant for the production of drugs. Therefore several medicinal plant species are on the verge of extinction.
6. **Illegal trade**: Illegal trade on wild life also reduces the bio-diversity and leads to habitat loss.
7. **Developmental activities**: Construction of massive dams in the forest areas, discharge industrial effluents which kill the birds and other aquatic organisms.

2. Poaching (Over Harvesting) Of Wildlife

Poaching means killing of animals (or) commercial hunting. It leads to loss of animal biodiversity.

1. Subsistence poaching: Killing animals to provide enough food for their survival is called subsistence poaching.

2. Commercial poaching: Hunting and killing animals to sell their products is called commercial poaching.

Factors Influencing Poaching

1. Human population: Increased human population in our country has led to pressure on forest resources, which ultimately causes degradation of wildlife habitats.

2. Commercial activities: Though international ban on trading the products of endangered species, smuggling of wildlife products continues. Since the trading of such wildlife products is highly profit, poaching makes the poachers to just hunt this prohibited wildlife and smuggle it to other countries.

Wild life products: Furs, horns, tasks, live specimens, herbal products.

Wealth of wildlife: The developing nations in Asia, Latin America and Africa have richest source of biodiversity.

Importers of wild life: The rich countries in Europe and North America, Japan, Taiwan, Hong Kong are the major importer of wildlife products (or) wildlife itself.

1. **Male gorilla:** In Rwanda and Zaire, it is hunted for tits body parts, head and hands.
2. **Blue morph butterfly**: In Brazil, it is poached for making attractive trays and other objects.
3. **Blubber:** It is used to prepare lamp oils and lubricating oils.
4. **Baleen**: It is used to prepare combs and other similar articles.
5. **Elephant feet**: It is used to make Ash trays.
6. **Elephant**: It is killed for ivory.
7. **Bengal tigers**: Its fur sell is more than $1,00,000 in the foreign market.

Remedy Measures

1. Illegal hunting and trade of animals and animal products should be stopped immediately.

2. We should not purchase furcoat, purse or bag or items made of crocodile skin or python skin.

3. Bio-diversity laws should be strengthened.

3. Man – wildlife conflicts

Man – wildlife conflicts arise, when wildlife starts causing immense damage and danger to the man. Under such condition it is very difficult for the forest department to compromise the affected villagers and to gain the villagers support for wildlife conservation.

Examples for man – wildlife conflicts

1. In sambalpur, Orissa, 195 humans were killed in the last 5 years by elephants. In retaliation, the villagers have killed 98 elephants and badly injured 30 elephants.

2. In the border of Kote – Chamarajanagar, Mysore, several elephants were killed because of the massive damage done by the elephants to the farmer's cotton and sugarcane crops.

3. Very recently, two men were killed by leopards in Poway, Mumbai.

4. A total of 14 persons were killed during 19 attacks by the leopards in Sanjay Gandhi National Park, Mumbai.

Factors influencing (or causes) man – animal conflicts

1. Shrinking of forest cover compels wildlife to move outside the forest and attack the fields and humans.

2. Human encroachment into the forest area induced a conflict between man and the wildlife.

3. Injured animals have a tendency to attack man. Usually the female wildlife attacks the human if she feels that her newborn cubs are in danger.

4. Earlier, forest departments used to cultivate sugarcane paddy, coconut trees, in the sanctuaries. When the favorite food of elephants (i.e., bamboo leaves) were not available, they feed them to the elephants. But, now due to lack of such practices the wild animals move out of the forest for searching food.

5. Often the villagers put electric wiring around their crop fields. The elephants get injured, suffer in pain and start violence.

6. The cash compensation paid by the government for the damage caused by the wild animals, is not enough. Therefore the agonized farmers get revengeful and kill the wild animals.

Examples A farmer, in Mysore, gets compensation of Rs. 400/- per quintal, but the market price is Rs. 2400/- per quintal.

7. Garbage near human settlements or food crops near forest areas attracts wild animals.

Remedial Measures (Or) Conservation Of Biodiversity

1. Adequate crop and cattle compensation schemes must be started.

2. Solar powered fencing must be provided along with electric current proof trenches to prevent the animals from entering into the fields.

3. Cropping pattern should be changed near the forest borders.

4. Adequate food and water should be made available for the wild animals within forest zones.

5. The development and constructional work in and around forest region must be stopped.

ENDANGERED SPECIES OF INDIA

The International Union for Conservation of Nature and Natural Resources (IUCN) publishes the Red Data Book which includes the list of endangered species of plants and animals. The red data symbol-izes the warning signals for those species which are endangered and if not protected are likely to become extinct in near future.

In India, nearly 450 plant species have been identified in the categories of endangered, threatened or rare. Existence of about l50 mammals and l50 species of birds is estimated to be threatened while an unknown number of species of insects are endangered. It may not be of direct relevance here to give a complete list of endangered flora and fauna of our country. However, a few species of endangered reptiles, birds, mammals and plants are given below:

(a) **Reptiles** : Gharial, green sea turtle, tortoise, python

(b) **Birds** : Great Indian bustard, Peacock, Pelican, reat Indian Hornbill, Siberian White Crane

(c) **Carnivorous** : Indian wolf, red fox, Sloth bear, red panda, Mammals tiger, leopard, striped hyena, Indian lion, golden cat, desert cat, dugong

(d) Primates : Hoolock gibbon, lion-tailed macaque, Nilgiriangur, Capped monkey, golden monkey

(e) **Plants** : A large number of species of orchids, Rhododendrons, medicinal plants like RauvoS/ia serpentina, the sandal wood tree Santa Sum, Cycas beddonei etc.

The Zoological Survey of India reported that Cheetah, Pink headed duck and mountain quail have already become extinct from India.

- A species is said to be extinct when it is not seen in the wild for 50 years at a stretch e.g. Dodo, passenger pigeon.
- A species is said to be endangered when its number has been reduced to a critical level or whose habitats, have been drastically reduced and if such a species is not protected and conserved, it is in immediate danger of extinction.
- A species is said to be in vulnerable category if its population is facing continuous decline due to overexploitation or habi-tat destruction. Such a species is still abundant, but under a serious threat of becoming endangered if causal factors are not checked.
- Species which are not endangered or vulnerable at present, but are at a risk are categorized as rare species. These taxa are usually localized within restricted areas i.e. they are usually endemic. Sometimes they are thinly scattered over a more extensive area.

Some important endangered and extinct species are shown in Plate

ENDEMIC SPECIES OF INDIA

India has two biodiversity hot spots and thus possesses a large number of endemic species. Out of about 47,000 species of plants in our country 7000 are endemic. Thus, Indian subcontinent has about 62% endemic flora, restricted mainly to Himalayas, Khasi Hills and Western Ghats. Some of the important endemic flora include orchids and species like Sapria hima Sayana, Uvaria Surida, Nepenthes khasiana, 9edicu Saris perroter etc. Some endemic plant species are shown in Plate V.

A large number out of a total of 8l, 000 species of animals in our country is endemic. The Western Ghats are particularly rich in amphibians (frogs, toads etc.) and reptiles (lizards, crocodiles etc.). About 62% amphibians and 50% lizards are endemic to Western Ghats. Different species of monitor lizards (Varanus), reticulated python and Indian Salamander and Viviparous toad Nectophhryne are some important endemic species of our country.

CONSERVATION OF BIODIVERSITY

The enormous value of biodiversity due to their genetic, commercial, medical, aesthetic, ecological and optional importance emphasizes the need to conserve biodiversity. Gradually we are coming to realize that wildlife is not just ‘a game to be hunted³, rather it is a ‘gift of nature³ to be

nurtured and enjoyed. A number of measures are now being taken the world over to conserve biodiversity including plants and wildlife.

There are two approaches of biodiversity conservation:

(a) Zn situ conservation (within habitat): This is achieved by protection of wild flora and fauna in nature itself. e.g. Biosphere Reserves,National Parks, Sanctuaries, Reserve Forests etc.

(b) Zx situ conservation (outside habitats) This is done by establishment of gene banks, seed banks, zoos, botanical gardens, culture collections etc.

1. *In Situ* Conservation

At present we have 7 major Biosphere reserves, 80 National Parks, 420wild-life sanctuaries and l20 Botanical gardens in our country cover-ing 4% of the geographic area.

Biosphere Reserves

The Biosphere Reserves conserve some representative ecosystemsas a whole for long-term in situ conservation. In India we have Nanda Devi (U.P.), Nokrek (Meghalaya), Manas (Assam), Sunderbans (West Bengal), Gulf of Mannar (Tamil Nadu), Nilgiri (Karnataka, Kerala, Tamil Nadu), Great Nicobars and Similipal (Orrisa) biosphere Reserves. Within the Biosphere reserves we may have one or more National Parks. For example, Nilgiri Biosphere Reserve has two National Parks vix. Bandipur and Nagarhole National Park.

National Park

A National Park is an area dedicated for the conservation of wildlife along with its environment. It is also meant for enjoyment through tourism but without impairing the environment. Grazing of domestic animals, all private rights and forestry activities are prohibited within a National Park. Each National Park usually aims at conservation specifically of some particular species of wildlife along with others. Some major National Parks of our country are enlisted below:

Example: Gir national park, Bandipur, Dachigam, Corbet, Kaziranga etc.,

Wildlife sanctuaries

Wildlife sanctuaries are also protected areas where killing, hunt-ing, shooting or capturing of wildlife is prohibited except under the control of highest authority. However, private ownership

rights are per-miscible and forestry operations are also permitted to an extent thatthey do not affect the wildlife adversely.

Some major wildlife sanctuaries of our country are given below

1) Hazaribagh sanctuary

2) Ghana Bird Sanctuary

3) Sultanpur Bird Sanctuary etc.,

Gene Sanctuary

For plants, there is one gene sanctuary for Citrus (Lemon family) and one for pitcher plant (an insect eating plant) in Northeast India. For the protection and conservation of certain animals, there have beenspecific projects in our country e.g. Project Tiger, Gir Lion Project, Crocodile Breeding Project, Project Elephant, Snow Leopard Projectetc.

Advantages of In Situ Conservation

- It is very cheap and convenient method
- The species gets adjusted to the natural disaster like drought, food, forest fires

Disadvantage of In Situ Conservation

- A large surface area of the earth is required to preserve the biodiversity
- Maintenance of the habits is not proper due to shortage of staff and pollution.

2. Ex Situ Conservation:

This type of conservation is mainly donefor conservation of crop varieties, the wild relatives of crops and all thelocal varieties with the main objective of conserving the total geneticvariability of the crop species for future crop improvement or affores-tation programmes. In India, we have the following important gene bank/seed bank facilities:

1. **National Bureau of Plant Genetic Resources (NBPGR)** is located in New Delhi. Here agricultural and horticultural crops and their wild relatives are preserved by cryo~preservatioл of seeds, pollenetc. by using liquid nitrogen at a temperature as low as -l96°C. Varietiesof rice,

pearl millet, Brassica, turnip, radish, tomato, onion, carrot, chilli, tobacco, poppy etc. have been preserved successfully in liquid nitrogenfor several years without losing seed viability.

2. **National Bureau** of **Animal Genetic Resources** (NBAGR) located at Karnal, Haryana. It preserves the semen of domesticatedbovine animals.
3. **National Facility for Plant Tissue Culture Repository (NFPTCR)** for the development of a facility of conservation of varietiesof crop plants/trees by tissue culture. This facility has been createdwithin the NBPGR.

The G-l5 countries have also resolved to set up a network of gene banks to facilitate the conservation of various varieties of aromatic and medicinal plants for which India is the networking coordinator country.

Advantage of Ex-Situ Conservation

- Survival of endangered species is increasing due to special care and attention.
- In captive breeding animals are assured food, water, shelter and also security and hence longer life span.
- It is carried out in cases of endangered species, which donot have any changes of survival in the world.

Disadvantage of Ex-Situ Conservation

- It is expensive method
- The freedom of wildlife is lost
- The animals cannot survive in natural environment.
- It can be adopted only for few selected species.