# Biodiversity, Conservation and Environmental Issues

## Biodiversity & Conservation

**Biodiversity**

- Biodiversity or biological diversity is the variety and variability of life on Earth, popularised by the socio-biologist Edward Wilson.
- A conservative and scientifically sound estimate made by Robert May places the global species diversity at about 7 million.
- Among animals, insects make more than 70% of total, i.e., out of every 10 animals on this planet, 7 are insects.
- Although, India has only 2.4% of world's land area, its share of the global species diversity is an impressive 8.1 percent.

**Patterns of Biodiversity**

- Species diversity decreases as we move away from equator towards the poles.
- Species richness within a region increased with increasing explored area, but only upto a limit (Humboldt).
- The relation between species richness and area for a wide variety of taxa (angiosperms, birds, bats, freshwater fishes) is a rectangular hyperbola. On a logarithmic scale, it is a straight line.
- The value of Z lies in the range of 0.1 to 0.2 regardless of region or taxa.
- Slope of the line is much steeper in very large areas like the entire continents.

**Importance of Species Diversity to the Ecosystem**

- Communities with more species, tend to be more stable than those with less species.
- David Tilman's long-term ecosystem experiments using outdoor plots show that plots with more species showed less year-to-year variation in total biomass and increased diversity contributed to higher productivity.
- The 'rivet popper hypothesis' of Paul Ehrlich states that loss of rivets on the wings (Key species, that drive major ecosystem functions) will be detrimental for the stability of the ecosystem (aeroplane). So, each species is important for the ecosystem.

**Loss of Biodiversity**

- The IUCN red list (2004) documents extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years.
- There were five episodes of mass extinction of species in the past, before humans appeared.
- The Sixth Extinction presently in progress is 100 to 1000 times faster than pre-human times and our activities are responsible for the faster rates.

**Causes of Biodiversity Losses**

- Habitat loss and fragmentation, over-exploitation, alien species invasions and co-extinctions are four major causes ('The Evil Quartet) of biodiversity losses.

**Table : Loss of biodiversity**

| Cause | Loss |
|---|---|
| Habitat loss and fragmentation | Forests for soybean cultivation |
| Over-exploitation | Steller's sea cow, passenger pigeon |
| Alien species invasions | cichlid fish due to Nile Perch, carrot grass (Parthenium), Lantana and water hyacinth (Eicchornia), indigenous fishes due to Clarias gariepinus |
| Co-extinctions | Host fish and its parasites, plant-pollinator |

**Biodiversity Conservation**

- The reasons for why should we conserve biodiversity can be grouped into three categories: narrowly utilitarian, broadly utilitarian, and ethical.

**Narrowly Utilitarian Arguments**

- Humans derive countless direct economic benefits from nature — food, firewood, fibre, construction material, industrial products and medicinal products.

**Broadly Utilitarian Arguments**

- Biodiversity plays a major role in many ecosystem services that nature provides.
- Pollination aesthetic pleasure etc.

**Ethical Arguments**

- We have a moral duty to care for their well-being.

**Types of Biodiversity Conservation**

**In-situ Conservation.**

- It is a type of conservation that performs inside the natural habitat it conserves biodiversity at all levels.
- Biodiversity hotspots are the regions with very high levels of species richness and high degree of endemism.
- Biodiversity hotspots and sacred groves are in situ conservation strategies.
- 14 biosphere reserves, 90 National Parks and 448 wild life sanctuaries provide legal protection in India.

**Ex-situ Conservation.**

- It is conservation of selected rare threatened plants/animals outside their natural habitat.
- Zoological Parks, Botanical gardens and wild-life Safari parks are included under ex- situ conservation.
- Plants can be propagated using tissue culture methods.
- Seeds of different genetic strains of commercially important plants can be kept for long periods in seed banks.
- Cryopreservation is a method to protect and preserve gametes of threatened species in viable and fertile condition.

**International Efforts for Conserving Biodiversity**

- The Earth Summit was held in Rio de Janeiro (1992) for biodiversity conservation and sustainable utilisation of benefits.
- World Summit on sustainable development held in 2002 in Johannesburg, South Africa, 190 countries pledged for significant reduction in current rate of biodiversity loss at global, regional and local levels by 2010.

## Environmental Issues

- Pollution is any undesirable change in physical, chemical or biological characteristics of air, land, water or soil.
- **Pollutants:** Agents that bring about such undesirable change
- The government of India passed the Environment (protection) Act, 1986 to protect and improve the quality of our environment.

**Air Pollution and its control**

- According to CPCB, particulate size 2.5 mm or less in diameter (PM 2.5), can be inhaled deep into the lungs causing respiratory symptoms, irritation, lungs damage and premature death.
- Electrostatic precipitator can remove 99% particulate matter present in exhaust from a thermal power plant.
- Scrubber can remove gases like $SO_2$.
- Catalytic converter with platinum, palladium and rhodium-as catalysts, are used in automobiles.
- Air (Prevention and control of pollution) Act 1981, was amended in 1987, to include noise as an air-pollutant which is any undesired high level of sound.

- Noise can cause loss of hearing, sleeplessness, increased heart beat, altered breathing pattern, thus considerably stressing humans.
- Euro III Norms stipulate sulphur at 350 ppm in diesel and 150 ppm in petrol.

**Water Pollution and its control**

- Government of India passed the water (prevention and control of pollution) Act, 1974 to safeguard our water resources.
- Amount of bidegradable organic matter in sewage is estimated by measuring the Biochemcial Oxygen Demand (BOD).
- Algal bloom, imparts colour to water bodies, deteriorates water quality and cause fish mortality.

**Table : Comparison of Biomagnification and Eutrophication**

| Biomagnification | Eutrophication |
|---|---|
| ❖ Increases in the concentration of toxicant at successive trophic levels, in the aquatic food chain, As the toxic substance is neither metabolised nor excreted, so passed on to next trophic level.<br>e.g : Mercury or DDT.<br>Water → Zooplanktons → Small fish → Fish-eating birds → Large fish<br>(0.003ppb) (0.04 ppm) (0.5 ppm) (2 ppm) (25 ppm) | ❖ Natural aging of lake by nutrient enrichment of its water, which may span thousands of years.<br>❖ Cultural of Accelerated Eutrophication: Pollutants from man's activities like effluents from industries and homes can radically accelerate the aging process. Prime contaminants are nitrates and phosphates, which act as plant nutrients. They overstimulate algal growth causing unsightly scum and unpleasant odours, robbing of dissolved oxygen in water vital to other aquatic life.<br>❖ Other pollutants flowing into a lake may poison for the whole populations of fish. The lake can literally choke to death. |

- Heated (thermal) Waste Waters from thermal power plants, eliminates or reduces the number of organisms sensitive to high temperature and may enhance the growth of plants and fish in extremely cold areas, after causing damage to indigenous flora and fauna.

**Solid Waste**

- Solid waste can be of three types i.e., municipal, electronic and hospital generated harzardous waste.
- Sanitary landfills, recycling of e-waste, use of incinerators are opted to reduce the solid waste. Radioactive Wastes
- Nuclear energy has two very serious inherent problems i.e., accidental leakage and safe disposal of radioactive waste.
- Radioactive waste after pre-treatment, should be buried within the rocks, about 500m deep below the earth surface.

**Greenhouse Effect and Global Warming**

- Greenhouse effect is a naturally occurring phenomenon responsible for heating Earth's surface and atmosphere.
- Greenhouse gases absorb long wave (infrared) radiation from earth and emit it again towards the earth.
- Relative contribution of various greenhouse gases to total global warming is $CO_2$ (60%); $CH_4$ (20%); CFCs (14%) and $N_2O$ (6%).

**OZONE DEPLETION IN THE STRATOSPHERE**

**Table 2: Types of Ozone**

| Good Ozone | Bad Ozone |
|---|---|
| Found in upper atmosphere, the stratosphere acts as a shield absorbing UV radiation from sun. | Found in lower atmosphere, the troposphere that harms plants and animals. |

- Chlorofluoro Carbons (CFCs) used as refrigerants degrade ozone layer, by releasing Cl atom.
- Thickness of the ozone in a column of air from the ground to the top of the atmosphere is measured in terms of dobson units (DU).
- UV-B-damages DNA, causes aging of skin, inflammation of cornea called snow blindness (cataract) etc.
- Montreal protocol was signed in 1987 (effective in 1989) for control of emission of ODS, i.e., CFCs.
- Ozone hole over Antarctica develops each year between late August and early October.

**Degradation by Improper Resource Utlisation and Maintenance**

**Soil Erosion and Desertification**

- Development of top soil takes centuries.
- Over-cultivation, unrestricted grazing, deforestation and poor irrigation degrades it making arid patches of land.
- Large barren patches meet to form desert.
- Desertification has become a major problem due to increased urbanisation.

**Water Logging and Soil Salinity**

- Irrigation without drainage results in water logging.
- Water logging draws salt on surface of soil, depositing in a thin crust or collects at the roots, affecting growth.
- Water logging and salinity are a result of Green Revolution.

**Deforestation**

- 40% forests have been lost in tropics compared to only 1% in temperate region.
- National forest policy (1968) of India re-commended 33% forest for plains and 67% for hills.
- Slash and burn agriculture (Jhum cultivation) in North-East of India contributes to deforestation.
- Enhanced $CO_2$ concentration, loss of biodiversity, disturbed hydrologic cycle, soil erosion and desertification are the consequences of deforestation