IMPORTANT CHAPTERS FOR

ENVIRONMENT FROM NCERT BIOLOGY

CLASS XII **(CHAPTER 13, 14, 15 & 16)**

CHAPTER-13-ORGANISMS AND POPULATION

Major Abiotic Factors

Temperature:

- the most ecologically relevant environmental factor.
- the average temperature on land varies seasonally, decreases progressively from the equator towards the poles and from plains to the mountain tops.
- ranges from subzero levels in polar areas and high altitudes to >50 degree C in tropical deserts in summer.
- unique habitats such as thermal springs and deep-sea hydrothermal vents where average temperatures exceed 100 degree C.
- mango trees do not and cannot grow in temperate countries like Canada and Germany, snow leopards are not found in Kerala forests and tuna fish are rarely caught beyond tropical.
- A few organisms can tolerate and thrive in a wide range of temperatures (they are called eurythermal), but, a vast majority of them are restricted to a narrow range of temperatures (such organisms are called stenothermal).
- Some organisms are tolerant of a wide range of salinities (euryhaline) but others are restricted to a narrow range (stenohaline).
- Many freshwater animals cannot live for long in sea water and vice versa because of the osmotic problems, they would face.
- For aquatic organisms the quality (chemical composition, pH) of water becomes important.
- The salt concentration (measured as salinity in parts per thousand), is less than 5 per cent in inland waters, 30-35 per cent the sea and > 100 per cent in some hypersaline lagoons.

Responses to Abiotic Factors

- Some organisms are able to maintain homeostasis by physiological (sometimes behavioural also) means which ensures constant body temperature, constant osmotic concentration, etc.
- All birds and mammals, and a very few lower vertebrate and invertebrate species are indeed capable of such regulation (thermoregulation and osmoregulation).
- Evolutionary biologists believe that the ‘success’ of mammals is largely due to their ability to maintain a constant body temperature and thrive whether they live in Antarctica or in the Sahara desert.
- An overwhelming majority (99 per cent) of animals and nearly all plants cannot maintain a constant internal environment. Their body temperature changes with the ambient temperature.
- In aquatic animals, the osmotic concentration of the body fluids changes with that of the ambient water osmotic concentration. These animals and plants are simply conformers.
- Thermoregulation is energetically expensive for many organisms.
- This is particularly true for small animals like shrews and humming birds.
- Heat loss or heat gain is a function of surface area.
- Since small animals have a larger surface area relative to their volume, they tend to lose body heat very fast when it is cold outside; then they have to expend much energy to generate body heat through metabolism. This is the main reason why very small animals are rarely found in polar regions.
- During the course of evolution, the costs and benefits of maintaining a constant internal environment are taken into consideration.
- Some species have evolved the ability to regulate, but only over a limited range of environmental conditions, beyond which they simply conform.

- If the stressful external conditions are localized or remain only for a short duration, the organism has two other alternatives.
- Keolado National Park (Bhartpur) in Rajasthan host thousands of migratory birds coming from Siberia and other extremely cold northern regions.
- In animals, the organism, if unable to migrate, might avoid the stress by escaping in time.
- The familiar case of bears going into hibernation during winter is an example of escape in time.
- Some snails and fish go into aestivation to avoid summer–related problems-heat and desiccation.
- Under unfavorable conditions many zooplankton species in lakes and ponds are known to enter diapause, a stage of suspended development.

Adaptations

- Adaptation is any attribute of the organism (morphological, physiological, behavioral) that enables the organism to survive and reproduce in its habitat.
- Many desert plants have a thick cuticle on their leaf surfaces and have their stomata arranged in deep pits to minimize water loss through transpiration.
- They also have a special photosynthetic pathway (CAM) that enables their stomata to remain closed during day time.
- Some desert plants like Opuntia, have no leaves – they are reduced to spines–and the photosynthetic function is taken over by the flattened stems.
- Mammals from colder climates generally have shorter ears and limbs to minimise heat loss. (This is called the Allen's Rule.)
- In the polar seas aquatic mammals like seals have a thick layer of fat (blubber) below their skin that acts as an insulator and reduces loss of body heat.
- Some organisms possess adaptations that are physiological which allow them to respond quickly to a stressful situation.
- altitude sickness symptoms include nausea, fatigue and heart palpitations.
- This is because in the low atmospheric pressure of high altitudes, the body does not get enough oxygen.
- But, gradually you get acclimatised and stop experiencing altitude sickness.
- Body Solution-The body compensates low oxygen availability by increasing red blood cell production, decreasing the binding capacity of hemoglobin and by increasing breathing rate.
- Many tribes live in the high altitude of Himalayas.
- In most animals, the metabolic reactions and hence all the physiological functions proceed optimally in a narrow temperature range (in humans, it is – 37 degree C).
- microbes (archaebacteria) that flourish in hot springs and deep sea hydrothermal vents where temperatures far exceed 100 degree C.
- Desert lizards lack the physiological ability that mammals have to deal with the high temperatures of their habitat, but manage to keep their body temperature fairly constant by behavioural means.
- They bask in the sun and absorb heat when their body temperature drops below the comfort zone, but move into shade when the ambient temperature starts increasing.
- Some species are capable of burrowing into the soil to hide and escape from the above-ground heat.
- The tiger census in our national parks and tiger reserves is often based on pug marks and fecal pellets.

Population Growth

(i) Natality refers to the number of births during a given period in the population that are added to the initial density.
(ii) Mortalityis the number of deaths in the population during a given period.
(iii) Immigration is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration.
(iv) Emigrationis the number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.

- the 'intrinsic rate of natural increase' is a very important parameter chosen for assessing impacts of any biotic or abiotic factor on population growth.
- Populations evolve to maximise their reproductive fitness, also called Darwinian fitness (high r value), in the habitat in which they live.
- Some organisms breed only once in their lifetime (Pacific salmon fish, bamboo) while others breed many times during their lifetime (most birds and mammals).
- Some produce a large number of small-sized offspring (Oysters, pelagic fishes) while others produce a small number of large-sized offspring (birds, mammals).

Population Interaction

- Interspecific interactions arise from the interaction of populations of two different species.
- They could be beneficial, detrimental or neutral (neither harm nor benefit) to one of the species or both.
- Both the species benefit in mutualism and both lose in competition in their interactions with each other.
- In both parasitism and Predation only one species benefits (parasite and predator, respectively) and the interaction is detrimental to the other species (host and prey, respectively).
- The interaction where one species is benefitted and the other is neither benefitted nor harmed is called commensalism.
- In amensalism on the other hand one species is harmed whereas the other is unaffected.
- Predation, parasitism and commensalisms share a common characteristic– the interacting species live closely together.
- Besides acting as 'conduits' for energy transfer across trophic levels, predators play other important roles. They keep prey populations under control.
- But for predators, prey species could achieve very high population densities and cause ecosystem instability. When certain exotic species are introduced into a geographical area, they become invasive and start spreading fast because the invaded land does not have its natural predators.
- The prickly pear cactus introduced into Australia in the early 1920's caused havoc by spreading rapidly into millions of hectares of rangeland.
- cactus was brought under control only after a cactus-feeding predator (a moth) from its natural habitat was introduced into the country.
- Biological control methods adopted in agricultural pest control are based on the ability of the predator to regulate prey population.
- Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species.
- In the rocky intertidal communities of the American Pacific Coast the starfish Pisaster is an important predator.
- In a field experiment, when all the starfish were removed from an enclosed intertidal area, more than 10 species of invertebrates became extinct within a year, because of interspecific competition.
- If a predator is too efficient and overexploits its prey, then the prey might become extinct and following it, the predator will also become extinct for lack of food. This is the reason why predators in nature are 'prudent'.
- Prey species have evolved various defenses to lessen the impact of predation.

- Some species of insects and frogs are cryptically-coloured (camouflaged) to avoid being detected easily by the predator.
- Some are poisonous and therefore avoided by the predators.
- The Monarch butterfly is highly distasteful to its predator (bird) because of a special chemical present in its body.
- Interestingly, the butterfly acquires this chemical during its caterpillar stage by feeding on a poisonous weed.
- For plants, herbivores are the predators.
- Nearly 25 per cent of all insects are known to be phytophagous (feeding on plant sap and other parts of plants).
- Thorns (Acacia, Cactus) are the most common morphological means of defence.
- In general, herbivores and plants appear to be more adversely affected by competition than carnivores.
- The life cycles of parasites are often complex, involving one or two intermediate hosts or vectors to facilitate parasitisation of its primary host.
- The human liver fluke (a trematode parasite) depends on two intermediate hosts (a snail and a fish) to complete its life cycle.
- Parasites that feed on the external surface of the host organism are called ectoparasites.
- The most familiar examples of this group are the lice on humans and ticks on dogs.
- Many marine fish are infested with ectoparasitic copepods.
- Cuscuta, a parasitic plant that is commonly found growing on hedge plants, has lost its chlorophyll and leaves in the course of evolution.
- It derives its nutrition from the host plant which it parasitises.
- The female mosquito is not considered a parasite, although it needs our blood for reproduction.
- In contrast, endoparasitesare those that live inside the host body at different sites (liver, kidney, lungs, red blood cells, etc.).
- The life cycles of endoparasites are more complex because of their extreme specialisation.
- Their morphological and anatomical features are greatly simplified while emphasising their reproductive potential.
- Brood parasitismin birds is a fascinating example of parasitism in which the parasitic bird lays its eggs in the nest of its host and lets the host incubate them.
- During the course of evolution, the eggs of the parasitic bird have evolved to resemble the host’s egg in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest.
- Try to follow the movements of the cuckoo (koel) and the crow in your neighborhood park during the breeding season (spring to summer) and watch brood parasitism in action.
- Commensalism: This is the interaction in which one species benefits and the other is neither harmed nor benefited. An orchid growing as an epiphyteon a mango branch, and barnacles growing on the back of a whale benefit while neither the mango tree nor the whale derives any apparent benefit.
- Mutualism: This interaction confers benefits on both the interacting species.
- Lichens represent an intimate mutualistic relationship between a fungus and photosynthesising algae or cyanobacteria.
- Similarly, the mycorrhizaeare associations between fungi and the roots of higher plants.
- The fungi help the plant in the absorption of essential nutrients from the soil while the plant in turn provides the fungi with energy-yielding carbohydrates.
- Orchids show a bewildering diversity of floral patterns many of which have evolved to attract the right pollinator insect (bees and bumblebees) and ensure guaranteed pollination by it.
- Not all orchids offer rewards.

- The Mediterranean orchid Ophrys employs ‘sexual deceit’ to get pollination done by a species of bee.
- One petal of its flower bears an uncanny resemblance to the female of the bee in size, colour and markings.
- The male bee is attracted to what it perceives as a female, ‘pseudocopulates’ with the flower, and during that process is dusted with pollen from the flower.
- When this same bee ‘pseudocopulates’ with another flower, it transfers pollen to it and thus, pollinates the flower.
- If the female bee’s colour patterns change even slightly for any reason during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.

CHAPTER-14-ECOSYSTEM

Terrestrial and the aquatic.

- Forest, grassland and desert are some examples of terrestrial ecosystems; pond, lake, wetland, river and estuary are some examples of aquatic ecosystems.
- Crop fields and an aquarium may also be considered as man-made ecosystems.
- Vertical distribution of different species occupying different levels is called stratification. For example, trees occupy top vertical strata or layer of a forest, shrubs the second and herbs and grasses occupy the bottom layers.

The components of the ecosystem are seen to function as a unit when you consider the following aspects:

(i) Productivity;
(ii) Decomposition;
(iii) Energy flow; and
(iv) Nutrient cycling.

- The abiotic component is the water with all the dissolved inorganic and organic substances and the rich soil deposit at the bottom of the pond.
- The solar input, the cycle of temperature, day-length and other climatic conditions regulate the rate of function of the entire pond.
- The autotrophic components include the phytoplankton, some algae and the floating, submerged and marginal plants found at the edges.
- The consumers are represented by the zooplankton, the free swimming and bottom dwelling forms.
- The decomposers are the fungi, bacteria and flagellates especially abundant in the bottom of the pond.
- This system performs all the functions of any ecosystem and of the biosphere as a whole, i.e., conversion of inorganic into organic material with the help of the radiant energy of the sun by the autotrophs; consumption of the autotrophs by heterotrophs; decomposition and mineralisation of the dead matter to release them back for reuse by the autotrophs, these event are repeated over and over again.
- There is unidirectional movement of energy towards the higher trophic levels and its dissipation and loss as heat to the environment.
- Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.
- The rate of biomass production is called productivity.
- It can be divided into gross primary productivity (GPP) and net primary productivity (NPP).
- Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis.
- A considerable amount of GPP is utilised by plants in respiration.
- Gross primary productivity minus respiration losses (R), is the net primary productivity (NPP).

- Net primary productivity is the available biomass for the consumption to heterotrophs (herbiviores and decomposers).
- Secondary productivity is defined as the rate of formation of new organic matter by consumers.
- Primary productivity depends on the plant species inhabiting a particular area.
- It also depends on a variety of environmental factors, availability of nutrients and photosynthetic capacity of plants.
- The annual net primary productivity of the whole biosphere is approximately 170 billion tons (dry weight) of organic matter.
- Of this, despite occupying about 70 per cent of the surface, the productivity of the oceans are only 55 billion tons.
- Rest of course, is on land. decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition.
- Dead plant remains such as leaves, bark, flowers and dead remains of animals, including fecal matter, constitute detritus, which is the raw material for decomposition.
- The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralisation.
- Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation.
- By the process of leaching, water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
- Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism.
- Humification and mineralisation occur during decomposition in the soil.
- Humification leads to accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate.
- Being colloidal in nature it serves as a reservoir of nutrients.
- The humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as mineralisation.
- Decomposition is largely an oxygen-requiring process.
- The rate of decomposition is controlled by chemical composition of detritus and climatic factors.
- In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.
- Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes.
- Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build up of organic materials.
- The detritus food chain (DFC) begins with dead organic matter.
- It is made up of decomposers which are heterotrophic organisms, mainly fungi and bacteria.
- They meet their energy and nutrient requirements by degrading dead organic matter or detritus.
- These are also known as Saprotrophs (sapro:to decompose).
- Decomposers secrete digestive enzymes that breakdown dead and waste materials into simple, inorganic materials, which are subsequently absorbed by them. In an aquatic ecosystem, GFC is the major conduit for energy flow.
- As against this, in a terrestrial ecosystem, a much larger fraction of energy flows through the detritus food chain than through the GRAZING FOOD CHAIN.

- Detritus food chain may be connected with the grazing food chain at some levels: some of the organisms of DFC are prey to the GFC animals, and in a natural ecosystem, some animals like cockroaches, crows, etc., are omnivores.
- These natural interconnection of food chains make it a food web.
- The consumers that feed on these herbivores are carnivores, or more correctly primary carnivores (though secondary consumers).
- Those animals that depend on the primary carnivores for food are labeled secondary carnivores.
- Organisms occupy a place in the natural surroundings or in a community according to their feeding relationship with other organisms.
- Based on the source of their nutrition or food, organisms occupy a specific place in the food chain that is known as their trophic level.
- Producers belong to the first trophic level, herbivores (primary consumer) to the second and carnivores (secondary consumer) to the third
- the amount of energy decreases at successive trophic levels.
- When any organism dies it is converted to detritus or dead biomass that serves as an energy source for decomposers.
- Organisms at each trophic level depend on those at the lower trophic level for their energy demands.
- Each trophic level has a certain mass of living material at a particular time called as the standing crop.
- The standing crop is measured as the mass of living organisms (biomass) or the number in a unit area.
- The biomass of a species is expressed in terms of fresh or dry weight.
- Measurement of biomass in terms of dry weight is more accurate.
- Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step.
- Each bar in the energy pyramid indicates the amount of energy present at each trophic level in a given time or annually per unit area.
- An important characteristic of all communities is that composition and structure constantly change in response to the changing environmental conditions.
- This change is orderly and sequential, parallel with the changes in the physical environment.
- These changes lead finally to a community that is in near equilibrium with the environment and that is called a climax community.
- The gradual and fairly predictable change in the species composition of a given area is called ecological succession.
- During succession some species colonise an area and their populations become more numerous, whereas populations of other species decline and even disappear.
- The entire sequence of communities that successively change in a given area are called sere(s).
- The individual transitional communities are termed seral stages or seral communities.
- In the successive seral stages there is a change in the diversity of species of organisms, increase in the number of species and organisms as well as an increase in the total biomass.
- Succession is hence a process that starts where no living organisms are there – these could be areas where no living organisms ever existed, say bare rock; or in areas that somehow, lost all the living organisms that existed there.
- The former is called primary succession, while the latter is termed secondary succession.
- Examples of areas where primary succession occurs are newly cooled lava, bare rock, newly created pond or reservoir.
- The establishment of a new biotic community is generally slow.

- Before a biotic community of diverse organisms can become established, there must be soil.
- Depending mostly on the climate, it takes natural processes several hundred to several thousand years to produce fertile soil on bare rock.
- Secondary succession begins in areas where natural biotic communities have been destroyed such as in abandoned farm lands, burned or cut forests, lands that have been flooded.
- Since some soil or sediment is present, succession is faster than primary succession.
- Based on the nature of the habitat – whether it is water (or very wet areas) or it is on very dry areas – succession of plants is called hydrach or xerarch, respectively.
- Hydrarch succession takes place in wetter areas and the successional series progress from hydric to the mesic conditions.
- As against this, xerarch successiontakes place in dry areas and the series progress from xeric to mesic conditions. Hence, both hydrarch and xerach successions lead to medium water conditions (mesic) – neither too dry (xeric) nor too wet (hydric).
- The species that invade a bare area are called pioneer species.
- In primary succession on rocks these are usually lichens which are able to secrete acids to dissolve rock, helping in weathering and soil formation.
- These later pave way to some very small plants like bryophytes, which are able to take hold in the small amount of soil.
- They are, with time, succeeded by bigger plants, and after several more stages, ultimately a stable climax forest community is formed.
- The climax community remains stable as long as the environment remains unchanged.
- With time the xerophytic habitat gets converted into a mesophytic one. succession, particularly primary succession, is a very slow process, taking maybe thousands of years for the climax to be reached.
- Another important fact is to understand that all succession whether taking place in water or on land, proceeds to a similar climax community – the mesic.
- The movement of nutrient elements through the various components of an ecosystem is called nutrient cycling.
- Another name of nutrient cycling is biogeochemical cycles (bio: living organism, geo: rocks, air, water).
- Nutrient cycles are of two types: (a) gaseous and (b) sedimentary.

Phosphorus Cycle

- Phosphorus is a major constituent of biological membranes, nucleic acids and cellular energy transfer systems.
- Many animals also need large quantities of this element to make shells, bones and teeth.
- The natural reservoir of phosphorus is rock, which contains phosphorus in the form of phosphates.
- When rocks are weathered, minute amounts of these phosphates dissolve in soil solution and are absorbed by the roots of the plants.
- Herbivores and other animals obtain this element from plants.
- The waste products and the dead organisms are decomposed by phosphate-solubilizing bacteria releasing phosphorus.
- Unlike carbon cycle, there is no respiratory release of phosphorus into atmosphere.
- The other two major and important differences between carbon and phosphorus cycle are firstly, atmospheric inputs of phosphorus through rainfall are much smaller than carbon inputs, and, secondly, gaseous exchanges of phosphorus between organism and environment are negligible.
- Healthy ecosystems are the base for a wide range of economic, environmental and aesthetic goods and services. The products of ecosystem processes are named as ecosystem services, for example, healthy forest ecosystems

purify air and water, mitigate droughts and floods, cycle nutrients, generate fertile soils, provide wildlife habitat, maintain biodiversity, pollinate crops, provide storage site for carbon and also provide aesthetic, cultural and spiritual values.

CHAPTER-15-BIODIVERSITY AND CONSERVATION

- In our biosphere immense diversity (or heterogeneity) exists not only at the species level but at all levels of biological organisation ranging from macromolecules within cells to biomes.
- Biodiversity is the term popularized by the sociobiologist Edward Wilson to describe the combined diversity at all the levels of biological organisation.

The most important of them are–

(i) **Genetic diversity**:

- A single species might show high diversity at the genetic level over its distributional range.
- The genetic variation shown by the medicinal plant Rauwolfia vomitoria growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (reserpine) that the plant produces. India has more than 50,000 genetically different strains of rice, and 1,000 varieties of mango.

(ii) **Species diversity**:

- The diversity at the species level. For example, the Western Ghats have a greater amphibian species diversity than the Eastern Ghats.

(iii) **Ecological diversity**:

- At the ecosystem level, India, for instance, with its deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows has a greater ecosystem diversity than a Scandinavian country like Norway.

Causes of biodiversity losses:

(i) Habitat loss and fragmentation:
(ii) Over-exploitation:
(iii) Alien species invasions:
(iv) Co-extinctions:

- When we conserve and protect the whole ecosystem, its biodiversity at all levels is protected - we save the entire forest to save the tiger.
- This approach is called in situ(on site) conservation.
- However, when there are situations where an animal or plant is endangered or threatened and needs urgent measures to save it from extinction, ex situ (off site) conservation is the desirable approach.

In situ conservation–

- Faced with the conflict between development and conservation, many nations find it unrealistic and conomically not feasible to conserve all their biological wealth.
- Invariably, the number of species waiting to be saved from extinction far exceeds the conservation resources available.
- On a global basis, this problem has been addressed by eminent conservationists.

- They identified for maximum protection certain ‘biodiversity hotspots’ regions with very high levels of species richness and high degree of endemism (that is, species confined to that region and not found anywhere else).
- Initially 25 biodiversity hotspots were identified but subsequently nine more have been added to the list, bringing the total number of biodiversity hotspots in the world to 34.
- These hotspots are also regions of accelerated habitat loss.
- Three of these hotspots – Western Ghats and Sri Lanka, Indo-Burma and Himalaya – cover our country’s exceptionally high biodiversity regions.
- Although all the biodiversity hotspots put together cover less than 2 percent of the earth’s land area, the number of species they collectively harbour is extremely high and strict protection of these hotspots could reduce the ongoing mass extinctions by almost 30 per cent.
- In India, ecologically unique and biodiversity-rich regions are legally protected as biosphere reserves, national parks and sanctuaries.
- India now has 14 biosphere reserves, 90 national parks and 448 wildlife sanctuaries.
- India has also a history of religious and cultural traditions that emphasised protection of nature.
- In many cultures, tracts of forest were set aside, and all the trees and wildlife within were venerated and given total protection. Such sacred grovesare found in Khasi and Jaintia Hills in Meghalaya, Aravalli Hills of Rajasthan, Western Ghat regions of Karnataka and Maharashtra and the Sarguja, Chanda and Bastar areas of Madhya Pradesh.
- In Meghalaya, the sacred groves are the last refuges for a large number of rare and threatened plants.

Ex situ Conservation–

- In this approach, threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care.
- Zoological parks, botanical gardens and wildlife safari parks serve this purpose.
- There are many animals that have become extinct in the wild but continue to be maintained in zoological parks.
- In recent years ex situ conservation has advanced beyond keeping threatened species in enclosures.
- Now gametes of threatened species can be preserved in viable and fertile condition for long periods using cryopreservation techniques, eggs can be fertilized in vitro, and 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.
- Biodiversity knows no political boundaries and its conservation is therefore a collective responsibility of all nations.
- The historic Convention on Biological Diversity (‘The Earth Summit’) held in Rio de Janeiro in 1992, called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.
- In a follow-up, the World Summit on Sustainable Development held in 2002 in Johannesburg, South Africa, 190 countries pledged their commitment to achieve by 2010, a significant reduction in the current rate of biodiversity loss at global, regional and local levels.

CHAPTER-16-ENVIRONMENTAL ISSUES

- Pollution is any undesirable change in physical, chemical or biological characteristics of air, land, water or soil. Agents that bring about such an undesirable change are called as pollutants.
- In order to control environmental pollution, the Government of India has passed the Environment (Protection) Act, 1986 to protect and improve the quality of our environment (air, water and soil).

- There are several ways of removing particulate matter; the most widely used of which is the electrostatic precipitator, which can remove over 99 per cent particulate matter present in the exhaust from a thermal power plant.
- It has electrode wires that are maintained at several thousand volts, which produce a corona that releases electrons.
- These electrons attach to dust particles giving them a net negative charge.
- The collecting plates are grounded and attract the charged dust particles.
- The velocity of air between the plates must be low enough to allow the dust to fall.
- A scrubber can remove gases like sulphur dioxide.
- In a scrubber, the exhaust is passed through a spray of water or lime.
- Recently we have realised the dangers of particulate matter that are very very small and are not removed by these precipitators.
- According to Central Pollution Control Board (CPCB), particulate size 2.5 micrometers or less in diameter (PM 2.5) are responsible for causing the greatest harm to human health.
- These fine particulates can be inhaled deep into the lungs and can cause breathing and respiratory symptoms, irritation, inflammations and damage to the lungs and premature deaths.
- Automobiles are a major cause for atmospheric pollution atleast in the metro cities.
- Proper maintenance of automobiles along with use of lead-free petrol or diesel can reduce the pollutants they emit.
- Catalytic converters, having expensive metals namely platinum-palladium and rhodium as the catalysts, are fitted into automobiles for reducing emission of poisonous gases.
- As the exhaust passes through the catalytic converter, unburnt hydrocarbons are converted into carbon dioxide and water, and carbon monoxide and nitric oxide are changed to carbon dioxide and nitrogen gas, respectively.
- Motor vehicles equipped with catalytic converter should use unleaded petrol because lead in the petrol inactivates the catalyst.
- In India, the Air (Prevention and Control of Pollution) Act came into force in 1981, but was amended in 1987 to include noise as an air pollutant. Noise is undesired high level of sound.
- A brief exposure to extremely high sound level, 150 dB or more generated by take off of a jet plane or rocket, may damage ear drums thus permanently impairing hearing ability.
- Even chronic exposure to a relatively lower noise level of cities may permanently damage hearing abilities of humans.
- Noise also causes sleeplessness, increased heart beating, altered breathing pattern, thus considerably stressing humans.
- the Government of India has passed the Water (Prevention and Control of Pollution) Act, 1974to safeguard our water resources.
- Domestic sewage primarily contains biodegradable organic matter, which readily decomposes – thanks to bacteria and other micro-organisms, which can multiply using these organic substances as substrates and hence utilise some of the components of sewage.
- It is possible to estimate the amount of organic matter in sewage water by measuring Biochemical Oxygen Demand (BOD). Micro-organisms involved in biodegradation of organic matter in the receiving water body consume a lot of oxygen, and as a result there is a sharp decline in dissolved oxygen downstream from the point of sewage discharge.
- This causes mortality of fish and other aquatic creatures.
- Presence of large amounts of nutrients in waters also causes excessive growth of planktonic (free-floating) algae, called an algal bloom which imparts a distinct colour to the water bodies.

- Algal blooms cause deterioration of the water quality and fish mortality. Some bloom-forming algae are extremely toxic to human beings and animals.
- They grow faster than our ability to remove them.
- These are plants of water hyacinth (Eichhornia crassipes), the world's most problematic aquatic weed, also called 'Terror of Bengal'.
- They grow abundantly in eutrophic water bodies, and lead to an imbalance in the ecosystem dynamics of the water body.
- A few toxic substances, often present in industrial waste waters, can undergo biological magnification (Biomagnification) in the aquatic food chain.
- Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.
- This happens because a toxic substance accumulated by an organism cannot be metabolised or excreted, and is thus passed on to the next higher trophic level.
- This phenomenon is well-known for mercury and DDT.
- Biomagnification of DDT in an aquatic food chain.
- the concentration of DDT is increased at successive trophic levels; say if it starts at 0.003 ppb (ppb = parts per billion) in water, it can ultimately can reach 25 ppm (ppm = parts per million) in fish-eating birds, through biomagnification.
- High concentrations of DDT disturb calcium metabolism in birds, which causes thinning of eggshell and their premature breaking, eventually causing decline in bird populations.
- Eutrophication is the natural aging of a lake by biological enrichment of its water.
- In a young lake the water is cold and clear, supporting little life.
- With time, streams draining into the lake introduce nutrients such as nitrogen and phosphorus, which encourage the growth of aquatic organisms.
- As the lake's fertility increases, plant and animal life burgeons, and organic remains begin to be deposited on the lake bottom.
- Over the centuries, as silt and organic debris pile up, the lake grows shallower and warmer, with warm-water organisms supplanting those that thrive in a cold environment.
- Marsh plants take root in the shallows and begin to fill in the original lake basin. Eventually, the lake gives way to large masses of floating plants (bog), finally converting into land.
- Depending on climate, size of the lake and other factors, the natural aging of a lake may span thousands of years.
- However, pollutants from man's activities like effluents from the industries and homes can radically accelerate the aging process. This phenomenon has been called Cultural or Accelerated Eutrophication.
- lakes in many parts of the earth have been severely eutrophied by sewage and agricultural and industrial wastes.
- The prime contaminants are nitrates and phosphates, which act as plant nutrients.
- They overstimulate the growth of algae, causing unsightly scum and unpleasant odors, and robbing the water of dissolved oxygen vital to other aquatic life.
- At the same time, other pollutants flowing into a lake may poison whole populations of fish, whose decomposing remains further deplete the water's dissolved oxygen content.
- In such fashion, a lake can literally choke to death. Irreparable computers and other electronic goods are known as electronic wastes (e-wastes).
- E-wastes are buried in landfills or incinerated.
- Over half of the e-wastes generated in the developed world are exported to developing countries, mainly to China, India and Pakistan, where metals like copper, iron, silicon, nickel and gold are recovered during recycling process.

- Unlike developed countries, which have specifically built facilities for recycling of e-wastes, recycling in developing countries often involves manual participation thus exposing workers to toxic substances present in e-wastes.
- Eventually recycling is the only solution for the treatment of e-wastes provided it is carried out in an environment-friendly manner.
- The greenhouse effect is a naturally occurring phenomenon that is responsible for heating of Earth's surface and atmosphere.
- Clouds and gases reflect about one-fourth of the incoming solar radiation, and absorb some of it but almost half of incoming solar radiation falls on Earth's surface heating it, while a small proportion is reflected back.
- Earth's surface re-emits heat in the form of infrared radiation but part of this does not escape into space as atmospheric gases (e.g., carbon dioxide, methane, etc.) absorb a major fraction of it.
- The molecules of these gases radiate heat energy, and a major part of which again comes to Earth's surface, thus heating it up once again.
- The above-mentioned gases – carbon dioxide and methane – are commonly known as greenhouse gases because they are responsible for the greenhouse effect. 'bad' ozone, formed in the lower atmosphere (troposphere) that harms plants and animals.
- There is 'good' ozone also; this ozone is found in the upper part of the atmosphere called the stratosphere, and it acts as a shield absorbing ultraviolet radiation from the sun.
- UV rays are highly injurious to living organisms since DNA and proteins of living organisms preferentially absorb UV rays, and its high energy breaks the chemical bonds within these molecules.
- The 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).
- Ozone hole is the area above Antarctica, shown in purple colour, where the ozone layer is the thinnest.
- Ozone thickness is given in Dobson unit (see carefully the scale shown in colour violet to red).
- The ozone hole over Antarctica develops each year between late August and early October.
- Ozone gas is continuously formed by the action of UV rays on molecular oxygen, and also degraded into molecular oxygen in the stratosphere.
- There should be a balance between production and degradation of ozone in the stratosphere.
- Of late, the balance has been disrupted due to enhancement of ozone degradation by chlorofluorocarbons (CFCs).
- CFCs find wide use as refrigerants.
- CFCs discharged in the lower part of atmosphere move upward and reach stratosphere. In stratosphere, UV rays act on them releasing Cl atoms.
- Cl degrades ozone releasing molecular oxygen, with these atoms acting merely as catalysts; Cl atoms are not consumed in the reaction.
- whatever CFCs are added to the stratosphere, they have permanent and continuing affects on Ozone levels.
- Although ozone depletion is occurring widely in the stratosphere, the depletion is particularly marked over the Antarctic region has resulted in formation of a large area of thinned ozone layer, commonly called as the ozone hole.
- UV radiation of wavelengths shorter than UV-B, are almost completely absorbed by Earth's atmosphere, given that the ozone layer is intact. But, UV-B damages DNA and mutation may occur.
- It causes aging of skin, damage to skin cells and various types of skin cancers.
- In human eye, cornea absorbs UV-B radiation, and a high dose of UV-B causes inflammation of cornea, called snow-blindness cataract, etc.

- Such exposure may permanently damage the cornea. Recognising the deleterious affects of ozone depletion, an international treaty, known as the Montreal Protocol, was signed at Montreal (Canada) in 1987 (effective in 1989) to control the emission of ozone depleting substances.
- Subsequently many more efforts have been made and protocols have laid down definite roadmaps, separately for developed and developing countries, for reducing the emission of CFCs and other ozone depleting chemicals. Soil erosion and desertification:
- The development of the fertile top-soil takes centuries.
- But, it can be removed very easily due to human activities like over-cultivation, unrestricted grazing, deforestation and poor irrigation practices, resulting in arid patches of land.
- When large barren patches extend and meet over time, a desert is created.
- Internationally, it has been recognised that desertification is a major problem nowadays, particularly due to increased urbanisation.
- Waterlogging and soil salinity: Irrigation without proper drainage of water leads to waterlogging in the soil.
- Besides affecting the crops, waterlogging draws salt to the surface of the soil.
- The salt then is deposited as a thin crust on the land surface or starts collecting at the roots of the plants. This increased salt content is inimical to the growth of crops and is extremely damaging to agriculture.
- Waterlogging and soil salinity are some of the problems that have come in the wake of the Green Revolution.
- Slash and burn agriculture, commonly called as Jhum cultivationin the north-eastern states of India, has also contributed to deforestation.
- In slash and burn agriculture, the farmers cut down the trees of the forest and burn the plant remains.
- The ash is used as a fertiliser and the land is then used for farming or cattle grazing.
- After cultivation, the area is left for several years so as to allow its recovery.
- The farmers then move on to other areas and repeat this process.
- In earlier days, when Jhum cultivation was in prevalence, enough time-gap was given such that the land recovered from the effect of cultivation.
- With increasing population, and repeated cultivation, this recovery phase is done away with, resulting in deforestation.
- Realising the significance of participation by local communities, the Government of India in 1980s has introduced the concept of Joint Forest Management (JFM) so as to work closely with the local communities for protecting and managing forests.
- In return for their services to the forest, the communities get benefit of various forest products (e.g., fruits, gum, rubber, medicine, etc.), and thus the forest can be conserved in a sustainable manner.