ENVIRONMENT & ECOLOGY

LIFE SCIENCE PART- 2		
Environment & Ecology		
12th std -Botany	Unit - 6	Principles of Ecology
	Unit - 7	Ecosytem
	Unit - 8	Environmental Issues
12th std -Zoology	Unit - 11	Organisms and Population
	Unit - 12	Biodiversity and its conservation
	Unit - 13	Environmental Issues
10TH Std	Unit - 22	Environimental Management
9 th Std	Unit - 24	Environmental Science
8th Std	Unit - 8	Conservation Of Plants And Animals

ENVIRONMENT & ECOLOGY

12th std –Botany
Unit – 6- Principles of Ecology

Ecological hierarchy

The interaction of organisms with their environment results in the establishment of grouping of organisms which is called ecological hierarchy or ecological levels of organization. The basic unit of ecological hierarchy is an individual organism. The different hierarchy of ecological systems is illustrated below:

- Biospher
- Biome
- Landscape
- Ecosystem
- Community
- Population
- Individual Organism

Branches of Ecology:

Ecology is mainly divided into two branches, they are autecology and synecology.

1. Autecology is the ecology of an individualspecies and is also called species ecology.
2. Synecology is the ecology of a population orcommunity with one or more species and alsocalled as community ecology.

Many advances and developments in the fieldecology resulted in various new dimensionsand branches. Some of the advanced fields areMolecular ecology, Eco technology, Statisticalecology and Environmental toxicology.

Habitat and Niche

The differences between habitat and niche are as follows.

	HABITAT	NICHE
1.	A Specific physical space occupied by an organism (species)	A functional space occupied by an organism in the same eco-system
2.	Same habitat may be shared by many organisms (species)	A single niche is occupied by a single species
3.	Habitat specificity is exhibited by organism.	Organisms may. change their niche with time and season.

Ecological factors

Many organisms, co-exist in an environment. The environment (surrounding) includes physical, chemical and biological components. When a component surrounding an organism affects the life of an organism, it becomes a factor. All such factors together are called environmental factors or ecological factors. These factors can be classified into living (biotic) and non-living (abiotic) which make the environment of an organism. However the ecological factors are meaningfully grouped into four classes, which are as follows:

i. Climatic factors
ii. Edaphic factors
iii. Topographic factors
iv. Biotic factors

Climatic Factors

Climate is one of the important natural factors controlling the plant life. The climatic factors includes light, temperature, water, wind and fire.

a. Light

Light is a well known factor needed for the basic physiological processes of plants, such as photosynthesis, transpiration, seed germination and flowering. The portion of the sunlight which can be resolved by the human eye is called visible light. The visible part of light is made-up of wavelength from about 400 nm (violet) to 700 nm (red). The rate of photosynthesis is maximum at blue (400 – 500 nm) and red (600 – 700 nm). The green (500 – 600 nm) wave length of spectrum is less strongly absorbed by plants.

Effects of light on plants

Based on the tolerance to intensities of light, the plants are divided into two types.

They are

1. Heliophytes - Light loving plants.Example: Angiosperms.
2. Sciophytes - Shade loving plants.Example: Bryophytes and Pteridophytes.

b. Temperature

Temperature is one of the important factorswhichaffect almost all the metabolic activitiesof an organism. Every physiological process inan organism requires an optimum temperatureat which it shows the maximum metabolic rate.Three limits of temperature can be recognizedfor any organism. They are

1. Minimum temperature - Physiologicalactivities are lowest.
2. Optimum temperature - Physiologicalactivities are maximum.
3. Maximum temperature - Physiologicalactivities will stop.

Based on the temperature prevailing inan area, Raunkiaer classified the world's vegetation into the following four types. They are megatherms, mesotherms, microtherms and hekistotherms. In thermal springs and deep sea hydrothermal vents where average temperature exceed 100oc.

Based on the range of thermal tolerance, organisms are divided into two types.

1. Eurythermal: Organisms which can tolerate a wide range of temperature fluctuations.
   Example: Zostera (A marine Angiosperm) andArtemisiatridentata.

2. Stenothermal: Organisms which cantolerate only small range of temperaturevariations. Example: Mango and Palm(Terrestrial Angiosperms).

Mango plant donot and cannot grow in temperate countries like Canada and Germany.

Thermal Stratification

It is usually found in aquatic habitat. The change in the temperature profile with increasing depth in a water body is called thermal stratification. There are three kinds of thermal stratifications.

1. Epilimniotn – The upper layer of warmerwater.
2. Metalimnion – The middle layer with azone of gradual decrease in temperature.
3. Hypolimnion - The bottom layer of colderwater.

Temperature based zonation

Variations in latitude and altitude do affect the temperature and the vegetation on the earth surface. The latitudinal and altitudinal zonation of vegetation is illustrated below:

Timber line / Tree line : It is an imaginary line in a mountain or higher areas of land that marks the level above which trees do not grow. The altitudinal limit of normal tree growth is about 3000 to 4000m.

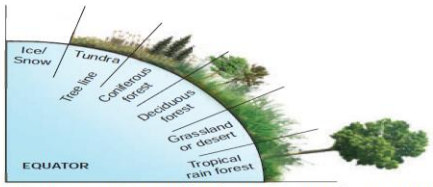


Figure 6.4: Latitudinal zonation of vegetation type

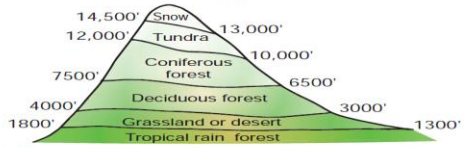


Figure 6.5: Altitudinal zonation of vegetation

Effects of temperature

The following physiological processes are influenced by temperature:

Temperature affects the enzymatic actionof all the bio-chemical reactions in a plantbody.

- ❖ It influences CO2 and O2 solubility in thebiological systems. Increases respirationand stimulates growth of seedlings.
- ❖ Low temperature with high humidity canspread diseases to plants.
- ❖ The varying temperature with moisturedetermines the distribution of thevegetation types.

c. Water

Water is one of the most important climaticfactors. It affects the vital processes of all livingorganisms. It is believed that even life hadoriginated only in water during the evolution ofEarth. Water covers more than 70% of the earth's surface. In nature, water is available to plants inthree ways. They are atmospheric moisture,precipitation and soil water.

The productivity and distribution of plants depend upon the availability of water. Further the quality of water is also important especially for the aquatic organisms. The total amount of water salinity in different water bodies are :i).5% in inland water (Fresh water) ii).30 – 35% in sea water and iii).More than 100% in hypersaline water (Lagoons)
Based on the range of tolerance of salinity, organisms are divided into two types.

1. Euryhaline: Organisms which can live inwater with wide range of salinity. Examples:Marine algae and marina angiosperms
2. Stenohaline: Organisms which can withstand only small range of salinity. Example: Plants ofestuaries.

Examples of tolerance to toxicity

i. Soyabean and tomato manage to tolerate presence of cadmium poisoning by isolating cadmium and storing into few group of cells and prevent cadmium affecting other cells .
ii. Rice and Eichhornia (water hyacinth) tolerate cadmium by binding it to their proteins.

These plants otherwise can also be used to remove cadmium from contaminated soil, this is known as Phytoremediation.

d. Wind

Air in motion is called wind. It is also a vital ecological factor. The atmospheric air contains a number of gases, particles and other constituents. The composition of gases in atmosphere is as follows: Nitrogen -78%, Oxygen -21%, Carbon-di-oxide - 0.03%, Argon and other gases - 0.93%. The other components of wind are water vapour, gaseous pollutants, dust, smoke particles, micro-organisms, pollen grains, spores, etc. Anemometer is the instrument used to measure the speed of wind.

Effects of wind

- Wind is an important factor for the formation of rain
- Causes wave formation in lakes and ocean, which promotes aeration of water
- Strong wind causes soil erosion and reduces soil fertility
- Increases the rate of transpiration
- Helps in pollination in anemophilous plants
- It also helps in dispersal of many fruits, seeds, spores, etc.
- Strong wind may cause up-rooting of big trees
- Unidirectional wind stimulates the development of flagforms in trees.

e. Fire

Fire is an exothermic factor caused due to the chemical process of combustion, releasing heat and light. It is mostly man-made and some-times develops naturally due to the friction between the tree surfaces. Fire is generally divided into

1. Ground fire – Which is flameless and subterranean.
2. Surface fire – Which consumes the herbs and shrubs.
3. Crown fire – Which burns the forest canopy.

Effects of fire

- Fire has a direct lethal effect on plants
- Burning scars are the suitable places for the entry of parasitic fungi and insects

- It brings out the alteration of light, rainfall,nutrient cycle, fertility of soil, pH, soil floraand fauna
- Some fungi which grow in soil of burnt areascalledpyrophilous.
  Example: Pyronemaconfluens.

Indicators of fire – Pteris (fern) and Pyronema (fungus) indicates the burnt up and fire disturbed areas. So they are called indicators of fire.

Fire break – It is a gap made in the vegetation that acts as a barrier to slow down or stop the progress of fire.
A natural fire break may occur when there is a lack of vegetation such as River, lake and canyon found in between vegetation may act as a natural fire break.

Rhytidome: It is the structural defense by plants against fire .The outer bark of trees which extends to the last formed periderm is called Rhytidome. It is composed of multiple layers of suberized periderm, cortical and phloem tissues. It protects the stem against fire , water loss, invasion of insects and prevents infections by microorganisms.

Edaphic factors

Edaphic factors, the abiotic factors related to soil, include the physical and chemical composition of the soil formed in a particular area. The study of soils is called Pedology.

The soil

Soil is the weathered superficial layer of the Earth in which plants can grow. It is a complex composite mass consisting of soil constituents, soil water, soil air and soil organisms, etc.

Soil formation

Soil originates from rocks and develops gradually at different rates, depending upon the ecological and climatic conditions. Soil formation is initiated by the weathering process. Biological weathering takes place when organisms like bacteria, fungi, lichens and plants help in the breakdown of rocks through the production of acids and certain chemical substances.

Soil types

Based on soil formation (pedogenesis), the soils are divided into

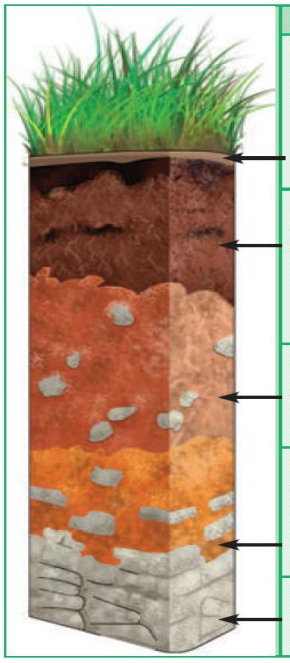
1. Residual soils –These are soils formed byweathering and pedogenesis of the rock.
2. Transported soils – These are transportedby various agencies.

The important edaphic factors which affect vegetation are as follows:

1. Soil moisture
2. Soil water
3. Soil reactions
4. Soil nutrients
5. Soil atmosphere
6. Soil organisms

Soil Profile

Soil is commonly stratified into horizons at different depth. These layers differ in their physical, chemical and biological properties. This succession of super-imposed horizons is called soil profile.



Horizon	Description
O–Horizon (Organic horizon) Humus	It consists of fresh or partially decomposed organic matter. O1 – Freshly fallen leaves, twigs, flowers and fruits O2 – Dead plants, animals and their excreta decomposed by micro-organisms. Usually absent in agricultural and deserts.
A–Horizon (Leached horizon) Topsoil - Often rich in humus and minerals.	It consists of top soil with humus, living creatures and in-organic minerals. A1 – Dark and rich in organic matter because of mixture of organic and mineral matters. A2 – Light coloured layer with large sized mineral particles.
B-Horizon (Accumulation horizon) (Subsoil-Poor in humus, rich in minerals)	It consists of iron, aluminium and silica rich clay organic compounds.
C - Horizon (Partially weathered horizon) Weathered rock Fragments - Little or no plant or animal life.	It consists of parent materials of soil, composed of little amount of organic matters without life forms.
R – Horizon (Parent material) Bedrock	It is a parent bed rock upon which underground water is found .

Figure 6.7: Soil Profile

Types of soil particles

Based on the relative proportion of soil particles, four types of soil are recognized.

	Soil type	Size	Realative prorportion
1	Clayey soil	Less than 0.002mm	50% clay and 50% silt (colt / heavy soil)
2.	slit soil	0.002 to 0.02mm	90% slit and 10% sand
3.	Loamy soil	0.002 to 2mm	70% sand and 30% clay/ silt or both (Garden soil)
4.	Sandy soil	0.2 to 2mm	85% sand and 15% clay (light soil)

Loamy soil is ideal soil for cultivation. It consists of 70% sand and 30% clay or silt or both. It ensures good retention and proper drainage of water. The porosity of soil provides adequate aeration and allows the penetration of roots.

Topographic factors

The surface features of earth are called topography. Topographic influence on the climate of any area is determined by the interaction of solar radiation, temperature, humidity, rainfall, latitude and altitude. It affects the vegetation through climatic variations in small areas (micro climate) and even changes the soil conditions. Topographic factors include latitude, altitude, direction of mountain, steepness of mountain etc.

a. Latitudes and altitudes

Latitudes represent distance from the equator.Temperature values are maximum at the equator and decrease gradually towards poles. Differenttypes of vegetation occur from equator to poleswhich are illustrated below.

Height above the sea level forms the altitude. At high altitudes, the velocity of wind remains high, temperature and air pressure decrease while humidity and intensity of light increases. Due to these factors, vegetation at different altitudes varies, showing distinct zonation.

b. Direction of Mountain

North and south faces of mountain or hill possess different types of flora and fauna because theydiffer in their humidity, rainfall, light intensity,light duration and temperature regions.

Ecotone - The transition zone between two ecosystems. Example: The border between forest and grassland.

Edge effect – Those species are found in the ecotone areas are due to the effect of environment of the two habitats. This is called edge effect. Example: Owl in the ecotone area between forest and grassland.

The two faces of the mountain or hill receive different amount of solar radiation, wind action and rain. Of these two faces, the windward region possesses good vegetation due to heavy rains and the leeward region possesses poor vegetation due to rain shadows (rain deficit).

Similarly in the soil of aquatic bodies like ponds the center and edge possess different depth of water due to soil slope and different wave actions in the water body. Therefore, different parts of the same area may possess different species of organisms.

c. Steepness of the mountain

The steepness of the mountain or hill allowsthe rain to run off. As a result the loss of watercauses water deficit and quick erosion of the topsoil resulting in poor vegetation. On the otherhand, the plains and valley are rich in vegetationdue to the slow drain of surface water and betterretention of water in the soil.

Biotic factors

The interactions among living organisms such as plants and animals are called biotic factors, which may cause marked effects upon vegetation. The effects may be direct and indirect and modifies the environment. The plants mostly which lives together in a community and influence one another. Similarly, animals in association with plants also affect the plant life in one or several ways. The different interactions among them can be classified into following two types they are positive interaction and negative interaction

Positive interactions

When one or both the participating species are benefited, it is positive interaction. Examples; Mutualism and Commensalism.

a.Mutualism
It is an interaction betweentwo species of organisms in which both arebenefitted from the obligate association. Thefollowing are common examples of mutualism.

Nitrogen fixation

Rhizobium (Bacterium) forms nodules in the roots of leguminous plants and lives symbiotically. The Rhizobium obtains food from leguminous plant and in turn fixes atmospheric nitrogen into nitrate, making it available to host plants.

Other examples:

- Water fern (Azolla) and Nitrogen fixing Cyanobacterium (Anabaena).
- Anabaena present incoralloid roots of Cycas.(Gymnosperm)
- Cyanobacterium (Nostoc) found in thethalloid body of Anthoceros.(Bryophytes)
- Wasps present in fruits of fig.
- Lichen is a mutual association of an algaand a fungus.
- Roots of terrestrial plants and fungalhyphae- Mycorrhiza

b. Commensalism:

It is an interaction betweentwo organisms in which one is benefitted andthe other is neither benefitted nor harmed.The species that derives benefit is called

thecommensal, while the other species is called thehost. The common examples of commensalismare listed below:

	Interaction type	Combination		Effects	Examples
1.Positive interaction					
1	**Mutualism**	(+)	(+)	Both species benefitted	Lichen, *Mycorrhiza* etc.
2	**Commensalism**	(+)	(0)	One species is benefitted and the other species is neither benefitted nor harmed	orchids, Lianas etc.
2.Negative interaction					
4	**Predation**	(+)	(-)	One species benefitted, the other species are harmed	*Drosera, Nepenthes* etc.
5	**Parasitism**	(+)	(-)	One species benefitted, the other species are harmed	*Cuscuta, Duranta, Viscum* etc.
6	**Competition**	(-)	(-)	Harmful for both	Grassland species
7	**Amensalism**	(-)	(0)	Harmful for one, but the other species are unaffected	*Penicillium* and *Staphylo coccus*

(+) Benefitted, (-) Harmed (0)Unaffected

Table 6.4: Different interactions of plant

Epiphytes

The plants which are found growing on other plants without harming them are called epiphytes. They are commonly found in tropical rain forest. The epiphytic higher plant (Orchids) gets its nutrients and water from the atmosphere with the help of their hygroscopic roots which contain special type of spongy tissue called Velamen. So it prepares its own food and does not depend on the host. They use the host plant only for support and does not harm it in any way.

- ❖ Many orchids, ferns, lianas, hanging mosses,Peperomia, money plant and *Usnea* (Lichen)are some of the examples of epiphytes.
- ❖ Spanish Moss –Tillandsia grows on the barkof Oak and Pine trees.

Proto Cooperation

An interaction between organisms of different species in which both organisms benefit but neither is dependent on the relationship. Example: Soil bacteria / fungi and plants growing in the soil.

Negative interactions

When one of the interacting species is benefitted and the other is harmed, it is called negative interaction . Examples: predation, parasitism, competition and amensalism.

a. Predation: It is an interaction between twospecies, one of which captures, kills and eatsup the other. The species which kills is calleda predator and the species which is killed iscalled a prey. The predator is benefitted whilethe prey is harmed.

Examples:

- A number of plants like Drosera (Sun dew Plant), Nepenthes (Pitcher Plant), Diaonaea (Venus fly trap), Utricularia (Bladder wort) and Sarracenia are predators which consume insects and other small animals for their food as a source of nitrogen. They are also called as insectivorous plants.
- Many herbivores are predators. Cattles,Camels, Goats etc., frequently browse onthe tender shoots of herbs, shrubs andtrees. Generally annuals suffer more thanthe perennials. Grazing and browsing maycause remarkable changes in vegetation.Nearly 25 percent of all insects are knownas phytophagous(feeds on plant sap andother parts of plant)
- Many defense mechanisms are evolved toavoid their predations by plants. Examples:Calotropis produces highly poisonous cardiacglycosides, Tobacco produces nicotine, coffeeplants produce caffeine, Cinchona plantproduces quinine. Thorns of Bougainvillea,spines of Opuntia, and latex of cacti alsoprotect them from predators.

b. Parasitism:

It is an interaction between twodifferent species in which the smaller partner(parasite) obtains food from the larger partner(host or plant). So the parasitic species isbenefited while the host species is harmed. Based on the host-parasite relationship, parasitism isclassified into two types they are holoparasiteand hemiparasite.

Holoparasites

The organisms which are dependent upon the host plants for their entire nutrition are called Holoparasites. They are also called total parasites.

Examples:

- Cuscuta is a total stem parasite of thehost plant Acacia, Duranta and manyother plants. Cuscuta even gets flowerinducing hormone from its host plant.
- Balanophora, orobanche and Refflesiaare the total root parasites found onhigher plants.

Hemiparasites

The organisms which derive only water and minerals from their host plant while synthesizing their own food by photosynthesis are called Hemiparasites. They are also called partial parasites.

Examples:

• Viscum and Loranthus are partial stemparasites.

• Santalum (Sandal Wood) is a partial rootparasite.

The parasitic plants produce the haustorialroots inside the host plant to absorb nutrients from the vascular tissues of host plants.

c. Competition:

It is an interaction betweentwo organisms or species in which both theorganisms or species are harmed. Competitionis the severest in population that has irregulardistribution. Competition is classified intointraspecific and interspecific.

1. Intraspecific competition: It is an interactionbetween individuals of the same species. This competition is very severe because all the members of species have similar requirements of food, habitat, pollination etc. and they also have similar adaptations to fulfill their needs.
2. Interspecific competition: It is an interactionbetween individuals of different species. In grassland, many species of grasses grow well as there is little competition when enough nutrients and water is available. During drought shortage of water occurs . A life and death competition starts among the different species of grass lands. Survival in both these competitions is determined by the quantity of nutrients, availability of water and migration to new areas. Different species of herbivores, larvae and grass hopper competing for fodder or forage plants. Trees, shrubs and herbs in a forest struggle for sunlight, water and nutrients and also for pollination and dispersal of fruits and seeds. The Utricularia (Bladderwort) competes with tiny fishes for small crustaceans and insects.

d. Amensalism:

It is an interspecific interactionin which one species is inhibited while the otherspecies is neither benefitted nor harmed. Theinhibition is achieved by the secretion of certainchemicals called allelopathic substances.Amensalism is also called antibiosis.

- ❖ Penicillium notatum produces penicillin toinhibit the growth of a variety of bacteriaespecially Staphylococcus.
- ❖ Trichoderma inhibits the growth of fungusAspergillus.
- ❖ Roots and hulls of Black Walnut Juglansnigra secretes an alkaloid Junglonewhichinhibits the growth of seedlings of Apple,Tomato and Alfalfa around it.

Ecological adaptations

The modifications in the structure of organisms to survive successfully in an environment are called adaptations of organisms. Adaptations help the organisms to exist under the prevailing ecological habitat. Based on the habitats and the

corresponding adaptations of plants, they are classified as hydrophytes, xerophytes, mesophytes, epiphytes and halophytes.

Hydrophytes

The plants which are living in water or wet places are called hydrophytes.

Lotus seeds showing highest longevity in plant kingdom.

Hygrophytes: The plants which can grow in moist damp and shady places are called hygrophytes. Examples: Habenaria (Orchid), Mosses (Bryophytes), etc.

Morphological adaptations of Hydrophytes:
In root

- Roots are totally absent in Wolffia andSalvinia or poorly developed in Hydrilla or well developed in Ranunculus.
- The root caps are replaced by root pockets.Example: Eichhornia

In stem

- The stem is long, slender, spongy and flexible in sub-merged forms.
- In free floating forms the stem is thick, shortstoloniferous and spongy; and in rootedfloating forms, it is a rhizome .

In leaves

- The leaves are thin, long and ribbon shaped in Vallisneria or long and linear in Potamogetonor finely dissected in Ceratophyllum

Anatomical adaptations

- Cuticle is either completely absent or ifpresent it is thin and poorly developed
- Single layer of epidermis is present
- Vascular tissues are poorly developed. Inemergent forms vascular elements are welldeveloped.

Physiological adaptations of Hydrophytes:

- Hydrophytes have the ability to withstandanaerobic conditions.

Xerophytes

The plants which are living in dry or xericcondition are known as Xerophytes. Based on adaptive characters xerophytes are classified into three categories. They are Ephemerals, Succulents and Non succulent plants

i. Ephemerals:These are alsocalled droughtescapers or drought evaders. These plants complete their life cycle within a short period (single season). These are not true xerophytes. Examples: Argemone, Mollugo, Tribulus and Tephrosia.
ii. Succulents: These are also called droughtenduring plants. These plants store water intheir plant parts during the dry period. Theseplants develop certain adaptive characters toresist extreme drought conditions. Examples:Opuntia, Aloe, Bryophyllum and Begonia.
iii. Non succulents: These are also calleddrought resistant plants (true xerophytes).They face both external and internal dryness.They have many adaptations to resist dryconditions. Examples: Casuarina, Nerium,Zizyphus and Acacia.

Morphological Adaptations
In root

- Root system is well developed and is greaterthan that of shoot system.
- Root hairs and root caps are also welldeveloped.

In Xerophytic plants with the leaves and stem are covered with hairs are called trichophyllous plants. Example: Cucurbits (Melothria and Mukia)

In stem

- Stems are mostly hard and woody. They maybe aerial or underground
- The stems and leaves are covered with waxcoating or covered with dense hairs.
- In some xerophytes all the internodes in thestem are modified into a fleshy leaf structurecalledphylloclades (Opuntia).

In leaves

- Leaves are generally leathery and shiny toreflect light and heat.
- In some plants like Euphorbia, Acacia,Ziziphus and Capparis, the stipules aremodified into spines.
- The entire leaves are modified into spines(Opuntia) or reduced to scales (Asparagus).

Anatomical adaptations

- Presence of multilayered epidermis withheavy cuticle to prevent water loss due totranspiration.
- Hypodermis is well developed withsclerenchymatous tissues.
- Sunken shaped stomata are present only in thelower epidermis with hairs in the sunken pits.
- Scotoactive type of stomata found insucculent plants.

- Vascular bundles are well developed withseveral layered bundle sheath.
- Mesophyll is well differentiated intopalisade and spongy parenchyma.
- In succulents the stem possesses a waterstorage region.

Physiological adaptations

- Most of the physiological processes aredesigned to reduce transpiration.
- Life cycle is completed within a shortperiod (Ephemerals).

Mesophytes

The plants which are living in moderate conditions (neither too wet nor too dry) are known as mesophytes. These are common land plants. Example: Maize and *Hibiscus.*

Morphological adaptations

- Root system is well developed with rootcaps and root hairs
- Stems are generally aerial, stout and highlybranched.
- Leaves are generally large, broad, thin with different shapes.

Anatomical adaptations

- Cuticle in aerial parts are moderatelydeveloped.
- Epidermis is well developed and stomata are generally present on both the epidermis.
- Mesophyll is well differentiated into palisade and spongy parenchyma.
- Vascular and mechanical tissues are fairlydeveloped and well differentiated.

Physiological adaptations

- All physiological processes are normal.
- Temporary wilting takes place at room temperature when there is water scarcity.

Tropophytes are plants which behave as xerophytes at summer and behave as mesophytes (or) hydrophytes during rainy season.

Epiphytes

Epiphytes are plants which grow perched on other plants (Supporting plants). They use the supporting plants only as shelter and not for water or food supply. These epiphytesare commonly seen in tropical rain forests. Examples: Orchids, Lianas, Hanging Mosses and Money plant.

Halophytes

- There are special type of Halophytic plants which grow on soils with high concentration of salts. Examples: Rhizophora, Sonneratia and Avicennia.
- Halophytes are usually found near the sea-shores and Estuaries. The soils are physically wet but physiologically dry. As plants cannot use salt water directly they require filtration of salt using physiological processes. This vegetation is also known as mangrove forest and the plants are called mangroves.

Morphological adaptations

- The temperate halophytes are herbaceousbut the tropical halophytes are mostly bushy
- In addition to the normal roots, many stiltroots are developed
- A special type of negatively geotropicroots called pneumatophores withpneumathodes to get sufficient aerationare also present. They are called breathingroots. Example: Avicennia
- Presence of thick cuticleon the aerial parts of theplant body
- Leaves are thick,entire, succulent andglossy. Some speciesare aphyllous (withoutleaves).
- Vivipary mode of seed germination is foundin halophytes

Anatomical adaptations

- Epidermal cells of stem is heavy cutinized,almost squarish and are filled with oil andtannins.
- 'Star' shaped sclereids and 'H' shaped heavy thickened spicules that provide mechanicalstrength to cortex are present in the stem.
- The leaves may be dorsiventral or isobilateral with salt secreting glands.

Physiological adaptations

- High osmotic pressure exists in someplants.
- Seeds germinate in the fruits of motherplant itself (Vivipary).

Out of three districts of Tamil Nadu (Nagapattinam, Thanjavur and Thiruvarur), Muthupet (Thiruvarur district) was less damaged by Gaja cyclone (November 2018) due to the presence of mangrove forest.

12th std –Botany
Unit – 7 – Ecosytem

Structure of ecosystem

Ecosystem comprises of two major components. They are:

i. **Abiotic (non-living) components:** It includes climatic factors (air, water, sunlight, rainfall, temperature and humidity), edaphic factors (soil air, soil water and pH of soil),topography (latitude, altitude), organic components (carbohydrates, proteins, lipids and humic substances) and inorganic substances (C, H, O, N and P). Abiotic components play vital role in any ecosystem and hence the total inorganic substances present in any ecosystem at a given time is called standing quality (or) standing state.

ii. **Biotic (living) components:** It includes all living organisms like plants, animals, fungi and bacteria. They form the trophic structures of any ecosystem. On the basis of nutritional relationships, trophic levels of an ecosystem has two components.

(1) **Autotrophic components:** Autotrophs are organisms which can manufacture the organic compounds from simple inorganic components through a process called photosynthesis. In most of the ecosystems, green plants are the autotrophs and are also called producers.

(2) **Heterotrophic components**: Those organisms which consume the producers are called consumers and can be recognized into macro and micro consumers. Macroconsumers refer to herbivores, carnivores and omnivores (primary, secondary and tertiary consumers). Microconsumers are called decomposers. Decomposers are organisms that decompose the dead plants and animals to release organic and inorganic nutrients into the environment which are again reused by plants. Example: Bacteria, Actinomycetes and Fungi.

The amount of living materials present in a population at any given time is known as standing crop, which may be expressed in terms of number or biomass per unit area. Biomass can be measured as fresh weight or dry weight or carbon weight of organisms. Biotic components are essential to construct the food chain, food web and ecological pyramids.

Functions of ecosystem

The function of ecosystem include to energy creation, sharing of energy and cycling of materials between the living and non-living component of an ecosystem.

Photosynthetically Active Radiation (PAR)

The amount of light available for photosynthesis of plants is called Photosynthetically Active Radiation (PAR) which is between the range of 400-700 nm wave length. It is essential for photosynthesis and plant growth. PAR is not always constant because of clouds, tree shades, air, dust particles, seasons, latitudes and length of the daylight availability.

Generally plants absorb more blue and red light for efficient photosynthesis.

Types of Carbon

Green carbon – carbon stored in the biosphere (by the process of photosynthesis).
Grey carbon – carbon stored in fossil fuel (coal, oil and biogas deposits in the lithosphere).

Blue carbon – carbon stored in the atmosphere and oceans.

Brown carbon – carbon stored in industrialized forests (wood used in making commercial articles)

Black carbon – carbon emitted from gas, diesel engine and coal fired power plants.

Productivity of an ecosystem

The rate of biomass production per unit area in a unit time is called productivity. It can be expressed in terms of gm /m2/year or Kcal/m2/ year. It is classified as given bellow.

1. Primary productivity
2. Secondary productivity
3. Community productivity

1. Primary productivity:

The chemical energy or organic matter generated by autotrophs during the process of photosynthesis and chemosynthesis is called primary productivity. It is the source of energy for all organisms, from bacteria to human.

a. Gross Primary Productivity (GPP)

The total amount of food energy or organic matter or biomass produced in an ecosystem by autotrophs through the process of photosynthesis is called gross primary productivity

b. Net Primary Productivity (NPP)

The proportion of energy which remains after respiration loss in the plant is called net primary productivity. It is also called as apparent photosynthesis. Thus the difference between GPP and respiration is known as NPP.

NPP = GPP – Respiration

NPP of whole biosphere is estimated to be about 170 billion tons (dry weight) per year. Out of which NPP of oceanic producers is only 55 billion tons per year in unit time.

2. Secondary productivity

The amount of energy stored in the tissues of heterotrophs or consumers is called secondary productivity.

a. Gross secondary productivity

It is equivalent to the total amount of plant material is ingested by the herbivores minus the materials lost as faeces.

b. Net secondary productivity

Storage of energy or biomass by consumers per unit area per unit time, after respiratory loss is called net secondary productivity.

3. Community productivity

The rate of net synthesis of organic matter (biomass) by a group of plants per unit area per unit time is known as community productivity.

Concept of trophic level in an ecosystem

(Greek word ' trophic' = to food or feeding)

A trophic level refers to the position of an organism in the food chain. The number of trophic levels is equal to the number of steps in the food chain. The green plants (producers) occupying the first trophic level (T_1) are called producers. The energy produced by the producers is utilized by the plant eaters (herbivores) they are called primary consumers and occupies the second trophic level (T_2).

Herbivores are eaten by carnivores, which occupy the third trophic level (T3). They are also called secondary consumers or primary carnivores. Carnivores are eaten by the other carnivores, which occupy the fourth trophic level (T4). They are called the

tertiary consumers or secondarycarnivores. Some organisms which eat both plants and animals are called as omnivores (Crow). Such organisms may occupy more than one trophic level in the food chain.

Energy flow

The transfer of energy in an ecosystem between trophic levels can be termed as energy flow. It is the key function in an ecosystem. Part of the energy obtained from the sun by producer is transferred to consumers and decomposers through the each trophic level, while some amount of energy is dissipated in the form of heat. Energy flow is always unidirectional in an ecosystem.

Laws of thermodynamics

The storage and loss of energy in an ecosystem is based on two basic laws of thermo-dynamics.

i. First law of thermodynamics

It states that energy can be transmitted from one system to another in various forms. Energy cannot be destroyed or created. But it can be transformed from one form to another. As a result, the quantity of energy present in the universe is constant.

Example:

In photosynthesis, the product of starch (chemical energy) is formed by the combination of reactants (chlorophyll, H2O, CO2). The energy stored in starch is acquired from the external sources (light energy) and so there isno gain or loss in total energy. Here light energy is converted into chemical energy.

$$6\,CO_2 + 6\,H_2O \xrightarrow[\text{Chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6\,O_2$$

Light energy ⟶ chemical energy

ii.Second law of thermodynamics

It states that energy transformation results in the reduction of the free energy of the system. Usually energy transformation cannot be 100% efficient. As energy is transferred from one organism to another in the form of food, a portion of it is stored as energy in living tissue, whereas a large part of energy is dissipated as heat through respiration. The transfer of energy is irreversible natural process. Example: Ten percent law

Ten percent law

This law was proposed by Lindeman (1942). It states that during transfer of food energy from one trophic level to other, only about 10% stored at every level and rest of them (90%) is lost in respiration, decomposition and in the form of heat. Hence, the law is called ten percent law.

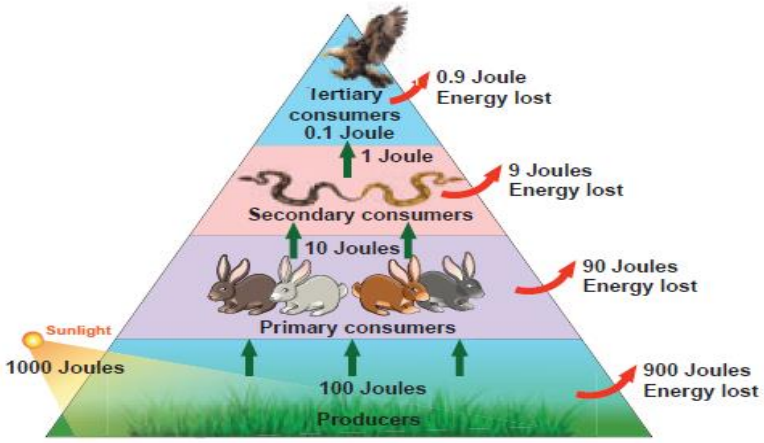


Figure 7.4: Ten percent law

Example: It is shown that of the 1000 Joules of Solar energy trapped by producers. 100 Joules of energystored chemical energy through photosynthesis. The remaining 900 Joules could be lost in the environment. In the next trophic level herbivores, which f ed on producers get only 10 Joules f energy and the remaining90 Joules is lost in the environment. Likewise, in the next trophic level, carnivores, which eatherbivores store only 1 Joule of energy and the remaining 9 Joules is dissipated. Finally, the carnivores are eaten by tertiary consumers which store only 0.1 Joule of energy and the remaining 0.9 Joule is lost in the environment. Thus, at the successive trophic level, only ten percent energy is stored.

Food chain

The movement of energy from producers upto top carnivores is known as food chain, i.e., in any food chain, energy flows from producers to primary consumers, then from primary consumers to secondary consumers, and finally secondary consumers to tertiary consumers. Hence, it shows linear network links. Generally, there are two types of food chain, (1) Grazing food chain and (2) Detritus food chain.

1. Grazing food chain

Main source of energy for the grazing food chain is the Sun. It begins with the first link, producers (plants). The second link in the food chain is primary consumers (mouse) which get their food from producers. The third link in the food chain is secondary consumers (snake) which get their food from primary consumers. Fourth

link in the food chain is tertiary consumers (eagle) which get their food from secondary consumers.

2. Detritus food chain:

This type of food chain begins with dead organic matter which is an important source of energy. A large amount of organic matter is derived from the dead plants, animals and their excreta. This type of food chain is present in all ecosystems.

The transfer of energy from the dead organic matter, is transferred through a series oforganisms called detritus consumers (detritivores)- small carnivores - large (top) carnivores with repeated eating and being eaten respectively. This is called the detritus food chain.

Food Web

The inter-locking pattern of a number of food chain form a web like arrangement called food web. It is the basic unit of an ecosystem, to maintain its stability in nature. It is called homeostasis.

Example: In a grazing food chain of a grass land, in the absence of a rabbit, a mouse may also eat food grains. The mouse in turn may be eaten directly by a hawk or by a snake and the snake may be directly eaten by hawks.

Hence, this interlocking pattern of food chains is the food web and the species of an ecosystem may remain balanced to each other by some sort of natural check.

Significance of food web

- Food web is constructed to describe species interaction called direct interaction.
- It can be used to illustrate indirect interactions among different species.
- It can be used to study bottom-up or top- down control of community structure.
- It can be used to reveal different patterns of energy transfer in terrestrial and aquatic ecosystems.

Ecological pyramids

Graphic representation of the trophic structure and function at successive trophic levels of an ecosystem is called ecological pyramids. The concept of ecological pyramids was introduced by Charles Elton (1927). Thus they are also called as Eltonian pyramids.

There are three types: (1) pyramid of number (2) pyramid of biomass (3) pyramid of energy.

1. Pyramid of number

A graphical representation of the number of organisms present at each successive trophic level in an ecosystem is called pyramids of number. There are three different shapes of pyramids upright, spindle and inverted.

There is a gradual decrease in the number of organisms in each trophic level from producers to primary consumers and then to secondary consumers, and finally to tertiary consumers. Therefore, pyramids of number in grassland and pond ecosystem are always upright.

In a forest ecosystem the pyramid of number is somewhat different in shape, it is because the base (T1) of the pyramid occupies large sized trees (Producer) which are lesser in number. Herbivores (T2) (Fruit eating birds, elephant, deer) occupying second trophic level, are more in number than the producers. In final trophic level (T4), tertiary consumers (lion) are lesser in number than the secondary consumer (T3) (fox and snake). Therefore, the pyramid of number in forest ecosystem looks spindle shaped.

The pyramid of number in a parasite ecosystem is always inverted, because itstarts with a single tree. Therefore there is gradual increase in the number of organisms in successive tropic levels from producer to tertiary consumers.

2. Pyramid of biomass

A graphical representation of the amount of organic material (biomass) present at each successive trophic level in an ecosystem is called pyramid of biomass. In grassland and forest ecosystems, there is a gradual decrease in biomass of organisms at successive trophic levels from producers to top carnivores (Tertiary consumer). Therefore, these two ecosystems show pyramids as upright pyramids of biomass. However, in pond ecosystem, the bottom of the pyramid is occupied by the producers, which comprise very small organisms possessing the least biomass and so, the value gradually increases towards the tip of the pyramid. Therefore, the pyramid of biomass is always inverted in shape.

3. Pyramid of energy

A graphical representation of energy flow at each successive trophic level in an ecosystem is called pyramids of energy. The bottom of the pyramid of energy is occupied by the producers. There is a gradual decrease in energy transfer at successive tropic levels from producers to the upper levels. Therefore, the pyramid of energy is always upright.

Decomposition:

Decomposition is a process in which the detritus (dead plants, animals and their excreta) are breakdown in to simple organic matter by the decomposers. It is an essential process for recycling and balancing the nutrient pool in an ecosystem.

Nature of decomposition

The process of decomposition varies based on the nature of the organic compounds, i.e., some of the compounds like carbohydrate, fatand protein are decomposed rapidly than the cellulose, lignin, chitin, hair and bone.

Mechanism of decomposition

Decomposition is a step wise process of degradation mediated by enzymatic reactions. Detritus acts as a raw material for decomposition. It occurs in the following steps.

a. Fragmentation - The breaking down of detritus into smaller particles by detritivores like bacteria, fungi and earth worm is known as fragmentation. These detritivores secrete certain substances to enhance the fragmentation process and increase the surface area of detritus particles.
b. Catabolism - The decomposers produce some extracellular enzymes in their surroundings to break down complex organic and inorganic compounds in to simpler ones. This is called catabolism
c. Leaching or Eluviation - The movement of decomposed, water soluble organic and inorganic compounds from the surface to the lower layer of soil or the carrying awayof the same by water is called leaching or eluviation.
d. Humification - It is a process by which simplified detritus is changed into dark coloured amorphous substance called humus. It is highly resistant to microbial action, therefore decomposition is very slow. It is the reservoir of nutrients.
e. Mineralisation - Some microbes are involved in the release of inorganic nutrients from the humus of the soil, such process is called mineralisation.

Factors affecting decomposition

Decomposition is affected by climatic factors like temperature, soil moisture, soil pH,oxygen and also the chemical quality of detritus.

Biogeochemical cycle (Nutrient cycle)

Exchange of nutrients between organisms and their environment is one of the essential aspects of an ecosystem. All organisms require nutrients for their growth, development, maintenance and reproduction. Circulation of nutrients within the

ecosystem or biosphere is known as biogeochemical cycles and also called as 'cycling of materials.' There are two basic types,

1. Gaseous cycle – It includes atmospheric Oxygen, Carbon and Nitrogen cycles.
2. Sedimentary cycle – It includes the cycles of Phosphorus, Sulphur and Calcium –Which are present as sediments of earth.

Many of the cycles mentioned above are studied by you in previous classes. Therefore, in this chapter, only the carbon and phosphorous cycles are explained.

Carbon cycle

The circulation of carbon between organisms and environment is known as the carbon cycle. Carbon is an inevitable part of all biomolecules and is substantially impacted by the change in global climate. Cycling of carbon between organisms and atmosphere is a consequence of two reciprocal processes of photosynthesis and respiration. The releasing of carbon in the atmosphere increases due to burning of fossil fuels, deforestation, forest fire, volcanic eruption and decomposition of dead organic matters.

Phosphorus cycle

It is a type of sedimentary cycle. Already we know that phosphorus is found in the biomolecules like DNA, RNA, ATP, NADP and phospholipid molecules of living organisms. Phosphorus is not abundant in the biosphere, whereas a bulk quantity of phosphorus is present in rock deposits, marine sediments and guano. It is released from these deposits by weatheringprocess. After that, it circulates in lithosphere as well as hydrosphere. The producers absorb phosphorus in the form of phosphate ions, and then it is transferred to each trophic level of food chain through food. Again death of the organisms and degradation by the action of decomposers, the phosphorus is released back into the lithosphere and hydrosphere to maintain phosphorus cycle.

Types of ecosystem

Biosphere consists of different types of ecosystems, which are as follows:

Stratification of pond ecosystem

Based on the factors like distance from the shore, penetration of light, depth of water, types of plants and animals, there may be three zones, littoral, limnetic and profundal. The littoral zone, which is closest to the shore with shallow water region, allows easy penetration of light. It is warm and occupied by rooted plantspecies. The limnetic zone refers the open water of the pond with an effective penetration of light and domination of planktons. The deeper region of a pond below the limnetic zone

is called profundal zone with no effective light penetration and predominance of heterotrophs. The bottom zone of a pond is termed benthic and is occupied by a community of organisms called benthos (usually decomposers).The primary

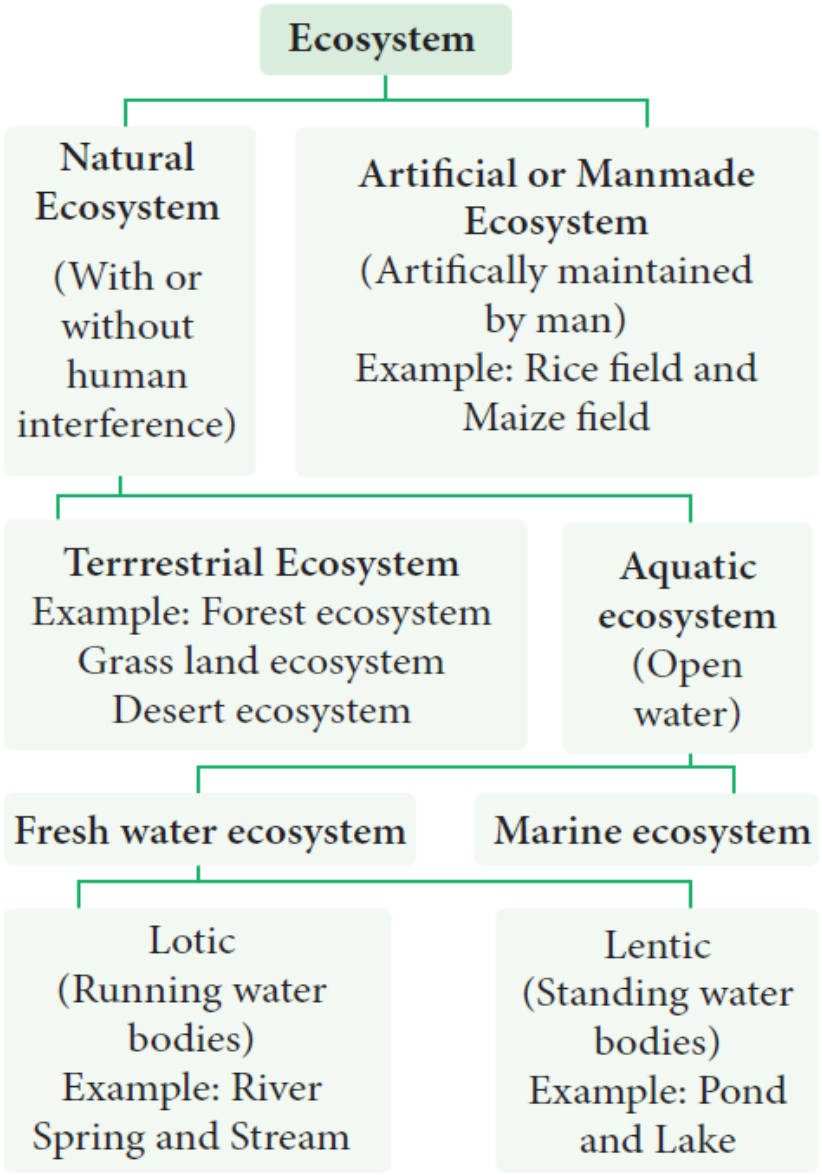


Figure 7.14: Types of Ecosystem

productivity through photosynthesis of littoral and limnetic zone is more due to greater penetration of light than the profundal zone.

Ecosystem services (Benefits)

Ecosystem services are defined as the benefits that people derive from nature. Robert Constanza et al (1927) stated "Ecosystem services are the benefits provided to human, through the transformation of resources (or Environmental assets including land, water, vegetation and atmosphere) into a flow of essential goods and services".

Study on ecosystem services acts as an effective tool for gaining knowledge on ecosystem benefits and their sustained use. Without such knowledge gain, the fate of any ecosystem will be at stake and the benefits they provide to us in future will become bleak.

Robert Constanza and his colleagues estimated the value of global ecosystem services based on various parameters. According to them in 1997, the average global value of ecosystems services estimated was US $ 33 trillion a year. The updated estimate for the total global ecosystem services in 2011 is US $ 125 trillion / year, indicating a four-fold increase in ecosystem services from 1997 to 2011.

Mangrove ecosystem services

- Offers habitat and act as nursery for aquatic plants and animals
- Provides medicine, fuel wood and timber.
- Act as bridge between sea and rivers by balancing sedimentation and soil erosion.
- Help to reduce water force during cyclones, tsunamis and high tide periods.
- Help in wind break, O2 production, carbon sequestration and prevents salt spray from waves.

The varieties of benefits obtained from the ecosystem are generally categorized into the following four types

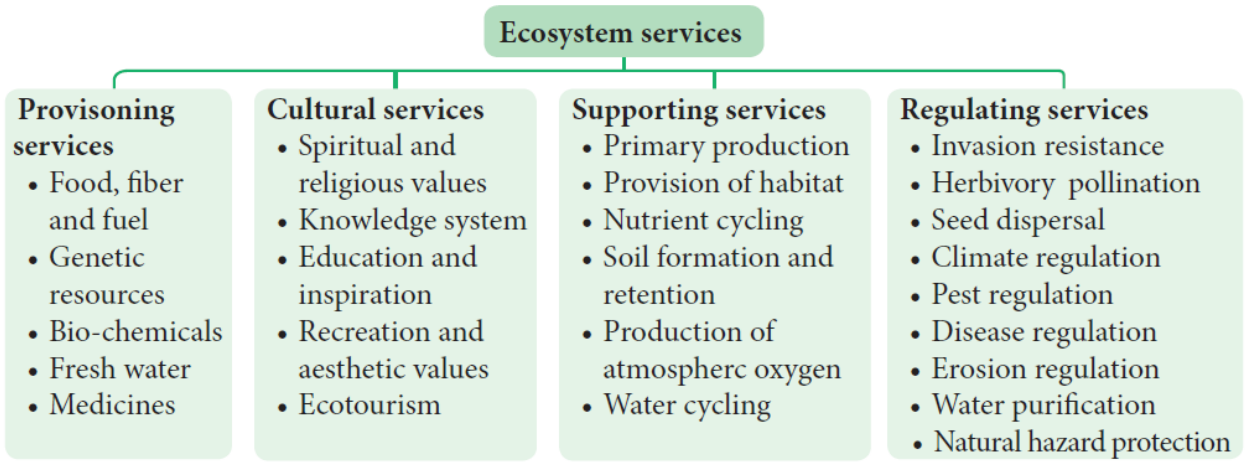


Figure 7.17: Types of Ecosystem services

How do anthropogenic activities affect ecosystem services?

Now, we all exploit the ecosystem more than that of our needs. The Millennium Ecosystem Assessment (2005) found that "over the past 50 years, humans have changed the ecosystem more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, medicine, timber, fiber and fuel."

Generally the following human activities disturb or re-engineer an ecosystem every day.

- Habitat destruction
- Deforestation and over grazing
- Erosion of soils
- Introduction of non-native species
- Over harvesting of plant material
- Pollution of land, water and air
- Run off pesticides, fertilizers and animal wastes

Ecosystem resilience

Ecosystem is damaged by disturbances from fire, flood, predation, infection, drought, etc., removing a great amount of biomasss. However, ecosystem is endowed with the ability to resist the damage and recover quickly. This ability of ecosystem is called ecosystem resilience or ecosystem robustness.

How to protect the ecosystem?

It is a practice of protecting ecosystem at individual, organisational and governmental levels for the benefits of both nature and humans. Threats to ecosystems are many, like adverse human activities, global warming, pollution, etc. Hence, if we change our everyday life style, we can help to protect the planet and its ecosystem.

"If we fail to protect environment, we will fail to save posterity".

Therefore, we have to practice the following in our day today life:

- Buy and use only ecofriendly products and recycle them.
- Grow more trees
- Choose sustained farm products (vegetables, fruits, greens, etc.)
- Reduce the use of natural resources.
- Recycle the waste and reduce the amount of waste you produce.
- Reduce consumption of water and electricity.
- Reduce or eliminate the use of house-hold chemicals and pesticides.
- Maintain your cars and vehicles properly. (In order to reduce carbon emission)
- Create awareness and educate about ecosystem protection among your friends and family members and ask them to find out solution to minimise this problem.

Ecosystem Management

It is a process that integrates ecological, socio economic and institutional factors into a comprehensive strategy in order to sustain and enhance the quality of the ecosystem to meet current and future needs.

Ecosystem management emphasis on human role in judicious use of ecosystem and for sustained benefits through minimal human impacts on ecosystems. Environmental degradation and biodiversity loss will result in depletion of natural resources, ultimately affecting the existence of human

"By 2025, at least 3.5 billion people, nearly 50% of the world's population are projected to face water scarcity." – IUCN.
"Forests house approximately 50% of global bio-diversity and at least 300 million people are dependent on forest's goods and services to sustain their livelihood." – IUCN

Strategy of ecosystem management

- It is used to maintain biodiversity of ecosystems.
- It helps in indicating the damaged ecosystem (Some species indicate the health of the ecosystem: such species are called a flagship species).
- It is used to recognize the inevitability of ecosystem change and plan accordingly.
- It is one of the tools used for achieving sustainability of ecosystem through sustainable development programme (or projects).
- It is also helpful in identifying ecosystems which are in need of rehabilitation.
- It involves collaborative management with government agencies, local population, communities and NGO's.
- It is used to build the capacity of local institutions and community groups to assume responsibility for long term implementation of ecosystem management activities even after the completion of the project.

Urban ecosystem restoration model

AdayarPoonga is located in Chennai and covers an area around a total of 358 acres of Adayar creek and estuary, of which 58 acres were taken up for eco restoration under the auspices of Government of Tamil Nadu. It is maintained by Chennai Rivers Restoration Trust (CRRT).This was a dumping site previously.

Presently it has 6 species of mangroves, about 170 species of littoral and tropical dry evergreen forests (TDF) which have successfully established as a sustainable ecosystem. Restoration of plants species has brought other associated fauna such as butterflies, birds, reptiles, amphibians and other mammals of the ecosystem.

Currently AdayarPoonga functions as an environmental education Centre for school and college students and the public. The entire area stands as one of the best examples for urban eco restoration in the state of Tamil Nadu.

Plant Succession

Successive replacement of one type of plant community by the other of the same area/ place is known as plant succession. The first invaded plants in a barren area are called **pioneers**. On the other hand, a series of transitional developments of plant communities one after another in a given area are called **seral communities**. At the end a final stage and a final plant community gets established which are called as climax and **climax community** respectively.

Causes of Succession

Ever since the onset of origin of life, organic evolution and ecological succession are taking place parallelly. Ecological succession is a complex process. There are three types of causes for any ecological succession. They are

a. Initiating causes - Activity of abiotic (light, temperature, water, fire, soil erosion and wind) and biotic factors (competition among organisms) leads to formation of a barren area or destruction of the existing community of an area, initiating primary or secondary succession respectively.
b. Continuing causes - The processes of migration, aggregation, competition, reaction etc, are the continuing causes which lead to change the plant communities and nature of the soil in an area.
c. Stabilizing causes - The stabilization of the plant community in an area is primarly controlled by climatic factors rather than other factors.

Characteristics of ecological succession

- It is a systematic process which causes changes in specific structure of plant community.
- It is resultant of changes of abiotic and biotic factors.
- It transforms unstable community into a stable community.
- Gradual progression in species diversity, total biomass, niche specialisation, and humus content of soil takes place.
- It progresses from simple food chain to complex food web.
- It modifies the lower and simple life form to the higher life forms.
- It creates inter-dependence of plants and animals.

Types of succession

The various types of succession have been classified in different ways on the basis of different aspects. These are as follows:

1. Primary succession - The development of plant community in a barren area where no community existed before is called primary succession. The plants which colonize first in a barren area is called pioneer species or primary

community or primary colonies. Generally, Primary succession takes a very long time for the occurrence in any region.
Example: Microbes, Lichen, Mosses.

2. Secondary succession - The development of a plant community in an area where an already developed community has been destroyed by some natural disturbance (Fire, flood, human activity) is known as secondary succession. Generally, This succession takes less time than the time taken for primary succession.
Example: The forest destroyed by fire and excessive lumbering may be re-occupied by herbs over period of times.

	Primary succession	Secondary Succession
1	Developing in an barren area	Developing in disturbed area
2.	Initiated due to a biological or any other external factors	Starts due to external factors only
3.	No Soil, while primary succession starts	It starts where soil covers already present
4.	Pioneer species come from outside environment	Pioneer species develop from existing environment
5.	It takes more time to complete	It takes comparatively less time to complete.

3. Autogenic succession

Autogenic succession occurs as a result of biotic factors. The vegetation reacts with its environment and modifies its own environment causing its own replacement by new communities. This is known as autogenic succession.

Example: In forest ecosystem, the larger trees produce broader leaves providing shade to theforest floor area. It affects the shrubs and herbs which require more light (heliophytes) but supports the shade tolerant species (sciophytes) to grow well.

4. Allogenic succession

Allogeneic succession occurs as a result of abiotic factors. The replacement of existing community is caused by other external factors (soil erosion, leaching, etc.,) and not by existing organisms.

Example: In a forest ecosystem soil erosion and leaching alter the nutrient value of the soil leading to the change of vegetation in that area.

5. Autotrophic succession

If the autotrophic organisms like green plants are dominant during the early stages of succession it is called autotrophic succession, this occurs in the habitat which is

rich in inorganic substances. Since, green plants dominate in the beginning of this succession, there is a gradual increase in organic matter and subsequently the energy flow in the ecosystem.

6. Heterotrophic succession

If heterotrophic organisms like bacteria, fungi, actinomycetes, and animals are dominant during the early stages of succession it is called heterotrophic succession. Such a succession takes place in organic habitats. Since heterotrophs dominate in the beginning of such succession, there will be a gradual decrease in the energy content.

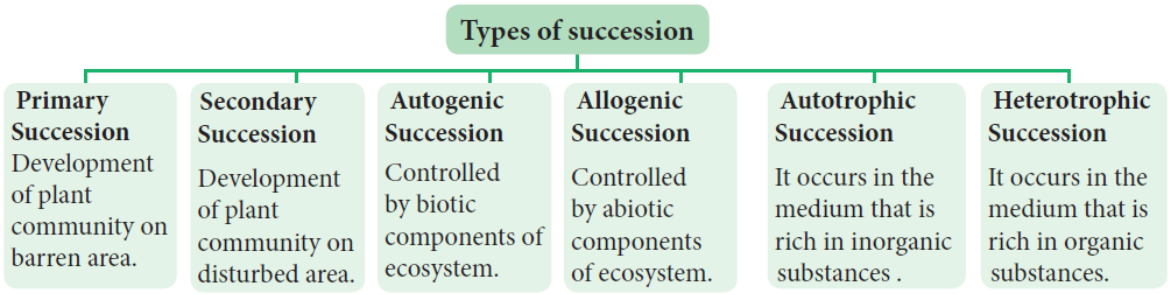


Figure 7.19: Types of succession

Process of succession

There are a number of sequential processes in primary autotrophic succession. They are (1) Nudation, (2) Invasion (migration) (3) Ecesis, (4) Aggregation, (5) Competition, (6) Reaction (7) Stabilization (climax).

1. Nudation - This is the development of a barren area without any form of life. The barren area may be developed due to topographic (soil erosion, wind action), climatic (hails, storm, fire), and biotic (human activities, epidemics, etc.,) factors.
2. Invasion - If species invade or reach a barren area from any other area it is called invasion. When the seeds, spores or other propagules of plant species reach the barren area, by air, water and various other agent, it is known as migration.
3. Ecesis (Establishment) - After reaching a new area (invasion), the successful establishment of the species, as a result of adjustment with the conditions prevailing in the area, is known as ecesis. If the establishment is complete, the plant will be able to reproduce sexually in that particular area.
4. Aggregation - The successful establishment of species, as a result of reproduction and increase in population of the species than the earlier stage is called aggregation.
5. Competition - It refers to the aggregation of a particular species in an area which leads to inter specific and intraspecific competition among the individuals for water, nutrient, radiant energy, CO2, O2 and space, etc.
6. Reaction - The species occupying a habitat gradually modify the environmental condition, where the existing species community is displaced

or replaced by another. This is called reaction. The community which is replaced by another community is called seral community.

7. Stabilization (Climax stage) - The final establishment of plant community is called stabilization. This establishment of a plant community which maintains itself in equilibrium with climax of the area and not replaced by others is known as climax community and the stage is climax stage.

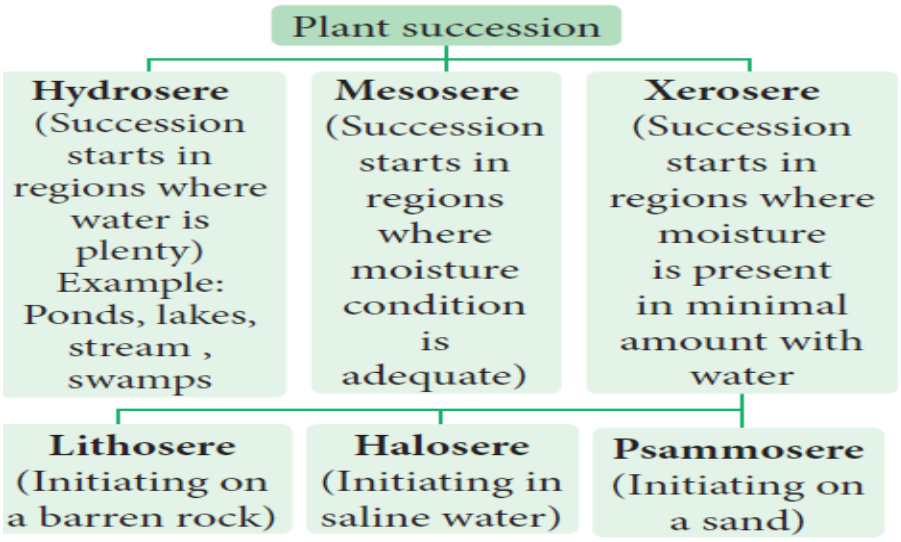


Figure 7.20: Classification of plant succession

Significance of Plant Succession

- Succession is a dynamic process. Hence an ecologist can access and study the seral stages of a plant community found in a particular area.
- The knowledge of ecological succession helps to understand the controlled growth of one or more species in a forest.
- Utilizing the knowledge of succession, even dams can be protected by preventing siltation.
- It gives information about the techniques to be used during reforestation and afforestation.
- It helps in the maintenance of pastures.
- Plant succession helps to maintain species diversity in an ecosystem.
- Patterns of diversity during succession are influenced by resource availability and disturbance by various factors.
- Primary succession involves the colonization of habitat of an area devoid of life.
- Secondary succession involves the reestablishment of a plant community in disturbed area or habitat.
- Forests and vegetation that we come across all over the world are the result of plant succession.

12th std –Botany
Unit – 8 Environmental Issues

Green House effect and Global Warming

Green House Effect is a process by which radiant heat from the sun is captured by gases in the atmosphere that increase the temperature of the earth ultimately. The gases that capture heat are called Green House Gases which include carbon dioxide (CO2), methane (CH4), Nitrous Oxide (N2O) and a variety of manufactured chemicals like chlorofluorocarbon (CFC). Increase in greenhouse gases lead to irreversible changesin major ecosystems and climate patterns. For example, coral ecosystem is affected by increase in temperature, especially coral bleaching observed in Gulf of Mannar, Tamil Nadu.

Human activities lead to produce the green house effect by

- Burning fossil fuels, which releases CO2 and CH4
- Way of Agriculture and animal husbandry practices
- Electrical gadgets like refrigerator and air conditioners release chlorofluoro carbons
- The fertilizers used in Agriculture which release N2O
- The emissions from automobiles.

The increase in mean global temperature (highest in 4000 years) due to increased concentration of green house gases is called global warming.

One of the reasons for this is over population which creates growing need for food, fibre and fuel and considered to be the major cause of global warming.

Effects of Global Warming

- Rise in global temperature which causes sea levels to rise as polar ice caps and glaciers begin to melt causing submergence of many coastal cities in many parts of the world.
- There will be a drastic change in weather patterns bringing more floods or droughts in some areas.
- Biological diversity may get modified, some species ranges get redefined. Tropics and sub-tropics may face the problem of decreased food production.

Sources of Green House Gases Emission (Natural and Anthropogenic)

CO_2 (Carbon dioxide)

- Coal based power plants, by the burning of fossil fuels for electricity generation.

- Combustion of fuels in the engines of automobiles, commercial vehicles and air planes contribute the most of global warming.
- Agricultural practices like stubble burning result in emission of CO2.
- Natural from organic matter, volcanoes, warm oceans and sediments.

Methane

Methane is 20 times as effective as CO_2 at trapping heat in the atmosphere. Its sources are attributed paddy cultivation, cattle rearing, bacteria in water bodies, fossil fuel production, ocean, non-wetland soils and forest / wild fi res.

N_2O (Nitrous oxide)

It is naturally produced in Oceans from biological sources of soil and water due to microbial actions and rainforests. Man-made sources include nylon and nitric acid production, use of fertilizers in agriculture, manures cars with catalytic converter and burning of organic matter.

Global Warming Effects on Plants

- Low agricultural productivity in tropics
- Frequent heat waves (Weeds, pests, fungi need warmer temperature)
- Increase of vectors and epidemics
- Strong storms and intense flood damage
- Water crisis and decreased irrigation
- Change in flowering seasons and pollinators
- Change in Species distributional ranges
- Species extinction

Strategies to deal with Global Warming

- Increasing the vegetation cover, grow more trees
- Reducing the use of fossil fuels and green house gases
- Developing alternate renewable sources of energy
- Minimising uses of nitrogeneous fertilizers, and aerosols.

Forestry
Agro forestry

Agroforestry is an integration of trees, crops and livestock on the same plot of land. The main objective is on the interaction among them. Example: intercropping of two or more crops between different species of trees and shrubs, which results in higher yielding and reducing the operation costs. This intentional combination of agriculture and forestry has varied benefits including increased bio-diversity and reduced erosion.

Some of the major species cultivated in commercial Agroforestry include Casuarina, Eucalyptus, MalaiVembu, Teak and Kadambu trees which were among the 20 species identified as commercial timber. They are of great importance to wood-based industries.

Benefits of agroforestry

- It is an answer to the problem of soil andwater conservation and also to stabilisethe soil (salinity and water table) reducelandslide and water run-off problem.
- Nutrient cycling between species improvesand organic matter is maintained.
- Trees provide micro climate for crops andmaintain O_2 – CO_2 balanced, atmospherictemperature and relative humidity.
- Suitable for dry land where rainfall isminimum and hence it is a good system foralternate land use pattern.
- Multipurpose tree varieties like Acacia areused for wood pulp, tanning, paper andfirewood industries.
- Agro-forestry is recommended for thefollowing purposes. It can be used asFarm Forestry for the extension of forests,mixed forestry, shelter belts and linear stripplantation.

Rehabilitation of degraded forests and recreation forestry

The production of woody plants combined with pasture is referred to silvopasture system. The trees and shrubs may be used primarily to produce fodder for livestock or they may be grown for timber, fuel wood and fruit or to improve the soil.

This system is classified into following categories.

i. Protein Bank: In this various multipurposetrees are planted in and around farmlands and range lands mainly for fodderproduction.

   Example: Acacia nilotica, Albizzia lebbek,Azadirachtaindica, Gliricidiasepium,Sesbania grandiflora.

ii. Livefence of fodder trees and hedges:Various fodder trees and hedges are plantedas live fence to protect the property fromstray animals or other biotic influences.
   Example: Gliricidiasepium, Sesbaniagrandiflora, Erythrina spp., Acacia spp..

Social forestry

It refers to the sustainable management of forests by local communities with a goal of climate carbon sequestration, change mitigation, depollution, deforestation, forest restoration and providing indirect employment opportunity for the youth. Social

forestry refers to the management of forests and afforestation on barren lands with the purpose of helping the environmental, social and rural development and benefits. Forestry programme is done for the benefit of people and participation ofthe people. Trees grown outside forests by government and public organisation reduce the pressure on forests.

In order to encourage tree cultivation outside forests, Tree cultivation in Private Lands was implemented in the state from 2007-08 to 2011-12.It was implemented by carrying out blockplanting and inter-crop planting with profitabletree species like Teak, Casuarina, Ailanthus,Silver Oak, etc. in the farming lands and by afree supply of profitable tree species for plantingin the bunds. The Tank foreshore plantationshave been a major source of firewood in TamilNadu. The 32 Forestry extension centresprovide technical support for tree growing inrural areas in Tamil Nadu. These centres providequality tree seedlings like thorn / thornlessbamboo, casuarinas, teak, neem, Melia dubia,grafted tamarind and nelli, etc. in private landsand creating awareness among students bytraining / camps.

Major activities of forestry extension centres

- Training on tree growing methods
- Publicity and propaganda regarding treegrowing
- Formation of demonstration plots
- Raising and supply of seedlings on subsidy
- Awareness creation among school childrenand youth about the importance of foreststhrough training and camps.

Deforestation

Deforestation is one of the major contributors to enhance green house effect and global warming. The conversion of forested area into a non-forested area is known as deforestation. Forests provide us many benefits including goods such as timber, paper, medicine and industrial products. The causes are

- The conversion of forests into agriculturalplantation and livestock ranching is a majorcause of deforestation.
- Logging for timber
- Developmental activities like roadconstruction, electric tower lines and dams.
- Over population, Industrialisation,urbanisation and increased global needs.

Effects of deforestation

- Burning of forest wood release storedcarbon, a negative impact just opposite ofcarbon sequestration.
- Trees and plants bind the soil particles. Theremoval of forest cover increases soil erosionand decreases soil fertility. Deforestation indry areas leads to the formation of deserts.

- The amount of runoff water increases soilerosion and also creates flash flooding, thusreducing moisture and humidity.
- The alteration of local precipitation patternsleading to drought conditions in manyregions. It triggers adverse climatic conditions and alters water cycle in ecosystem.
- It decreases the bio-diversity significantly astheir habitats are disturbed anddisruptionof natural cycles.
- Loss of livelihood for forest dwellers andrural people.
- Increased global warming and account forone-third of total CO_2 emission.
- Loss of life support resources, fuel, medicinal herbs and wild edible fruits.

Afforestation

Afforestation is planting of trees where there was no previous tree coverage and the conversion of non-forested lands into forests by planting suitable trees to retrieve the vegetation. Example: Slopes of dams afforested to reduce water run-off, erosion and siltation. It can also provide a range of environmental services including carbon sequestration, water retention.

The Man who SingleHandedly Created a Dense Forest
Jadav "Molai" Payeng (born 1963) is an environmental activist has single-handedly planted a forest in the middle of a barren wasteland. This Forest Man of India has transformed the world's largest river island, Majuli, located on one of India's major rivers, the Brahmaputra, into a dense forest, home to rhinos, deers, elephants, tigers and birds. And today his forest is larger than Central Park.

Former vice-chancellor of Jawahar Lal Nehru University, Sudhir Kumar Sopory named Jadav Payeng as Forest Man of India, in the month of October 2013. He was honoured at the Indian Institute of Forest Management during their annual event 'Coalescence'. In 2015, he was honoured with Padma Shri, the fourth highest civilian award in India. He received honorary doctorate degree from Assam Agricultural University and Kaziranga University for his contributions.

Afforestation Objectives

- To increase forest cover, planting more trees,increases O2 production and air quality.
- Rehabilitation of degraded forests toincrease carbon fixation and reducing $CO_2$from atmosphere.
- Raising bamboo plantations.
- Mixed plantations of minor forest produceand medicinal plants.
- Regeneration of indigenous herbs / shrubs.
- Awareness creation, monitoring andevaluation.
- To increase the level and availability of watertable or ground water and also to reducenitrogen leaching in soil and nitrogencontamination of drinking water, thusmaking it pure not polluted with nitrogen.

- Nature aided artificial regeneration.

Achievements

- Degraded forests were restored
- Community assets like overhead tanksbore-wells, hand pumps, community halls,libraries, etc were established
- Environmental and ecological stability wasmaintained.
- Conserved bio-diversity, wildlife and genetic resources.
- Involvement of community especiallywomen in forest management.

Agrochemicals and their effects

An agro-chemical is useful in managing agriculture or in farming area which is one of the major issues of the environment. Agro-chemicals includes fertilizers, liming and acidifying agents, soil conditioners, pesticides and chemicals used in animal husbandry, such as antibiotics and hormones.

Excessive use of fertilizers and pesticides leads to the contamination of groundwater and makes it non-potable, ultimately affecting the soil fertility. Most of the chemical fertilizers contain varying amounts of nitrogen, phosphorous, potassium and nutrients that plants need to grow. Soil acidity influences C and N cycles by affecting soil microbes, also green house gas flux in soils and affect bio availability of N, P, S like major nutrients. This makes the soil too acidic or alkaline so that it becomes difficult for the plants to survive. These residues and synthetic chemicals like DDT (dichloro diphenyl trichloro ethane) and PCBs (polychlorinated biphenyls) cause nutrient and pH imbalance and quality reduction of agricultural produce. This problem can be minimised by sustainable agriculture.

Pesticides increase incidence of brain, blood cancer and neurotoxicity, Parkinson like symptoms, infertility, birth defects, reproductive and behavioural disorders.

- Nitrates from fertilizers interact with the haemoglobin to form methyl haemoglobin. This reduces oxygen uptake, results in Blue baby syndrome (cyanosis) and hypoxia. Nitrates vasodilate and reduce blood pressure.
- Bio-magnification: Pollutants, toxic substances increase in water move from one food chain to many and finally reach human being and this process of bio-amplification or increase in concentration is called bio-magnification.

Alien invasive species

Invasion of alien or introduced species disrupts ecosystem processes, threaten biodiversity,reduce native herbs, thus reducing the ecosystem services (benefits). During eradication of these species, the chemicals used increases greenhouse gases. Slowly they alter ecosystem, micro climate and nature of soil and make it unsuitable

for native species and create human health problems like allergy, thus resulting in local environmental degradation and loss of important local species.

According to World Conservation Union invasive alien species are the second most significant threat to bio-diversity after habitat loss.

What is invasive species?

A non-native species to the ecosystem or country under consideration that spreads naturally, interferes with the biology and existence of native species, poses a serious threat to the ecosystem and causes economic loss.

It is established that a number of invasive species are accidental introduction through ports via air or sea. Some research organisations import germplasm of wild varieties through which also it gets introduced. Alien species with edible fruits are usually spread by birds.

Invasive species are fast growing and are more adapted. They alter the soil system by changing litter quality thereby affecting the soil community, soil fauna and the ecosystem processes.
It has a negative impact on decomposition in the soils by causing stress to the neighbouring native species. Some of the alien species which cause environmental issues are discussed below

Eichhorniacrassipes

It is an invasive weed native to South America. It was introduced as aquatic ornamental plant, which grows faster throughout the year. Its widespreadgrowth is a major cause of biodiversity loss worldwide. It affects the growth of phytoplanktons and finally changing the aquatic ecosystem.

It also decreases the oxygen content of the waterbodies which leads to eutrophication. It poses a threat to human health because it creates a breeding habitat for disease causing mosquitoes (particularly Anopheles) and snails with its free floating dense roots and semi submerged leaves. It also blocks sunlight entering deep and the waterways hampering agriculture, fisheries, recreation and hydropower.

Lantana camara

Identified as one of the worst invasive species by Global Invasive Species Database. It is also an invasive weed native to South America introduced as ornamental plant. It occupies a widely adaptable range of habitats.

This species is spread by birds It exerts allelopathic effect, which reduces the growth of surrounding plants by inhibiting germination and root elongation. Root removal

and bio-control are the best methods to control. Now tribes are trained to use the stem as fibre for making household materials like baskets, furniture and even cots.

Parthenium hysterophorus

Parthenium hysterophorus native to South America introduced accidently into many regions of the world along with imported food grains. It is a harmful weed in the forest which suppresses the growth of native species and reduces the availability of fodder for animals It infests pastures and farmland causing often loss of yield. The plant produces allelopathic chemicals that suppress crop and native plants and its pollen causes allergic rhinitis and asthma, dermatitis in humanbeing.

Prosopis juliflora

Prosopis juliflora is an invasive species native to Mexico and South America. It was first introduced in Gujarat to counter desertification and later on in Andhra Pradesh, Tamil Nadu as a source of firewood. It is an aggressive coloniser and as a consequence the habitats are rapidly covered by this species. Its invasion reduced the cover of native medicinal herbaceous species. It is used to arrest wind erosion and stabilize sand dunes on coastal and desert areas. It can absorb hazardous chemicals from soil and it is the main source of charcoal.

Conservation

India due to its topography, geology and climate patterns has diverse life forms. Now this huge diversity is under threat due to many environmental issues for this conservation becomes an important tool by which we can reduce many species getting lost from our native land. By employing conservation management strategies like germplasm conservation, in situ, ex-situ, in-vitro methods, the endemic as well as threatened species can be protected.

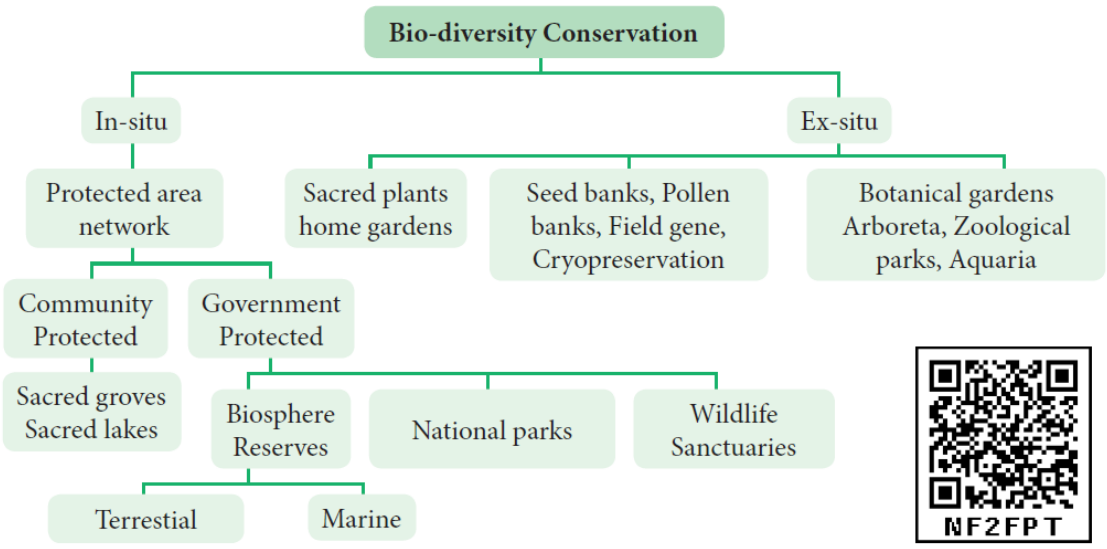


Figure 8.9: Flow chart on biodiversity conservation

Sacred groves

These are the patches or grove of cultivated trees which are community protected and are based on strong religious belief systems which usually have a significant religious connotation for protecting community. Each grove is an abode of a deity mostly village God Or Goddesses like Aiyanar or Amman. 448 grooves were documented throughout Tamil Nadu, of which 6 groves (Banagudi shola, Thirukurungudi and Udaiyankudikadu, Sittannnavasal, Puthupet and Devadanam) were taken up for detailed floristic and faunistic studies. These groves provide a number of ecosystem services to the neighbourhood like protecting watershed, fodder, medicinal plants and micro climate control.

International Union for Conservation of Nature (IUCN)

Founded in 1948, the International Union for Conservation of Nature (IUCN) is the world's oldest environmental organisation with its headquarters at Gland, Switzerland. It is a neutral forum for Governments, NGO's, Scientists, business and local communities with the aim of developing solution and implementing policies related to the conservation of environment and sustainable development.

IUCN Red List

IUCN Red List categories help us to evaluate the degree of threat and conservation priorities to the flora and fauna It is also a powerful tool forpersuading governments to protect threatened species and for most of the plant and animal species world-wide. IUCN has developed protected areas and developed criteria for threatened species.

Conservation movement

A community level participation can help in preservation and conservation of our environment. Our environment is a common treasure for all the living organisms on earth. Every individual should be aware of this and participate actively in the programs meant for the conservation of the local environment. Indian history has witnessed many people movements for the protection of environment.

Chipko Movement

The tribal women of Himalayas protested against the exploitation of forests in 1972. Later on it transformed into Chipko Movement by Sundarlal Bahuguna in Mandal village of Chamoli district in 1974. People protested by hugging trees together which were felled by a sports goods company. Main features of Chipko movement were,

- This movement remained non political
- It was a voluntary movement based onGandhian thought.

- ❖ It was concerned with the ecological balance of nature
- ❖ Main aim of Chipko movement was to give a slogan of five F's – Food, Fodder, Fuel, Fibreand Fertilizer, to make the communities selfsufficient in all their basic needs.

Appiko Movement

The famous Chipko Andolen of Uttarakhand in the Himalayas inspired the villagers of Uttar Karnataka to launch a similar movement to save their forests. This movement started in Gubbi Gadde a small village near Sirsi in Karnataka by Panduranga Hegde. This movement started to protest against felling of trees, monoculture, forest policy and deforestation.

The criteria are as follows.

A - Population reduction
B - Geographic range
C - Small population size and decline
D - Very small or restricted population
E - Quantitative analysis

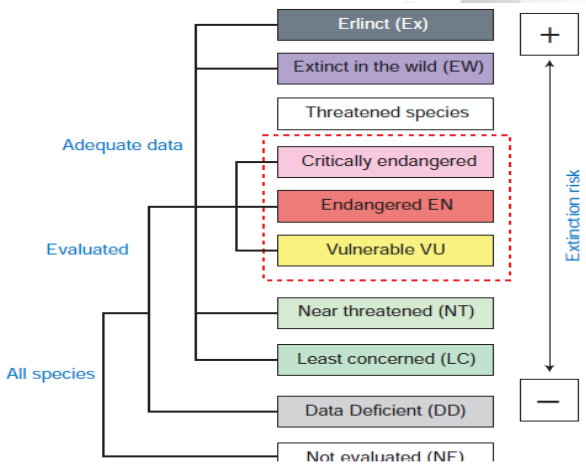


Figure 8.10: IUCN Red List categories

IUCN Red List categories
Extint (EX)

A taxon is Extinct when there is no reasonable doubt on the death of the last individual. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Example: Neuracanthusneesianus.

Extinct in the wild (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. Example: Ginkgo biloba

Critically endangered (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinctions in the wild. Example: Euphorbia santapaui, Piper barberi, Syzygiumgambelianum.

Endangered (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild. Example: Elaeocarpus venustus, Pogostemonnilagricus, Eugenia singampattiana.

Vulnerable (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any other criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild. Example: Dalbergialatifolia, Santalum album, Chloroxylonsweitenia

Near threatened (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for threatened category in the near future.

Least concerned (LC)

A taxon is Least Concerned when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, Widespread and abundant taxa are included in this category.

Data deficient (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of the risk of extinction based on its distribution and/or population status.

Not evaluated (NE)

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

Carbon Capture and Storage (CCS)

Carbon capture and storage is a technology of capturing carbondioxide and injects it deep into the underground rocks into a depth of 1 km or more and it is an approach to mitigate global warming by capturing CO_2 from large point sources such as industries and power plants and subsequently storing it instead of releasing it into the atmosphere. Various safe sites have been selected for permanent storage in various deep geological formations, liquid storage in the Ocean and solid storage by reduction of CO_2 with metal oxide to produce stable carbonates. It is also known as Geological sequestration which involves injecting CO_2 directly into the underground geological formations (such as declining oil fields, gas fields saline aquifers and unmineable coal have been suggested as storage sites).

Carbon Sink

Any system having the capacity to accumulate more atmospheric carbon during a given time interval than releasing CO_2. Example: forest, soil, ocean are natural sinks. Landfills are artificial sinks.

Carbon Sequestration

Carbon sequestration is the process of capturing and storing CO_2 which reduces the amount of CO_2 in the atmosphere with a goal of reducing global climate change.

Carbon sequestration occurs naturally by plants and in ocean. Terrestrial sequestration is typically accomplished through forest and soil conservation practices that enhance the storage carbon.

As an example microalgae such as species of Chlorella, Scenedesmus, Chroococcus and Chlamydomonas are used globally for CO2 sequestration. Trees like Eugenia caryophyllata, Tecomastans, Cinnamomumverum have high capacity and noted to sequester carbon macroalgae and marine grasses and mangroves are also have ability to mitigate carbon-di-oxide.

Carbon Foot Print (CFP)

Every human activity leaves a mark just like our footprint. This Carbon foot print is thetotal amount of green house gases produced by human activities such as agriculture, industries, deforestation, waste disposal, buring fossil fuels directly or indirectly. It can be measured for an individual, family, organisation like industries, state level or national level. It is usually estimated and expressed in equivalent tons of CO2 per year. The burning of fossil fuels releases CO2and other green house

gases. In turn these emissions trap solar energy and thus increase the global temperature resulting in ice melting, submerging of low lying areas and inbalance in nature like cyclones, tsunamis and extreme weather conditions. To reduce the carbon foot print we can follow some practices like

(i) Eating indigenous fruits and products
(ii) Reduce use of your electronic devices
(iii) Reduce travelling
(iv) Do not buy fast andpreserved, processed, packed foods.
(v) Plant agarden
(vi) Less consumption of meat and seafood. Poultry requires little space, nutrients andless pollution comparing cattle farming.
(vii) reduce use of Laptops (when used for 8 hours, itreleases nearly 2 kg. of CO_2 annually)
(viii) Linedry your clothes. (Example: If you buy importedfruit like kiwi, indirectly it increases CFP.How? The fruit has travelled a long distance inshipping or airliner thus emitting tons of CO2)

Biochar

Biochar is another long term method to store carbon. To increase plants ability to store more carbon, plants are partly burnt such as crop waste, waste woods to become carbon rich slow decomposing substances of material called Biochar. It is a kind of charcoal used as a soil amendment. Biochar is a stable solid, rich in carbon and can endure in soil for thousands of years. Like most charcoal, biochar is made from biomass via pyrolysis. (Heating biomas in low oxygen environment) which arrests wood from complete burning. Biochar thus has the potential to help mitigate climate change via carbon sequestration. Independently, biochar when added to soil can increase soil fertility ofacidic soils, increase agricultural productivity, and provide protection against some foliar and soil borne diseases. It is a good method of preventing waste woods and logs getting decayed instead we can convert them into biochar thus converting them to carbon storage material.

Rain water harvesting – RWH (Solution to water crisis – A ecological problem)

Rainwater harvesting is the accumulation and storage of rain water for reuse in-site rather than allowing it to run off. Rainwater can be collected from rivers, roof tops and the water collected is directed to a deep pit. The water percolates and gets stored in the pit. RWH is a sustainable water management practice implemented not only in urban area but also in agricultural fields, which is an important economicalcost effective method for the future.

Environmental benefits of Rain Water Harvesting:

- Promotes adequacy of underground waterand water conservation.
- Mitigates the effect of drought.

- Reduces soil erosion as surface run-off isreduced.
- Reduces flood hazards.
- Improves groundwater quality and watertable / decreases salinity.
- No land is wasted for storage purpose andno population displacement is involved.
- Storing water underground is an eco-friendly measure and a part of sustainablewater storage strategy for local communities.

Importance of Lakes

Water bodies like lakes, ponds not only provide us a number of environmental benefits but they strengthen our economy as well as our quality of life like health. Lakes as a storage of rain water provides drinking water, improves ground water level and preserve the fresh water bio-diversity and habitat of the area where in occurs.

In terms of services lakes offer sustainable solutions to key issues of water management and climatic influences and benefits like nutrient retention, influencing local rainfall, removal of pollutants, phosphorous and nitrogen and carbon sequestration.

Important lakes in Tamil Nadu

Lakes are man-made surface water harvesting systems. They are useful for irrigation, drinking, fishing and recreation purposes. It is the responsibility of the individuals as well as communities collectively to maintain and manage water bodies. Understanding catchment areas help us to halt the degradation of water bodies and protecting it from getting polluted.

SholavaramLake : It is located in Ponneri Taluk of Thiruvallur District. It is one of the rain fed reservoir from where water is drawn for supply to Chennai city. The full capacity of the lake is 65.5 ft. Built in the British era this lake is responsible for treating the guests to water sports too. This lake is rich in varied species of flora and fauna.

Chembarampakkam Lake: It is located about 25 km. from Chennai. This lake is 500 yrs old. This lake is a rain fed water body which aids the Chennai City in its water supply. A river named Adyar also incepts from this lake which acts as the primary outflow for this reservoir. This lake is spread over an area of 15 square km.

Maduranthakam Lake: It is located in Kancheepuram district and it is a man-made creation. An ideal spot for an evening picnic, the widespread pristine waters of the lake are an exceptionally calming sight. The full capacity of the reservoir is 23.3ft. Kiliyar is a small river that originates from Madhuranthagam reservoir. It spreads to an area of 2908 acres and was built by Uttama Chola and the boundaries (stretched

upto 12960 feet) are strengthened by Britishers with a storing capacity of 690 million cu.feet. Rain water from Cheyyar, Thiruvannamalai and Vandavasi reaches this lake.

Sewage disposal

Sewage disposal treatment helps to transform raw sewage into an easier manageable waste and to retrieve and reuse treated residual sewage materials. Greenhouse gases like carbon-dioxide, methane, nitrous oxide are produced during sewage treatment which apart from causing the impact on the atmosphere, it also affect the urban ecosystem, aquatic ecosystems. By making use of advanced disposal treatment plants, climate change and pollution can be minimised.

Sewage is waste matter such as faeces or used dirty water from homes and factories, which flows away through sewers. Sewage treatment is the process of removing contaminants from waste water, primarily from household sewage. Physical, chemical and biological processes are used to remove contaminants and produce treated waste water, that is safer for the environment. Sewage contains large amounts of organic matter and microbes. This cannot be discharged into natural water bodies like rivers and streams directly. Hence sewage is treated in sewage treatment plants (STPs) to make it lessSewage treatment generally involves three stages, called primary, secondary and tertiary treatment.

Solid waste management

Solid waste refers to all non liquid wastes which causes health problems and unpleasant living environment leading to pollution. Solid waste management is a term that is used to refer to the process of collecting and treating solid wastes. It is all about how it can be changed and recycled as a valuable resource.

Methods of solid waste management includes Landfill, incineration, recovery, recycling, composting, and pyrolysis.

- Technologicaladvancement for processingtreatment and disposal of solidwaste helps in converting it intorenewable energy and organicmanure.
- Electronicwaste contains toxic materials and are found to be non-biodegradable which causes threat to human health and the smoke during recycling and leaching causes great threat to water bodies. Agricultural landfills method stands a good method to reduce these problems.

Liquid Waste Management

Liquid waste includes point source and non-point source discharges such as storm water and waste water. Examples of liquid waste include wash water from homes, liquids, used for cleaning in industries and waste detergents.

Grey water is the one from municipal waste which contains harmful pathogens. Water coming from domestic equipments other than toilets (bathtub, showers, sinks, and washing machine) is also referred as grey water. Municipal wastes can be detoxified biologically and then recycled. Domestic waste water can be recycled and used for gardening.

Environmental Impact Assessment (EIA)

Environmental Impact Assessment is an environmental management tool. It helps to regulate and recommend optimal use of natural resources with minimum impact on ecosystem and biotic communities. It is used to predict the environmental consequences of future proposed developmental projects (example: river projects, dams, highway projects) taking into account inter-related socio-economic, cultural and human-health impacts. It reduces environmental stress thus helping to shape the projects that may suit local environment by ensuring optimal utilization of natural resources and disposal of wastes to avoid environmental degradation.

The benefits of EIA to society

- A healthier environment
- Maintenance of biodiversity
- Decreased resource usage
- Reduction in gas emission and environmentdamage

Biodiversity Impact Assessment (BIA)

Biodiversity Impact Assessment can be defined as a decision supporting tool to help biodiversity inclusive of development, planningand implementation. It aims at ensuring development proposals which integrate bio-diversity considerations. They are legally compliant and include mechanisms for the conservation of bio-diversity resources and provide fair and equitable sharing of the benefits arising from the use of bio-diversity.

Biomonitoring

The act of observing and assessing the current state and ongoing changes in ecosystem, biodiversity components, landscape including natural habitats, populations and species.

An agricultural drone is an unmanned aerial vehicle applied to farming in order to help increased crop production and monitor crop growth. Agricultural drones let farmers see their fields from the sky. This bird's eye-view can reveal many issues such as irrigation problems, soil variation and pest and fungal infestations. It is also used for cost effective safe method of spraying pesticides and fertilizers, which proves very easy and non-harmful

Bio-diversity impacts can be assessed by

- Change in land use and cover
- Fragmentation and isolation
- Extraction
- External inputs such as emissions, effluentsand chemicals
- Introduction of invasive, alien or geneticallymodified species
- Impact on endemic and threatened flora andfauna.

Geographic Information System

GIS is a computer system for capturing, storing, checking and displaying data related to positionson Earth's surface. Also to manipulate, analyse, manage and present spacial or geographic data.

GPS is a satellite navigation system used to determine the ground position of an object. It is a constellation of approximately 30 well spaced satellites that orbit the earth and make it possible for the people with ground receivers to pinpoint their geographic location. Some applications in which GPS is currently being used for around the world include Mining, Aviation, Surveying Agricultural and Marine ecosystem.

Importance of GIS

- Environmental impact assessment
- Disaster management
- Zoning of landslide hazard
- Determination of land cover and land use
- Estimation of flood damage
- Management of natural resources
- Soil mapping
- Wetland mapping
- Irrigation management and identification ofvolcanic hazard
- Vegetation studies and mapping ofthreatened and endemic species.

Remote Sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance from the targeted area. It is an tool used in conservation practices by giving exact picture and data on identification of even a single tree to large area of vegetation and wild life for classification of land use patterns and studies, identification of biodiversity rich or less areas for futuristic works on conservation and maintenance of various species including commercial crop, medicinal plants and threatened plants.

Specific uses

- Helps predicting favourable climate, for thestudy of spreading of disease and control ingit.
- Mapping of forest fire and speciesdistribution.
- Tracking the patterns of urban areadevelopment and the changes in Farmlandor forests over several years
- Mapping ocean bottom and its resources

Applications of Satellites

Name of the Satellites	Year of Launch	Application
SCATSAT – I	Sep. 2016	Weather forecasting, cyclone prediction and tracking services in India
INSAT 3DR	Sep. 2016	Disaster management
CARTOSAT – 2	Jan. 2018	Earth observation
GSAT – 6A	March 2018	Communication
CARTOSAT – 2 (100^{th} Satellite)	Jan. 2018	To watch border surveillance

Van't Hoff's rule

Van't Hoff proposed that, with the increase of every 10°C, the rate of metabolic activity doubles or the reaction rate is halved with the decrease of 10°C. This rule is referred as the van't Hoff's rule. The effect of temperature on the rate of reaction is expressed in terms of temperature coefficient or Q10 value. The Q10 values are estimated taking the ratio between the rate of reaction at X°C and rate of reaction at (X-10°C). In the living system the Q10 value is about 2.0. If the Q10 value is 2.0, it means 10°C increase and the rate of metabolism doubles.

- **Phototaxis:** The movement of organism in response to light, either towards the source of light as in Moths (positive phototaxis) or away from light (Euglena, Volvox, earthworm (negative phototaxis).
- **Phototropism:** The growth or orientation of an organism in response to light, either towards the source of light (positive phototropism) as seen in Sunflower, or a way from light (negative phototropism) as in case of the root of plants.
- **Photokinesis:** A change in the speed of locomotion (or frequency of turning) in a motile organism or cell which is made in response to a change in light intensity is called Photokinesis. It involves undirected random movement in response to light.

12th zoology

Unit - 12 Biodiversity and its conservation

Biodiversity

The 1992 UN Earth Summit defined Biodiversity as the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes diversity within species, between species and ecosystems of a region. It reflects the number of different organisms and their relative frequencies in an ecological system and constitutes the most important functional component of a natural ecosystem.It helps to maintain ecological processes, create soil, recycle nutrients, influence climate, degrade waste and control diseases. It provides an index of health of an ecosystem.The survival of human race depends on the existence and wellbeing of all life forms (plants and animals) in the biosphere.

Concept of biodiversity

The term biodiversity was introduced by Walter Rosen (1986). Biodiversity is the assemblage of different life forms. Each species is adapted to live in its specific environments.The changes in climatic conditions are reflected in the distribution and pattern of biodiversity on our planet. The number of species per unit area declines as we move from tropics towards the poles. The Tundra and Taiga of northern Canada, Alaska, northern Europe and Russia possess less than 12 species of trees. The temperate forests of the United states have 20-35 species of trees,while the tropical forests of Panama have over 110 species of trees in a relatively small area.

Levels of biodiversity

Edward Wilson popularized the term 'Biodiversity' to describe diversity at all levels of biological organization from populations to biomes. There are three levels of biodiversity - Genetic diversity, Species diversity and Community/Ecosystem diversity (Fig. 12.1).

Genetic diversity refers to the differences in genetic make-up (number and types of genes) between distinct species and to the genetic variation within a single species; also covers genetic variation between distinct populations of the same species. Genetic diversity can be measured using a variety of molecular techniques. India has more than 50,000 genetic variants of Paddy and 1000 variants of Mango. Variation of genes of a species increases with diversity in size and habitat. It results in theformation of different races, varieties and subspecies. Rouwolfavomitaria, a medicinal plant growing in different ranges of the Himalayas shows differences in the potency and concentration of the active ingredient reserpine due to genetic diversity. Genetic diversity helps in developing adaptations to changing environmental conditions.

Species diversity refers to the variety in number and richness of the species in any habitat. The number of species per unit area at a specific time is called species richness, which denotes the measure of species diversity. The Western Ghats have greater amphibian species diversity than the Eastern Ghats. The more the number of species in an area the more is the species richness (Fig. 12.1a). The three indices of diversity are - Alpha, Beta and Gamma diversity.

i. Alpha diversity: It is measured by counting the number of taxa (usually species) within a particular area, community or ecosystem.
ii. Beta diversity: It is species diversity between two adjacent ecosystems and is obtaining by comparing the number of species unique to each of the ecosystem.
iii. Gamma diversity refers to the diversity of the habitats over the total landscape or geographical area.

Community/Ecosystem diversity is the variety of habitats, biotic communities, and ecological processes in the biosphere. It is the diversity at ecosystem level due to diversity of niches, trophic levels and ecological processes like nutrient cycles, food webs, energy flow and several biotic interactions. India with its alpine meadows, rain forests, mangroves, coral reefs, grass lands and deserts has one of the greatest ecosystem diversity on earth.

Magnitude of biodiversity

Biodiversity is often quantified as the number of species in a region at a given time. The current estimate of different species on earth is around 8-9 million. However, we really don't know the exact magnitude of our natural wealth. This is called the 'The Taxonomic impediment'. So far about 1.5 million species of microorganisms, animals and plants have beendescribed. Each year about 10-15 thousand new species are identified and published worldwide, of which 75% are invertebrates. The number of undescribed species is undoubtedly much higher.

India is very rich in terms of biological diversity due to its unique bio-geographical location, diversified climatic conditions and enormous eco-diversity and geo-diversity According to world biogeographic classification, India represents two of the major realms (The Palearctic and Indo-Malayan) and three biomes (Tropical humid forests, Tropical Dry/ Deciduous forests and Warm Deserts/Semi deserts). With only about 2.4% of the world's total land surface, India is known to have over 8 % of the species of animals that the world holds and this percentage accounts for about 92,000 known species.India is the seventh largest country in the world in terms of area. India has a variety of ecosystems, biomes with its varied habitats like, hills, valleys, plateaus, sea shores, mangroves, estuaries, glaciers, grasslands and river basins. It also reflects different kinds of climates, precipitation, temperature distribution, river flow and soil. India is one of the 17 mega biodiversity countries of the world and has ten biogeographic zones with characteristic habitat and biota.

"The world is currently undergoing a very rapid loss of biodiversity comparable with the great mass extinction events that have previously occurred only five or six times in the earth's history."

- World Wildlife Fund

Patterns of biodiversity distribution

The distribution of plants and animals is not uniform around the world. Organisms require different sets of conditions for theiroptimum metabolism and growth. Within this optimal range (habitat) a large number and type of organisms are likely to occur, grow and multiply. The habitat conditions are determined by their latitudes and altitudes.

Latitudinal and altitudinal gradients:

Temperature, precipitation, distance from the equator (latitudinal gradient), altitude from sea level (altitudinal gradient) are some of the factors that determine biodiversity distribution patterns. The most important pattern of biodiversity is latitudinal gradient in diversity. This means that there is an increasing diversity from the poles to equator. Diversity increases as one moves towards the temperate zones and reaches the maximum at the tropics. Thus, tropics harbour more biodiversity than temperate or polar regions, especially between the latitudes of 23.5ºN and 23.5ºS (Tropic of Cancer to the Tropic of Capricorn). Harsh conditions exist in temperate areas during the cold seasons while very harsh conditions prevail for most of the year in polar regions.

Columbia located near the equator (0º) has nearly 1400 species of birds while New York at 41ºN has 105 species and Greenland at 71ºN has 56 species. India, with much of its land area in the tropical latitudes, is home for more than 1200 species of birds. Thus it is evident that the latitude increases the species diversity.Decrease in species diversity occurs as one ascends a high mountain due to drop in temperature (temperature decreases @ 6.5º C per Km above mean sea level). The reasons for the richness of biodiversity in the Tropics are:

- Warm tropical regions between the tropic of Cancer and Capricorn on either side of equator possess congenial habitats for living organisms.
- Environmental conditions of the tropics are favourable not only for speciationbut also for supporting both variety and number of organisms.
- The temperatures vary between 25ºC to 35ºC, a range in which most metabolic activities of living organisms occur with ease and efficiency.
- The average rainfall is often more than 200 mm per year.
- Climate, seasons, temperature, humidity, photoperiods are more or less stable and encourage both variety and numbers.
- Rich resource and nutrient availability.

Importance of biodiversity – Global and India

Biodiversity is the variety of life on earth. That is, it is the number of different species of flora and fauna including microorganisms. These organisms can inhabit different ecosystems with varying conditions like the Rainforests, Coral reefs, Grasslands, Deserts, Tundra and the Polar ice caps. This variety (Biodiversity) is essential for the wellbeing of our planet and sustenance of life as a whole. The importance of biodiversity can be viewed and measured as

a) Ecosystem services b) Biological resources c) Social benefits of biodiversity

The organization and functioning of ecosystems world over is effected and dependent on biodiversity and its richness. The major functional attributes are:

- continuity of nutrient cycles or biogeochemical cycles (N2, C, H2O, P, S cycles)
- soil formation, conditioning or maintenance of soil health (fertility) by soil microbial diversity along with the different trophic members
- increases ecosystem productivity and provide food resources
- act as water traps, filters, water flow regulators and water purifiers (forest cover and vegetation)
- climate stability (forests are essential for rainfall, temperature regulation, CO2 absorption, which in turn regulate the density and type of vegetation)
- forest resource management and sustainable development
- maintaining balance between biotic components
- cleaning up of pollutants – microbes are the biggest degraders of molecules including many anthropogenic ones which are present in effluents, sewage, garbage and agro-chemicals
- ecological stability – the varieties and richness of species contribute to ecological stability and survival of species. Biodiverse regions are reservoirs of biological resources like food resources, gene pool, genetic resource, medicinal resources, bio-prospecting
- to provide unique aesthetic value and hot spots for Ecotourism. Along with forest resources and wildlife it has commercial significance
- an indicator of the health of the ecosystem. Endemism is a crucial indicator of richness.

Do you know?

The interrelationship and interdependence of all living components in a system can be seen from the example of the fruit bats of Guam (South East Asia). The fruit bats are a delicacy here, and hence their population has dwindled which is not surprising. What is surprising is that local fruit production has got affected as it was identified that the bats served as pollinators. Hence there is a need for conservation of diversity as that could avert such situations.

Biogeographical regions of India

As per the international 'biome' type of classification based upon climate, fauna and flora and the soil conditions, India can be divided into ten different biogeographic zones, (Fig. 12.3) namely:

1. **Trans Himalayan Region**: An extension of the Tibetan plateau, high-altitude cold desert in Ladakh (J&K) and LauhalaSpiti (H.P) comprising 5.7% of the country's landmass. The mountains of this region have the richest wild sheep and goat community in the world, renowned for its quality wool and wool products. Otherfauna include Chiru and Black-rocked Crane.

2. **Himalayas**: The entire mountain chain running from north-western to northeastern India, comprising a diverse range of biotic provinces and biomes and covers 7.2% of the country's landmass. The common fauna of the Himalayan ranges, are the wild sheep, mountain goats, shrew, snow leopard and panda, many of which are endangered.

3. **Indian Desert**: The extremely arid area west of the Aravalli hill range, comprising both the salty desert of Gujarat and the sand desert of Rajasthan. It comprises 6.9% of the country's land-mass. Wild ass is endemic to this region. It is also the habitat for the Indian Bustard, camel, foxes and snakes, many of which are endangered.

4. **Semi – Arid Zones**: This zone is between the desert and the Deccan plateau, including the Aravalli hill range covering 15.6% of the country's landmass. Fauna found here are nilghai, blackbuck, four horned antelopes, sambar, chital and spotted deer which are herbivores along with predators like Asiatic lion, tiger, leopard and jackal.

5. **Western Ghats**: Western Ghats, are mountain ranges along the west coast of India, extending over almost 1,500km from Sat Pena in south Gujarat to the southernmost tip of Kerala. The annual rainfall is about 2000 mm. This zone has large populations of Nilgiritahr (State animal of Tamil Nadu), Nilgirilangur, tiger, leopard, and Indian elephant.The grizzled squirrel and lion tailed macaque are endemic to this region.

6. **Deccan Peninsula**: This covers much of the southern and south-central plateau with predominantly deciduousvegetation and 4.3% of the country's landmass. It is known for deciduous forests, thorn forests and pockets of semi ever green forests. Fauna found here are Chital, Sambhar, Nilghai, elephant, sloth bear, black buck and barking deer. It is the catchment area of major Indian rivers like Godavari, Tapti, Narmada and Mahanadi.

7. **Gangetic Plains**: These plains are relatively homogenously defined by the Ganges river system and occupy about 11% of the country's landmass. This

region is very fertile and extends up tothe Himalayan foothills. Fauna includes rhinoceros, elephant, buffalo, swamp deer, hog-deer.

8. **North-East India:** The plains and non-Himalayan hill ranges of north eastern India are home to a wide variety of vegetation. With 5.2% of the country's landmass, this region represents the transition zone between the Indian, Indo-Malayan and Indo-Chinese bio-geographical regions and is the meeting point of the Himalayan Mountains andpeninsular India. The North-East is thus the biogeographical 'Gateway' for much of India's fauna and flora and also biodiversity hotspot (Eastern Himalaya), which includes the Indian rhinoceros, leopard and golden langur.

9. **Coastal Region:** Coastal region of India with sandy beaches, mud flats, coral reefs, mangroves constitutes 2.5% of the total geographical area. The coastline from Gujarat to Sundarbans is estimated to be 5423km long. Apart from this a total of 25 islets constitute the Lakshadweep, which are of coral origin and have a typical reef lagoon system, rich in biodiversity. The fauna includes native crabs, turtles and tunas

10. **Andaman and Nicobar Islands**: The Andaman and Nicobar Islands in the Bay of Bengal have highly diverse set of biomes, constituting 0.3% of the total geographical area. They are centers of high endemism and contain some of India's finest evergreen forests and support a wide diversity of corals. Fauna includes Narcondam hornbills of the Andamans and the South Andaman Krait.

Threats to biodiversity

Even though India is one of the 17 identified mega diverse countries of the world, it faces lots of threats to its biodiversity.Apart from natural causes, human activities, both directly and indirectly are today's main reason for habitat loss and biodiversity loss. Fragmentation and degradation due to agricultural practices, extraction (mining, fishing, logging, harvesting) and development (settlements, industrial and associated infrastructures) leads to habitat loss and fragmentation leads to formation of isolated, small and scattered populations and as endangered species.

Some of the other threats include specialized diet, specialized habitat requirement, large size, small population size, limited geographic distribution and high economic or commercial value. Large mammals by virtue of their size require larger areas to obtain the necessities of life - food, cover, mates than do smaller mammals. Individual home range of Lion can be about 100 square Km. Mammals have specialized dietary needs such as carnivores, frugivores and the need to forage over much larger areas than general dietary herbivores and omnivores. Mammals also have low reproductive output other than small rodents.

Causes of biodiversity loss

The major causes for biodiversity decline are:

- Habitat loss, fragmentation and destruction (affects about 73% of all species)
- Pollution and pollutants (smog, pesticides, herbicides, oil slicks, GHGs)
- Climate change
- Introduction of alien/exotic species
- Over exploitation of resources (poaching, indiscriminate cutting of trees, over fishing, hunting, mining)
- Intensive agriculture and aqua cultural practices
- Hybridization between native and non-native species and loss of native species
- Natural disasters (Tsunami, forest fire, earth quake, volcanoes)
- Industrialization, Urbanization, infrastructure development, Transport – Road and Shipping activity, communication towers, dam construction, unregulatedtourism and monoculture are common area of specific threats
- Co-extinction

Hotspots

Hotspots are areas characterized with high concentration of endemic species experiencing unusual rapid rate of habitat modification loss. Norman Myers defined hot spots as "regions that harbour a great diversity of endemic species and at the same time, have been significantly impacted and altered by human activities."A hotspot is a region that supports at least 1500 endemic vascular plant species (0.5% of the global total) has lost more than 70% of its original vegetation. There are 35 biodiversity hotspots in the world. India is home to four biodiversity hotspots (as per ENVIS). They are

a. Himalaya (the entire Indian Himalayan region)
b. Western Ghats
c. Indo-Burma: includes entire North-eastern India, except Assam and Andaman group ofIslands (and Myanmar, Tailand, Vietnam, Laos, Cambodia and Southern China)
d. Sundalands: includes Nicobar group of Islands (and Indonesia, Malaysia, Singapore, Brunei, Philippines)

IUCN

The International Union for Conservation of Nature (IUCN) is an organization working in the field of nature conservation and sustainable use of natural resources. It was established in 1948 and located at Gland VD, Switzerland. It is involved in data gathering and analysis research, field projects and education on conservation, sustainable development and biodiversity. IUCN's mission is to influence, encourage and assist societies throughout the world to conserve nature

and to ensure that any use of natural resources is equitable and ecologically sustainable. It influences governments and industries through partnerships by providing information and advice. The organization collects, compiles and publishes the IUCN red list of threatened species and their conservation status in the world. It plays a vital role in the implementation of several international conventions on nature conservation and biodiversity.

Red Data Book

Red Data book or Red list is a catalogue of taxa facing risk of extinction. IUCN – International Union of Conservation of Nature and Natural Resources, which is renamed as WCU – World Conservation Union (Morges Switzerland) maintains the Red Data book. The concept of Red list was mooted in 1963. The purpose of preparation of Red List are:

- To create awareness on the degree of threat to biodiversity
- Identification and documentation of species at high risk of extinction
- Provide global index on declining biodiversity
- Preparing conservation priorities and help in conservation of action
- Information on international agreements on conservation of biological diversity

Red list has eight categories of species Extinct ii) Extinct in wild iii) Critically Endangered iv) Endangered v) Vulnerable vi) Lower risk vii) Data deficiency viii) Not evaluated.

Biodiversity and its conservation

The natural resources of the Earth, including air, water, land, flora and fauna of natural ecosystems must be safeguarded for the benefit of the present and future generations through careful planning and management, as appropriate – Principle of the Stockholm Declaration, 1972.The large-scale loss of biodiversity and its global impact makes conservation the need of the hour. Conservation of biodiversity is protection and scientific management of biodiversity so as to maintain it at its optimum level and derive sustainable benefits for the present as well as future generations. It aims to protect species from extinction and their habitats and ecosystems from degradation.

General strategies in conservation

- identify and protect all threatened species
- identify and conserve in protected areas the wild relatives of all the economically important organisms
- identify and protect critical habitats for feeding, breeding, nursing, resting of each species

- resting, feeding and breeding places of the organisms should be identified and protected
- Air, water and soil should be conserved on priority basis
- Wildlife Protection Act should be implemented

There are two aspects of conservation strategies (Fig. 12.3)

i) In-situ conservation
ii)Ex-situ conservation

In-situ Conservation (Conservation in the natural habitat):

This is the conservation of genetic resources through their protection within a natural or manmade ecosystem in which they occur. It is conservation and protection of the whole ecosystem and its biodiversity at all levels in order to protect the threatened species.Maximum protection of biodiversity hotspots regions with very high levels of species richness. Although all the biodiversity hotspots together cover less than 2 percent of the earth land area, the number of species they harbour is extremely high and protection of these hotspots could reduce the ongoing mass.

Protected Areas:

These are biogeographical areas where biological diversity along with natural and cultural resources is protected, maintained and managed through legal measures. protected areas include national parks, wild life sanctuaries, community reserves and biosphere reserves. World Conservation monitoring centre has recognized 37,000 protected areas world-wide. India has about 771 protected areas covering 162099 km2 comprising of National Parks (104), Wild Life Sanctuaries (544), biosphere reserves (18) and several sacred groves.

National Parks (NP):

It is a natural habitat that is notified by the state government to be constituted as a National Park due to its ecological, faunal, floral, geomorphological, or zoological association of importance. No human activity is permitted inside the national park except the activities permitted by the Chief Wildlife Warden of the state under the conditions given in CHAPTER IV, of the Wildlife Protection Act (WPA) 1972 (Table 12.1).

Project Tiger:

The Government of India launched the 'Project Tiger' in 1973 to protect our national animal. From 9 tiger reserves since its inception, the Project Tiger coverage has increased to 50 at present. Project Tiger is an ongoing Centrally Sponsored Scheme of the Ministry of Environment and Forests, providing central assistance to the states for tiger conservation in designated tiger reserves. Project Tiger was

launched in the Jim Corbett National Park, Uttarakhand in1973. The project ensures a viable population of Bengal tigers in their natural habitats, protecting them from extinction and preserving areas of biological importance as a natural heritage.

The National Tiger Conservation Authority (NTCA) is a statutory body of the Ministry, created under the Wildlife (Protection) Act, 1972. India holds over half the world's tiger population. According to the latest tiger census report released on 20th January 2015 by NTCA, the current tiger population is estimated at 2,212. There are 50 tiger reserves in the country.

National Parks in Tamil Nadu

National Parks in Tamil Nadu	Year of establishment	District(s)
Guindy NP	1976	Chennai
Gulf of Mannar Marine NP	1980	Ramanathapuram and Tuticorin
Indira Gandhi (Annamalai) NP	1989	Coimbatore
Mudumalai NP	1990	Nilgris
Mukurthi NP	1990	Nilgris

There are 104 existing national parks in India covering an area of 40,501 km2, which is 1.23% of the geographical area of the country (National Wildlife Database, Aug. 2018). National Park is an area which is strictly reserved for the betterment of wildlifeand biodiversity and where activities like development, forestry, poaching, hunting, grazing and cultivation are not permitted. They are large areas of scenic and national beauty maintained for scientific educational and recreational use. They are not used for commercial extraction of resources. KazirangaNational park is a protected area for the one Horned Rhinoceros in Assam.

Wild Life Sanctuaries (WLS):

Any area other than the area comprised with any reserve forest or the territorial waters can be notified by the State Government to constitute as a sanctuary if such area is of adequate ecological, faunal, floral, geomorphological, natural or zoological significance. This is for the purpose of protecting, endangered factual species. Some restricted human activities are allowed inside the Sanctuary area details of which are given in CHAPTER I V, of the Wildlife Protection Act (WPA) 1972. Ecotourism is permitted, as long as animal life is undisturbed.

There are 544 existing wildlife sanctuaries in India covering an area of 118,918 km2, which is 3.62 % of the geographical area of the country (National Wildlife Database, 2017).Sanctuaries are tracts of land where wild animals and fauna can take refuge without being hunted or poached. Other activities like collection of forest products, regulated harvesting of timber, private ownership of land are permitted.

Periyar wild life sanctuary in Kerala is famous for the Indian Tiger and Asiatic Elephant.

Wild life sanctuaries in Tamil Nadu

Prominent WLS in Tamil Nadu	Year of establishment	Districts
Vedanthangal Lake Birds WLS	1936	Chengalpet
Mudumalai WLS	1942	Nilgiris
Point Calimere WLS	1967	Nagapattinam
Indira Gandhi (Annamalai) WLS	1976	Coimbatore
Mundanthurai WLS	1977	Tirunelveli

THE MADRAS CROCODILE BANK TRUST

The Madras Crocodile Bank Trust and Centre for Herpetology was the brain child of the legendary Romulus Whitaker and a handful of like-minded conservation visionaries, who began work on the facility in 1976. It aimed to save India's dwindling crocodilian population. The mission is to promote the conservation of reptiles and amphibians and their habitats through education, scientific research and capture breeding. The crocodile bank remains a world leader in the field of frontline conservation and the preservation of natural landscapes. The Crocodile Bank currently consists of a large reptile park near Chennai and several field projects located throughout the subcontinent reaching as far as the Nicobar Islands. About half a million people visit the bank every year, making it one of the most popular tourist attractions along the East Coast Road.

Arignar Anna Zoological Park, Vandalur

Arignar Anna Zoological Park is spread over an area of 602 hectares. of Reserve Forest at Vandalur, Chennai. It is one of the largest zoo in South East Asia in terms of area. The Zoological Park exhibits different classes of animals - it has around 2500 wild animals of nearly 180 species which includes Mammals, Birds and Reptiles. 34 years since its establishment, the Zoological Park has emerged as a successful ex-situ conservation centre and a captive breeding centre for many endangered species like Royal Bengal Tiger, Lion Tailed Macaque, NilgiriLangur, Gray Wolf, etc.,

The Zoo has many attractive features like Butterfly Park, Children's Park, Walk Through Aviary, Lion & Deer Safari, Forest Museum, Interpretation centre, etc., which attractsof installing CCTV Cameras for both visitors and animal management under the name of Zoo e-Eye. 24 x 7 Animal Live Streaming was introduced for the benefit of the visitors for the first time in the world. Vandalur Zoo Mobile Application was introduced to provide services to the visitors like facility to book tickets, Zoo navigation, Animal information in text and audio format. Digital payments at ticket counters are also available.

The Zoo school has been involved in education and outreach programmes. One such successful programme is 'Zoo Ambassador' which is been conducted for school children. In the year 2018, more than 400 students were trained and titled as Zoo Ambassadors. The Zoo also has a Rescue Centre which accommodates rescued wild animals and treats them to come out of stress.

Source: Director, Arignar Anna Zoological Park, Vandalur, Chennai

Biosphere Reserve (BR):

Biosphere Reserve (BR) is an international designation by UNESCO for representative parts of natural and cultural landscapes extending over large area of terrestrial or coastal/ marine ecosystems or a combination thereof. BRs are designated to deal with the conservation of biodiversity, economic and social development and maintenance of associated cultural values. Biosphere Reserves are thus special environments for both people and nature and are living examples of how human beings and nature can co-exist while respecting each other's needs. The Biosphere Reserve Programme is guided by UNESCO's Man and Biosphere (MAB) programme, as India is a signatory to the landscape approach supported by MAB programme. The scheme called Biosphere Reserve was implemented by the Government of India in 1986. There are 18 Biosphere Reserves in the country. Agasthyamalai (Karnataka - Tamil Nadu -Kerala), Nilgiri (Tamil Nadu - Kerala), Gulf of Mannar (Tamil Nadu) are the BRs notifed in Tamil Nadu.

Sacred Groves

A sacred grove or sacred woods are any grove of trees that are of special religious importance to a particular culture. Sacred groves feature in various cultures throughout the world.

Ex-Situ Conservation

It is conservation of selected rare plants/ animals in places outside their natural homes. It includes offsite collections and gene banks.

Offsite Collections:

They are live collections of wild and domesticated species in Botanical gardens, Zoological parks, Wildlife safari parks, Arborata (gardens with trees and shrubs). The organisms are well maintained for captive breeding programmes. As a result, many animals which have become extinct in the world continue to be maintained in Zoological Parks. As the number increases in captive breeding, the individuals are selectively released in the wild. In this way the Indian crocodile and Gangetic dolphin have been saved from extinction.

Gene Banks:

Gene banks are a type of biorepository which preserve genetic materials. Seeds of different genetic strains of commercially important plants can be stored in long periods in seed banks, gametes of threatened species can be preserved in viable and fertile condition for long periods using cryopreservation techniques.However, it is not economically feasible to conserve all biological wealth and all the ecosystems. The number of species required to be saved from extinction far exceeds the conservation efforts.

Different between Insitu and Exsitu Conservation

Insitu Conservation	Existu Conservation
It is the on-site conservation or the conservation of genetic resources in natural populations of plant or animal species.	This is a conservation strategy which involves placing of threatened animals and plants in special care locations for their protection.
It is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or restoring the habitat itself, or by defending the species from predators.	It helps in recovering populations or preventing their extinction under simulated conditions that closely resemble their natural habitats.
National Parks, Biosphere Reserve, Wild Life Sanctuaries form insitu conservation strategies	Zoological parks and Botanical gardens are common exsitu conservation programs.

Role of WWF and CITES

World Wild Fund for Nature (WWF) is an international non-governmental charitable trust founded in 1961, with headquarters at Gland, Vaud, Switzerland. It aims at wildness preservation and the reduction of human impact on the environment. It was formerly named the World Wildlife Fund. The living planet report is being published every two years by WWF since 1998.The vision of WWF is to conserve nature and reduce the most pressing threats to the diversity of life on Earth by conserving the world's most ecologically important regions, protect and restore species and their habitats, strengthen local communities' ability to conserve the natural resources they depend upon and to ensure that the value of nature is reflected in decision made by individuals, communities, governments and businesses.

CITES:

The Convention on International Trade in Endangered Species (CITES) of wild faunaand flora, also known as the Washington Convention, is a multilateral treaty to protect endangered plants and animals. It was drafted from a resolution adopted from a meeting of members of the IUCN in 1963 and opened for signature

in 1973. It came into force during July 1975.It aims to ensure that international trade in specimens of wild animals and plants should not be a threat to the survival of the species in the wild. It accords varying degrees of protection to more than 35,0000 species of animals and plants.

ZOOLOGICAL SURVEY OF INDIA

The Zoological Survey of India (ZSI) was established in 1916 to promote survey, exploration and research leading to the advancement in our knowledge of various aspects of biodiversity of our country.

The objectives of ZSI are:

- Exploration, Survey, Inventorying and Monitoring of faunal diversity in various states, ecosystems and protected areas of India.
- Periodic review of the status of threatened and endemic species.
- Preparation of Red Data Book and Fauna of India.
- Biological studies on selected important species.
- Maintenance and Development of National Zoological Collections.

Restoration of Degraded Habitat

Biodiversity conservation through eco development - an Indian case study

The Forestry Research Education and Extension Project FREEP (A World Bank Initiative) in India is employing a strategy called 'eco development' which enlists local commodities in the preservation of biodiversity. The strategy involves developing alternate resources and sources of income for those who depend on the protected natural habitat (forest) for their livelihood.

FREEP is conducting pilot eco-development programmes in the Kalakad-Mundanthurai Tiger Reserve (KMTR) in Tamil Nadu. The reserve contains a unique and varied array of flora ranging from thorn and dry teak to tropical evergreen, and supports a rich variety of birds and mammals, including tigers, leopards and elephants.Te last tiger refuge in Tamil Nadu, the KMTR is one of 50 sites covered under the Indian Government's Project Tiger, a programme receiving international assistance to enhance tiger habitat.

Over 100 villages are now participating in the KMTR project. Communities and individual farmers have planted fuelwood and fodder plantations. Some villagers have installed cow dung-based gas plants for home fuel needs and are using fuel-saving pressure cookers and more efficient wood-burning stoves (smokeless chulas). Loans for a wide array of alternative income-generating activities such as dairy and poultry farming, tailoring, coconut leaf weaving, and setting up tea and dry goods shops are made available. Thus, the eco-development programme at the KMTR is rapidly coming to be seen as a model for conserving biodiversity through local participation.

Biodiversity Act (BDA)

The Convention on Biological Diversity (CBD) is a United Nations initiative to protect Biodiversity and encourage the sustainable use of natural resources. The convention was held in 1992 at the 'Earth Summit' in Brazil. India is a signatory of the CBD. The Biological Diversity Act, 2002 is an Act of the Parliament of India for preservation of biological diversity in India, and provides mechanism for equitable sharing of benefits arising out of the use of traditional biological resources and knowledge. The Act was enacted to meet the obligations under Convention on Biological Diversity (CBD), to which India is a party.

The National Biodiversity Authority (NBA) was established by the Central Government in 2003 to implement India's Biological Diversity Act (2002). The NBA is a Statutory Body and it performs facilitative, regulatory and advisory functions for the Government of India on issues of conservation, sustainable use of biological resources and fair and equitable sharing of benefits arising out of the use of biological resources. The Headquarters of the NBA is situated in Chennai.

12th Zoology
Unit – 13 Environmental Issues

Bio-magnification

Food chains are components of all ecosystems. Producers and consumers form trophic levels in a chain through which energy flow is carried out by the process of eating and being eaten. Usage, storage and transformation of food and biomolecules by metabolism are a normal process. Degradation or breakdown is an essential part of any food chain and hence all naturally occurring substances are degradable.

Bio- magnification of DDT

When non-degradable substances enter the food chain, they do not get metabolized or broken down or expelled and instead get transferred up the tropic levels of the food chain. During this process, they show an increase in concentration which is referred to as biomagnifcation. This results in increased toxicity and may even be lethal. Tis phenomenon is well established for mercury and DDT. Figure 13.4 schematically shows biomagnifcation of DDT in an aquatic food chain where the concentration of DDT is enhanced at successive trophic levels.

Eutrophication

When run-of from land containing nutrients reaches water bodies like lakes, it results in dense growth of plant life. Tis phenomenon is called Eutrophication. Natural aging of lakes also leads to nutrient enrichment of its water. In a lake, the water is cold and clear (oligotrophic stage), supporting little life. With time, streams draining into the lake introduce nutrients such as nitrates and phosphates, which encourage the growth of aquatic organisms. Aquatic plants and animal life grow rapidly, and organic remains begin to be deposited on the lake bottom (mesotrophic stage).

Pollutants from anthropogenic activities like effluents from the industries and homes can radically accelerate the aging process. Tis phenomenon is known as Cultural or Accelerated Eutrophication.Nutrients stimulate the growth of algae, water hyacinth and can cause clogging of canals, rivers and lakes as well as, displacing native plants. It causes unsightly foam and unpleasant odours, and deprives the water of dissolved oxygen.

Organic Farming and Its Implementation

It is a method of farming system which primarily aims at cultivating the land and raising crops in such a way, so as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients

to crops for increased sustainable production in an eco-friendly pollution free environment.

G. Nammalvar was a supporter and expert of organic farming. He was an agricultural scientist, environmental activist celebrated for his work on spreading Ecological farming & Organic farming. He was against the use of chemical fertilisers and pesticides. He trained hundreds of farmers in natural farming. Nammalvar was the author of several Tamil and English books on natural farming, pesticides &fertilisers and was featured in magazines & television programs. He founded the Nammalvar Ecological Foundation for Farm Research and Global Food Security Trust or simply Vaanagam at Karur, Tamilnadu. He developed social forest at Ammankurai and the Kolunji Ecological Farm in Pudukottai. He and his friends made a 10-acre barren land into fertile cultivable land in the dry Pudukottai district. He planted 52 varieties of trees in the same waste land extending in 20 acres. His organization 'Kudumbam' preserves and regenerates hundreds of native flora and fauna, in order to ensure a sustainable livelihood.

Integrated Wastewater Management

Wastewater Treatment

Wastewater or sewage originates from domestic waste waters, industrial wastes andanimal wastes. Realizing the importance of clean potable water, the Government passed the Water (Prevention and Control of Pollution) Act in 1974, which made it mandatory to treat wastewater in treatment plants. Te treatment can be carried out by three ways:

1. Physical methods
2. Chemical methods
3. Biological methods

1. Physical methods of wastewater treatment

Wastewaters containing insolublesubstances or colloids are treated through processes such as flotation, sedimentation, filtration and centrifugal separation.

2. Chemical methods of Wastewater treatment

Chemical methods of wastewater treatment include:

- Generation of insoluble solids.
- Produce an insoluble gas.
- Produce biologically degradable substances from a non-biodegradable substance.

- Oxidize or reduce to produce a non-objectionable substance.

3. Biological methods of Wastewater treatment

1. Bioremediation of wastewater includes the aerobic treatment (oxidation ponds, aeration lagoons) and anaerobic treatment (anaerobic bioreactors, anaerobic lagoons).

2. Phytoremediation of wastewater includes constructed wetlands, Root Zone Wastewater Treatment (RZWT), and Decentralized Waste Water Treatment System (DEWATS) (Fig. 13.6 a).

Case Study: Auroville, located in South India near Puducherry has been experimenting with natural wastewater recycling systems (Fig:13.6a). Such treatment plants have now also been implemented in Aravind Eye Hospital, Puducherry and the Chennai Mathematical Institute, Siruseri IT Park, Chennai.

Solid Waste Management

Every day, tonnes of solid wastes are disposed of at landfill sites. Tis waste comes from homes, offices, industries and various other agricultural related activities. These landfill sites produce foul smell if waste is not stored and treated properly. When hazardous wastes like pesticides, batteries containing lead, cadmium, mercury or zinc, cleaning solvents, radioactive materials, e-waste and plastics are mixed up with paper and other scraps and burnt, they produce gases such as dioxins. These gases are toxic and carcinogenic. These pollute the surrounding air, ground water and can seriously affect the health of humans,wildlife and our environment. Te following are major sources of solid waste.

People's Participation in Conservation of Forests

People's participation is vital in forest conservation, especially those living in them or close to the forest. This is referred to as Community forestry, which varies widely in legal, political and cultural settings and the term covers a wide range of experiences and practices.TheBishnois, who are known conservators of their forest, were inspiration to many people's participatory movements for Environmental protection in India. The **Chipko movement** resisted the destruction of forests of India in the 1970s. **SunderlalBahuguna**was the leader of this movement. People in the movement hugged the trees, and prevented felling of trees by contractors.

The 'Forest man of India', **JadavPayeng** who created 1,360 acres of dense and defiant forest was born in Arunasapori (a river island on the Brahmaputra). He had just completed his Class X exams in1979 when he started to sow the seeds and shoots on the eroded island covered with sand and silt. Thirty-six years later he had converted the once unproductive land into a forest. Payeng's forest is now home to

five Royal Bengal tigers, over a hundred deer, wild boar, vultures, and several species of birds. For his remarkable initiative, the Jawaharlal Nehru University invited Payeng in 2012 on Earth Day and honoured him with the title of the 'Forest Man of India'. Later, the President APJ Abdul Kalam felicitated him with a cash award in Mumbai. The same year, he received the 'Padma Shri'.

The Indian Constitution also stresses on the importance of the role of the People in protecting their environment.

Amrita Devi was a brave lady from Khejarli Village of Jodhpur District, Rajasthan. She sacrificed her life to maintain Bishnoi Dharma. In 1730, Maharaja Abhay Singh, ruler of Marwar, Rajasthan state wanted to log green Khejri (Prosopis cineraria) trees to burn lime for the construction of his new palace. Since there was a lot of greenery in the Bishnoi villages even in the middle of Tar Desert, the king ordered his men to get the wood from Khejri trees. When she came to know about the cutting of trees by the King's men, she and many others had hugged the Khejri trees to save from cutting. But king's men killed Amrita Devi along with more than 363 other Bishnois. It was a Tuesday, black Tuesday in Khejarli. Tis incident took place to save trees and is recorded in India's history. To commemorate her bravery, the Government of Rajasthan and Madhya Pradesh have initiated the prestigious state level award named as Amrita Devi BishnoiSmriti Award' for excellent contribution to the protection and conservation of wildlife.

Ecosan Toilets

About 150 liters of wastewater at an average is generated by an Indian individual daily, and a large amount of it is generated from toilets. Ecological sanitation (EcoSan) is a sustainable system for handling human excreta by using dry composting toilets. EcoSan toilets not only reduce wastewater generation but also generate the natural fertilizer from recycled human excreta, which forms an excellent substitute for chemical fertilizers. This method is based on the principle of recoveryand recycling of nutrients from excreta to create a valuable supply for agriculture. 'EcoSan' toilets are being used in several parts of India and Sri Lanka.

10TH STD
UNIT - 22.ENVIRONIMENTAL MANAGEMENT

Forest and its Importance

Forests are an important component of our environment and are dominated by microorganisms, flowering plants, shrubs, climbers, dense trees and provide a vast habitat for wild animals. Forests also contribute to the economic development of our country. Forests are vital for human life, it is a source for a wide range of renewable natural resource. They provide wood, food, fodder, fibre and medicine.
Forests are major factor of environmental concern. They act as carbon sink, regulate climatic conditions, increase rainfall, reduce global warming, prevent natural hazards like flood and landslides, protect wildlife and also act as catchments for water conservation. They also play a vital role in maintaining the ecological balance.

Deforestation and its Effects

Deforestation is the destruction of large area of forests. This happens for many reasons like intensive agriculture, urbanization, construction of dams, roads, buildings and industries, hydroelectric projects, forest fires, construction of mountain and forest roads. It is a threat to the economy, quality of life and future of the environment. India is losing about 1.5 million hectares of forest cover every year.

Effects of Deforestation

Deforestation gives rise to ecological problems like floods, drought, soil erosion, loss of wild life, extinction of species, imbalance of biogeochemical cycles, alteration of climatic conditions and desertification.

Conservation of Forests

India has an area of 752.3 lakh hectare classified as reserved forests and 215.1 lakh hectare as protected forests. The important measures taken for conservation of forests are as follows

Afforestation: Activities for afforestation programme (Van Mahotsav) includes planting and protecting trees with multiple uses which help in restoration of green cover. Destruction of trees should be curtailed.

Social forestry programme: It should be undertaken on a large scale with active participation of the public and utilization of common land to produce firewood, fodder and timber for the benefit of the rural community. This relieves pressure on existing forests and to safeguard future of tribals.

Forest Conservation through Laws: Adopting stringent laws and policies to conserve and protect forests are through National Forest Policy, (1952 and 1988) and Forest Conservation Act, 1980.

Wildlife and its Conservation

Wild life refers to the undomesticated animals living in their natural habitats (forests, grasslands and deserts) an area without human habitation. They are needed for maintaining biological diversity. It also helps in promoting economic activities that generates revenue through tourism. Conservation of forest and wildlife is interrelated with each other.

Decline in Wildlife Population

Wildlife of India is a great natural heritage. Exploitation of wildlife resources has decreased global wildlife population by 52% between 1970 and 2014. Over exploitation and shrinking of forest cover areas has resulted in animals becoming extinct, some arethreatened and some are on the verge of extinction. In recent years, increase in human encroachment has posed a threat to India's wildlife.

Aims of Wildlife Management

The main aimof wildlife conservation are:

- To control and limit exploitation ofspecies.
- To preserve the plants and animals fromextinction.
- Maintenance of threatened species andprotect species which are on the verge ofextinction.
- Preserve the endangered species.
- To study the ecological relationship ofthe plants and animals in natural habitat.
- Hunting and poaching should beprohibited.
- Establishment of National parks, Wildlifesanctuaries, protected areas and Biosphererereserves.

The Wildlife protection Act was established in 1972. The provisions of the act are

- Prohibit killing and hunting of specifiedanimals.
- Constitute sanctuaries, national parks,and closed areas for wildlife conservation.
- Special schemes for preservation ofendangered species.
- Constitute Central Zoo Authority andrecognition of zoos.
- Restrict, regulate or prohibit trade in wildanimals and products obtained from them.

No You Know?

- Jim Corbett National Parkwas the first to be establishedin 1936 in Uttarakhand, India.
- There are 15 biosphere reserves in India.
- The Nilgiris is a biosphere reserve inTamil Nadu.

Organisations Involved in Conservation of Wildlife

(i)Indian Board for WildLife (IBWL)
(ii)World Wildlife Fund (WWF) for Nature
(iii)World Conservation Union (WCN)
(iv)International Union for Conservation ofNature and Natural resources (IUCN)
(v)Convention of International Trade inEndangered Species (CITES)
(vi)Bombay Natural History Society
(vii)Wild life Preservation Society of India,Dehradun

Info bits

Wildlife Conservation Initiatives In India.

- Project Tiger and Project Elephant has been launched in 1973 and 1992 respectively
- Crocodile Conservation Project was launched in 1976.
- Sea Turtle Conservation Project was launched in 1999.
- Indian Rhino Vision 2020 is to conserve at least 3000 greater one-horned rhinos in Assam, India by 2020.

Soil Erosion

The top layers of soil contain humus and mineral salts, which are vital for the growth of plants. Removal of upper layer of soil by wind and water is called soil erosion. Soil erosion causes a significant loss of humus, nutrients and decrease the fertility of soil.

Agents of Soil Erosion

Agents of soil erosion are high velocity of wind, air currents, flowing water, landslide, human activities (deforestation, farming and mining) and overgrazing by cattle.

Management of Soil Erosion

- Retain vegetation cover, so that soil is not exposed.
- Cattle grazing should be controlled.
- Crop rotation and soil management improve soil organic matter.
- Runoff water should be stored in the catchment.
- Reforestation, terracing and contour ploughing.
- Wind speed can be controlled by planting trees in form of a shelter belt.

E-Wastes and its Management

E-wastes are generally called as electronicwastes, which includes the spoiled, outdated, non-repairable electrical and electronic devices. These wastes contain toxic metals like lead, cadmium, chromium and mercury, though also contain iron,

copper, silicon, aluminum and gold which can be recovered. Neverthless, only 5 % of e-wastes produced are recycled.

Sources of e-wastes

Electronic devices: Computers, laptops, mobile phones, printers, monitors, televisions, DVD players, calculators, toys, sport equipments, etc.
Household electrical appliances: Refrigerators, washing machine, microwave oven, mixer, grinder, water heater, etc.

Accessories: Printing cartridges, batteries and chargers.

E-wastes include
Computer components -66%
Telecommunication components - 12 %
Electronic components -5 %
Biomedical components -7 %
Other components -6 %

Environmental impact of e-wastes

Disposal of any kind of electrical and electronic devices without knowledge can become the landfill and water pollutants.

Electronic equipments contain many hazardous heavy metals such as lead, cadmiumthat can cause severe soil and groundwater pollution.

E-waste dumping yards and the places nearby are polluted and cause severe health hazard.

Sewage Management

Untreated sewage or wastewater generated from domestic and industrial process is the leading polluter of water sources in India. Sewage water results in agricultural contamination and environmental degradation.

Sources of Sewage/wastewater

- Domestic purpose or household activities
- Dye and textile industries
- Leather industries
- Sugar and breweries industries
- Paper and pulp industries

Sewage/wastewater treatment method

The conventional wastewater treatment methods involve the following steps

(a) Pre-screening (b) Aeration (c) Sludge Management and (d) Water Reuse.

Pre-screening: Wastewater generated from domestic and industrial activities is screened to remove soil and solid particulates.
Aeration: Screened wastewater is then pumped to an aeration tank. Here the microbial contaminants are removed by the biological degradation that occurs in the presence of air.

Sedimentation process: In this process, the solid particles in suspension form are allowed to settle. The particles that settle out from the suspension is known as sludge.

Sludge removal: The sludge generated by the degradation process is transferred periodically from the tank for safe disposal.

Disinfection: Chlorination and ultraviolet (UV) radiation of treated water is required to remove any microorganism contamination.

Water recycling: The water will then be supplied for domestic or industrial purposes.

Solid Waste Management

Solid wastes mainly include municipal wastes, hospital wastes, industrial wastes and e-wastes etc. The solid wastes are dumped in the soil which results in landscape pollution.

Solid-waste management involves the collection, treatment and proper disposing of solid material that is discarded from the household and industrial activities.

Methods of solid wastes disposal

(i)**Segregation:** It is the separation of differenttype of waste materials like biodegradableandnon biodegradable wastes.

(ii)**Sanitary landfill:** Solid wastes are dumpedinto low lying areas. The layers arecompacted by trucks to allow settlement.The waste materials get stabilised in about2-12 months. The organic matter undergoesdecomposition.

(iii)Incineration: It is the burning of nonbiodegradable solid wastes (medicalwastes) in properly constructed furnace athigh temperature.

(iv)Composting: Biodegradable matter ofsolid wastes is digested by microbial actionor earthworms and converted into humus.

Recycling of wastes

- Papers from old books, magazines andnewspapers are recycled to produce papersin papermills.
- Agricultural wastes like coconut shells, jutecotton stalk, bagasse of sugarcane can beused to make paper and hard board. Paddyhusk can be used as livestock fodder.
- Cowdung and other organic wastes can beused in gobar gas plant to provide biogasand manure for fields.

3R Approach

The 3R approach such as Reduce, Reuse and Recycle may be followed for effective waste management.

9 th book
Unit- 24 – Environmental Science

Biogeochemical Cycles (bio – life; geo – earth)

Biosphere is the part of the earth where life exists. All resources of biosphere can be grouped into two major categories namely:
(i) Biotic or living factors which include plants, animals and all other living organisms.
(ii) Abiotic or non-living factors which include all factors like temperature, pressure, water, soil, air and sunlight which affect the ability of organisms to survive and reproduce.

There is a constant interaction between biotic and abiotic components in the biosphere and that makes the biosphere a dynamic and stable system. Cyclic flow of nutrients between non-living and living factors of the environment are termed as bio-geo-chemical cycles. Some of the important biogeochemical cycles are:

1.Water cycle 2. Nitrogen cycle 3. Carbon cycle

Water Cycle

Water cycle or hydrological cycle is the continuous movement of water on earth. In this process, water moves from one reservoir to another by processes such as evaporation, sublimation, transpiration, condensation, precipitation, surface runoff and infiltration, during which water converts itself to various forms like liquid, solid and vapour (Fig. 24.1).

Evaporation: Evaporation is a type of vaporization, where liquid is converted to gas before reaching its boiling point. Water evaporates from the surface of the earth and water bodies such as the oceans, seas, lakes, ponds and rivers.

Sublimation: Sublimation is conversion of solid to gas, without passing through the intermediate liquid phase. Ice sheets and ice caps from north and south poles, and icecaps on mountains, get converted into water vapour directly, without converting into liquid.

Transpiration: Transpiration is the process by which plants release water vapour into the atmosphere through stomata in leaves and stems.

Condensation: Condensation is the changing of gas phase into liquid phase and is the reverse ofvaporisation. At higher altitudes, the temperature is low. The water vapour present there condenses to form very tiny particles of water droplets. These particles come close together to form clouds and fog.

Precipitation: Due to change in wind or temperature, clouds combine to make bigger droplets, and pour down as precipitation(rain). Precipitation includes drizzle, rain, snow and hail.

Run off : As the water pours down, it runs over the surface of earth. Runoff water combines to form channels, rivers, lakes and ends up into seas and oceans.

Infiltration: Some of the precipitated water moves deep into the soil. Then it moves down and increases the ground water level.

Percolation: Some of the precipitated water flows through soil and porous or fractured rock.
Infiltration and percolation are two related but different processes describing the movement of water through soil.

Human impacts on water cycle

Major human activities affecting the water cycle on land are urbanisation, dumping of plastic waste on land and into water, polluting water bodies and deforestation.

Nitrogen Cycle

Nitrogen is the important nutrient needed for the survival of all living organisms. It is an essential component of proteins, DNA and chlorophyll. Atmosphere is a rich source of nitrogen and contains about 78% nitrogen. Plants and animals cannot utilize atmospheric nitrogen. They can use it only if it is in the form of ammonia, amino acids or nitrates.

Processes involved in nitrogen cycle are explained below.
Nitrogen fixation : Nitrogen fixation is the conversion of atmospheric nitrogen, which is in inert form, to reactive compounds available to living organisms. This conversion is done by a number of bacteria and **blue green algae** (Cyanobacteria).

Leguminous plants like pea and beans have a symbiotic relationship with nitrogen fixing bacteria *Rhizobium*. Rhizobium occur in the root nodules of leguminous plants and fixes nitrogenous compounds.

Nitrogen assimilation: Plants absorb nitrate ions and use them for making organic matter like proteins and nucleic acids. Herbivorous animals convert plant proteins into animal proteins. Carnivorous animals synthesize proteins from their food.

Ammonification: The process of decomposition of nitrogenous waste by putrefying bacteria and fungi into ammonium compounds is called ammonification. Animal proteins are excreted in the form of urea, uric acid or ammonia. The putrefying bacteria and fungi decompose these animal proteins, dead animals and plants into ammonium compounds.

Nitrification:The ammonium compounds formed by ammonification process are oxidised to soluble nitrates. This process of nitrate formation is known as nitrification. The bacteria responsible for nitrification are called as nitrifying bacteria.

Microorganisms involved in nitrogen cycle

Role played in nitrogen cycle	**Name of the Microorganisms**
Nitrogen fixation	Azotobacter (in soil) Rhizobium (in root nodules) Blue green algae- Nostoc
Ammonification	Putrefying bacteria, Fungi
Nitrification	Nitrifying bacteria i. Nitrosomonas ii. Nitrobacter
Denitrification	Denitrifying bacteria Pseudomonas

animals release carbon into atmosphere in the form of carbon dioxide. Carbon dioxide is also returned to the atmosphere through decomposition of dead organic matter, burning fossil fuels and volcanic activities.

Human impacts on carbon cycle

More carbon moves into the atmosphere due to burning of fossil fuels and deforestation. Most of the carbon in atmosphere is in the form of carbon dioxide. Carbon dioxide is a greenhouse gas. By increasing the amount of carbon dioxide, earth becomes warmer. This leads to greenhouse effect and global warming.

Water Conservation

Water conservation is the preservation, control and management of water resources. It also includes activities to protect the hydrosphere and to meet the current and future human demand.

Importance of Water Conservation

- It creates more efficient use of the water resources.
- It ensures that we have enough usable water.
- It helps in decreasing water pollution.
- It helps in increasing energy saving.

Water Conservation Measures
Industrial conservation

Water conservation measures that can be taken by industries are:

- using dry cooling systems.

- if water is used as cooling agent, reusing the water for irrigation or other purposes.

Agricultural conservation

Agricultural water is often lost due to leaks in canals, run off and evaporation. Some of the water conserving methods are:

- using lined or covered canals that reduce loss of water and evaporation.
- using improved techniques such as sprinklers and drip irrigation.
- encouraging the development of crops that require less water and are drought resistant.
- mulching of soil in vegetable cultivation and in horticulture.

World Water Day on 22nd March every year, is about focusing attention on the importance of water.

Domestic conservation

All of us have the responsibility to conserve water. We can conserve water by the following activities:

• Using a bucket of water to take bath than taking a shower.
• Using low flow taps.
• Using recycled water for lawns.
• Repairing the leaks in the taps.
• Recycling or reusing water wherever it is possible.

Strategies adopted to conserve Water

(i) Rain water harvesting.
(ii) Improved irrigation techniques.
(iii) Active use of traditional water harvesting structures.
(iv) Minimising domestic water consumption.
(v) Awareness on water conservation.
(vi) Construction of farm ponds.
(vii) Recycling of water.

Farm Ponds

Farm ponds are used as one of the strategies to support water conservation. Much of the rainfall runs off the ground. The run off not only causes loss of water but also washes away precious top soil. Farm ponds help the farmers to store water and to use it for irrigation.

Layout of a Farm Pond

Farm pond is a dugout structure with definite shape and size. They have proper inlet and outlet structures for collecting the surface runoff flowing from the farm area. The stored water is used for irrigation.

Advantages of Farm Ponds

The advantages of farm ponds are:

- They provide water to growing crops, without waiting for rainfall.
- They provide water for irrigation, even when there is no rain.
- They reduce soil erosion.
- They recharge ground water.
- They improve drainage.
- The excavated soil can be used to enrich soil in fields and levelling lands.
- They promote fish rearing.
- They provide water for domestic purposes and livestock.

Water Recycling

Water recycling, apart from rain water harvesting, is also one of the key strategies to conserve water. Water recycling is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, flushing in toilets and ground water recharge.

Wastewater Recycling Stages

Conventional waste water treatment consists of a combination of physical, chemical and biological processes which remove solids, organic matter and nutrients from waste water. The waste water treatment involves the following stages:

Primary treatment

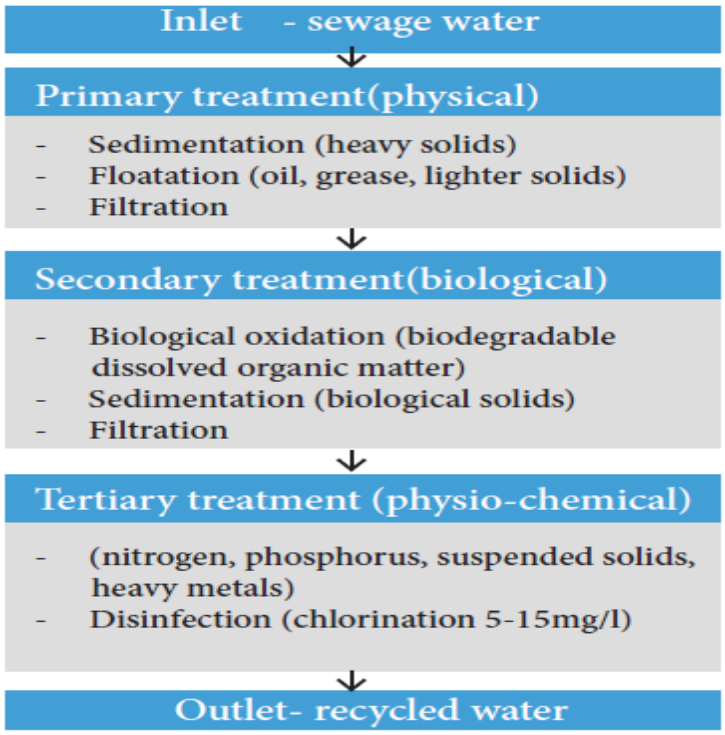
Primary treatment involves temporary holding of the wastewater in a tank. The heavy solids get settled at the bottom while oil, grease and lighter solids float over the surface. The settled and floating materials are removed. The remaining liquid undergoes secondary treatment.

Secondary treatment

Secondary treatment is used to remove the biodegradable dissolved organic matter. This is performed in the presence of oxygen by aerobic microorganisms (Biological oxidation). The microorganisms must be separated from treated water waste by sedimentation. After separating the sediments of biological solids, the remaining liquid is discharged for tertiary treatment.

Tertiary treatment

Tertiary or advanced treatment is the final step of sewage treatment. It involves removal of inorganic constituents such as nitrogen, phosphorus and microorganisms. The fine colloidal particles in the sewage water are precipitated by adding chemical coagulants like alum or ferric sulphate.



Uses of Recycled Water

- Agriculture
- Landscape
- Public parks
- Cooling water for power plants and oil refineries
- Toilet flushing
- Dust control
- Construction activities

IUCN (International Union for Conservation of Nature and Natural Resources)

IUCN is an international organization working in the field of nature conservation and sustainable use of natural resources. IUCN is the global authority on the status of the natural world and the measures needed to safeguard it.

Vision of IUCN

The vision of IUCN is 'A just world that values and conserves nature'.

Mission of IUCN

The mission of IUCN is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.
The organization is best known to the wider public for compiling and publishing the IUCN red list of threatened species, which assesses the conservation status of species worldwide.

India, a mega diverse country with only 2.4 % of world's land area, accounts for 7-8% of all recorded species. It includes over 45,000 speciesof plants and 91,000 species of animals. The country's diverse physical features and climatic conditions have resulted in a variety of ecosystems such as forests, wetlands, grasslands, desert, coastal and marine ecosystems. Four of 34 globally identified biodiversity hotspots are found in India. They are:

- The Himalayas
- The Western ghats
- The North-East
- The Nicobar islands

India became state member of IUCN in 1969, through the Ministry of Environment, Forest and Climate change(MoEFCC).

IUCN was founded on 5th October 1948 at Gland, Switzerland.

8th book

Unit – 8 CONSERVATION OF PLANTS AND ANIMALS

Deforestation

Forests are the important renewable resources. They cover about 30 percent of the world's land surface. They produce oxygen and maintain the level of carbon dioxide in the atmosphere. Forests provide many important goods such as timber, paper and medicinal plants. They control water runoff, protect soil, and regulate climate changes. But the forests all around the world are being destroyed. Destruction of forests in order to make the land available for different uses is known as deforestation. Deforestation has resulted in several ecological imbalances such as increase in temperature, deficiency in rainfall etc. It has also resulted in the extinction of several species of animals and plants.

Causes of Deforestation

Deforestation may be caused by nature or it may be due to human activities. Fires and floods are the natural causes for deforestation. Human activities which are responsible for deforestation include agricultural expansion, cattle breeding, illegal logging, mining, oil extraction, damconstruction and infrastructure development. Let us study about some of them in this section.

Agricultural Expansion

With increasing population, there is an overgrowing demand for food production. Hence, large amount of trees are chopped down for crops and for cattle grazing. More than 40% of the forests are cleaned to obtain land and to meet the needs of agriculture.

Urbanization

Increase in population necessitates the expansion of cities. With the expansion of cities more land is needed to establish housing and settlement. Requirements like construction of roads, development of houses, mineral exploitation and expansion of industries also arise due to urbanisation. Forests are destroyed to meet all these needs.

Mining

Mining of coal, diamond and gold require a large amount of forest land. So, a large number of trees is cut down to clear the forest area. Moreover, the waste that comes out from mining pollutes the environment and affects the nearby plants.

Construction of dams

To provide water supply to the increasing population, large size dams are constructed. Hence, a great extend of forest area is being cleared.

Timber Production

We need wood to meet the needs of our daily life. Wood-based industries like paper,match-sticks, furniture need a substantial amount of wood supply. Wood is the most commonly used fuel. Thus, a large number of trees are being cut down for fuel supplies. Some people are involved in illegal wood cutting and destroy more number of trees. This is the main reason for the destruction of some valuable plants.

Chipko Movement is primarily a forest conservation movement. The word 'Chipko' means 'to stick' or 'to hug'. SunderlalBahuguna was the founder of this movement. It was started in 1970s with the aim of protecting and conserving trees and preserving forest from being destroyed.

Forest fire

In many forests, fires are usually expected from time to time. They may be caused by humans, accidents or natural factors. Forest fires wipe out thousands of acres of forest land each year all over the world. This has tremendous effects on biodiversity and the economy as well.

Cyclones

Cyclones destroy the trees on a massive scale. They not only destroy the trees but also affect the livelihood of so many people who depend on them.

Effects of Deforestation

There has been a long history of interdependence between man and the forests. Our survival without forest will be very difficult. They supply us the oxygen we need, cause rainfall and provide so many things needed for our life. But increase in population has resulted in the destruction of forests. Every year 1.1 crore hectares of forests has been cut down around the world. In India alone 10 lakh hectares of forests are destroyed which has resulted in so many harmful effects. Let us study about some of them.

a. Extinction of species

Deforestation has resulted in the loss of many wonderful species of plants and animals and many are on the verge of extinction. More than 80% of the world's species remain in the tropical rainforest. Reports say that about 50 - 100 species of animals are being lost each day as a result of destruction of their habitats.

b. Soil Erosion

Widespread trees in the forests protect the soil from the heat of the sun. When the trees are cut down, soils are exposed to the sun's heat. Extreme temperature of the summer dries up the moisture and makes the nutrients to evaporate. It also affects the bacteria that helps in the breakdown of organic matter. The roots of the trees retain the water and the top soil which provides nutrients to the plants. When the trees are cut down, soil is eroded and washed away along with the nutrients.

c. Water cycle

Trees suck the water from the roots and release the water into the atmosphere in the form of vapour during transpiration. When trees are cut down the amount of water vapour released decreases and hence there is a decrease in the rainfall.

d. Floods

Trees absorb and store a large amount of water with the help of their roots. When the trees are cut down, the flow of water is disrupted and it leads to flooding in some areas.

Amazon forest is the largest rain forest in the world, located in Brazil. It covers 6000000 square km. It helps to stabilize the earth's climate and slow global warming by fixing Co2, and producing 20% of the world's oxygen in the process. It has about 390 billion trees. It is the lungs of the planet.

e. Global warming

We inhale oxygen present in the atmosphere and release carbon dioxide as waste. In turn trees absorb the carbon dioxide and provide us the oxygen during photosynthesis. Deforestation reduces the number of trees and hence the amount of carbon dioxide accumulates in the atmosphere. Carbon dioxide along with water vapor, methane, nitrous oxide and ozone forms the green house gases. These gases are responsible for global warming.

The solar energy falling on the earth's surface is reflected into the atmosphere. A part of this energy is reflected by the green house gases back to the earth to keep it warm and a part goes into the space. But gases such as methane and carbon dioxide accumulating in the atmosphere trap the heat energy inside the atmosphere leading to increase in temperature. This is called global warming. This results in the melting of glaciers in the polar region and affects the living organisms like polar bear.

f. Destruction of home land

Indigenous people live in and depend on forests for their survival. They get their food and many other resources from the forests. Destruction of forests affects their livelihood .

Afforestation

Afforestation is the process of planting trees, or sowing seeds, in a barren land to create a forest. As we all know due to deforestation the climate is changing alarmingly in these days and there is no seasonal rainfall. Because of this many cities are facing water scarcity and many of the lands are becoming barren. Water is needed for life to exist on the earth.

The term social forestry was first used in 1976 by the then National Commission on Agriculture, Government of India. It means the management and protection of forests and afforestation on barren land with the purpose of helping the environment, social and rural development. It is to raise the plantations thereby reducing the pressure on the traditional forest area.

Afforestation helps us to create the forests differently from natural forests.

Importance of Afforestation

The world is experiencing a great change in the climate in the recent years than ever before. These changes in the climate have given an alarming signal to everyone. To protect our planet earth afforestation would be a better solution. Importance of afforesatation is given below.

- Afforestation helps the wild animals and even humans to have shelter and to find their food source.
- Through afforestation we can increase the supply of oxygen. Trees planted can increase the water vapour in the atmosphere to get the rainfall.
- By planting trees the amount of carbon dioxide in the atmosphere can be reduced and thus the effects of air pollution, green house gases and global warming can be controlled.
- Afforestation enables us to avoid desertification of land.

- Barren lands experience strong winds and it causes soil erosion. Top soil is washed away during rainfall. Afforestation helps to grow more trees so that they can hold the top soil along with the nutrients.
- Creating forests provides us fodder, fruits, firewood and many other resources.
- Industries need specific type of trees. Afforestation helps us to grow a particular type of trees.

WangariMaathai founded the Green Belt Movement in Kenya in the year 1977. GBM has planted over 51 million trees in Kenya. She was awarded the Nobel Peace Prize for 2004.

Reforestation

Reforestation is the natural or intentional replanting of the existing forests that have been destroyed through deforestation. Reforestation may sound similar to afforestation but both of them are not same. Reforestation is replanting of trees in a land area which had lost its forest cover for some reason. But afforestation is growing forest in an area which originally had no tree cover. Reforestation is an effective strategy to fight global warming. In addition to benefiting the climate, reforestation helps in protecting important species of animals. Reforestation helps to rebuild habitats and degradation which are the leading threats to the health and endangerment of species.

Importance of Reforestation

Both afforestation and reforestation are important for protecting the habitat, increasing the supply of forest products,
finding solution to climate changes and for many other reasons. Importance of reforestation is given below.

- Reforestation improves the quality of air we breathe by reducing carbon dioxide in it.
- The effects of deforestation can be checked and global warming can be reduced.
- Reforestation restores habitat loss and degradation and threats to species.
- Forest restoration can reverse the damage done by soil erosion. Reforestation will revive the watersheds which are important aspects of environmental well-being.
- Reforestation maintains the water cycle of the area as trees absorb moisture through the leaves and roots.
- Transpiration of trees helps to restore the moisture of the atmosphere and to maintain the temperature in the local environment.
-

Difference between Deforestation and Reforestation

Deforestation	Reforestation
When the plants or trees are cut down, it is called deforestation.	When the plants or trees are grown or planted, it is called reforestation.
Deforestation has a negative effect on the environment.	Reforestation has a very good effect on the nature, as it builds the environment.

Differences between Afforestation and Reforestation

Afforestation	Reafforestation
Trees are planted in new areas where there was no forest cover.	It is practiced in areas where forests have been destroyed.
One sapling is planted to get one tree.	Two saplings are planted to replace every felled tree.
It is practiced to bring more area under forest.	It is practiced to avoid deforestation

Endangered Species

Our country is a home for variety of species and rich flora and fauna. Flora is the plant life occurring in a particular area. Fauna is the animal life occurring in a particular area.The Royal Bengal Tigers, the Asiatic Cheetah and several other birds are found in India. But due to various reasons likeenvironmental pollution, deforestation, loss of habitat, human interference, poaching and hunting many animals in India are extinct and many are endangered. Species which no longer exist on earth are called extinct species. e.g. Dinosaurs, Dodo. An endangered species is an animal or a plant that is considered to be at the risk of extinction. It means that there are only few of them left on the earth and soon they might extinct. It is reported that nearly 132 species of plants and animals are critically endangered in India. Snow leopard, Bengal tiger, Asiatic lion, Purple frog and Indian giant squirrel are some of the endangered animals in India.

Many algae, fungi, bryophytes, ferns and gymnosperms are disappearing with the destruction of forests. And, each disappearing species may take away with it many species of animals and microbes which depend on them for food and shelter. Similarly, list of animals on the verge of being lost is endless. Prawns, oysters, lobsters, crabs, squid, octopus, cuttlefish, beetles, dragonfly, grasshoppers, fish and even frogs are dying of absorbing poisonous gasesthrough their skin. Locust is one insect which has almost disappeared from India. Following animals are getting rare these days.

- Reptiles: Some lizards, turtles, crocodiles and gharials.
- Birds: Falcon, eagle, hawk, vulture, peacock-peahen, pigeon, duck.
- Mammals: Wild cats such as tigers, lions, deer such as chinkara and blackbuck, chiru (Tibetan goat), musk deer, rhino, elephants, blue whale, flying squirrel.

Each year, 22nd May is celebrated as World Biodiversity Day. Biodiversity is a term used to describe the different plants, animals, marine life, microorganisms, insects, habitats, ecosystem etc. that make our planet so unique and so fascinating.

Endangered Plants	Endangered Animal
Umbrella tree	Snow Leopard
Malabar lily	Asiatic Lion
Rafflesia flower	Lion tailed macaque
Indian mallo	Indian Rhinoceros
Musli plant	NilgiriTahr

Determination

Whether a particular species is endangered or not is determined by the following ways.

- When the geographical range of the species is limited.
- The population of the species is limited i.e., less than 50 adult individuals.
- When the population has decreased or will decrease by more than 80% in 10 years.
- If the population is less than 250 individuals and is continuously declining at 25% for the past three years.
- There is a high possibility of extinction in the wild.

Yeoman Butterfly has been declared state butterfly of Tamil Nadu. This species is endemic to Western Ghats. It is among 32 butterfly species found in Western

Causes for Endangerment

There are various reasons why a species may become endangered or extinct. Some of them are explained below.

Loss of habitat

Trees that provide food and shelter to so many species are destroyed due to human intervention.

Over hunting and poaching

Large number of animals is hunted for their horns, skin, teeth and many other valuable products.

Pollution

Number of animals are affected by pollutions like air pollution and water pollution. In the recent years more number of animals is affected by wastes in the form of plastic.

New habitat

Sometimes animals are taken by people to new habitat where they do not naturally live. Some of them may extinct and some may survive. The new ones may also get attacked by the species already living there and cause their extinction.

Chemicals

We use pesticides and other chemicals to get rid of damaging insects, pests or weeds. But they can also poison desired plants and animals if we do not use them correctly.

Diseases

Diseases due to various unknown reasons may affect the animals and make them extinct.

Natural calamities

Animals may also be destroyed due to natural disasters like flood and fire.

Saving Endangered Species

Nature is beautiful and it is filled with different plants and animals. For maintaining healthy ecological balance on the earth, animal and plant species are important. They have medicinal, scientific, ecological and commercial value. Each organism on the earth has a unique place in food chain that contributes to the ecosystem. But they are endangered mainly due to human activity. We need to take certain measures to protect them and preserve them.

- Some of the animal species are endangered mainly because of hunting and poaching. If it is controlled there can be a significant change in the number of endangered animals.
- Controlling pollution can have a positive impact on animals, fish and birds all over the world.
- When we consume more, more pollutants are put into the environment. By consuming less, we can protect the ecosystems.
- Animals often mistake plastic for food and hence plastics harm and cause endangerment of many species. Limiting the amount of plastic and recycling it can save the endangered animals.

- ❖ Recycling things and buying eco friendly products will preserve the environment resources and hence the animals.
- ❖ Pesticides and chemicals which cause damage to the environment should be avoided.
- ❖ Planting native trees will provide food to the animals.

Planting the native trees like Neem tree, Umbrella tree and Banyan tree in our surrounding will be helpful for the animals. Many birds and animals find shelter in those trees.

Government Initiatives

In order to preserve the plants and animals, government has taken lot of initiatives and some acts have been passed to protect them. For example, Project Tiger is a wildlife conservation project initiated in India in 1972 to protect the Bengal Tiger. It was launched on 1st April 1973 and has become one of the most successful wildlife conservation ventures. Corbett National Park was the first National Park in India to be covered under project Tiger. Due to 'Project Tiger' the population of Tiger has increased in India from 1400 in 2006 to 2967 in 2018. The government has enacted the following Acts.

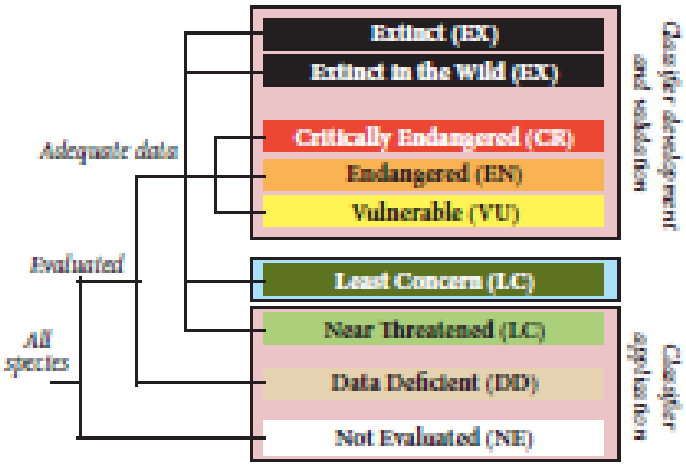
1. Madras Wildlife Act, 1873.
2. All India Elephant Preservation Act, 1879.
3. The Wild Bird and Animal Protection Act, 1912.
4. Bengal Rhinoceros Preservation Act, 1932.
5. All India Wildlife Protection Act, 1972.
6. Environmental Protection Act, 1986.

Red Data Book

The Red Data Book is the file for recording rare and endangered species of animals, plants and fungi. Even some local sub-species that exist within the territory of a state or country are recorded in red data books. Red data book gives important data for observational studies and monitoring programmes on habits and habitats of rare and endangered species. This book is created to identify and protect the species which are about to extinct.

Red Data Book is maintained by the International Union for Conservation of Nature. It is an international organization working in the field of nature conservation and sustainable use of natural resources. It was founded in 1964 with the aim of maintaining a complete record of every species that ever lived. The Red Data Book classifies species mainly into three categories namely, threatened, not threatened and unknown. This Book also has information as to why a species has become extinct along with the population trends and its distribution.

The Red Data Book contains colour-coded information sheets like black for species which are extinct, red for species that are endangered and so on. They are arranged according to the extinction risk of many species and subspecies. The following figure gives the colour coded information.



IUCN Red List Categories

WWF – World Wildlife Fund ZSI – Zoological Survey of India BRP – Biosphere Reserve Programme CPCB – Central Pollution Control Board IUCN – International Union for Conservation of Nature

Advantages of the Red Data Book

- It helps to evaluate the population of a particular species.
- The data given in this book can be used to evaluate the species at the global level.
- The risk of a species becoming globally extinct can be estimated with the help of this book.
- It provides guidelines for implementing protective measures for endangered species.

Disadvantages of the Red Data Book

- The information available in the Red Data Book is incomplete. Many extinct species are not updated in this book.
- The source of the book's data has been speculated.
- This book maintains the complete record of all animals, plants, other species but it has no information about the microbes.

World Wildlife Day is observed on March 3rd every year.

Red Data Book of India

India, a mega-diverse country with only 2.4% of the world's land area, accounts for 7-8% of all recorded species, including over 45,000 species of plants and 91,000 species of animals. The country's diverse physical features and climatic conditions have resulted in a variety of ecosystems such as forests, wetlands, grasslands, deserts, coastal and marine ecosystems which harbour and sustain high biodiversity and contribute to human well being. Four out of 34 globally identified biodiversity hotspots, the Himalayas, the Western Ghats, the North-East, and the Nicobar Islands, can be found in India.

India became a State Member of IUCN in 1969, through the Ministry of environment, Forest and Climate Change (MOEFCC). The IUCN India Country Office was established in 2007 in New Delhi. Red Data Book of India contains the conservation status of animals and plants which are found in the Indian subcontinent. Surveys conducted by the Zoological Survey of India and the Botanical Survey of India under the guidance of the Ministry of Environment, Forest and Climate Change provide the data for this book.

CONSERVATION

According to WWF (World Wildlife Fund) there has been 60% decrease in the size of population of animals, birds, fish, reptiles and amphibians over the past 40 years. In order to leave something for the future generation, we need to conserve it now. Conservation is the protection, preservation, management of wildlife and natural resource such as forest and water. Conservation of biodiversity helps usto protect, maintain and recover endangered animals and plant species. Conservation is of two types. They are:

- In-situ conservation (within habitat)
- Ex-situ conservation (outside the habitat)

In-situ conservation

It is nothing but conservation of living resources within the natural ecosystem in which they occur. This is achieved by protection of natural habitat and maintenance of endangered species in certain protected areas such as national parks, wildlife or bird sanctuaries and biosphere reserves. In India, there are about 73 national parks, 416 sanctuaries and 12 biosphere reserves.

National Parks

A National park is an area which is strictly reserved for the betterment of the wildlife. Here, activities like forestry, grazing or cultivation are not permitted. Even private ownership rights are not allowed in these areas. The national parks cover an

area of 100 – 500 square kilometers. In these parks a single plant or animal species are preserved.

Name	State	Established year
Jim Corbett National Park	Uttarakhand	1936
Dudhwa National Park	Uttar Pradesh	1977
Gir National Park	Gujarat	1975
Kanha National Park	Madhyapradesh	1955
Sundarbans National Park	West Bengal	1984

Name	Established year	District
Guindy National Park	1976	Chennai
Gulf of Mannar National Park	1980	Ramanathapuram
Indira Gandhi National Park	1989	Coimbatore
Mudumalai National Park	1990	The Nilgiris
Mukurthi National Park	1990	The Nilgiris

Wildlife sanctuaries

A sanctuary is a protected area which is reserved for the conservation of animals only. Human activities like harvesting of timber, collection of forest products and private ownership rights are allowed here. Controlled interference like tourist activity is also allowed. The differences between national parks and wildlife sanctuaries are given in Table.

Difference between National Parks and Wildlife Sanctuaries

Wildlife Sanctuary	National Parks
Human activities are allowed.	No human activities are allowed.
Main aim is to protect a particular flora or fauna.	Can include flora, fauna or any other objects of historical significance.
There are no fixed boundaries.	Boundaries are fixed and defined.
It is open to the general public	Not usually open to the public.
Sanctuaries are usually formed by the order of Central or the State Government	National Parks are formed by the State or Central Legislature.
A sanctuary can be upgraded to a national park	A national park cannot be downgraded to a sanctuary.

Wildlife Sanctuaries in Tamil Nadu

Name	Established year	District
Meghamalai Wildlife Sanctuary	2016	Theni
Vandaloor Wildlife Sanctuary	1991	Chennai
Kalakad Wildlife Sanctuary	1976	Thirunelveli
Grizzled Squirrel Wildlife Sanctuary	1988	Virudhunagar
Vedanthangal Wildlife Sanctuary	1936	Kanchipuram

Biosphere reserves

Biosphere is a protected area where human population also forms the part of the system. The area of these places will be around 5000 square kilometers. They conserve the eco system, species and genetic resources. These areas are set up mainly for economic development.

Biosphere Reserves in India

Name of Biosphere	State
Nanda Devi	U.P
Nokrek	Assam
Manas	Meghalaya
Sunderbans	West Bengal
Gulf of Mannar	Tamil Nadu
Nilgiri	Tamil Nadu
Great Nicobars and Similipal	Orissa

Advantages of In-situ conservation

- Species can be adapted to their habitat.
- Species can interact with each other.
- Natural habitat is maintained.
- It is less expensive and easy to manage.
- Interests of indigenous people are protected.

Ex-situ Conservation

It is the conservation of wildlife outside their habitat. Establishing zoos and botanical gardens, conservation of genes, seedling and tissue culture are some of the strategies followed in this method.

Biomagnification

Biomagnification is the increase in contaminated substances due to the intoxicating environment. The contaminants might be heavy metals such as mercury, arsenic, and pesticides such as polychlorinated biphenyls and DDT (DichloroDiphenylTrichloro ethane). These substances are taken up by the organisms through the food they consume. When the organisms in the higher food chain feed on the organisms in the lower food chain containing these toxins, these toxins get accumulated in the higher organisms.

Causes of Bio-magnification

Following are the major causes of bio-magnification:

a. The agricultural pesticides, insecticides, fertilizers and fungicides are very toxic and are released into the soil, rivers, lakes, and seas. These cause health issues in aquatic organisms and humans.
b. Organic contaminants cause adverse impact on the health of humans, animals, and wildlife.
c. Industrial activities release toxic substances which enter into the food chain leading to bio-magnification.
d. Mining activities generate a large amount of sulphide and selenium deposits in water. These toxic substances are absorbed by the aquatic organisms in the food chain.

Effects of Bio-magnification

Following are the effects of bio-magnification on living organisms and the environment:

a. It has more impact on humans causing cancer, kidney problems, liver failure, birth defects, respiratory disorders, and heart diseases.
b. It also affects the reproduction and development of marine organisms
c. The destruction of coral reefs affects the lives of many aquatic animals.
d. The chemicals and toxins which are released into the water bodies disrupt the food chain.

Animal welfare organisations

Animal welfare organizations are the group of people concerned with the health, safety and psychological wellness of animals. They include animal rescue groups which help animals in distress, and others which help animals suffering from some epidemic. In this section we will study about some of them.

Blue Cross

Blue Cross is a registered animal welfare charity in the United Kingdom, founded in 1897 as 'Our Dumb Friends League'. The vision of this charity is that

every pet will enjoy a healthy life in a happy home. The charity provides support for pet owners who cannot afford private veterinary treatment, helps to find homes for unwanted animals, and educates the public in the responsibilities of animal ownership.

The organisation was founded to care for working horses on the streets of London, UK. It opened its first animal hospital, in Victoria, London, on 15 May 1906.

Captain V. Sundaram founded the Blue Cross of India, the largest animal welfare organization of Asia in Chennai in the year 1959. He was an Indian pilot and animal welfare activist. Now, Blue Cross of India is country's largest animal welfare organizations and it runs several animal welfare events like pet adaptation and animal right awareness. Blue Cross of India has received several international and national awards. This organization is entirely looked after by volunteers. The main office is located at Guindy, Chennai, with all amenities like hospitals, shelters, ambulance services and animal birth controls, etc. Activities of the organization include, providing shelters, re-homing, adoption, animal birth control, maintaining hospitals and mobile dispensary and providing ambulance services.

CPCSEA

CPCSEA stands for 'The Committee for the Purpose of Control and Supervision of Experiments on Animals'. It is a statutory committee set up under the Preservation of Cruelty to Animals Act, 1960. It has been functioning since 1991 to ensure that animals are not subjected to unnecessary suffering during experiments on them.

Objectives of CPCSEA

1. To avoid unnecessary pain before and after experiment.
2. To promote the human care of animal used in experiments.
3. To provide guidelines for animal Housing, breeding and maintenances.
4. To promote the human care of animal used in biomedical and behavioural research and testing.

Functions of CPCSEA

1. Approval of animal house facilities.
2. Permission for conducting experiments involving usage of animals
3. Action against establishments in case of established violation
4. Registration of establishments conducting animal experimentation or breeding of animals for this purpose.