COMPILATION FROM SHANKAR IAS ENVIRONMENT

PART-I-ENVIRONMENT ECOLOGY

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ECOLOGY

- defined "as a scientific study of the relationship of the living organisms with each other and with their environment."
- The classical texts of the Vedic period such as the Vedas, the Samhitas, the Brahmanas and the Aranyakas-Upanishads contain many references to ecological concepts
- The Indian treatise on medicine, the Caraka- Samhita and the surgical text Susruta-Samhita.
- contain classification of animals on the basis of habit and habitat, land in terms of nature of soil, climate and vegetation; and description of plants typical to various localities.
- Caraka- Samhita contains information where air, land, water and seasons were indispensable for life and that polluted air and water were injurious for health.
- **The environment** is defined as 'the sum total of living, non-living components; influences and events, surrounding an organism.
- **Components of Environment**
  1. **Abiotic** – Energy, Radiation, TEMP, Water, etc.
  2. **Biotic- plants, animals, man, DECOMPOSER ETC.**
- Diesel engine exhaust fumes can cause cancer, humans" and it belong to the same potentially deadly category as asbestos, arsenic and 'mustard gases. World Health Organization (WHO)
- if a marine fish is transferred to a fresh water environment, it will not be able to Survive.

Six main levels of organisation of ecology are:

1. **Individual**- Organism is an individual living being that has the ability to act or function independently.
2. **Population**-Population is a group of organisms usually of the same species, occupying a defined area during a specific time,
3. **Community**- Communities in most instances are named after the dominant plant form (species). A community is not fixed or rigid; communities may be large or small.

Types of Community-

- On the basis of size and degree of relative independence communities may be divided into two types-

(a) **Major Community**

- These are large-sized, well organized and relatively independent. They depend only on the sun's energy from outside and are independent of the inputs and outputs from adjacent communities.

E.g: tropical ever green forest in the North-East

(b) **Minor Communities**

- These are dependent on neighbouring communities and are often called societies. They are secondary aggregations within a major community and are not therefore completely independent units as far as energy and nutrient dynamics are concerned.
- e.g: A mat of lichen on a cow dung pad.

- The environmental factors determine the characteristic of the community as well as the pattern of organisation of the members in the community
- The characteristic pattern of the community is termed as structure which is reflected in the roles played by various population, their range, the type of area they inhabit, the diversity of species in the community and the spectrum of interactions between them

4. **Eco-System-**An ecosystem is defined as a structural and functional unit of biosphere consisting of community of living beings and the physical environment, both interacting and exchanging materials between them.

- It includes plants, trees, animals, fish, birds, micro-organisms, water, soil, and people.
- When an ecosystem is healthy (i.e. sustainable) it means that all the elements live in balance and are capable of reproducing themselves

Components of Ecosystem

- The components of the ecosystem is categorised into abiotic of non-living and biotic of living components. Both the components of ecosystem and environment are same.

1. Abiotic Components

- the inorganic and non-living parts of the world.
- consists of soil, water, air, and light energy etc.
- involves a ,large number of chemicals like oxygen, nitrogen-, etc. and physical processes including volcanoes, earthquakes, floods, forest fires, climates, and weather conditions.
- Abiotic factors are the most important determinants of where and how well an organism exists in its environment. Although these factors interact with each other, **one single factor can-limit the range of an organism**.

a) Energy

- Energy from the sun is essential for maintenance of life. Energy determines the distribution of organisms in the environment.

b) Rainfall

c) Temperature

- Temperature is a critical factor of the environment which greatly influences survival of organisms. Organisms can tolerate only a certain range of temperature and humidity.

d) Atmosphere

- It is made up of 21% oxygen, 78% nitrogen , 0.038% carbon dioxide and other inert gases (0.93% Argon, Neon etc).

e) Substratum

- Land is covered by soil and a wide variety of microbes, protozoa, fungi and small animals (invertebrates) thrive in it

f) Materials:

(i) Organic compound

- ✓ Such as proteins, carbohydrates, lipids, humic substances are formed from inorganic compound on decomposition.

(ii) Inorganic compound

- ✓ Such as carbon, carbon dioxide, water, sulphur, nitrates, phosphates, and ions of various metals are essential for organisms to survive.

g) Latitude and altitude

- Latitude has a strong influence on an area's temperature, resulting in change of climates such as polar, tropical, and temperate. These climates determine different natural biomes.
- From sea level to highest peaks, wild life is influenced by altitude. As the altitude increases, the air becomes colder and drier, affecting wild life accordingly.(wild life decrease as altitude increase)

2. Biotic Components

- Biotic components include living organisms comprising plants, animals and microbes and are classified according to their functional attributes into producers and consumers.
- **Primary producers** - Autotrophs (self-nourishing) Primary producers are basically green plants (and certain bacteria and algae). They synthesise carbohydrate from simple inorganic raw materials like carbon dioxide and water in the presence of sunlight by the process of photosynthesis for themselves, and supply indirectly to other non-producers.
- In terrestrial ecosystem, producers are basically herbaceous and woody plants, while in aquatic ecosystem producers are various species of microscopic algae.

b) Consumers — Heterotrophs or phagotrophs (other nourishing)

- Consumers are incapable of producing their own food (photosynthesis).
- They depend on organic food derived from plants, animals or both.
- Consumers can be divided into two broad groups

(i) Macro consumers- They feed on plants or animals or both and are categorised on the basis of their food sources.

- Herbivores are primary consumers which feed mainly on plants e.g. cow, rabbit.
- Secondary consumers feed on primary consumers e.g. wolves.
- Carnivores which feed on secondary consumers are called tertiary consumers e.g. lions which can eat wolves.
- Omnivores are organisms which consume both plants and animals e.g. man.

(ii) Micro consumers - Saprotrophs (decomposers or osmotrophs)

- They are bacteria and fungi which obtain energy and nutrients by decomposing dead organic substances (detritus) of plant and animal origin.
- The products of decomposition such as inorganic nutrients which are released in the ecosystem are reused by producers and thus recycled.
- Earthworm and certain soil organisms (such as nematodes, and arthropods) are detritus feeders and help in the decomposition of organic matter and are called detrivores.

Classification of Eco-system

1. **Natural Ecosystem**-
   - Terrestrial- Forests, Grasslands, Deserts
   - Aquatic- Fresh Waters, Saline Waters, Marine Waters

Ecotone

- a zone of junction between two or more diverse ecosystems. For e.g. the mangrove forests represent an ecotone between marine and terrestrial ecosystem.

Characteristics of Ecotone

- It may be very narrow or quite wide. It has the conditions intermediate to the adjacent ecosystems. Hence it is a zone of tension.
- It is linear as it shows progressive increase in species composition of one in coming community and a simultaneous decrease in species of the other out going adjoining community.
- A well developed ecotones contain some organisms which are entirely different from that of the adjoining communities.
- Sometimes the number of species and the population density of some of the species is much greater in this zone than either community. This is called edge effect For example the density of birds is greater in the mixed habitat of the ecotone between the forest and the desert.

Niche

- a description of all the biological, physical and chemical factors that a species needs to survive, stay healthy and reproduce.
- NO two species have exact identical niches. Niche plays an important role in conservation of organisms.

Types of Niche

1. Habitat niche - where it lives
2. Food niche - what is eats or decomposes & what species it competes with
3. Reproductive niche -how and when it reproduces.
4. Physical & chemical niche - temperature, land shape, land slope, humidity & other requirement.

Biome

- The terrestrial part of the biosphere is divisible into enormous regions called biomes, which are characterized, by climate, vegetation, animal life and general soil type.
- No two biomes are alike.
- The most important climatic factors are temperature and precipitation.

1. **Tundra-** Northern most region adjoining the ice bound poles.
   - Devoid of trees except stunted shrubs in the southern part of tundra biome, ground flora includes lichen, mosses and sedges.
   - The typical animals are reindeer, arctic fox polar bear, snowy owl, lemming, arctic hare, ptarmigan. Reptiles and amphibians are almost absent

2. **Taiga-** Northern Europe, Asia and North America. Moderate temperature than tundra. Also known as boreal forest.

- The dominating vegetation is coniferous evergreen mostly spruce, with some pine and firs.
- The fauna consists of small seed eating birds, hawks, fur bearing carnivores, little mink, elks, puma, Siberian **tiger,** wolverine, wolves etc.

3. **Temperate Deciduous Forest**- Extends over Central and Southern Europe, Eastern North America, Western China, Japan, New Zealand etc.
- Moderate average temperature and abundant rainfall. These are generally the most productive agricultural areas of the earth
- The flora includes trees like beech, oak, maple and cherry.
- Most animals are the familiar vertebrates and invertebrates.

4. **Tropical rain forest**- Tropical areas in the equatorial regions, which is a bound with life. Temperature and rainfall high.
- Tropical rainforest covers about 7% of the earth's surface & 40% of the world's plant and animal species.
- Multiple storey of broad-leafed evergreen tree species are in abundance.
- Most animals and epiphytic plants(An epiphyte is a plant that grows harmlessly upon another plant) are concentrated in the canopy or tree top zones

5. **Savannah**- Tropical region: Savannah is most extensive in Africa
- Grasses with scattered trees and fire resisting thorny shrubs.
- The fauna include a great diversity of grazers and browsers such as antelopes, buffaloes, zebras, elephants and rhinoceros;
- the carnivores include lion, cheetah, hyena; and mongoose, and many rodents

6. **Grassland**- North America, Ukraine, etc . Dominated by grasses. Temperate conditions with rather low rainfall. **Grasses dominate the vegetation. The fauna include large herbivores like bison, antelope, cattle, rodents, prairie dog, wolves, and a** rich **and diverse array of ground nesting bird**

7. **Desert**- Continental interiors with very low and sporadic rainfall with low humidity. The days are very hot but nights are cold**.**
- The flora is drought resistance vegetation such as cactus, euphorbias, sagebrush. Fauna : Reptiles, Mammals and birds.

Aquatic Zones

- Aquatic systems are not called biomes,
- The major differences between the various aquatic zones are due to salinity, levels of dissolved nutrients; water temperature, depth of sunlight penetration.

1. **Fresh Water Ecosystem**-Fresh water ecosystem are classified as lotic (moving water) or lentic (still or stagnant water).

2. **Marine Ecosystem**-
3. **Estuaries**-Coastal bays, river mouths and tidal marshes form the estuaries.
- In estuaries, fresh water from rivers meet ocean water and the two are mixed by action of tides.
- Estuaries are highly productive as compared to the adjacent river or sea

Biosphere

- a part of the earth where life can exist.
- represents a highly integrated and interacting zone comprising of atmosphere (air), hydrosphere (water) and lithosphere (land)
- Life in the biosphere is abundant between 200 metres (660 feet) below the surface of the ocean and about 6,000 metres (20,000 feet) above sea level.
- absent at extremes of the North and South poles.
- Living organisms are not uniformly distributed throughout the biosphere

FUNCTIONS OF AN ECOSYSTEM

- **ENERGY FLOW**- Energy is the basic force responsible for all metabolic activities. The flow of energy from producer to top consumers is called energy flow which is unidirectional.
- Energy flows through the trophic levels: from producers to subsequent trophic levels.
- There is a loss of some energy in the form of unusable heat at each trophic level.
- **The trophic level interaction involves three concepts namely** :-
  1. Food Chain
  2. Food Web
  3. Ecological Pyramids

1. **FOOD CHAIN**- A food chain starts with producers and ends with top carnivores. The sequence of eaten and being eaten, produces transfer of food energy and it is known as food chain.

- **Grazing food chain-**The consumers which start the food chain, utilising the plant or plant part as their food, constitute the grazing food chain.
- This food chain begins from green plants at the base and the primary consumer is herbivore
- **For example, In terestrial ecosystem, grass is eaten up by caterpillar, which is eaten by lizard and lizard is eaten by snake.**
- **In Aquatic ecosystem phytoplanktons (primary producers) is eaten by zoo planktons which is eaten by fishes and fishes are eaten by pelicans**

- **Detritus food chain**- The food chain starts from dead organic matter of decaying animals and plant bodies to the micro-organisms and then to detritus feeding organism called detrivores or decomposer and to other predators.

Litter —■Earthworms —■Chicken—■Hawk

Detritus food chain

- The distinction between these two food chains is the source of energy for the first level consumers.

2. **FOOD WEB**

- "A food web illustrates, all possible transfers of energy and nutrients among the organisms in an ecosystem, whereas a food chain traces only one pathway of the food".

3. **ECOLOGICAL PYRAMIDS**

- The steps of trophic levels expressed in a diagrammatic way are referred as ecological pyramids.

- The food producer forms the base of the pyramid and the top carnivore forms the tip. Other consumer trophic levels are in between.
- The pyramid consists of a number of horizontal bars depicting specific trophic levels which are arranged sequentially from primary producer level through herbivore, carnivore onwards.
- The length of each bar represents the total number of individuals at each trophic level in an ecosystem.
- **The ecological pyramids are of three categories-**

  1.Pyramid of numbers,

  2.Pyramid of biomass, and

  3.Pyramid of energy or productivity

1. **Pyramid of Numbers**

- This deals with the relationship between the numbers of primary producers and consumers of different levels.
- Depending upon the size and biomass, the pyramid of numbers may not always be upright, and may even be completely inverted.

(a) Pyramid of numbers - upright

- In this pyramid, the number of individuals is decreased from lower level to higher trophic level.
- This type of pyramid can be seen in grassland ecosystem.

(b) Pyramid of numbers - inverted

- In this pyramid, the number of individuals is increased from lower level to higher trophic level.
- A count in a forest would have a small number of large producers, for e.g. few number of big trees. This is because the tree (primary producer) being
- few in number and would represent the base of the pyramid and the dependent herbivores (Example - Birds) in the next higher trophic level and it is followed by parasites in the next trophic level. Hyper parasites being at higher trophic level represents higher in number.
- A pyramid of numbers does not take into account the fact that the size of organisms being counted in each trophic level can vary
- the pyramid of number does not completely define the trophic structure for an ecosystem.

2. **Pyramid of Biomass**

- In this approach individuals in each trophic level are weighed instead of being counted. This gives us a pyramid of biomass, i.e., the total dry weight of all organisms at each trophic level at a particular time.
- Biomass is measured in g/m2.

(a) Upward -pyramid For most **ecosystems on land**, the pyramid of biomass has a large base of primary producers with a smaller trophic level perched on top

(b) Inverted pyramid-In contrast, in many aquatic ecosystems, the pyramid of biomass may assume an inverted form

3. **Pyramid of Energy**

- To compare the functional roles of the trophic levels in an ecosystem, an energy pyramid is most suitable.
- An energy pyramid, reflects the laws of thermodynamics, with conversion of solar energy to chemical energy and heat energy at each trophic level and with loss of energy being depicted at each
  transfer to another trophic level.

- Hence the pyramid is always upward, with a large energy base at the bottom.

POLLUTANTS AND TROPHIC LEVEL :-

- Movement of these pollutants involves two main processes:

1. **Bioaccumulation**

- refers to how pollutants enter a food chain. there is an increase in concentration of a pollutant from the environment to the first organism in a food chain.

2. **Biomagnification**

- refers to the tendency of pollutants to concentrate as they move from one trophic level to the next.
- there is an increase in concentration of a pollutant from one link in a food chain to another.
- In order for biomagnification to occur, the pollutant must be: long-lived, mobile, soluble in fats, biologically active.
- If a pollutant is not active biologically, it may biomagnify, but we really don't worry about it much, since it probably won't cause any problems Examples : DDT.

BIOTIC INTERACTION

- The interaction between the organisms is fundamental for its survival and functioning of ecosystem as a whole.

Type of Biotic Interaction

1. Mutualism:

- both species benefit.
- Example: in pollination mutualisms, the pollinator gets food (pollen, nectar), and the plant has its pollen transferred to other flowers for cross-fertilization (reproduction).

2. **Commensalism:**

- one species benefits, the other is unaffected.
- Example: cow dung provides food and shelter to dung beetles. The beetles have no effect on the cows.

3. **Competition**:

- both species are harmed by the interaction.
- Example: if two species eat the same food, and there isn't enough for both, both may have access to less food than they would if alone. They both suffer a shortage of food

4. **Predation and parasitism:**

- one species benefits, the other is harmed.
- Example : predation—one fish kills and eats ..parasitism: tick gains benefit by sucking blood; host is harmed by losing blood.

5. Amensalism :

- One species is harmed, the other is unaffected.
- Example: A large tree shades a small plant, retarding the growth of the small plant. The small plant has no effect on the large tree.

6. **Neutralism** :

- There is no net benefit or harm to either species. Perhaps in some interspecific
- interactions, the costs and benefits experienced by each partner are exactly the same so that they sum to zero

BIOGEOCHEMICAL CYCLE

- The elements or mineral nutrients are always in circulation moving from non-living to living and then back to the non-living components of the ecosystem in a more or less circular fashion. This circular fashion is known as biogeochemical cycling (bio for living; geo for atmosphere).

1. **Nutrient Cycling:**

- The nutrient cycle is a concept that describes how nutrients move from the physical environment to the living organisms, and subsequently recycled back to the physical environment.
- It is essential for life and it is the vital function of the ecology of any region. In any particular environment, to maintain its organism in a sustained manner, the nutrient cycle must be kept balanced and stable.

Types of Nutrient Cycle

- **Based on the replacement period a nutrient** cycle is referred to as Perfect or Imperfect cycle.
- **A perfect nutrient cycle** is one in which nutrients are replaced as fast as they are utilised. Most gaseous cycles are generally considered as perfect cycles.
- In contrast sedimentary cycles are considered **relatively imperfect**, as some nutrients are lost from the cycle and get locked into sediments and so become unavailable for immediate cycling.
- **Based on the nature of the reservoir**, there are two types of cycles namely Gaseous and sedimentary cycle
- Gaseous Cycle — where the reservoir is the atmosphere or the hydrosphere, and
- Sedimentary Cycle — where the reservoir is the earth's crust.

2. **Gaseous Cycles:**

- **Water Cycle (Hydrologic)**
- The hydrologic cycle is the continuous circulation of water in the Earth-atmosphere system which is driven by solar energy.
- Water moves from one reservoir to another by the processes of evaporation, transpiration, condensation, precipitation, deposition, runoff, infiltration, and groundwater flow.

3. **The Carbon Cycle**

- without carbon dioxide life could not exist, because it is vital for the production of carbohydrates through photosynthesis by plants. It is the element that anchors all organic substances from coal and oil to DNA(deoxyribonudeic acid: the compound that caries genetic information)
- Carbon cycle involves a continuous exchange of carbon between the atmosphere and organisms. Carbon from the atmosphere moves to green plants by the process of photosynthesis, and then to animals. By process of respiration and decomposition of dead organic matter it returns back to atmosphere.

4. The Nitrogen Cycle

- an essential constituent of protein and is a basic building block of all living tissue. It constitutes nearly 16% by weight of all the proteins.
- There is an inexhaustible supply of nitrogen in the atmosphere but the elemental form cannot be used directly by most of the living organisms
- needs to be 'fixed', that is, converted to ammonia, nitrites or nitrates, before it can be taken up by plants.
- on earth it is accomplished in three different ways:
  (i) By microorganisms (bacteria and blue-green algae)

(ii) By man using industrial processes (fertilizerfactories) and
(iii) To a limited extent by atmospheric phenomenon such as thunder and lighting

- The amount of Nitrogen fixed by man through industrial process has far exceeded the amount fixed by the Natural Cycle.
- As a result Nitrogen has become a pollutant which can disrupt the balance of nitrogen. It may lead to Acid rain, Eutrophication and Harmful Algal Blooms.
- Certain microorganisms are capable of fixing atmospheric nitrogen into ammonium ions. These include free living nitrifying bacteria (e.g. aerobic Azotobacter and anaerobic Clostridium) and symbiotic nitrifying bacteria living in association with leguminous plants(pulse etc) and symbiotic bacteria living in non leguminous root nodule plants (e.g. Rhizobium) as well as blue green algae (e.g. Anabaena, Spirulina).
- Ammonium ions can be directly taken up as a source of nitrogen by some plants, or are oxidized to nitrites or nitrates by two groups of specialised bacteria:
- Nitrosamines bacteria promote transformation of ammonia into nitrite. Nitrite is then further transformed into nitrate by the bacteria Nitrobacter.
- The nitrates synthesised by bacteria in the soil are taken up by plants and converted into amino acids, which are the building blocks of proteins.
- These then go through higher trophic levels of the ecosystem.
- During excretion and upon the death of all organisms nitrogen is returned to the soil in the form of ammonia.
- Certain quantity of soil nitrates, being highly soluble in water, is lost to the system by being transported away by surface run-off or ground water. In the soil as well as oceans there are special denitrifying bacteria (e.g. Pseudomonas), which convert the nitrates/nitrites to elemental nitrogen. This nitrogen escapes into the atmosphere, thus completing the cycle.
- The periodic thunderstorms convert the gaseous nitrogen in the atmosphere to ammonia and nitrates which eventually reach the earth's surface through precipitation and then into the soil to be utilized by plants.(Better if You Check Diagram)

5. **Sedimentary Cycle**

- Phosphorus, calcium and magnesium circulate by means of the sedimentary cycle.

(a) Phosphorus Cycle

- Phosphorus plays a central role in aquatic ecosystems and water quality.
- Phosphorus occurs in large amounts as a mineral in phosphate rocks and enters the cycle from erosion and minning activities.
- This is the nutrient considered to be the main cause of excessive growth of rooted and free-floating microscopic plants in lakes.
- The main storage for phosphorus is in the earth's crust.
- On land phosphorus is usually found in the form of phosphates.
- By the process of weathering and erosion phosphates enter rivers and streams that transport them to the ocean.
- In the ocean once the phosphorus accumulates on continental shelves in the form of insoluble deposits
- After millions of years, the crustal plates rise from the sea floor and expose the phosphates on land.
- After more time, weathering will release them from rock and the cycle's geochemical phase begins again.

(b) Sulphur Cycle

- The sulphur reservoir is in the soil and sediments where it is locked in organic (coal, oil and peat) and inorganic deposits (pyrite rock and sulphur rock) in the form of sulphates, sulphides and organic sulphur.

- It is released by weathering of rocks, erosional runoff and decomposition of organic matter and is carried to terrestrial and aquatic ecosystems in salt solution.
- The sulphur cycle is mostly sedimentary except two of its compounds hydrogen sulphide (H_2S) and sulphur dioxide (SO_2) add a gaseous component to its normal sedimentary cycle.
- Atmospheric sulphur dioxide is carried back to the earth after being dissolved in rainwater as weak sulphuric acid.
- sulphur in the form of sulphates is take up by plants and incorporate through a series of metabolic processes into sulphur bearing amino acid which is incorporated in the proteins of autotroph tissues. It then passes through the grazing food chain.
- Sulphur bound in living organism is carried back to the soil, to the bottom of ponds and lakes and seas through excretion and decomposition of dead organic material.

SUCCESSION

- a universal process of directional change in vegetation, on an ecological time scale.
- occurs when a series of communities replace one another due to large scale destruction either natural or manmade.
- continues -one community replacing another community, until a stable, mature community develops.
- The first plant to colonise an area is called the pioneer community. The final stage of succession iscalled the climax community.
- The stage leading to th e climax community are called successional stages or seres.
- characterised by the following: increased productivity, the shift of nutrients from' the reservoirs, increased diversity of organisms with increased niche development, and a gradual increase in the complexity of food webs.

Primary Succession

- In primary succession on a terrestrial site the new site is first colonized by a few hardy pioneer species that are often microbes, lichens and mosses.
- The pioneers through their death any decay leave patches of organic matter in which small animals can live.
- The organic matter produced by these pioneer species produce organic adds during decomposition that dissolve and etch the substratum releasing nutrients to the substratum. Organic debris accumulates in pockets and crevices, providing soil in which seeds can become lodged and grow.
- As the community of organisms continues to develop, it becomes more diverse and competition increases, but at the same time new niche opportunities develops.
- The pioneer species disappear as the habitat conditions change and invasion of new species progresses, leading to the replacement of the preceding community.

Secondary Succession

- occurs when plants recognize an area in which the climax community has been disturbed.
- is the sequential development of biotic communities after the complete or partial destruction of the existing community.
- This abandoned farmland is first invaded by hardy species of grasses that can survive in bare, sun-baked soil. These grasses may be soon joined by tall grasses and herbaceous plants. These dominate the ecosystem for some years along with mice, rabbits, insects and seed-eating birds.

- Eventually, some trees come up in this area, seeds of which may be brought by wind or animals. And over the years, a forest community develops. Thus an abandoned farmland over a period becomes dominated by trees and is transformed into a forest.
- The differences between primary and secondary succession, the secondary succession starts on a well-developed soil already formed at the site. Thus secondary succession is relatively faster as compared to primary succession which may often require hundreds of years.

Autogenic and Allogenic Succession

- When succession is brought about by living inhabitants of that community itself, the process is called autogenic succession, while change brought about by outside forces is known as allogenic succession.

Autotrophic and Heterotrophic succession

- Succession in which, initially the green plants are much greater in quantity is known as autotrophic succession;
- and the ones in which the heterotrophs are greater in quantity is known as heterotrophic succession.
- Succession would occur faster in area existing in the middle of the large continent. This is because, here all prop gules or seeds of plants belonging to the different seres would reach much faster, establish and ultimately result in climax community(imp for short ans type question)

TERRESTRIAL ECOSYSTEMS

- The interrelations between organisms and environment on the land constitute "Terrestrial Ecology".
- The most important limiting factors of the terrestrial ecosystems are moisture and temperature.

TUNDRA

- The word tundra means a "barren land" since they are found where environmental conditions are very severe. There are two types of tundra- arctic and alpine.

Distribution:

- **Arctic tundra** extends as a continuous belt below the polar ice cap and above the tree line in the northern hemisphere. It occupies the northern fringe of Canada, Alaska, European Russia, Siberia and island group of Arctic Ocean.
- On the south pole, tundra is very small since most of it is covered by ocean .
- **Alpine tundra** occurs at high mountains above the tree line. Since mountains are found at all latitudes therefore alpine tundra shows day and night temperature variations.

Flora and fauna:

- Typical vegetation of **arctic tundra** is cotton grass, sedges, dwarf heath, willows, birches and lichens. Animals of tundra are reindeer, musk ox, arctic hare, caribous, lemmings and squirrel.
- Most of them have long.
- They are protected from chillness by the presence of thick cuticle and epidermal hair.
- Mammals of the tundra region have large body size and small tail and ear to avoid the loss of heat from the surface.
- The body is covered with fur for insulation.

FOREST ECOSYSTEM

- includes a complex assemblage of different kinds of biotic communities. Optimum conditions such as temperature and ground moisture are responsible for the establishment of forest communities.
- Forests may be evergreen or deciduous.
- distinguished on the basis of leaf into broad-leafed or needle leafed coniferous forests in the case of temperate areas.
- classified into three major categories: coniferous forest, temperate forest and tropical forest.
- All these forest biomes are generally arranged on a gradient from north to south latitude or from high to lower altitude

Coniferous forest (boreal forest):

- Cold regions with high rainfall, strong seasonal climates with long winters and short summers
- evergreen plant species such as Spruce, fir and pine trees, etc and by animals such as the lynx, wolf, bear, red fox, porcupine, squirrel, and amphibians like Hyla, Rana, etc.
- Boreal forest soils are characterized by thin podozols and are rather poor. Both because, the weathering of rocks proceeds slowly in cold environments and because the litter derived from conifer needle (leaf is decomposed very slowly and is not rich in nutrients.
- These soils are acidic and are mineral deficient.
- This is due to movement of large amount of water through the soil, without a significant counter-upward movement of evaporation, essential soluble nutrients like calcium, nitrogen and potassium which are leached sometimes beyond the reach of roots. This process leaves no alkaline oriented cations to encounter the organic acids of the accumulating litter.
- The productivity and community stability of a boreal forest are lower than those of any other forest ecosystem.

Temperate deciduous forest:

- The temperate forests are characterised by a moderate climate and broad-leafed deciduous trees, which shed their leaves in fall, are bare over winter and grow new foliage in the spring.
- The precipitation is fairly uniform throughout.
- Soils of temperate forests are podozolic and fairly deep.

Temperate evergreen forest*:*

- Parts of the world that have Mediterranean type of Climate are characterised by warm, dry summers and cool, moist winters.
- low broad leafed evergreen trees.
- Fire is an important hazardous factor in this ecosystem and the adaptation of the plants enable them to regenerate quickly after being burnt.

Temperate rain forests:

- seasonality with regard to temperature and rainfall
- Rainfall is high, and fog may be very heavy. It is the important source of water than rainfall itself
- The biotic diversity of temperate rain forests is high as compared to other temperate forest.
- the diversity of plants and animals is much low as compared to the tropical rainforest.

Tropical rain forests:

- Near the equator.
- Among the most diverse and rich communities on the earth.
- Both temperature and humidity remain high and more or less uniform.
- The annual rainfall exceeds 200 cm and is generally distributed throughout the year.
- The flora is highly diversified The **extreme dense vegetation of the tropical** rain forests remains vertically stratified with tall trees often covered with vines, creepers, lianas, epiphytic orchids and bromeliads.
- The lowest layer is an understory of trees, shrubs, herbs, like ferns and palms.
- Soil of tropical rainforests are red latosols, and they are very thick

Tropical seasonal forests:

- also known as monsoon forest occur in regions where total annual rainfall is very high but segregated into pronounced wet and dry periods.
- This kind of forest is found in South East Asia, central and south America, northern Australia, western Africa and tropical islands of the pacific as well as in India.

Subtropical rain forests:

- Broad-leaved evergreen subtropical rain forests are found in regions of fairly high rainfall but less temperature differences between winter and summer
- Epiphytes are common here.
- Animal life of subtropical forest is very similar to that of tropical rainforests.

INDIAN FOREST TYPES

- Forest types in India are classified by Champion and Seth into sixteen types.

Tropical Wet evergreen forests

- are found along the Western Ghats, the Nicobar and Andaman Islands and all along the north-eastern region.
- It is characterized by tall, straight evergreen trees.
- The trees in this forest form a tier pattern:
- Beautiful fern of various colours and different varieties of orchids grow on the trunks of the trees.
- Among the following States, which one has the most suitable climatic conditions for the cultivation of a large variety of orchids with minimum cost of production, and can develop an export oriented industry in this field ? (2011 pre question)
  a. Andhra Pradesh
  b. Arunachal Pradesh
  c. Madhya Pradesh
  d. Uttar Pradesh

Tropical Semi-evergreen forests

- found in the Western Ghats, Andaman and Nicobar Islands, and the Eastern Himalayas.
- Such forests have a mixture of the wet evergreen trees and the moist deciduous trees. The forest is dense

Tropical Moist deciduous forests

- found throughout India except in the western and the north-western regions.

- The trees are tall, have broad trunks, branching trunks and roots to hold them firmly to the ground.
- These forests are dominated by sal and teak, along with mango, bamboo, and rosewood.

Littoral and swamp

- found along the Andaman and Nicobar Islands and the delta area of the Ganga and the Brahmaputra.
- They have roots that consist of soft tissue so that the plant can breathe in the water.

Tropical Dry deciduous forest

- The northern part of the country except in the North-East. It is also found in Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka, and Tamil Nadu. The canopy, of the trees does not normally exceed 25 metres.
  The common trees are the sal, a variety of acacia, and bamboo.

Tropical Thorn forests

- This type is found in areas with black soil: North, West, Central, and South India. The trees do not grow beyond 10 metres. Spurge, caper, and cactus are typical of this region.

Tropical Dry evergreen forest

- Dry evergreens are found along Tamil Nadu Andhra Pradesh and Karnataka coast. It is mainly hard-leaved evergreen trees with fragrant flowers, along with a few deciduous trees.

Sub-tropical Broad-leaved forests

- Broad-leaved forests are found in the Eastern Himalayas and the Western Ghats, along the Silent Valley.
- There is a marked difference in the form of vegetation in the two areas.
- In the Silent Valley, the poonspar, cinnamon, rhododendron, and fragrant grass are predominant.
- In the Eastern Himalayas, the flora has been badly affected by the shifting cultivation and forest fires.
- There are oak, alder, chestnut, birch, and cherry trees. There are a large variety of orchids, bamboo and creepers.

Sub-tropical Pine forests

- found in Shivalik Hills, Western and Central Himalayas, Khasi, Naga, and Manipur Hills.
- The trees predominantly found in these areas are the chir, oak, rhododendion, and pine as well as sal, amla, and laburnum are found in the lower regions.

Sub-tropical Dry evergreen forests

- hot and dry season and a cold winter. It generally has evergreen trees with shining leaves that have a varnished look.
- found in the Shivalik Hills and foothills of the Himalayas up to a height of 1000 metres.

Montane Wet temperate forests

- In the North, found in the region to the east of Nepal into Arunachal Pradesh, receiving a minimum rainfall of 2000 mm. In the North, there are three layers of

forests: the higher layer has mainly coniferous, the middle layer has deciduous trees such as the oak and the lowest layer is covered by rhododendron and champa.

- In the South, it is found in parts of the Niligiri Hills, the higher reaches of Kerala.
- The forests in the northern region are denser than in the South. Rhododendrons and a variety of ground flora can be found here.

Himalayan Moist temperate Forest

- This type spreads from the Western Himalayas to the Eastern Himalayas. The trees found in the western section are broad-leaved oak, brown oak, walnut, rhododendron,
- Eastern Himalayas, the rainfall is much heavier and therefore the vegetation is also more lush and dense. There are a large variety of broad-leaved trees, ferri, and bamboo.

Himalayan Dry temperate Forest

- This type is found in Lahul, Kinnaur, Sikkim, and other parts of the Himalayas.
- There are predominantly coniferous trees, along with broad-leaved trees such as the oak, maple, and ash. At higher elevation, fir, juniper, deodar, and chilgoza are found.

Sub alpine forest

- Sub alpine forests extend from Kashmir to Arunachal Pradesh between 2900 to 3500 metres.
- In the Western Himalayas, the vegetation consists mainly of juniper, hododendron, willow, and black currant.
- In the eastern parts, red fir, black juniper, birch, and larch are the common trees.
- Due to heavy rainfall and high humidity the timberline in this part is higher than that in the West.
- Rhododendron of many species covers the hills in these parts.

Moist Alpine scrub

- Moist alpines are found all along the Himalayas and on the higher hills near the Myanmar border. It has a low scrub, dense evergreen forest, consisting mainly of rhododendron and birch. Mosses and ferns cover the ground in patches. This region receives heavy snowfall.

Dry alpine scrub

- Dry alpines are found from about 3000 metres to about 4900 metres. Dwarf plants predominate, mainly the black juniper, the drooping juniper, honeysuckle, and willow.

GRASSLAND ECOSYTEM

- found where rainfall is about 25-75 cm per year, not enough to support a forest, but more than that of a true desert.
- vegetation formations that are generally found in temperate climates.
- In India, they are found mainly in the high Himalayas. The rest of India's grasslands are mainly composed of steppes and savannas.
- Steppe formations occupy large areas of sandy and saline soil; in western Rajasthan, where the climate is semi-arid,
- The major difference between steppes and savannas is that all the forage in the steppe is provided only during the brief wet season whereas in the savannas forage is largely from grasses that not only grow during the wet season but also from the smaller amount of regrowth in the dry season.

Types of Grasslands

1. **semi-arid zone (The Sehima-dichanthium type)**
   - It covers the northern portion of Gujarat, Rajasthan (excluding Aravallis), western Uttar Pradesh, Delhi and Punjab.
   - The topography is broken up by hill spurs and sand dunes.
   - senegal, Calotropis gigantia, Cassia auriculata, Prosopis cineraria, Salvadora oloides and zizyphus Nummularia which make the savanna rangeland look like scrub.
2. **dry sub humid zone (The Dichanthium- cenchrus-lasitrrus type)**
   - It covers the whole of peninsular India (except Nilgiri).
   - The thorny bushes are Acacia catechu, Mimosa, Zizyphus (ber) and sometimes fleshy Euphorbia, along with low trees of Anogeissus latifolia, Soymida febrifuga and other deciduous species.
   - Sehima (grass)is more prevalent on gravel and the cover maybe 27%. Dichanthium (grass) flourishes on level soils and may cover 80% of the ground.

3) moist subhumid zone(The Phragmities- sacchrum-imperata type)

- It covers the Ganga alluvial plain in Northern India.
- The topography is level, low lying and ill-drained.
- Bothriochloa pertusa, Cypodon dactylon and Dichanthium annulatum are found in transition zones.
- The common trees and shrubs are Acacia arabica, hogeissus, la tifolia, Butea monosperma, Phoenic sylvestris and Zizyphus nummularia.
- Some of these are replaced by Borassus sp in the palm savannas especially near Sunderbans.

4) **The Themeda - Arundinella type**

- This extends to the humid montane regions and moist sub-humid axeas of Assam, Manipur,West Bengal, Uttar Pradesh, Punjab, Himachal Pradesh and. Jammu and Kashmir.
- The savanna is derived from the humid forests on account of shifting cultivation and sheep grazing.
- Indian Grasslands and Fodder Research Institute, Jhansi and Central Arid Zone Research institute, Jodhpur

Role of fire

- fire plays, an important role in the management of grasslands.
- Under moist conditions fire favours grass over trees, whereas in dry conditions fire is often necessary to maintain grasslands against the invasion of desert shrubs.
- Burning increases the forage yields, e.g. Cynodon daotylon

DESERT ECOSYSTEM

- Deserts are formed in regions with less than 25 cm of annual rainfall, .or sometimes in hot regions where there is more rainfall, but unevenly distributed in the annual ycle.
- Lack' of rain in the mid latitude is often due to stable high pressure zones; deserts in temperate regions often lie in "rain shadows", that is where high mountains block off moisture frorri the seas.
- The climate:of these biomes is modified by altitUde and latitude. At high. at greater distance from the equator the deSerts are cold and hot near equator and tropics.
- As the large volume of water passes through the irrigation system, salts may be left behind that will gradually accumulate over the years until they become limiting, unless means of avoiding this difficulty are devised

Adaptations

(i) These plants conserve water by following methods:

They are mostly shrubs.

- Leaves are absent or reduced in size.
- Leaves and stem are succulent and water storing.

- In some plants even the stem contains chlorophyll for photosynthesis.
- Root system is well developed and spread over large area.
- The annuals wherever present germinate, bloom and reproduce only during the short rainy season, and not in summer and winter.

(ii) The animals are physiologically and behaviorally adapted to desert conditions.

- They are fast runners.
- They are nocturnal in habit to avoid the sun's heat during day time.
- They conserve water by excreting concentrated urine.
- Animals and birds usually have long legs to keep the body away from the hot ground.
- Lizards are mostly insectivorous and can live without drinking water for several days.
- Herbivorous animals get sufficient water from the seeds which they eat.
- Mammals as a group are poorly adapted to deserts

Indian Desert — Thar desert (hot)

The climate of this region is characterised by excessive drought, the rainfall being scanty and , irregular.

- The winter rains of northern India rarely penetrate into the region.
- The proper desert plants may be divided into two main groups.

  i) depending directly upon on rain and

  ii) those depending on the presence of subterranean water.

The first group consists of two types:

- the 'ephemera's' and the rain perennials'.
- The ephemera's are delicate annuals, apparently free from any xerophilous adaptations, having slender stems and root-systems and often large Flowers.
- They appear almost immediately after rain, develop flowers and fruits in an incredibly short time, and die as soon as the surface layer of the soil dries up.
- The rain perennials are visible above the ground only during the rainy season, but have a perennial underground stem.
- The second group - depending on the presence of subterranean water
- By far the largest number of indigenous plants are capable of absorbing water from deep below the surface of the ground by means of a well-developed root system, the main part of which generally consists of a slender, woody tap root of extraordinary length.
- Generally, various other xerophilous adaptations are resorted to such as reduced leaves, thick hairy growth, succulence, coatings of wax, thick cuticle, protected stomata, etc., all having for their object of reduction of transpiration.

Fauna

- It is home to some of India's most magnificent grasslands and sanctuary for a charismatic bird, the Great Indian Bustard.
- Among the mammal fauna, the blackbuck, wild ass, chinkara, caracal, Sandgrouse and desert fox inhabit the open plains, grasslands, and saline depressions.
- The nesting ground of Flamingoes and the only known population of Asiatic wild Ass lies in the remote part of Great Rarm, Gujarat.
- It is the migration flyway used by cranes and flamingos.
- Some endemic flora species of Thar Desert includes Calligonum Polygonoides, Prosopis cineraria, Tecomella undulate, Cenchrus biflorus and Sueda fruticosa , etc

Cold Desert/ Temperate Desert

- Cold desert of India include areas of ladak, leh and kargil of kashmir and spiti valley of Himachal Pradesh and some parts of northern Uttaranchal and Sikkim. Lies in rain shadow of Himalaya

- Oak, pine, deodar, birch and rhododendron are the important trees and bushes found there. Major animal include yaks, dwarf cows, and goats.
- Severe arid conditions - Dry Atmosphere
- Mean annual rainfall less than 400mm
- Soil type - sandy to sandy loam , Soil pH - neutral to slight alkaline.
- Soil nutrient - Poor organic matter content ,low water retention capacity

Bio-diversity

- Cold desert is the home of highly adaptive, rare endangered fauna, such as Asiatic Ibex, Tibetan Argali, Ladakh Uriyal, Bharal, Tibetan Antelope (chiru), Tibetan Gazelle, Wild Yak, Snow Leopard, Brown Bear, Tibetan Wolf, Wild Dog and Tibetan Wild Ass ('Kiang' a close relative of the Indian wild ass) , Woolly hare, Black Necked Crane, etc.
- India as a signatory to United Nations Convention to Combat Desertification (UNCCD) has submitted four National Reports to UNCCD in the years 2000, 2002, 2006 and 2010

Some of the major programmes currently implemented that address issues related to land degradation and desertification is:-

- Integrated Watershed Management Programme (IWMP),
- National Afforestation Programme (NAP),
- National Mission for Green India (GIM),
- The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS),
- Soil Conservation in the Catchment of River Valley Project and Flood Prone River,
- National Watershed Development Project for Rainfed Areas (NWDPRA),
- Desert Development Programme (DDP)
- Fodder and Feed Development Scheme-component of Grassland Development including Grass Reserves, Command Area Development and Water Management (CADWM) programme etc

AQUATIC ECOSYSTEM

- **Fresh water ecosystems**- The salt content of fresh bodies is very low, always less than 5 ppt (parts per thousand). E.g lakes, ponds, pools, springs, streams, and rivers
- **Marine ecosystems** - the water bodies containing salt concentration equal to or above that of sea water (i.e., 35 ppt or above). E.g shallow seas and open ocean
- **Brackish water ecosystems**- these water bodies have salt content in between 5 to 35 ppt. e.g. estuaries, salt marshes, mangrove swamps and forests.

AQUATIC ORGANISMS

- The aquatic organisms are classified on the basis Of their one of occurrence and their ability to cross these zones.
- can be classified on the basis of their life form or location into five groups

1. **Neuston:**

- These are unattached organisms which live at the air-water interface such as floating plants, etc.
- Some organisms spend most of their lives on top of the air-water interface such as water striders, while others spend most of their time just beneath the air-water interface and obtain most of their food within the water.
- E.g., beetles and back-swimmers.

2. **Periphyton:**

- These are organisms which remain attached to stems and leaves of rooted plants or substances emerging above the bottom mud such as sessile algae and their associated group of animals.

3. Plankton

- This group includes both microscopic plants like algae (phytoplankton) and animals like crustaceans and protozoans (zooplankton) found in all aquatic ecosysteins, except certain swift moving waters
- The locomotory power of the planktons is limited so that their distribution is controlled, largely, by currents in the aquatic ecosystems.

4. **Nekton:**

- This group contains animals which are swimmers.
- The nektons are relatively large and powerful as they have to overcome the water currents.

5. **Benthos:**

- The benthic organisms are those found living in the bottom of the water mass.
- Practically every aquatic ecosystem contains well developed benthos

Factors Limiting the Productivity of Aquatic Habitats

1. Sunlight :

- Sunlight penetration rapidly diminishes as it passes down the column of water. The depth to which light penetrates a lake determines the extent of plant distribution.
- Based on light penetration and plant distribution they are classified as photic and aphotic zones

Photic zone:

- It is the upper layer of the aquatic ecosystems, up to which light penetrates and within which photosynthetic activity is confined.
- The depth of this zone depends on the transparency of water.
- photic (or ."euphotic") zone is the lighted and usually well-mixed portion that extends from the lake surface down to where the light level is 1% of that at the surface.

Aphotic zone:

- The lower layers of the aquatic ecosystems, where light penetration and plant growth are restricted forms the aphotic zone.
- Only respiration activity takes place.(photic-both respiration and photosynthesis take place)
- Aphotic zone is positioned below the littoral and photic zones to bottom of the lake where light levels are too low for photosynthesis.
- This deep, unlit region is also known as the profundal zone.

Dissolved oxygen:

- Oxygen enters the aquatic ecosystem through the air water interface and by the photosynthetic. average concentration of dissolved oxygen as 10 parts per million by weight.
- Dissolved oxygen escapes the water body through air-water interface and through respiration of organisms (fish, decomposers, zooplanktons, etc)
- The amount of dissolved oxygen retained in water is also influenced by temperature.

Other limiting factors which influence on aquatic productivity are

Transparency:

- Transparency affects the extent of light penetration.
- Suspended particulate matters such as clay, silt, phytoplankton, etc make the water turbid.

- Consequently it limits the extent of light penetration and the photosynthetic activity in a significant way.

Temperature:

- The water temperature changes less rapidly than the temperature of air because water has a considerably higher specific heat than air.
- Since water temperatures are less subject to change, the aquatic organisms have narrow temperature tolerance limit.

LAKE ECOLOGY

- Any - body of standing water, generally large enough in area and depth, irrespective of its hydrology, ecology, and other characteristics is generally known as lake.

Ageing of Lakes

- The nutrient-enrichment of the lakes promotes the growth of algae, aquatic plants and various fauna. This process is known as natural eutrophication.
- Similar nutrient enrichment of lakes at an accelerated rate is caused by human activities and the consequent ageing phenomenon is known as 'cultural eutrophication'.
- In India, natural lakes (relatively few) mostly ile in the Himalayan region, the floodplains of Indus, Ganga and Brahmaputra.
- Lake 'Sudarshan' in Gujarat's Girnar area was perhaps the oldest man-made lake in India, dating back to 300 BC.
- Lakes are also classified on the basis of their water chemistry. Based-on the levels of salinity, they are known as Freshwater, Brackish or Saline lakes (similar to that of classification of aquatic ecosystem).
- On the basis of their nutrient content, they are categorized as Oligotrophic (very low nutrients), Mesotrophic (moderate nutrients) and Eutrophic (highly nutrient rich).

Removal of the nutrients from a lake

- Flushing with nutrient-poor waters.
- Deep water abstraction.
- On-site P-elimination by flocculation/flotation with water backflow, or floating Plant NESSIE with adsorbents.
- On-site algae removal by filters and P-adsorbers.
- 0n-site algae skimming and separator thickening.
- Artificial mixing / Destratification (permanent or intermittent).
- Harvest of fishes and macrophytes.
- Sludge removal

EUTROPHICATION

- a syndrome of ecosystem, response to the addition of artificial or natural substances such as nitrates and phosphates through fertilizer, sewage, etc that fertilize the aquatic ecosystem.
- The growth of green algae which we see in the lake surface layer is the physical identification of an Eutrophication.
- Some algae and blue-green bacteria thrive on the excess ions and a population explosion covers almost entire surface layer is known as algal bloom.
- **Nitrogen testing is a technique to find the optimum amount of fertilizer required for crop plants. It will reduce the amount of nitrogen lost to the surrounding area.**

HARMFUL ALGAL BLOOMS

- Algae or phytoplankton are microscopic organisms that can be found naturally in coastal waters. They are major producers of oxygen and food for many of the animals that live in these waters.
- Algal blooms can be any color, but the most common ones are red or brown.

- Most algal blooms are not harmful but some produce toxins and do affect fish, birds, marine mammals and humans.

Use of algae

- Most species of algae or phytoplankton serve as the energy producers at the base of the food web, without which higher life on this planet would not exist.

Why Red Tide is a misnomer?

- "Red Tide" is a common name for such a phenomenon where certain phytoplankton species contain pigments and "bloom" such that the human eye perceives the water to be discoloured.
- Blooms can appear greenish, brown, and even reddish orange depending upon the type of organism, the type of water, and the concentration of the organisms.
- The term "red tide" is thus a misnomer because blooms are not always red, they are not associated with tides, they are usually not harmful, and some species can be harmful or dangerous at low cell concentrations that do not discolour the water.

What are the causes of these blooms?

- Two common causes are nutrient enrichment and warm waters.

WET LAND ECOSYSTEM

- Areas of marsh, fen, peatland/water, whether natural (or) artificial, permanent (or) temporary with water that is static (or) flowing, fresh, brackish (or) salt, including areas of marine water the depth of which at low tide does not exceed 6 mtrs.

Wetlands Classification-

1. Inland wetland-
   a)Natural- Lakes / Ponds, Ox-bow Lakes, Waterlogged, Swamp/marsh
   b) Manmade- Reservoirs Tank, Ash pond
2. Costal Wetland-

A) Natural- Coral reef, Tidal flat, Mangroves, Salt marsh, Estuary, Lagoon, Creek, Backwater, Bay

b)-manmade -• Salt pans, Aquculture

Functions of Wetlands-

- Habitat to aquatic flora and fauna, birds
- Filtration of sediments and nutrients from surface water,
- Nutrients recycling, Water purification

Floods mitigation,

- Ground water recharging, Buffer shorelines against erosion,
- Genetic reservoir for various species of plants(rice)
- the National Lake Conservation Programme (NLCP) considers lakes as standing water bodies which have a minimum water depth of 3 m, generally cover a water spread of more than ten hectares, and have no or very little aquatic vegetation.
- Wetlands (generally less than 3 m deep over most of their area) are usually rich in nutrients (derived from surroundings and their sediments) and have .abundant growth of aquatic macrophytes

India's Wetland

- Wetlands occupy 18.4% of the country's area of which 70% are under paddy cultivation.
- Inland wetlands >Costal Wetlands

National Wetlands Conservation Programme (NWCP)

- NWCP was implemented in the year 1985-86.
- Under the programme, 115 wetlands have been identified by the Ministry which require urgent conservation and management interventions.

Aim

- Conservation of wetlands to prevent their further degradation and ensuring their wise use for the benefit of local communities and overall conservation of biodiversity.

Objectives

- to lay down policy guidelines for conservation and management of wetlands in the country.
- to provide financial assistance for undertaking intensive conservation measures in the identified wetlands
- The Central Government is responsible for overall coordination of wetland conservation programmes and initiatives at the international and national levels. It also provides guidelines, financial & technical assistance to state govt.
- State Governments/UT Administration are responsible for management of wetlands and implementation of the NWCP for ensuring their wise-use

Criteria for Identification of Wetlands of National Importance

- Criteria for identification of wetlands of national importance under NWCP are same as those prescribed under the 'Ramsar Convention on Wetlands' and are as given below:

1. **Sites containing representative, rare or unique wetland types**
   - example of a natural or near-natural wetland type' found within the appropriate biogeographic region.

2. **Criteria based on species and ecological communities**
- If it supports vulnerable, endangered, or critically endangered species; or threatened ecological communities.
- If it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.
- If it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

3. **Specific criteria based on water birds**
- If it regularly supports 20,000 or more water birds.
- If it regularly supports 1% of the individuals in a population of one species or subspecies of waterbirds.

4. **Specific criteria based on fis**h
- If it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.
- If it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend. Specific criteria based on water/life and culture

- If it is an important source of food and water resource, increased possibilities for recreation
- and eco-tourism, improved scenic values, educational opportunities, conservation of cultural heritage (historic or religious sites)

ESTUARY ECOSYSTEM

- located where river meets the sea.
- the most productive water bodies in the world
- The complete salinity range from 0-35 ppt is seen from the head (river end) to the mouth (sea end) of an estuary
- Coastal lakes which have their connection with the sea through small openings are better known as lagoons or backwaters
- acting as a natural water filter

Estuary Formation:

- grouped into four geomorphic categories based on the physical processes responsible for their formation:
- 1) rising sea level; (2) movement of sand and sandbars; (3) glacial processes; and (4) tectonic processes.

India Estuarine Ecosystem

- The Country has 14 major, 44 medium and 162 minor rivers drains into the sea through various estuaries.
- Major estuaries occur in the Bay of Bengal.
- Most of the India's major estuaries occur on the east coast. In contrast, the estuaries on the west coast are smaller.

MANGROVES

- are the characteristic littoral plant formation of tropical and subtropical sheltered coastlines.
- are trees and bushes growing below the high water level of spring tides which exhibits remarkable capacity for salt water tolerance.
- basically evergreen land plants
- growing on sheltered shores, typically on tidal flats, deltas, estuaries, bays, creeks and the barrier islands.
- require high solar radiation and have the ability to absorb fresh water from saline/ brackish water.
- produces pneumatophores (blind roots) to overcome respiration problem in the anaerobic soil conditions
- Leaves are thick and contain salt secreting glands.
- exhibit viviparity mode of reproduction. i.e. SeedS germinate in the tree itself (before falling to the ground). This is an adaptative medianiSintoovercome the problem of germination in Saline water.
- crystals of salt on the back of the leaves; others block absorption of salt at their roots

The mangroves of **Sundarbans are** the largest

- single block of tidal holophytic mangroves of the world.
- famous for the Royal Bengal Tiger and crocodiles.

- The mangroves of Bhitarkanika (Orissa), which is the second largest in the Indian sub continent, harbour high concentration of typical mangrove species and high genetic diversity
- have (additional) special roots such as prop roots, pneumatophores which help to impede water flow and thereby enhance the deposition of sediment in areas (where it is already occurring), stabilize the coastal shores, provide breeding ground for fishes.
- protects coastal lands from tsunami, hurricanes:and floods
- release oxygen back to the atmosphere, along with a little methane gas

CORAL REEFS

- Coral is actually a living animal.
- has a symbiotic relationship (each gives something to the other and gets something back in return) With 'zooxanthellae' microscopic algae which live on coral [i.e. instead of living on the sea floor, the algae lives up on the coral which is closer to the ocean surface and so that the algae gets lots of light.
- The tissues of corals themselves are actually not the beautiful colors of the coral reef, but are instead clear (white). The corals receive their coloration from the zooxanthellae living within their tissues.
- There are two types of corals: hard corals and soft corals, such as sea fans and gorgonians. Only hard corals build reefs.
- The builders of coral reefs are tiny animals called polyps. As these polyps thrive, grew, then die, they leave their limestone (calcium carbonate) skeletons behind. The limestone is colonized by new polyps.
- found in tropical and sub-tropical water, there are also deep water corals in colder regions
- The United Nations Environment Programme reports that there are more cold-water coral reefs worldwide than tropical reefs.
- There are only about 6 different coral species associated in building with these reefs. The largest cold-water coral reef is the Rost 'Reef off Norway
- occur in shallow tropical areas where the sea water is clean, clear and warm.
- one of the most productive and complex coastal ecosystems with high biological diversity
- classified depending on their locations into fringing, patch, barrier and atoll.
- The fringing reefs are contiguous with the shore and they are the most common - by occurring reef form, found in Andamans.
- Patch reefs are isolated and discontinuous patches, lying shoreward of offshore reef structures as seen in the Palk bay, Gulf of Mannar and Gulf of Katchchh.
- Barrier reefs are linear offshore reef structures that run parallel to coastlines and arise from submerged shelf platforms. The water body between the reef and the shore is termed as lagoon. Barrier reefs are seen in Nicobar and Lakshadweep.
- Atolls are circular or semi-circular reefs that arise from subsiding sea floor platforms as coral reef building keeps ahead of subsidence. The examples are the atolls of Lakshadweep and Nicobar.
- Among the four major reef areas of India, Andaman and Nicobar Islands are found to be very rich in species diversity followed by the Lakshadweep Islands, the Gulf of Mannar and finally the Gulf of Kachchh.

Coral Bleaching

- Bleaching, or the paling of coral colour occurs; when (i) the densities of zooxanthellae decline and (ii) the concentration of photosynthetic pigments within the zooxanthellae fall.

Ecological causes of coral bleaching

- **Temperature (Major Cause)**
- **Sub aerial Exposure**-Sudden exposure of reef flat corals to the atmosphere during events such as extreme low tides, ENSO-related sea level drops or tectonic uplift can potentially induce bleaching.
- **Sedimentation**
- Fresh Water **Dilution**
- **Inorganic Nutrients(**e.g. ammonia and nitrate)
- **Xenobiotics** -Zooxanthellae loss occurs during exposure of coral to elevated concentrations of various chemical contaminants, such as Cu, herbicides and oil.
- **Epizootics**

KEY INITIATIVES TO PROTECT MARINE AND COASTAL ENVIRONMENTS

1. **Coastal Ocean Monitoring and Prediction System (COMAPS)**

- Being implemented from 1991. Assesses the health of coastal waters and facilitates management of pollution-related issues
- Programme was restructured and modified in 2000-2001 to include pollution monitoring; liaison, regulation and legislation; and consultancy services.

2.**Land Ocean Interactions in the Coastal Zone (LOICZ)**

- Launched in 1995. Investigates the effects of global change on the coastal zone
- Aims to develop, on a scientific basis, the integrated management of coastal environments

3. **Integrated Coastal and Marine Area Management (ICMAM)**

- Launched in 1998
- Aims at integrated management of coastal and marine areas.
- Model plans for Chennai, Goa and Gulf of Kutch being prepared

4. **Society of Integrated Coastal Management (SICOM)**

- Launched in 2010
- Major national initiative to protect coastal ecosystems
- A professional body with experts in various aspects of coastal *science* and management

5. **Institutions for Coastal Management**

- The Notification on Coastal Regulation Zone (CRZ), 1991 (as amended from time to time) aims at protecting coastal stretches in India.
- India has created institutional mechanisms such as National Coastal Zone Management Authority (NCZMA) and State Coastal Zone Management Authority (SCZMA) for enforcement and monitoring of the CRZ Notification.
- These authorities have been delegated powers under Section 5 of the Environmental (Protection) Act, 1986 to take various measures for protecting and improving the quality-of the coastal environment and preventing, abating and controlling environmental pollution in coastal areas.

ENVIRONMENT POLLUTION

- defined as 'an addition or excessive addition of certain materials to the physical environment (water, air and lands), making it less fit or unfit for life'.
- Pollutants are the materials or factors, which cause adverse effect on the natural quality of any component of the environment.

Classifications

1. **According to the form in which they persist after release into the environment**.

- **Primary pollutants**: These persist in the form in which they are added to the environment e.g. DDT, plastic.
- **Secondary Pollutants**: These are formed by interaction among the primary pollutants. For example, peroxyacetyl nitrate (PAN) is formed by the interaction of nitrogen oxides and hydrocarbons.

2. **According to their existence in nature.**

- **Quantitative Pollutants**: These occur in nature and become pollutant when their concentration reaches beyond a threshold level. E.g. carbon dioxide, nitrogen oxide.
- **Qualitative Pollutants**: These do not occur in nature and are man-made. E.g. fungicides, herbicides, DDT etc.

3. **According to their nature of disposal**.

- **Biodegradable Pollutants**: Waste products, which are degraded by microbial action. E.g. sewage.
- **Non-biodegradable Pollutants**: Pollutants, which are not decomposed by microbial action. E.g. plastics, glass, DDT, salts of heavy metals, radioactive substances etc

4. **According to origin**
    - Natural
    - Anthropogenic

AIR POLLUTION

- aggravated because of four developments:
  Increasing traffic, growing cities, rapid economic development, and industrialization
- contamination of air by the discharge of harmful substances

Major air pollutants and their sources

1. **Carbon monoxide (CO)**

- **It** is a colourless, odourless gas that is produced by the incomplete burning of carbon-based fuels including petrol, diesel, and wood.
- It is also produced from the combustion of natural and synthetic products such as cigarettes.
- It lowers the amount of oxygen that enters our blood. It can slow our reflexes and make us confused and sleepy.

2. **Carbon dioxide (CO2)**

- principle greenhouse gas

3. **Chloroflorocarbons (CFC)**

- gases that are released mainly fromair-conditioning systems and refrigeration.

- When released into the air, CFCs rise to the stratosphere, where they come in contact with few other gases, which lead to a reduction of the ozone layer that protects the earth from the harmful ultraviolet rays of the sun.

4. **Lead**

- present in petrol, diesel, lead batteries, paints, hair dye products, etc.
- affects children in particular.
- cause nervous system damage and digestive problems and, in some cases, cause cancer.

5. **Ozone**

- occurs naturally in the upper layers of the atmosphere.
- at-the ground level, it is a pollutant with highly toxic effects.
- Vehicles and industries are the major source of ground-level ozone emissions.
- Ozone makes our eyes itch, burn, and water. It lowers our resistance to cold and pneumonia.

6. Nitrogen oxide (Nox)

- causes smog and acid rain. It is produced from burning fuels including petrol, diesel, and coal.
- Nitrogen oxide can make children susceptible to respiratory diseases in winters.

7. Suspended particulate matter (SPM)

- consists of solids in the air in the form of smoke, dust, and vapour that can remain suspended for extended periods
- The finer of these particles when breathed in can lodge in our lungs and cause lung damage and respiratory problems.

8. Sulphur dioxide (S02)

- a gas produced from burning coal, mainly in thermal power plants.
- Some industrial processes, such as production of paper and smelting of metals, produce sulphur dioxide.
- a major contributor to smog and acid rain.
- Sulphur dioxide can lead to lung diseases

9. **Smog**

- a combination of the words fog and smoke. Smog is a condition of fog that had soot or smoke in it.
- interaction of sunlight with certain chemicals in the atmosphere.
- primary components of photochemical smog is ozone.
- Ozone is formed through a complex reaction involving hydrocarbons, nitrogen oxides, and sunlight. It is formed when pollutants released from gasoline, diesel-powered vehicles and oil-based solvents react with heat and sunlight
- **from biofuels, the four most serious pollutants are particulates**, carbon monoxide, polycyclic organic matter, and formaldehyde

Pollutants

i**) Volatile organic compounds**

- The main indoor sources are perfumes, hair sprays, furniture polish, glues, air fresheners, moth repellents, wood preservatives, and other products.

ii) **Biological pollutants**

- It includes pollen from plants, mite, and hair from pets, fungi, parasites, and some bacteria.

iii) **Formaldehyde**

- Mainly from carpets, particle boards, and insulation foam. It causes irritation to the eyes and nose and allergies.

iv) **Radon**

- It is a gas that is emitted naturally by the soil. Due to modern houses having poor ventilation, it is confined inside the house and causes lung cancers.

Fly Ash

Ash is produced whenever combustion of solid material takes place.

Composition

1. Aluminium silicate (in.large amounts)
2. silicon dioxide (Si02) and
3. Calcium oxide (Ca0).

- Fly ash particles are oxide rich and consist of silica, alumina, oxides of iron, calcium, and magnesium and toxic heavy metals like lead, arsenic, cobalt, and coppers

Policy measures of MoEF:

- The Ministry of Environment and Forests vide its notification in 2009, has made it mandatory to use Fly Ash based products in all construction projects, road embankment works and low lying land filling works within 100 kms radius of Thermal Power Station.
- To use Fly Ash in mine filling activities within 50 kms radius of Thermal Power Stations.
- Arresters: These are used to separate particulate matters from contaminated air.
- Scrubbers: These are used to clean air for both dusts and gases by passing it through a dry or wet packing material.

Government Initiatives

(1) **National Air Quality Monitoring Programme**

- In India, the Central Pollution Control Board (CPCB) has been executing a nationwide programme of ambient air quality monitoring known as National Air Quality Monitoring Programme (NAMP).
- The National Air Quality Monitoring Programme (NAMP) is undertaken in India
  (i) to determine status and trends of ambient air quality;
  (ii) to ascertain the compliance of NAAQS;
  (iii) to identify non-attainment cities;
  (iv) to understand the natural process of cleaning in the atmosphere; and
  (v) to undertake preventive and corrective measures.
- Annual average concentration of SOx levels are within the prescribed National Ambient Air Quality Standards (NAAQS).
- National Ambient Air Quality Standards (NAAQS) were notified in the year 1982, duly revised in 1994 based on health criteria and land uses.
- The NAAQS have been revisited and revised in November 2009 for 12 pollutants, which include. sulphur dioxide (S02), nitrogen dioxide (NO2), particulate matter having size less than 10 micron

(PM10),particulate matter having size less than 2.5micron (PM2.5), ozone, lead, carbon monoxide (CO), arsenic, nickel, benzene, ammonia, and. Benzopyrene.

WATER POLLUTION

- Addition of certain substances to the water such as organic, inorganic, biological, radiological, heat, which degrades the quality of water so that it becomes unfit for use.
- Putrescibility is the process of decomposition of organic matter present in water by microorganisms using oxygen.
- Water having DO (dissolved oxygen) content below 8.0 mg/L may be considered as contaminated. Water having DO content below. 4.0 mg/L is considered to be highly polluted.
- Water pollution by organic wastes is measured in terms of Biochemical Oxygen Demand-(BOD). BOD is the amount of dissolved oxygen needed by bacteria in decomposing the organic wastes present in water.
- Chemical oxygen demand (COD) is a slightly better mode used to measure pollution load in water. It is the measure of oxygen equivalent of the requirement of oxidation of total organic matter (i.e. biodegradable and non-biodegradable) present in water.
- A cripling deformity called Minamata disease due to consumption of fish captured from mercury contaminated Minamata Bay.
- Water contaminated with cadmium can cause itai itai disease also called ouch-ouch disease (a painful disease of bones and joints) and cancer of lungs and liver.
- The compounds of lead cause anaemia, headache, loss of muscle power and bluish line around the gum
- Excess nitrate in drinking water reacts with hemoglobin to form non-functional met haemoglobin, and impairs oxygen transport. This condition is called methaemoglobinemia or blue baby syndrome.
- Over exploitation of ground water may lead to leaching of arsenic from soil and rock sources and contaminate ground water. Chronic exposure to arsenic causes black foot disease. It also causes diarrhoea,-peripheral neuritis, hyperkerotosis and also lung and skin cancer.

SOIL POLLUTION

- Industrial waste includes chemicals such as mercury, lead, copper, zinc, cadmium, cynides, thiocynates, chromates, acids, alkalies, organic substances etc
- Four R's: Refuse, Reduce, Reuse, and Recycle

NOISE POLLUTION

- Sound is measured in decibels (dB). An increase of about 10 dB is approximately double the increase in loudness.
- A person's hearing can be damaged if exposed to noise levels over 75 dB over a prolonged period of time.
- The World Health Organization recommends that the sound level indoors should be less than 30 dB.
- Ambient Noise Level Monitoring - Noise Pollution (Control and Regulation) Rules, 2000 define ambient noise levels for various areas as follows-

A. Industrial Area—75DB to 70Db (Day time-6am to 10pm and night time 10pm to 6am ..75 is day time and 70 is night time)

B. Commercial Area--65 to 55

C. Residential Area--55 to 45

D. Silence Zone-- 50 to 40

- The Government of India on Mar 2011 launched a Real time Ambient Noise Monitoring Network.
- Under this network, in phase- I, five Remote Noise Monitoring Terminals each have been installed in different noise zones in seven metros (Delhi, Hyderabad, Kolkata, Mumbai, Bangalore, Chennai and Lucknow).
- In Phase II another 35 monitoring stations will be installed in the same seven cities.
- Phase III will cover installing 90 stations in 18 other cities.
- Phase-III cities are Kanpur, Pune, Surat, Ahmedabad, Nagpur, Jaipur, Indore, Bhopal, Ludhiana, Guwahati, Dehradun, Thiruvananthpuram, Bhubaneswar, Patna, Gandhinagar, Ranchi, Amritsar and Raipur.
- Silence Zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other t area declared as such by a competent authority.

RADIO ACTIVE POLLUTION

- Non-ionising radiations affect only those components which absorb them and have low penetrability. They include short-wave radiations such as ultraviolet rays, which forms a part of solar radiation. **Sunburns is due to these radiation**
- Ionising radiations have high penetration power & cause breakage of macro molecules They include X-rays, cosmic rays and atomic radiations -(radiations emitted by radioactive elements
- Alpha particles, can be blocked by a piece of paper and human skin.
- Beta particles can penetrate through skin, while can be blocked by some pieces of glass and metal.
- Gamma rays can penetrate easily to human skin and damage cells on its way through, reaching far, and can only be blocked by a very thick, strong, massive piece of concrete
- radium-224, uranium-238, thorium-232, potassium-40, carbon-14, etc.
- The nuclear arms use uranium-235 and plutonium-239 for fission and hydrogen or lithium as fusion material
- The radio nuclides with long half-time are the chief source of environmental radioactive pollution.

E — WASTE (in news)

- E-waste is not hazardous if it is stocked in safe storage or *recycled* by scientific methods or transported from one place to the other in parts or in totality in the formal sector. The e-waste can be considered hazardous if recycled by primitive methods
- Survey was carried out by the Central Pollution Control Board (CPCB) during 2005
- In India, among top ten cities; Mumbai ranks first in generating e-waste followed by Delhi, Bangalore, Chennai, Kolkata, Ahmadabad, Hyderabad, Pune, Surat and Nagpur.

SOLID WASTE

- the discarded (abandoned or considered waste-like) materials

- does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges0
- Conventional plastics have been associated with reproductive problems in both humans and wildlife.
- Dioxin (highly carcinogenic and toxic) by-product of the manufacturing process is one of the chemicals believed to be passed on through breast milk to the nursing infant.
- Burning of plastics, especially PVC releases this dioxin and also furan into the atmosphere.
- Pyrolysis-It is a process of combustion in absence of oxygen or the material burnt under controlled atmosphere of oxygen. It is an alternative to incineration. The gas and liquid thus obtained can be used as fuels.

Waste Minimization Circles (WMC)

- helps Small and Medium Industrial Clusters in waste minimization in their industrial plants.
- assisted by the World Bank with the Ministry of Environment and Forests acting as the nodal ministry.
- being implemented with the assistance of National Productivity Council (NPC), New Delhi.
- aims to realise the objectives of the Policy Statement for Abatement of Pollution (1992), which states that the government should educate citizens about environmental risks, the economic and health dangers of resource degradation and the real economic cost of natural resources.

BIOREMEDIATION

- the use of microorganisms (bacteria and fungi) to degrade the environmental contaminants into less toxic forms.

Phytoremediation

- is use of plants to remove contaminants from soil and water .

Rhizofiltration

- a water remediation technique that involves the uptake of contaminants by plant roots.
- used to reduce contamination in natural wetlands and estuary areas.

ENVIRONMENTAL IMPACT ASSESSMENT

- Notification on Environmental Impact Assessment (EIA) of developmental projects 1994 under the provisions of Environment (Protection) Act, 1986 making EIA mandatory for 29 categories of developmental projects. One more item was added to the list in January, 2000. environmental impact assessment statutory for 30 activities
- Environment Impact Assessment Notification of 2006 has categorized the developmental projects in two categories, i.e., Category A and Category B
- Ministry of Environment & Forests
- 'Category A' projects are appraised at national level by expert appraisal committee
- India has constituted the State Level Environment Impact Assessment Authority (SEIAA) and State Level Expert Appraisal Committee (SEAC) to decentralize the environmental clearance process
- The objective of EIA is to foresee and address potential environmental problems/ concerns at an early stage of project planning and design.

The EIA notification establishes four stages for obtaining Environmental Clearance.

1. Screening
2. Scoping and consideration of alternatives Baseline data collection
3. Impact prediction
4. Assessment of alternatives, delineation of mitigation measures and environmental impact statement
5. Public hearing
6. Environment Management Plan Decision making
7. Monitoring the clearance conditions

- **Screening- It is only for Categories B**
- Screening Criteria are based upon:
    - Scales of investment; • Type of development; and, • Location of development
- B1 Categories project require Environmental Impact Assessment while B2 category projects are exempted from EIA.
- State Level Expert Appraisal Committee determine about project categories

COMPILATION FROM SHANKAR IAS ENVIRONMENT

PART-II-BIODIVERSITY

CONTENTS

1. BIODIVERSITY
2. INDIAN BIODIVERSITY
3. ANIMAL DIVERSITY OF INDIA
4. PLANT DIVERSITY OF INDIA
5. MARINE ORGANISM
6. PROTECTED AREA NETWORK
7. GLOBAL INITIATIVE
8. CONSERVATION EFFORTS

BIODIVERSITY

- 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;
- Includes diversity within species, between species and of ecosystems'.

Levels of Biodiversity

- Biodiversity is considered to exist at three levels: genetics, species, and ecosystems

(a) Genetic diversity:

- variation in genes within a particular species.
- It is the total number of genetic characteristics in the genetic makeup of a species.
- Genetic diversity allows species to adapt to changing environments.
- The genetic diversity gives us beautiful butterflies, roses, parakeets or coral in a myriad hues, shapes and sizes

(b) Species diversity:

- It refers to the variety of living organisms on earth.
- Species differ from one another, markedly in their genetic makeup, do not inter-breed in nature.
- It is the ratio of one species population over total number of organisms across all species in the given biome.
- 'Zero' would be infinite diversity, and 'one' represents only one species present.(Imp)

(c) Ecosystem/ Community diversity:

- This refers to the different types of habitats. A habitat is the cumulative factor of the climate, vegetation and geography of a region.
- Change in climatic conditions is accompanied by a change in vegetation as well.
- Thus the variety or diversity of species in the ecosystem is influenced by the nature of the ecosystem

Biodiversity is measured by two major components:

1. species richness, and
2. species evenness

(i) Species richness

- It is the measure of number of species found in a community

A) Alpha diversity-It refers to the diversity within a particular area or ecosystem, and is usually expressed by the number of species (i.e., species richness) in that ecosystem.

B) Beta diversity-It is a comparison of diversity between ecosystems, usually measured as the change in amount of species between the ecosystems.

C) Gamma diversity-It is a measure of the overall diversity for the different ecosystems within a region.

(ii) Species evenness

- It measures the proportion of species at a given site, e.g. low evenness indicates that a few species dominate the site.
- The building blocks of plants, animals and humans are identical, and are made of the four elements - carbon, oxygen, nitrogen and hydrogen
- The chain that links consumers to producers is called the food chain or web of life.

Services provided by Biodiversity:

(a) Ecosystem services:

- Protection of water resources, Soils formation and protection, Nutrient storage and recycling
- Pollution breakdown and absorption
- Contribution to climate stability

- Maintenance of ecosystems
- Recovery from unpredictable events

(b) Biological services:

- Food, Medicinal resources and pharmaceutical drugs
- Wood products, Ornamental plants
- Diversity in genes, species and ecosystems. Etc.

(c) Social services:

- Research, education and monitoring
- Recreation and tourism
- Cultural values

Causes for Biodiversity Loss

- Loss of biodiversity occurs when either a particular species is destroyed or the habitat essential for its survival is damaged. The latter is more common as habitat destruction is inevitable fallout of development.
- The extinction of species takes place when they are exploited for economic gain or hunted as sport or for food. Extinction of species may also occur due to environmental reasons like ecological substitutions, biological factors and pathological causes which can be caused either by nature or man
- Extinction- end of a species, which is inevitable when capacity to bread &recovery lost ;when they are no longer able to survive in changing environment or against superior competitor , finally marked by the death of last individual of that species.

Biodiversity conservation-

- Conservation of biological diversity leads to conservation of essential ecological diversity to preserve the continuity of food chains.

Ex-situ conservation:

- Conserving biodiversity outside the areas where they naturally occur is known as ex-situ conservation.
- For example, the Gangetic gharial has been reintroduced in the rivers of Uttar Pradesh, Madhya Pradesh and Rajasthan where it had become extinct.

In-situ conservation:

- Conserving the animals and plants in their natural habitats is known as in-situ conservation.
- The established natural habitats are: National parks, Sanctuaries, Biosphere reserves and Reserved forests, Protected forests, Nature reserves

Constraints in biodiversity conservation:

- Low priority for conservation of living natural resources.
- Exploitation of living natural resources for monetary gain.
- Values and knowledge about the species and ecosystem inadequately known.
- Unplanned urbanization and uncontrolled industrialization.

Botanical garden

- Botanical garden refers to the scientifically planned collection of living trees, shrubs, herbs, climbers and other plants from various parts of the globe.

ZOO

- An establishment, whether stationary or mobile, where captive animals are kept for exhibition, to the public and includes a circus and rescue centers but does not include an establishment of a licensed dealer in captive animals - CZA

INDIAN BIODIVERSITY

- Of the 34 globally identified biodiversity hotspots, India harbors two hotspots, i.e., Eastern Himalayas, Western Ghats and Sri Lanka.

INDIA REPRESENTS:

1. **Two 'Realms**-

- Biogeographic realms are large spatial regions within which ecosystems share a broadly similar biota. Realm is a continent or sub- continent sized area with unifying features of geography and fauna & flora
- the Himalayan region represented by Palearctic Realm and
- the rest of the sub-continent represented by Malayan Realm
- In world Eight terrestrial biogeographic realms are typically recognized. They are 1. nearctic realm ,2. palaearctic realm, 3. africotropical realm, 4. indomalayan realm,5. ocenaia realm 6. Australian realm, 7. Antarctic realm, 8. Neotropical realm

2. **Biomes of India** :

- The term biome means the main groups of plants and animals living in areas of certain climate patterns.
- The five biomes of India are:
  1) Tropical Humid Forests
  2) Tropical Dry or Deciduous Forests (including Monsoon Forests)
  3) Warm deserts and semi-deserts
  4) Coniferous forests and
  5) Alpine meadows.

3. **Bio-geographic Zones**-

- ✓ Trans-Himalayas. An extension of the Tibetan plateau, harboring high-altitude cold desert in Laddakh (J&K) and Lahaul Spiti (H.P) comprising 5.7 % of the country's landmass. East to west parallel to Himalayas
- ✓ Himalayas.-The entire mountain chain running from north-western to northeastern India,
  3) Desert-The extremely arid area west of the Aravalli hill range, comprising both the salty desert of Gujarat and the sand desert of Rajasthan. 6.9% of the country's landmass
- ✓ Semi-arid- The zone between the desert and the Deccan plateau, including the Aravalli hill range 15.6 % of the country's landmass.
- ✓ Western ghats-The hill ranges and plains running along the western coastline, south of the Tapti river,
- ✓ Deccan peninsula- The largest of the zones, covering much of the southern and south Central plateau with pre-dominantly deciduous vegetation. 4.3 % of the country's landmass.
- ✓ Gangetic plain-Defined by the Ganges river system, these plains are relatively homogenous.
- ✓ North-east India- The plains and non-Himalayan hill ranges of northeastern India, with a widevariation of vegetation. 5.2% of the country's landmass.
- ✓ Islands-The Andaman and Nicobar Islands in the Bay of Bengal, with a highly diverse set of biomes.
- ✓ Coasts-A large coastline distributed both to the west and east, with distinct differences between the two; Lakshadeep islands are included in this with the percent area being negligible
- India further divided into 25 biogeographic provinces.

Vertebrates-

- ✓ Vertebrates are animals with backbones and spinal columns. Vertebrates are the most advanced organisms on Earth. Although vertebrates represent only a very small percentage of all animals, their size and mobility-often allow them to dominate their environment.
- ✓ Fishes, Amphibians, Reptiles, Ayes, Mammals

Invertebrates-

- ✓ do not have backbones.
- ✓ More than 98% animal species in the world are invertebrates.
- ✓ don't have an internal skeleton made of bone.

- ✓ Many invertebrates have a fluid-filled, hydrostatic skeleton, like the jelly fish or worm. Others have a hard outer shell, like insects and crustaceans.

Annelids-

- ➢ have bodies that are divided into segments.
- ➢ very well-developed internal organs.
- ➢ Found almost anywhere in the world.
- ➢ don't have any limbs.
- ➢ E.g-earthworms, leeches, roundworms.

Mollusks-

- ➢ have a soft, skin-like organ covered with a hard outside shell.
- ➢ Some mollusks live on land, such as the snail and slug.
- ➢ Other mollusks live in water, such as the oyster, mussel, clam, squid and octopus.

Echinoderms-

- ➢ are marine animals.
- ➢ Most echinoderms have arms or spines that radiate from the center of their body.
- ➢ Common echinoderms include the sea star, sea urchin, sand dollar and sea cucumber.
- ➢ Protozoa, Arthropods, Crustaceans, Insects, Arachnids are the other Invertebrates.

FLORAL DIVERSITY

1. **Algae** –

- ➢ The green non differentiated plants (non -differentiated into organs like root, stem and leaf.) possessing chlorophyll is known as Algae.
- ➢ The fresh-water algae are generally green or blue-green in colour, whereas the marine ones are red or brown.
- ➢ These are autotrophic plants, as they can manufacture their own food.

2. **Fungi**:

- ➢ Non-green non differentiated plants characterized by total absence of chlorophyll are called Fungi.
- ➢ Moulds and mushrooms are the familiar examples of saprophytic fungi.
- ➢ The maximum diversity of fungi is in the Western Ghats followed by the eastern Himalaya and the western Himalaya.

3. Bacteria

- ➢ Non-chlorophyllous micro-organisms which lead saprophytic or parasitic existence.
- ➢ Many of them are pathogenic;
- ➢ Saprophytic bacteria are rather beneficial. They are soil borne and many of them are used in industries.

4. Lichens

- ➢ A peculiar combination of an alga and a fungus—the two live deriving mutual benefit.
- ➢ They are group of greyish green plants which grow on rocks, three-trunks, dead wood, etc.
- ➢ The algae manufactures carbohydrate food which becomes available to the fungus, and the latter absorbs and retains water and -thus keeps the algal cells moist. So it is a nice example of symbiosis.

5. Bryophytes

- ➢ The plant body is differentiated into a small stem and simple leaves, but true roots are absent.
- ➢ They usually grow in moist places. E.g. Liverworts, mosses
- ➢ They are the second largest group of green plants in India distributed largely in Eastern
- ➢ Himalaya, North-eastern India, Western Himalaya and the Western Ghats.
- ➢ Mosses constitute the major component of Indian bryo flora followed by liverworts and bornworts

6. **Pteridophytes**

- ➢ Have well-differentiated plant bodies, consisting of roots, stems and leaves. Moreover, they possess vascular bundles.

7. Gymnosperms

- Gymnosperms (gymnos=naked, sperma=seed) are the naked-seeded plants.
- They have very simple flowers without accessory whorls and the microsporophylls (stamens) and megasporophylls (carpels) remain aggregated in cones.

8. <u>Angiosperms</u>:

- Angiosperms (angeion=a case) are the closed seeded plants. '
- These are the most highly developed plants which bear flowers having conspicuous accessory and essential whorls.
- Carpels have the ovary, style and stigma

<u>Crop genetic diversity</u>

- The national gene bank at National Bureau Of Plant Genetic Resources (NBPGR), Delhi is primarily responsible for conservation of unique accessions on long-term basis, as base collections for posterity, predominantly in the form of seeds

<u>Livestock genetic diversity</u>

- India ranks first in buffaloes, second in cattle and goats, third in sheep, fourth in ducks, fifth in chicken and sixth in camels in the world.

WILDLIFE OF INDIA (please read it with IUCN list)

<u>(1) Himalayan foothills</u> –

- **Flora**: Natural monsoon evergreen and semi-evergreen forests; dominant species are sal, silk-cotton trees, giant bamboos; tall grassy meadow with savannahs in tarai.
- **Fauna** : Includes big mammals of like elephant, sambar, swamp deer, cheetal, hog deer, barking deer, wild boar tiger, panther, wild dogs, hyena, black bear, sloth bear, porcupine, Great Indian one-horned rhinoceros, wild buffalo, gangetic gharial, golden langur.

<u>(2) Western Himalayas (High altitude region)</u>

- **Flora**: Natural monsoon evergreen and semi-evergreen forests; rhododendrons; dwarf hill bamboo and birch forests mixed with alpine pastures.
- **Fauna**: Wild ass, wild goats (thar, markhor, ibex) and sheep (Nayan, Marcopolo's sheep, bharal or blue sheep) ; antelopes (Chiru and Tibetan gazelle), deers (hangul of Kashmir stag and shou or Sikkim stag, musk deer); marmots and pikas or mouse hares; golden eagle, snow cocks, snow partridges; snow leopard, wolf, fox, cats, black and brown bears; birds like Himalayan monal pheasant, western trogopan, Koklass, whitecrested khalij cheer pleasant; Griffon vultures, lammergiers, choughs, ravens

<u>(3) Eastern Himalayas</u>-

- **Flora**-Oaks, magnolias, laurels and birches covered with moss and ferns; coniferous forests of pine, fir, yew and junipers with undergrowth of scrubby rhododendrons and dwarf bamboos; lichens, moses, orchids, and other epiphytes
  dominant (due to high humid ty and high rainfall).
- **Fauna**- Red panda, hog badgers forest badgers, crestless porcupines, goat antelopes (Scrow, Goral, Takins).

<u>(4)Peninsular India</u>-

- It is home to tropical moist deciduous to tropical dry deciduous and scrub vegetation depending upon the variation in rainfall and humidity.

- **Flora**: Sal in north and east extensions (higher rainfall) and teak in southern plateau are dominant trees.

- ✓ West Ghats have evergreen vegetation (flora and fauna similar to evergreen rainforests of north eastern of India.
- ✓ In dry areas of Rajasthan and Aravalli hills, trees are scattered and thorny scrub species predominate. The forests give way to more open savannah habit.
- ➢ **Fauna** : Elephant, wild hoar, deers (cheetal or axis deer), hog deer swamp deer or barasinga, Sambar, muntjak or barking deer, antelopes (four-- hourned antelope, nilgai, blackbuck, chinkara gazelle), wild dog or dhole, tiger, leopard, cheetah, lion, wild pig, monkey, striped hyena, jackal, gaur

(5)Indian desert-

- ➢ **Flora**: Throny trees with reduced leaves; cacti, other succulents are the main plants.
- ➢ **Fauna**: Animals are mostly burrowing ones. Among mammals rodents are the largest group. The Indian desert gerbils are mouse like, rodents, other animals are, wild ass, black buck, desert cat, caracal, red fox; reptiles (snackes, lizards and tortoise) well represented. Desert lizards include agamids, lacertids and geckos.
- ➢ Among birds the most discussed is Great Indian bustard.

(6)Tropical rain forest region

- ➢ Distributed in areas of western ghats and north east India.
- ➢ **Flora**: Extensive grass lands interspersed with densely forested gorges of evergreen vegetation known as sholas occur in the Nilgiris (an offshoot of Western ghats).
- ✓ The rain forests of the Westernghats have dense and lofty trees with much species-diversity. Mosses, ferns, epiphytes, orchids, lianas and vines, herbs, shrubs make diverse habitat.
- ✓ Ebony trees predominate in these forests. A variety of tropical orchids are found.
- ✓ Stratification in rain forests is very distinct-three horizontal layers are distinguished.
- ➢ **Fauna**-There are wild elephants, gaur and other larger animals. Most species are tree dwellers. The most prominent are hoolock gibbon (only ape found in India), golden langur, capped langur or leaf monkey, Assam macaque and the pig-tailed macaque, lion-tailed macaque, Nilgiri langur slender loris, bats, gaint squirrel, civets, flying squirrels, Nilgiri mongoose, spiny mouse

(7)Andaman and Nicobar Islands

- ✓ **Flora**. These are home for tropical rain forests
- ➢ Among marine mammals there are dugong, false killer whale, dolphin. Among birds are rare one is Narcondum hornbill.
- ➢ Nicobar pigeon and megapode. There are also other birds like white-bellied sea-eagle, white-breasted swiftlet and several fruit pigeons

ANIMAL DIVERSITY OF INDIA

- ➢ THE RED DATA BOOK-issued by the International Union for Conservation of Nature (IUCN) located in Morges, Switzerland
- ➢ information for endangered mammals and birds are more extensive than for other groups of animals and plants, coverage is also given to less prominent organisms facing extinction.
- ➢ The pink pages in this publication include the critically endangered species.
- ➢ Green pages are used for those species that were formerly endangered, but have now recovered to a point where they are no longer threatened.
- ➢ Extinct (EX) - A taxon is Extinct when there is no reasonable doubt that the last individual has died.
- ➢ 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 naturalized population (or populations) well outside the past range.

Critically Endangered (CR)- criteria for Critically Endangered.(any1)

- reduction in population (> 90% over the last 10 years),
- population size (number less than 50 mature individuals),
- quantitative analysis showing the probability of extinction in wild in at least 50% in their 10 years) and
- it is therefore considered to be facing an extremely high risk of extinction in the wild

Endangered (EN)- criteria for Endangered.(any1)

- reduction in population size (70% over the last10 years),
- population size estimated to number fewer than 250 mature individuals,
- quantitative analysis showing the probability of extinction in wild in at least 20% within 20 years and
- it is therefore considered to be facing a very high risk of extinction in the wild

Vulnerable (VU)- criteria

- reduction in population (> 50% over the last 10 years)
- population size estimated to number fewer than10,000 mature individuals,
- Probability of extinction in wild is at least 10% within 100 years, and.
- It is therefore considered to be facing a high risk of extinction in the wild.

CRITICALLY ENDANGERED

MAMMALS-

1. **Pygmy Hog (Porcula salvania)- (in news nov 2014)** http://www.thehindu.com/news/national/other-states/visitors-to-assam-zoo-can-soon-view-endangered-pygmy-hogs/article6584759.ece
   - Is the world's smallest wild pig, with adults weighing only 8 kgs. This species constructs a nest throughout the year.
   - The grasslands where the pygmy hog resides are crucial for the survival of other endangered species such as Indian Rhinoceros, Swamp Deer, Wild Buffalo, Hispid Hare, Bengal Florican and Swamp Francolin.
   - In 1996, a captive-breeding programme of the species was initiated in Assam, and some hogs were reintroduced in Sonai Rupai area in 2009.
   - Habitat: Relatively undisturbed, tall 'terai' grasslands.
   - Distribution: Formerly, the species was more widely distributed along the southern Himalayan foothills but now is restricted to only a single remnant population in Manas Wildlife Sanctuary and its buffer reserves.
   - Pygmy hog-sucking Louse (Haematopinus oliveri), a parasite that feeds only on Pygmy Hogs will also fall in the same risk category of critically endangered as its survival is linked to that of the host species.
2. **Andaman White-toothed Shrew (Crocidura andamanensis), Jenkin's Andaman Spiny Shrew**
   - (Crocidura jenkinsi) and the Nicobar White- tailed Shrew (Crocidura nicobarica) Endemic to India.
   - They are usually active by twilight or in the night and have specialized habitat requirements.
   - Habitat: Leaf litter and rock crevices.
   - Distribution: The Andaman White-toothed Shrew is found on Mount Harriet in the South Andaman Islands.
   - The Jenkin's Andaman Spiny Shrew is found on Wright Myo and Mount Harriet in the South Andaman Islands.
3. **Kondana Rat (Millardia kondana) (in news)**
   - It is a nocturnal burrowing rodent that is found only in India.. It is sometimes known to build nests. Habitat: Tropical and subtropical dry deciduous forests and tropical scrub.
   - Distribution: Known only from the small Sinhagarh Plateau (about one km2), near Pune in Maharashtra. Reported from an elevation of about 1,270 m above mean sea level.
   - http://www.thehindu.com/news/national/half-of-mammals-face-habitat-loss-zoological-survey-of-india/article7283074.ece
4. **The Large Rock Rat or Elvira Rat, (Cremnomys elvira)(in news)**
   - It is a medium sized, nocturnal and burrowing rodent. endemic to India.
   - Habitat: Tropical dry deciduous shrubland forest, seen in rocky areas.

- Habitat / distribution: Known only from Eastern Ghats of Tamil Nadu. Recorded from an elevation of about 600 m above mean sea level.

5. **The Namdapha Flying Squirrel (Biswamoyopterus biswasi)**
   - It is a unique (the only one in its genus) flying squirrel that is restricted to a single valley in the Namdapha N.P. (or) W.L.S. in Arunachal Pradesh.
   - Habitat: Tropical forest.
6. **The Malabar Civet (Viverra civettina)(in news)**
   - It is, considered to be one of the world's rarest mammals.
   - It is endemic to India and was first reported from Travancore, Kerala.
   - Habitat / distribution: Western Ghats.
7. **The Sumatran Rhinoceros (Dicerorhinus sumatrensis)(already extinct from india)**
   - It is the smallest and most endangered of the five rhinoceros species.
   - It is now thought to be regionally extinct in India, though it once occurred in the foothills of the Himalayas and north-east India.
8. **The Javan Rhinoceros (Rhinoceros sondaicus)**
   - is also believed to be extinct in India and only a small number survive in Java and Vietnam
9. **Kashmir stag/ hangul (Cervus elaphus hanglu)**
   - It subspecies of Red Deer which is native to India.
   - Habitat / distribution - in dense riverine forests, high valleys, and mountains of the. Kashmir valley and northern Chamba in Himachal Pradesh.
   - State animal of J&k.

BIRDS

10. **The Jerdon's Courser (Rhinoptilus bitorquatus)**
    - It is a flagship species for the extremely threatened scrub jungle.
    - The species was considered to be extinct until it was rediscovered in 1986 and the area of rediscovery was subsequently declared as the Sri Lankamaleswara Wildlife Sanctuary.
    - Distribution: Jerdon's Courser is endemic to Andhra Pradesh.(northen part of ap)

11. **The Forest Owlet (Heteroglaux blewitti)**
    - Had been lost for more than a century. After 113 long years, the owlet was rediscovered in 1997 and reappeared on the list of Indian birds.
    - Habitat: Dry deciduous forest.
    - Habitat / distribution: South Madhya Pradesh, in north-west Maharashtra and north-central Maharashtra.
12. **The White-bellied Heron (Ardea insignis)**
    - Extremely rare bird found in five or six sites in Assam and Arunachal Pradesh, one or two sites in Bhutan, and a few in Myanmar.
    - Habitat: Rivers with sand or gravel bars or inland lakes.
13. **The Bengal Florican (Houbaropsis bengalensis)**
    - A rare bustard species that is very well known for its mating dance. Among the tall- grasslands, secretive males advertise their territories by springing from the ground and flitting to and fro in the air.
    - Habitat: Grasslands occasionally interspersed with scrublands.
    - Distribution: Native to only 3 countries in the world - Cambodia, India and Nepal. In India, it occurs in 3 states, namely Uttar Pradesh, Assam and Arunachal Pradesh.
14. **The Himalayan Quail (Ophrysia superciliosa)**
    - It is presumed to be extinct since no reliable records of sightings of this species exist after 1876. Intensive surveys are required as this species is hard to detect due to its reluctance to fly and its preference for dense grass habitats. Possible sighting of this species was reported in Nainital in 2003.

- Habitat: Tall grass and scrub on steep hillsides.
- Distribution: Western Himalayas.

15. Pink- headed Duck (Rhodonessa caryophyllacea)

- It has not been conclusively recorded in India since 1949. Males have a deep pink head and neck from which the bird derives its name.
- Habitat: Overgrown still-water pools, marshes and swamps in lowland forests and tall grasslands.
- Distribution: Recorded in India, Bangladesh and Myanmar. Maximum records are from north-east India.

16. Sociable Lapwing (Vanellus gregarious)

- It is a winter migrant to India. This species has suffered a sudden and rapid population decline due to which it has been listed as critically endangered
- Distribution: central Asia, Asia Minor, Russia, Egypt,, India, Pakistan. In India, habitat / distribution is restricted to the north and north-west of the country.

17. Spoon Billed Sandpiper (Eurynorhyndms pygmeus)

- It requires highly specialized breeding habitat, a constraint that has always kept its population scarce.
- India is home to some of the last existing wintering grounds of this species.
- Habitat: Coastal areas with sparse vegetation. No breeding records further inland than 7 km from the seashore.
- Distribution: Has been recorded in West Bengal, Orissa, Kerala and Tamil Nadu.

18. Siberian Crane (Grus leucogeranus)

- It is a large, strikingly majestic migratory bird that breeds and winters in wetlands. They are
- known to winter at Keoladeo National Park, Rajasthan. However the last documented sighting of the bird was in 2002.
- Habitat: Wetland areas.
- Located distribution: Keoladeo National Park in Rajasthan.

REPTILES

19. Gharial (Gavialis gangeticus)

- It is the most uniquely evolved crocodilian in the world, a specialized, river-dwelling, fisheater.
- Habitat: Clean rivers with sand banks.
- Distribution: Only viable population in the National Chambal Sanctuary, spread across three states of Uttar Pradesh, Rajasthan and Madhya Pradesh in India.
- Small non-breeding populations exist in Son, Gandak, Hoogly and Ghagra rivers.
- Now extinct in Myanmar, Pakistan, Bhutan and Bangladesh.

20. Hawksbill Turtle (Eretmochelys imbricata)

- It is a heavily exploited species. The species is migratory in nature and nesting occurs in about 70 countries across the world. Maturation is slow and is estimated between 25 — 40 years.
- Habitat: Nesting occurs on insular, sandy beaches.
- Distribution: In India they are found in the Andaman and Nicobar Islands, the coast of Tamil Nadu and Orissa.

21. Leatherback Turtle (Dennochelys coriacea)

➢ It is the largest of the living sea turtles, weighing as much as 900 kg.

➢ Adult leatherback turtles are excellent swimmers. They swim an average of 45-65 km a day, travel, Jellyfish is their primary food.

➢ the population spikes of leatherback coincide with abundance of jellyfish, making them Important top-predators in marine environments.

➢ Habitat: Tropical and subtropical oceans.

- Distribution: Found in tropical and temperate waters of the Atlantic, Pacific, and into Indian
  Oceans.

22. <u>Four-toed River Terrapin or River Terrapin (Batagur baska) (a type Turtle)</u>

- The omnivorous diet of the river terrapin and other terrapin species makes them an essential part of the efficient clean-up systems of aquatic habitats.
- Habitat: Freshwater rivers and lakes.
- Distribution: Bangladesh, Cambodia, India, Indonesia and Malaysia.

23. <u>Red-crowned Roofed Turtle or the Bengal Roof Turtle (Batagur kachuga)</u>

- mainly restricted to the Ganga basin. Males have a bright red coloration during the breeding season.
- Habitat: Deep, flowing rivers but with terrestrialnest sites.
- Distribution: Found in India, Bangladesh and Nepal. In India it resides basically in the watershed of the Ganga.

24. <u>Sispara day gecko (Cnemaspis sisparensis)</u>

- It is a large gecko which dwells usually in forests, it is largely insectivorous and nocturnal.
- Habitat / distribution: Endemic to Western Ghats, and found in Sispara, Nilgiris, Kavalai near Cochin.

<u>FISH</u>

25. <u>The Pondicherry Shark (Carcharhinus hemiodon)</u>

- It is a marine fish that occurs or occurred inshore on continental and insular shelves.
- This is a very rare and little-known species.
- Habitat / distribution: Indian Ocean— from Gulf of Oman to Pakistan, India and possibly Sri Lanka.
- In scattered localities spanning India to New Guinea. Also been recorded at the mouth of the Hooghly river.

26. <u>The Ganges Shark (Glyphis gangeticus)</u>

- It is a uniquely adapted fish-eating shark that occurs in the turbid waters of the Ganga river and the Bay of Bengal. The small eyes suggest that it is adapted to living in turbid water, while the slender teeth of the species suggests that it is primarily a fish-eater.
- Habitat / distribution: It occurs in India and possibly in Pakistan. The Ganga river system and Hooghly river mouth are its known habitats.

27. <u>The Knife-tooth Sawfish (Anoxypristis cuspidata)</u>

- It has a long narrow snout with blade-like teeth and a shark-like body. It spends most of its time near the bottom of the sea,
- It is found in shallow coastal waters and estuaries.
- Habitat / distribution: Widespread in western part of the Indo-Pacific region, including Red Sea.

28. <u>Large-tooth Sawfish (Pristis micro don)</u>

- They are heavy-bodied sawfish with a short but massive saw, and grow up to 3 m. in length.
- It is seen seasonally and very occasionally caught along with the Bull Sharks and the Green Sawfish.
- Habitat / distribution and habitat : Western part of the Indo-Pacific (East Africa to New Guinea, Philippines and .Vietnam to Australia).
- In India, it is known to enter the Mahanadi river, up to 64 km inland, and also is very common in the estuaries of the Ganga and Brahmaputra.

29. <u>Long-comb Sawfish or Narrow-snout Sawfish (Pristis zij sron)</u>

- ✓ It grow up to 4.3m in length and are heavily exploited by, humans.
- ✓ This species was reported as frequently found in shallow water.
- ✓ It inhabits muddy bottoms and also enters estuaries. Its presence has been recorded in inshore marine waters, and it goes down to depths of at least 40 m.

- ✓ Habitat / distribution and habitat: Indo-Pacific region including Australia, Cambodia, China, India, Indonesia and Malaysia.

SPIDERS

30. **Rameshwaram Ornamental or Rameshwaram Parachute Spider (Poecilotheria hanumavilasumica)**

- ➢ It was recently described in 2004, and is only found in India.
- ➢ It can give a nasty bite which usually is not fatal.
- ➢ The species is semi-social, which means they live partly in groups.
- ➢ Habitat: Arboreal and tend to live in hiding.
- ➢ Distribution: Endemic to India. Spread along the coastal savannah, tropical lowland rain forests and montane forests upto an altitude of 2000 m above mean sea level.

31. **Gooty Tarantula, Metallic Tarantula or Peacock Tarantula (Poecilotheria metallica)**

- ➢ Steel blue in colour with patches of intense orange-yellow, black and white.
- ➢ It was first found in Gooty (Ooty/Udagamandalam) in south India in a burn pile during railway construction.
- ➢ it has been in great demand in the illegal pet trade.
- ➢ Habitat: Wooded mountain area.
- ➢ Distribution: Endemic to South India

ENDANGERED

MAMMALS

1. **Wild ass/ khur (Equus hemionus khur)**

- ➢ Once extended from western India, southern Pakistan, Afghanistan, and south-eastern Iran, Today, its last refuge lies in the Indian Wild Ass Sanctuary, Little Rann of Kutch.
- ➢ Threat -Diseases- in 1958-1960, surra disease, caused by Trypanosoma evansi and transmitted by flies,

2. **Dhole/ Asiatic wild dog or Indian wild dog (Cuon alpinus)**
3. **Eld's deer/ thamin or brow-antlered deer (Panolia eldii)**

- ➢ deer indigenous to Southeast Asia
- ➢ Found in the Keibul Lamjao National Park (KLNP), Manipur.

4. **Himalayan Brown/ red Bear (Ursus arctos isabellinus).**

- ➢ India's largest animals in the Himalayas,omnivores. Himalayan Brown Bears exhibit sexual dimorphism.
- ➢ Distribution - Nepal, Pakistan, and Northern India.

5. **Golden langur (Trachypithecus geei)**

- ➢ Primate, is an Old World monkey
- ➢ Distribution - small region of western Assam and in the neighboring foothills of the Black Mountains of Bhutan.

6- **Himalayan wolf**

- ➢ Habitat / distribution - trans-Himalayan region of Himachal Pradesh, Jammu and Kashmir in northern India.

7. **Himalayan / White-bellied Musk Deer**

- ✓ Habitat / distribution - Kashmir, Kumaon and Sikkim.
- ✓ Musk deer lack antlers, but they possess a pair of enlarged canines that grow continuously.
- ✓ Deer musk is a substance with a persistent odor obtained from a gland of the male musk deer (Only males produce the musk).

- ✓ The substance has been used as a perfume fixative, incense material, and medicine.

8. Hispid hare/ Assam rabbit (Caprolagus hispidus)

- ✓ Habitat / distribution - southern foothills of the central Himalayas. Status - endangered.
- ✓ The habitat of hispid hares is highly fragmented due to increasing agriculture, flood control, and human development.

9. Hog deer

- ✓ Habitat / distribution - northern india.
- ✓ Name - The hog deer runs through the forests with its head hung low (hog-like manner) so that it duck under obstacles instead of leaping over them like most other deer do.

10. Lion-tailed macaque/ wandero (Macaca silenus)

- ➢ Endemic to the Western Ghats.
- ➢ Avoid human presence and they do not live, feed or travel, through plantations.
- ➢ Habitat: Lion-tailed macaques live in southwest India in pockets of evergreen forests, called sholas, in the Western Ghats range. Today, they only live in mountain forests scthree Indian states: Karnataka, Kerala, and Tamil Nadu.
- ➢ Captive breeding - aringnar anna zoological park, Chennai and in Mysore Zoo.

11- Markhor (Capra falconeri)

- ➢ Exhibit sexual dimorphism national animal of Pakistan.
- ➢ Habitat / distribution-mountains of central Asia.
- ➢ In India - some parts of jammu and Kashmir . Status - endangered
- ➢ Threat - hunting (both for meat and for its twisted horns),

12- Nilgiri langur/ Nilgiri leaf monkey (Trachypithecus johnii)

- ➢ Habitat / distribution - hilly areas of western ghats in tamilnadu and .kerala. tropical wet evergreen, semi-evergreen and riparian forests.

13- Nilgiri tahr

- ➢ The Nilgiri tahr is the largest of the three tahr species, inhabit montane grasslands of western ghats.
- ➢ It is the state animal of Tamil nadu.
- ➢ shoals forest (stunted evergreen forests) are typically avoided by tahr.

14. Great Indian one horn Rhinoceros

- ➢ Habitat: Found only in the tall grasslands and forests in the foothills of the Himalayas.
- ➢ National Parks: Kaziranga National Park, pabitora wildlife sanctuary, Manas National Park, Assam

15- Wild Ass

- ➢ Habitat: Flat grassland covered expanse known as bets (islands where coarse grasses springs up during the monsoon).
- ➢ National Parks: Little Rann Of Kutch, Gujarat

VULNERABLE MAMMALS

1. **Chiru / Tibetian Antelope**
   - ➢ Habitat : Tibet cold desert
   - ➢ Threat : The chiru is threatened by hunting for its fine wool which is used to make the shahtoosh scarves, meat, magnificent horns.
2. **Himalayan tahr**
   - ➢ habitat — Himalayas
   - ➢ tahr have many characters in common with true goats, but lack a beard and have several other unique features.

3. **Black buck**
- ✓ Habitat — Grass land
- ✓ Black buck show sexual dimorphism.

4. **Gaur**
- ✓ The gaur (Bos gaurus), also called Indian bison, is a large bovine native to South Asia and Southeast Asia.
- ✓ The domesticated form of the gaur, Bos frontalis, is called gayal or mithun

5. **Four-horned antelope, Chousingha**
- ➢ The four-horned antelope must drink water regularly in order to survive

6. **Takin**
- ➢ Mountainous regions in the Himalayan Mountains and western China

7. **Nilgiri marten**
- ➢ Endemic to the Western Ghats.
- ➢ inhabits areas that are far from human disturbance Semi-arboreal lifestyle. Martens are Carnivorous animal.
- ➢ Only species of marten considered vulnerable to extinction.
- ➢ Only species of marten found in southern India

8. **Red Panda**
- ✓ endemic to the temperate forests of the Himalayas,
- ✓ Diet - omnivorous (mainly on bamboo).
- ✓ Habitat / distribution — Sikkim and assam, northern arunachal Pradesh.

9. **Marbled cat (Pardofelis marmorata)**
- ➢ Habitat / distribution - from northern India and Nepal, through south-eastern Asia to Borneo and Sumatra
- ➢ In india - Sikkim, Darjeeling, moist tropical forest.
- ➢ Arboreal in nature

10. **Barasingha or swamp deer (Rucervus duvaucelii)**
- ➢ Habitat / distribution- isolated localities in northern and central India, and southwestern Nepal.

11. **Indian wolf**
- ➢ Habitat / distribution - range extends from south of the Himalayas

12. **Oriental small-clawed otter/ Asian small-clawed otter (Aonyx cinerea),**
- ✓ Otter - any of 13 living species of semiaquatic mammals which feed on fish and shellfish, and also other invertebrates, amphibians, birds and small mammals.
- ✓ It is a smallest otter species in the world,
- ✓ It lives in mangrove swamps and freshwater wetlands.

13. **Clouded leopard (Neofelis nebulosa)**
- ➢ Habitat / distribution - Himalayan foothills through mainland Southeast Asia into China,
- ➢ They occur in northern West Bengal, Sikkim, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.

14. **Asian black bear/ moon bear or white- chested bear (Ursus thibetanus)**
- ➢ medium-sized species of bear, largely adapted for arboreal life,
- ➢ Habitat / distribution - seen across much of the Himalayas, Korea, northeastern China, the Russian far east and the Honshu and Shikoku islands of Japan.

Herbivorous Marine Mammals

➢ include dugong and manatees and they inhabit swamps, rivers, estuaries, marine wetlands, and coastal marine waters.

1. **Dugorig**
   - ➢ (Dugong dugon) also called as sea cow.
   - ➢ Status - vulnerable.
2. **Manatees- Habitat / distribution - Caribbean Sea, Gulf of Mexico, the Amazon Basin, and West Africa**
   - ➢ Threat - coastal development, red tide, hunting.

FEW EXCEPTIONS

Egg Laying Mammals

- ➢ The unique feature of monotremes, a sub division of mammal, is that monotremes lay eggs rather than giving birth to their young.
- ➢ There are only five living Monotreme/ egg laying Mammals species: they are –
- ➢ the duck-billed platypus and four species of spiny anteaters (also known as echidna).
- ➢ All of them are found only in Australia and New Guinea.

1. **Echidnas are also known as spiny ant eaters.**
   - ➢ Habitat / distribution - Australia and New Guinea
   - ➢ In echidnas, the egg is carried in a pouch on the female's belly until the young hatches, at which point the barely-developed young must find a mammary gland and latch onto it for nourishment.
2. **Platypus is a semi-aquatic mammal**.
   - ➢ Habitat / distribution - endemic to eastern Australia, including Tasmania.
   - ➢ In the platypus, the female retires to a burrow in the bank of a river or pond. The burrow is lined with dry vegetation, and there the eggs are laid.
   - ➢ The male platypus has venom strong enough to can kill a small dog, or cause excruciating pain among humans.

Marsupials

- ➢ the group of mammals commonly thought of as pouched mammals (like the wallaby and kangaroo).
- ➢ have placenta but it is very short-lived and does not make as much of a contribution to fetal nourishment.
- ➢ They give birth very early and the young animal, essentially a helpless embryo, climbs from the mother's birth canal to the nipples.
- ➢ They have short gestation time. due to having a yolk-type placenta inthe mother marsupial.
- ➢ Extinct - Marsupial - quagga, the marsupial wolf .
- ➢ Placental mammals all bear live young, which are nourished before birth in the mother's uterus through a specialized embryonic organ attached to the uterus wall, the placenta.
- ➢ Placental mammals nourish the developing embryo using the mother's blood supply, allowing longer gestation times. List of Marsupials

Phalangers	OpoSsum
Kola	Tasmanian devils

Kangaroo	Mursupial Mole (4 foot)
Wallaby	Bandi coot
Wombats	Tasmanian Wolf /Tiger Dasyure

Flying squirrel

- Flying squirrels are mammals too, but they don't really fly.
- They jump from high in a trees glide through the air like a kite.

PLANT DIVERSITY OF INDIA

PLANT CLASSIFICATION

- **Herb** is defined as a plant whose stem is always green and tender with height of not more than 1 meter.
- **Shrub** is defined as a woody perennial plant differing from a perennial herb in its persistent. and woody stem. It differs from- a tree in its long stature and its habit of branching from the base. Not more than 6 meters in height.
- **Tree** is defined as a large woody perennial plant having a single well defined stem with more or less definite crown.
- **Parasites**- An organism that draws a part or whole of its nourishment from another living organism(not from soil). They grow on some living plant called host and penetrate their sucking roots, called haustoria, into the host plants. -
- **Epiphytes** - plant growing on the host plant but not nourished by the host plant. They only take the help of the host plant in getting access to light. Their roots perform two functions. While changing roots establish the plant on the branches of the host plant, aerial roots draw moisture from the air. Eg. Vanda - Climbers

EFFECT OF ABIOTIC COMPONENTS ON PLANTS

- Intensity of light on growth of plants
- Extremely high intensity favours root growth than shoot growth which results in increased transpiration, short stem, smaller thicker leaves, low intensity of light retards growth, flowering arid fruiting.
- Out of 7 colours in the visible part of spectrum, only red and blue are effective in photosynthesis.
  Plant grown in blue light are small, red light results in elongation of cells results in etiolated
  plants.

Effect of frost on plants

- Killing of young plants - frost chills the soil resulting in freezing the soil moisture. The plants growing in such soil, get exposed to direct sun light in the morning, they are killed due to increased transpiration when their roots are unable to supply moisture. This is the main reason for innumerable death of sal seedlings.
- Death of plants due to damage to cells - As a result of frost, water in the intercellular spaces of the plant gets.frozen into ice which withdraws water from the interior of the cells. This results in increasing concentration of salts and dehydration of cells. Thus coagulation and precipitation of the cell colloid results in death of plant.
- Leads to Formation of canker.

Effect of temperature on plants

- Excessive high temperature results in death of plant due to coagulation of protoplasmic proteins.

INSECTIVOROUS PLANTS

- These plants are specialised in trapping insects and are popularly known as insectivorous plants.

- Insectivorous plants can broadly be divided into active and passive types based on their method of trapping their prey.
- The active. ones can close their leaf traps the moment insects land on them.
- The passive plants have a 'pitfall' mechanism, having some kind of jar or pitcher-like structure into which the insect slips and falls, to eventually be digested.

Why do they hunt despite having normal roots and photosynthetic leaves?

- These plants are usually associated with rain-washed, nutrient-poor soils, or wet and acidic areas that are ill-drained.
- wetlands are acidic due to anaerobic conditions, which cause partial decomposition of organic matter releasing acidic compounds into the surroundings.
- most microorganisms necessary for complete decomposition of organic matter cannot survive in such poorly oxygenated conditions.
- Normal plants find it difficult to survive in such nutrient poor habitats.
- The hunter plants are successful in such places because they supplement their photosynthetic food production by trapping insects and digesting their nitrogen rich bodies.

The Indian Hunters

Insectivorous plants of India belong mainly to three families:
1. Droseraceae (3 species),
2 Nepenthaceae (1 species)and
3. Lentibulariaceae (36 species

1. Family: Droseraceae:

➢ This includes 4 genera of which 2, namely Drosera and Aldrovanda, occur in India

2. Family Nepenthaceae:

➢ It consists of a single genus Nepenthes having about 70 species distributed throughout the tropical Old World. The members of the family are commonly known as 'pitcher plants' because their leaves bear jar-like structures.

➢ Distribution - It is confined to the high rainfall hills and plateaus of north-eastern region, at altitudes ranging from 1.00 —1500 rn, particularly in Garo, Khasi and Jaintia hills of Meghalaya

3-Family: Lentibulariaceae:

- It have 4 genera, of which Utricularia and Pinguicula, occur in India

Medicinal properties

- Drosera are capable of curdling milk, its bruised leaves are applied on blisters, used for dyeing silk.
- Nepenthes in local medicine to treat cholera patients, the liquid inside the pitcher is useful for urinary troubles, it is also used as eye drops.
- Utricularia is useful against cough, for dressing of wounds, as a remedy for urinary disease.
- In India, species like Drosera peltata, Aldrovanda vesiculosa and Nepenthes khasiana have been -included in the Red Data Book as endangered plants

INVASIVE ALIEN SPECIES

- Alien species that threaten native plants and animals or other aspects of biodiversity are called alien invasive species

Effects

- Loss of Biodiversity
- Decline of Native Species (Endemics).
- Habitat Loss
- Introduced pathogens reduce crop and stock yields
- Degradation of marine and freshwater ecosystems
- This biological invasion constitutes the greatest threat to biodiversity

SOME INVASIVE ALIEIN FLORA OF INDIA

1. **Needle Bush**
   - Nativity: Trop. South

- Distribution in India: A shrub or small tree.

2. Black Wattle

- Nativity: South East Australia
- Distribution in India: Western Ghats
- Remarks: Introduced for afforestation in Western Ghats. Regenerates rapidly after fire and forms dense thickets. It is distributed in forests and grazing lands in high altitude areas.

3. Goat weed

- Nativity: Trop. America
- Distribution in India: Throughout
- Remarks: Aggressive colonizer. Troublesome weed in gardens, cultivated fields and forestS

MEDICINAL PLANTS

1. **Beddomes Cycad / Perita I Konciaitha** –

- Eastern Peninsular India.
- Uses : The male cones of the plant are used by local herbalists as a cure for rheumatoid arthritis and muscle pains.
- Fire resistant property is also there.

2. Blue vanda / Autumn Ladies Tresses Orchid

- Distribution : Assam, Arunachal Pradesh, Manipur, Meghalaya, Nagaland.
- Vanda is one of the few botanical orchids with blue flowers a property much appreciated for producing interspecific and intergeneric hybrids.

3. Kuth / Kustha / Pooshkarmoola / Uplet

- Distribution : Kashmir, Himachal Pradesh
- Uses : It is used as an anti-inflammatory drug

4. Ladies Slipper Orchid

- Uses : These types of orchids are mainly used as collector's items And treat anxiety insomnia

5. Red vanda

- Distribution : Manipur, Assam, Andhra Pradesh
- Uses : As a whole orchids are collected to satisfy an ever demanding market of orchid fanciers, especially in Europe, North America and Asia

6. Sarpagandha

- Distribution : Sub Himalayan tract from Punjab eastwards to Nepal, Sikkim, Assam, Eastern & Western Ghats, parts of Central India & in the Andamans.
- Uses : It is used for treating various central nervous system disorders.

MARINE ORGANISMS

- Includes both microscopic plants like algae (phytoplankton) and animals like crustaceans and protozoans (zooplankton) found in all aquatic ecosystems, except certain swift moving waters.
- The major inorganic nutrients required by phytoplankton for growth and reproduction are nitrogen and phosphorus.
- Marine phytoplankton are not uniformly distributed throughout the oceans of the world.
- The highest concentrations are found at high latitudes, with the exception of bliwelling areas on the continental shelves, While the tropics and subtropics.
- Phytoplanktons are the foundation of the aquatic food web, the primary producers
- Phytoplankton are responsible for most of the transfer of carbon dioxide from the atmosphere to the ocean. Carbon dioxide is consumed during photosynthesis, and the carbon is incorporated in the -phytoplankton, just as carbon is stored in the wood and leaves of a tree.

ZOO PLANKTON

- Play vital role in food web of the food chain, nutrient recycling, and in transfer of organic matter from primary producers to secondary consumers like fishes.

SEA-GRASS

- Specialized angiosperms (marine flowering plants) that resemble grass in appearance.
- They produce flowers; have strap-like or oval leaves and a root system.
- They grow in shallow coastal waters with sandy or muddy bottoms & require comparatively calm areas.
- They are the only group of higher plants adapted to life in the salt water.
- Major Sea grass meadows in India occur along the south east coast of Tamil Nadu and in the lagoons of a few Lakshadweep Islands.
- few grass beds around Andaman and Nicobar islands.

SEAWEEDS

- are (thalloid plants) macroscopic algae, which mean they have no differentiation of true tissues such as roots, stems and leaves.
- have leaf-like appendages.
- grow in, shallow coastal waters wherever sizable substata is available.

Uses of seaweeds

- Seaweeds are important as food for humans, feed for animals, and fertilizer for plants.
- Seaweeds are used as a drug for goiter treatment, intestinal and stomach disorders.
- Products like agar-agar and alginates, iodine which are of commercial value, are extracted
- from seaweeds.
- By the biodegradation of seaweeds methane like, economically important' gases can be produced
- in large quantities.
- potential indicators of pollution 4n coastal ecosystem, particularly heavy metal pollution due to their ability to bind and accumulate metals strongly.
- Rotting seaweed is a potent source of hydrogen sulfide, a highly toxic gas

PROTECTED AREA NETWORK

PROTECTED AREAS (PA)

- The adoption of a National Policy for Wildlife Conservation in 1970 and the enactment of the Wildlife (Protection) Act in 1972 lead to a significant growth in the protected areas - 669 Protected Areas including 102 National Parks, 515 Wildlife Sanctuaries, 49 Conservation Reserves and 4 Community Reserves

WILD LIFE SANCTUARY (WLS)

- The Wild Life (Protection) Act of 1972 provided for the declaration of certain areas by the State Government as wildlife sanctuaries if the area was thought to be of adequate ecological, geomorphological and natural significance.
- There are over 500 wildlife sanctuaries in the country, of Which Tiger Reserves are governed by Project Tiger.
- The Central Government may also declare a sanctuary under certain conditions

National Park (NP)

- The Wild Life (Protection) Act (WPA) of 1972 provided for the declaration of National Parks by the State Government are declared in areas that are considered to be of adequate ecological, geomorphological and natural significance although within the law,
- the difference in conservation value of a National Park from that of a sanctuary is not specified in the WPA 1972

Difference between the two

- National Parks enjoy a greater degree of protection than sanctuaries.
- Certain activities which are regulated in sanctuaries, such as grazing of livestock, are prohibited in National Parks.

- Wildlife sanctuary can be created for a particular species (for e.g. grizzled giant squirrel w.l.s in srivalliputhur) whereas the national park is not primarily focused on a particular species.

CONSERVATION RESERVE AND COMMUNITY RESERVES

- outcome of Amendments to the Wild life protection act in 2003
- It provides for a flexible system wherein the wildlife conservation is achieved without compromising the community needs.

Conservation Reserves

- It is an area owned by the State Government adjacent to National Parks and sanctuaries for protecting the landscape, seascape and habitat of fauna and flora. It is managed through a Conservation Reserve Management Committee
- State Government may, after having consultations with the local communities; declare any area owned by the Government-as conservation reserve.
- Tiruppadaimarathur conservation reserve in Tirunelveli, tamilnadu is the first conservation reserve established in the Country.

Community Reserve

- State Govt may notify any community land or private land as a Community Reserve, provided that the members of that community or concerned are agreeable to offer such area for protecting the fauna and flora, as well as their traditions, cultures and practices.
- The declaration of such an area is aimed at improving 'the socio-economic conditions of the living in such areas as well as conserving The Reserve is managed through a Reserve Management Committee
- No change in the land use pattern shall be made within the Community Reserve, except in according with a resolution passed by the management Committee and approval of same by the State Government

COASTAL PROTECTED AREAS

- It aims to protect and conserve the natural marine ecosystems in their pristine condition
- Marine Protected Area (MPA), as "any area of intertidal or sub tidal terrain, together with its overlaying water and Associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment" - IUCN.
- The MPAs in marine environment in India, are primarily classified. into following three categories:
- Category-I: This covers National Parks and Sanctuaries and having entire areas in intertidal/sub-tidal or mangroves, coral reefs, creeks, seagrass beds, algal beds, estuaries, lagoons.
- Category-II: This includes Islands, which have major parts in marine ecosystem and some part in terrestrial ecosystem.
- Category-IIIA: This includes sandy beaches beyond intertidal line but occasionally interacting with the seawater.
- Category-MB: This includes ever green or semi ever green forests of Islands

SACRED GROVES OF INDIA

- Sacred groves comprise of patches of forests or natural vegetation - from a few trees to forests of several acres - that are usually dedicated to local folk deities.
- In India, sacred groves _are found all over the country and abundantly along the western ghats in the states of Kerala and Karnataka

THE MAN AND BIOSPHERE

- The Man and the Biosphere (MAB) Programme is an Intergovernmental Scientific Programme aiming to set a scientific basis for the improvement of the relationships between people and their environment globally.
- Launched in the early 1970s, it proposes an interdisciplinary research agenda and capacity building that target the ecological, social and economic dimensions of biodiversity loss and the reduction of this loss.
- identify and assess the changes in the biosphere resulting from human and natural activities and the effects of these changes on humans and the environment, in particular in the context of climate change;
- study and compare the dynamic interrelationships between natural/near- natural ecosystems and socio-economic processes
- promote the exchange and transfer of knowledge on environmental problems and solutions, and to foster environmental education for sustainable development.

- ensure basic human welfare and a livable environment in the context of rapid urbanization and energy consumption as drivers of environmental change.

BIOSPHERE RESERVE (BR)

- The International coordinating council (ICC) of UNESCO, November, 1971, introduced the designation Biosphere Reserve' for natural areas.
- Biosphere Reserve (BR) is an international designation by UNESCO for representative parts of natural and cultural landscape's extending over large area of terrestrial or coastal/marine ecosystems or a combination thereof.
- BRs are special environments for ,both people and the nature and are living examples of how human beings and nature can co-exist while respecting each other's needs
- Biosphere reserves are sites established by countries and recognized under. UNESCO's Man and the Biosphere (MAB) Programme.

Biosphere Reserves: an Indian approach

1. National Biosphere Reserve Programme.
   - initiated in 1986.

Objectives

- ✓ To conserve the diversity integrity of plants and animals within natural ecosystems;
- ✓ To safeguard genetic diversity of species on which their continuing evolution depend
- ✓ To provide areas for multi-faceted research and monitoring;
- ✓ To provide facilities for education and training;
- ✓ To ensure sustainable use of natural resources through most appropriate technology for improvement of economic well-being of the local people.

BIODIVERSITY HOT SPOTS

- ✓ Biodiversity hot spot concept was put forth by Norman Myers in 1988
- ✓ To qualify as a hot spot, a region must meet two strict criteria:

a. Species endemism - it must contain at least 1,500 species of vascular plants (> 0.5% of the world's total) as endemics, and

b. Degree of threat - it has to have lost at least 70% of its original habitat.

Indian Biodiversity Hot Spots

1. The Eastern Himalayas
2. Indo- Burma and
3. The western Ghats & Sri Lanka

Eastern Himalayas Hot Spot:

- the region encompassing Bhutan, northeastern India, and southern, central, and eastern Nepal.
- The region is geologically young and shows high altitudinal variation.
- has nearly 163 globally threatened species (both flora and fauna) including the One horned- Rhinoceros , the Wild Asian Water buffalo.
- a plant species Ermania Himalayensis was found at an altitude of 6300 meters in northwestern Himalayas.
- A few threatened endemic bird species such as the Himalaya Quail, Cheer pheasant, Western tragopan are found here, along with some of Asia's largest and most endangered birds such as the Himalayan vulture and White-bellied heron.
- Endemic Mammals like the Golden langur, The Himalayan tahr, the pygmy hog, Langurs, Asiatic wild dogs, sloth bears, Gaurs, Muntjac, Sambar, Snow leopard, Mack bear, Blue sheep, Takin, the gangetic dolphin, wild water buffalo, swamp deer call the Himalayan ranged their home.

Western Ghats and Sri Lanka:

- Western Ghats, also known as the "Sahyadri Hills" encompasses the mountain forests in the South western parts of India and highlands of southwestern Sri Lanka.
- The important populations include Asian elephant, Niligiri tahr, Indian tigers, lion tailed macaque, Giant squirrel; etc.

WORLD HERITAGE SITES

- The sites are designated as having outstanding universal value under the Convention concerning the Protection of the World. Cultural and Natural "Heritage.
- Until the end of 2004, there were six criteria for cultural heritage and four criteria for natural
- heritage. In 2005 this was modified so that there is only one set of ten criteria. Nominated sites must be of "outstanding universal value" and meet at least one of the ten criteria.
- The United Nations proclaimed May 22 as The International Day for Biological Diversity (IDB) to increase understanding and awareness of biodiversity issues.

CONSERVATION EFFORTS

PROJECT TIGER

- Project Tiger centrally sponsored scheme was launched in 1973 with the following objectives:
- To ensure maintenance of available population of Tigers in India for scientific, economic, aesthetic, cultural and ecological value
- To preserve, for all times, the areas of such biological importance as a national heritage for the benefit, education and enjoyment of the people

Aim

- Conservation of the endangered species and harmonizing the rights of tribal people living in and around tiger reserves.

Tiger Reserve

- Tiger reserves are areas that are notified for the protection of the tiger and its -prey, and are governed by Project Tiger which was launched in the country in 1973.
- Initially 9 tiger reserves were covered under the project, and has currently increased to 42, falling in 17 States (tiger reserve States)

PROJECT ELEPHANT

- Project Elephant was launched in February, 1992 as centrally sponsored scheme to assist states having free ranging populations of wild elephants and to ensure 'long term survival of identified viable populations of elephants in their natural habitats.
- implemented in 13 States / LITs , viz. ,Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Karnataka, Kerala, Meghalaya, Nagaland, Orissa, Tamil Nadu, Uttaranchal, Uttar Pradesh and West Bengal. Small support is also being given to Maharashtra and Chhattisgarh.
- (A3JK2MNOTU2wb.)

Objectives

- To protect elephants, their habitat & corridors
- To address issues of man-animal conflict
- Welfare of domesticated elephants

Monitoring of Illegal Killing of Elephants (MIKE) Programme

- Mandated by COP resolution of CITES, MIKE program started in South Asia in the year 2003 with following, purpose —
- To provide information needed for elephant range States to make appropriate management and enforcement decisions, and to build institutional capacity within the range States for the long-term management of their elephant populations.

Main objectives

1. to measure levels and trends in the illegal hunting of elephants;
2. to determine changes in these trends over time;

3. to determine the factors causing or associated, with such changes, and to try and assess in particular to what extent observed trends are a result of any decisions taken by the Conference of the Parties to CITE.

Haathi Mere Saathi

- Haathi Mere Saathi is a campaign launched by the Ministry of environment and forest (MoEF) in partnership with the wildlife trust of India.
- To improve conservation and welfare prospects of the elephant - India's National Heritage Animal.
- The campaign was launched at the "Elephant- 8" Ministerial meeting held in Delhi on 24th May 2011
- The E-8 countries comprise of India, Botswana, the Republic of Congo, Indonesia, Kenya, Srilanka, Tanzania, and Thailand (I2T2BCKS)

The campaign mascot 'Gaju'.

- The campaign focuses on various target audience groups including locals near elephant habitats, youth, policy makers, among others.
- It envisions setting up of Gajah (the elephant) centres in elephant landscapes across the country to spread awareness on their plight and invoke people's participation in addressing the threats to them
- Tiger, faces threat of extinction, whereas the elephant faces threat of attrition
- elephant particularly the tuskers (male), in India is as threatened as the tiger. There are just about 1200 tuskers left in the country.

The E-8 ministerial meeting represented regions with all 3 species of elephants,

1.	Elephas	maximus	(Asian elephant)
2.	Loxodonta	africana	(African Bush Elephant)
3.	Loxodonta	cyclotis	(African Forest Elephant

E-50:50 forum

- the umbrella of elephant-50:50 forum. It is the shared vision of 50 states to promote conservation, management and welfare of elephants in the next 50 years.
- E-50:50 forum The E-8 countries decided to hold the 1st International Congress of E-50:50 forum in early

2013 at New Delhi, India

- for adopting a common global vision on conservation, management and welfare of elephants across all range countries.

VULTURE

India has nine species of vultures in the wild. They are the

1. Oriental White-backed Vulture (Gyps bengalensis),
2. Slender billed Vulture (Gyps tenuirostris),
3. Long billed Vulture (Gyps indicus),
4. Egyptian Vulture (Neophron percnopterus),
5. Red Headed Vulture (Sarcogyps calvus),
6. Indian Griffon Vulture (Gyps fulvus),
7. Himalayan Griffon (Gyps himalayensis),
8. Cinereous Vulture (Aegypius monachus)
9. Bearded Vulture or Lammergeier (Gypaetus barbatus).

- Decline of vulture populations in India was first recorded at the Keoladeo Ghana National Park, Rajasthan
- Red-headed vulture or king vulture, Slender billed Vulture and Long billed Vulture are listed as critically endangered.

- Populations of Egyptian vultures and White- backed Vulture have also undergone decline in India and are now classified as Endangered.(Egypt people are white)
- decline in population was due to the drug diclofenac
- Meloxicam - An Alternative-Meloxicam is a second generation NSAID and rated better than Diclofenac for the treatment of livestock, with reduced risk of side effects, and is also approved for human use in more than 70 countries. Meloxicam is licensed as a veterinary drug in India, Europe and USA.

Vulture Safety Zones

- Aim of developing VSZs is to establish targeted awareness activities surrounding .150 km radius of vultures' colonies so that no diclofenac or the veterinary toxic drugs are found in cattle carcasses, the main food of vultures(to provide safe food).

Zones

1. The zone between Uttarkhand to Nepal, which spans from Corbett to Katriya Ghat, a Tarai belt, covering 30,000 square kilometers will be earmarked as Vulture Safe zone. Slender-billed vulture and white-backed vulture are Found hi this area, which is marshy grassland, savannas and forests.

2. Similarly, a belt between Dibrugarh in Assam to North Lakhimpur in Arunachal Pradesh will also be conserved as a vulture safe zone where slender-billed and white-backed species of vultures are found.

3. The third zone would be in central India, covering Chhatisgarh, where white-hacked and long-billed vultures are found

ONE HORN RHINO

Indian Rhino Vision 2020

- ✓ Indian rhino vision 2020 implemented by the department of environment and forests, Assam with The Bodo autonomous council as a active partner.
- ✓ The prograinine will be supported by WWF - India; WWF areas (Asian rhino and elephant action strategy) programme, the international rhino foundation (IRF), save the rhino's campaign of zoological institutions worldwide.
- ✓ The vision of this program is to increase the total rhino foundation in Assam from about 2000 to 3000 by theyear2020 and to ensure that these rhinos are distributed over at least 7 protected areas. (PA) to provide long term viability of the one-horned rhino population.
- ✓ Translocations are the backbone of the IRV 2020 program
- ✓ The goal set was, to populate the potential rhino habitat areas identified viz. Manas NP, Dibru Saikhowa WLS, Laokhowa - Bura Chapori WLS with a viable population of rhino through translocations from Kaziranga NP and Pobitora WLS.

PROJECT SNOW LEOPARD

SNOW LEOPARD:

- ✓ The mystical apex predator
- ✓ The snow leopard is a globally endangered species. Merely 7,500 are estimated to be surviving over two million square kilometers in the Himalaya and Central Asian mountains, where they are facing tremendous human pressures.
- ✓ India is perhaps home to 10% of the global population in less than 5% of its global range,
- ✓ having a substantial proportion of its global population.
- ✓ Distribution in India — in Indian Himalayas, high altitude areas located above the forests.
- ✓ in the five Himalayan states of Jammu & Kashmir, Himachal Pradesh, Uttarakhand , Sikkim and Arunachal Pradesh.
- ✓ Most snow leopard occurring in China, followed by Mongolia and India
- ✓ Jan 2009 - The Project Snow Leopard is an Indian initiative for strengthening wildlife conservation in the Himalayan high altitudes.

Goal:

- To safeguard and conserve India's unique natural heritage of high altitude wildlife populations and their habitats by promoting conservation through participatory policies and actions
- The high altitudes of India (> 3000 m. to 130,000 km2, including the Himalaya and Trans-Himalaya biogeographic zones) support a unique wildlife assemblage of global conservation importance.
- This includes highly endangered populations of species such as the snow leopard, two species of bears, wolf, red panda, mountain ungulates such as the wild yak, chiru, Tibetan gazelle, Tibetan argali, Ladakh urial, two species of musk deer, the hangul, three species of goral, serow, and takin, etc. High altitude lakes and bogs provide breeding grounds for a variety of fauna including the black-necked crane, barheaded Geese, brahminy ducks, and brown-headed gulls, etc.
- In 2003, the Convention on International Trade in Endangered Species (CITES) expanded the scope of the CITES Tiger Enforcement Task Force to include all Asian big cat species including the snow leopard.

SEA TURTLE PROJECT

- A significant proportion of world's Olive Ridley Turtle population migrates every winter to Indian coastal waters for nesting mainly at eastern coast.
- conservation of olive ridley turtles and other endangered marine turtles, Ministry of Environment & Forests initiated the Sea Turtle Conservation Project in collaboration of UNDP in November, 1999 with Wildlife Institute of India, Dehradun as the Implementing Agency
- Implemented in 10 coastal States of the country with special emphasis in State of Orissa.
- One of the important achievements have been demonstration of use of Satellite Telemetry to locate the migratory route of Olive Ridley Turtles in the sea and sensitizing the fishermen and State Government for the use of Turtle Exclusion Device (TED) in fishing trawlers to check turtle mortality in fishing net

INDIAN CROCODILE CONSERVATION PROJECT

- The Indian Crocodile Conservation Project has pulled back the once threatened crocodilians from the brink of extinction and place them on a good path of recovery.
- The Project has not just produced a large number of crocodiles, but has contributed towards conservation in a number of related fields as well.
- Central Crocodile Breeding and Management Training Institute, Hyderabad

PROJECT HANGUL

- The Kashmir stag (Cervus affinis hanglu) also called Hangul is a subspecies of Central Asian Red Deer native to northern India.
- It is the state animal of jammu & kasmir
- This deer lives in groups of two to 18 individual in dense riverine forests, high valleys, and mountains of the Kashmir valley and northern Chamba in Himachal Pradesh.
- In Kashmir, it's found in Dachigam National Park at elevations of 3,035 meters.
- They were threatened, due to habitat destruction, over-grazing by domestic livestock and poaching.
- captive breeding of lion tailed macaque in Arignar Anna Zoological Park, Chennai and in mysore zoo.

GANGES DOLPHIN

- The Ministry of Environment and Forests notified the Ganges River Dolphin as the National Aquatic Animal
- The River Dolphin inhabits the Ganges- Brahmaputra-Meghna and Karnaphuli-Sangu river systems of Nepal, India, and Bangladesh
- they are listed in Schedule I of the Wildlife Protection Act (1972).
- The Ganges Dolphin is among the four "obligate" freshwater dolphins found in the world - the other three are the 'baiji found in the Yangtze River (China), the 'bhulan' of the Indus (Pakistan) and the 'boto' of the Amazon River (Latin America).
- The Chinese River Dolphin was declared functionally extinct by a team of international scientists in 2006.

SCHEDULE LIST-WPA, 1972

- WPA 1972 consists of 6 schedule lists, which give varying degrees of protection.
- Poaching, smuggling and illegal trade of animals listed Schedule 1 to schedule 4 are prohibited.
- Animals listed in schedule 1 and part II of schedule 2 have absolute protection - offences under these are prescribed the highest penalties.
- Examples of animals listed in schedule 1 are lion tailed macaque, rhinoceros, great Indian bustard, narcondam hornbill, nicobar megapode, black buck, etc.
- Examples of animals listed in schedule 2 are rhesus macaque, dhole, Bengal porcupine, king cobra, flying squirrel, himalyan brown bear.
- Animals listed in schedule 3 and schedule 4 are also protected, but the penalties are lower compared to schedule 1 and part 2 of schedule
- Examples of animals listed in schedule 3 are hyaena, hogdeer, nilgai, goral, sponges, barking deer, etc
- Examples of animals listed in schedule4 are mangooses, vultures, etc.
- Animals listed in schedule 5 are called "vermin" which can be hunted.
- Mice, rat, 'common crow" and flying fox (fruit eating bats) are the list of animals (only 4 nos) in schedule 5.
- Cultivation, Collection, extraction, trade, etc. of Plants and its derivatives liSied in schedule 6 are prohibited.
- Red Vanda, bite Vanda, kuth, pitcher plant, beddomes cycad and ladies slipper orchid are the list of plants listed in schedule 6.

COMPILATION FROM SHANKAR IAS ENVIRONMENT

PART-III-CLIMATE CHANGE

CONTENTS

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4. IMPACT OF CLIMATE CHANGE-INDIA
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CLIMATE CHANGE

- The long-term average of a region's weather events.
- The phrase 'climate change' represents a change in the long-term weather patterns
- The measurable effects of the continual warming trend.
- Usually measured in major shifts in temperature, rainfall, snow, and wind patterns lasting decades or more

GLOBAL WARMING

- ✓ An average increase in the temperature of the atmosphere near the Earth's surface and in the troposphere, which can contribute to changes in global climate patterns

GREENHOUSE EFFECT

- ✓ The greenhouse effect is a naturally occurring phenomenon that blankets the earth lower atmosphere and warms it, maintaining the temperature suitable for living things to survive.
- ✓ water vapor and green house gases warms the Earth.

Incoming Energy

- ✓ The Sun emits energy that is transmitted to Earth.
- ✓ Because the Sun is very hot, the energy is emitted in high-energy short wavelengths that penetrate the Earth's atmosphere.

Absorption

- ✓ About 30% of the Sun's energy is reflected directly back into space by the atmosphere, clouds, and surface of the Earth.
- ✓ The rest of the Sun's energy is absorbed into the Earth's system (70%)

Emission

- ✓ The Earth re-emits energy back into the atmosphere.
- ✓ Because the Earth is cooler than the Sun, the energy is emitted in the form of infrared radiation, at wavelengths longer than the incoming solar energy.

Role of Greenhouse Gases

- ✓ Greenhouse gases in the atmosphere absorb much of the long-wave energy (infrared radiation) emitted from the Earth's surface,
- ✓ The greenhouse gases then re-emit this energy in all directions, warming the Earth's surface and lower atmosphere.

GREEN HOUSE GASES

- ✓ Greenhouse gases" means those gaseous constituents of the atmosphere, both natural and anthropogenic, those absorbs and re-emit infrared radiation.

1. **WATER VAPOUR**
   - ✓ the biggest overall contributor to the greenhouse effect and humans are not directly responsible for emitting this gas in quantities sufficient to change its concentration in the atmosphere.
   - ✓ CO_2 and other greenhouse gases is increasing the amount of water vapour in the air by boosting the rate of evaporation.

2. **CARBON DIOXIDE**
   - **The main sources**

   i. The combustion of fossil fuels to generate electricity.
   ii. The combustion of fossil fuels such as gasoline and diesel used for transportation

iii. Many industrial processes emit CO2 through fossil fuel combustion.
iv. Several processes also produce CO2 emissions through chemical reactions that do not involve combustion.

- **Reducing Carbon Dioxide Emissions** - The most effective way to reduce carbon dioxide (CO2) emissions is to reduce fossil fuel consumption.
- Other strategies include Energy Efficiency, Energy Conservation, Carbon Capture and Sequestration.

3. METHANE

- (CH4) is emitted by natural sources such as wetlands, as well as human activities such as leakage from natural gas systems and the raising of livestock.
- Natural processes in soil and chemical reactions in the atmosphere help remove CH4 from the atmosphere

Human induced:

- Agriculture: Domestic livestock such as cattle, buffalo, sheep, goats, and camels produce large amounts of CH4 as part of their normal digestive process.
- Globally, the Agriculture sector is the primary source of CH4 emissions
- Methane is the primary component of natural gas.
- Some amount of, CH4 is emitted to the atmosphere during the production, processing, storage, transmission, and distribution of crude oil & natural gas.

4.NITROUS OXIDE

- (N20) is naturally present in the atmosphere as part of the Earth's nitrogen cycle, and has a variety of natural sources.
- Natural emissions of N20 are mainly from bacteria breaking down nitrogen In soils and the oceans.
- emitted when people add nitrogen to the soil through the use of synthetic fertilizers.
- also emitted during the breakdown of nitrogen in livestock manure and urine, which contributed to 6% of N20 emissions in 2010
- emitted when transportation fuels are burned
- generated as a byproduct during the production of nitric acid, which is used to make synthetic commercial fertilizer, and in the production of adipic acid, which is used to make fibers, like nylon, and other synthetic products.
- removed from the atmosphere when it is absorbed by certain types of bacteria or destroyed by ultraviolet radiation or chemical reactions.

5. FLUORINATED GASES

- They are emitted through a variety of industrial processes such as aluminum and semiconductor manufacturing & Substitution for Ozone-Depleting Substances.
- very high global warming potentials (GWPs) relative to other greenhouse gases.
- well-mixed in the atmosphere, spreading around the world after they're emitted.
- removed from the atmosphere only when they are destroyed by sunlight in the far upper atmosphere.
- the most potent and longest lasting type of greenhouse gases emitted by human activities.

1. hydrofluorocarbons (HFCs),
2. perfluorocarbons (PFCs), and
3. sulfur hexafluoride (SF6).

- Hydrofluorocarbons are used as refrigerants, aerosol propellants, solvents, and fire retardants. These chemicals were developed as a replacement for chlorofluorocarbons (CFCs) and hydro chlorofluoro carbons (HCFCs) because they do not deplete the stratospheric ozone layer.
- Unfortunately, HFCs are potent greenhouse gases with long atmospheric lifetimes and high GWPs,
- Perfluorocarbons are compounds produced as a by-product of various ,industrial processes associated with aluminum production and the manufacturing of semiconductors.
- Like HFCs, PFCs generally have long atmospheric lifetimes and high. GWPs.
- Sulfur hexafluoride is used in magnesium processing and semiconductor manufacturing, as well as a tracer gas for leak detection. Sulfur hexafluoride is used in electrical transmission equipment, induding circuit breakers.

BLACK CARBON

- commonly known as soot, is a form of particulate air pollutant, produced from incomplete combustion.
- consists of pure carbon in several linked forms.
- a solid particle or aerosol, (though not a gas) contributes to warming of the atmosphere.
- biomass burning, cooking with solid fuels, diesel exhaust, etc
- warms the Earth by absorbing heat in the atmosphere and by reducing albedo, (the ability to reflect sunlight) when deposited on snow and ice.
- the strongest absorber of sunlight and heats the air directly.
- it darkens snow packs and glaciers through deposition and leads to melting of ice and snow.
- disrupts cloudiness and monsoon rainfall and accelerates melting of mountain glaciers such as the Hindu Kush-Himalayan glaciers

Government Measures

- Project Surya has been launched to reduce black carbon in atmosphere by introducing efficient stove technologies, solar cookers, solar lamps and biogas plants

Brown Carbon

- a ubiquitous and unidentified component of organic aerosol which has recently come into the forefront of atmospheric research.
- Light-absorbing organic matter (other than soot) in atmospheric aerosols of various origins, e.g., soil humics, humic-like substances (HLTLIS), tarry materials from combustion, bio aerosols.

CLIMATE FORCINGS

- are factors in the climate system that either increase or decrease the effects to the climate system.
- Positive forcings such as excess greenhouse gases warm the earth
- negative forcings, such as the effects of most aerosols and volcanic eruptions, actually cool the earth.

Natural Forcing's

- include changes in the amount of energy emitted by the Sun, very slow variations in Earth's orbit, and volcanic eruptions

Human-Induced Forcing's

- Activities include greenhouse gas and aerosol emissions from burning fossil fuels and modifications of the land surface, such as deforestation.

- Greenhouse gases are a positive climate forcing; that is, they have a warming effect.
- Carbon dioxide emitted from the burning of fossil fuel is presently the largest single climate forcing agent, accounting for more than half of the total positive forcing since 1750
- Burning fossil fuels adds aerosols to the atmosphere.
- Aerosols are tiny particles in the atmosphere composed of many things, including water, ice, ash, mineral dust, or acidic droplets.
- Aerosols can deflect the Sun's energy and impact the formation and lifetime of clouds. Aerosols are a negative forcing; that is, they have a cooling effect.

Estimate the effect of each gas (three main factors)

1. How much of these gases are in the atmosphere
2. How long do they stay in the atmosphere
3. How strongly do they impact global temperatures

GLOBAL WARNING POTENTIAL

- ✓ The Global Warming Potential (GWP) for a gas is a measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to carbon dioxide.
- ✓ Gases with a higher GWP absorb more energy, per pound, than gases with a lower GWP, and thus contribute more to warming Earth.
- ✓ Methane (CH4) has a GWP more than 20 times higher than CO2 for a 100-year time scale
- ✓ Nitrous Oxide (N20) has a GWP 300 times that of CO2 for a 100-year timescale
- ✓ Chloro fluoro carbons (CFCs), hydro fluoro carbons (HFCs), hydro chloro fluoro carbons (HCFCs), perfluoro carbons (PFCs), and sulfur hexafluoride (SF6) are called high-GWP.

GLOBAL EMISSIONS BY SOURCE

- **Energy Supply (26%)**
- **Industry (19%)**
- **Land Use, Land-Use Change, and Forestry (17%)**
- **Agriculture (14%)**
- **Transportation (13%)**
- **Waste and Wastewater (3%)**

ACIDIFICATION

- the rainfall that has been acidified.
- formed when oxides of sulfur and nitrogen react with the moisture in the atmosphere.
- rain with a pH of less than 5.6.

TYPES OF ACID DEPOSITION

- ✓ Acid rain" is a broad term referring to a mixture of wet and dry deposition (form of deposition material) from the atmosphere

Sources of compounds causing acid rain

(a) Sulphur

1) Natural sources: - seas and oceans, volcanic eruptions,
   - ✓ Biological processes in the soil e.g.,
   - ✓ Decomposition of organic matter.

2) **Man-made sources**:

- ✓ burning of coal (60% of S02) and
- ✓ petroleum products (30% of S02), and
- ✓ The smelting of metal sulfide ores to obtain the pure metals.
- ✓ Industrial production of Sulfuric acid in metallurgical, chemical and fertilizer industries

(b) Nitrogen

- ✓ Natural sources: lightening, volcanic eruption, and Biological activity.
- ✓ Anthropogenic sources: Forest fires Combustion of oil, coal, and gas

(c) Formic acid

- ✓ Biomass burning due to forest fires causes emission of formic acid (HCOOH) and formaldehyde (HCHO) into the atmosphere.
- ✓ Large fraction formaldehyde gets photo - oxidation and forms formic acid in the atmosphere.
- ✓ These are three main compounds that cause acidification of rain in the atmosphere

(d)Other Acids:

- ✓ Chlorine, Phosphoric acid, Hydrochloric acid (smokestacks), Carbon monoxide and carbon dioxide(automobiles). These become carbonic acid.
- ✓ Lichgns serve as good bio-indicators for air pollution
- ✓ Acid rain containing ions of sulfate, nitrate, ammonium and hydrogen falls as wet deposition.

Impact Of Acid Rain

(a)Soil

- ✓ The exchange. between hydrogen ions and the nutrient cations like potassium and magnesium in the soil cause leaching Of the nutrients, making soil infertile.
- ✓ Increase in ammonia in the soil due to a decrease in other nutrients decrease the rate of decomposition.
- ✓ The impact of acid rain on soil is less India; because Indian soils are mostly alkaline, with good buffering ability.

Micro organisms

- ✓ pH determines the proliferation of any microbial species in a particular environment and the rate at which it can produce.
- ✓ The optimum pH of most bacteria and protozoa is near neutrality; most fungi-prefer an acidic environment,
- ✓ most blue-green bacteria prefer 'an alkaline environment.
- ✓ after a long run of acid rain, microbial species in the soil and water shift from bacteria-bound to fungi-bound
- ✓ cause an imbalance in the microflora.
- ✓ causes a delay in the decomposition of soil organic material, and an increase in fungal disease in aquatic life and forests.

Acid rain affects human health is a number of ways.

- ✓ The obvious ones are bad smells, reduced visibility; irritation of the skin, eyes and the respiratory tract
- ✓ Some direct effects include chronic bronchitis, pulmonary emphysema and cancer

Acid rain damage on Materials

- ✓ Metals, stone, Paints , Paper, Photographic Micro material , Leather—by sulpher oxide mainly and some other gas oxides .
- ✓ Rubber- ozone gas
- ✓ Textiles- nitrogen oxide
- ✓ Ceramic and Surface glass- Acid gases, fluoride-containing

Trigger Effect of Acid Rain on Pollutants:

1. **Mercury**
   - ✓ Methyl mercury and related short chain alkyl, mercurial compounds are most dangerous to humans, as they accumulate in edible fish tissue.
   - ✓ Although acid deposition may not increase the production of methyl mercury, it may increase the partitioning of methyl mercury into the water column.
   - ✓ The use of lime has helped in reducing the mercury levels in fish.

2. **Aluminium**:
   - ✓ Acidified waters are known to leach substantial amounts of aluminum from watersheds.
   - ✓ Even at relatively low levels, aluminum has been implicated in dialysis dementia, a disorder of the central nervous system, which may be toxic to individuals with impaired kidney function

3. **Cadmium**:
   - ✓ Cadmium can enter the drinking water supply through corrosion of galvanized pipe or from the copper-zinc through corrosion of galvanized piper or from the copper-zinc solder used in the distribution systems.
   - ✓ A decrease in water pH from 6.5 to 4.5 can result in a fivefold increase in cadmium and could cause renal tubular damage

4. **Lead**:
   - ✓ Foetuses and infants are highly susceptible to drinking water lead contamination.
   - ✓ High blood lead levels in children (>30 mug/ Ml) are believed to induce biochemical and neurophysiological dysfunction.
   - ✓ However, lower than normal blood levels of lead can cause mental deficiencies and behavioral problems

OCEAN ACIDIFICATION

- ✓ the change in ocean chemistry - lowering of ocean pH (i.e. increase in concentration of hydrogen ions) driven by the uptake of carbon compounds by the ocean from the atmosphere.
- ✓ As the uptake of atmospheric carbon dioxide by the ocean increases, the concentration of hydrogen, ions in the ocean increases, the concentration of carbonate ions decreases, the pH of the oceans decreases and the oceans become less alkaline — this process is know as ocean acidification.
- ✓ The ocean currently has a pH around 8.0 and is therefore 'basic'

Forms of calcium carbonate

1- **Calcite** is the mineral form found in the shells of planktonic algae, amoeboid protists, some corals, echinoderms, and some molluscs (e.g. oysters); it is relatively less soluble.

2 - **Aragonite** is a more soluble form of calcium carbonate; it is found in most corals, most mollusks (small planktonic snails), as well as some species

Effect of ocean acidification

- ✓ Seawater absorbs CO, to produce carbonic acid (H,CO3), bicarbonate (HCO3--) and carbonate ions (Co2-).
- ✓ These carbonate ions are essential to the calcification process that allows certain marine organisms to build their calcium carbonate shells and skeletons.
- ✓ increases in atmospheric CO2 levels lead to decrease in pH level, increase in the concentration of carbonic acid and bicarbonate ions, causing a decrease in the concentration of carbonate ions.
- ✓ Thus carbonate ions are less available and calcification is therefore harder to achieve

Saturation horizons

- ✓ Deep, cold ocean waters are naturally under saturated with carbonate ions causing the shells of most calcifying organisms to dissolve.
- ✓ Surface waters are oversaturated with carbonate ions and do not readily dissolve shells of calcifying organisms.
- ✓ The saturation horizon is the level below which calcium carbonate minerals undergo dissolution
- ✓ The saturation horizon of calcite occurs at a greater ocean depth than that for aragonite, but both horizons have moved closer to the surface presently when compared to the 1800s.
- ✓ lysocline, the depth at which dissolution strongly increases in the deep ocean.
- ✓ carbonate compensation depth(CCD), the depth at which all carbonate is dissolved

OZONE HOLE

- ✓ It is found in two different layers of the atmosphere.
- ✓ Ozone in the troposphere is "bad" because it dirties the air and helps to form smog, which is not good to breathe.
- ✓ Ozone in the stratosphere is "good" because it protects life on Earth by absorbing some of the sun's harmful Ultra Violet (UV) rays
- ✓ decrease in the concentration of ozone in a particular region of the atmosphere - 'ozone hole'
- ✓ The best example of such an ozone hole is theatmosphere over the Antarctic which has only about 50 percent of the ozone that originally occurred there.

Sources

1. **Chlorofluorocarbons (CFCs):**

- ✓ CFCs molecules are made up of chlorine, fluorine and carbon.
- ✓ They are used as refrigerants(66%) ; propellants in aerosol sprays, foaming agents in plastic manufacturing(30%) , fire extinguishing agents, solvents for cleaning electronic and metallic components, for freezing foods etc
- ✓ CFCs has a wide and varied application due to its properties like non-corrosiveness, non-inflammability, low toxicity and chemical stability, etc.
- ✓ the residence time of CFCs in the atmosphere estimated to be between 40 and 150 years

The chemical reaction

- ✓ CFCs + UV radiation = freeing chlorine atoms.
- ✓ A free chlorine atom + ozone molecule to = chlorine monoxide (00).
- ✓ chlorine monoxide + atom of oxygen.= (02) and reformation of the free chlorine atom (CI).
- ✓ The element that destroys 03 (i.e chlorine) is being reformed at the end of cycle.
- ✓ A single chlorine atom destroy thousands of ozone molecules before encountering reactive nitrogen or hydrogen compounds that eventually return chlorine to its reservoirs.

Nitrogen Oxides:

- ✓ The chemical reaction- Nitric oxide (NO) catalytically destroys ozone.
- ✓ Nitric oxide + ozone =Nitrogen dioxide + o2
- ✓ Nitrogen dioxide + monoxide =Nitric oxide + Oxygen

Bromine

- ✓ containing compounds called halons and HBFCs, i.e. hydrobromo fluorocarbons [both used in fire extinguishers and methyl bromide (a widely used pesticide)].
- ✓ Each bromine atom destroys hundred times of more ozone molecules than what a chlorine atom does.

Sulphuric acid particles:

- ✓ These particles free chlorine from molecular reservoirs, and convert reactive nitrogen into inert forms thus preventing, the formation of chlorine reservoirs.

Role of polar stratospheric clouds in ozone depletion

- ✓ The ice particles of the cloud provided substrates for chemical reactions which freed chlorine from its reservoirs.
- ✓ the reaction between HC1 and C1ONO2 is very slow, but this reaction occurs at a faster rate in the presence of a suitable substrate which is provided by the stratospheric clouds at the poles.
- ✓ The PSCs not only activate chlorine, but they also absorb reactive nitrogen.
- ✓ If nitrogen, - oxides were present they would combine with chlorine monoxide to form a reservoir of chlorine nitrate, (ClONO2).
- ✓ Every spring, a hole as big as the USA develops in the ozone layer over Antarctica, in the South Pole.
- ✓ A smaller hole develops each year over the Arctic, at the North Pole.

Why is the ozone hole predominant at the Antarctic?

- ✓ The Antarctic stratosphere is much colder. The low temperature enables the formation of Polar stratospheric Clouds (PSCs), below 20 km
- ✓ The vortex is a ring of rapidly circulating air that confines the ozone depletion in the Antarctic region.
- ✓ The longetivity of the Antarctic vortex is another factor, enhancing favorable conditions for the depletion of ozone.
- ✓ The vortex remains, in fact, throughout the polar winter, well into midspring Whereas- the vortex in the Arctic disintegrates by the time the polar spring (March-April) arrives.

- ✓ The ozone measurement instruments and techniques are varied. Some of them are the Dobson spectrophotometer and the filter ozonometer called M83, and total ozone mapping pectrometer (TOMS) in the Nimbus-7 satellite.
- ✓ The Umheher technique- The most common measure of total ozone abundance is the Dobson unit (named afterthe pioneering atmospheric physical Gordon Dobson) which is the thickness of the ozone column (compressed at Standard Temperature and Pressure (STP)) in milli-centimeters.

IMPACT OF CLIMATE CHANGE

AGRICULTURE AND FOOD SECURITY

- ✓ The Third Assessment Report of the IPCC, 2001 concluded that climate change would hit the poorest countries severely in terms of reducing the agricultural products
- ✓ Crop yield would be reduced in most tropical and sub-tropical regions due to decreased water availability, and new or changed insect/pest incidence.

Impacts on Indian agriculture

- ✓ Agriculture will be adversely affected not only by an increase or decrease in the overall amounts of rainfall but also by shifts in the timing of the rainfall.
- ✓ Summer rainfall accounts for almost 70 per cent of the total annual rainfall over India and is crucial to Indian agriculture
- ✓ Semi arid regions of western India are expected to receive higher than normal rainfall as temperatures soar, while central India will experience a decrease of between 10 and 20 per cent in winter rainfall by the 2050s
- ✓ there would be a decline in the productivity of rabi as compared to kharif season crops

WATER STRESS AND WATER INSECURITY

- ✓ By 2020, between 75 and 250 million people are projected to be exposed to increased water stress due to climate change
- ✓ By 2050s freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease.

Impacts on water situation in India

- ✓ Available records suggest that the Gangotri glacier is retreating about 28 m per year
- ✓ A serious environmental problem has also been witnessed in the Indo-Gangetic Plain Region (IGPR) in the past whereby different rivers (including Kosi, Ganga, Ghaghara, Son, Indus and its tributaries and Yamuna) changed their course a number of times.
- ✓ available statistics on water demand shows that the agriculture sector is the largest consumer of water in India

Impacts on Coastal States in India

- ✓ The coastal states of Maharashtra, Goa and Gujarat face a grave risk from the sea level rise, which could flood land (including agricultural land) and cause damage to coastal infrastructure and other property.
- ✓ Goa will be the worst hit, losing a large percentage of its total land area, including many of its famous beaches and tourist infrastructure
- ✓ The states along the coasts like Orissa will experience worse cyclones. Many species living along the coastline are also threatened.
- ✓ The coral reefs that India has in its biosphere reserves are also saline sensitive and thus the rising sea level threatens their existence too, not only the coral reefs but the phytoplankton.

ECOSYSTEMS AND BIO-DIVERSITY

- ✓ International World Wildlife Fund (WWF) asserted that one-fifth of the world's most vulnerable natural areas may be facing a "catastrophic" loss of species

IMPACTS ON INDIA'S BIODIVERSITY

- ✓ It is predicted that there will be an increase in the phenomenon of Glacial Lake: Outburst Floods (GLOFs) in the eastern and the central Himalayas, causing catastrophic flooding downstream, with serious damage.

CLIMATE CHANGE AND HEALTH

- ✓ The warmer the climate the likelihood of its impact on human health becomes worse.
- ✓ It is anticipated that there will be an increase in the number of deaths due to greater frequency and severity of heat waves and other extreme weather events.
- ✓ The World Health Organization (WHO) in their studies have indicated that due to rising temperatures, malaria cases are now being ." reported for the first time from countries like Nepal and Bhutan.
- ✓ The projections by WHO and IPCC suggest that the negative effects of climate change on health are greater

MITIGATION STRATEGIES

CARBON SEQUESTRATION:-

- ✓ Carbon capture and storage, also known as CCS or carbon sequestration, describes the technologies designed to tackle global warming by capturing CO_2 at power stations, industrial sites or even directly from the air and permanently storing it underground.
- ✓ Carbon sequestration describes long-term storage of carbon dioxide or other forms of carbon
  - ➢ 'carbon sinks'— an area that absorbs carbon.
    - **Natural sinks -** Oceans, forests, soil etc.
    - **Artificial sinks -** Depleted oil reserves, unmineable mines, etc

There are three main steps to carbon capture and storage (CCS) —

- ✓ trapping and separating the CO_2 from other gases,
- ✓ transporting this captured CO_2 to a storage location, and
- ✓ storing that CO_2 far away from the atmosphere (underground or deep in the ocean).

Ocean Sequestration: Carbon stored in oceans through direct injection or fertilization.
Geologic Sequestration: Natural pore spaces in geologic formations serve as reservoirs for long-term carbon dioxide storage.

Terrestrial Sequestration: A large amount of carbon is stored in soils and vegetation, which are our natural carbon sinks. Increasing carbon fixation through photosynthesis, slowing down or reducing decomposition of organic matter, and changing land use practices can enhance"• carbon uptake in these natural sinks.

- ✓ Geologic Sequestration is thought to have the largest potential for near-term application
- ✓ Carbon dioxide can be effectively stored in the earth's subsurface by hydrodynamic trapping and solubility trapping - usually a combination of the two is most effective

Green Carbon

- ✓ Green carbon is carbon removed by photosynthesis and stored in the plants and soil of natural ecosystems and is a vital part of the global carbon cycle.

Blue Carbon

- ✓ Blue Carbon refers to coastal, aquatic and marine carbon sinks held by the indicative vegetation, marine organism and sediments
- ✓ These coastal ecosystems are very efficient at sequestering and storing carbon - each square mile of these systems can remove carbon from the atmosphere and oceans at rates higher than each square mile of mature tropical forests.

CARBON CREDIT:

- ✓ A carbon credit is a Tradable certificate or permit representing the right to emit one tonne of carbon or carbon dioxide equivalent (tCO2e).
- ✓ An organisation which produces one tonne less of carbon or carbon dioxide equivalent than the standard level of carbon emission allowed for its outfit or activity, earns a carbon credit
- ✓ Countries which are signatories to the Kyoto Protocol under the UNFCCC have laid down gas emission norms for their companies to be met by 2012. In such cases, a company has two ways to reduce emissions.
  (i) It can reduce the GHG (greenhouse gases) by adopting new technology or improving upon the existing technology to attain the new norms for emission of gases.
  (ii) It can tie up with developing nations and help them set up new technology that is eco-friendly, thereby helping developing country or its companies 'earn' credits.
- ✓ This credit becomes a permit for the company to emit GHGs in its own country.
- ✓ However, only a portion of carbon credits of the company in developing country can be transferred to the company in developed country.
- ✓ Carbon, like any other commodity, has begun to be traded on India's Multi Commodity Exchange.
- ✓ MCX has become first exchange in Asia to trade carbon credits.

CARBON OFFSETTING:

- ✓ are credits for reductions in greenhouse gas emissions made at another location, such as wind farms which create renewable energy and reduce the need for fossil-fuel powered energy.
- ✓ are quantified and sold in metric tonnes of carbon dioxide equivalent (CO2e)
- ✓ the fastest way to achieve the deepest reductions within businesses and it also often delivers added benefits at the project site, such as employment opportunities, community development programmes and training and education.
- ✓ For a Carbon offset to be credible it must meet **essential quality criteria**, including proof that it
- ✓ is additional (the reduction in emissions would not have occurred without the carbon finance), that it will be retired from the carbon market so it cannot be double counted, and
- ✓ it addresses issues such as permanence (it delivers the reductions it stated) and leakage (the emission reduction in one area doesn't cause an increase in emissions somewhere else)

CARBON TAX

- ✓ the potential alternative to the 'cap and trade' method currently used by the protocol.
- ✓ The aim of this tax is to cause less fossil fuel use and hopefully cause an incentive to use other sources of energy.

India's Position on carbon tax:

- ✓ India will bring a WTO challenge against any "carbon taxes" that rich countries impose on Indian imports.

GEO-ENGINEERING

- ✓ Geo-engineering primarily aims at modifying and cooling Earth's environment, defeating the environmental damage and ensuing climate changes to make the planet more inhabitable.
- ✓ Geo engineering, at this point, is still only a theoretical Concept
- ✓ Hydrogen sulfide is an even better candidate for atmospheric seeding than sulfur dioxide.

INDIA AND CLIMATE CHANGE

INDIA'S POSITION ON CLIMATE CHANGE

- ✓ India's per capita emission levels will never exceed that of the per capita emission levels of developed countries-PM india
- ✓ India cannot and will not take on emission reduction targets
- ✓ India will continue to be a low-carbon economy (World Bank study).
- ✓ India's primary focus is on"adaptation", with specific focus for "mitigation
- ✓ India has already unveiled a comprehensive National Action Plan on Climate Change
- ✓ Only those Nationally Appropriate Mitigation Actions (NAMAs) can be subject to international monitoring, reporting and verification that are enabled and supported by international finance and technology transfer
- ✓ India wants a comprehensive approach to Reducing Emissions from Deforestation & Forest Degradation (REDD) and advocates REDD+ that includes conservation, afforestation and sustainable management of forests
- ✓ India advocates collaborative research in future low-carbon technology and access to intellectual Property Rights (IPRs) as global public goods.

CURRENT CARBON DIOXIDE EMISSIONS IN INDIA

- ✓ India's CO2 emissions per capita are well below the world's average.(1.02 metric ton)

OBSERVED CLIMATE AND WEATHER CHANGES IN INDIA

- ✓ India's National Communication (NATCOM) to UNFCCC has consolidated some of the observed changes in climate parameters in India.

1. **Surface Temperature**

- ✓ At the national level, increase of 0.4° C has been observed in surface air temperatures overmthe past century.
- ✓ A warming trend has been observed along the west coast, in central India, the interior peninsula, and north-eastern India.
- ✓ cooling trends have been observed in north-west India and parts of south India.

2. **Rainfall**

- ✓ While the observed monsoon rainfall at the all- India level does not ,show any significant trend,regional monsoon variations have been recorded
- ✓ A trend of increasing monsoon seasonal rainfall has been found along the west coast, northern Andhra Pradesh, and north-western India (+10% to +12% of the normal over the last 100 years)

- ✓ while a trend of decreasing monsoon seasonal rainfall has been observed over eastern Madhya Pradesh, north-eastern India, and some parts of Gujarat and Kerala (-6% to --8% of the normal over the last 100 years).

3. **Extreme Weather Events**

- ✓ the states of West Bengal and Gujarat have reported increasing trends, a decline has been observed in Orissa

4. **Rise in Sea Level**

- ✓ Sea level rise was between 1.06-1.75 mm per year. These rates are consistent with 1-2 mm per year global sea level rise estimates of IPCC.

5. **Impacts on Himalayan Glaciers**-

- ✓ recession of someglaciers, has occurred in some Himalayan regions in recent years, the trend is not consistent across the entire mountain chain.
- ✓ It is accordingly, too early to establish long-term trends, or their causation, in respect of which there are several hypotheses.

CURRENT ACTIONS FOR ADAPTATION AND MITIGATION

- ✓ Current Indian government expenditure on adaptation to climate variability, exceeds 2.6% of the GDP.

1. **AGRICULTURE**

- ✓ Two risk-financing programmes support adaptation to climate impacts.
- ✓ **The Crop Insurance Scheme**- supports the insurance of farmers against climate risks, and
- ✓ **the Credit Support Mechanism**- facilitates the extension of credit to farmers, especially for crop failure due to climate variability.

2. **FORESTRY**

- ✓ India has a strong and rapidly growing afforestation programme.
- ✓ **Forest Conservation Act of 1980**, which aimed at stopping the clearing and degradation of forests through a strict, centralized control of the rights to use forest land and mandatory requirements of compensatory afforestation in case of any diversion of forest land for any non-forestry purpose.
- ✓ an aggressive afforestation and sustainable forest management programme, resulted in annual reforestation of 1.78 mha during 1985-1997, and is currently 1.1 mha annually.

3. **WATER**

- ✓ **The National Water Policy (2002)** stresses that non-conventional methods for utilization of water, including inter-basin transfers, artificial recharge of groundwater, and desalination of brackish or sea water, as well as traditional water conservation practices like rainwater harvesting, including roof-top rainwater harvesting, should be practised to increase the utilizable water resources.

4. **COASTAL REGIONS**

- ✓ In coastal regions, restrictions have been imposed in the area between 200m and 500m of the Htl (high tide line)
- ✓ **special restrictions** have been imposed in the area up to 200m to protect the sensitive coastal ecosystems and prevent their exploitation.

5. **HEALTH**

- ✓ The prime objective present of health programmes is the surveillance and control of vector borne diseases such as Malaria, Kala-azar, Japanese Encephalitis, Filaria and Dengue.

- ✓ Programmes also provide for emergency medical relief in the case of natural calamities, and to train and develop human resources for these tasks.

6. DISASTER MANAGEMENT

- ✓ **The National Disaster Management programme** provides grants-in-aid to victims of weather related disasters, and manages disaster relief operations.
- ✓ It also supports proactive disaster prevention programmes, including dissemination of information and training of disaster-management staff.

India's NATIONAL ACTION PLAN ON CLIMATE CHANGE

- ✓ The National Action Plan hinges on the development and use of new technologies.
- ✓ The implementation of the Plan would be through appropriate institutional mechanisms suited for effective delivery of each individual Mission's objectives and include public private partnerships and civil society action.

Eight National Missions

1. NATIONAL SOLAR MISSION

- ➢ The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge.

- ✓ To establish India as a global leader in solar energy
- ✓ The Mission will adopt a 3-phase approach
- ✓ remaining period of the 11th Plan and first year of the 12th Plan (up to 2012-13) as Phase 1,
- ✓ the remaining 4 years of the 12th Plan (2013-17) as Phase 2
- ✓ the 13th Plan (2017-22) as Phase 3.
- ✓ there will be an evaluation of progress, review of capacity and targets for subsequent phases,

Mission targets are:

1. To create an enabling policy framework for the deployment of 20,000 MW of solar power by 2022.

2. To ramp up capacity of grid-connected solar power generation to 1000 MW within three years —by 2013; an additional 3000 MW by 2017 through the mandatory use of the renewable purchase obligation by utilities backed with a preferential tariff.

3. To create favorable conditions for solar manufacturing capability, particularly solar **thermal for** indigenous production and market leadership.

4. To promote programmes for off grid applications, reaching 1000 MW by 2017 and 2000 MW by 2022

5. To achieve 15 million sq. meters solar thermal collector area by 2017 and 20 million by 2022.

6. To deploy 20 million solar lighting systems for rural areas by 2022.

2. THE NATIONAL MISSION FOR ENHANCED ENERGY EFFICIENCY (NMEEE):-

- ✓ To **strengthen the market** for energy efficiency by creating conducive regulatory and policy regime.

Mission Goals

- ✓ Market-based approaches to unlock energy efficiency opportunities.

Four New Initiatives to Enhance Energy Efficiency:

a) Perform Achieve and Trade (PAT)
b) Market Transformation for Energy Efficiency
c) Energy Efficiency Financing Platform (EEP)
d) Framework for Energy Efficient Economic Development (FEEED)

3. NATIONAL MISSION ON SUSTAINABLE HABITAT

- ✓ to promote sustainability of habitats through improvements in energy efficiency in buildings, urban planning, improved management of solid and liquid waste, modal shift towards public transport and conservation through appropriate changes, in legal and regulatory framework.
- ✓ It also seeks to improve ability of habitats to adapt to climate change by improving resilience of infrastructure, community based disaster management and measures for improving advance warning systems for extreme weather events.

4. NATIONAL WATERMISSION (NWM) MISSION OBJECTIVES

- ✓ Ensuring integrated water resource management for conservation of water, minimization of wastage and equitable distribution both across and within states.
- ✓ Developing a framework for optimum water use through increase in water use efficiency by 20% through regulatory mechanisms with differential entitlements and pricing, taking the National Water Policy (NWP) into consideration.

5. NATIONAL MISSION FOR SUSTAINING THE HIMALAYAN ECOSYSTEM (NMSHE)

- ➢ The most crucial and primary objective of the mission is to develop a sustainable National capacity to continuously assess the health status of the Himalayan Ecosystem and enable policy bodies in their policy-formulation functions and assist States in the Indian Himalayan Region with their implementation of actions selected for sustainable development

6. NATIONAL MISSION FOR A GREEN INDIA

- ➢ Increased forest/tree cover on 5 million hectares (ha) of forest/non- forest -lands and
- ➢ improved quality of forest cover on another 5 million ha of non-forest/forest lands' (a total of 10 million ha)
- ➢ Improved ecosystem services including biodiversity, hydrological services, and carbon sequestration from the 10 million ha of forest/ non-forest lands mentioned above

7. NATIONAL MISSION FOR SUSTAINABLE AGRICULTURE (NMSA)

- ➢ The NMSA has identified 10 key dimensions for adaptation and mitigation:

1. Improved Crop Seeds, Livestock and Fish Culture
2. Water Efficiency
3. Pest Management
4. Improved Farm Practices
5. Nutrient Management
6. Agricultural Insurance
7. Credit Support
8. Markets

9. Access to Information
10. Livelihood Diversification

The National Mission on Strategic Knowledge for Climate Change (NMSKCC) (not complete)

- ✓ Formation of knowledge networks among the existing knowledge institutions engaged in research and development relating to climate science and facilitating data sharing and exchange through a suitable policy framework and institutional support
- ✓ Establishment of global technology watch groups with institutional capacities to carry out research on risk minimised technology selection for developmental choices.
- ✓ Development of national capacity for modeling the regional impact of climate change
- ✓ Establishing research networks and encouraging research in the areas of climate change impacts on important socio-economic sectors
- ✓ Building alliances and partnerships through global collaboration in research & technology development

National Bio-Energy Mission

- ✓ to boost power generation from biomass, a renewable energy source abundantly available in India
- ✓ launched during the 12th Five-Year Plan, will offer a policy and regulatory environment to facilitate large-scale capital investments in biomass-fired power stations.
- ✓ It will also encourage development of rural enterprises.
- ✓ It will also propose a GIS-based National Biomass Resource Atlas to map potential biomass regions in the country
- ✓ adopt a two phase approach, spanning the 12th Plan in Phase and the 13th Plan in Phase 2

INDIAN NETWORK ON CLIMATE CHANGE ASSESSMENT

- ✓ (INCCA) was launched in October 2009 by the Ministry of Environment and Forests (MoEF) in an effort to promote domestic research on climate change, and build on the country's climate change expertise.
- ✓ Consists of over 120 institutions and over 250 scientist country wide is aimed at bringing in more science-based policy-making, based on measurement , monitoring and modelling.
- ✓ Reports prepared by the INCCA will form a part of India's National Communication (Nat Com) to the United. Nations framework Convention on Climate Change (UNFCCC)
- ✓ **INCCA — First Assessment** - INCCA prepared the Country's greenhouse gas (GHG) emission data "India: Greenhouse Gas Emissions 2007" in 2010 . which said the country's emissions grew by 58 per cent during 1994 to 2007
- ✓ INCCA - **Second Assessment 'Climate Change and India: A 4x4 Assessment'** (4 regions and 4 sector)
- ✓ A 4x4 Assessment' addresses the impact of climate change in 2030s to the natural resources and livelihoods of the people in the four climate sensitive regions of Himalayan region, North- East region, the Western Ghats and the Coastal plains for the 4 key sectors of Agriculture, Water, Health and Natural Ecosystems and Biodiversity
- ✓ using a regional climate model (PRECIS).

Impacts Agriculture

- ✓ Up to 50% reduction in maize yields
- ✓ 4-35% reduction in rice yields (with someexceptions)
- ✓ Rise in coconut yields (with some exceptions);
- ✓ reduced apple production
- ✓ Forests and natural ecosystems Increased net primary productivity

NATIONAL COMMUNICATION (NATCOM)-

- ➢ National Communication (NATCOM) to the UNFCCC has been initiated in 2002 funded by the Global Environment Facility under its enabling activities programme through the United Nations Development Programme, New Delhi.

To communicate the following information to the Secretariat of the Conference of Parties:

- ✓ A national inventory of anthropogenic emissions by sources and removal by sink of all GHGs not controlled by the Montreal protocol (what is montreal protocol)
- ✓ A general description of steps taken or envisaged by the Party to implement the Convention
- ✓ The Ministry of Environment and Forests (MoEF) is implementing and executing agency of the project
- ✓ base year 1994
- ✓ Creation of reliable and comprehensive database for all the outputs produced through the establishment of a Data Centre' (DC)
- ✓ The areas of energy, industrial processes, agriculture land use and land use change and forestry (LULUCF) and waste.
- ✓ The gases to be inventoried include carbon dioxide methane, nitrous oxide, hydro fluorocarbons, perfluorocarbon and sulphur hexafluoride released from various anthropogenic sources of the base year 1994.
- ✓ Strengthening of the ecology security is one of the goal of the MGNREGA. MGNREGA is designed to strengthen the ongoing effort for water harvesting, watershed management, and soil health care and enhancement.

INDIA'S POLICY STRUCTURE RELEVANT TO GHG MITIGATION

- ✓ **The Integrated Energy Policy was adopted in 2006**- Promotion of energy efficiency in all sectors, Emphasis on mass transport, Emphasis on renewables including biofuels plantations
- ✓ Accelerated development of nuclear and hydropower for clean energy
- ✓ Focused R&D on several clean energy related technology

The Rural Electrification Policy, 2006

- ➢ It promotes renewable energy technology where grid connectivity is not possible or cost-effective.

ENERGY CONSERVATION BUILDING CODE

- ✓ was launched in May, 2007, which addresses the design of new, large commercial buildings to optimize the buildings' energy demand based on their location in different climatic zones
- ✓ Compliance with ECBC norms is voluntary at present but is expected to soon become mandatory.

Green Building

- ✓ Buildings are one of the major pollutants that affect urban air quality and contribute to climate change

- ✓ The aim of a green building design is to: 1) Minimize the demand on non-renewable resources and maximize the utilization efficiency of these resources when in use, and Maximize reuse and recycling of available resources 2) Utilization of renewable resources.
- ✓ It costs a little more to design and construct a green building. However, it costs less to operate a greenbuilding
- ✓ Building system designed in a way to efficiently use HVAC (heating ventilation and air conditioning), lighting, electrical, and water heating.
- ✓ Integration of renewable energy sources to generate energy onsite.

Green Rating for Integrated Habitat Assessment (GRIHA)

- ✓ GRIHA is a Sanskrit word meaning - 'Abode'.
- ✓ GRIHA has been conceived by TERI and developed jointly with the Ministry of New and Renewable Energy, Government of India.
- ✓ The green building rating system devised by TERI and the MNRE is a voluntary scheme
- ✓ to help design green buildings and, in turn, help evaluate the 'greenness' of the buildings.
- ✓ GRIHA is a rating tool that helps people assess the performance of their building against certain nationally acceptable benchmarks and is suitable for all kinds of buildings in different climatic zones of the country
- ✓ building is assessed based on its predicted performance over its entire life cyde — inception through operation.
- ✓ **The stages of the life cycle that have been identified for evaluation** are:-
- ✓ Pre-construction stage, Building operation and maintenance stage

GRIHA rating system consists of 34 criteria categorized under 4 categories

1. Site Selection and Site Planning,
2. Conservation and efficient utilization of resources,
3. Building operation and maintenance, and
4. Innovation points:

- ✓ It means that a project intending to meet the criterion would qualify for the points.
- ✓ Different levels of certification (one star to five stars) are awarded based on the number of points earned.
- ✓ The minimum points required for certification is 50.

ENERGY AUDITS OF LARGE INDUSTRIAL CONSUMERS

- ✓ In March 2007 the conduct of energy audits was made mandatory in large energy-consuming units in nine industrial sectors.
- ✓ These units, notified as "designated consumers" are also required to employ "certified energy managers", and report energy consumption and energy conservation data annually.

MASS TRANSPORT

- ✓ The National Urban Transport Policy emphasizes extensive public transport facilities and non-motorized modes over personal vehicles.
- ✓ The expansion of the Metro Rail Transportation System in Delhi and other cities (Chennai, Bangalore, Jaipur, etc)

CLEAN AIR INITIATIVES

(i) introduction of compressed natural gas (CNG) in Delhi and other cities;

(ii) Retiring old, polluting vehicles; and
(iii) Strengthening of mass transportation.

- ✓ Some state governments provide subsidies for purchase and use of electric vehicles.
- ✓ For thermal power plant, the installation of electrostatic precipitators is mandatory.

Promotion OF ENERGY SAVING DEVICES-

- ✓ The bureau of Energy efficiency has introduced "The BaChat Lamp Yojana",
- ✓ a program under which households may exchange incandescent lamps for CFLs (compact fluorescent lamps) using clean development mechanism (CDM) Credits to equate purchase price.

PROMOTION OF BIOFUELS

- ✓ The Biodiesel Purchase Policy mandates biodiesel procurement by the petroleum industry.
- ✓ A mandate on Ethanol Blending of Gasoline requires 5% blending of ethanol with gasoline from 1st January, 2003, in 9 States and 4 Union Territories.

INDIAN SOLAR LOAN PROGRAMME

- ✓ In April 2003, the United Nations Environment Programme ("UNEP") initiated a, three-year Programme, credit facility in Southern India to help rural households finance the purchase of Solar Home Systems.
- ✓ Canara Bank and Syndicate bank, along with their eight associate Regional Rural Banks, partnered with LTNEP
- ✓ assistance with technical issues, vendor qualification and other activities to develop the institutional capacity for this type of finance.

NATIONAL INITIATIVE ON CLIMATE RESILIENT AGRICULTURE (NICRA)

- ✓ The ICAR has launched National Initiative on Climate Resilient Agriculture (NICRA) during 2010-11 with an outlay of Rs.350 crores for the XI Plan.
- ✓ This initiative will primarily enhance the resilience of Indian Agriculture covering crops, livestock and fisheries

The project is comprised of four components.

- ❖ Strategic research on adaptation and mitigation
- ❖ Technology demonstration on farmers' fields to cope with current climate variability
- ❖ Sponsored and competitive research grants to fill critical research gaps
- ❖ Capacity building of different stake holders

- ✓ the project is focusing on crops like wheat, rice, maize, pigeonpea, groundnut, tomato, mango and banana;
- ✓ cattle, buffalo and small ruminants among livestock and both marine and freshwater fish species of economic importance

The major research themes are:

• **Vulnerability assessment** of major production zones
• **Linking weather based agro-advisories to contingency planning**
• **Assessing the impacts** and evolving varieties tolerant to key climatic stresses (drought, heat, frost, flooding, etc)

- ✓ Evolving adaptation and mitigation strategies
- ✓ Continuous monitoring of greenhouse gases
- ✓ Studying changes in pest dynamics
- ✓ Adaptation strategies in livestock

- ✓ Harnessing the beneficial effects of temperature in inland and marine fisheries

➢ Seven major research institutes of the ICAR will work in unison to evolve coping technologies with Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad as the lead centre.

BSE-GREENEX

- ✓ The BSE-GREENEX Index is a veritable **first step in creating a credible marke**t based response mechanism in India, whereby both businesses and investors can rely upon purely quantitative and objective performance based signals, to assess "carbon performance
- ✓ gTrade Carbon Ex Ratings Services Private Limited (gTrade) is a company based in India, which has co-developed the BSE-GREENV Index in close association with the BSE .
- ✓ includes the top 20 companies which are good in terms of Carbon Emissions, Free-Float Market Capitalization, and Turnover.
- ✓ Cap Weighted Free-Float Market Capitalization weighted Index comprising from the list of BSE-100 Index.
- ✓ lst October, 2008 (Base Date) with the base index value of 1000.
- ✓ rebalanced on a bia-nnual basis i.e. end of March and September quarters.
- ✓ The September quarter review will be based on the fresh set of carbon emission numbers and
- ✓ the March quarter review will be based on the existing carbon emission numbers but latest financial data.

CLIMATE CHANGE ORGANIZATIONS

UNFCCC

- ✓ UN Summit Conference on Environment and Development (UNCED) held in Rio de Janerio in June 1992 adopted, by consensus, the first multilateral legal instrument on Climate Change, the UN Framework Convention on Climate Change or the UNFCCC.
- ✓ There are now 195 Parties to the Convention.
- ✓ All subsequent multilateral negotiations on different aspects of climate change, including both adaptation and mitigation, are being held based on the principles and objectives set out by the UNFCCC

KYOTO PROTOCOL: COP-3.

- ✓ to strengthen the global response to climate change.
- ✓ The Kyoto Protocol was adopted in Kyoto Japan,, on 11 December 1997. Due to a complex ratification process, it entered into force on '16 February 2005.
- ✓ Kyoto Protocol is what "operationalizes" the Convention.
- ✓ It commits industrialized countries to stabilize greenhouse gas emissions based on the principles of the Convention.
- ✓ The major distinction between the Protocol and the Convention is that while the Convention encouraged industrialized countries to stabilize GHG emissions, the Protocol commits them to do so.
- ✓ sets binding emission reduction targets for 37 industrialized countries and the European community in its first commitment period.
- ✓ It only binds developed countries

- ✓ KP places a heavier burden on developed nations under its central principle: that of "common but differentiated responsibility"
- ✓ these targets add up to an average five per cent emissions reduction compared to 1990 levels over the five-year period 2008 to 2012

KP is made up of:

- ❖ Reporting and verification procedures;
- ❖ Flexible market-based mechanisms, which in turn have their own governance procedures;
- ❖ A compliance system.

So, two things make KP tick

1. **Emissions Reduction Commitments**

- ✓ The first was binding emissions reduction commitments for developed country parties. This meant the space to pollute was limited.
- ✓ carbon dioxide, became a new commodity.KP now began to internalize what was now recognized as an un priced externality.

2. Flexible Market Mechanisms

- Joint Implementation (JI)
- The Clean Development Mechanism (CDM)
- Emission Trading

The objectives of Kyoto mechanisms:

- ✓ Stimulate sustainable development through technology transfer and investment
- ✓ Help countries with Kyoto commitments to meet their targets by reducing emissions or removing carbon from the atmosphere in other countries in a cost-effective way
- ✓ Encourage the private sector and developing countries to contribute to emission reduction efforts

Joint Implementation

- ✓ allows a country with an emission reduction or limitation commitment under the Kyoto Protocol to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one tonne of CO2, which can be counted towards meeting its Kyoto target.
- ✓ Projects starting as from the year 2000 may be eligible as JI projects, ERU issued from 2008

Clean Development mechanism:

- ✓ Allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries.
- ✓ It is the first global, environmental investment and credit scheme of its kind,
- ✓ Such projects can earn saleable certified emission reduction (CER) credits, each equivalent **to** one tonne of CO2, which can be counted towards meeting Kyoto targets.

Example

- ✓ A CDM project activity might involve, for example, a rural electrification project using solar Panels or the installation of more energy-efficient boilers.
- ✓ The mechanism stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction or limitation targets.

- ✓ Most of the CDM projects were implemented in China and India as climate in these countries is favorable for implementing projects for almost all the spheres

Carbon Trading:

- ✓ the name given to the exchange of emission permits. This exchange may take place within the economy or may take the form of international transaction.

Two types of Carbon trading:

1. Emission trading- Emission permit is known alternatively as carbon credit
2. Offset trading-Another variant of carbon credit is to be earned by a country by investing some amount of money in such projects, known as carbon projects, which will emit lesser amount of green-house gas in the atmosphere.

Non-Compliance of Kyoto And Penalties

- ✓ If a country does not meet the requirements for measurements and reporting said country looses the privilege of gaining credit through joint implementation projects.
- ✓ If a country goes above its emissions cap, and does not try to make up the difference through any of **the** mechanisms available, then said country must make up the difference plus an additional thirty percent during the next period.
- ✓ The country could also be banned from participating in the 'cap and trade' program.

BALI MEET:

- ✓ Bali Meet was the meeting of 190 countries that are party.to a UN treaty on climate change held in December 2007.
- ✓ to discuss what happens after 2012-what are countries expected to do after the first phase of Kyoto ends in 2012.

Bali Road Map includes

- ✓ The Bali Action Plan (BAP)
- ✓ The Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol negotiations and their 2009 deadlinre,
- ✓ Launch of the Adaptation Fund,
- ✓ Decisions on technology transfer and
- ✓ On reducing emissions from deforestation.

Bali Action Plan (BAP)

- ✓ A shared vision for long-term cooperative action, including a long-term global goal for emission reductions.
- ✓ Enhanced national/international action on mitigation of climate change.
- ✓ Enhanced action on adaptation.
- ✓ Enhanced action on technology development and transfer to support action on mitigation and adaptation.
- ✓ Enhanced action on the provision of financial resources and investment to support action on mitigation and adaptation and technology cooperation

COP 15 COPENHAGEN SUMMIT

- ✓ The summit concluded with the CoP taking a note of Copenhagen Accord (a five nation accord- BASIC and US).
- ✓ The Copenhagen Accord is a non-binding agreement.

- ✓ Developed countries (Annex-I) agree to set targets for reductions in their greenhouse gas emissions by 2020.
- ✓ Developing countries agree to pursue nationally appropriate mitigation strategies to slow the growth of their emissions, but are not committed to reducing their carbon output.
- ✓ developed countries would raise funds of $30 billion from 2010-2012 of new and additional resources
- ✓ Agrees a "goal" for the world to raise $100 billion per year by 2020. New multilateral funding for adaptation will be delivered, with a governance structure.

COP 16 CANCUN SUMMIT

- ✓ all Parties to the Convention (including the developed and developing countries) have agreed to report their voluntary mitigation goals for implementation
- ✓ Decisions were taken at Cancun to set up a Green Climate Fund, a Technology Mechanism, and an Adaptation Committee at global level to support developing country actions for adaptation and mitigation
- ✓ process to design a 'Green Climate Fund'

Mechanism of COP 16

1. **Technology mechanism**-in 16th session of the COP in Cancun 2010. Facilitate the implementation of enhanced action-on technology development and transfer in Order to support action on mitigation and adaptation to climate change.

2. **Green climate fund**- will support projects, programme, policies and other activities in **developing** country Parties. **The Fund will** be governed by the GCF Board.
   - ✓ The World Bank was invited by to serve as the interim trusteed

3. **The Adaptation Fund** was established to finance concrete adaptation projects and programmes in developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change.
   - ✓ financed from the share of proceeds on the clean development mechanism project activities.
4. **Adaptation committee-**
   - ✓ Providing technical support and guidance to the Parties
   - ✓ Sharing of relevant information, knowledge, experience and good practices
   - ✓ Promoting synergy and strengthening engagement with national, regional and international organizations, centers and networks.
   - ✓ Considering information communicated by Parties on their monitoring and review of adaptation actions, support provided and received

COP 17 DURBAN SUMMIT

- ✓ India had gone to Durban with two major demands — that the principle of equity remain intact in any new climate regime and that this new global deal be launched after 2020.

Outcome

- New deal to be finalized by 2015 and launched by 2020
- Second phase of Kyoto Protocol secured
- Green Climate Fund launched, though empty as yet Green tech development mechanism put in place

- Equity finds place back in future climate talks
- Adaptation mechanism
- Transparency mechanism

➢ India regains leadership of developing world, Wins on all its important non-negotiable Common but differentiated responsibility principle retained.
➢ India Secures 10 years of economic growth without carbon containment Intellectual Property Rights and technology not as well anchored in new deal Loopholes for developed world not fully blocked
➢ Agriculture brought in by developed nations under climate change

REDD & REDD+

✓ REDD (Reducing Emissions from Deforestation and Forest Degradation) is the global endeavor **to create an incentive for developing countries to protect, better** manage and save ,their forest resources, thus contributing to the global fight against climate change
✓ REDD+ goes beyond merely., Checking deforestation and forest degradation, and includes incentives for positive elements of conservation, sustainable management of forests and enhancement of forest carbon stocks.
✓ REDD+ conceptualizes flow of positive incentives' for demonstrated reduction in deforestation or for enhancing quality and expanse of forest cover.
✓ India has made a submission to UNFCCC on "REDD, Sustainable Management of Forest(SMF) and Afforestation and Reforestation, (A&R)" in December 2008

THE GEF (Global Environment Facility)

✓ to function under the guidance of the UNFCCC COP and be accountable to the COP
✓ established in 1991 by the World Bank in consultation with the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP), to provide funding to protect the global environment

The GEF now has six focal areas:

1. biological diversity;
2. climate change;
3. international waters;
4. land degradation, primarily desertification and deforestation;
5. ozone layer depletion; and
6. persistent organic pollutants.

CLIMATE-SMART AGRICULTURE

✓ While agriculture is the sector most vulnerable to climate change, it is also a major cause, directly accounting for about 14 percent of greenhouse gas emissions (IPCC 2007).
✓ **This is called the 'triple win'**: interventions that Would increase yields (poverty reduction **and** food Security) , make yields more resilient in the **face extremes** (adaptation), and make **the farm** a solution to the climate change problem rather than part of the problem (mitigation).
✓ These triple wins are likely to require a package of interventions and be country- and locality specific in their application. This method of practicing agriculture is called 'Climate Smart Agriculture'

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

✓ established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988 to provide the governments of the world with a clear scientific view of what is happening to the world's climate.
✓ headquarters in Geneva.

- ✓ Currently 195 countries are members of the IPCC
- ✓ The IPCC is a scientific body. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change
- ✓ It does not conduct any research nor does it monitor climate related data or parameters

Key AR5 cross-cutting themes will be:

- ✓ Water and the Earth System: Change, Impacts and Responses;
- ✓ Carbon Cycle including Ocean Acidification;
- ✓ Ice Sheets and Sea-Level Rise;
- ✓ Mitigation, Adaptation and Sustainable Development; and
- ✓ Article 2 of the UNFCCC (see UNFCCC for definition).

NATIONAL GREEN HOUSE GAS INVENTORIES PROGRAMME (NGGIP)

- ✓ The IPCC established the NGGIP,
- ✓ TO provide methods for estimating-national inventories of greenhouse gas emissions to, and removals from, the atmosphere.

GREEN ECONOMY

- ✓ The 'Green Economy' can be considered synonymous to a 'sustainable' economy. However, the Green Economy concept often carries a more distinctive meaning
- ✓ Green economy focuses specifically on the fundamental changes that are required to ensure that economic systems are made more sustainable.
- ✓ Green Economy focuses on the ways to overcome the deeply rooted causes of unsustainable economic development.
- ✓ **A Green Economy is one** whose growth in income and employment is driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystems

Three priorities in transition of economy to green economy are

- decarbonizes the economy;
- commit the environmental community to justice and equity; and
- conserve the biosphere.

COMPILATION FROM SHANKAR IAS ENVIRONMENT

PART-IV- AGRICULTURE & VARIOUS ORGANISATIONS (LAST PART)

CONTENTS

1. AGRICULTURE
2. ACTS AND POLICIES
3. INSTITUTION AND MEASURES
4. ENVIRONMENTAL ORGANISATIONS
5. INTERNATIONAL ENVIRONMENTAL CONVENTIONS
6. ENVIRONMENTAL ISSUES AND HEALTH EFFECTS

AGRICULTURE

- a broad term encompassing all aspects of crop production, livestock farming, fisheries, forestry etc.
- accounts for about 14.7% of the total export earnings and provide raw material to a large number of Industries.

Problems of Indian agriculture

- ✓ Fragmentation of land holding.
- ✓ Existence of small and marginal farmers
- ✓ Regional variation.
- ✓ Dependence of seasonal rainfall.
- ✓ Low productivity of land.
- ✓ Increasing of disguised unemployment
- ✓ Disorder in marketing of Agricultural products.
- ✓ Weak land reformation.

Revolution	Related with
Green	**Food grain Production**
Golden	**Fruit Production**
Grey	**Fertilizer Production**
Blue	**Fish Production**
Black	**Petroleum Production**
Pink	**Prawn Production**
Round	**Potato Production**
Red	**Meat/Tomato Production**
Silver	**Egg/Poultry Production**
White	**Milk Production**
Yellow	**Oil seeds Production**

CROP AND ITS CLASSIFICATIONS:

Classification based on climate -

1. **Tropical:** Crops grow well in warm & hot climate. E.g. Rice, sugarcane, Jowar etc

2. Temperate: Crops grow well in COO1 climate. E.g. Wheat, Oats, Gram, Potato etc.

Classification Based on-growing-season:

1. Kharif/Rainy/Monsoon crops:

- ✓ crops grown in monsoon months from June to Oct-Nov,
- ✓ require warm, wet, weather at major period of crop growth,
- ✓ also required short day length for flowering.
- ✓ E.g. Cotton, Rice, Jowar, bajara.

2. **Rabi/winter/cold seasons crops**:

- ✓ The crops grown in winter season from Oct to March month.
- ✓ Crops grow well in cold and dry weather.
- ✓ Require longer day length for flowering.
- ✓ E.g. Wheat, gram, sunflower etc.

3. **Summer/Zaid crops:**

- ✓ crops grown in summer month from March to June.
- ✓ Require warm dry weather for major growth period and longer day length for flowering.

- ✓ E.g. Groundnuts, Watermelon, Pumpkins, Gourds.

Agronomic Classification of Crops :

1. **Cereals**

- ➢ cultivated grasses grown for their edible starchy grains.
- ➢ Larger grains **used as** staple food are cereals Rice, wheat, maize, barley and oats.
- ➢ The important cereal of world RICE.

2. **Millets:**

- ✓ annual grasses of the group cereals. But they are grown in less area or less important area whose productivity and economics are also less important.
- ✓ staple food of poor people. In India pearl millet is a staple food in Rajasthan
- ✓ It is based on area production and productivity and grain size.
- ✓ **Major millets-** Sorghum /Jowar/Cholam, Pearl Millet /Bajra/cumbu, Finger millet or ragi
- ✓ **Minor millets-** Fox tail millet / Thenai, Little millet / Samai, Common millet /Panivaraugu, Barnyard millet /Kudiraivali, Kodomillet / Varagu

Sugar Crops

- ✓ Juice extracted from stem used for jiggery or sugar
- ✓ Number of by products like Molasses, bagasse, pressmud
- ✓ Molasses used for alcohol and yeast formation
- ✓ Bagasse for paper making and fuel
- ✓ Pressmud used for soil amendment
- ✓ Trash (green leaf + dry foliage) — the waste is used for cattle feed
- ✓ Sugar beet =Tuber for extraction of sugar

Starch Crops or Tuber Crops

1. Potato 2. Tapioca or cassava 3. Sweet potato

Fibre Crops

- ✓ Epidermal hairs of seed coats is the economic portion
- ✓ Lint (cappas — seed) has industrial value (fibre)
- ✓ Stalk is of fuel nature, garment purpose Seed for cattle feed, Oil is edible

Cotton

- ✓ Gassypium arboreum (Karunganni)
- ✓ G. herbaceuth (uppam cotton)
- ✓ G. hirsutirm (American cotton or Cambodium cotton)
- ✓ G. barbadense (Egyptian cotton or Sea island cotton)

Stem Vibres

- ✓ Jute (channal), Mesta (pulicha keerai) , Sun hemp, SiSal hemp

Spices and Condiments

- ✓ Products of crop plants are used to flavour taste and sometime color the fresh preserved food.
- ✓ E.g. ginger,garlic,chili, cumin onion; coriander, cardamom, pepper, turmeric etc.
- ✓ **Medicinal & aromatic crops:** Medicinal plants includes cinchona, isabgali, opium poppy, senna, belladonna, rauwolfra, iycorice and
- ✓ **Aromatic plants** such as lemon grass, citronella grass, palmorsa, Japanese mint, peppermint, rose, jasmine, henna etc.

Classification based on No. of cotyledons:

1. **Monocots or monocotyledons**: Having one cotyledon in the seed. E.g. all cereals & Millets.

2. Dicots or dicotyledonous: Crops having two cotyledons in the seed. E.g. all legumes & pulses and almost all the trees.

Classification based on length of photoperiod required for floral initiation:

Most plants are influenced by relative length of the day & night, especially for floral initiation, the effect on plant is known as photoperiodism depending on the length of photoperiod required for floral ignition, plants are classified as

- ✓ **Short-day plants**: Flower initiation takes place when days are short less then ten hours. E.g rice, Jowar, green gram, black gram etc.
- ✓ **2 Long day's plants**: require long days are more than ten hours for floral initiation. E.g. Wheat, Barley, etc.
- ✓ **Day neutral plants**: Photoperiod does not have much influence for phase change for these plants. E.g. Cotton, sunflower, etc.

1. **Zero tillage (No tillage)::In** this, new crop is planted in the residues of the previous crop without any prior soil tillage or seed bed preparation and it is-possible when all the weeds are controlled by. the use of herbicides.

Advantages of Zero –tillage:

1. Zero tilled soils are homogenous in structure with more number of earthworms
2. Organic matter content increases due to less mineralization
3. Surface runoff is reduced due to presence of mulch

Disadvantages"

1. Higher amount of nitrogen has to be applied for mineralization of orgartie-matter in zero tillage
2. Perennial weeds may be a problem
3. High number of volunteer plants and build-up of pests

<u>CROPPING:</u>

Cropping intensity:

- ✓ Number of crops cultivated in a piece of land per annum is cropping intensity.
- ✓ In Punjab and Tamilnadu the cropping intensity is more than 100 percent i.e. around 140-145%. In Rajasthan the cropping intensity is less

Cropping pattern.

- ✓ The yearly sequence and spatial arrangement of crops and fallow on a given area is called cropping pattern

Multiple cropping system:

- ✓ Growing more than two crops in a Piece of land in a year in orderly succession.
- ✓ **also called as intensive cropping**.
- ✓ used to intensify the production. It is possible only When assured resources are available (land, labour, capital and water).

Monoculture:

- ✓ Repetitive growing of the same sole crop in the same land.

Mono cropping:

- ✓ Continuous production of one and the same crop year after year or season season is called mono cropping.

Sole cropping:

- ✓ One crop variety grown alone in a pure stand at normal density

Relay cropping:

- ✓ **G**rowing the succeeding crop when previous crop attend its maturity stage-or-sowing of the next crop immediately before the harvest of the standing crops. E.g.Paddy-Lucerne, Rice-Cauliflower-Onion-summer gourds.

Intercropping

- Growing two or more crops simultaneously with distinct row arrangement on the same field at the same time.

Base crop:

- ✓ primary crop which is planted/ sown at its optimum sole crop population in an intercropping situation.

Intercrop:

- ✓ This is a second crop planted in between rows of base crop with a view to obtain extra yields ,with intercrop without compromise in the main crop yields.
  Ex: Maize + Cowpea; Sorghum + Red gram; Groundnut + Red gram; Potato + Mustard ;Wheat + Mustard

Synergestic Cropping-

- ✓ Yields of both crops are higher than of their pure crops on unit area basis
  Ex: Sugarcane + Potato Multi

Mixed cropping

- ✓ Growing of two Or more crops' simultaneously intermingled without row arrangement is
- ✓ known as mixed-cropping
- ✓ It is a common practice in most of dryland tracts in India
- ✓ Seeds of different crops are mixed in certain proportion and are sown
- ✓ Ex: Sorghum, Bajra and cowpea are mixed and broadcasted in rainfed conditions (with low rainfall situations) to avoid complete crop failures and with ascertaining the minimum yields

Dryland farming:

- ✓ is the practice of crop production entirely depending upon rainfall and the moisture conserved in the soil.
- ✓ This is practiced in areas where annual rainfall is less than 750mm. The crops may face moisture stress frequently due to erratic distribution or failure of monsoon

Rain fed farming

- Crop production in areas where rainfall is more than 750mm (i.e assured rainfall areas). Here moisture stress will be minimum. Soil conservation is given more importance.

ELEMENTS REQUIRED IN PLANT GROWTH:

1. **Macro nutrients:** Based on the relative abundance in plants, viz.,
   - Nitrogen (N); Phosphorous (P), Potassium (K), Sulfur (S), Calcium (Ca) and Magnesium (Mg)
2. **Micronutrients:**
   - ✓ Their concentration is very small. They are also referred to as minor elements.
   - ✓ Iron (Fe); Zinc (Zn); Manganese (Mg),Copper (Cu),Boron (B), Chlorine (Cl) and Molybdenum (Mo) .In some plants, other than the above, Sodium (Na), Cobalt (Co), Vanadium (Va), Nickel (Ni) and Silicon (Si) are considered as essential micronutrients

Nitrogen (N)

- ✓ N is an essential constituent of proteins and is present in many other compounds of greatly physiological importance in plant metabolism
- ✓ N is an integral part of chlorophyll, which is primary observer of light energy needed for photosynthesis.
- ✓ N also imparts vigorous vegetative growth and dark green colour to plants.

Phosphorus (P)

- ✓ is an essential part of the enzymes which help the crop to fix light energy.

- ✓ It forms an integral part of nucleic acids, the carriers of genetic information, and is important in stimulating root growth

Potassium (K):

- ✓ is involved in processeswhich ensure carbon assimilation and the transportation of photosynthates throughout the plant for growth and the storage of sugars and proteins.
- ✓ The potassium ion is also important for water regulation and uptake.
- ✓ Furthermore, the presence of potassium in sufficient amounts ensures resistance to frost, drought and certain diseases

Magnesium

- ➢ occurs in chlorophyll and is also an activator of enzymes,

Sulphur-

- ➢ forms part of two essential amino adds which are among the many building blocks of protein. It is also found in vitamin B1 and in several important enzymes.

Calcium

- ➢ is required for plant growth, cell division and enlargement.
- ➢ The growth of root and shoot tips and storage organs is also

Concentrated organic manures

Oil cakes

- ➢ There are many varieties of oil cakes which contains not only nitrogen but also some P and K along with large percentage of organic matter. These oil cakes are of two types.
  i. Edible oil cakes- suitable for feeding cattle.
  ii. Non-edible oil cakes-not suitable for feeding cattle.
- ➢ Oil cakes are quick acting organic manure. Though they are insoluble in water, their nitrogen became quickly available to plants in about a week or in 10 days after application.

Integrated Nutrient Management (INM)

- ➢ Judicious combination of organic, inorganic and biofertilizers which replenishes the soil nutrients which are removed by the crops is referred as Integrated Nutrient Management system

Genetically modified crops (GM crops, orbiotech crops)

- ➢ are plants, the DNA of which has been modified using genetic engineering techniques, which are then used in agriculture.

Watershed Management

- ➢ A watershed is an area of land and water bounded by a drainage divide within which the surface runoff collects and flows out of the watershed through a single outlet into a lager river (or) lake.

<u>SOIL:</u>

Soil profile:

- ✓ The vertical section of the soil showing the various layers from the surface to the unaffected parent material is known as a soil profile. The various layers are known as horizons.
- ✓ There are 5 master horizons in the soil profile. Not all soil profiles contain all 5 horizons; and so, soil profiles differ from one location to another.

Loam:

- ✓ A type of soil texture **with good water holding** capacity and drainage suitable for cultivation of variety of crops.

Soil structure:

- ✓ The arrangement and organization of primary and secondary particles in a soil mass is known as soil structure

Acid soils

- ➢ Acid soils are characteristically low in pH (< 6.0). Predominance of H + and Al3+ cause acidity resulting in deficiency of P, K, Ca, Mg, Mo and B.

Laterization:

- ➢ The term laterite is derived from the word later meaning brick or tile and was originally applied to a group of high clay Indian soils found in Malabar hills of Kerala, Tamil Nadu, Karnataka and Maharashtra.
- ➢ Laterization is the process that removes silica, instead of sesquioxides from the upper layers and thereby leaving sesquioxides to concentrate in the solum

System of Rice Intensification (SRI)-

- ✓ **Emerged** in **the** 1980's as a synthesis of **locally advantageous** r**i**ce production- practices encountered in Madagascar by Fr Henri de **Laulanie**
- ✓ A combination of several practices those include changes in nursery management, time of transplanting, water and weed management.
- ✓ It emphasizes altering of certain agronomic practices of the conventional way of rice cultivation. All these new practices are together known as System of Rice Intensification (SRI).
- ✓ Principle - 'More with Less'
- ✓ SRI is not a fixed package of technical specifications, **but a system of production with four main components**, viz., soil fertility management, planting method, weed control and water (irrigation) management.
- ✓ Rice yield increased with less water and with reduction in chemical inputs

Sustainable Sugarcane Initiative (SSI)

- ➢ an innovative set of agronomic practices that involves using less seeds, raising seeds in a nursery, and following new planting methods, with wider seed spacing, and better water and nutrient management to increase the cane yields significantly.
- ➢ SSI methods can increase sugarcane yields by at least 20% with 30% less water and a 25% reduction in chemical inputs.
- ➢ The SSI method of sugarcane cultivation was evolved from the principles of 'More with Less' followed in SRI (System of Rice Intensification) and introduced in India by the WWF-ICRISAT collaborative project in 2009.

ACT AND POLICIES

- ✓ On 5th June 1972, environment was first discussed as an item of international agenda in the U.N. Conference of Human. There for 5th June is celebrated all over the world as World Environment Day.
- ✓ The Wildlife (Protection) Act was passed in 1972, followed by the Water (Prevention and Control of Pollution) Act 1974, the Forest (Conservation) Act, 1980, Air (Prevention and Control of Pollution) Act, 1981 and subsequently the Environment (Protection) Act, 1986.

Constitutional Provisions

- ✓ though the 42nd amendment
- ✓ Article-48-A of the constitution provides:
- ✓ "The state shall endeavour to protect and improve the environment and to safeguard forest and wildlife of the country

Article 51-A (g) Provides:

- ✓ It shall be duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures.

The Wildlife (Protection) Act of 1972

- ✓ Provides the basic framework to ensure the protection and management of wildlife.
- ✓ has 7 Chapters, 66 Sections and 6 Schedules. The Act with its various amendments provides the necessary tool to prevent damage to the wildlife.
- ✓ With the amendment of the Act in 1991, powers of the State Governments have been withdrawn almost totally.
- ✓ Now the State Governments are not empowered to declare any wild animal a vermin.
- ✓ Further by addition of provision, immunization of livestock within a radius of 5 km from a National Park or sanctuary has been made compulsory

ENVIRONMENT (PROTECTION) ACT, 1986

- ✓ a more effective and bold measure to fight the problem of pollution.
- ✓ The genesis of the Environmental (Protection) Act, 1986, is in Article 48A (Directive Principles of State Policy) and Article 51A (g) (Fundamental Duties) of the Indian Constitution.
- ✓ The Environment (Protection) Act, 1986 has 26 Sections and it has been divided into four chapters relating to i) Preliminary, ii) General Powers of the Central Government, iii) Prevention, Control, and Abatement of Environmental Pollution, iv) Miscellaneous.
- ✓ The minimum penalty for contravention or violation of any provision of the law is an imprisonment for a term which may extend to five years or fine up to one lakh rupees, or both.
- ✓ The Act prescribes a special procedure for handling hazardous substances.
- ✓ Act, 1986 has relaxed the rule of "Locus Standi" and because of such relaxation even a common citizen can approach the Court provided he has given a notice of sixty days of the alleged offence and his intention to make a complaint

NATIONAL FOREST POLICY-1988

- ➢ The principal aim is to ensure environmental stability and maintenance of ecological balance including atmospheric equilibrium which are vital for sustenance of all life forms, human, animal and plant.
- ➢ Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of flora and fauna, which represent the remarkable biological diversity and genetic resources of the country.
- ➢ Checking soil erosion and denudation in the catchments areas of rivers, lakes, reservoirs
- ➢ Checking the extension of sand-dunes in the desert areas of Rajasthan and along the coastal tracts.
- ➢ Increasing substantially the forest/tree cover in the country and Increasing the productivity of forests to meet essential national needs
- ➢ Creating a massive people's movement with, the involvement of women, for achieving these objectives and to minimise pressure on existing forests

BIOLOGICAL DIVERSITY ACT, 2002

- ➢ It was born out of India's attempt to realize the objectives enshrined in the United Nations Convention on Biological Diversity (CBD) 1992
- ➢ An Act to provide for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected therewith or incidental thereto.
- ➢ three-tier structure to regulate access to the biological resources, comprising of National Biodiversity Authority (NBA), State Biodiversity Boards (SBB) and Biodiversity Management Committees (BMC) at the local level

THE SCHEDULED "TRIBES AND OTHER TRADITIONAL FOREST DWELLERS (RECOGNITION OF FOREST RIGHTS) ACT, 2006

- provides for the restitution of deprived forest rights across India, including both individual rights to cultivated land in forestland and community rights over common property resources.
- The Act is significant as it provides scope and historic opportunity of integrating conservation and livelihood rights of the people.

FRA is a potential tool

I. To empower and strengthen the local self governance
II. To address the livelihood security of the people
III To address the issues of Conservation and management of the Natural Resources and conservation governance of India.

- Nodal Agency for the implementation is MoTA
- The maximum limit of the recognizing rights on forest land is 4 ha.
- National Parks and Sanctuaries have been included along with Reserve Forest, Protected Forests for the recognition of Rights.
- The Act recognizes the right of ownership access to collect, use, and dispose of minor forest produce which has been traditionally collected within or outside village boundaries.
- term "minor forest produce" to include all non-timber forest produce of plant origin, including bamboo, brush wood, stumps, cane, tussar, cocoons, honey, wax, lac, tendu or kendu leaves, medicinal plants and herbs, roots, tubers and the like.
- diversion of forest land for the purpose of schools, hospitals, anganwadis, drinking water supply and water pipelines, roads, electric and telecommunication lines, etc.
- The rights conferred under the Act shall be heritable but not alienable or transferable
- Gram Sabha has been designated as the competent authority

COASTAL REGULATION ZONE (CRZ)

- The coastal stretches of seas, bays, estuaries, creeks, rivers and back waters which are influenced by tidal action up to 500 meters from the High Tide Line (HTL) and the land between the Low Tide Line (LTL) and the HTL are declared "Coastal Regulation Zone" (CRZ), on 19.2.1991.
- National Coastal Zone Management Authority (NCZMA) and State Coastal Zone Management Authority (SCZIVIA) for enforcement and monitoring of the CRZ Notification.
- Classification Criteria and Regulatory Norms:
- The coastal regulation zone has been classified for the purpose of regulation of the permitted activities.

CRZ-I:

- Ecological sensitive area and the area between High Tide Line (HTL) and Low Tide Line (LTL).
- No new construction is permitted except for a few specified most essential activities like support activities for Atomic Energy Plants and Defense requirements, facilities required for disposal of treated effluents and other port related water front activities

CRZ-2:

- The area that have been developed up to or close to the shore line which includes the designated urban areas that are substantially built up.
- Buildings permitted only on the landward side of the existing road (or roads approved in the coastal zone Management Plan of the area) or on the landward side of the existing authorized structures as defined in the notification

CRZ-III:

- The areas that are relatively undisturbed and those which do not belong to either CRZ-I or CRZ-II which includes mainly the rural area and those not substantially built up within designated urban areas.
- The area up to 200 meters from HTL is earmarked as "No Development Zone".

- No construction is permitted within this zone except for repairs to the existing authorized, structures without exceeding existing FSI, plinth area and density.
- Development of vacant plots between 200 and 500 meters of HTL is permitted in CRZ III for the purpose of construction of dwelling units and hotels/beach resorts subject to certain conditions

CRZ-IV:

- No untreated sewage effluents, ballast water, ship washes, fly-ash or solid waste from all activities including from aquaculture operations shall be let off or dumped.
- A comprehensive plan for treatment of sewage generating from the coastal towns and cities shall be formulated within a period of one year in consultation with stakeholders including traditional coastal communities, traditional fisher folk and implemented;
- Pollution from oil and gas exploration and drilling, mining, boat house and shipping;
- There shall be no restriction on the traditional fishing and allied activities undertaken by local communities.

WETLANDS (CONSERVATION AND MANAGEMENT) RULES 2010

- The Ministry of Environment and Forests has notified the Wetlands (Conservation and Management) Rules 2010 in Order to ensure that there is no further degradation of wetlands.
- The rules specify activities which are harmful to wetlands.
- Central Wetland Regulatory Authority has been set up to ensure proper implementation of the Rules and perform all functions for management of wetlands in India.

NATIONAL GREEN TRIBUNAL (NGT)

- The National Green Tribunal Act, 2010 is aAct of the Parliament of India which enables creation of a special tribunal to handle the expeditious disposal of the cases pertaining to environmental issues. It was enacted under India's constitutional provision of Article 21, which assures the citizens of India the right to a healthy environment.
- India is third country in the world to full-fledged green tribunal followed by New-Zealand and Australia.
- NGT is mandated to dispose the cases within six months of their respective appeals.
- 10 expert members and 10 judicial members although the act allows for up to 20 of each.
- The Chairman of the tribunal is required to be a serving or retired Chief Justice of a High Court or a judge of the Supreme Court of India
- Members are chosen by a selection committee (headed by a sitting judge of the Supreme Court of India) that reviews their applications and conducts interviews. The Judicial members are chosen from applicants who are serving or retired judges of High Courts.

THE OZONE DEPLETING SUBSTANCES RULES

- The Ozone Depleting Substances (Regulation and Control)Rules, 2000 under the Environment (Protection)Act, in July 2000
- These Rules set the deadlines for phasing out of various ODSs, besides regulating production, trade import and export of ODSs and the product containing ODS.
- These Rules prohibit the use of CFCs in manufacturing various products beyond 1st January 2003 except in metered dose inhaler and for other medical purposes.
- use of halons is prohibited after 1st January 2001 except for essential use.
- Other ODSs such as carbon tetrachloride and methylchoroform and CFC for metered dose inhalers can be used upto 1st January 2010.
- Further, the use of methyl bromide has been allowed upto 1st January 2015.
- Since HCFCs are used as interim substitute to replace CFC, these are allowed upto 1st January 2040.

INSTITUTIONS AND MEASURES

NATIONAL WILDLIFE ACTION PLAN

- The first National Wildlife Action Plan (NWAP) was adopted in 1983

- The plan had outlined the strategies and action points for wildlife conservation
- The first National Wildlife Action Plan (NWAP) of 1983 has been revised and the new Wildlife Action Plan (2002-2016) has been adopted.
- Strengthening and Enhancing the Protected Area Network
- Effective Management of Protected Areas'
- Conservation of Wild and Endangered Species and Their Habitats
- Restoration of Degraded Habitats outside Protected Areas
- Control of Poaching, Taxidermy and Illegal Trade in Wild Animal and Plant Species
- Monitoring and Research
- Ensuring Peoples' Participation in Wildlife Conservation
- Conservation Awareness and Education X Wildlife Tourism
- Domestic Legislation and International Conventions
- Enhancing Financial Allocation for Ensuring Sustained Fund Flow to the Wildlife Sector
- Integration of National Wildlife Action Plan with Other Sectoral Programmes

NATIONAL AFFORESTATION AND ECO-DEVELOPMENT BOARD

- The Ministry of Environment and Forests
- August 1992
- evolved specific schemes for promoting afforestation and management strategies,

National Afforestation Programme

- Launched in 2002, which involves plantation in degraded forests of the country
- NAFP is a flagship programme of National Afforestation and Eco-development Board (NAEB)
- provides physical and capacity building support to the Forest Development Agencies (FDAs), which are the implementing agencies.

COMPENSATORY AFFORESTATION FUND MANAGEMENT AND PLANNING AUTHORITY (CAMPA)

- In April 2004, the central government, under the orders of the Supreme Court, constituted (CAMPA) for the management of money towards compensatory afforestation, and other money recoverable, in compliance of the conditions stipulated by the central government and in accordance with the Forest (Conservation) Act
- These remittances relate to Compensatory Afforestation (CA), Additional Compensatory Afforestation (ACA), Penal Compensatory Afforestation (PCA), Catchment Area Treatment (CAT) Plan, Protected Area Management and Net Present Value (NPV) etc.
- the Supreme Court order, a sum of Rs.1000 crores per year, for the 5 years, shall be released to the State CAMPAs in proportion of 10% of the principal amount deposited by the States/Union Territories in Ad-hoc CAMPA.

JOINT FOREST MANAGEMENT (JFM)

- an initiative to institutionalize participatory governance of country's forest resources by involving the local communities living close to the forest.
- a co-management institution to develop partnerships between forest fringe communities and the Forest Department (FD) on the basis of mutual trust and jointly defined roles and responsibilities with regard to forest protection and regeneration.
- started in consonance with the National Forest Policy 1988
- Most of the states in India have adopted JFM
- Under JFM, both forest departments and local communities come to an agreement to form the committee to manage and protect forests by sharing the costs and benefits.
- One of the key objectives is the rehabilitation of degraded forestlands with people's participation involving Forest Protection Committees
- win-win situation for both forest departments as well as the local communities in terms of greater access to minor forest produces from these regenerated forests.

SOCIAL FORESTRY

- The National Commission on Agriculture, Government of India, first used the term 'social forestry' in 1976.
- It was then that India embarked upon a social forestry project with the aim of taking the pressure off the forests and making use of all unused and fallow land.
- Government forest areas that are close to human settlement and have been degraded over the years due to human activities needed to be afforested.
- Trees were to be planted in and around agricultural fields. Plantation of trees along railway lines and roadsides, and river and canal banks were carried out. They were planted in village common land, Government wasteland and Panchayat land.
- aims at raising plantations by the common man so as to meet the growing demand for food, fuel wood, fodder, fiber and fertilizer (5 F's) etc, thereby reducing the pressure on the traditional forest area.
- the government formally recognised the local communities' rights to forest resources, and encouraged rural participation in the management of natural resources.
- Farm forestry, Community forestry, Extension forestry (Planting of trees on the sides of roads, canals and railways, along with planting on wastelands), Recreational forestry

NATIONAL BAMBOO MISSION

- a Centrally Sponsored Scheme with 100% contribution from Central Government. It is being implemented by the Horticulture Division under Department of Agriculture and Co-operation in the Ministry of Agriculture, New Delhi
- Bamboo Mission envisages integration of different Ministries/Departments and involvement of local people/initiatives for the holistic development of bamboo sector in terms of growth of bamboo through increase in -area coverage, enhanced yields and scientific management, marketing of bamboo and bamboo based handicrafts, generation of employment opportunities etc.
- Set up National, State and sub-State level structures, to ensure adequate returns for the produce of the farmers and eliminate middlemen, to the extent possible

COMPREHENSIVE ENVIRONMENTAL POLLUTION INDEX (CEPI)

- is a rational number to characterize the environmental quality at a given location following the algorithm of source, pathway, receptor and various parameters like pollutant concentration, impact on human health and level of exposure have been taken into consideration for the calculation of pollution indices for air, water and land
- The present. CEPI is intended to act as an early warning tool.
- It can-help in categorizing the industrial clusters in terms of priority of planning needs for interventions
- The Central and state Pollution Control Board, in collaboration with IIT, Delhi has applied the CEPI
- 43 such industrial clusters having CEPI greater than 70, on a scale of 0 to 100, have been identified as critically polluted

LIGHTING A BILLION LIVES (LABL)

- a campaign by TERI that promotes the use of solar lanterns specially designed and manufactured on a decentralized basis.
- has been able to engage with government interventions under Sarva Shiksha Abhiyan, Madhya Pradesh Rural Livelihood Project, Rasthriya Gramin Vikas Nidhi, and has facilitated the spread of mobile telephony with support from Department of Telecommunications, Government of India.
- successfully engaged the private sector and leveraged Corporate Social Responsibility
- initiative has the potential to contribute towards the realization of the Millennium Development Goals (MDGs) by improving energy access for the rural poor
- Formation of more than 100 women-led Self Help Groups (SHGs), and strengthening of
- around 150 SHGs are among the impacts of this initiative
- The campaign has demonstrated how Public- Private-People partnerships can support rural development schemes, particularly in the areas of health, education, environment and women's empowerment

ECO MARK

- labeling of environment friendly products to provide accreditation and labelling ' for household and other consumer products which meet certain environmental criteria along with quality requirements of the Bureau of Indian Standards for that product.
- Objective - to recognize good environmental performance as well as improvements in performance of the unit
- Any product, which is made, used or disposed of in a way that significantly reduces the harm to environment, could be considered as 'Environment Friendly Product'

URBAN SERVICES ENVIRONMENTAL RATING SYSTEM (USERS)

- Project funded by UNDP executed by Ministry of Environment and Forests and implemented by TEM.
- Aim - to develop an analytical tool to measure the performance, with respect to delivery of basic services in local bodies of Delhi and Kanpur. (identified as pilot cities).
- Performance measurement (PM) tool was developed through a set of performance measurement indicators that are benchmarked against set targets using the inputs-outputs efficiency outcomes framework.

BIODIVERSITY CONSERVATION & RURAL LIVELIHOOD IMPROVEMENT PROJECT (BCRLIP)

- Aim - conserving Biodiversity in selected landscapes, including wildlife protected areas/ critical conservation areas while improving rural livelihoods through participatory approaches.
- Development of Joint Forest Management (JFM) and eco-development
- The Project would be implemented as a Centrally Sponsored Scheme with five financiers (IDA loan, GEF grant, contributions from Government of India, State Governments and beneficiaries), amounting to around Rs. 137.35 crores, and spread over six years.

NATIONAL CLEAN ENERGY FUND

- 'National Clean Energy Fund' (NCEF) was constituted in the public account of India in the Finance Bill 2010-11.
- Objective - to invest in entrepreneurial ventures and research & innovative projects in the field of clean energy technology.
- The Central Board of Excise and Customs consequently notified the Clean Energy Cess Rules 2010 under which producers of specified goods namely raw coal, raw lignite and raw peat were made liable to pay Clean Energy Cess.
- Any project with innovative methods to adopt to clean energy technology and research & development shall be eligible for funding under the NCEF.
- Government assistance under the NCEF shall in no case exceed 40% of the total project cost.
- The Indo-French Centre for the Promotion of Advanced Research (CEFIPRA) launched a multi-disciplinary Indo-French research project titled 'Adaptation of Irrigated Agriculture to Climate Change (AICHA).'
- The study aims at developing an integrated model for analysing the impact of climate change on ground water-irrigated agriculture in south India.
- Berambadi village and surrounding areas in Hangla hobli of Gundlupet taluk in Chamaraja nagar district have been selected for a field study under the project.
- The project would explore adaptation strategies based on innovative cropping systems and water resource management policies,
- The methodology will combine remote sensing, field surveys and advanced numerical analysis with hydrological, agronomical and economic modeling, and will pay particular attention to sustainability and acceptability issues.

NATIONAL MISSION FOR ELECTRIC MOBILITY

- to promote electric mobility and manufacturing of electric vehicles in India,
- The setting up of NCEM has been influenced by the following three factors:
- 1.Fast dwindling petroleum resources

- 2.Impact of vehicles on the environment and climate change
- 3.Worldwide shift of the automobile industry towards more efficient drive technologies and alternative fuels including electric vehicles
- The NCEM will be the apex body in the Government of India for making recommendations in these matters

SCIENCE EXPRESS - BIODIVERSITY SPECIAL (SEBS)

- an innovative mobile exhibition mounted on a specially designed 16 coach AC train, traveling across India from 5 June to 22 December 2012 (180 days) to create widespread awareness on the unique biodiversity of the country.
- SEBS is the fifth phase of the iconic and path-breaking Science Express.
- The SEBS is a unique collaborative initiative of Department of Science & Technology (DST) and Ministry of Environment & Forests (MoEF), Government of India.

ENVIRONMENT EDUCATION, AWARENESS & TRAINING (EEAT) SCHEME

- A Central Scheme launched during the 6th Five Year Plan in 1983-84

Objectives:

1. To promote environmental awareness among all sections of the society
2. To spread environment education, especially in the non-formal system.
3. To facilitate development of education/training materials and aids in the formal education sector.
4. To promote environment education through existing educational/scientific institutions.
5. To ensure training and manpower development for EEAT.
6. To encourage NGOs, mass media and other concerned organizations for promoting awareness about environmental issues.
7. To use different media (audio & visual) for spreading messages concerning environment and awareness and
8. To mobilize people's participation for preservation and conservation of environment.

NATIONAL ENVIRONMENT AWARENESS CAMPAIGN (NEAC)

- ✓ launched in 1986 with the objective of creating environmental awareness at the national level.
- ✓ It is a multi-media campaign which utilises conventional and non-conventional methods of communication for disseminating environmental messages.
- ✓ Under this campaign, nominal financial assistance is provided to registered NGOs, schools, colleges, universities, research institutions, women and youth organisations, army units, State Government Departments etc. from all over the country for organising/ conducting awareness raising activities.

ECO-CLUBS (NATIONAL GREEN CORPS)

- ✓ The main objectives of this programme are to educate children about their immediate environment and impart knowledge about the eco-systems, to mobilise youngsters by instilling in them the spirit of scientific inquiry into environmental problems and involving them in the efforts of environmental preservation.
- ✓ Global Learning and Observations to Benefit the Environment (GLOBE)
- ✓ The GLOBE is an International Science, and Education Programme, which stress on hands on participatory approach.
- ✓ India joined this programme during the August, 2000.
- ✓ aimed at school children.

MANGROVES FOR THE FUTURE

- ✓ a partnership-based initiative promoting investment in coastal ecosystems for sustainable development.
- ✓ to promote healthy coastal ecosystems through a partnership-based, people-focused, policy-relevant and investment-orientated approach, which builds and applies knowledge, empowers communities and other

stakeholders, enhances ' governance, secures livelihoods, and increases resilience to natural hazards and climate change.

- ✓ Member countries: India, Indonesia, Maldives, Pakistan, Seychelles, Sri Lanka, Thailand, VietNam.
- ✓ Outreach countries: Bangladesh, Cambodia, Myanmar, Timor-Leste.
- ✓ Dialogue countries: Kenya, Malaysia, Tanzania.

ORGANIZATIONS

THE ANIMAL WELFARE BOARD OF INDIA

- ✓ statutory advisory body on Animal Welfare Laws and promotes animal welfare in the country
- ✓ The Animal Welfare Board of India, the first of its kind to be established by any Government in the world, was set up in 1962, in accordance with Section 4 of the Prevention of Cruelty to Animals Acts 1960
- ✓ Shrimati Rukmini Devi Arundale pioneered the setting up of the Board, with its Headquaters at Chennai.

Functions

- ✓ To keep the law in force in India for the Prevention of Cruelty to Animals under constant study and to advise the government on the amendments to be undertaken in any such law from time to time.
- ✓ To advise the Central Government on the making of rules under the Act with a view to preventing unnecessary pain or suffering to animals generally, and more particularly when they are being transported from one place to another or when they are used as performing animals or when they are kept in captivity or confinement.
- ✓ To take all such steps as the Board may think fit for amelioration of animals by encouraging, or providing for the construction of sheds, water troughs and the like and by providing for veterinary assistance to animals.
- ✓ To advise the Government or any local authority or other person in the design of slaughter houses
- ✓ To take all such steps as the Board may think fit to ensure that unwanted animals are destroyed by local authorities
- ✓ To encourage by the grant of financial assistance or otherwise, the formation or establishment of pinjarapoles, rescue homes, animals sanctuaries and the like, where animals and birds may find a shelter when they have become old and useless or when they need protection.
- ✓ To advise the Government on matters relating to the medical care and attention which maybe provided in animal hospitals, and to give financial and other assistance to animal hospitals whenever the Board think it is necessary to do so.
- ✓ The Board consists of 28 Members. The term of office of Members is for a period of 3 years

CENTRAL ZOO AUTHORITY

- ✓ The amendment made to the Wild Life (Protection) Act in 1991 added a new chapter dealing with zoos to the Act and allowed for the Central Government to constitute an authority known as the Central Zoo Authority

Imp Functions

- ✓ To specify the minimum standards for housing, upkeep and veterinary care of animals kept in a zoo
- ✓ To identify endangered species of wild animals for purposes of captive breeding and assigning responsibility in this regard to a zoo
- ✓ To co-ordinate the acquisition, exchange and loaning of animals for breeding purposes
- ✓ To ensure maintenance of stud-books, of endangered species of wild animals bred in captivity
- ✓ To co-ordinate training of zoo personnel in India and abroad

THE NATIONAL BIODIVERSITY AUTHORITY OF INDIA — CHENNAI

- ✓ established in 2003 to implement India's Biological Diversity Act (2002).
- ✓ The NBA is a Statutory, Autonomous Body and

- ✓ it performs facilitative, regulatory and advisory function 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.

Objectives of the NBA

- ✓ Anybody seeking any kind of intellectual, property rights on a research based upon biological resource or knowledge obtained from India has to obtain prior approval of the NBA.
- ✓ The NBA will impose benefit-sharing conditions.

Main **functions:**

(1) The National biodiversity Authority may-

(a) advise the Central Government on matters relation into-the conservation of biodiversity, sustainable use of its components

(b) advise the State Governments in the selection of areas of biodiversity importance to be notified as heritage sites and measures for the management of such heritage sites;

2) The National Biodiversity Authority may, on behalf of the Central Government, take any measures necessary to oppose the grant of intellectual property rights in any country outside India on any biological resource obtained from India or knowledge associated with such biological resource which is derived from India.

WILDLIFE CRIME CONTROL BUREAU (WCCB)

- ✓ The Government of India constituted a statutory body, the Wildlife Crime Control Bureau on 6th June 2007, by amending the Wildlife (Protection) Act, 1972.
- ✓ The bureau would complement the efforts of the state governments, primary enforcers of the Wildlife (Protection) Act, 1972 and other enforcement agencies of the country.

Functions

- ✓ Collection, collation of intelligence and its dissemination and establishment of a centralized Wildlife Crime data bank;
- ✓ Co-ordination of actions by various enforcement authorities towards the implementation of the provisions of this Act.
- ✓ Implementation of obligations under the various international Conventions and protocols
- ✓ Assistance to concerned authorities in foreign countries and concerned international organizations to facilitate co-ordination and universal action for wildlife crime control;
- ✓ Development of infrastructure and capacity building for scientific and professional investigation;
- ✓ Advice the Government of India on issues relating to wildlife crimes having national and international ramifications, and suggest changes required in relevant policy and laws from time to time.

NATIONAL LAKE CONSERVATION PLAN (NLCP)

- ✓ Ministry of Environment and Forests
- ✓ for conservation and management of polluted and degraded lakes in urban and semi-urban areas through an integrated ecosystem approach.

Activities Covered Under NLCP

- ✓ Prevention of pollution from point sources by intercepting, diverting and treating the pollution loads entering the lake.
- ✓ In situ measures of lake cleaning such as de-silting, de-weeding, bioremediation, aeration, bio-manipulation, nutrient reduction, withdrawal of anoxic hypolimn ion, constructed wetland approach or any other successfully tested eco-technologies etc depending upon the site conditions.
- ✓ Lake front eco-development including public interface.
- ✓ Solid waste management & provision of dhobi ghats is generally not covered under NLCP.
- ✓ Prevention of pollution from non-point sources by providing low cost sanitation.

- ✓ Public awareness and public participation.Capacity building, training and research in the area of Lake Conservation.

NATIONAL GANGA RIVER BASIN AUTHORITY (NGRBA)

- ✓ NGRBA was constituted on February 2009 under the Environment (Protection) Act, 1986.
- ✓ The NGRBA is a planning, financing, monitoring and coordinating body of the centre and the states.
- ✓ The objective of the NGRBA is to ensure effective Abatement of pollution and conservation of the river Ganga by adopting a river basin approach for comprehensive planning and management.
- ✓ The Authority has both regulatory and developmental functions.
- ✓ Development of a river basin management plan;

WILDLIFE TRUST OF INDIA

- ✓ ➢ NGO founded: 1998
- ✓ ➢ Aim: To conserve nature, especially endangered species and threatened habitats, in partnership with communities and governments.

INTERNATIONAL CONVENTIONS

MAJOR ENVIRONMENT INTERNATIONAL CONVENTIONS:

Nature conservation

- ✓ 1. United Nations Conference On Environment And Development (UNCED)
- ✓ 2. Convention on Biological Diversity (CBD)
- ✓ 3. Ramsar Convention on Wetlands
- ✓ 4. Convention on International Trade in Endangered Species of Fauna and Flora (CITES)
- ✓ 5. The Wildlife Trade Monitoring Network (TRAFFIC)
- ✓ 6. Convention on the Conservation of Migratory Species (CMS)
- ✓ 7. Coalition Against Wildlife Trafficking (CAWT)
- ✓ 8. International Tropical Timber Organization (ITTC)
- ✓ 9. United Nations Forum on Forests (LTNFF)
- ✓ 10. International Union for Conservation of Nature and Natural Resources (IUCN)
- ✓ 11. Global Tiger Forum (GTF)

Hazardous material

- ✓ 12. Stockholm Convention
- ✓ 13. Basel Convention
- 14. Rotterdam Convention

Land

- ✓ 15. United Nations Convention to Combat Desertification (UNCCD)

Marine environment

- ✓ 16. International Whaling Commission (MC) Atmosphere
- ✓ 17. Vienna convention and Montreal Protocol
- ✓ 18. United Nations Framework Convention on Climate Change (UNFCCC)
- ✓ 19. Kyoto Protocol

United Nations Conference On Environment And Development (UNCED)

- ✓ Also known as the Rio Summit, Rio Conference, Earth Summit held in Rio de Janeiro in June 1992. The issues addressed included:
- ✓ Systematic scrutiny of patterns of production — particularly-the production of toxic components, such as lead in gasoline, or poisonous waste including radioactive chemicals
- ✓ Alternative sources of energy to replace the use of fossil fuels which are linked to global climate change
- ✓ New reliance on public transportation systems in order to reduce vehicle emissions, congestion in cities and the health problems caused by polluted air and smog

- ✓ The growing-scarcity of water

Rio Declaration on Environment and Development

- ✓ Agenda 21
- ✓ Forest Principles

Two important legally binding agreements

- ✓ 1. Convention on Biological Diversity
- ✓ 2. Framework Convention on Climate Change (UNFCCC).
- ➢ The Rio Declaration on Environment and The Rio Declaration consisted of 27 principles intended to guide future sustainable development around the world.

Agenda 21

- ✓ Agenda 21 is an action plan of the United Nations (UN) related to sustainable development
- ✓ It is a comprehensive blueprint of action to be taken globally, nationally and locally by organizations of the UN, governments, and major groups in every area in which humans directly affect the environment.
- ✓ The number 21 refers to an agenda for the 21st century.

Agenda 21 for culture

- ✓ During the first World Public Meeting on Culture, held in Porto Alegre, Brazil in 2002.
- ✓ The first document with worldwide mission that advocates establishing the groundwork of an undertaking by cities and local governments for cultural development.

Rio +20

- ✓ "Rio+20" is the short name for the United Nations Conference on Sustainable Development which took place in Rio de Janeiro, Brazil in June 2012 - twenty years after the landmark 1992 Earth Summit in Rio
- ✓ The official discussions focussed on two main themes:

1. how to build a green economy to achieve sustainable development and lift people out of poverty; and
2. how to improve international coordination for sustainable development.

Convention on Biological Diversity (CBD)

- ➢ CBD is a Legally binding Convention recognized for the first time, that the conservation of biological diversity is "a common concern of humankind" and is an integral part of the development process. The agreement covers all ecosystems, species, and genetic resources.

Objectives

- ➢ The conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.

Cartagena Protocol on Biosafety to the Convention on Biological Diversity

- ➢ Biosafety refers to the need to protect human health and the environment from the possible adverse effects of the products of modern biotechnology.
- ➢ The Convention clearly recognizes these twin aspects of modern biotechnology.
- ➢ 1. Access to and transfer of technologies
- ➢ 2. Appropriate procedures to enhance the safety of biotechnology technologies
- ➢
- ➢ The Protocol establishes procedures for regulating the import and export of LMOs from one country to another.

Nagoya—Kuala Lumpur Supplementary Protocol

- ➢ The Cartagena Protocol is reinforced by theNagoya—Kuala Lumpur Supplementary Protocol on Liability and Redress.

- The Supplementary Protocol specifies response measures to be taken in the event of damage to biodiversity resulting from LMOs.

Biodiversity Target

- It was adopted in May 2002 during the sixth Conference of the Parties to the Convention on Biological Diversity.
- The Target aimed to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth'.

Strategic Plan For Biodiversity 2011-2020

- In the tenth meeting of the Conference of the Parties, held in 2010, in Nagoya, Aichi Prefecture, Japan, adopted a revised and updated Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the 2011-2020 period.
- The tenth meeting of the Conference of the Parties agreed to translate this overarching international framework into national biodiversity strategies and action plans within two years.
- Additionally, the meeting decided that the fifth national reports, due by 1 March 2014, should focus on the implementation of the 2011-2020 Strategic Plan and progress achieved towards the Aichi Biodiversity Targets.

1. **Strategic Goal A:**
   - Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society
2. **Strategic Goal B:**
   - Reduce the direct pressures on biodiversity and promote sustainable use
3. **Strategic Goal C:**
   - To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity.
4. **Strategic Goal D:**
   - Enhance the benefits to all from biodiversity and ecosystem services
   - By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization
5. **Strategic Goal E:**
   - Enhance implementation through participatory planning, knowledge management and capacity building

COP 11 HYDERABAD:

- One of the most important outcomes of the CoP is the commitment of the Parties to double the international financial flows for Bio Diversity by 2015. This will translate into additional financial flows to the developing countries to the tune of about US $ 30 billion in the next 8 years.
- India has committed US $50 million towards strengthening the institutional mechanism for biodiversity conservation in the country during its presidency of the Convention on Biodiversity (CBD) called the Hyderabad Pledge
- The funds will be used to enhance technical and human capabilities at the national and state-level mechanisms to attain the CBD objectives
- India formally took charge of the presidency of CBD from Japan for the next two years on October 8 at the inaugural of the eleventh meeting of the Conference of Parties (CoP 11) to CBD.
- India has instituted together with UNDP Biodiversity Governance Awards.
- The first such awards were, given during the CoP 11.
- It is now proposed to institute Rajiv Gandhi International Award for Harnessing Biodiversity for Livelihood.

RAMSAR CONVENTION ON WETLANDS:

- The Convention on Wetlands [waterfowl convention] is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
- It was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975, and it is the only global environmental treaty that deals with a particular ecosystem.
- Ramsar is not affiliated with the United Nations system of Multilateral Environmental Agreements, but it works very closely with the other MEAs and is a full partner among the "biodiversity-related cluster" of treaties and agreements.
- World Wetlands Day, 2 February every year.
- Number of Contracting Parties: 163 (Please refer my Ramsar Compilation which is already posted in Teamwork 2015 Group)

Mission

- "The conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world".
- "Three pillars" of the Convention

The Parties have committed themselves to

- Work towards the wise use of all their wetlands through national land-use planning, appropriate policies and legislation, management actions, and public education;
- Designate suitable wetlands for the List of Wetlands of International Importance ("Ramsar List") and ensure their effective management;
- Cooperate internationally concerning trans boundary wetlands, shared wetland systems, shared speeds, and development projects that may affect wetlands.

The Montreux Record

- Adopted by the Conference of the Contracting Parties in Brisbane, 1996, accompanying the Guidelines for Operation of the Montreux Record
- The Montreux Record is a register of wetland sites on the List of Wetlands of International Importance where changes in ecological character have occurred, are occurring, or are likely to occur as a result of technological developments, pollution or other human interference.
- It is the the principal tool of the Convention and is maintained as part of the Ramsar List.

Indian wetland and the Montreux Record

- Keoladeo National Park, Rajasthan and Loktak Lake, Manipur have been included in Montreux Record in 1990 and in 1993 respectively
- Chilika Lake, Orissa included in Montreux Record in 1993 but have been removed in November 2002.
- Chilika Lake gets Wetland Conservation Award for 2002.

"IOPs"

- Five global non-governmental organizations (NGOs) have been associated with the treaty since its beginnings and were confirmed in the formal status of International Organization Partners (I0Ps) of the Convention.
- 1. Bird Life International (formerly ICBP)
- 2. IUCN - The International Union for the Conservation of Nature
- 3. IWMI - The International Water ManagementInstitute
- 4. Wetlands International (formerly IWRB, the Asian Wetlands Bureau, and. Wetlands for the Americas)
- 5. WWF (World Wide Fund for Nature) International

The Changwon Declaration on human well-being and wetlands

- The Changwon Declaration highlights positive action for ensuring human well-being and security in the future under the themes - water, climate change, people's livelihood and health, land use change, and biodiversity,

India and wetland convention

- India became a contracting party to the Ramsar Convention in 1981 and has been implementing conservation programmes for wetlands, mangroves and coral reefs.
- India presently has 26 sites designated as Wetlands of International Importance.
- There is close coordination between implementing units of Ramsar with that of CBD at the national level. India took a lead role in the formulation of Ramsar guidelines on integration of wetlands into river basin management.

4. CITES

- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments entered' into force in 1975, and became the only treaty to ensure that international trade in plants and animals does not threaten their survival in the wild.
- Currently 176 countries are Parties to CITES
- CITES is administered through the United Nations Environment Programme (UNEP).

Protecting Species from Unsustainable Trade

- Species for which trade is controlled are listed in one of three Appendices to CITES, each conferring a different level of regulation and requiring CITES permits or certificates.

Appendix I:

- ➢ Includes species threatened with extinction and provides the greatest level of protection, including restrictions on commercial trade.
  Examples include gorillas, sea turtles, most lady slipper orchids, and giant pandas.

Appendix II:

➢ Includes species that although currently not threatened with extinction, may become so without trade controls. It also includes species that resemble other listed species and need to be regulated in order to effectively control the trade in those other listed species.

Appendix III:

➢ Includes species for which a range country has asked other Parties to help in controlling international trade. Examples include map turtles, walruses and .Cape stag beetles

- CoP13, these meeting were held every two years; since then, CoPs are held every three years.
- CoP16 is scheduled to occur from March 3-14, 2013 in Bangkok, Thailand.

TRAFFIC: The Wildlife Trade Monitoring Network

- ➢TRAFFIC is a joint conservation programme of WWF and IUCN.
- It was established in 1976 by the Species Survival Commission of IUCN,
- TRAFFIC has grown to become the world's largest wildlife trade monitoring programme, and a global expert on wildlife trade issues.
- This non-governmental organization
- ➢To ensure that trade in wild plants and animals is not a threat to the conservation of nature

Convention on the Conservation of Migratory Species (CMS)

- The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention)
- ➢aims to conserve terrestrial, aquatic and avian migratory species throughout their range.
- ➢It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment
- The Agreements may range from legally binding treaties (called Agreements) to less formal instruments, such as Memoranda of Understanding, and can be adapted to the requirements of particular regions

Coalition Against Wildlife Trafficking (CAWT)

- aims to focus public and political attention and resources on ending the illegal trade in wildlife and wildlife products.
- Initiated in 2005, CAWT is a unique voluntary public-private coalition
- CAWT is leveraging the combined strengths of government and nongovernmental partners to:
- Improve Wildlife Law Enforcement by expanding enforcement training and information sharing and strengthening regional cooperative networks
- Reduce consumer demand for illegally traded wildlife by raising awareness of the impacts of illegal wildlife trade on biodiversity
- Catalyse high-level political will to fight wildlife trafficking

The International Tropical Timber Organization (ITTO)

- ITTO is an intergovernmental organization, under UN (1986) promoting the conservation and sustainable management, use and trade of tropical forest resources.

United Nations Forum on Forests (UNFF)

- The Economic and .Social Council of the United Nations (ECOSOC), established the UNFF In October 2000, a subsidiary body
- with the main objective to promote "the management, conservation and sustainable development of all types of forests and to strengthen long-term political commitment to this end" based on the Rio Declaration, the Forest Principles, Chapter 11 of Agenda 21 and the outcome of the Intergovernmental Panel on Forests (IPF) I intergovernmental Forum on Forests (IFF) Processes and other key milestones of international forest policy.
- The Forum has universal membership, and is composed of all Member States of the United Nations and specialized agencies
- Enhance the contribution of forests to the achievement of the internationally agreed development goals, including the Millennium Development Goals,

The four Global Objectives seek to:

- 1. Reverse the loss of forest cover worldwide through sustainable forest management (SFM), including protection, restoration, afforestation and reforestation, and increase efforts to prevent forest degradation;
- 2. Enhance forest-based economic, social and environmental benefits; including by improving the livelihoods of forest-dependent people;
- 3. Increase significantly the area of sustainably managed forests, including protected forests, and increase the proportion of forest products derived from sustainably managed forests; and
- 4. Reverse the decline in official development assistance for sustainable forest management and mobilize significantly-increased new and additional financial resources from all sources for the implementation of SFM

IUCN

- IUCN was founded in October 1948 as the International Union for the Protection of Nature (or IUPN) following an international conference in Fontainebleau, France.
- ALL READY COVERD IN PREVIOUS CHAPTERS
  - ✓ Priority Areas of IUCN
  - ✓ Biodiversity
  - ✓ Climate change
  - ✓ Sustainable energy
  - ✓ Human well-being
  - ✓ Green economy

THE GLOBAL TIGER FORUM (GTF)

- ✓ is an inter-governmental and international body established with members from willing countries to embark on a worldwide campaign, common approach, promotion of appropriate programmes and controls to save the remaining five sub-species of tigers in the wild

distributed over 14 tiger range countries
of the world.

- ✓Formed in 1994 with its secretariat at New Delhi, GTF is the only inter-governmental & international body campaigning to save the TIGER worldwide.
- ✓The General Assembly of GTF shall meet once in three years.
- ✓ To promote a worldwide campaign to save the tiger, its prey and its habitat;
- ✓To promote a legal framework in the countries involved for bio-diversity conservation;
- ✓ To increase the protected area network of habitats of the tiger and facilitate their inter passages in the range countries;
- ✓ To promote eco-development programmes with the participation of the communities living in and around protected areas;
- ✓elimination of illegal trade;
- ✓scientific research
- ✓the development and exchange among themselves , of appropriate technologies and training programmes for scientific wildlife management
- ✓To set up a participative fund of an appropriate size to engender awareness in all places

Global Tiger Initiative

- ✓An alliance of governments, international, agencies, civil society, and the private sector united to save wild tigers from extinction

Goals of GTI

- ✓ To support capacity-building in governments for responding effectively to the transnational challenge of illegal trade in wildlife and for scientifically managing tiger landscapes in the face of mounting and varied threats;
- ✓To curtail international demand for tiger parts and other wildlife
- ✓To develop mechanisms for safeguarding habitats from development through planning 'smart, green' infrastructure and sensitive industrial development;
- ✓To create innovative and sustainable financing mechanisms for tiger landscapes including
- ✓protected areas;
- ✓ To build strong local constituencies for tiger conservation through development of economic incentives and alternative livelihoods for local people;"
- ✓ To spread the recognition among governments, international aid agencies and the public that tiger habitats are high-value diverse ecosystems with the potential to provide immense benefits- both tangible and intangible

THE STOCKHOLM CONVENTION ON POP

- ✓ The Stockholm Convention on Persistent Organic Pollutants was adopted at a Conference of Plenipotentiaries on 22 May 2001 in Stockholm, Sweden and entered into force on 17 May 2004,

POP

- ✓ Persistent Organic Pollutants (POPs) are organic chemical substances, that is, they are carbon-based:
- ✓ They possess a 'particular combination of physical and chemical properties such that, once released into the environment, they:
- ✓ remain intact for exceptionally long periods of time (many years);
- ✓ become widely distributed throughout the environment as a result of natural processes involving soil, Water and, most notably, air;
- ✓ accumulate in the fatty tissue of living organisms including humans;
- ✓ and are found at higher concentrations at higher levels in the food chain;
  are toxic to both humans and wildlife
- ✓ not soluble in water

The 12 initial POPs

- ✓ Initially, twelve POPs have been recognized as causing adverse effects on humans and the ecosystem and these can be placed in 3 categories:
- ✓ 1. Pesticides: aldriri, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene;
- ✓ 2. Industrial chemicals: hexachlorobenzene, polychlorinated biphenyls (PCBs); and
- ✓ 3. By-products': hexachlorobenzene; polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDF), and PCBs.

The new POPs under the Stockholm Convention Nine new POPs

1. **Pesticides**: chlordecone, alpha hexachloro- cyclohexane, beta hexachlorocyclohexane, lindane, pentachlorobenzene;

2. **Industrial chemicals:** hexabromobiphenyl, hexabromodiphenyl ether and hePtabro-modiphenyl ether, pentachlorobenzene, perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride, tetrabromodiphenyl ether and pentabromodiphenyl ether; and

3. **By-products:,** alpha hexachlorocyclohexane, beta hexachlorocyclohexane and pentachlorobenzene

Endosulfan

At its fifth meeting held in 2011, the CoP adopted an amendment to Annex A to the Stockholm Convention to list technical endosulfan and related isomers with a specific exemption

BASEL CONVENTION

- ✓ The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes_ and their Disposal was adopted on 22 March 1989 by the Conference of Plenipotentiaries in Basel, Switzerland,

Objective

- ✓ To protect human health and the environment against the adverse effects of hazardous wastes.
- ✓ Its scope of application covers a wide range of wastes defined as "hazardous wastes" based on their origin , and/or composition and their characteristics, as well as two types of wastes defined as "other wastes" -**household waste and incinerator ash.**

Principal aims:

- ✓ The reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal;
- ✓ the restriction of transboundary movements of hazardous wastes
- ✓ a regulatory system applying to cases where transboundary movements are permissible
- ✓ Examples of wastes regulated by the Basel Convention
- ✓ Biomedical and healthcare wastes
- ✓ Used oils
- ✓ Used lead acid batteries
- ✓ Persistant Organic Pollutant wastes (POPs wastes),
- ✓ Polychlorinated Biphenyls (PCBs),
- ✓ Thousands of chemical wastes generated by industries and other consumers

ROTTERDAM CONVENTION

- ✓ It was adopted in 1998 by a Conference of Plenipotentiaries in Rotterdam, the Netherlands and entered into force on 24 February 2004.
- ✓ The Convention creates legally binding obligations for the implementation of the Prior Informed Consent (PIC) procedure. It built on the voluntary PIC procedure, initiated by UNEP and FAO in 1989 and ceased on 24 February 2006.

- ✓ The Convention covers pesticides and industrial chemicals that have been banned ,or severely restricted for health or environmental reasons by Parties and which have been notified by Parties for inclusion in the PIC procedure.

Objectives:

- ✓ to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm;

UNCCD

- ✓ Established in 1994, UNCCD is the sole legally binding international agreement linking environment and development to sustainable land management.
- ✓ The UNCCD is particularly committed to a bottom-up approach, encouraging the participation of local people in combating desertification and land degradation.
- ✓ The United Nations Convention to Combat Desertification (UNCCD) is one of the Rio Conventions that focuses on desertification, land degradation and drought (DLDD).
- ✓ 'Desertification' as-defined in the UNCCD refers to land degradation in the drylands (arid, semi arid and dry sub humid regions) resulting from various factors and does not connote spread or expansion of deserts.
- ✓ UNCCD with 194 Parties
- ✓ The convention aims at adaption and can, on implementation, significantly contribute to achieving the Millennium Development Goals (MDGs), as well as sustainable development and poverty reduction by means of arresting and reversing land degradation.
- ✓ The convention promotes sustainable land management (SLM) as solution to global challenges

International Whaling Commission

- ✓ is the global intergovernmental body charged with the conservation of whales and the management of whaling with headquarters in Cambridge, United Kingdom.
- ✓ It was set up under the International Convention for the Regulation of Whaling which was signed in Washington DC on 2nd December 1946

Preamble

- ✓ To provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry.
- ✓ In 1986 the Commission introduced zero catch limits for commercial whaling. This provision is still in place today, although the Commission continues to set catch limits for aboriginal subsistence whaling.

VIENNA CONVENTION

- ✓ Vienna convention adopted in the year 1985 and entered into force in 1988.
- ✓ It acts as a framework for the international efforts to protect the ozone layer however it does not include legally binding reduction goals for the use of CFCs.
- ✓ With 197 parties, they are the most widely ratified treaties in United Nations history.

Montreal Protocol

- ✓ The Montreal Protocol on Substances that Deplete the Ozone Layer was designed to Reduce the production and consumption of ozone depleting substances in order to reduce their abundance in the atmosphere, and thereby protect the earth's fragile ozone Layer.
- ✓ The treaty was opened for signature on September 16, 1987, and entered into force on January 1, 1989, followed by a first meeting in Helsinki, May 1989.
- ✓ Since then, it has undergone seven revisions, in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), and 1999 (Beijing).

India and Protection of Ozone Layer

- ✓ India became a Party to the Vienna Convention for the Protection of Ozone Layer on 19 June 1991and the Montreal Protocol on substances that deplete the ozone layer on 17 September 1992
- ✓ Consequently, it ratified the Copenhagen, Montreal and Beijing Amendments in 2003.
- ✓ India produces CFC-11, CFC-12, CFC-113, Halon-1211, HCFC-22, Halon-1301, Carbontetrachloride (CTC), methyl chloroform and methyl bromide.
- ✓ These ozone Depleting Substances (ODS) are used in refrigeration and air conditioning, fire fighting, electronics, foams, aerosol fumigation applications.
- ✓ A detailed India Country Programme for phase out of ODS was prepared in 1993
- ✓ The Ministry of Environment and Forests established an Ozone Cell and a steering committee on the Montreal Protocol to facilitate implementation of the India Country Programme for phasing out ODS (ozone depleting substances) production by 2010.
- ✓ In order to meet the objectives of the Protocol, the Indian government has granted full exemption from payment of Customs and Central Excise Duties on import of goods designed exclusively for non-ODS technology

GLOBALLY IMPORTANT AGRICULTURAL HERITAGE SYSTEMS

- ✓ The FAO recognizes the agricultural heritage regions of the world under a programme titled Globally Important Agricultural Heritage Systems (GIAHS).
- ✓ purpose of GIAHS is to recognize "Remarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations for sustainable development".
- ✓ In our country so far the following sites have received recognition under this programme:
  1. Traditional Agricultural System, Koraput, Odisha
  2. Below Sea Level Farming System, Kuttanad, Kerala
- ✓ In the Koraput system, women have played a key role in the conservation of biodiversity.
- ✓ The Kuttanad system was developed by farmers over 150 years ago to ensure their food security by learning to cultivate rice and other crops below sea level.
- ✓ The Kuttanad System is now attracting worldwide attention since one of the effects of global warming is sea level rise.
- ✓ It has therefore been an act of vision on the part of Kerala government to have decided to, set up an International Research and Training Centre for Below Sea Level Farming in Kuttanad.

ENVIRONMENT ISSUES AND HEALTH EFFECTS

TOXICOLOGY EFFECTS

- ➢ Eco-toxicology is "a study of the effects of released pollutants on the environment and on the biota that inhabit it.

Rem

- ➢ It gives an indication of biological damage. It is an estimate of the amount of radiation of any type, which produces the same biological injury in man as that resulting from the absorption of a given amount of X-ray radiation or gamma radiation.

Iodine - 131

- ➢ Iodine -131 produced by nuclear tests is passed to vegetation and then appears in the milk of the cattle that consume the contaminated vegetation and is passed to humans.
- ➢ Iodine-131 causes serious damage to thyroid gland, especially among children.
- ➢ About 99% of long-term radioactivity from either strontium or radium taken into the human body is found in the bones.

Lead

- ➢ Lead is highly toxic to plants and animals including man. Lead generally affects children more severely than adults.

- Lead poisoning causes a variety of symptoms. These include liver and kidney damage, reduction in hemoglobin formulation, mental retardation and abnormality in fertility and pregnancy. Symptoms of chronic lead-poisoning are of three general types.
  a. Gastrointestinal troubles - most common in industrial workers includes intestinal stress.
  b. Neuromuscular effects - collectively called lead palsy, and impairment of muscle metabolism resulting into residual paralysis and muscular atrophy.
  c. Central nervous system effects - CNS syndrome- a panoply of nervous system disorders, they may lead to delirium, convulsions coma and death.

Mercury

- This is the most common and most toxic in water bodies. It occurs , in water as monomethyl mercury.
- Methyl mercury vapours cause fatal poisoning.
- The recent popularity of energy efficient compact to fluorescent lamps or CFLs has added another dimension to the controversy.
- Toxicity of mercury is much greater than any other substance, about 1000 times more potent than colchicines.

Fluorine

- It occurs in nature as fluoride, in air, soil and water.
- Fluorisis is a common problem in several states of the country due to intake of high fluoride content water.
- Fluorides cause dental fluorisis, stiffness of joints (particularly spinal cord) causing humped back. Pain in bones and joint and outward bending of legs from the knees is called Knock-Knee syndrome.
- In cattle, fluoride intake causes staining, mottling and abrasion of teeth, lameness and decrease in milk production.

DDT

- Toxic pesticides as BHC, PCB, DDT etc., are not easily degraded and are long-lasting in the environment.
- Their concentration therefore goes on increasing in water and soil with successive applications.
- DDT was sprayed for many years on marshes to control mosquitoes.
- The DDT has bio-magnified from water to fish eating birds and humans. DDT is known to depress the activity of estrogen, the female sex hormone and testosterone, male sex hormone.

LEAD IN PAINTS

- present in paints.
- Though several countries have banned the use of this substance India is yet to: do so, which is why paint makers use them.
- 'Inhaling lead dust like opening or closing windows is the most common source of lead poisoning.
- The human body is not designed to process lead. Young children are particularly vulnerable to lead as it can damage the central nervous system and the brain.
- If lead is so poisonous why do paint makers continue to use it?
- Using lead, substitutes increases the cost and also reduces paint performance.

TRANSFAT

- Transfats are formed during the process of addition of hydrogen atoms to oils, a process which industry prefers as it keeps the oil from turning rancid and ensures a longer Shelf life. (E.g trans-fatty acid in vanaspati).

- Transfats are associated with a host of serious health problems ranging from diabetes to heartdisease to cancer.
- The health ministry in 2008 came out with a notification for labelling food including transfats.
- Junk food high in transfats,

HIGH CAFFEIENE IN ENERGY.DIUNKS

- Energy drinks are in controversy because of its high caffeine content. Most of these brands
- have upto 320 ppm of caffeine in them. These drinks are marketed as an instant source of energy.
- The manufacturers claim that it is the combination of caffeine, taurine, glucoronolactone, vitamins, herbal supplements, and sugar or sweeteners that gives the energy.
- According to study reports, it is the sugar that gives the energy rush, the caffeine only gives a 'feeling' of energy.
- Energy drinks fall under the category of 'Proprietary foods' in the Prevention of Food Adulteration (PFA) Act of 1954.
- An amendment in the PFA act 2009 ensured that caffeine in energy drinks should be capped at 145 ppm, the limit that was set for carbonated beverages.
- However, Red Bull managed to get a stay order on the amendment of the PFA act in2010 and since then the energy drink market is expanding unregulated.
- The Food Safety and Standards Authority of India (FSSAI) is currently making regulations on energy drinks.

PESTICIDE IN HUMAN BLOOD

- Pesticides are commonly used in India but this comes at great cost to human health. It found that 15 different pesticides in the 20 blood samples tested from four villages in Punjab.

TESTING OF PESTICIDE TOXICITY

- All pesticides are tested to establish toxicity — a dose necessary to produce a measurable harmful effect; it is usually established through tests on mice, rats, rabbits and dogs.
- Results are then extrapolated on humans, and safe exposure levels predicted.
- he value commonly used to measure acute toxicity is LD 50 (a lethal dose in the short term; the subscript 50 indicates the dose is toxic enough to"killl 50 per cent of lab animals exposed to the chemical).
- LD 50 values are measured zero onwards; the lower the LD 50 the more highly toxic the pesticide.
- comparison of DDT most Used in India up to the early 1990s ,with monocrotophos, currently most used.
- DDT' S LD 50 is 113 mg/kg; monocrotophos, 14 mg/kg. But never forget that lower LD 50 means higher acute toxicity

DISEASES CAUSED BY ENVIRONMENTAL DEGRADATION

a) Minamata disease

- first discovered in Minamata city in Kumamoto prefecture, Japan in 1956.
- caused by the release of methyl mercury in the industrial wastewater from the Chisso Corporation's chemical factory, which continued from 1932 to 1968.
- referred to as Chisso-Minamata diseas, is a neurological syndrome caused by severe mercury poisoning.

b)Yokkaichi asthma

- occurred in the city of Yokkaichi in Mie Prefecture, Japan between 1960 and 1972.
- The burning of petroleum and crude oil released large quantities of sulfur oxide that caused severe smog.

c) Itai-itai disease

- was the documefited case of mass cadmium poisoning in Toyama Prefecture, Japan, starting around 1912.
- The cadmium poisoning caused softening of the bones and kidney failure.
- The cadmium was released into rivers by mining companies in the mountains.

d) Blue baby syndrome

- caused by high nitrate contamination in ground water resulting in decreased oxygen carrying capacity of hemoglobin in babies leading to death.

e) Pneumoconiosis

- The coal miners are frequently caught by the black lung disease, which is also called as Pneumoconiosis
- caused due to the deposit of coal dust in the lungs of coal miners, leads to a serious lung disease called as Black Lung disease

f) Asbestosis

- Workers working in the asbestos industry are caught by the serious lung disease called as asbestosis.

G) Silicosis

- caused due to the deposit of silica in the lungs of workers working in silica industries or at the sand blasting sites

h) Emphysema

- The breaking down of sensitive tissue of lungs due to air pollution and smoke of cigarette is called as Emphysema.
- Once this disease happens, the lungs cannot expand and contract properly

I) Sick Building Syndrome (SBS)

- Sick building syndrome (SBS) is a combination of ailments (a syndrome) associated with an individual's place of work or residence.
- Most of the sick building syndrome is related to poor indoor air quality.

The National Wastelands Development Board (NWDB)

- ✓ The National Wastelands Development Board (NWDB) was set up under the. Ministry of Environment & Forests in 1985 with the objective of
  i. to increase tree and other green cover on wastelands,
  ii. to prevent good land from becoming wasteland, and
  iii. to formulate within the overall nodal policy, perspective plans and programmes for the management and development of the wastelands in the country.
- ✓ In 1992, the Board was transferred to the Ministry of Rural Development, putting under a New Department of Wastelands Development under the charge of a Minister of State

Bioassay

- ✓ a test in which organisms are used to detect the presence or the effects of any other physical factor, chemical factor, or any other type of ecological disturbance.
- ✓ are very common in pollution studies.
- ✓ can be conducted by using any type of organisms.
- ✓ The fish and insect bioassays are very common.
- ✓ The aim is to find out either lethal concentration or effective concentration causing mortality or other effects. Ultimately they are to be used for determination of safe concentration of a chemical or maximum acceptable toxicant concentration (MATC).