



IAS NETWORK



UPSC 2022

ENVIRONMENT

NOTES

BY TOPPERS

To the Point Content, Relevant for Actual Exam

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BASICS OF ECOLOGY

WHAT IS ECOLOGY?

Ecology **Oikos** means home or **place to live in**. Literally it is the study of the home of nature. Scientific study of the relationship of the living organisms with each other and with their environment.

ENVIRONMENT AND ITS COMPONENT

The relationship and **interaction between organisms and the environment** are highly complex. It comprises both living (biotic) and non-living (abiotic) components.

Abiotic : Energy ; Radiation ; Temperature & heat flow; Water Atmospheric gases and wind; Fire; Gravity ; Topography; Soil; Geologic substratum

Biotic: Green plants; Non green plants; Decomposers; parasites; symbionts; Animals; Man

LEVELS OF ORGANISATIONS IN ECOLOGY

The main levels of organisation of ecology are six and are as follows.

1. Individual

Living being that has the **ability to act or function independently**. It may be plants, animals, bacteria, fungi, etc.

2. Population

Population is a **group of organisms usually of the same species**, occupying a defined area during a specific time.

The main factors that make population **increase** : birth and **immigration**

The main factors that make the population **decrease** : death and **emigration**.

Population density is the relation between number of individuals of population and area they acquire.

3. Community

Communities in most instances are named after the **dominant plant form (species)**.

For example: A grassland community is dominated by grasses, though it may contain herbs, shrubs, and trees, along with associated animals of different 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. E.g: tropical evergreen 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.

4. Ecosystem

An ecosystem is defined as a **structural and functional unit of biosphere** consisting of a 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.

Components of Ecosystem : The components of the ecosystem are categorised into **abiotic of non-living and biotic of living components**. Both the components of the ecosystem and environment are the same.

1. Abiotic Components :

- The inorganic and nonliving 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.

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.

a) Primary Producers - Autotrophs (self nourishing)

- Green plants (and certain bacteria and algae).
- In the terrestrial ecosystem, producers are basically herbaceous and woody plants, while in aquatic ecosystems 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 namely micro and macro consumers.

(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 eg.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, eg 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.
- **Earthworms and certain soil organisms (such as nematodes, and arthropods) are detritus feeders** and help in the decomposition of organic matter and are called **detritivores**.

Classification of Ecosystem

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 ecosystems.

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 incoming community and a simultaneous decrease in species of the other outgoing adjoining community.
- A well developed ecotone contains 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 it 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 requirements.

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, and 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 storeys of broad-leaved evergreen tree species are in abundance.

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

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 resistant vegetation such as cactus, euphorbias, sagebrush. Fauna : Reptiles, Mammals and birds.

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

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 the food chain.
- Types of food chain:

1. **Grazing food chain** :It starts from the living green plants, goes to grazing herbivores, and on to carnivores.
 - **For example** –The phytoplanktons →zooplanktons →Fish sequence or the grasses →rabbit →Fox.
2. **Detritus food chain**: It goes from dead organic matter into microorganisms and then to organisms feeding on detritus and their predators.
 - Such ecosystems are thus less dependent on direct solar energy.
 - These depend chiefly on the influx of organic matter produced in another system. For example – food chain operating in the accumulated litter in a temperate forest.

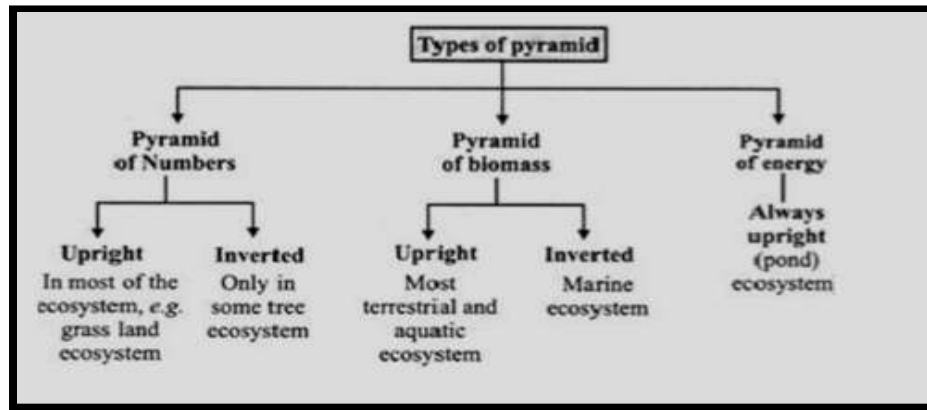
2. FOOD WEB : "A food web illustrates all possible transfers of energy and nutrients among the organisms in an ecosystem, whereas a food chain traces only one pathway of the food".

3.ECOLOGICAL PYRAMIDS

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

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	2. Pyramid of Biomass	3. Pyramid of Energy
<p>This deals with the <u>relationship between the numbers of primary producers and consumers of different levels</u>.</p> <p>Depending upon the size and biomass, the pyramid of numbers <u>may not always be upright</u>, and may even be completely inverted.</p> <p>(a) Pyramid of numbers – (upright)</p> <p>In this pyramid, the number of individuals is <u>decreased from lower level to higher</u> trophic level.</p> <p>This type of pyramid can be seen in <u>grassland</u> ecosystems.</p> <p>(b) Pyramid of numbers – (inverted)</p> <p>In this pyramid, the number of individuals is <u>increased from lower level to higher trophic level</u>.</p> <p>- The pyramid of number does not completely define the trophic structure for an ecosystem.</p>	<p>In this approach individuals in each trophic level are <u>weighed instead of being counted</u>. This gives us a pyramid of biomass, i.e., the total dry weight of all organisms at each trophic level at a particular time.</p> <p><u>Biomass is measured in g/m²</u>.</p> <p>(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</p> <p>(b) Inverted pyramid-In contrast, in many aquatic ecosystems, the pyramid of biomass may assume an inverted form</p>	<p>To compare the functional roles of the trophic levels in an ecosystem, an energy pyramid is most suitable.</p> <p>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.</p> <p>Hence the pyramid is always upward, with a large energy base at the bottom.</p>



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 the 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.

Interactions	Species A	Species B	Examples
Mutualism/ Symbiotic	+	+	<ul style="list-style-type: none"> Leguminous plants and nitrogen fixing bacteria Process of pollination in plants.
Commensalism	+	0	<ul style="list-style-type: none"> Remoras eating leftover food of the shark without depleting shark's resources.
Amensalism	-	0	<ul style="list-style-type: none"> Shading out of one plant by a taller and wider one. Allelopathy - inhibition of one plant by the secretions of another.
Parasitism	+	-	<ul style="list-style-type: none"> Mosquitoes, ticks, and the protozoan that causes malaria.
Competition	-	-	<ul style="list-style-type: none"> Lion and tiger in the same niche.
Predation	+	-	<ul style="list-style-type: none"> Lion and zebra, bear and fish, and fox and rabbit.

BIOGEOCHEMICAL CYCLE

- The elements or mineral nutrients are always in circulation moving from nonliving 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.

Types of Nutrient Cycle: Based on the replacement period a nutrient cycle is referred to as Perfect or Imperfect cycle.

- 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)

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

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 the atmosphere.

4. The Nitrogen Cycle

-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 (fertilizer factories) and (iii) To a limited extent by atmospheric phenomenon such as thunder and lightning

-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.

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.

- This is the nutrient considered to be the main cause of excessive growth of rooted and free-floating microscopic plants in lakes.

- On land phosphorus is usually found in the form of phosphates

-In the ocean once the phosphorus accumulates on continental shelves in the form of insoluble deposits

(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 (H₂S) and sulphur dioxide (SO₂) add a gaseous component to its normal sedimentary cycle.

ECOLOGICAL SUCCESSION

- A process of directional change in vegetation on an ecological time scale. In this process, a series of communities replace one another due to large scale natural or anthropogenic destructions.

TYPES OF ECOLOGICAL SUCCESSION

- **Primary Succession:** When a terrestrial site is first colonised by the pioneer species. (New Site)

-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:** Sequential development of biotic communities after disturbance/destruction (occurs when plants recognize an area in which the climax community has been disturbed)

• Examples of succession: For terrestrial land: Bare rocks – Lichens -- Annual Plants -- Perennial Plants and Grasses – Shrubs – Softwood Trees, Pines – Hardwood trees

• For Hydrosere: Phytoplankton – submerged plant stage – Submerged free floating plant stage – Reed swamp stage(Sedge) – Marsh meadow stage – Scrub stage - Forest

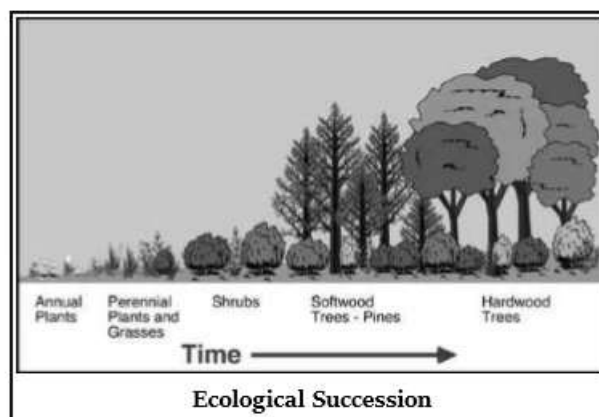
Autogenic and Allogenic Succession

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.

SERAL COMMUNITY (SERE) :An intermediate stage found in ecological succession in an ecosystem advancing towards its climax community.



TERRESTRIAL ECOSYSTEMS

The interrelations between organisms and environment on the land constitute "Terrestrial Ecology".

FOREST ECOSYSTEM

- Forests may be evergreen or deciduous.
- distinguished on the basis of leaf into broad-leaved or needle-leaved coniferous forests in the case of temperate areas.
- classified into three major categories: coniferous forest, temperate forest and tropical forest.

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 podzols and are rather poor. Both because the weathering of rocks proceeds slowly in cold environments and because the litter is derived from conifer needles (leaves decompose very slowly and are not rich in nutrients).
- These soils are acidic and are mineral deficient.

Temperate deciduous forest:

- The temperate forests are characterised by a moderate climate and broad-leaved 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 podzolic 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 leaved 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 rainforests is high as compared to other temperate forests.

Tropical rain forests:

- Near the equator, 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 extreme dense vegetation of the tropical rain forests remains vertically stratified with tall trees often covered with vines, creepers, lianas, epiphytic orchids and bromeliads.
- 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 rainforests:

- 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.

1.Tropical Wet evergreen forests i).They are found along the Western Ghats, the Nicobar and Andaman Islands and all along the north-eastern region. ii) It is characterized by tall, straight evergreen trees.	2.Tropical Semi-evergreen forests i)found in the Western Ghats, Andaman and Nicobar Islands, and the Eastern Himalayas. ii)Such forests have a mixture of the wet evergreen trees and the moist deciduous trees. The forest is dense	3.Tropical Moist deciduous forests i)found throughout India except in the western and the north-western regions. ii) The trees are tall, have broad trunks, branching trunks and roots to hold them firmly to the ground. Iii) Flora: sal and teak, along with mango, bamboo, and rosewood	4.Tropical Dry deciduous forest i) 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. ii)The canopy of the trees does not normally exceed 25 metres.
5.Tropical Thorn forests i) 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.	6.Tropical Dry evergreen forest i) 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.	7.Sub-tropical Broad-leaved forests i) Broad-leaved forests are found in the Eastern Himalayas and the Western Ghats, along the Silent Valley. Ii)There is a marked difference in the form of vegetation in the two areas	8.Littoral and swamp i)found along the Andaman and Nicobar Islands and the delta area of the Ganga and the Brahmaputra. ii) They have roots that consist of soft tissue so that the plant can breathe in the water.
9.Sub-tropical Pine forests i) found in Shivalik Hills, Western and Central Himalayas, Khasi, Naga, and Manipur Hills. ii)Flora: chir,oak, rhododendron,and pine as well as sal, amla, and laburnum are found in the lower regions	10.Sub-tropical Dry evergreen forests i)hot and dry season and a cold winter. It generally has evergreen trees with shining leaves that have a varnished look. Ii) found in the Shivalik Hills and foothills of the Himalayas up to a height of 1000 metres	11.Sub alpine forest i)Sub alpine forests extend from Kashmir to Arunachal Pradesh between 2900 to 3500 metres.	12.Moist Alpine scrub i) Moist alpiners are found all along the Himalayas and on the higher hills near the Myanmar border. ii)It has a low scrub, dense evergreen forest, consisting mainly of rhododendron and birch. iii)Mosses and ferns cover the ground in patches. This region receives heavy snowfall.

<p>13.Montane-Wet temperate forests i) 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. ii) In the South, it is found in parts of the Nilgiri Hills, the higher reaches of Kerala</p>	<p>14.Himalayan Moist temperate Forest i) 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, ferries, and bamboo.</p>	<p>15.Himalayan Dry temperate Forest This type is found in Lahaul, Kinnaur, Sikkim, and other parts of the Himalayas.</p>	<p>16.Dry alpine scrub Dry alpine are found from about 3000 metres to about 4900 metres. Dwarf plants predominate, mainly the black juniper, the drooping juniper, honeysuckle, and willow.</p>
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GRASSLAND ECOSYSTEM

- Rainfall is about 25-75 cm per year, not enough to support a forest, but more than that of a true desert.
- 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.

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 cycle.
- 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 from the seas.
- 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**
These plants conserve water by following methods: They are mostly shrubs. I) Leaves are absent or reduced in size. Ii) Leaves and stems are succulent and water storing.
iii) In some plants even the stem contains chlorophyll for photosynthesis.
iv) Root system is well developed and spread over a large area.

STATE OF FOREST REPORT 2019

- The report is published by the Forest Survey of India (FSI)

- Starting 1987, 16 assessments have been completed so far. ISFR 2019 is the 16th report in the series.

SALIENT FEATURES

- India is among the few countries in the world where forest cover is consistently increasing.
- Total forest and tree cover of the country is 80.73 million hectares which is 24.56 percent of the geographical area. Total forest cover – 21.67% o Tree cover – 2.89%
- As compared to 2017, there is an increase of 5188 sq km in the total forest and total tree cover (forest cover – 3976 sq km; tree cover – 1,212 sq km).
- Highest range increase in forest cover has been observed in open forest followed by very dense forest and moderately dense forest.
- Top three states showing an increase in forest cover are Karnataka (1,025 sq. km) followed by Andhra Pradesh (990 sq km) and Kerala (823 sq km), Jammu and Kashmir and Himachal Pradesh.
 - Area wise Madhya Pradesh has largest area of forests in the country followed by Arunachal Pradesh, Chhattisgarh, Odisha and Maharashtra.
 - In terms of forest cover **as percentage of total geographical area**, the top five States are Mizoram (85.41%), Arunachal Pradesh (79.63%), Meghalaya (76.33%), Manipur (75.46%) and Nagaland (75.31%).
 - Top three states showing mangrove cover increase are Gujarat (37 sq km) followed by Maharashtra (16 sq km) and Odisha (8 sq km)
 - Amongst the States, Gujarat has the largest area of wetlands within the reserved forest area followed by West Bengal.

AQUATIC ECOSYSTEM

- Freshwater 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 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 ecosystems, 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

Sunlight : Sunlight penetration rapidly diminishes as it passes down the column of water. 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.

a photo (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 the 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.

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 lie 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 ecosystems).
- 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.
- On-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 covering almost the entire surface layer on water 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.

WETLAND ECOSYSTEM

- Wetlands are transition zones between terrestrial and aquatic ecosystems.

- E.g. Mangroves, lake littorals (marginal areas between highest and lowest water level of the lakes), floodplains (areas lying adjacent to the river channels beyond the natural levees and periodically flooded during high discharge in the river) and other marshy or swampy areas.

- Waterlogged soil adapted plant life (hydrophytes) and hydric soils (not enough O₂) are the chief characteristics of wetlands.

Wetlands Classification-

1. Inland wetland-

a) Natural- Lakes / Ponds, Ox-bow Lakes, Waterlogged, Swamp/marsh

b) Man Made- Reservoirs Tank, Ash pond

2. Coastal Wetland-

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

b)-manmade -Salt pans, Aquaculture

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)

India's Wetland

- Wetlands occupy 18.4% of the country's area of which 70% are under paddy cultivation.
- Inland wetlands > Coastal 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 ensure their wise use for the benefit of local communities and overall conservation of biodiversity.

Objectives :

- o to lay down policy guidelines for conservation and management of wetlands in the country.
- o to provide financial assistance for undertaking intensive conservation measures in the identified wetlands
- o 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.
- o 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:

- Sites containing representative, rare or unique wetland types -found within the appropriate biogeographic region.
- 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.
- 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.
- Specific criteria based on fish- If it supports a significant proportion of indigenous fish subspecies, species or families.

WETLANDS INTERNATIONAL

• Wetlands International is a non-profit organization established in 1937 as 'International Wildfowl Inquiry' • HQ in the Netherlands.

ESTUARY ECOSYSTEM

- Estuaries are located where rivers meet the sea.
- 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
- Estuaries acts as a natural water filter
- India 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 India's major estuaries occur on the east coast. In contrast, the estuaries on the west coast are smaller.

MANGROVES

- Mangroves are salt-tolerant plants, also called halophytes, that are adapted to harsh coastal conditions of tropical and subtropical intertidal regions of the world receiving rainfall between 1,000 to 3,000 mm and temperature ranging between 26-35°C.
- These require high solar radiation and have the ability to absorb fresh water from saline/ brackish water.
- They produce pneumatophores (blind roots) to overcome respiratory problems in the anaerobic soil conditions - Pneumatophores (aerial roots) allow mangroves to absorb gases directly from the atmosphere.
- Leaves are thick and contain salt secreting glands.
- They exhibit a viviparity mode of reproduction. i.e. Seeds germinate in the tree itself (before falling to the ground).

- The mangroves of Sundarbans are the largest - single block of tidal halophytic mangroves of the world. They are famous for the Royal Bengal Tiger and crocodiles.
- Mangroves 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, and provide breeding ground for fishes.
- Mangrove protects coastal lands from tsunami, hurricanes and floods.
- ❖ According to the State of Forest Report 2019
 - Mangroves cover 0.15% of the country's total geographical area.
 - There has been a net increase of 54 sq km of mangrove cover in the country as compared to 2017 assessment.
 - Order of States by Mangrove Cover: West Bengal (42.5%), Gujarat (23.6%), Andaman and Nicobar Islands (12.4%), Andhra Pradesh (8.1%), Maharashtra, Odisha, etc.

MANGROVES FOR FUTURE (MFF)

- It is a collaboration between multiple partners, including governments, NGO, research institutes etc.
- It is co-chaired by the IUCN and UNDP.
- It promotes investment in coastal ecosystems for sustainable development.
- The goal is to promote an integrated ocean-wide approach to coastal management and to build the resilience of ecosystem-dependent coastal communities.
- Mangroves are the flagship of the initiative, but MFF is inclusive of all types of coastal ecosystem, such as coral reefs, estuaries, lagoons, sandy beaches, seagrass and wetlands.
- India is a member country.

CORAL REEFS

- Coral is actually a living animal. Coral 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 seafloor, the algae lives up on the coral which is closer to the ocean surface and so that the algae gets adequate light].
- Zooxanthellae assist the coral in nutrient production through its photosynthetic activities.

Features

- They occur in shallow tropical areas where the sea water is clean, clear and warm.
- The coral reef cover in Indian waters is roughly estimated up to 19,000 sq. Km.
- Coral reefs are one of the most productive and complex coastal ecosystems with high biological diversity.
- The high productivity is owing to the combination of its own primary production and support from its surrounding habitat.
- Reef building corals are a symbiotic association of polyps (coral animals) and 'zooxanthellae' (the microscopic algae)
- The corals are generally slow growing colonies of animals while zooxanthellae are fast growing plants.
- In coral reef ecosystem, many invertebrates, vertebrates, and plants live in close association to the corals, with tight resource coupling and recycling, allowing coral reefs to have extremely high productivity and biodiversity, such that they are referred to as 'the Tropical Rainforests of the Oceans'.

Corals are classified depending on their locations into fringing, patch, barrier and atoll.

- o The fringing reefs are contiguous with the shore and they are the most common - by occurring reef form, found in Andamans.
- o 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 Kachchh.
- o 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.
- o 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.
- o 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 / or
- (ii) the concentration of photosynthetic pigments within the zooxanthellae fall.

Causes of coral bleaching:

1. Temperature disruption (Major Cause)- low and high sea temperatures can induce coral bleaching
2. Solar radiation has been suspected to play a role in coral bleaching.
3. 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.
4. Sediment loading could make zooxanthellate species more likely to bleach
5. Rapid dilution of reef waters from storm-generated precipitation and runoff has been demonstrated to cause coral reef bleaching.

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
2. Land Ocean Interactions in the Coastal Zone (LOICZ) - Launched in 1995. Investigates the effects of global change on the coastal zone.
3. Integrated Coastal and Marine Area Management (ICMAM) - Launched in 1998 , Aims at integrated management of coastal and marine areas.
4. Society of Integrated Coastal Management (SICOM) - Launched in 2010, Major national initiative to protect coastal ecosystems
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.

6. The mangroves and coral reefs areas are categorized as ecological sensitive areas (CRZ-I) where no new constructions are permitted except projects relating to Department of Atomic Energy; pipelines, conveying systems including transmission lines; installation of weather radar for monitoring of cyclones movement and prediction by Indian Meteorological Department and construction of trans harbour sea link and without affecting the tidal flow of water.

7. Coral reef is included in Schedule I of the Wild Life Protection Act, 1972 which affords it the highest degree of protection.

ENVIRONMENTAL POLLUTION

Environmental pollution is 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 effects 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 pollutants 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. Chlorofluorocarbons (CFC)

gases that are released mainly from air-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 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 (SO₂)

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 has soot or smoke in it.

Interaction of sunlight with certain chemicals in the atmosphere.

The primary component 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

Fly Ash

Ash is produced whenever combustion of solid material takes place.

Composition 1. Aluminium silicate (in large amounts) 2. silicon dioxide (SiO_2) and 3. Calcium oxide (CaO).

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 copper

BLACK CARBON

Black carbon is inorganic in nature consisting of soot particles that directly come out of combustion process, exhaust fumes that form part of particulate matter present in the air.

It is a short-lived climate pollutant with a lifetime of only days to weeks after release in the atmosphere.

Black carbon absorbs sunlight and in turn warms the atmosphere. When inhaled it causes severe health problems.

Black carbon absorbs light in the visible spectrum.

It absorbs both incoming and terrestrial radiations.

PHOTOCHEMICAL SMOG

It occurs in warm, dry and sunny climates. The main components of the photochemical smog result from the action of sunlight on unsaturated hydrocarbons and nitrogen oxides produced by automobiles and factories. Photochemical smog has high concentration of oxidising agents and is, therefore, called as oxidising smog.

The common components of photochemical smog are ozone, nitric oxide, acrolein, formaldehyde and Peroxyacetyl nitrate (PAN).

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).

- **BIOCHEMICAL OXYGEN DEMAND (BOD)**

It is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present.

The more organic matter there is (e.g., in sewage and polluted bodies of water), the greater the BOD; and the greater the BOD, the lower the amount of dissolved oxygen available for higher animals such as fishes.

- Chemical oxygen demand (COD) is a slightly better mode used to measure pollution load in water. It is the measure of oxygen equivalent to the requirement of oxidation of total organic matter (i.e. biodegradable and nonbiodegradable) present in water.

- A crippling 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 methemoglobinemia or blue baby syndrome.
- Over exploitation of ground water may lead to leaching of arsenic from soil and rock sources and contaminate groundwater. Chronic exposure to arsenic causes black foot disease. It also causes diarrhoea, -peripheral neuritis, hyperkeratosis and also lung and skin cancer.

SOIL POLLUTION

- Industrial waste includes chemicals such as mercury, lead, copper, zinc, cadmium, cyanides, thiocyanates, 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.
- Silence Zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area declared as such by a competent authority.

RADIOACTIVE POLLUTION

- Non-ionising radiations affect only those components which absorb them and have low penetrability. They include short-wave radiation 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 macromolecules 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
- The nuclear arms use uranium-235 and plutonium-239 for fission and hydrogen or lithium as fusion material
- The radionuclides 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 discharges
- 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 a 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)

It 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. It is used to reduce contamination in natural wetlands and estuary areas.

ENVIRONMENTAL IMPACT ASSESSMENT

- EIA integrates the environmental concerns in the developmental activities right at the time of initiating for preparing the feasibility report.
- 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
- '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 process in India is made up of the following phases:**
 - Screening
 - Scoping
 - Baseline data collection
 - Impact prediction
 - Assessment of alternatives, delineation of mitigation measures and environmental impact statement
 - Public hearing
 - Environment Management Plan
 - Decision making
 - Monitoring the clearance conditions
- Salient Features of 2006 Amendment Environment Impact Assessment Notification of 2006 has decentralised the environmental clearance projects by categorizing the developmental projects in two categories, i.e., Category A and Category B.
- After the 2006 Amendment the **EIA cycle comprises four stages** : 1. Screening 2. Scoping 3. Public hearing 4. Appraisal
- **PARIVESH (Proactive and Responsive facilitation by Interactive, Virtuous and Environmental Single-window Hub):** PARIVESH is a Single-Window Integrated Environmental Management System. Key features include single registration and single sign-in for all types of clearances (i.e. Environment, Forest, Wildlife and CRZ), unique-ID for all types of clearances required for a particular project and a single Window interface for the proponent to submit applications for getting all types of clearances (i.e. Environment, Forests, Wildlife and CRZ clearances).

BIODIVERSITY

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 interbreed in nature.

- It is the ratio of one species population over the total number of organisms across all species in the given biome.
- **'Zero' would be infinite diversity, and 'one' represents only one species present.**

(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.

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:

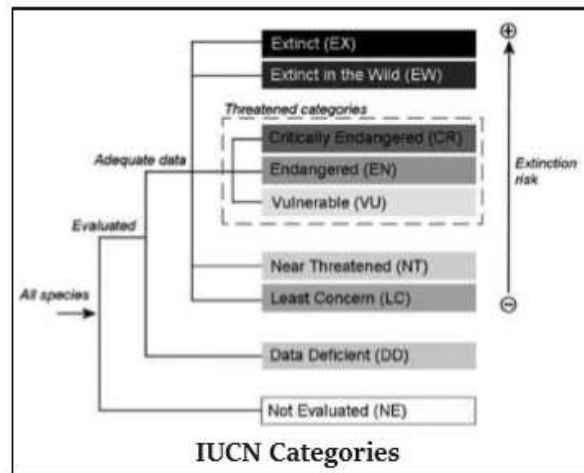
- Conserving the animals and plants in their natural habitats is known as in-situ conservation.
- The established natural habitats are: National parks, Sanctuaries, Biosphere reserves and Reserved forests, Protected forests, Nature reserves

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

THE RED DATA BOOK

- Species judged as threatened are listed by various agencies as well as by some private organizations. The most cited of these lists is the Red Data Book.
- It is issued by the International Union for Conservation of Nature (IUCN) located in Morges, Switzerland.
- The pink pages in this publication include the critically endangered species.
- Green pages- species formerly endangered, but have now recovered to a point where they are no longer threatened



IUCN CLASSIFICATION OF CONSERVATION PRIORITY

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

- 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

- reduction in population size (70% over the last 10 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 very high risk of extinction in wild in near future

Vulnerable (VU) - criteria

- reduction in population (> 50% over the last 10 years)

- population size estimated to number fewer than 10,000 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.

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 the world Eight terrestrial biogeographic realms are typically recognized.
- They are 1. nearctic realm ,2. palaeartic realm, 3. afrotropical realm, 4. indomalayan realm,5. oceania 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.

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 a group of greyish green plants which grow on rocks, tree-trunks, dead wood, etc.
- The alga 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 hornworts

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. Angiosperms

- 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

SCHEDULE ANIMALS OF WPA 1972

SCHEDULE LIST-WPA, 1972 Wildlife Protection Act (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.

❖ Schedule 1 and part II of Schedule 2

- Animals listed in schedule 1 and part II of schedule 2 have absolute protection - offences under these are prescribed the highest penalties.

❖ Schedule 3 and schedule 4

- 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 2.

❖ schedule 5

- 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 [i.e. vermin].

❖ **Schedule 6**

- Cultivation, Collection, extraction, trade, etc. of Plants and its derivatives listed in schedule 6 are prohibited.
- Red Vanda, blue Vanda, kuth, pitcher plant, beddomes cycad and ladies slipper orchid are the list of plants listed in schedule 6.

❖ **EXTINCT SPECIES**

- Caspian tiger, Bali tiger and Java tiger are extinct. The species which are alive are Bengal tiger, Amur tiger, South china tiger, Sumatran and Malayan tiger, Indo-Chinese tiger.
- Black soft-shell turtles are classified as extinct in the wild and are being bred in Assam.
- Australia officially declared a Great Barrier Reefrodent called Bramble Cay melomys extinct recently. It became the first mammal believed to have been killed off by human-induced climate change.
- The rodent lived solely on a tiny sand island in the Torres Strait, near the coast of Papua New Guinea
- African Cheetah - The only mammal to become extinct in India in the last 1,000 years.

ANIMAL DIVERSITY OF INDIA

CRITICALLY ENDANGERED MAMMALS

1. Pygmy Hog (*Porcula salvania*)

- 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*)

- 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.

4. The Large Rock Rat or Elvira Rat, (*Cremnomys elvira*)

- It is a medium sized, nocturnal and burrowing rodent. endemic to India.
- Habitat: Tropical dry deciduous shrubland forest, seen in rocky areas.
- 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*)

- 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*)

- It 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 is a 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.

MARINE MAMMALS

1. Freshwater / river dolphin

- Habitat / distribution - India, Bangladesh, Nepal and Pakistan which is split into two subspecies, the Ganges river dolphin and Indus river dolphin.

2. Ganges river dolphin

- Habitat / distribution - Ganges and Brahmaputra Rivers and their tributaries in Bangladesh, India and Nepal.
- The Ganges river dolphin has been recognized by the government of India as its National Aquatic Animal.

3. Indus river dolphin

- Habitat / distribution - Indus River in Pakistan and its Beas and Sutlej tributaries.

4. Herbivorous Marine Mammals

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

Dugong - (Dugong dugon) also called as sea cow.

Status - vulnerable.

Threat - hunting (meat and oil), habitat degradation, and fishing-related fatalities.

Manatees

- Habitat / distribution - Caribbean Sea, Gulf of Mexico, the Amazon Basin, and West Africa
- Threat - coastal development, red tide, hunting.

FEW EXCEPTIONS

1. **Egg Laying Mammals** The unique feature of monotremes, a subdivision of mammals, 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.
2. **Platypus** is a semi-aquatic mammal. ➤ Habitat / distribution - endemic to eastern Australia, including Tasmania.
3. **Marsupials**
 - Marsupials are the group of mammals commonly thought of as pouched mammals (like the wallaby and kangaroo).
 - Marsupial mammals have placenta but it is very short lived and does not make as much of a contribution to fetal nourishment.
 - They do not have long gestation times like placental mammals. The short gestation time is due to having a yolk-type placenta in the mother marsupial.
 - Extinct - Marsupial - quagga, the marsupial wolf .

List of Marsupials: Phalangers, Opossum, Kola, Tasmanian devils, Kangaroo, Marsupial Mole (4 foot), Wallaby, Bandicoot, Wombats, Tasmanian Wolf /Tiger, Dasyure.

BIRDS - CRITICALLY ENDANGERED

1. **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 Lankamalleswara Wildlife Sanctuary.
 - Distribution: Jerdon's Courser is endemic to Andhra Pradesh.
2. **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.
3. **The White-bellied Heron (Ardea insignis)**
 - Extremely rare bird is 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.
4. **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.
- 5. 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.
- 6. 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.
- 7. Sociable Lapwing (*Vanellus gregarius*)**
- 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.
- 8. Spoon Billed Sandpiper (*Eurynorhynchus 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.
- 9. 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

1. 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, Hooghly and Ghagra rivers.
- Now extinct in Myanmar, Pakistan, Bhutan and Bangladesh.

2. 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.

3. Leatherback Turtle (*Dermochelys 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.

4. Four-toed River Terrapin or River Terrapin (*Batagur baska*) (a type Turtle)

- 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.

5. Red-crowned Roofed Turtle or the Bengal Roof Turtle (*Batagur kachuga*)

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

6. Sispara day gecko (*Cnemaspis sisparensis*)

- 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.

FISH

1. The Pondicherry Shark (*Carcharhinus hemiodon*)

- It is a marine fish that occurs or occurs 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 recorded at the mouth of the Hooghly river.

2. The Ganges Shark (*Glyphis gangeticus*)

- 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 suggest 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.

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).

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 ducks 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 three Indian states: Karnataka, Kerala, and Tamil Nadu.
 - Captive breeding - arignar 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, inhabiting montane grasslands of western ghats.
 - It is the state animal of Tamil nadu.
 - Shola forests (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, Pobitora Wildlife Sanctuary, Manas National Park, Assam
- 15. Wild Ass**
- Habitat: Flat grassland covered expanse known as bets (islands where coarse grasses spring up during the monsoon).
 - National Parks: Little Rann Of Kutch, Gujarat

VULNERABLE MAMMALS

1. Chiru / Tibetan 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, and magnificent horns.

2. Himalayan tahr

- habitat — Himalayas
- Tahr have many characteristics 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 animals.
 - Only species of marten are 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.

Important species

GANGES RIVER DOLPHIN

- Also known as “SuSu”; IUCN-Endangered; CITES- Appendix I
- The South Asian river dolphin is a freshwater or river dolphin found in India, Bangladesh, Nepal and Pakistan which is split into two subspecies, the Ganges river dolphin and Indus river dolphin
- The Ganges river dolphin is primarily found in the Ganges and Brahmaputra Rivers and their tributaries in Bangladesh, India and Nepal, while the Indus river dolphin is found in the Indus River in Pakistan and its Beas and Sutlej tributaries.
- The Ganges river dolphin has been recognized by the government of India as its National Aquatic Animal.
- Nearly 50 per cent of the total population of Ganges River dolphins is found in Bihar • These dolphins are found in Assam, Uttar Pradesh, Madhya Pradesh, Rajasthan, Bihar, Jharkhand

and West Bengal (7 states) and ideal habitats are in the Ganga, Chambal, Ghagra, Gandak, Sone, Kosi, the Brahmaputra and Kulsi rivers.

- The Ganges river dolphin is essentially blind. They hunt by emitting ultrasonic sounds, which bounces off of fish and other prey.

PANGOLIN

- Pangolin is the only scaly mammal on the planet.
- According to the Convention on International Trade in Endangered Species (CITES), it is also the most illegally traded vertebrate within its class (Mammalia).
- CITES Appendix I- All eight pangolin species are being transferred from Appendix II to Appendix I – thus prohibiting any international commercial trade in pangolin parts.
- Of the eight species of pangolin worldwide, two are found in India. They are Chinese pangolins, mostly found in northeast India and Indian pangolins.
- Indian Pangolin – IUCN status is endangered. Wildlife (Protection) Act 1972 Schedule I.
- Chinese Pangolin- Critically Endangered
- Pangolins are smuggled for its scales as it is believed that they possess magic or charms and have medicinal properties.

SARUS CRANE

- It is the tallest flying bird in the world standing.
- Sarus Crane is Listed in Schedule IV of the Wildlife (Protection) Act 1972
- It is state bird of U.P

OTTER

- Eurasian Otter, Smooth- Coated Otter, Small- Clawed Otter are found in India.
- The occurrence of all three species has been reported from northeast India and the Western Ghats.
- They are usually poached for their skin.
- River otters are an important indicator species. This is because the otter is a strict carnivore and contaminants that occur in the environment may concentrate in the otter over time in a process known as bio magnification.
- IUCN conservation status – o Smooth- Coated Otter – Vulnerable o Small- Clawed Otter – Vulnerable

INDIAN STAR TORTOISE

- The Indian star tortoise is a threatened species of tortoise found in dry areas and scrub forest in India, Pakistan and Sri Lanka.
- It is listed in Schedule IV of Wildlife Protection Act, 1972.
- It is listed as vulnerable in IUCN's Red List.

GHARIAL

- The gharial is one of three crocodiles native to India, the other two being the mugger crocodile and the saltwater crocodile.
- The male gharial has a distinctive boss at the end of the snout, which resembles an earthenware pot known in Hindi as ghara. The gharial's common name is derived from this similarity.
- Highest number of Gharial is found in River Chambal.

- **MUGGER CROCODILE** - The mugger crocodile, also called the Indian crocodile, or marsh crocodile, is found throughout the Indian subcontinent. It is listed as vulnerable by IUCN. The mugger is mainly a freshwater species, and found in lakes, rivers and marshes.
- **SALTWATER CROCODILE** - It is the largest of all living reptiles ; It is listed as least concerned by IUCN. It is found throughout the east coast of India

Great Indian Bustard

- Endemic to Indian subcontinent; Largest Bird Horizontally; Heaviest Flying bird; Highest population in Rajasthan
- Flagship Grassland species
- WPA-schedule I
- IUCN- Critically Endangered; also “CR” by Birdlife International
- CITES- Appendix I
- Listed in CMS or Bonn Convention
- Recovery programme under Integrated Development of Wildlife Habitat

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 state. and a 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 a 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

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.

The Indian Hunters

- Insectivorous plants of India belong mainly to three families: 1. Droseraceae , 2 Nepenthaceae and 3. Lentibulariaceae

- 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

Purposely or accidentally, people often bring non-native species into new areas where the species have few or no natural predators to keep their populations in check.

Aliens are species that occur outside their natural range. Alien species that threaten native plants and animals or other aspects of biodiversity are called alien invasive species.

Biological invasion by alien species is recognised as one of the major threats to native species and ecosystems. The effects on biodiversity are enormous and often irreversible.

SOME INVASIVE ALIEN FLORA OF INDIA

1. Needle Bush • Nativity: Trop. South America
2. Black Wattle • Nativity: South East Australia • Distribution in India: Western Ghats
3. Goat weed • Nativity: Trop. America
4. Prickly Poppy • Nativity: Trop. Central & South America
5. Blumea eriantha • Nativity: Trop. America
6. Palmyra, Toddy Palm • Nativity: Trop. Africa
7. Calotropis / Madar, Swallow Wort • Nativity: Trop. Africa
8. Datura, Mad Plant, Thorn Apple • Nativity: Trop. America
9. Water Hyacinth • Nativity: Trop. America
10. Impatiens, Balsam • Nativity: Trop. America
11. Touch-Me-Not, Sleeping Grass • Nativity: Brazil
12. 4 'O' clock plant • Nativity: Peru
13. Parthenium / Congress grass, Parthenium • Nativity: Trop. North America
14. Prosopis juliflora / Mesquite • Nativity: Mexico
15. Townsend grass • Nativity: Trop. W. Asia

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.

IMPORTANT MARINE ORGANISMS OF INDIA

PLANKTON

- The term 'plankton' refers to the group of organisms which float in the surface waters of the rivers, lakes and oceans.
- 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 locomotory power of the planktons is limited so that their distribution is controlled

PHYTOPLANKTON

- Derived from the Greek words phyto (plant) and plankton (made to wander or drift), phytoplankton are microscopic plant organisms that live in aquatic environments, both salty and fresh.
- Some phytoplankton are bacteria, some are protists, and most are single-celled plants. Among the common kinds are cyanobacteria, silica-encased diatoms, dinoflagellates, green algae, and chalk-coated coccolithophores.
- Phytoplankton produce more than 60% of oxygen produced from all plants.
- All phytoplankton photosynthesize, but some get additional energy by consuming other organisms.
- Their total biomass is many times greater than that of the total plants on land and they serve as the "pasture grounds" in the aquatic environment.

ZOOPLANKTON

- Play a vital role in the 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 Seagrass 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 substrata is available.

Uses of seaweeds

1. Seaweeds are important as food for humans, feed for animals, and fertilizer for plants.
2. Seaweeds are used as a drug for goiter treatment, intestinal and stomach disorders.
3. Products like agar-agar and alginates, iodine which are of commercial value, are extracted from seaweeds.
4. By the biodegradation of seaweed methane like, economically important gases can be produced in large quantities.
5. potential indicators of pollution in the coastal ecosystem, particularly heavy metal pollution due to their ability to bind and accumulate metals strongly.
6. 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.
- A wildlife sanctuary is defined by the State Government via a Notification.
- There is no need to pass legislation (act) by the state assembly to declare a wildlife sanctuary. Fixation and alteration of boundaries can be done by the state legislature via resolution.
- No alteration of boundaries in wildlife sanctuaries can be done without approval of the NBWL (National Board of Wildlife) Limited human activities are permitted in the sanctuary

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.
- No human activity is permitted inside the national park except for the ones permitted by the Chief Wildlife Warden of the state under the conditions given in the Wildlife Protection Act 1972.

Difference between NP and BR:

- the difference in conservation value of a National Park from that of a sanctuary is not specified in the WPA 1972
- 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 sanctuary in srivilliputhur) whereas the national park is not primarily focused on a particular species.

General Provision for Sanctuary and National Park

- Declaration of the Protected Area by the State Government
- No alteration of boundaries of a sanctuary/National Park shall be made except on recommendation of the National Board for Wild Life.
- Settlement of rights
 - The State Government shall make alternative arrangements required for making available fuel, fodder and other forest produce
- Claim of rights: In the case of a claim to a right in or over any land referred to, the Collector shall pass an order admitting or rejecting the same in whole or in part
 - collector may allow, in consultation with the Chief Wildlife Warden, the continuation of any right of any person in or over any land within the limits of the sanctuary

CONSERVATION RESERVE AND COMMUNITY RESERVES

- It is outcome of Amendments to the Wild life protection act in 2003
- It provides for a flexible system wherein 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 environments in India, are primarily classified. into following three categories:
- Category-I: This covers National Parks and Sanctuaries and has entire areas in intertidal/subtidal 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 evergreen or semi evergreen forests of Islands

SACRED GROVES OF INDIA

- Sacred groves comprise 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

ECOLOGICALLY SENSITIVE ZONES (ESZ's)

- It is created to act as a buffer for further protection around Protected Areas (PAs) such as National Parks and Wildlife Sanctuaries Activities around such areas are regulated and managed so as to protect the environment.
- ESZ is notified under Section 3 of the Environment (Protection) Act, 1986 by the Union Ministry of Environment and Forest.
- ESZ Guidelines classify activities under three categories:
 - o Prohibited: Commercial Mining, Setting of Saw Mill, Setting of industries causing pollution, establishment of major hydroelectric projects etc.
 - o Regulated: Felling of Trees, Establishment of hotels and resorts, erection of electrical cables, drastic change of agricultural systems etc.
 - o Permitted: Ongoing agriculture and horticulture practices by local communities, rain water harvesting, organic farming etc.

GLOBAL INITIATIVES

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 targets 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;
- MAB combines the natural and social sciences, economics and education to improve human livelihoods and the equitable sharing of benefits, and to safeguard natural and managed ecosystems
- study and compare the dynamic interrelationships between natural/near- natural ecosystems and socioeconomic 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.
- Its World Network of Biosphere Reserves currently counts 669 sites in 120 countries all over the world, including 16 transboundary sites.

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 landscapes extending over a 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.
 - o Biosphere Reserves: an Indian approach 1. National Biosphere Reserve Programme. initiated in 1986.
 - o 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 the most appropriate technology for the improvement of economic well-being of the local people.

Structure and Design of Biosphere Reserves

- In order to undertake complementary activities of biodiversity conservation and development of sustainable management aspects, Biosphere Reserves are demarcated into three interrelated zones.

1.The Core Zone:

- The core zone should be kept absolutely undisturbed; The core zone is to be kept free from all human pressures external to the system.

2.The Buffer Zone:

- Buffer Zone adjoins or surrounds core zone. Its uses and activities are managed in ways that protect the core zone. These uses and activities include restoration, demonstration sites for enhancing value addition to the resources, limited recreation, tourism, fishing and grazing, which are permitted to reduce its effect on the core zone. Research and educational activities are to be encouraged.

3. The Transition Zone:

- The Transition Zone is the outermost part of a Biosphere Reserve. This is usually not a delimited one and is a zone of cooperation where conservation, knowledge and management skills are applied and uses are managed in harmony with the purpose of the Biosphere Reserve. This includes settlements, crop lands, managed forests and areas for intensive recreation, and other economic uses characteristic of the region.

BIODIVERSITY HOTSPOTS

- Biodiversity hotspot concept was put forth by Norman Myers in 1988
- To qualify as a hotspot, 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 Hotspots 1. The Eastern Himalayas 2. Indo- Burma and 3. The western Ghats & Sri Lanka

Eastern Himalayas HotSpot:

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.

the plant species *Ermanium 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, Nilgiri 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
- "Natural heritage sites are restricted to those natural areas that
 1. furnish outstanding examples of the Earth's record of life or its geologic processes.
 2. provide excellent examples of ongoing ecological and biological evolutionary processes.
 3. contain natural phenomena that are rare, unique, superlative, or of outstanding beauty or 4.
 4. furnish habitats or rare endangered animals or plants or are sites of exceptional biodiversity".

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)
- The State Government shall, on recommendation of the National Tiger Conservation Authority, notify an area as a tiger reserve.

National Tiger Conservation Authority (NTCA):

- The Amendment Act of 2006 provides for the constitution of a statutory authority known as the National Tiger Conservation Authority to aid in the implementation of measures for the conservation of the tiger

Estimation of Tiger Populations

- ✓ The most commonly used technique in the past was 'Pugmark Census Technique'. In this method the imprints of the pugmark of the tiger were recorded and used as a basis for identification of individuals. Now it is largely used as one of the indices of tiger occurrence and relative abundance.
- ✓ Recent methods used to estimate the numbers of tigers are camera trapping and DNA finger-printing.
- ✓ In camera trapping, the photograph of the tiger is taken and individuals are differentiated on the basis of the stripes on the body.
- ✓ In the latest technique of DNA fingerprinting, tigers can be identified from their scats.

PROJECT ELEPHANT

- Project Elephant was launched in February, 1992 as a 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.
- 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
- The E-8 ministerial meeting represented regions with all 3 species of elephants, viz., 1. *Elephas maximus* (Asian elephant) 2. *Loxodonta africana* (African Bush Elephant) 3. *Loxodonta cyclotis* (African Forest Elephant)

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

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*)- (Schedule 1, Wildlife Conservation Act)
 3. Long billed Vulture (*Gyps indicus*),
 4. Egyptian Vulture (*Neophron percnopterus*),
 5. Red Headed Vulture (*Sarcogyps calvus*)- (IUCN Status: Critically Endangered)
 6. Indian Griffon Vulture (*Gyps fulvus*)- (Schedule 1, Wildlife Conservation Act) (IUCN Status: Critically Endangered)
 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.
 - ✓ White Rumped vulture-(Schedule 1, Wildlife Conservation Act) (IUCN Status – Critically Endangered)
 - ✓ Populations of Egyptian vultures and White- backed Vulture have also undergone decline in India and are now classified as Endangered.
 - ✓ There are currently 9 Vulture Conservation and Breeding Centres in India. Out of the 9, three are directly administered by Bombay Natural History Society.
 - ✓ Three species of vultures bred in these VCBCs are White backed Vulture; Long-billed Vulture; Slender-billed Vulture
 - ✓ Jatayu Conservation Breeding Centre, Pinjore (Haryana), within the Bir Shikargah Wildlife Sanctuary is the largest conservation centre for vultures in India
 - ✓ 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 the .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 Uttarakhand to Nepal, which spans from Corbett to Katriya Ghat, a Terai belt, covering 30,000 square kilometers, will be earmarked as Vulture Safe zone. Slender-billed vulture and white-backed vulture are Found in 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 Chhattisgarh, where white-backed and long billed vultures are found
4. Vulture Restaurants - At this restaurant, tables are reserved only for the unique and rare vultures by Maharashtra and Punjab forest departments.

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 programme 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.
- 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.
- Manas National Park was selected as the first site for translocation of rhinos.

PROJECT SNOW LEOPARD SNOW LEOPARD:

- In 2013, the 12 snow leopard range countries and partners signed the Bishkek Declaration and agreed to secure at least 20 snow leopard landscapes across the cat's range by 2020 or – “Secure 20 by 2020.”
- 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.

ASIATIC LION CONSERVATION PROJECT

- A dedicated “Asiatic Lion Conservation Project” has been launched. The Asiatic Lion endemic to Gir landscape of Gujarat is one of the 21 critically endangered species identified by the Ministry for taking up recovery programmes.
- Asiatic Lion, being listed in Schedule-I of Wildlife (Protection) Act, 1972, to be accorded the highest degree of protection.
- The long-term survival of the lion as a species was best served if they could be present outside Gujarat, too, so that they are protected against, say, a forest fire, a disease, or calamities. The Kuno-Palpur Wildlife Sanctuary in Madhya Pradesh was identified to be the most suitable for reintroducing the species

SECURE HIMALAYA

- The project was launched by the MoEF&CC in collaboration with UNDP. The plan intends to conserve the snow leopards by protecting their habitats and improve the ecology of Himalayan ranges and lives of the mountain communities. It covers Himachal Pradesh, Jammu and Kashmir, Uttarakhand and Sikkim.

SEA TURTLE PROJECT

- A significant proportion of the 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 the 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 placed 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 & kashmir
- This deer lives in groups of two to 18 individuals 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, overgrazing by domestic livestock and poaching.
- captive breeding of lion tailed macaques 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.

INDIA ADOPTS SAWEN

- India has adopted the Statute of the South Asia Wildlife Enforcement Network (SAWEN) and become its formal member in order to strengthen ties with the member countries in controlling the trans-boundary wildlife crime through communication, coordination, collaboration, capacity building and cooperation in the region.

- SAWEN, a Regional network, is composed of eight countries in South Asia: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

CLIMATE CHANGE

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's lower atmosphere and warms it, maintaining the temperature suitable for living things to survive.
- water vapor and greenhouse gases warms the Earth.

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.
- Water vapour (H₂O), Carbon Dioxide (CO₂), Nitrous Oxide (N₂O) and Methane (CH₄) are the primary greenhouse gases in the Earth's atmosphere.
- The most dominant greenhouse gas overall is water vapour, but it has a very short atmospheric lifetime

GREEN HOUSE GASES

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

- UNFCCC's (United Nations Framework Convention on Climate Change) Kyoto Protocol has recognised six main greenhouse gases primarily responsible for global warming. They are:

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.
- CO₂ and other greenhouse gases are 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.

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.

4. NITROUS OXIDE

- (N₂O) is naturally present in the atmosphere as part of the Earth's nitrogen cycle, and has a variety of natural sources.
- Natural emissions of N₂O 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 N₂O 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).
- Substitution for Ozone-Depleting Substances:
Hydrofluorocarbons are used as refrigerants, aerosol propellants, solvents, and fire retardants. These chemicals were developed as a replacement for chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) because they do not deplete the stratospheric ozone layer.
- 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. HFC-23 is produced as a by-product of HCFC-22 production.

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 the 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

- Climate forcings are factors in the climate system that either increase or decrease the effects on 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.

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.

GLOBAL WARMING 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 (N₂O) 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), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆) are called high-GWP.

GLOBAL EMISSIONS BY SOURCE

1. Energy Supply (26%)
2. Industry (19%)
3. Land Use, Land-Use Change, and Forestry (17%)
4. Agriculture (14%)
5. Transportation (13%)
6. Waste and Wastewater (3%)

OCEAN ACIDIFICATION

- Ocean acidification is 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 known as ocean acidification.
- Acid rain formed when oxides of sulfur and nitrogen react with the moisture in the atmosphere. Rain with a pH of less than 5.6.
- Eutrophication: Coastal waters are also affected by excess nutrient inputs, mostly nitrogen, from agriculture, fertilizers and sewage. The resulting eutrophication leads to large plankton blooms, and when these blooms collapse and sink to the sea bed the subsequent respiration of bacteria decomposing the algae leads to a decrease in sea water oxygen and an increase in CO₂ (a decline in pH).
- 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 CO₂ to produce carbonic acid (H₂CO₃), bicarbonate (HCO₃⁻) and carbonate ions (CO₃²⁻).

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

- **OCEAN DEOXYGENATION**

Ocean deoxygenation is the expansion of oxygen minimum zones in the world's oceans as a consequence of anthropogenic emissions of carbon dioxide. Climate change is accelerating loss of life sustaining oxygen from the ocean. Ocean Deoxygenating will adversely impact food security and human populations the world over.

THE LOSS OF OXYGEN IN THE OCEAN HAS TWO MAJOR CAUSES

- ✓ Ocean warming-driven deoxygenation: Warmer ocean water holds less oxygen and is more buoyant than cooler water. This leads to reduced mixing of oxygenated water near the surface with deeper waters, which naturally contain less oxygen. Warmer water also raises oxygen demand from living organisms. As a result, less oxygen is available for marine life.
- ✓ Excessive growth of algae: Fertilizer run-off, sewage, animal waste, aquaculture and deposition of nitrogen from the burning of fossil fuels are promoting excessive growth of plant life – a process known as eutrophication, which mostly affects coastal areas. Warming of ocean waters is expected to cause further oxygen loss in nutrient-rich coastal areas, exacerbating the situation.

OZONE DEPLETION

OZONE LAYER

- The Earth's atmosphere is divided into several layers.
- The lowest region, the troposphere, extends from the Earth's surface up to about 10 kilometres (km) in altitude.
- The next layer, the stratosphere, continues from 10 km to about 50 km. Most atmospheric ozone is concentrated in a layer in the stratosphere, about 15-30 kilometers above the Earth's surface.
- This ozone layer in the Earth's stratosphere absorbs most of the Sun's ultraviolet (UV) radiation that may cause skin cancer.

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 UltraViolet (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 the atmosphere 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 have 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
2. Nitric oxide (NO): catalytically destroys ozone.
 - Nitric oxide + ozone = Nitrogen dioxide + O_2
 - Nitrogen dioxide + monoxide = Nitric oxide + Oxygen
3. 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 hundreds times more ozone molecules than what a chlorine atom does.
4. 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 $ClONO_2$ 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, ($ClONO_2$).

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 longevity 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 mid spring 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 spectrometer (TOMS) in the Nimbus-7 satellite.

The Umheher technique- The most common measure of total ozone abundance is the Dobson unit (named after the pioneering atmospheric physicist Gordon Dobson) which is the

thickness of the ozone column (compressed at Standard Temperature and Pressure (STP)) in milli-centimeters.

INDIAN LABORATORIES IN ANTARCTICA

- Dakshin Gangotri, the first Indian base, was established in 1984. It is currently being used as a supply base and transit camp.
- The government is rebuilding its station, Maitri which is the second permanent station in Antarctica.
- Bharati is India's third Antarctic research facility and one of two active Indian research stations, alongside Maitri.

Arctic Ozone Depletion

- The Ozone Depletion has been increasingly evident over the Arctic as well.
- The Arctic Ozone Depletion which swept across Britain in March 96 was the greatest depletion of ozone ever seen in the northern hemisphere.
- Scientists claim that it had been caused, in the past, by a dramatic cooling of the upper atmosphere in the northern latitudes.
- The ozone depletion over the northern hemisphere has been increasing steadily since the winter of 1992.

STATUS OF INDIA'S PRESENCE IN ARCTIC

- India has set up an underground observatory, called IndARC, at the Kongsfjorden fjord, halfway between Norway and the North Pole.
- Indian Arctic station 'Himadri' is located at NyAlesund, Spitsbergen Island, Norway and serves as a hub of Indian scientific investigations

ARCTIC COUNCIL

- ✓ The Arctic Council is the leading intergovernmental forum promoting cooperation, coordination and interaction among the Arctic States, Arctic indigenous communities and other Arctic inhabitants on common Arctic issues.
- ✓ The Ottawa Declaration lists the following countries as Members of the Arctic Council: Canada, the Kingdom of Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States.
- ✓ Observer status in the Arctic Council is open to non-Arctic states.
- ✓ India is an observer at the Arctic Council.

CLIMATE CHANGE AND 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 CO₂ 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 CO₂ from other gases,
- ✓ transporting this captured CO₂ to a storage location, and
- ✓ storing that CO₂ 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"

- 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 .
- 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 countries 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 a developing country can be transferred to the company in a developed country.
- Carbon, like any other commodity, has begun to be traded on India's Multi Commodity Exchange(MCX).
- MCX has become the first exchange in Asia to trade carbon credits.

CARBON OFFSETTING:

- These 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.
- These 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.

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.
- Hoisting parasols, placing mirrors in space, whitening the stratosphere with sulfate aerosols, whitewashing building roofs to reflect sunlight or flinging iron filings into the ocean to promote carbon-gulping algae are some of the modes.

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.

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, an increase of 0.4° C has been observed in surface air temperatures over the 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 some glaciers, 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

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.
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 the 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 WATER MISSION (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

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

INDC

- Conference of Parties (COP) of United Nations Framework Convention on Climate Change (UNFCCC) at 19th Session held in Warsaw in 2013, all parties initiate domestic preparations for their INDC towards achieving the objective of the Convention and to communicate them, well in advance of the 21st session of the Conference of Parties.
- The concept of 'Nationally Determined Contributions', taking into account the outcomes of both Warsaw COP 19 and Lima COP 20 has to (i) reflect the principles of equity and Common But Differentiated Responsibilities (CBDR) and (ii) the Country's contributions must be seen in a balanced and comprehensive context.
- India declared a voluntary goal of reducing the emissions intensity of its GDP by 20–25%, over 2005 levels by 2020, despite having no binding mitigation obligations as per the Convention

NATIONAL COMMUNICATION (NATCOM)

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

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 green building
- ✓ 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 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.
- 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.
- 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.

NATIONAL INITIATIVE ON CLIMATE RESILIENT AGRICULTURE (NICRA)

- The ICAR has launched the 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 has four components.
 - 1.Strategic research on adaptation and mitigation
 2. Technology demonstration on farmers' fields to cope with current climate variability
 3. Sponsored and competitive research grants to fill critical research gaps
 4. Capacity building of different stakeholders

BSE-GREENEX

- The BSE-GREENEX Index is a veritable first step in creating a credible market 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-GREEN Index in close association with the BSE .

LONG TERM ECOLOGICAL OBSERVATORIES (LTEO)

- LTEO Programme aims to understand the biophysical and anthropogenic drivers of ecosystem change in the selected biomes and their effects on social- ecological responses through a network of scientific institutions.

THE NATIONAL ADAPTATION FUND FOR CLIMATE CHANGE (NAFCC)

- The National Adaptation Fund for Climate Change (NAFCC) is a Central Sector Scheme set up in 2015-16. The aim of NAFCC is to support concrete adaptation activities which mitigate the adverse effects of climate change.
- National Bank for Agriculture and Rural Development (NABARD) is the National Implementing Entity (NIE).

CLIMATE CHANGE ORGANIZATIONS

AGENDA 21

- It is an environmental action plan for the 21st century.
- It is a product of the Earth Summit held in Rio de Janeiro, Brazil, in 1992.
- It is not legally binding

UNFCCC

- The UN Summit Conference on Environment and Development (UNCED) held in Rio de Janeiro 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. It came into force in 1994.
- Secretariat is located in Bonn, Germany.
- The convention is legally non-binding, but makes provisions for meeting called 'protocols' where negotiating countries can set legally binding limits
- 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
- It aims to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.
- The Kyoto Protocol was negotiated under this framework.
- It has two commitment periods, the first of which lasted from 2008–2012. The second one from 2013-2020 is based on the Doha Amendment to the Protocol, which has not entered into force.
- Annex I countries: Industrialized countries and economies in transition
- Annex II countries: Developed countries which pay for costs of developing countries. Annex II countries are a subgroup of the Annex I countries.
- Non-Annex I countries: Developing countries are not required to reduce emission levels unless developed countries supply enough funding and technology.
- India is Non Annex party to UNFCCC

KYOTO PROTOCOL:

- It is an international treaty negotiated under UNFCCC and adopted in 1997 in Kyoto, Japan and came into force in 2005.

- Parties: 192 (Canada withdrew). The USA was not a part of the Kyoto Protocol.
- It gave binding targets to Annex I countries
- The 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 encourages industrialized countries to stabilize GHG emissions, the Protocol commits them to do so.
- The Protocol's first commitment period started in 2008 and ended in 2012.
- A second commitment period was agreed on in 2012, known as the Doha Amendment to the protocol. This has not entered into force as a required number of nations has not ratified this amendment.
- Paris agreement (2015) is not an amendment to Kyoto Protocol but a separate instrument altogether
- Target under this protocol applies to following GHGs: Carbon Dioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O), Sulphur Hexafluoride (SF₆), Hydrofluorocarbons (HFCs) and Perfluorocarbons (PFCs).
- It only binds developed countries- highly responsible for GHG emission
- 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

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 unpriced externality.

2. Flexible Market Mechanisms

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

Joint Implementation:

- ✓ The mechanism known as "joint implementation", allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party – developed country) 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.
- ✓ Joint implementation offers Parties a flexible and cost-efficient means of fulfilling a part of their Kyoto commitments, while the host Party benefits from foreign investment and technology transfer.
- ✓ Projects starting as from the year 2000 may be eligible as JI projects, ERU issued from 2008

Clean Development mechanism:

- ✓ The Clean Development Mechanism (CDM) 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, providing standardized emissions offset instrument, CERs

- ✓ 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.

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 an international transaction.

Two types of Carbon trading:

1. Emission trading- Emission permit is known alternatively as carbon credit; For each Annex I country, the protocol has assigned a fixed amount of carbon emission in the agreement. Each unit gives the owner the right to emit one metric tonne of carbon dioxide or other equivalent green-house gases.
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 a lesser amount of green-house gas in the atmosphere.

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 deadline; 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 the 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, programmes, 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 trustee
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. Fund 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

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
- India regains leadership of developing world, Wins on all its important nonnegotiable 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

DOHA OUTCOMES COP 18, 2012

- Global Climate Change Agreement -Governments agreed to work towards a universal climate change agreement by 2015 covering all countries which will come into effect from 2020.

- Amendment of the Kyoto Protocol- The Kyoto Protocol is the only existing and binding agreement under which developed countries undertake quantitative commitments to cut greenhouse gases. It was amended so that it could seamlessly continue.
- Doha Amendments to the Kyoto Protocol was made at Doha climate conference in 2012 and extended the obligation of the developed countries under Kyoto Protocol to make targeted cuts in their greenhouse gas (GHGs) emissions till 2020

WARSAW OUTCOMES,COP 19, 2013

2015 Agreement

- Governments advanced the timeline for the development of the 2015 agreement. Nationally determined contributions would be put forward in a clear and transparent manner.

Strengthening efforts to mobilize USD 100 billion by 2020

- To mobilize USD 100 billion annually by 2020 to support developing countries in their climate change actions, developed countries agreed to make their efforts on a biennial basis from 2014 to 2020.

Cutting emissions from deforestation – “the Warsaw Framework for REDD+”

- Governments agreed on a set of decisions on ways to reduce emissions from deforestation and forest degradation.
- It establishes the means for results-based payments if developing countries can demonstrate the protection of forests.

LIMA OUTCOMES,COP 20, 2014

- The Lima Climate Conference achieved “firsts” in the history of the international climate process.
- Pledges were made by both developed and developing countries prior to and during the COP that took the capitalization of the new Green Climate Fund (GCF) past an initial \$10 billion target.
- Progress was made in Lima on elevating adaptation onto the same level as the curbing and cutting of curbing greenhouse gas emissions. This will be done through National Adaptation Plans (NAPs).

PARIS CLIMATE CHANGE CONFERENCE COP 21, 2015

- Long Term Goal: To limit global temperature increase to well below 2 degrees, while pursuing efforts to limit the increase to 1.5 degrees
- Nationally determined contributions The Paris Agreement requires all Parties to put forward their best efforts through “nationally determined contributions” (NDCs) and to strengthen these efforts in the years ahead.
- The Paris Agreement entered into force on 4 November 2016. The first session of the Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement (CMA 1) took place in Marrakech, Morocco from 15-18 November 2016.

MARRAKECH CLIMATE CHANGE CONFERENCE –COP22, 2016

- Finance- Heading into Marrakech, developed countries released a roadmap outlining how they foresee meeting the goal of mobilizing \$100 billion a year in public and private finance for developing countries by 2020.

- Loss and Damage- Parties conducted the first review of the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (WIM).

BONN CLIMATE CHANGE CONFERENCE - COP23, 2017

- Fiji presided over UNFCCC's COP23 in Bonn. COP23 took place in Bonn, Germany in November 2017.
- Key outcomes agreed at the UN climate talks in Bonn
 - ✓ Powering Past Coal Alliance It is launched in COP23, Bonn and led by UK and Canada. It has more than 20 members aimed at accelerating clean growth and achieving the rapid phase-out of traditional coal power.
 - ✓ Fiji's COP Fiji is the first small-island state to host the UNFCCC climate talks. The outcomes were the
 - Gender Action Plan - highlights the role of women in climate action and promotes gender equality in the process.
 - Local Communities and Indigenous Peoples Platform - aims to support the exchange of experience and sharing of best practices on mitigation and adaptation.
 - ✓ **Talanoa Dialogue** : "Talanoa is a traditional word used in Fiji and across the Pacific to reflect a process of inclusive, participatory and transparent dialogue. Talanoa Dialogue is a process designed to help countries implement and enhance their Nationally Determined Contributions by 2020.

COP 26 (MOST IMPORTANT FOR EXAM)

- The Glasgow summit has urged countries to strengthen their targets, by 2027 COP to be held in Egypt
- Target of not letting global warming increase by 1.5 Degrees
- 140 Countries announced target timeline for achieving net zero
- India has termed 2070 as its net zero target
- Glasgow breakthrough agenda : accelerate development of clean tech
- phasing down of coal power

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 expense 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

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).

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

THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY (TEEB)

- The Economics of Ecosystems and Biodiversity (TEEB) was launched by Germany and the European Commission in 2007. It is a study led by Pavan Sukhdev.
- It is an international initiative to draw attention to the global economic benefits of biodiversity.
- Objective- Highlight the growing cost of biodiversity loss and ecosystem degradation and to draw together expertise from the fields of science, economics and policy to enable practical actions.

GLOBAL CLIMATE FINANCE ARCHITECTURE

Strategic Climate Fund

- ✓ Administered by the World Bank
- ✓ Area of focus - Adaptation, Mitigation - general, Mitigation - REDD
- ✓ Date operational – 2008

Forest Investment Program

- ✓ Administered by The World Bank
- ✓ Area of focus - Mitigation - REDD
- ✓ Date operational – 2009
- ✓ The Forest Investment Program (FIP) is a targeted program of the Strategic Climate Fund (SCF) within the Climate Investment Funds (CIF).

Biocarbon Fund

- ✓ Administered by The World Bank

- ✓ Area of focus - Adaptation, Mitigation - general, Mitigation - REDD
- ✓ Date operational – 2004

Special Climate Change Fund

- ✓ Administered by The Global Environment Facility (GEF)
- ✓ Area of focus - Adaptation
- ✓ Date operational – 2002 The Special Climate Change Fund (SCCF) was created in 2001 to address the specific needs of developing countries under the UNFCCC.

Least Developed Countries Fund

- ✓ Administered by The Global Environment Facility (GEF)
- ✓ Area of focus - Adaptation
- ✓ Date operational – 2002 The Least Developed Countries Fund (LDCF) was established to meet the adaptation needs of least developed countries (LDCs).

Green Climate Fund

- ✓ Administered by - to be confirmed
- ✓ Area of focus - Adaptation, Mitigation - general, Mitigation - REDD
- ✓ Date operational – 2015 The Green Climate Fund (GCF) was adopted as a financial mechanism of the UN Framework Convention on Climate Change (UNFCCC) at the end of 2011.

Adaptation Fund

- ✓ Administered by Adaptation Fund Board
- ✓ Area of focus - Adaptation
- ✓ Date operational - 2009
- ✓ The Adaptation Fund is a financial instrument under the UNFCCC and its Kyoto Protocol (KP) and has been established to finance concrete adaptation projects and programmes in developing country Parties to the KP, in an effort to reduce the adverse effects of climate change facing communities, countries and sectors.
- ✓ The Fund is financed with a share of proceeds from Clean Development Mechanism (CDM) project activities as well as through voluntary pledges of donor governments.
- ✓ The share of proceeds from the CDM amounts to 2% of Certified Emission Reductions (CERs) issued for a CDM project activity.

Global Climate Change Alliance

- ✓ Administered by The European Commission
- ✓ Area of focus - Adaptation, Mitigation - general, Mitigation - REDD
- ✓ Date operational – 2008 The Global Climate Change Alliance (GCCA) is an initiative of the European Union.

UN-REDD Programme

- ✓ Administered by UNDP
- ✓ Area of focus - Mitigation - REDD
- ✓ Date operational – 2008 Three UN Agencies – United Nations Environment Programme (UNEP), United Nations Development Programme (UNDP) and Food and Agriculture Organization of the United Nations (FAO) – have collaborated in the establishment of the

UN-REDD programme, a multi-donor trust fund that allows donors to pool resources and provide funding with the aim of significantly reducing global emissions from deforestation and forest degradation in developing countries.

Amazon Fund (Fundo Amazônia)

- ✓ Administered by Brazilian Development Bank (BNDES)
- ✓ Area of focus - Mitigation - REDD
- ✓ Date operational – 2009 The Amazon Fund was created to raise donations so that investments can be made in efforts to prevent, monitor and combat deforestation, as well as to promote the conservation and sustainable use of forests in the Amazon Biome.

ACTS AND POLICIES

WILD LIFE PROTECTION ACT 1972

- India is the first country in the world to have made provisions for the protection and conservation of the environment in its constitution. On 5th June 1972, environment was first discussed as an item of international agenda in the U.N. Conference of Human Environment in Stockholm and thereafter 5th June is celebrated all over the world as World Environment Day.
- 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
- Prohibition of hunting of animals provided in Schedule I, II, III and IV except by the process laid down in the act such as danger to human life, property, or the animal being so disabled or deceased as to be beyond recovery or killing or wounding in good faith of any animal in defence of oneself or of any other person, or for education, scientific research etc. However, usually a permission has to be granted by Chief Wildlife Warden of the state before such killing takes place.
- National Tiger Conservation Authority to be headed by Minister of MOEFCC
- It provides a captive breeding programme for endangered species. Several Conservation Projects for individual endangered species like Lion (1972), Tiger (1973), Crocodile (1974) and Brow antlered Deer (1981) were stated under this Act.

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.

- ✓ “Forest” including “Wildlife” was then a State subject falling in Entry 20 List II of Seventh Schedule, Parliament had no power to make law on the same except as provided in Articles 249, 250 and 252 of the constitution.

ENVIRONMENT (PROTECTION) ACT, 1986

- The Act is 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
- Objectives (i) Conservation of biological diversity; (ii) Sustainable use of its components; and (iii) Fair and equitable sharing of the benefits arising from the utilization of genetic resources.

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 Min. Tribal Affairs
- 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 (SCZMIA) 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.

1. CRZ-I:

Ecologically 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 waterfront activities

2. CRZ-2:

The area that has 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

3. 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

4. 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.

ISLAND PROTECTION ZONE NOTIFICATION, 2011

- There are about 500 islands in Andaman & Nicobar and about 30 in Lakshadweep. These two groups of oceanic islands are home to some of the country's most thriving biodiversity hotspots.
- The A&N Islands are known for their terrestrial and marine biodiversity including forest area which covers 85% of the Andaman and Nicobar geographical area, while Lakshadweep is a coral island.
- The geographical areas of these islands are so small that in most of the cases the 500 metres Coastal Regulation Zone regulations overlap.
- Hence, a separate Notification is being issued which takes into account the management of the entire island (except for four islands of A&N which include North Andaman, Middle Andaman, South Andaman and Great Nicobar).

SOLID WASTE MANAGEMENT, 2016 RULES

- **Mandatory Segregation-** All waste generators will have to segregate and store the waste generated by them under three separate categories - biodegradable, non-biodegradable and domestic hazardous waste - in suitable bins before handing it over to authorised rag pickers or waste collectors.
- **Concept of Extended Producer Responsibility:** Local bodies can charge a fee from the generator of wastes. The new rules have asked all such brand owners who sell products in

non-biodegradable packaging material to put in place a system to collect back the packaging waste generated due to their production (ET).

- Burning of Solid Waste has been prohibited
- The Ministry of Power shall fix tariffs or charges for the power generated from the Waste to Energy plants based on solid waste and ensure compulsory purchase of power generated from such Waste to Energy plants by DISCOMs .
- The Ministry of New and Renewable Energy Sources shall facilitate infrastructure creation for Waste to Energy plants and provide appropriate subsidies or incentives for such Waste to Energy plants.

HAZARDOUS AND OTHER WASTES (MANAGEMENT AND TRANSBOUNDARY MOVEMENT) AMENDMENT RULES, 2019

- Solid plastic waste has been prohibited from import into the country including in Special Economic Zones (SEZ) and by Export Oriented Units (EOU).
- Exporters of silk waste have now been given exemption from requiring permission from the MOEFCC.
- Electrical and electronic assemblies and components manufactured in and exported from India, if found defective can now be imported back into the country, within a year of export, without obtaining permission from the MOEFCC.
- Industries which do not require consent under Water Act 1974 and Air Act 1981, are now exempted from requiring authorization also under the Hazardous and Other Wastes (Management & Trans-boundary Movement) Rules, 2016 provided that hazardous and other wastes generated by such industries are handed over to the authorized actual users, waste collectors or disposal facilities.

BIO-MEDICAL WASTE MANAGEMENT RULES, 2016

- Bio-medical waste has been classified into 4 categories instead of 10 to improve the segregation of waste at source and these 4 categories have colour-codes.
 - o Red Bin for plastic waste such as bottles, syringes, etc.
 - o Yellow Bin for infectious wastes such as cotton, bandage, placenta, etc.
 - o Blue Bin for glass bottles like discarded medicines
 - o Black Bin for needles without syringes, metal articles, etc.
- Phase-out the use of chlorinated plastic bags, gloves and blood bags within two years.
- The ambit of the rules has been expanded to include vaccination camps, blood donation camps, surgical camps or any other healthcare activity.
- Pre-treatment of the laboratory waste, microbiological waste, blood samples and blood bags through disinfection or sterilisation on-site in the manner as prescribed by WHO or NACO.
- State Government to provide land for setting up common bio-medical waste treatment and disposal facilities.
- No occupier shall establish on-site treatment and disposal facility, if a service of `common bio-medical waste treatment facility is available at a distance of seventy-five kilometer.
- The new rules prescribe more stringent standards for incinerator to reduce the emission of pollutants in environment;
- Inclusion of emissions limits for Dioxin and furans;
- Establish a Bar-Code System for bags or containers containing bio-medical waste for disposal.
- Provide training to all its health care workers and immunise all health workers regularly.

E-WASTE (MANAGEMENT) AMENDMENT RULES, 2018

- Amendment in 2016 rules has been done with the objective of channelizing the E-waste generated in the country towards authorized dismantlers and recyclers in order to formalize the e-waste recycling sector.
- Collection targets under the provision of Extended Producer Responsibility (EPR) in the Rules have been revised and targets have been introduced for new producers who have started their sales operations recently.
- Some of the salient features of the E-waste (Management) Amendment Rules, 2018 are as follows:
 - 1 Producer Responsibility Organizations (PROs) shall apply to the Central Pollution Control board (CPCB) for registration to undertake activities prescribed in the Rules.
 2. Under the Reduction of Hazardous Substances (RoHS) provisions, cost for sampling and testing shall be borne by the government for conducting the RoHS test. If the product does not comply with RoHS provisions, then the cost of the test will be borne by the Producers.

Bhopal Municipal Corporation (BMC) and the Central Pollution Control Board (CPCB) have signed an agreement to set up the country's first e-waste clinic in Bhopal, Madhya Pradesh.

PLASTIC WASTE MANAGEMENT RULES, 2016

- Increase minimum thickness of plastic carry bags from 40 to 50 microns and stipulate minimum thickness of 50 micron for plastic sheets also to facilitate collection and recycle of plastic waste
- CPCB has been mandated to formulate the guidelines for thermoset plastic (plastic difficult to recycle). In the earlier Rules, there was no specific provision for such type of plastic.
- Phasing out of Multilayered Plastic (MLP) is now applicable to MLP, which are non-recyclable, or non energy recoverable, or with no alternative use.
- Explicit pricing of carry bags has been omitted.

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.
- The 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 an act 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 the third country in the world to have a full-fledged green tribunal followed by New-Zealand and Australia.
- NGT is mandated to dispose of 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 methyl chloroform and CFC for metered dose inhalers can be used up to 1st January 2010.
- Further, the use of methyl bromide has been allowed up to 1st January 2015.
- Since HCFCs are used as interim substitutes to replace CFC, these are allowed up to 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
- The plan has adopted the Landscape approach rather than the earlier strategies more concentrated on national parks and wildlife sanctuaries
- Plan also highlights the role of the private sector in wildlife protection by ensuring adequate fund flow from the Corporate Social Responsibility (CSR) fund.

NATIONAL AFFORESTATION AND ECO-DEVELOPMENT BOARD

- The Ministry of Environment and Forests –in 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.
- These Funds will receive payments for: (i) compensatory afforestation, (ii) net present value of forest (NPV), and (iii) other project specific payments. The National Fund will receive 10% of these funds, and the State Funds will receive the remaining 90%.
- These Funds will be primarily spent on afforestation to compensate for loss of forest cover, regeneration of forest ecosystem, wildlife protection and infrastructure development.
- The Bill also establishes the National and State Compensatory Afforestation Fund Management and Planning Authorities to manage the National and State Funds

CAMPA. JOINT FOREST MANAGEMENT (JFM)

- ✓ an initiative to institutionalize participatory governance of a 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 forest lands with people's participation involving Forest Protection Committees

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 the Central Government. It is being implemented by the Horticulture Division under Department of Agriculture and Cooperation 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)

- 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
- CEPI Score: >70 – critically polluted ; 60- 70 Severely polluted; <60 Normal
- The Central and state Pollution Control Board, in collaboration with IIT, Delhi has applied the CEPI

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 the 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
- 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 the 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).
- The 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)

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 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 multidisciplinary 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 groundwater-irrigated agriculture in south India.

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.
- The SEBS is a unique collaborative initiative of the 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.

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 stresses on hands-on participatory approach.
- India joined this programme during 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

- The Animal Welfare Board of India is a 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 Headquarters 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.

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 to oversee the functioning and development of zoos in the country.
- 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 coordinate 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 coordinate 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 a 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.

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.
- WCCB has conducted Operation Save Kurma, ThunderBird, Wildnet, Lesknow, Birbil, etc.

Functions

- Collection, collation of intelligence and its dissemination and establishment of a centralized Wildlife Crime data bank;
- Coordination 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 coordination and universal action for wildlife crime control;
- Development of infrastructure and capacity building for scientific and professional investigation;
- Advise 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, biomanipulation, nutrient reduction, withdrawal of anoxic hypolimnion, constructed wetland approach or any other successfully tested eco-technologies etc depending upon the site conditions.
- ✓ Lakefront eco-development including public interface.
- ✓ Solid waste management & provision of dhobi ghats is generally not covered under NLCP.
- ✓ Prevention of pollution from nonpoint sources by providing low cost sanitation.

NATIONAL GANGA RIVER BASIN AUTHORITY (NGRBA)

- NGRBA was constituted in 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

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 a 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 that 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 technologiesThe Protocol establishes procedures for regulating the import and export of LMOs from one country to another.

Advance Informed Agreement - Under the AIA procedure, a country intending to export an LMO for intentional release into the environment must notify in writing to party of import before export

Nagoya—Kuala Lumpur Supplementary Protocol

- The Cartagena Protocol is reinforced by the Nagoya—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.
- The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) to the Convention on Biological Diversity is a supplementary agreement to the Convention on Biological Diversity.
- Objective Is the fair and equitable sharing of benefits arising from the utilization of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity.
- 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.

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

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.
- Wise use (the core philosophy of Ramsar) is the maintenance of ecological character within the context of sustainable development.
- 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

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 principal tool of the Convention and is maintained as part of the Ramsar List.

Indian wetland and 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 the Montreux Record in 1993 was removed in November 2002. It is placed on the Montreux Record due to problems caused by siltation and sedimentation which was choking the mouth of the lake; removed from the Record in 2002 following rehabilitation efforts for which the Chilika Development Authority received the Ramsar Wetland Conservation Award for 2002.
- India became a contracting party to the Ramsar Convention in 1981 and has been implementing conservation programmes for wetlands, mangroves and coral reefs.

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, walrus and Cape stag beetles

CoP13, these meetings 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)

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.
- IUCN supports scientific research, manages field projects globally and brings governments, non-government organizations, United Nations agencies, companies and local communities together to develop and implement policy
- IUCN Members include both States and non-governmental organizations.

THE GLOBAL TIGER FORUM (GTF)

- It is an intergovernmental 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 subspecies 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 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: aldrin, 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 heptabromodiphenyl 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 ; Persistent 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.

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

- It is a Multilateral Environmental Agreement that was agreed upon at the 1985 Vienna Conference 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.
- Vienna convention is not legally binding

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).
- It was the first treaty in history to achieve universal ratification – i.e. ratified by every member state of the United Nations.
- It is an international treaty and aims to protect the ozone layer by phasing out:
 1. Chlorofluorocarbons (CFCs),
 2. Hydrochlorofluorocarbons (HCFCs),
 3. Hydrobromofluorocarbons (HBFCs),
 4. Carbon Tetrachloride (CCl₄),
 5. Methylbromide (CH₃Br),
 6. Bromochloromethane (CH₂BrCl),
 7. Methyl chloroform (CH₃CCl₃),
 8. Halons.

KIGALI AGREEMENT (2016)

- The Kigali Agreement amends 1987 Montreal Protocol (conceived only to plug gases that were destroying the ozone layer) to phase out Hydrofluorocarbons (HFCs), a family of potent greenhouse gases by the late 2040s.

- This move will help to prevent a potential 0.5 degree Celsius rise in global temperature by the end of the century.
- All signatory countries have been divided into three groups
- ✓ First group includes countries like the US and those in the European Union (EU). They will freeze production and consumption of HFCs by 2018. They will reduce them to about 15% of 2012 levels by 2036.
- ✓ Second group includes countries like China, Brazil and all of Africa which will freeze HFC use by 2024 and cut it to 20% of 2021 levels by 2045.
- ✓ Third group countries like India, Pakistan, Pakistan, Iran, Saudi Arabia etc will be freezing HFC use by 2028 and reducing it to about 15% of 2025 levels by 2047

India and Protection of Ozone Layer

- India became a Party to the Vienna Convention for the Protection of Ozone Layer on 19 June 1991 and 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).
- the 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.

MINAMATA CONVENTION

- The Minamata Convention on Mercury is a global treaty to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.

- It was adopted in 2013 in Kumamoto, Japan.
- It also controls the trans-boundary movement of mercury. It does not include natural emissions of mercury.
- The Minamata Convention entered into force in August 2017. The first CoP to the Minamata Convention on Mercury (COP1) took place in September 2017 at the International Conference Centre in Geneva.

ENVIRONMENT ISSUES AND HEALTH EFFECTS

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.

TRANSFAT

- Trans Fats 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).
- Trans Fats are associated with a host of serious health problems ranging from diabetes to heart disease to cancer.
- The health ministry in 2008 came out with a notification for labelling food including trans fats.

DISEASES CAUSED BY ENVIRONMENTAL DEGRADATION

- Minamata disease-It was caused by the release of methyl mercury in the industrial wastewater from the Chisso Corporation's chemical factory, which continued from 1932 to 1968. It is also referred to as Chisso-Minamata disease, is a neurological syndrome caused by severe mercury poisoning.
- Yokkaichi asthma - The burning of petroleum and crude oil released large quantities of sulfur oxide that caused severe smog, resulting in severe cases of chronic obstructive pulmonary disease, chronic bronchitis, pulmonary emphysema, and bronchial asthma among the local inhabitants.
- Itai-itai disease -the cadmium poisoning caused softening of the bones and kidney failure.
- Blue baby syndrome - It is believed to be caused by high nitrate contamination in ground water resulting in decreased oxygen carrying capacity of hemoglobin in babies leading to death
- Pneumoconiosis -The coal miners are frequently caught by the black lung disease, which is also called as Pneumoconiosis
- 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.

MISCELLANEOUS TOPICS

CHIPKO MOVEMENT

- It is a social-ecological movement that practised the Gandhian methods of satyagraha and non-violent resistance, through the act of hugging trees to protect them from falling.

- The modern Chipko movement started in the early 1970s in the Garhwal Himalayas of Uttarakhand, with growing awareness towards rapid deforestation.

APPIKO MOVEMENT

- The Appiko movement was a revolutionary movement based on environmental conservation in India.
- The Chipko movement in Uttarakhand in the Himalayas inspired the villagers of the district of Karnataka province in southern India to launch a similar movement to save their forests.
- In September 1983, men, women and children of Salkani “hugged the trees” in Kalase forest. (The local term for “hugging” in Kannada is appiko.)

Bioassay - Bioassay is 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.

Flagship species - A flagship species is a species chosen to represent an environmental cause, such as an ecosystem in need of conservation.

Keystone species - Keystone species is a species whose addition to or loss from an ecosystem leads to major changes in abundance or occurrence of at least one other species. All top predators (Tiger, Lion, Crocodile, Elephant) are considered as keystone species because it regulates all other animals' population indirectly

Indicator species - Indicator species is a species whose presence indicates the presence of a set of other species and whose absence indicates the lack of that entire set of species

Umbrella species - Umbrella species is a wide-ranging species whose requirements include those of many other species. The protection of umbrella species automatically extends protection to other species

Oligotrophic Lake is a lake with low primary productivity, the result of low nutrient content. These lakes have low algal production, and consequently, often have very clear waters, with high drinking-water quality

Eutrophic lake is a lake that has high primary productivity due to excessive nutrients and is subject to algal blooms resulting in poor water quality. The bottom waters of such bodies are commonly deficient in oxygen, ranging from hypoxic to anoxic.

Mesotrophic lakes is a lake with an intermediate level of productivity, greater than oligotrophic lakes, but less than eutrophic lakes. These lakes are commonly clear water lakes and ponds with beds of submerged aquatic plants and medium levels of nutrients

Ecotopes are the smallest ecologically-distinct landscape features in a landscape mapping and classification system. As such, they represent relatively homogeneous, spatially-explicit landscape functional units that are useful for stratifying landscapes into ecologically distinct features for the measurement and mapping of landscape structure, function and change.

Ecozones delineate large areas of the Earth's surface within which organisms have been evolving in relative isolation over long periods of time, separated from one another by geographic features, such as oceans, broad deserts, or high mountain ranges, that constitute barriers to migration

Bioterrorism is terrorism involving the intentional release or dissemination of biological agents. These agents are (bacteria, viruses, or toxins), and may be in a naturally occurring or a human-modified form.

Bioleaching is the extraction of specific metals from their ores through the use of living organisms. This is much cleaner than the traditional heap leaching using cyanide. Bioleaching is one of several applications within bio hydrometallurgy and several methods are used to recover copper, zinc, lead, arsenic, antimony, nickel, molybdenum, gold, silver, and cobalt.

Biopiracy is the theft of genetic materials especially plants and other biological materials by the patent process. Biopiracy is a situation where indigenous knowledge of nature, originating with indigenous people, is exploited for commercial gain without permission from and with no compensation to the indigenous people themselves.

Carbon diet refers to reducing the impact on climate change by reducing greenhouse gas (principally CO₂) production, without lowering their standard of living

Earth Hour is a global event organized by WWF and is held on the last Saturday of March annually, asking households and businesses to turn off their non-essential lights and other electrical appliances for one hour to raise awareness towards the need to take action on climate change

RAMSAR WETLANDS SITES IN INDIA

RAMSAR SITE	LOCATION	DESCRIPTION
1 Chandertal Land (Freshwater)	Himachal Pradesh	<ul style="list-style-type: none"> • Situated in Spiti part of Lahul&Spiti at SamudraTapu Plateau which overlooks Chandra river • It is a high altitude lake on the upper Chandra valley near the Kunzum pass joining the Himalayan and Pir Panjal ranges. • It supports the IUCN Red Listed Snow Leopard and many other species.
2 Pong Dam Lake (Freshwater) (Reservoir)	Himachal Pradesh	<ul style="list-style-type: none"> • A water storage reservoir created in 1975 on the Beas River in the low foothills of the Himalaya on the northern edge of the Indo-Gangetic plain. • It is located at the trans-Himalayan flyway.
3 Renuka Wetland (Freshwater) (Natural)	Himachal Pradesh	<ul style="list-style-type: none"> • It is a wetland with springs and inland subterranean karst formations, fed by a small stream flowing from the lower Himalayan out to the Giri river.
4 Chilika Lake (Breaking Water) (Natural Lagoon)	Orissa	<ul style="list-style-type: none"> • Though added in Montreux Record in 1993, was removed in 2002. • It is a brackish lake separated from the Bay of Bengal by a long sandy ridge. • One of the only two lagoons with population of Irrawaddy dolphins
5 Bhitarkanika Wetlands (Mangrove Swamps)	Orissa	<ul style="list-style-type: none"> • One of the finest remaining patches of mangrove forests along the Indian coast. <p>The site's Gahirmatha beach is said to host the largest known Olive Ridley sea turtle nesting beach in the world</p> <ul style="list-style-type: none"> • Saltwater crocodiles, Gahirmathabeach(largest known Olive Ridley sea turtle nesting in the world)

6 Deepor Beel (Freshwater) (Natural)	Assam	<ul style="list-style-type: none"> • A permanent freshwater lake in a former channel of the Brahmaputra river. • It is the only major storm water storage basin for the city of Guwahati. It is a staging site on migratory flyways.
7 East Calcutta Wetlands	West Bengal	<ul style="list-style-type: none"> • World-renowned as a model of a multiple use wetland. • The wetland forms an urban facility for treating the city's waste water and utilizing the treated water for pisciculture and agriculture
8 Sundarban Wetland	West Bengal	<ul style="list-style-type: none"> • Sundarban Wetland is located within the largest mangrove forest in the world • The Sundarban Tiger Reserve is situated within the Site and part of it has been declared a "critical tiger habitat" under national law and also a "Tiger Conservation Landscape" of global importance. • The Site is also home to a large number of rare and globally threatened species such as the critically endangered northern river terrapin (Batagurbaska), the endangered Irrawaddy dolphin (Orcaella Brevirostris), and the vulnerable fishing cat (Prionailurus viverrinus). • It is listed as World Heritage Site and also in UNESCO Biosphere Reserve
9 Harike Lake (Freshwater) (Man-Made)	Punjab	<ul style="list-style-type: none"> • Harike Lake is a shallow water reservoir with thirteen islands, at the confluence of two rivers, i.e., Beas and Sutlej. • Indira Gandhi Canal starts from this place.
10 Kanjli (Man-Made reservoir) (Freshwater)	Punjab	<ul style="list-style-type: none"> • It is a man-made wetland, with a permanent stream, the Kali Bein, a tributary of Beas River converted by construction of a small barrage in 1870 into a water storage area for irrigation purposes. • The stream is considered to be the most significant in the state from the religious point of view, as it is associated with the first guru of the Sikhs, Shri Guru Nanak Dev Ji
11 Ropar (Freshwater Lake) (Manmade)	Punjab	<ul style="list-style-type: none"> • A wetland of lake and river formed by the 1952 construction of a barrage for diversion of water from the Sutlej River for drinking and irrigation supplies. • The site is an important breeding place for the nationally protected Smooth Indian Otter, Hog Deer, Sambar, and several reptiles, and the endangered Indian Pangolin is thought to be present.
12 Keoladeo National Park (Freshwater Swamps) (Manmade)	Rajasthan	<ul style="list-style-type: none"> • It has been in MONTREUX RECORD since 1990 due to "water shortage and an unbalanced grazing regime". • Included in world heritage site. • The invasive growth of the grass Paspalum Distichum has changed the ecological character of large areas of the site. • The Siberian Crane is found here.

13 Sambhar Lake (Saline) (Natural)	Rajasthan	<ul style="list-style-type: none"> • A large lake fed by four streams set in a shallow wetland and subject to seasonal fluctuations. (Inland drainage) • The site is important for a variety of wintering waterbirds, including the second largest breeding ground for flamingos in India.
14 Kolleru Lake (Freshwater) (Natural)	Andhra Pradesh	<ul style="list-style-type: none"> • A eutrophic lake, situated between the two major river basins of Godavari and Krishna, fed by two seasonal rivers and a number of drains and channels, which functions as a natural flood balancing reservoir between the deltas of the two rivers. • Known for its spot-billed pelican sighting.
15 Loktak Lake (Freshwater) (Natural)	Manipur	<ul style="list-style-type: none"> • This lake was added to MONTREUX RECORD in June 1993 as a result of ecological problems such as deforestation in the catchment area, infestation of water hyacinth, and pollution. Thick, floating mats of weeds covered with soil (phumids') are a characteristic feature
16 Nalsarovar (Freshwater) (Natural)	Gujarat	<ul style="list-style-type: none"> • The largest natural wetland in the Thar Desert Biogeographic Province and represents a dynamic environment with salinity and depth varying depending on rainfall. • It is an important stopover site within the Central Asia Flyway, with globally threatened species such as the critically endangered Sociable Lapwing (<i>Vanellus gregarius</i>). • The wetland is also a lifeline for a satellite population of the endangered Indian Wild Ass.
17 Point Calimere Wildlife and Bird Sanctuary (Coastal Swamps and salt pans)	Tamil Nadu	<ul style="list-style-type: none"> • Illegal collection of firewood and forest produce such as fruits (gathered by lopping off tree branches), • The spread of <i>Prosopis Chilensis</i> (Chilean mesquite), increasingly brackish groundwater caused by expansion of the historical salt works and decreasing inflow of freshwater are all seen as potential causes for concern.
18 Sasthamkotta Lake (Freshwater lake) (Natural)	Kerala	<ul style="list-style-type: none"> • The largest freshwater lake in Kerala.
19 Vembanad-Kol Wetland (Natural) (Brackish)	Kerala	<ul style="list-style-type: none"> • The largest brackish, humid tropical wetland ecosystem on the southwest coast of India • Famous for backwater tourism and sub-fossil clam deposits. • Longest lake in India
20 Ashtamudi Wetland (Brackish)(Natural)	Kerala	An extensive estuarine system, the second largest in Kerala State.
21	Jammu & Kashmir	<ul style="list-style-type: none"> • It is a composite lake in semi-arid Panjab Plains, adjoining the Jhelum Basin

Surinsar-Mansar Lakes (freshwater) (Natural)		
22 Wular Lake (Freshwater) (Natural)	Jammu & Kashmir	<ul style="list-style-type: none"> • The largest freshwater lake in India with extensive marshes of emergent and floating vegetation, particularly water chestnut, that provide an important source of revenue for the State Government and fodder for domestic livestock. • Fed by Jhelum river.
23 Hokera Wetland (natural) (Freshwater)	Jammu and Kashmir	Located at the northwest Himalayan biogeographic province of Kashmir, back of the snow-draped Pir Panchal.
24 Tsomoriri (Freshwater to brackish)	Ladakh	<ul style="list-style-type: none"> • A freshwater to brackish lake lying at 4,595m above sea level, with wet meadows and borax-laden wetlands along the shores. • The site is said to represent the only breeding ground outside of China for one of the most endangered cranes, the Black-necked crane (<i>Grus nigricollis</i>), and the only breeding ground for Bar-headed geese in India.
25 Bhoj Wetland (Freshwater) (Man-made)	Madhya Pradesh	Two contiguous human-made reservoirs - the "Upper Lake" was created in the 11th century by construction of an earthen dam across the Kolans River, and the lower was constructed nearly 200 years ago, largely from leakage from the Upper, and is surrounded by the city of Bhopal
26 Upper Ganga River (Freshwater) (Riverstretch) (freshwater)	Uttar Pradesh	<ul style="list-style-type: none"> • A shallow river stretch of the great Ganges with intermittent small stretches of deepwater pools and reservoirs upstream from barrages. • The river provides habitat for Ganges River Dolphin, Gharial, Crocodile
27 RudraSagar Lake (Freshwater) (Natural)	Tripura	A lowland sedimentation reservoir in the northeast hills, fed by three perennial streams discharging to the River Gomti.
28 Nandur Madhyameshwar	Maharashtra	<ul style="list-style-type: none"> • First Ramsar site in Maharashtra • It has been developed by making a low dam at the confluence of the Godavari and Kadwa Rivers. • Habitat of critically endangered species including Deolali minnow (a fish), Indian vulture and white-rumped vulture.
29 Saman Bird Sanctuary	Uttar Pradesh	• Seasonal oxbow lake on the Ganges floodplain.
30 Nawabganj Bird Sanctuar	Uttar Pradesh	<ul style="list-style-type: none"> • Shallow wetland fed by monsoon rain and Sarda canal. • Known to host Siberian cranes during winter.

31 Samaspur Bird Sanctuary	Uttar Pradesh	<ul style="list-style-type: none"> • Perennial lowland marsh typical of the Indo-Gangetic Plains • It harbours threatened species such as the endangered Egyptian vulture, Pallas's fish eagle and vulnerable common Pochard. • A tall grass called Sarpat is also found in bunches at every spot.
32 Sandi Bird Sanctuary	Uttar Pradesh	<ul style="list-style-type: none"> • It is a freshwater marsh. • Important Bird Area, declared by Birdlife International. • River Garra passes near the sanctuary.
33 ParvatiArga Bird Sanctuary	Uttar Pradesh	<ul style="list-style-type: none"> • Permanent freshwater environment consisting of two oxbow lakes. • It is raining and has deep natural depression. • Species: critically endangered whiterumped vulture and Indian vulture and the endangered Egyptian vulture
34 SarsaiNawarJheel	Uttar Pradesh	<ul style="list-style-type: none"> • It is an example of co-habitation of humans and wildlife: farming practices across most of the Site play important roles in sustaining the Waterbird habitats. • Recognized as an Important Bird Area by Birdlife International. • Species: vulnerable sarus crane, critically endangered whiterumped vulture and endangered woolly-necked stork.
35 Beas Conservation Reserve	Punjab	<ul style="list-style-type: none"> • It is a 185-kilometre stretch of the Beas River majorly in Punjab. • Hosts the only known population in India of the endangered Indus river dolphin. • Other Important species: endangered mahseer and hog deer as well as the vulnerable smooth coated otter
36 Nangal Wildlife Sanctuary	Punjab	<ul style="list-style-type: none"> • Located in the Shivalik foothills of Punjab • It occupies a human-made reservoir constructed as part of the Bhakra-Nangal Project on Sutlej River in 1961. • Historic importance - Indian and Chinese Prime Ministers formalized the "Five Principles of Peaceful Coexistence" there in 1954.
37 Keshopur-Miani Community Reserve	Punjab	<ul style="list-style-type: none"> • The Site is an example of wise use of a community-managed wetland, which provides food for people and supports local biodiversity • Species: vulnerable common pochard and the endangered spotted pond turtle
38 Bhindawas Wildlife Sanctuary (Man Made) (Freshwater)	Haryana	<p>It Is largest wetland site in Haryana First Ramsar Site of Haryana, in Jhajjar District Also known for Bird Sanctuary</p>
39 Sultanpur National Park	Haryana	<p>Destination for winter migratory birds Site for endangered Egyptian vultures, saker Falcon</p>

40 Thol Lake Wildlife Sanctuary	Gujarat	It is artificial lake It is located on Central Asian Flyway Fauna: Critically endangered- White rumped Vultures, sociable Lapwing
41 Vadhvana Wetland	Gujarat	Fauna: Endangered- palla's fish eagle, Vulnerable- common pochard
42 Lonar Lake	Maharashtra	The wetland on Deccan Plateau is a closed basin formed by Meteorite impact onto Basalt bedrock. Lake is highly saline and alkaline. Site lies in Buldhana district MH
43 Kabartal Wetland	Bihar	Bihar's first Ramsar site, located in Begusarai District The wetland is important for stopover along the central Asian flyway.
44 Sur Sarovar	Uttar Pradesh	Also known as Keetham Lake. It is Man Made Reservoir, originally made to supply water to city of Agra
45 Asan Conservation Reserve	Uttarakhand	In Dehradun District of Uttarakhand Important for waterbird species and Vultures
46 Tso kar Wetland Complex	Ladakh	It is high altitude wetland complex, consisting two principal water bodies- Startapuk Tso(Freshwater) + Tso Kar(Hypersaline lake) Tso Kar= White Lake(because of white salt efflorescence)

LIST OF BIOSPHERE RESERVES IN INDIA

BIOSPHERE RESERVES	LOCATION	DESCRIPTION
Nilgiri (Included in MAB list of UNESCO)	Part of Wayanad, Nagarhole, Bandipur and Mudumalai, Nilambur, Silent Valley and Siruvani hills in Tamil Nadu, Kerala and Karnataka.	Flora- Tropical forest; Mixed mountain and highland systems Fauna- Tiger, Elephant, Nilgiri Tahr, Lion-tailed macaque Tribals- Cholanaikans only surviving hunter gatherers of the Indian subcontinent
Nanda Devi (Included in MAB list of UNESCO)	Part of Chamoli, Pithoragarh and Almora districts in Uttarakhand	Flora- Plant species including lichens, fungi, bryophytes and pteridophytes Fauna- snow leopard, Himalayan black bear, brown bear, musk deer and bharal/blue sheep, Asiatic black bear Tribe- Bhotia tribe
Nokrek (Included in MAB list of UNESCO)	Part of East, West and South Garo Hill districts in Meghalaya	Flora- Evergreen and semi evergreen deciduous forests dominate the landscape Fauna- Slow Loris, Giant flying squirrel, Pig-tailed macaque, tigers, Red Panda, leopards, elephants and Hoolock Gibbons, etc. Tribals- Garo (Achikmande), Baniyas or Hajjons

Manas	Part of Kokrajhar, Bongaigaon, Barpeta, Nalbari, Kamrup and Darang districts in Assam.	Fauna-Golden Langur, Red Panda Flora- Semi evergreen and Deciduous forests
Sunderban (Included in MAB list of UNESCO)	Part of delta of Ganges Brahmaputra river system in West Bengal.	Flora-Tropical humid forest; Mangroves Fauna-Royal Bengal tiger (Panthera Tigris Tigris)
Gulf of Mannar (Included in MAB list of UNESCO)	India is part of the Gulf of Mannar extending from Rameswaram island in the North to Kanyakumari in the South of Tamil Nadu. There are 21 Islands	Flora- coral reefs and mangrove, seagrass beds, coral reefs Fauna-Dugong or Sea Cow, Sea cucumber Tribals-Marakeyars, local people mainly engaged in fishing
Great Nicobar (Included in MAB list of UNESCO)	Southernmost island of Andaman and Nicobar Islands. It incorporates two national parks Campbell Bay National Park and Galathea National Park.	Flora-Part of Sundaland Biodiversity Hotspot, Tropical Wet Evergreen Forests. Fauna-Saltwater Crocodile, Edible-nest swiftlet, Nicobar lion-tailed macaque, Giant Leatherback sea turtle, Nicobar tree shrew, Nicobar Scrubfowl Tribals-Shompen and Nicobarese
Similipal (Included in MAB list of UNESCO)	Part of Mayurbhanj district in Orissa.	Flora-The park derives its name from the abundance of semul (red silk cotton trees) that grow here. Orchids, medicinal plants, etc. Fauna-Asiatic Elephant, Gaur, Royal Bengal Tiger, Wild elephant. Mugger Crocodile management program was launched here. Tribals-Erengakharias and the Mankirdias, Ho, Gonda and Munda, etc
Dibru- Saikhowa	Part of Dibrugarh and Tinsukia districts in Assam.	Fauna-Golden Langur
DehangDibang	Part of Upper Siang, West Siang and Dibang Valley districts in Arunachal Pradesh.	Fauna-Mishmi takin, Red goral, musk deer, red panda, Asiatic Black bear

Pachmarhi (Included in MAB list of UNESCO)	Satpura Hills runs across it. Covers three protected areas – Satpura National Park, Bori and Pachmarhi Wildlife Sanctuary	Flora- Sal Forests Fauna-Gaura, bears, tigers and leopards, Giant Squirrel and Crested , Flying Squirrel. Tribals: Gond, Korkus;Most primitive Bhariya Tribe are found here.
Khangchendzonga (Included in MAB list of UNESCO)	Part of North and West districts in Sikkim.	Fauna- Snow Leopard, Red Panda It is one of the highest ecosystems in the world. • It is located at the trijunction of India (Sikkim), bordering Nepal to the west and Tibet (China) to the north-west. • The site is one among the world's 34 biodiversity hotspots. • The Khangchendzonga National Park (KNP), which comprises the core area of the KBR, was inscribed as India's first 'Mixed World Heritage Site' in 2016.
Agasthyamalai (Included in MAB list of UNESCO)	Covers Peppara and Shendurney wildlife sanctuaries and parts of the Neyyar sanctuary in Kerala and the KalakadMundanthurai Tiger Reserve of Tamil Nad	Flora-Tropical Wet Evergreen Forests Fauna-NilgiriTahr, Elephants, Tiger Tribals-Kani tribes from both Tamil Nadu and Kerala
Achanakmar-Amarkantak (Included in MAB list of UNESCO)	Maikala hills of Satpura range pass through it. It separates the rivers that drain into the Arabian Sea and Bay of Bengal. The reserve is also the source of three rivers: Narmada, Son and Johila.	Four horned antelope, Indian wild dog ,Saras crane , Asian whitebacked vulture, Sacred grove bush frog ,striped Hyena, , Chital, Wild Bear, Leopard.
Kachchh	Part of Kachchh, Rajkot, Surendranagar and Patan districts in Gujarat.	Flora-Banni Grasslands Fauna-Indian Wild Ass, Site for Flamingo breeding (Flamingo City), Chinkara, Caracal, Desert Cat and Desert Fox Tribals-Maldhari pastoralists
Cold Desert	Pin Valley National Park and surroundings; Chandratal Sarchu; and Kibber Wildlife	Fauna-Snow Leopard

	sanctuary in Himachal Pradesh.	
Seshachalam	Seshachalam hill ranges in Eastern Ghats. Tirupati Balaji temple is located here.	Tropical dry deciduous forests, Red Sanders Slender Loris, Indian giant squirrel, Mouse deer Golden Gecko
Panna	Part of Panna and Chhatarpur Districts in Madhya Pradesh	Flora-Dry deciduous forests of Teak, Salai, Kardhai Fauna-Tiger, Chital, Chinkara, Sambharand Sloth bear Tribals-Gond

State Animal and State Birds

State	State Bird	State Animal
Arunachal Pradesh	Great Hornbill	Mithun
Assam	White winged wood duck	One horned Rhino
Manipur		Sangai
Meghalaya	Hill Myna	Clouded Leopard
Mizoram		Hillock Gibbon
Nagaland	Blyth's Tragopan	Mithun
Sikkim	Blood Pheasant	Red Panda
Tripura	Imperial Pigeon	Phayre's Langur
Rajasthan	Sarus Crane	
Tamil Nadu		Nilgiri tahr
Kerala	Great Hornbill	Elephant
J&K	Black Necked crane	Hangul
Gujarat	Great Flamingo	Asiatic Lion

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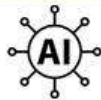
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1

Congratulations

GAURAV SINGH

RANK 1
65TH BPSC

IAS NETWORK



Received all now ? 12:40 AM ✓✓

Yup 1:32 AM

April 13

Hello sir.. 1:11 AM

Thanks for all support 😊😊😊😊
1:11 AM

Which service ? 7:39 AM ✓✓

Assistant district employment officer
7:53 AM

Congratulations!! 7:53 AM ✓✓

Thanku sir 7:53 AM

Better than nothing 8:48 PM ✓✓

I mean 8:48 PM ✓✓

Atleast clearing exam 8:48 PM ✓✓

Gives confidence 8:48 PM ✓✓

Yes sir.. Not clearing upsc mains from



Gaurav Singh

Got in uppsc though not Very good post
Better than nothing

8:48 PM ✓✓

I mean

8:48 PM ✓✓

Atleast clearing exam

8:48 PM ✓✓

Gives confidence

8:48 PM ✓✓

Yes sir.. Not clearing upsc mains from
last two times.. Finally got some good
news. It's really encouraging for next
attempt.

11:36 PM

September 24

Hmm

9:15 PM ✓✓

Today

Sir.. 65th BPSC AIR-1

6:04 PM

You secured 1st rank ?

6:06 PM ✓✓

Whoa !!!!

6:06 PM ✓✓

Congratulations 🎉

6:07 PM ✓✓



Whoa !!!!

6:06 PM ✓✓

Congratulations 🎉

6:07 PM ✓✓

Unread Messages

IAS NETWORK

You secured 1st rank ?

Yes sir

6:22 PM

Congratulations, Enjoy your moments

6:22 PM ✓✓

IAS NETWORK

Atleast clearing exam

Also this

6:23 PM ✓✓

You should be happy now 😊😊

6:23 PM ✓✓



6:23 PM

Yes sir

6:23 PM

Enjoy Bro, You deserve it 👍👍

6:23 PM ✓✓



Message





IAS Shahnaz AIR 217 U...



Yes 20:42

AIR 217 20:42

Congratulations 20:42 ✓✓

Thank you so much. IAS network was an important part of my preparation 21:14

Thanks 21:19 ✓✓

Today

I wanted to thank your team. I have scored 140 in essay. I was very happy. Particularly Rachita Singh. Her criticism were the words in my head on the way to exam..

I kept in my mind all that her mails had conveyed. 12:57

And incorporated them while writing... i didn't make the mistakes i made while practising...

Your team's quick reply and elaborate response in essays were very helpful. 12:58





IAS Shahnaz AIR 217 U...



Thank you so much. IAS network was an important part of my preparation

21:14

Thanks

21:19 ✓✓

Today

I wanted to thank your team. I have scored 140 in essay. I was very happy. Particularly Rachita Singh. Her criticism were the words in my head on the way to exam..

I kept in my mind all that her mails had conveyed.

12:57

And incorporated them while writing... i didnt make the mistakes i made while practusing...

Your team's quick reply and elaborate response in essays were very helpful.

12:58

I have referred you to couple of aspirants!

Keep up the good work! Kudos to you and your team

12:59

Thanks 👍

12:58 ✓✓





Swathika GS PSIR 10K



Can you please resend your queries 14:07 ✓

20 December 2020

?? 10:34 ✓

Today

Good evening Sir 00:12

I am Swathika. Got 593 rank 00:12

I am truly grateful for your timely evaluation of my GS and PSIR answer papers 😊 00:13

I will need your continued support to improve the rank further Sir 😊 00:13

Congratulations 00:36 ✓✓



00:36 ✓✓

Swathika GS PSIR 10k

I will need your continued support to improve the rank further Sir 😊

Sure

00:47 ✓✓



ALL MESSAGES

R ranjit 1 4 Nov
Need to improve content keep writing ATG (no body)
ethical 3

S Sandeep Goyal 2 Nov
Corrected FVI
gaurav 0111 12...

S me, students 9 1 Nov
Fee payment for anthropology optional to...
On 2020-11-01 07:42, budania gaurav wro...
IMG-20201024...

Neha Bhamu 31 Oct
0015
6248_Covid_Related_Initiatives_Session...

MakeMyTrip 31 Oct
LAST DAY to Grab Up to 15% Cashback...
on Taj, SeleQbons, Vism...

Swiggy 31 Oct
Mull

3:56 PM

November 29, 2020

Hey 9:54 AM ✓

January 20

Thank you sir to you and your team

7:06 PM

For answer writing 7:06 PM

We all the friends got benefited from your team and their analysisnow hoping for good results

7:07 PM





YouTube channel link for our video series

9:44 PM ✓✓

<https://m.youtube.com/c/IASNETWORK>

9:44 PM ✓✓

Can use questions from any source though

9:44 PM ✓✓

Yes sir , rest i know all about procedure

9:45 PM

Ok sir

9:49 PM

September 24

Hey

8:32 PM ✓✓

Congratulations

9:27 PM ✓✓

If I am correct

9:27 PM ✓✓

Rank 13

9:27 PM ✓✓

Hearty congratulations

9:38 PM ✓✓

September 25

Thank you sir

4:40 AM

Congratulations 7:07 PM ✓

Thank you friend 7:21 PM

442 rank 7:21 PM

Today

Getting good marks in mains is very vital for getting into the final list. For this, continuous practice is a must. But practice without unbiased assessment fails to explain to us our mistakes. This is where IAS NETWORK has helped me. It provided a precise, unbiased, and to the point evaluation of my answers. Which helped me to improve the content and structure of my answers. The easy and optional evaluation also helped me tremendously. Moreover, they provide the evaluation in less than 2 days, which helps in constantly modifying and improving our answers in accordance with the feedback.

Thank you IAS NETWORK!

3:14 PM

Thanks 3:15 PM ✓