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ForumIAS

Environment

RED BOOK | PT Things

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This Red Book is a part of a Supplementary Study Material for ForumIAS Academy Comprehensive Guidance Program (CGP) 2022
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Dear Friends,

We have finally come out with the first version of the Environment Red Book [PT Things]

For years we had been longing for a good book on Environment given the high weightage accorded to the subject in the Civil Services Preliminary Examination.

The first edition of the Environment Red Book [PT Things] is dedicated to the ForumIAS Community and the wonderful members that make it up.

We look forward to your suggestions, feedback and fresh and new ideas. You can reach us at ravi@forumias.com

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CHAPTER 1

ENVIRONMENT, ECOLOGY AND ECOSYSTEM

1.1 ENVIRONMENT

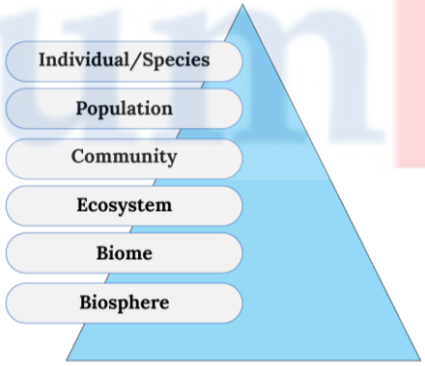
Environment means anything that surrounds us. It consists of both living (biotic) and non-living (abiotic) things. Interactions among the biotic and abiotic components shape the habitat and ecosystem of an organism.

The environment includes the physical (air, water), chemical (carbon cycle, nitrogen cycle) and biological (biomolecules, organisms) interactions that affect an organism.

Components of Environment	
Abiotic	**Biotic**
Water	Green plants
Soil	Non-green plants
Atmospheric gases	Man
Fire	Animals
Energy	Parasites
Temperature	Decomposers

1.2 ECOLOGY

Ecology is the study of relationships between living organisms, including humans and their physical environment. There are five main levels of organization of ecology.



Ecological Organization

Population refers to a group of individuals usually of the same species, occupying a defined area during a specific time.
Community refers to all populations of different species that live in the same area and interact with one another. A community is composed of all of the biotic factors of a site. Communities in most instances are named after the dominant plant form and can be divided into two types:

a. **Major Community**- These are large-sized and relatively independent. They depend only on the sun's energy from outside. E.g., Tropical Evergreen Forests.
b. **Minor Community**- These are dependent on the neighboring communities. E.g., A mat of lichen on a cow dung pad.

Ecosystem is the structural and functional unit of a biosphere. It consists of a community of living organisms in conjunction with their environment's non-living components, both interacting and exchanging materials between them.

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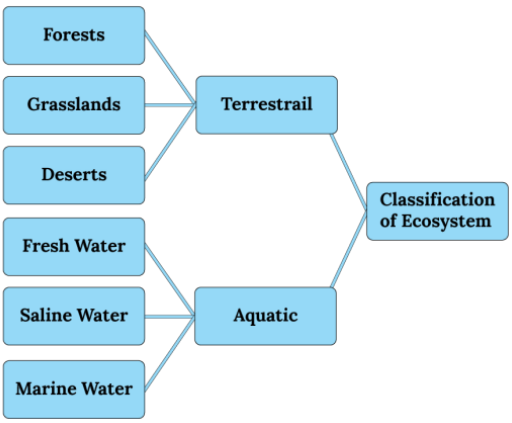


Some terms to remember:

1. **Autotrophs** -Primary producers like green plants, microscopic algae.
2. **Heterotrophs/Phagotrophs**- Consumers who are incapable of producing their own food, e.g., humans.
3. **Saprotrophs/Osmotrophs**- They are decomposers like bacteria, fungi, earthworms.

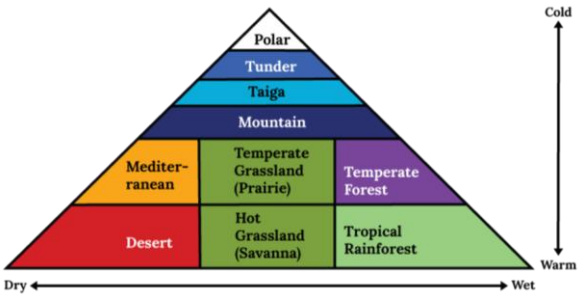
Ecotone is a zone of junction between two or more diverse ecosystems. E.g., the mangrove forests are an ecotone between marine and terrestrial ecosystems while grasslands represent an ecotone between forest and desert. Other ecotones are estuary and riverbank.

Important **characteristics of ecotone** are:

a. It is a **zone of tension** with conditions intermediate to the ecosystems bordering it.
b. It is **linear** as there is a progressive increase in species composition of incoming community and simultaneous decrease in species of outgoing adjoining community.
c. There may be **organisms in an ecotone entirely different** from that of adjoining communities.
d. Ecotones may have an '**edge effect**' wherein the number of species and population density of some species in this zone is much greater than either community.

Niche refers to the unique functional role or place of a species in an ecosystem. A niche is unique for a species and no two species in a habitat can have the same niche. Niche is important for the conservation of organisms. If we need to conserve a species in its native habitat, we need to know about the niche requirements of the species and ensure that all requirements of its niche are fulfilled.

Biome is the terrestrial part of the biosphere. They are characterized by climate, vegetation, animal life and general soil type.



Biome distribution based on Temperature and Precipitation:

Sl. No	Biome	Distribution	Important characteristics
1	Tundra	Northern and Southernmost regions of the world adjoining the ice-bound poles.	• There are no trees due to permafrost. The lowest forms of vegetation like mosses, lichens are sparsely found on bare rocks. • Reptiles and amphibians are almost absent.

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			• Most of the animals found have a long life. They are protected by thick cuticle and epidermal hair or fur.
2	Taiga	Northern Europe, Asia and North America.	• They are also known as boreal forests. Their productivity is lower than those of any other forest ecosystem. • Soils of boreal forests are characterized by thin podzols. Podzols have low pH (acidic) due to excessive leaching.
3	Temperate Deciduous Forest	Central and Southern Europe, Eastern North America, Western China, Japan, New Zealand etc.	• Soils of temperate forest are podzolic and fairly deep. • The flora includes oak, beech and maple.
4	Tropical Rainforest	They are found in the equatorial region.	• Multiple storey of broad-leafed, tall, closely set evergreen trees with crowns forming a continuous canopy are found. • The soil of rainforest is nutrient-poor as most of the nutrients are washed away by heavy rains. • Coexistence of a large number of species. • Presence of numerous epiphytes. • Flora includes mahogany, ebony etc.
5	Savannah	Tropical region: It is most extensive in Africa.	• Tall grass and short trees. • Trees are deciduous and have broad trunks for water storage. • Also known as 'Big Game Country' as thousands of animals are hunted for sports.
6	Steppe	Temperate conditions with low rainfall.	• They are practically treeless. • Grasses are short and nutritious.
7	Desert	Continental interiors with very low and sporadic rainfall.	• Vegetation is predominantly xerophytic or drought resistant. • Plants have long roots, few or no leaves, and the foliage is either waxy, leathery, hairy or needle-shaped to reduce the loss of water through transpiration. E.g., cacti.

Aquatic ecosystems are not called biomes; however, they are divided into distinct life zones. Based on the salinity, aquatic ecosystems are classified into the following types:

a. **Freshwater ecosystems** which have salt content less than 5 ppt. There are two types of freshwater ecosystems- Static or still water (Lentic) ecosystem like ponds, lakes, bogs, swamps and Running water (Lotic) ecosystem like springs, streams, rivers.
b. **Marine ecosystems** that have salt content of 35 ppt or more.
c. **Brackish water ecosystems** with salt content in between 5 to 35 ppt like mangroves, estuaries, salt marshes.

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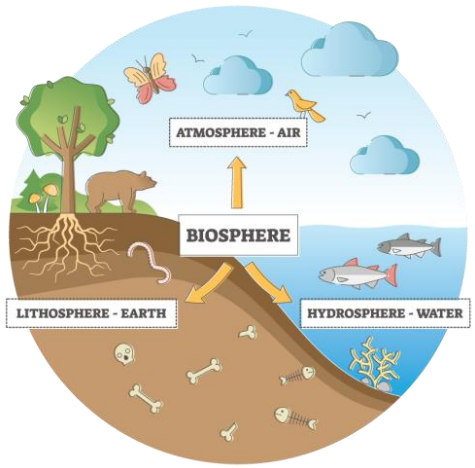
Biosphere is a part of the earth where life can exist. It comprises of the atmosphere (air), hydrosphere (water) and lithosphere (land).



Pointers for prelims:

1. **Biosphere is absent at extremes of North and South poles, the highest mountains and deepest oceans** since existing in hostile conditions there; do not support life.
2. Occasionally, spores of fungi do exist at great heights beyond 8000 meters, but they are metabolically inactive.

1.3 FUNCTIONS OF ECOSYSTEM

1.3.1 Ecological Succession

Ecological succession is the process of change in the species structure of an ecological community over time. The time scale can range from decades to even millions of years. Plants and animal species in an area are replaced or changed into another over a period of time. One community replaces another until a stable and mature climax community develops.

The stages leading to the climax community are called seres or successional stages. Succession is characterized by increased productivity, a gradual increase in food webs' complexity and increased diversity of organisms with increased niche development.

Succession occurs faster in regions existing in the middle of the large continent because seeds of plants belonging to the different seres would reach here much faster.

Stages in succession are:

a. **Primary Succession**: It takes place over an area where no community has previously existed. Few hardy pioneer species like lichens, mosses and microbes first colonialize the new site. The pioneers, over a few generations, alter the habitat conditions by their growth and development. These new conditions may be conducive to establishing additional organisms that may subsequently arrive at the site.

b. **Secondary Succession**: It is the sequential development of biotic communities following the complete or partial destruction of the existing community. A mature or intermediate community may be destroyed by natural events like floods or human interventions like deforestation.

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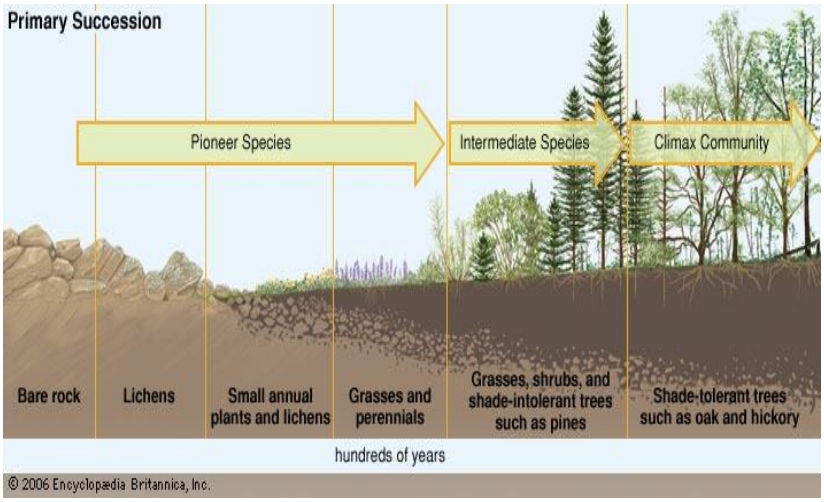
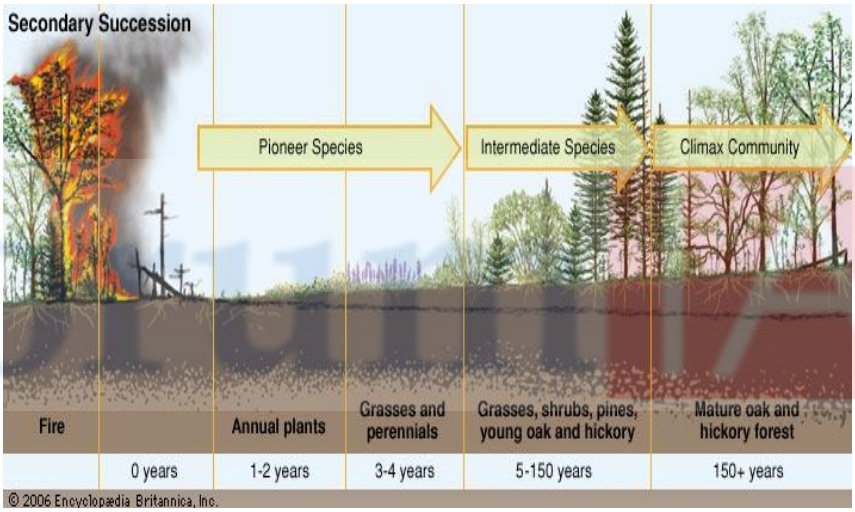


This abandoned land is first invaded by hardy grasses species that can survive in bare, sunbaked soil. Tall grasses and herbaceous plants may soon join these grasses. Eventually, some trees come up in this area, seeds of which may be brought by wind or animals. And over the years, a forest community develops.

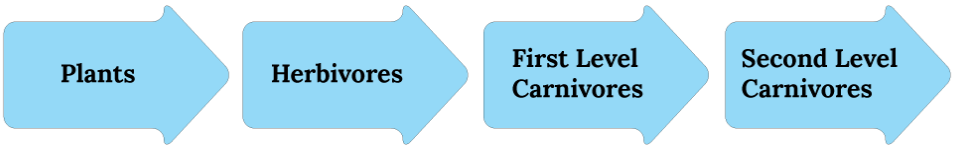


The **difference between primary and secondary succession** is that secondary succession is relatively faster than primary succession as it starts on a well-developed site already formed at the site. Also, secondary succession starts on a well-developed soil already formed at the site.

Types of succession are:

a. **Autogenic Succession**: When living inhabitants of the community itself bring about succession.
b. **Allogenic Succession**: When outside forces bring about succession.
c. **Autotrophic Succession**: Succession in which green plants are much more significant in quantity.
d. **Heterotrophic Succession**: Succession in which heterotrophs are more significant in quantity.

1.3.2 Energy Flow Through an Ecosystem



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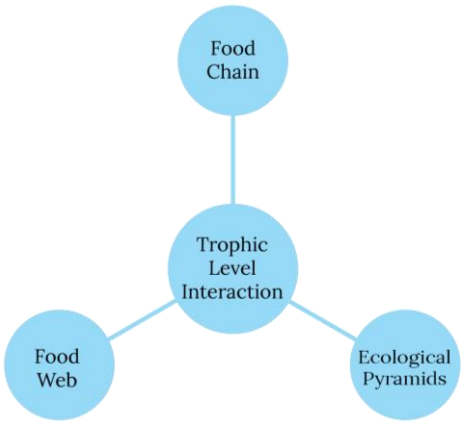
Energy flow is **unidirectional** and decreases from the first trophic level to upwards. This is due to loss in energy in the form of heat at each trophic level.

Trophic level interaction deals with how members of an ecosystem are connected based on nutritional needs.

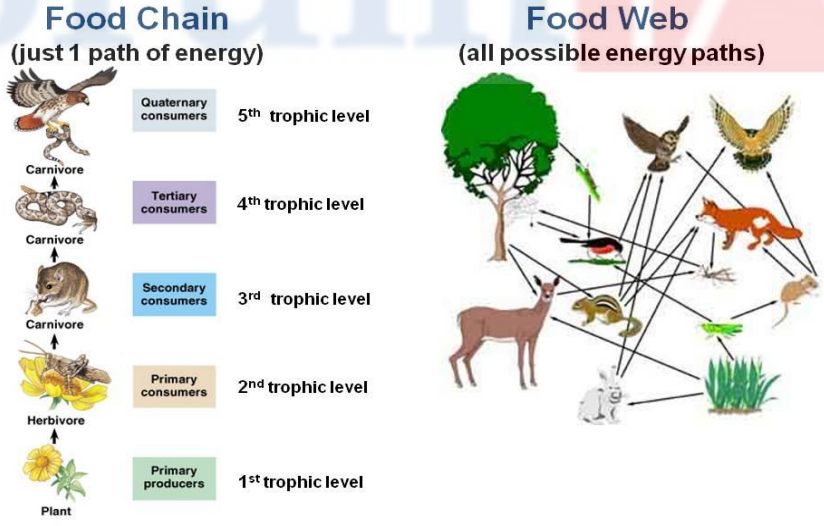


Basic Concepts:

1. **Food Chain**: A sequence of organisms that feed on one another form a food chain. It can be a grazing food chain (beginning from green plants at the base) or a detritus food chain (beginning from dead organic matter). Food chains are not found within the population of a species (for e.g., a lion won't eat a lion).
2. **Food Web**: Multiple interlinked food chains make a food web. A food web denotes the numbers of each organism which are eaten by others.

A **food web consists of many food chains**. A food chain only follows just one path as animals find food. E.g., a hawk eats a snake, which has eaten a frog, which has eaten a grasshopper, which in turn has eaten grass.

However, a **food web consists of many food chains**. A food web shows many different paths through which plants and animals are connected. For e.g., a hawk might also eat a mouse, a squirrel or some other animal. The snake may eat a beetle or a caterpillar. And the process continues for all the other animals in the food chain.



The *arrow* points to the eater and shows the transfer of energy.

Picture Credits: www.cadavies.com/food-chains-and-food-webs.html

Food Chain v/s Food Web

Terrestrial Food Chain: Grass→Grasshopper→Mouse→Snake→Hawk.
Aquatic Food Chain: Phytoplankton (diatoms, cyanobacteria) →Crustaceans→Herrings.

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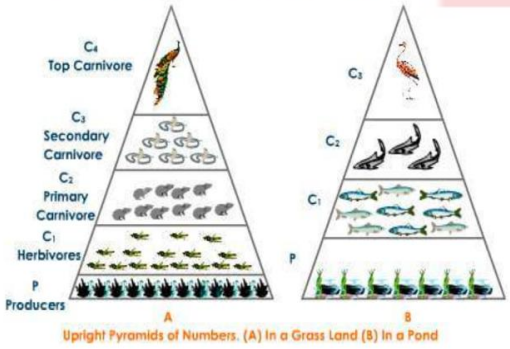
Biotic Interactions				
Sl. No	**Type**	**Species 1**	**Species 2**	**Example**
1	Mutualism	+	+	• Sea Anemone gets attached to the cell of hermit crab • Coral reefs • Pollination
2	Commensalism	+	0	• Suckerfish attaches to shark • Cow dung and dung beetles. • Trees and epiphytic plants
3	Amensalism	-	0	• A large tree shades a small plant
4	Competition	-	-	• Two species compete for the same food
5	Predation	+	-	• Predators like lion, tiger
6	Parasitism	+	-	• Parasites getting nourishment from the host
'+' means benefitted '- 'means harmed '0' means neither benefitted nor harmed				

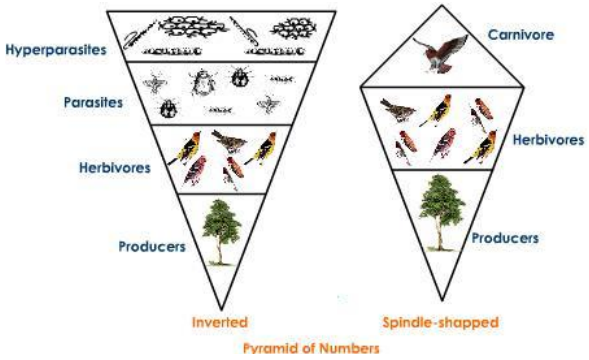
Ecological Pyramids: They are pyramidical representation of trophic levels of different organisms based on their ecological position (producer to final consumer). They are classified into three categories:

1. **Pyramid of numbers**: This shows the total number of individual organisms at each level in an ecosystem's food chain.
    a. **Pyramid of numbers-upright**: In this pyramid, the number of individuals decreases as one moves from lower to higher trophic level. Grassland and pond ecosystem shows this type of pyramid.



Upright Pyramids of Numbers. (A) In a Grass Land (B) In a Pond

    b. **Pyramid of numbers-inverted**: In this, the number of individuals is increased from lower to higher trophic level. E.g., tree ecosystem.



Pyramid of Numbers

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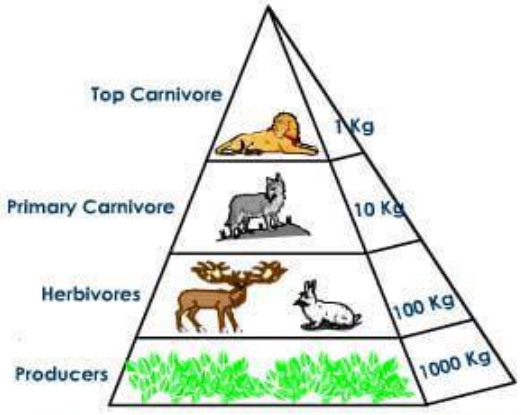
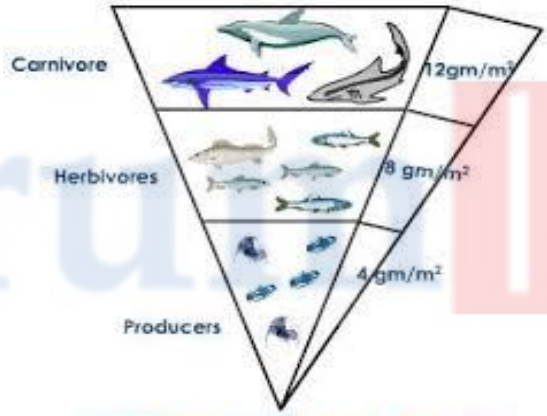
2. **Pyramid of biomass**: It is determined by collecting all organisms at each trophic level and measuring their dry weight.
    a. **Pyramid of biomass-upright**: For the majority of ecosystems on land, the pyramid of biomass shows a large base of primary producers and a smaller trophic level perched on top.



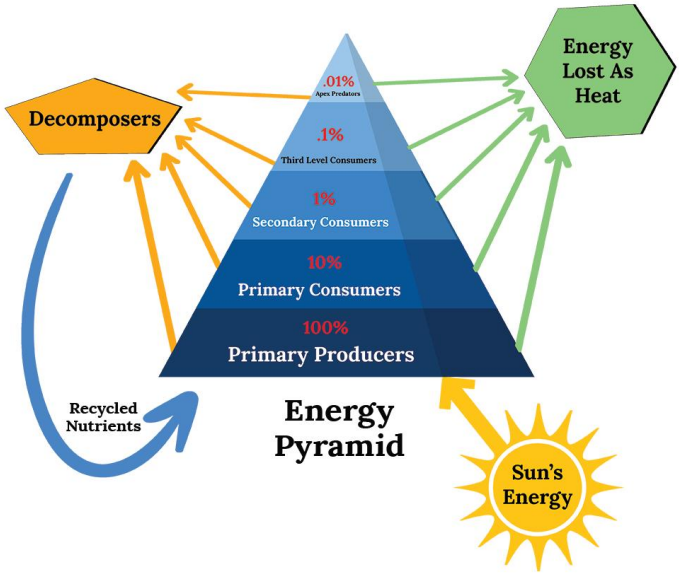
Upright Pyramid of biomass in a Terrestrial Ecosystem

    b. **Pyramid of biomass-inverted**: In contrast, in many aquatic ecosystems, the pyramid of biomass may assume an inverted form. This is because producers are tiny phytoplankton.



Inverted Pyramid in an Aquatic Ecosystem

3. **Pyramid of Energy**: An energy pyramid is a model that shows the flow of energy from one trophic level to the next along a food chain. It is always upright with a large energy base at the bottom.



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Issues with Ecological Pyramid:

1. Saprophytes are not given a place in ecological pyramids.
2. It does not consider the same species belonging to two or more trophic levels.
3. It does not accommodate a food web.

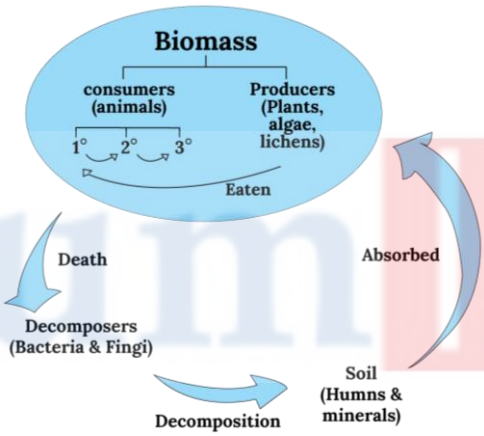
Basic Concepts:

1. **Bioaccumulation**: It refers to how pollutants enter a food chain. Bioaccumulation occurs when an organism absorbs a toxic substance at a rate greater than that at which the substance is eliminated.
2. **Biomagnification**: It refers to the pollutant's tendency to concentrate as they move from one trophic level to the next. For biomagnification to occur, pollutants must be long-lived, mobile, soluble in fats, biologically active. For e.g., the concentration of DDT moves up the food chain, from one trophic level to another.

1.3.3 Bio-geo-chemical cycle

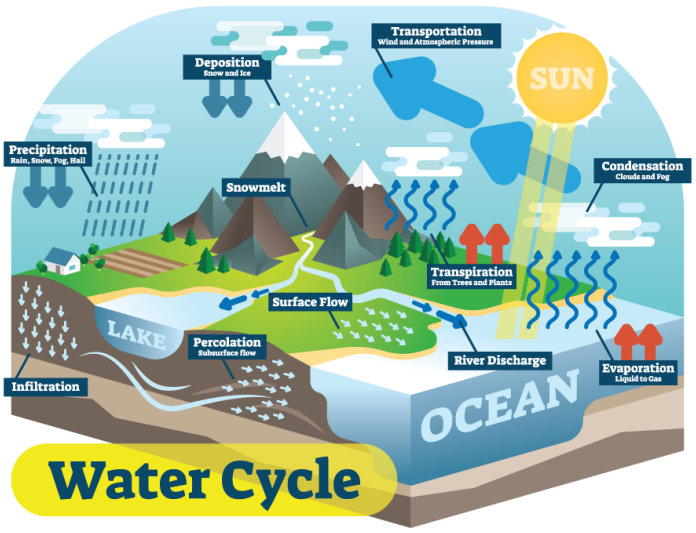
Bio-geo-chemical cycle is a pathway by which a chemical substance moves through the biotic and abiotic compartments of the earth. They are of the following types:

1. **Nutrient Cycling**: It is a concept that describes how nutrients move from the physical environment to the living organisms and subsequently back to the physical environment.



Nutrient Cycling

2. **Gaseous Cycles**: Some of the most important gaseous cycles are water, carbon and nitrogen.
    a. **Water Cycle**: It involves a continuous circulation of water in the Earth-atmosphere system, which is driven by solar energy.



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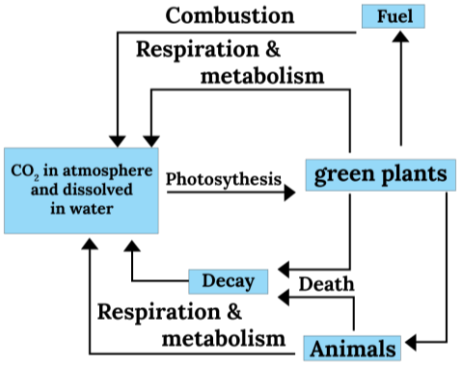
b. **Carbon Cycle**: It involves a continuous exchange of carbon between the atmosphere and organisms. It is usually a short-term cycle. Respiration, decay and volcanic actions are some factors that add CO_2 to the Carbon Cycle.



Carbon Cycle

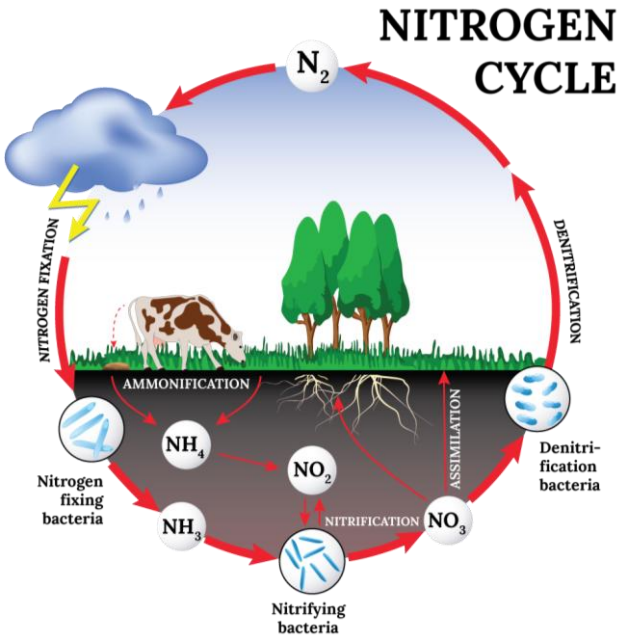
c. **Nitrogen Cycle**: Nitrogen is converted into many chemical forms as it circulates from the atmosphere to the soil to organism and back into the atmosphere.

i. **Nitrogen fixation**: They are accomplished in three different ways: by microorganisms like bacteria and blue-green algae, by man using industrial process like fertilizer factories and to a limited extent by atmospheric phenomenon like thunder and lighting.

> Certain microorganisms are capable of fixing atmospheric nitrogen into ammonium ions. These are free living nitrifying bacteria (e.g., aerobic azotobacter and anaerobic clostridium) and symbiotic nitrifying bacteria living in association with leguminous plants and symbiotic bacteria living in non-leguminous root nodule plants (e.g., rhizobium) as well as blue green algae (e.g., anabaena, spirulina)

ii. **Nitrification**: Ammonium ions are oxidized to nitrites or nitrates by two specialized bacteria; Nitrosomonas bacteria to promote ammonia transformation into nitrite, which is then further transformed into nitrate by the bacteria Nitrobacter.

iii. **Denitrification**: Special denitrifying bacteria pseudomonas convert nitrites/nitrates to elemental nitrogen.



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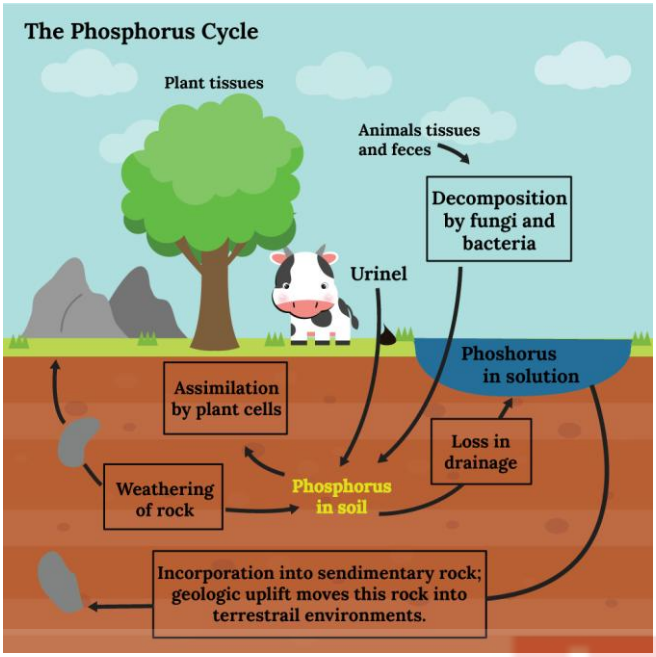
3. **Sedimentary Cycles**: Phosphorus and sulphur circulate by means of sedimentary cycle.

   a. **Phosphorus Cycle**: The main storage for phosphorus is in the earth's crust. It occurs in large amounts as a mineral in phosphate rocks and enters the cycle from erosion, weathering and mining activities.

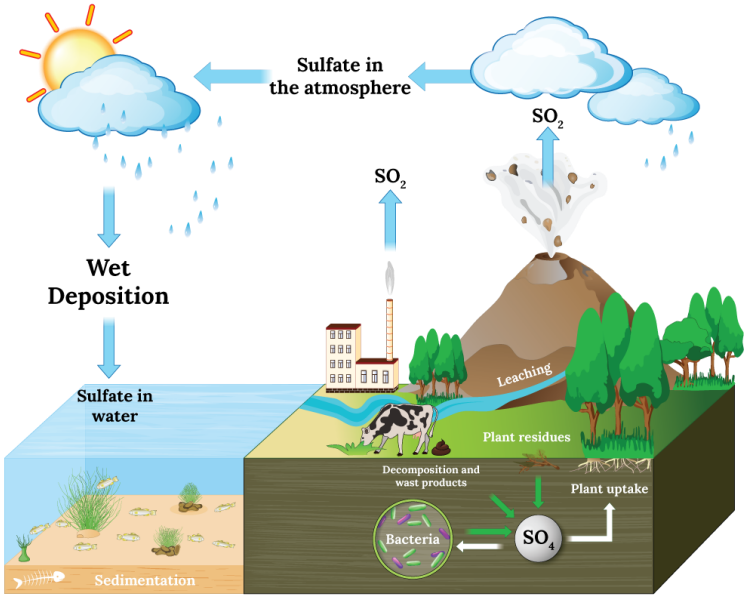


   b. **Sulphur Cycle**: Sulphur is locked in organic (coal, oil and peat) and inorganic deposits (pyrite rocks and Sulphur rocks).

   It is released by weathering activities. It also enters the atmosphere from sources like volcanic eruptions, fossil fuel combustion, ocean surface and decomposition.

   While the Sulphur cycle is mostly sedimentary, hydrogen sulphide and Sulphur dioxide add a gaseous component to it. This hydrogen sulphide also gets oxidized into Sulphur dioxide which dissolves in rainwater and falls as acid rain.

Sulfur Cycle



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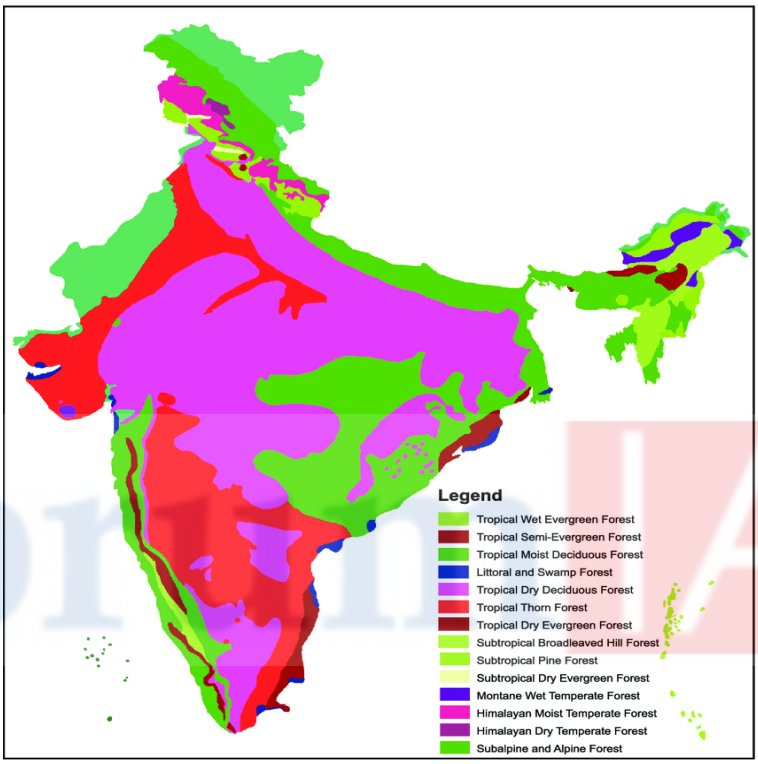
1.4 TERRESTRIAL AND AQUATIC ECOSYSTEMS

1.4.1 Terrestrial Ecosystem

Terrestrial ecosystems, namely tundra forest, boreal forest, temperate deciduous forest, tropical rain forest, savannah, steppe and desert have been discussed earlier in this booklet.

Important terrestrial ecosystems required from prelims point of view will be discussed in this chapter.

1. **Indian Forest Types (based on Champion and Seth classification of forest)**



Picture Credits: Wildlife Institute of India

2. **Grassland Ecosystem**: These are found in regions where rainfall is about 25-75 cm per year. Rainfall is not enough to support a forest, but more than a true desert. Steppe formations are found in western Rajasthan while dry savannah grasslands are found in the central and eastern parts of Rajasthan. Fire is a natural part of the grassland ecosystem which helps control trees, woody shrubs and invasive species and maintain its health and vigor.

   Heavy grazing in grasslands leads to a reduction of the mulch cover of the soil. Microclimate becomes dry and is readily invaded by xerophytes. Due to the absence of humus cover, the mineral soil surface is heavily trampled. It reduces the infiltration of water into the soil and accelerates run-off, resulting in soil erosion.

   Banni Grassland of Gujarat is the largest natural grassland in the Indian subcontinent. Maldhari tribes dominate this area. A huge freshwater lake, Chhari-Dhand is a prominent feature of the Banni grassland.

3. **Desert Ecosystem**: Animals are physiologically and behaviorally adapted to desert conditions: they are fast runners, nocturnal in habit, have long legs to keep the body away from the hot ground and conserve water by excreting concentrated urine.

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Thar desert is an example of Indian desert. It is home to the **Great Indian Bustard, Flamingoes and Asiatic Wild Ass**. Asiatic Wild Ass, also known as **ghudkhur** in local Gujrati language, is a sub-species of the onager native of South Asia. The animal has no predators in that area, but its existence is threatened due to the destruction of habitats. It is currently listed as Near Threatened by IUCN.

Cold Desert of India is found in Leh, Ladakh and Kargil of Kashmir and Spiti valley of Himachal Pradesh and some parts of Uttarakhand and Sikkim. The soil of this region is sandy to sandy loam, while the pH type is neutral to slightly alkaline. Tibetan Wild Ass (**Kiang**) and **Snow Leopard** are important fauna found here.

Pointers for prelims:

1. **Forest-plus 2.0**, a 5-year program focusing on improving the status of forests in three terrains in Bihar, Kerala and Telangana, has been launched by **USAID and MoEF&CC.**
2. Kerala has adopted **Miyawaki style afforestation** technique used to create urban forests. The Miyawaki method, also called the Potted Seedling Method, is an afforestation technique that uses native species to create dense, multilayered forests.
3. **New York Declaration on Forests (NYDF)** is a voluntary and non-binding international declaration to take action to halt global deforestation.
4. **Bonn Challenge** was launched in 2011 by the government of Germany and IUCN. It envisages a global goal to bring 150 million hectares of degraded land and deforested landscapes into restoration by 2020 and 350 million hectares by 2030.
5. **Red Sanders** is an endemic tree of South India. It is found in Tropical Dry Deciduous Forest of Palakonda and Seshachalam hill ranges of Andhra Pradesh and is also found in Tamil Nadu and Karnataka. IUCN has classified it under endangered category.
6. **Shola forests** are stunted tropical montane forests found in Nilgiris, Annamalai and Palani hills.
7. **Nilambur teak**, grown in Kerala's Nilambur region, is the first forest produce to get GI tag in India. It exhibits high resistance to fungal decay and has antioxidant properties.
8. **Kelp forests** are large brown algae seaweeds. They grow in "underwater forests" in shallow oceans and nutrient-rich waters. Generally speaking, kelps live farther from the tropics than coral reefs. However, a few species have been known to occur exclusively in tropical deep waters.
    a. They are considered as keystone species.
    b. They help reduce coastal erosion and acts as a breakwater during large storms.
    c. They are an important source of potash and iodine. Many kelps produce algin, a complex carbohydrate useful in industries such as tire manufacturing, ice-cream industry.

Indian State of Forest Report, 2019 (ISFR)

ISFR report is a biennial publication of **Forest Survey of India (FSI).**

1. **Forest Cover**
    a. Forest Cover (Area wise): M.P.>Arunachal Pradesh>Chhattisgarh>Odisha
    b. Forest Cover (Percent wise): Mizoram>Arunachal Pradesh>Meghalaya
2. The total **forest and tree cover** of the country is 24.56% of the country's geographical area, which is an increase of 0.65% over the previous assessment.
    a. The total forest cover of the country is 21.67% and the total tree cover is 2.89%.
    b. The percentage of Very Dense Forests has increased over the assessment of 2017.
    c. The top five states and UT to have shown an increase in forest cover include Karnataka>Andhra Pradesh>Kerala>J&K>Himachal Pradesh
3. There has been a **decline in the forest cover in the North Eastern Region** to the extent of 0.45%. **Except for Assam and Tripura**, all the states in the region have shown a decrease in forest cover.

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4. There has been a decrease of 741 sq km of forest cover within the Recorded Forest Area/Green Wash (RFA/GW) in the tribal districts.
5. Increase in the tree cover
    a. Maharashtra has the highest increase in tree cover.
6. **Mangrove cover** in the country has increased by 54 sq km as compared to the previous assessment.
7. **Total Carbon Stock** of the country has increased by 42.6% compared to the last assessment.
8. **Gujarat** has the highest number of wetlands within the Recorded Forest Area (RFA).
9. The analysis revealed that 21.40% of the country's forest cover is extremely fire prone.
10. **Special Features in ISFR 2019**
    a. Includes the "extent of trees outside forest (TOF)"
    b. Assesses "plant biodiversity in forests"
    c. Provides for "refined forest type map of India"
    d. Maps "fire prone forest areas"
    e. Includes "wetlands in forest areas"
    f. Provides information on "forest cover on slopes"
    g. Lists "major invasive species"
    h. Lists "important NTFP species"

The **State of World's Forests (SOFO) 2020 report** is published by Food and Agricultural Organization (FAO) and United Nations Environment Program (UNEP). The report assesses the progress to date in meeting global targets and goals related to forest biodiversity and examines the effectiveness of policies, actions and approaches, in terms of both conservation and sustainable development outcomes.

The report focusses on combining conservation and sustainable use of forest biodiversity to create balanced solutions for both people and the planet.

Due to increasing population, pressure on forest resources have increased. This has led to **higher frequency of forest fires**. In general, forest fires play an important role in forest ecosystem. It helps recycle nutrients, remove invasive species and maintain habitat for some wildlife. In a way, forest fire helps in better regeneration of tree species.

However, as the cycle of fire has spun out of balance, forest fires have become a global concern. Forest fires have drastic impacts like:

1. It releases billions of tonnes of CO_2 into the atmosphere, thus aggravating global warming.
2. Habitats of several animals are destroyed.
3. Exposure to smoke from forest fires has led to various health issues in humans.
4. Forest fires also have a major impact on the micro-climate, thus affecting local weather and precipitation patterns.

Some of the **reasons for forest fires** include:

1. Natural causes include thunderstorms, volcanic eruptions.
2. Dry deciduous forest in India faces 5 to 6 months of dry period and are vulnerable to fires.
3. Man-made causes include slash and burn cultivation practiced in North-East India. Also, many a times, people visiting forests would leave behind inflammable materials like burning bidis, thus causing fire.

Australian Bushfire was the most devastating bushfire faced by Australia in at least 20 years. Although bushfires are common in Australia, the spread and intensity of 2020 bushfire was never seen before. Some of the reasons for the 2020 bushfire in Australia includes:

1. Prolonged drought in the region.

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2. Rare stratospheric warming over Antarctica which contributed to the unusual heat and dryness in Australia.
3. Presence of positive Indian Ocean Dipole (IOD) which are often associated with more severe fire season in South-east Australia.
4. Climate change has also increased the intensity and frequency of forest fires.

Deemed Forest: There are areas that are like forests but are neither recorded nor notified. Supreme Court has ordered that states classify them as deemed forests. Deemed forests are already a legal category of forests in some states.

Forest Advisory Committee (FAC) is a statutory body under the Forest Conservation Act 1980, which considers questions on diversion of forest land for non-forest purposes such as mining, townships and advises the government on the issue of granting forest clearances.

1.4.2 Aquatic Ecosystem

Ecosystems consisting of water as the main habitat are known as aquatic ecosystems.

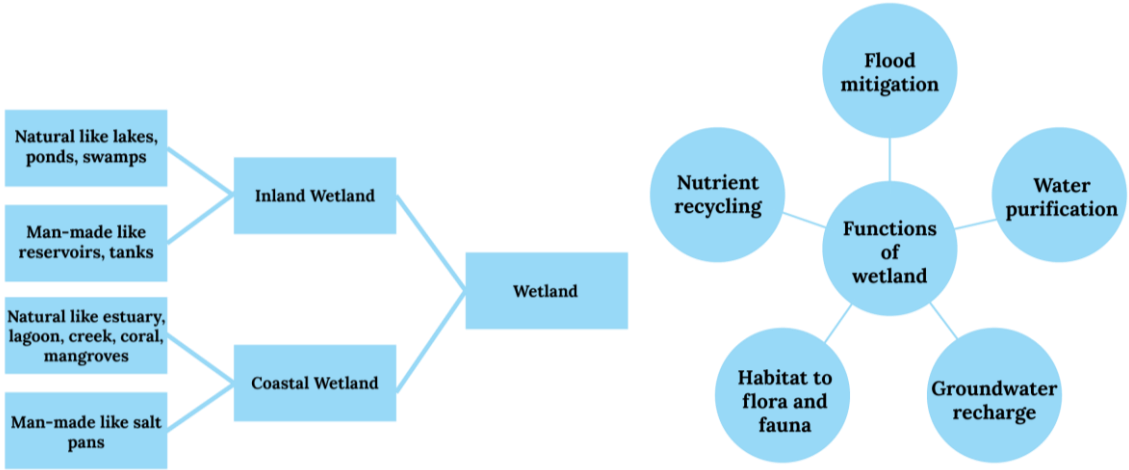
1. **Aquatic organisms** are classified based on their zone of occurrence and their ability to cross these zones.

    a. **Neuston**: They live at the air-water interface. E.g., beetles, back-swimmers
    b. **Periphytons**: These organisms remain attached to the stems and leaves of rooted plants.
    c. **Plankton**: This group includes microscopic plants like algae and animals like crustaceans and protozoans (zooplankton). Their locomotory powers are primarily controlled by ocean currents.
    d. **Nekton**: This group contains animals that are swimmers.
    e. **Benthos**: These organisms are found at the bottom of the water mass.

    Factors like sunlight and oxygen are the most important limiting factors of the aquatic ecosystem. Other factors include dissolved oxygen, transparency and temperature.

2. **Wetland Ecosystem**: Wetlands are areas of marsh or peatland with water that is static or flowing, fresh, brackish or saline, including areas of marine water, the depth of which at low tide does not exceed 6 m. Wetlands are ecotones between terrestrial and aquatic ecosystems.

    Wetlands occupy 18.4% of the country's area, of which 70% is under paddy cultivation. They are usually rich in nutrients and have an abundant growth of aquatic macrophytes. Wetlands support high densities and diverse fauna.



3. **Lake Ecology**: A body of standing water, generally large enough in area and depth, irrespective of its hydrology, ecology and other characteristics, is generally known as lake.

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Ageing of lake occurs as it accumulates mineral and organic matter and gradually gets filled up. Lakes are less productive than the estuary ecosystem but are more than oceans.

The term "**Oligotrophic**" is used to describe lakes with low primary productivity due to nutrient deficiency.

Eutrophication is the process by which a body of water becomes overly enriched with minerals and nutrients from activities like agricultural run-off, disposal of industrial wastes and sewage discharge. This in turn induces excessive growth of algae.

Dead Zones or hypoxia, which refers to reduced levels of oxygen in the water, results from eutrophication. When excessive algae due to eutrophication die, they are decomposed. The bacterial decomposition of their biomass consumes the oxygen in water, thereby creating a state of hypoxia.

Eutrophication thus leads to decreased biodiversity, new species invasion, toxicity and migration of species. Gradually, the water body is reduced into a marsh.

Oligotrophic v/s Eutrophic		
Parameters	Oligotrophic lake	Eutrophic lake
Aquatic plant and animal production	Low	Eliminated due to eutrophication
Nutrient influx	Low	High
Depth	Deeper	Shallow
Water quality	Good	Poor
Oxygen in the bottom layer	Present	Absent

Lake v/s Wetland		
Characteristic	Lake	Wetland
Origins	Tectonic forces	Mostly fluvial
Thermal Stratification	Yes	No
Vertical mixing	Thermally regulated	Wind regulated
Dominant producer	Phytoplanktons	Macrophytes
Food Chain	Grazing pathway	Detritus pathway
Littoral:Pelagial ratio	Small	Large
Productivity	Low	High

Majuli Island is the largest inhabited river island in the world and India's first island district. It is surrounded by the Brahmaputra river, KherkatiaSuti, LuitSuti and Subansiri Rivers.

Ameenpur Lake is the first waterbody in the country to be declared a Biodiversity Heritage Site. Under the Biological Diversity Act 2002, State Government in consultation with local bodies notifies Biodiversity Heritage Sites.

Floating Treatment Wetland (FTW) was set up on **Neknampur Lake** in Hyderabad. It helps purify the lake by breaking down and consuming the organic matter in water with the help of microorganisms growing in the plant root system of FTW through microbial decomposition.

Red Tide refers to Harmful Algal Blooms (HAB), which are large concentrations of aquatic microorganisms such as protozoa and unicellular algae. Nutrient enrichment, warm waters, surface run-off and upwelling in seas are common causes for such blooms.

Marine upwelling is an oceanographic phenomenon that involves wind-driven motion of nutrient-rich water from deep water towards the ocean surface, thus replacing the nutrient-depleted surface water.

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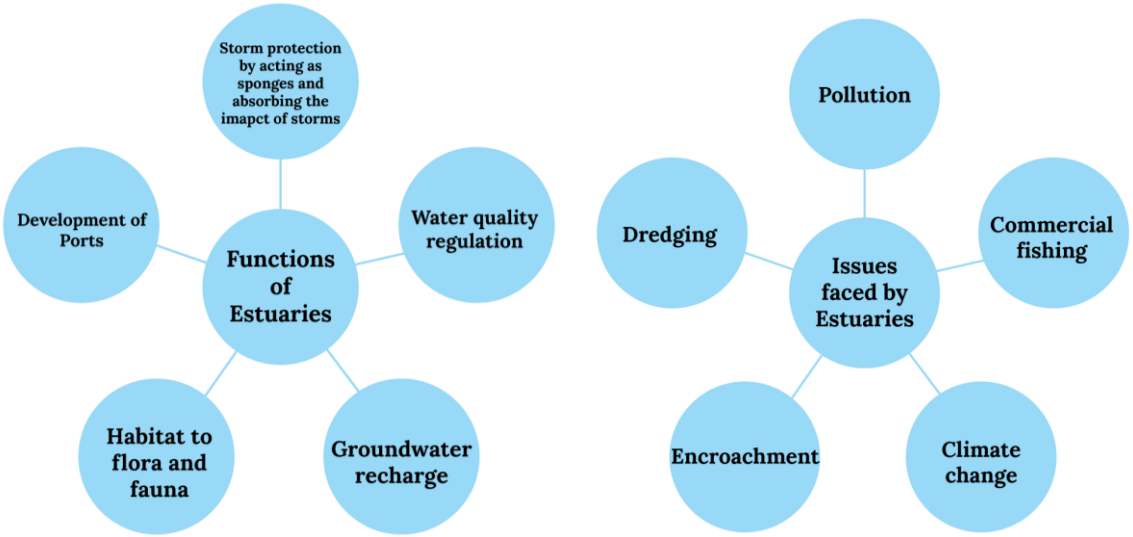
4. **Estuarine ecosystem**: An estuary is a place where a river or stream opens into the sea. They are the most productive water bodies in the world.



5. **Mangroves**: Evergreen forests that grow in sheltered low-lying coasts, estuaries, mudflats, tidal creek backwaters, marshes and lagoons of the tropical and subtropical regions. They are salt-tolerant or halophytes and are adapted to harsh ecological conditions. E.g., Sonneratia and Avicennia.

Some **characteristics of mangroves** are:

a. Require high solar radiation.
b. Produces pneumatophores (blind roots/aerial roots) to overcome respiration problems in anaerobic soil conditions or adventitious roots (roots emerging from main trunk of the tree).
c. Exhibit viviparity mode of reproduction (seeds germinate in the tree itself before falling to the ground).
d. Some secrete excess salts through their leaves.

Role of mangroves:

1. Preventing coastal soil erosion.
2. Acting as "**Bio-Shields**" by protecting coastal lands from tsunamis and floods as they do not get uprooted during tsunami due to extensive roots.
3. Nutrient recycling.
4. Provides habitat to flora and fauna.
5. Supplies woods, fire and medicinal plants.
6. Provides employment to locals.

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Mangrove Profile

Pointers for prelims:

1. **Sundarbans** is a UNESCO World Heritage Site. It is dominated by 'Sundri trees' and is the largest single block of halophytic mangrove forest in the world.
    a. It is the only mangrove reserve in the world inhabited by tigers.
2. **Mangrove for the Future (MFF)** is a regional initiative coordinated by UNDP and IUCN. It aims at promoting coastal ecosystem conservation in six tsunami hit countries including India.

6. **Coral Reefs**: Corals are marine invertebrates. They typically live in compact colonies of many identical individual polyps. Corals are in a symbiotic relationship with 'zooxanthellae' microscopic algae which live on coral. Zooxanthellae assists the coral in nutrient production while the coral polyp in return provides zooxanthellae with a protected environment to live within. A coral reef is made of a thin layer of Calcium Carbonate.

    Corals are of two types- hard corals and soft corals. Only hard corals build reefs. Most of the world's corals are found in tropical shallow waters less than 50 meters deep. Scientists estimate that more than 25,000 described species from thirty-two of the world's thirty-three animal phyla live in reef habitats-four times the number of animal phyla found in tropical rain forests. Australia accounts for around 17% and Indonesia around 16% of the world's corals.

    They are highly productive and are also referred to as the '**Tropical Rainforests of the Oceans**'. They are classified into fringing reefs, patch reefs, barrier reefs and atolls.

    Coral reefs have been included in Schedule I of the Wildlife Protection Act, 1972, thus offering it maximum protection. Also, they have been classified as CRZ-I A under the Coastal Regulation Zone (CRZ) notification, 2011.

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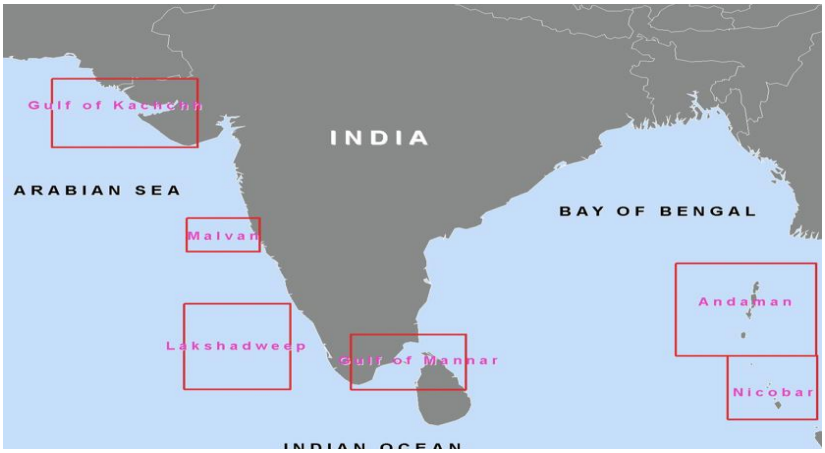
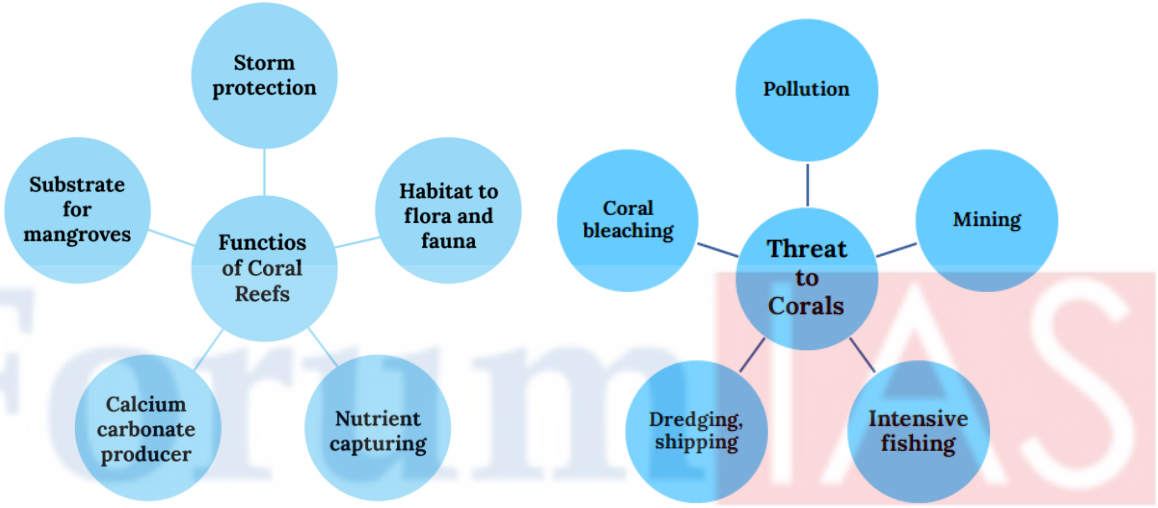


Coral Reef distribution in India



Coral Bleaching occurs when coral polyps expel algae that lives inside their tissues. In such cases, corals lose their vibrant colours and turn white. Several reasons for coral bleaching are:

a. Warm water temperature.
b. Solar irradiance.
c. Subaerial exposure.
d. Sedimentation.
e. Freshwater dilution.
f. Epizootics (Pathogen).

Angria Bank is a shallow submerged atoll located 100 miles off the coast of Ratnagiri and Sindhudurg district of Maharashtra. Coral reefs have been found in this area and the peculiarity of coral reefs present here is that it is in the middle of the ocean, unlike other corals which are either coastal or island corals.

Angria Bank has the potential to become **India's Great Barrier Reef**.

Pointers for prelims:

1. **Coral species in news**:
   a. **Fire Coral** is critically endangered as per IUCN.
   b. **Orange Cup-Coral** is an Invasive Alien Species (IAS) as per Zoological Survey of India (ZSI).

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2. The **International Conference on Status and Protection of Coral Reefs (STAPCOR)**-2018 took place at Bangaram Coral island of Lakshadweep. Theme of the conference was "Reef for Life".
    a. STAPCOR takes place in every 10 years since its foundation in 1998.
3. Tamil Nadu deployed **artificial reefs** in Vaan island in the Munnar region.
4. ZSI with the help from Gujarat's forest department, attempted for the first time a process to restore coral reefs using **bio-rock or mineral accretion technology**. Bio-rock technology is a method that applies safe, low voltage electric currents through seawater, causing dissolved minerals to crystallize on structures, growing into white limestone ($CaCO_3$) similar to that which naturally makes up coral reefs and tropical white sand beaches.
5. World's **largest artificial coral reef** is installed in Maldives.
6. **Coral Bleaching Alert System (CBAS)** has been developed by Indian National Centre for Ocean Information Services (INCOIS).
7. **Coral Reef Recovery Project** is a joint venture between Wildlife trust of India and the Gujarat forest department.
8. **Reef-Watch India** is an NGO that has taken up two projects- Re(ef)Build and Re(ef)Grow.
9. **Palau** is the first country to ban 'Reef toxic' sun cream. Sun cream includes common ingredients like oxybenzone that disrupts coral reproduction, causes coral bleaching and damages coral DNA.
10. **International Coral Reef Initiative (ICRI)** is an informal partnership between nations and organizations that strives to preserve coral reefs and related ecosystems worldwide. The initiative was founded in 1994.
    a. India is a member but not a founding member.
    b. Decisions are not binding.
    c. It is not a United Nations body.

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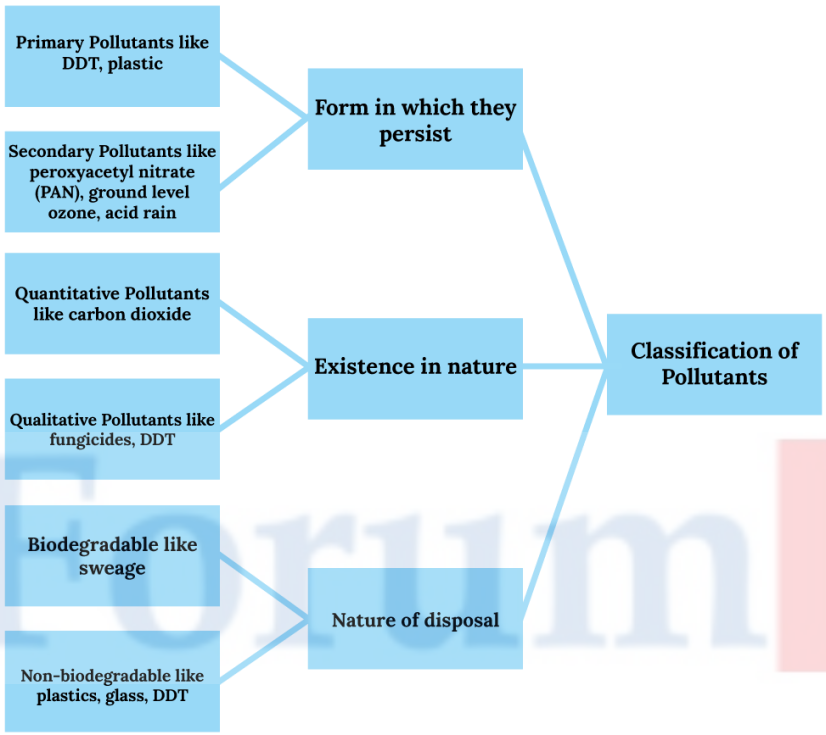
CHAPTER 2

ENVIRONMENTAL CHALLENGES

Pollution is the introduction of harmful materials into the environment. These harmful materials are called pollutants.

2.1 ENVIRONMENTAL POLLUTION

Pollutants are elements, molecules and particles involved in pollution.



1. **Primary pollutants** are emitted directly from the source.
2. **Secondary pollutants** are not emitted directly but form when primary pollutants react.
3. **Quantitative pollutants** are those occurring in nature and become pollutants when their concentration cross a threshold.
4. **Qualitative Pollutants** are substances which are not normally present in the environment and are added by human beings and are pollutants by nature.

2.1.1 Air Pollution

Some of the major air pollutants include Carbon Monoxide (CO), Carbon Dioxide (CO_2), Chlorofluorocarbons (CFC), Lead, ground-level Ozone, Suspended particulate matter, Sulphur Dioxide and Smog (a combination of fog and smoke).

Vehicles and industries are the main sources of ground-level ozone. Ground-level ozone further contributes to **photochemical smog** when nitrogen oxides (from vehicular emissions, industries) react with volatile organic compounds (from paints, inks etc.) in the presence of sunlight.

Sources of **indoor air pollution** are formaldehyde (from carpets, particle boards and insulation foam), Radon (gas emitted naturally from the soil), Volatile organic compounds (from perfumes, hair sprays, furniture polish etc.) and asbestos among others.

CPCB has been executing **National Air Quality Monitoring Programme** to determine the ambient air quality status and trends and ascertain the compliance of National Ambient Air Quality Standards (NAAQS).

NAAQS includes the following pollutants (CO_2 is not included):

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1. Sulphur dioxide (SO_2)	Carbon Monoxide (CO)
2. Nitrogen dioxide (NO_2)	Arsenic
3. PM10	Nickel
4. PM2.5	Benzene
5. Ozone	Ammonia
6. Lead	Benzopyrene

National Air Quality Index (AQI) has six categories of air quality, namely Good, Satisfactory, Moderately Polluted, Poor, Very Poor and Severe with a distinct colour scheme. AQI considers the following pollutants (CO_2 not included):

PM10	CO
PM2.5	O_3
NO_2	NH_3
SO_2	Lead

National Clean Air Program (NCAP) is being implemented by MoEFCC. It is a pollution control initiative to cut the concentration of particles (PM10 and PM2.5) by 20-30% by 2024. It will have 2017 as the base year and 2019 as the first year. NCAP will be implemented in 102 non-attainment cities and is not legally binding.

CPCB, a statutory body under the Water (Prevention and Control of Pollution) Act, 1974 will execute the nationwide program. Further, CPCB is also entrusted with powers under the Air (Prevention and Control of Pollution) Act, 1981.

Pointers for prelims:

1. NITI Aayog has launched a 15-point action plan, '**Breathe India**' for combating air pollution in ten most polluted cities in India.
2. NITI Aayog and the International Transport Forum (ITF) of OCED jointly launched the '**Decarbonizing Transport in Emerging Economies (DTEE)**' project in India. The ambitious five-year project will help India develop a pathway towards a low-carbon transport system.
3. **Clean Air-India** is a collaborative project between Get in The Ring (a platform for start-ups by the government of Netherlands), Start-up India and INDUS forum (an online matchmaking platform of Indian and Dutch businesses).
4. **Environment Pollution (Prevention and Control) Authority**:
    a. It was constituted under Environment (Protection) Act, 1986 (but it is not a statutory body).
    b. It was empowered by the Supreme Court to enforce the **Graded Response Action Plan (GRAP)**. GRAP specifies actions required to control particulate matter (PM) emissions from various pollution sources and is being implemented in the Delhi-NCR region only.
5. Steps taken to control **Delhi Air Pollution**:
    a. Delhi became the first city running on **BS VI fuels**. Bharat Stage Emission Standards (BS) are based on European norms. BS VI fuels contain 10 ppm Sulphur compared to 50 ppm in BS IV. Also, harmful NOx emissions from diesel cars can be brought down by nearly 70%. Due to the above advantages, a direct jump from BS IV to BS VI was made, thus skipping BS V norms.
    b. Delhi is scheduled to run **Hydrogen-CNG (H-CNG)** fueled buses to curb emissions. H-CNG is a blend of Hydrogen and CNG, the ideal concentration of Hydrogen being 18%. The use of H-CNG can curb carbon monoxide (CO) emissions by 70%.
6. To curb **stubble burning**, a significant contributor to air pollution in North India, following steps have been taken:
    a. **Torrefaction**, a Swedish technology that can convert rice stubble into 'bio-coal', is being tested by India.

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   b. **Happy Seeder machine** has been developed by Punjab Agricultural University (PAU) for in-situ management of paddy stubble.
   c. **Pusa decomposer**, a microbial spray that can cause decomposition of the harvested stubble, has been developed by Indian Agriculture Research Institute (IARI).
7. CSIR-NEERI has developed **green crackers**, namely- Safe Water Releaser (SWAS), Safe Thermite Cracker (STAR) and Safe Minimal Aluminum (SAFAL) using Potassium Nitrate (KNO_3) as oxidant.
8. **System of Air Quality and Weather Forecasting and Research (SAFAR**) is a national initiative introduced by the Ministry of Earth Sciences (MoES). It measures the air quality of a metropolitan city by measuring the overall pollution level as well as location-specific air quality of the city. The system has been indigenously developed by the Indian Institute of Tropical Meteorology (IITM), Pune.
9. **Taj Trapezium Zone** is a defined area of 10,400 sq km around the Taj Mahal to protect the monument from pollution. It is an 'eco-sensitive area' covering three world heritage sites, namely Taj Mahal, Agra fort and Fatehpur Sikri. It is spread over Uttar Pradesh and Rajasthan.
10. **Lichens** serve as a good indicator of air pollution.

Fly Ash is produced whenever combustion of solid materials takes place. Its composition includes Aluminum silicate, Silicon dioxide and Calcium oxide. Fly Ash has a number of advantages like:

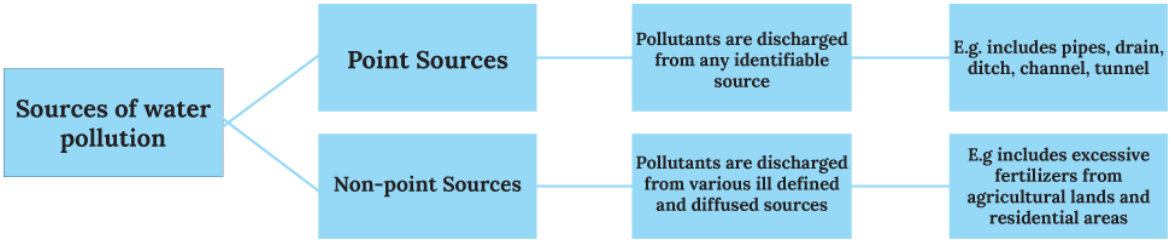
1. Fly Ash bricks are lightweight and have high strength.
2. Fly Ash can be used in the reclamation of wastelands, filling up abandoned mines.
3. Fly Ash can increase crop yield.

Notification on Fly Ash Utilization in 2016 had the following features:

1. Mandatory to use Fly Ash-based products in all construction projects, road embankments and low-lying filling works within 300 km of thermal power stations.
2. Cost of transportation of Fly Ash to be borne entirely by TPS up to 100 km and equally shared between user and TPS for more than 100 km and up to 300 km.
3. Mandatory use of Fly Ash-based products in all government schemes like MGNREGA etc.
4. Target 100% Fly Ash utilization by 2017.

2.1.2 Water Pollution

Addition of certain substance to water which degrades the quality of water so that it becomes unfit for use is Water Pollution.



Oil Spill is one of the most dangerous of all water pollutants. Oil floats on the water surface and poses the threat of swift-spreading fire. It also decreases the oxygen level in the water. Oil spills can be cleared with the help of 'bregoli' (a by-product of paper industry resembling saw dust), **oilzapper** and micro-organisms.

Basic Concepts:

1. **Biological Oxygen Demand (BOD)** and **Chemical Oxygen Demand (COD)**
   a. BOD represents how much dissolved oxygen is required by bacteria to break down

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organic matter in water.
   b. COD represents the measure of oxygen equivalent of the requirement of oxidation of total organic matter (both biodegradable and non-biodegradable) present in water.

COD value is always higher than BOD values. Polluted as well as warm waters increase the BOD and COD values.

2. Diseases caused due to polluted waters
   a. Itai-Itai disease is caused by Cadmium contamination.
   b. Minamata disease is caused by Mercury contamination.
   c. Blue baby syndrome is caused by Nitrate poisoning.
   d. Black foot disease is caused by exposure to Arsenic.

Pointers for prelims:

1. **Central Water Commission** released a recent report titled 'Status of trace and toxic metals in Indian rivers 2018.'
   a. The report highlighted that 42 rivers in India have at least two toxic heavy metals in quantities beyond the permissible limit.
2. **Composite Water Management Index** was released by NITI Aayog to assess and improve the performance of states/UTs in the efficient management of water resources. As per the report-
   a. 600 million people in India face high to extreme water stress in the country.
   b. 75% of the households in the country do not have drinking water on their premises.
   c. 84% of rural households do not have piped water access.
   d. Per capita annual availability of water has decreased.
   e. 14 out of 24 states scored below 50% on water management and have been classified as "low performer".
3. Uranium contamination of groundwater has increased due to overexploitation of groundwater and excessive use of nitrogenous fertilizers. **Bureau of Indian Standards** prescribes drinking water specifications. However, no such limit has been provided for uranium.
   a. Arsenic contamination of groundwater has also increased in states along the Ganga-Brahmaputra-Meghna (GBM) river basin; Uttar Pradesh, Bihar, Jharkhand, West Bengal and Assam.
5. **National Hydrology Project** is a central sector scheme launched to store and analyze hydro-meteorological data.
   a. **National Water Informatics Centre** is a component of the National Hydrology Project.
6. **Jal Shakti Abhiyan** is a time-bound campaign for water conservation and water security with a mission mode approach. The focus of the campaign is on water-stressed districts and blocks.
7. **Jal Jeevan Mission** aims at providing Functional Household Tap Connection (FHTC) to every rural household by 2024.
   a. Fund sharing pattern is 90:10 for Himalayan and North-eastern states, 50:50 for other states and 100% for UTs.
   b. It follows a community driven approach.
8. **Atal Bhujal Yojana** has been launched by Ministry of Jal Shakti.
   a. It is a Central Sector Scheme to improve groundwater management through community participation.
   b. It covers seven states- Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.
   c. It is being implemented (starting 2020) over a period of 5 years with 50% support from the World Bank.

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2.1.3 Noise Pollution

Noise pollution is generally defined as regular exposure to elevated sound levels, leading to adverse effects in humans or other living organisms. As per the World Health Organization, sound levels less than 70 dB are not damaging to living organisms, whereas exposure for more than 8 hours to constant noise beyond 85 dB may be hazardous.

Silence zone is an area comprising not less than 100 meters around hospitals, educational institutions, courts, religious places or any other area declared as such by a competent authority.

2.1.4 Radioactive Pollution

Radioactivity is a phenomenon of spontaneous emission of proton (α), electrons (β), gamma rays due to disintegration of atomic nuclei of some elements. Natural sources include cosmic rays from space and terrestrial radiations from radio-nuclides present in the earth's crust such as radium-224, uranium-238 etc. Man-made sources include nuclear power plants, uranium mining and radiation therapy.

2.1.5 E-Waste

E-waste is electronic products that are unwanted, not working, and nearing or at the end of their "useful life." Computers, televisions, VCRs, stereos, copiers, and fax machines are everyday electronic products.

E-waste and its Source

Sl. No	Particulars	Source
1	Lead	Glass panels in computer monitors, solder in printed circuit board
2	Cadmium	Semiconductor chips, IR detectors, cathode-ray tubes
3	Mercury	Thermostats, sensors, relay, switches, lamps, flat panel displays and electric and electronic equipment
4	Hexavalent Chromium	PVC (Dioxin is released when PVC is burned)

Pointers for prelims:

1. **1st E-waste clinic** has been set up in Bhopal, Madhya Pradesh.
2. As per **Global E-Waste Monitor**, India ranks 5th among e-waste producing countries.

2.1.6 Plastic Pollution

Plastic pollution is the accumulation of plastic objects and particles (e.g., plastic bottles, bags and microbeads) in the Earth's environment that adversely affects wildlife, wildlife habitat, and humans. Plastics that act as pollutants are categorized into micro-, meso-, or macro debris, based on size. Some of the major sources of plastic pollution are:

Single-use plastic: Disposable plastics that are commonly used for plastic packaging and include items intended to be used only once before they are thrown away or recycled.

Microbeads: Plastic pieces or fibre, which is very small, generally measuring less than 1 mm. They are present in a variety of products, from cosmetics to synthetic clothing to plastic bags and bottles and are carcinogenic in nature.

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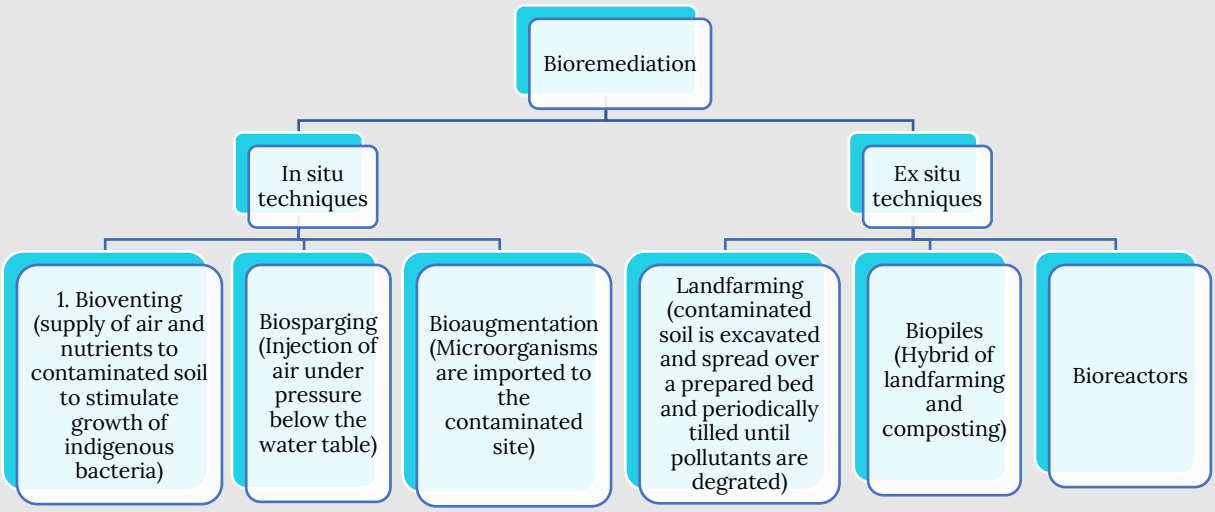
Pointers for prelims:

1. **Plasticrust** is a thin coating on plastic that's growing on rocks at the seashore.
2. Global steps to counter plastic pollution:
    a. UNEP had declared '**Beat Plastic Pollution**' as the theme for World Environment Day 2018.
    b. UN Environment launched **#CleanSeas campaign** with the target of ending marine plastic pollution.
    c. **Honolulu Strategy** is a comprehensive and global effort to reduce the ecological, human health and economic impacts of marine debris.
3. **Alliance to End Plastic Waste** was recently founded as a non-profit organization that includes companies across the globe. From India, Reliance Industries is a part of this alliance.
4. **Ocean Cleanup** is a non-profit organization that is developing advanced technologies to rid the world's ocean of plastics.
    a. It is directed at cleaning the 'Great Pacific Garbage Patch (GPGP)', a zone between Hawaii and California.
5. **Blue Flag beach standards** were established by the Copenhagen-based Foundation for Environmental Education in 1985 in France. It is an environmental award for beaches and sustainable tourism.
    a. Chandrabhaga beach of Odisha was the first in Asia to get Blue Flag certification.
    b. Further, **Society for Integrated Coastal Management (SICOM)**, established under the aegis of MoEFCC, is developing 12 beaches in India for a 'Blue Flag' certification. SICOM is also implementing the World Bank assisted Integrated Coastal Zone Management (ICZM) project.

2.1.7 Soil Pollution

It is a build-up of persistent toxic compounds, chemicals, salts, radioactive materials or disease-causing agents in the soil that have adverse effects on plant growth, human and animal health.

Bioremediation is the use of microorganisms like fungi and bacteria to degrade the environmental contaminants. Mycoremediation is a form of bioremediation which uses fungi to decontaminate the area.



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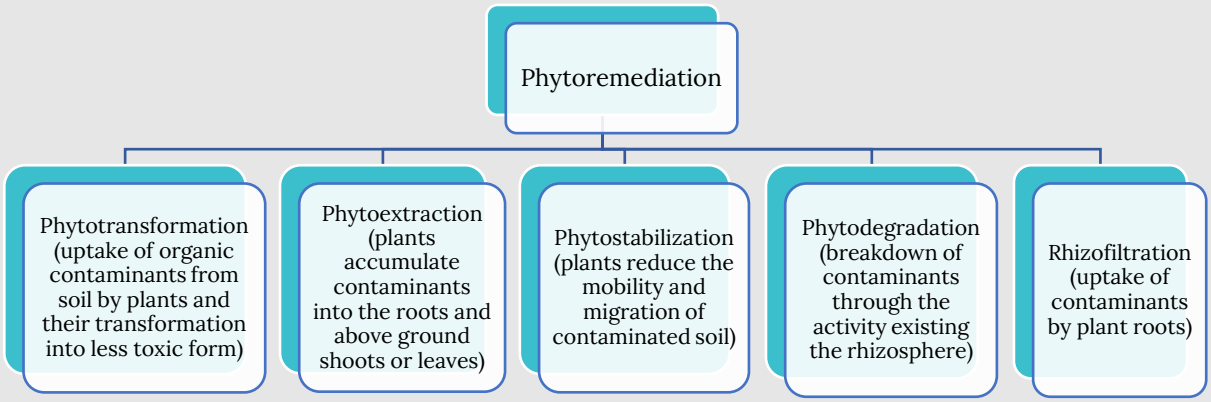
Phytoremediation is the use of plants to remove contaminants from soil and water.



Advantages of bioremediation:

1. Complete destruction of target pollutants is possible.
2. It is environmentally friendly.

However, disadvantage is that bioremediation is limited to those compounds that are biodegradable and it takes a longer time than other treatment processes.

2.1.8 General pointers

Waste Minimization Circles (WMC) helps small and medium industrial clusters in waste minimization in their industrial wastes. This is assisted by World Bank with the help of MoEFCC. The project is being implemented with the assistance of National Productivity Council.

Acid rain is the rainfall that has been acidified. It is formed when oxides of sulphur and nitrogen react with moisture in the atmosphere. Impact of acid rain includes:

1. Microbial species in the soil shift from bacteria-bound to fungi-bound as most fungi favor an acidic environment.
2. It causes leaching of nutrients from the soil, making it infertile.
3. It leads to discoloration, loss of foliar mass, prodigious production of lichens and premature senescence (aging) in vegetation.

MoEFCC has categorized industrial sectors into **White, Green, Orange and Red industries** based on the pollution index. White industries are practically non-polluting and do not require environmental consent. No red category of industries shall normally be permitted in the ecologically fragile/protected area.

2.2 ENVIRONMENTAL ISSUES

2.2.1 Sand Mining in India

Sand is a minor mineral defined under the Mines and Minerals (Development and Regulation) Act, 1957.

Consequences of sand mining are:

1. It can change the course of river.
2. Pollution as well as depletion of groundwater tables.
3. Destruction of habitat of microorganisms.
4. Saline water ingress into freshwater may happen.

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MoEFCC has released the **Enforcement & Monitoring Guidelines for Sand Mining (EMGSM-2020)**. Its major points include:

1. District Survey Reports (DSR) are to be prepared to identify and define mining and no mining zones.
2. All districts to prepare a comprehensive mining plan for the district.
3. Abandoned stream channels to be preferred rather than active channels.
4. Suggested use of technology for checking illegal mining.
5. Annual audit of each mining lease to be carried out.
6. State government should develop an online portal for the sale and purchase of sand and riverbed material.
7. State government should constitute a District Level Task Force (DLTF) under the chairmanship of Collector.

2.2.2 Other issues

'**Colony Collapse Disorder**' is an abnormal phenomenon that occurs when the majority of worker bees in a honey bee colony disappear, leaving behind a queen, plenty of food, and a few nurse bees to care for the remaining immature bees. Pesticides like neonicotinoids and other factors like global warming, metal pollution, stress, habitat loss and malnutrition are responsible for this disorder.

Locust attacks have struck parts of Rajasthan and Gujarat, causing heavy damage to standing crops. Locusts are a group of short-horned grasshoppers that migrate up to 150 km in a day and migrate rapidly. Locusts are voracious feeders, eating up to their body weight daily. Four species of locusts are found in India, out of which desert locust is the most destructive pest.

While there are three breeding seasons: winter breeding, spring breeding and summer breeding, India has only summer breeding season. Unusual weather patterns exacerbated by climate change have created ideal conditions for insect numbers to surge.

Palm oil forms 33% of the world's vegetable oil production mix. Indonesia and Malaysia contribute almost 87% of the production of palm oil, while India and China account for 34% of the imports. Palm oil production leads to deforestation of tropical forests in order to make rooms for plantations. Indiscriminate falling of trees has destroyed the habitats of **Orangutans** living in the tropical forests of Indonesia and Malaysia.

Roundtable on Sustainable Oil (RPSO) was established in 2004 to promote the production of sustainable palm oil. Around 14% of palm oil globally is certified by RPSO.

In India, **nitrogen emissions** grew at 69% from 2001 to 2011 and have replaced methane as the second-largest Greenhouse Gas (GHG) from Indian agriculture. Agricultural soils contribute to over 70% of Nitrous oxide (N_2O) emissions, followed by waste water (12%) and residential/commercial activities (6%). Further, India is globally the biggest source of ammonia emissions. Cattles are a major source of ammonia.

International Nitrogen Initiative (INI) is an international program set up in 2003 under the sponsorship of Scientific Committee on Problems of the Environment (SCOPE) and International Geosphere-Biosphere Program (IGBP) to optimize nitrogen's beneficial role in sustainable food production.

Pet Coke, also known as "bottom of the barrel" fuel, is a solid carbon-rich material derived from oil refining. It emits 11% more Green House Gases (GHGs) than coal. Recently, government has banned the import of pet coke as a fuel. It is now only allowed for cement, lime kiln, calcium carbide and gasification industries when used as a feedstock or in the manufacturing process on actual user condition.

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CHAPTER 3

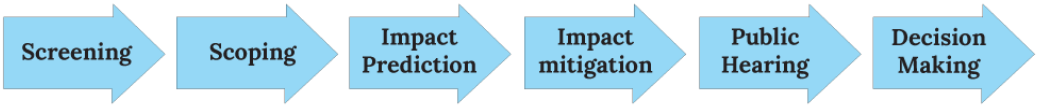
ENVIRONMENTAL IMPACT ASSESSMENT

What is EIA?

EIA stands for "Environmental Impact Assessment" and is notified under the Environment (Protection) Act 1986. Simply put, EIA is a detailed study regarding the impact of any project on the environment. It serves as a decision-making tool which helps policy makers approve, reject or find an alternative to a project.

EIA Process

A project requiring environmental clearance goes through screening and scoping processes. Screening is done to see whether a project requires environmental clearance as per the statutory notification. Scoping is a process of detailing the terms of reference of EIA. Thereafter, an impact prediction and impact mitigation analysis are done. Then, a draft EIA report is prepared which is then sent for public hearing.



Under the existing **2006 EIA notification**, projects are categorized into **Category A and Category B**. EIA for Category A project requires clearance by Environment Ministry and for Category B project, State Environment Impact Assessment Authority (SEIAA) clearance is required. All Category A project needs to mandatorily undergo the EIA process.

However, Category-B project are further sub-classified into **Category B1 and Category B2 projects**, depending on their scope and environmental impact. Amongst the two, Category-B2 projects have been exempted from the EIA process.

Rapid EIA requires collection of one season data of all significant environmental impacts and their mitigation while comprehensive EIA collects data from all four seasons.

The **Environment Management Plan (EMP)** is a site-specific plan developed to ensure that the project is implemented in an environmentally sustainable manner where all contractors and subcontractors, including consultants understand the potential environmental risks arising from the project and take appropriate actions to properly manage that risk.

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An **Environmental Supplemental Plan (ESP)** is an environmentally beneficial project or activity that is not required by law, but an alleged violator of EIA Notification 2006 agrees to undertake as a part of the process of environmental clearance. ESP allows violator companies to continue their activities by paying a financial penalty.

PARIVESH (Pro-Active and Responsive facilitation by Interactive, Virtuous and Environmental Single-window Hub) is a web based, role-based workflow application which has been developed for online submission and monitoring of the proposals submitted by the proponents for seeking Environment, Forest, Wildlife and CRZ Clearances from Central, State and district level authorities.

Major Provisions of draft EIA 2020

1. **Public Consultation**
    a. Period of public consultation hearings is proposed to be reduced to a maximum of 40 days.
    b. Time provided for the public to submit their responses is proposed to be reduced from present 30 to 20 days.
2. **More discretionary powers to government**
    a. Central government can declare "economically sensitive areas" without public hearing or environmental clearance.
    b. Government also gets to decide which projects are to be considered "strategic".
3. **Post-facto clearance**
    a. Legalisation of projects that have commenced operations without obtaining necessary clearances; subject to a payment of penalty.
4. **Extended period of clearances**
5. **Exemptions clause**
    a. It identifies a long list of projects like roads and pipelines in border areas which have been exempted from public consultation and prior clearance.
6. **Baseline Data**
    a. Does away with the need to carry out studies covering all seasons in a year.
7. **Frequency of compliance reports increased** from once every six months to a year.

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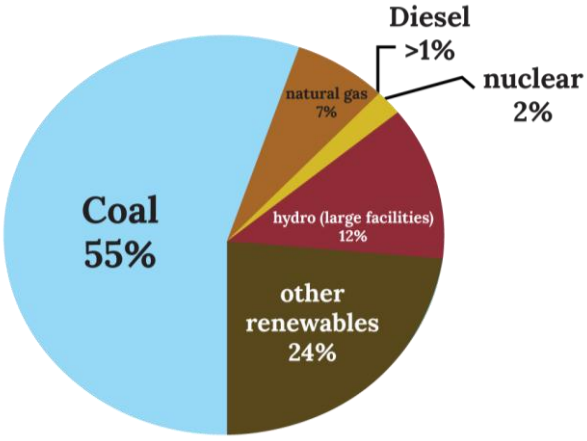
CHAPTER 4

SUSTAINABLE DEVELOPMENT

4.1 RENEWABLE ENERGY

Renewable energy refers to the energy that is generated from natural sources that are continuously replenished. Solar energy, hydel energy, biomass, geothermal energy, ocean thermal energy, co-generation and fuel cells are all different forms of renewable energy.



India's installed power capacity by fuel, June 2020

4.1.1 Solar Energy

Solar energy refers to the radiation that is received from the sun and utilized in the form of electricity and thermal energy by using various available technologies like photovoltaic cells and solar thermal technology.

1. **Photovoltaic electricity**: Uses photovoltaic cells that absorb direct sunlight to produce Direct Current (DC).
2. **Concentrated Solar Power (CSP) or solar thermal technology**: Uses a solar collector that has a mirrored surface. The mirrored surface reflects sunlight onto a receiver which in turn heats up a liquid. Steam is then generated from this heated-up liquid, which in turn is used to produce electricity.

India's current installed solar power capacity, according to Central Electricity Authority, is 34% of total renewable energy sources. India's Intended Nationally Determined Contributions (INDC) commitment to UNFCCC includes 100 GW of solar power out of 175 GW renewable energy by 2022.

International Solar Alliance (ISA): It was conceived as a coalition of solar-resource-rich countries (lying completely or partly between the Tropic of Cancer and the Tropic of Capricorn) to address their special needs. ISA membership has been recently extended to all member states of the UN, including those lying beyond the tropics.

1. Launched in COP 21 climate conference in Paris, 2015 by India and France.
2. The ISA's major objectives include globally deploying over 1,000GW of solar generation capacity as well as mobilizing investment of over US $1000 billion into solar energy by 2030.
3. It is headquartered in Gurugram, India.

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One Sun, One World, One Grid (OSOWOG) initiative was proposed by India to set up a framework for facilitating global cooperation which aims at building a global ecosystem of interconnected renewable energy sources that can be easily shared. Ministry of New and Renewable Energy (MNRE) is the parent body.

The term "**Surya Putra**" was coined by the Indian Prime Minister for all the nations which fall between the Tropic of Cancer and the Tropic of Capricorn.

Green Energy Corridor Project, launched by MNRE, aims at synchronizing electricity produced from renewable sources like solar and wind with conventional power stations in the grid.

Solar Charkha Mission is an initiative of Ministry of Micro Small and Medium Enterprises (MSME). Khadi and Village Industries Commission (KVIC) is the implementing agency.

Global Solar Council is an international non-profit association of the national, regional and international associations in solar energy and the world's leading corporation. It was founded in the 2015 Paris Climate Conference.

National Solar Energy Federation is a founding member of the Global solar Council.

International Renewable Energy Agency (IRENA) is an intergovernmental organization that supports countries in their transition to a sustainable energy future. It is headquartered in Abu Dhabi.

Solar Park scheme has been launched by Solar Energy Corporation of India (SECI). SECI is a Central Public Sector Undertaking under MNRE.

Association of Renewable Energy Agencies of the States (AREAS) has been formed at MNRE initiative to interact and learn from each other's experiences and also share their best practices and knowledge regarding technologies/schemes. The AREAS is registered under Society Registration Act. Union Minister for New and Renewable Energy is the patron of the Association and Secretary, MNRE is the ex-officio President.

PM Kisan Urja Suraksha Evam Utthaan Mahabhiyan (PM KUSUM) scheme has been launched recently by MNRE. The scheme aims to provide energy security along with financial and water security to farmers. It will encourage farmers to generate solar power in their farms. The target is to add decentralised solar power capacity of 25,750 MW by 2022. Components of KUSUM Scheme are:

1. Component A: 10,000 MW of decentralised ground mounted grid connected renewable power plants.
2. Component B: Installation of 2 million standalone solar pumps.
3. Component C: Solarisation of 1.5 million grid connected solar powered agricultural pumps.

Farmers can sell surplus solar power generated off-grid to DISCOMS, thereby increasing their incomes.

4.1.2 Wind Energy

Wind energy refers to the energy generated using the kinetic energy of wind. Wind turbines convert this kinetic energy into mechanical energy, further converting to electric power to generate electricity.

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Wind farm consists of a group of wind turbines in the same location which is used for production of electricity. A wind farm can be located onshore as well as offshore.

India is the world's fourth largest onshore wind market by installations, with 37.5 GW of capacity as of 2019 and has the potential for more than 695 GW at 120 metres. As per the National Institute for Wind Energy (based in Chennai), western states have larger potential in terms of a stable, steady and a speedy wind flow starting from Gujarat, Maharashtra, Karnataka to Tamil Nadu and Andhra Pradesh.

National Offshore Wind Energy Policy-2015 is aimed at exploring and promoting deployment of offshore wind farms in the Exclusive Economic Zone (EEZ) of the country, including those under Public Private Partnership.
National Institute of Wind Energy (NIWE) has been authorized as the nodal agency for the development of offshore wind energy. India's first 1 GW offshore wind project is to be installed in **Gulf of Khambhat**.

Solar-Wind Hybrid Policy was issued to provide a framework for promotion of large grid connected wind-solar photovoltaic hybrid system for optimal and efficient utilization of wind and solar resources, transmission infrastructure and land.

The wind - solar PV hybrid systems will help in reducing the variability in renewable power generation.

4.1.3 Hydro power

Hydraulic power is generated when water flows from a higher elevation to a lower elevation. This is used to turn the turbine, thereby converting the kinetic energy of water into mechanical energy to drive the generator. **Small Hydropower** is defined as any hydropower project which has an installed capacity of less than 25 MW.

India is endowed with a large hydropower potential of 1,45,320 MW of which only about 45,000 MW has been utilized so far. Only about 10,000 MW hydropower has been added in the last 10 years. Hydropower sector is facing several challenges and the share of hydropower declined has from 50.36% in 1960s to around 13% in 2018-19.

Cabinet approved the following **measures to promote hydropower sector**:

1. Large hydropower projects were declared as renewable energy source (As per the earlier practice, only hydropower project projects less than 25MW were categorized as renewable energy).
2. Hydro Purchase Obligation (HPO) were declared a separate entity within non-solar Renewable Purchase Obligations.
3. Tariff rationalization measures were taken, including flexibility to developers to determine tariff by back loading of tariff after increasing project life to 40 years.
4. Budgetary support was provided for funding flood moderation component of hydropower projects on case-to-case basis.
5. Budgetary support was provided for funding cost of enabling infrastructure i.e., roads and bridges on a case-to-case basis.

4.1.4 Other forms of renewable energy

1. **Ocean Thermal energy**: It uses the temperature difference between the surface of the ocean and the depths of about 1000 m to operate a heat engine, which produces electric power.

2. **Co-generation**: It involves producing two forms of energy using one fuel. One of the forms of energy is heat and the other may be electricity or mechanical energy.

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"**Scheme to support promotion of biomass-based cogeneration in sugar mills and other industries in the country**" has been launched by Ministry of New and Renewable Energy. It will provide Central Financial Assistance (CFA) for projects utilizing biomass like crop residues, bagasse, weeds, wood waste produced in industrial operations etc. However, municipal solid waste is not covered under the programme.

3. **Waste to Energy Technology (WtE)**: WTE technologies convert non-recyclable waste into usable forms of energy. The heat from the combustion of waste generates superheated steam in boilers. This steam drives turbogenerators and produces electricity. This technology can help reduce the amount of waste available for disposal and at the same time help generate electricity from it.
    a. Some of the techniques at WtE are incineration, gasification, pyrolysis and bio-methanation.

   However, high costs, choice of technology and improper segregation of waste remain a major challenge in its effective use.

4. **Geothermal Energy**: It refers to harnessing the geothermal energy or the vast reservoir of heat stored in the earth's inner core.
    a. Potential Sites for Geothermal energy are Puga Valley (J&K), Tattapani (Chhattisgarh), Manikaran (Himachal Pradesh), Bakreshwar (West Bengal), Tuwa (Gujarat), Unai and Jalgaon (Maharashtra).

ONGC has planned to implement **India's first Geothermal Energy Project** at Ladakh.

5. **Fuel Cells**: Fuel cells generate electricity through an electrochemical process. The fuel cell combines hydrogen and oxygen to generate an electric current, water being the only by-product. There are no moving parts in fuel cells, so they are more efficient and reliable by comparison. Fuel cells have efficiency of 55% compared to 35% of conventional power plants.

6. **Bio-methanation**: It is a scientific process whereby anaerobic microorganisms in an anaerobic environment decompose biodegradable matter producing methane-rich biogas and effluent.

7. **Pyrolysis**: It refers to heating of an organic material, such as biomass, in the absence of oxygen.

4.1.5 Miscellaneous

Pointers for prelims:

1. **Bio Jet Fuel** is a blend of jatropha oil and aviation turbine fuel
    a. Jatropha is a plant of Latin American origin.
    b. It is a drought resistant perennial plant.
    c. Jatropha oil is directly used in diesel engines.
    d. Jatropha seed cakes make an excellent organic fertilizer with a high nitrogen content. It can also be used as a livestock feedstock.
    e. It is also used as an insecticide and fungicide.

2. **Biofuels**: It is any hydrocarbon fuel that is produced from organic matter in a short period of time.
    a. **First Generation (1G) biofuels**: It uses food crops like wheat for making ethanol.
    b. **Second Generation (2G) biofuel**: It uses non-food crops like wood, grass, organic waste.
    c. **Third Generation (3G) biofuel**: It uses specially engineered algae.
    d. Fourth Generation biofuel: It aims at only producing sustainable energy but also a way of capturing and storing CO_2.

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However, requirement of high levels of technology and the resultant high cost is a major impediment in its adoption.

3. **Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)** is the International Civil Aviation Organization (ICAO) resolution for a global market-based measure to address CO_2 emissions from international aviation from 2021 to 2035.

4. **Methane Hydrate** is a solid clathrate compound in which a large amount of methane is trapped within a crystal structure of water, forming a solid similar to ice.
    a. Large amounts of methane are frozen in Arctic Tundra soils and in Marine Sediments including gas hydrates. As earth's climate warms, the methane is vulnerable to possible release into the atmosphere.

5. "**Net Metering**" is a billing mechanism that credits solar energy system owners for the electricity they add to the grid.

PM JI-VAN scheme under Ministry of Petroleum and Natural Gas (MoP&NG) will provide financial support to integrated Bioethanol Projects using lignocellulosic biomass and other renewable feedstock. 2G ethanol projects will be provided viability gap funding support over the next six years.

The ethanol produced will be mandatorily supplied to Oil Marketing Companies (OMCs) to further enhance the blending percentage under Ethanol Blended Petrol Programme. The government has fixed a target of 10% ethanol blending by 2022 and 20% by 2030.

Centre for High Technology (CHT), a technical body under the aegis of MoP&NG will be the implementing agency for the scheme.

SATAT (Sustainable Alternative Towards Affordable Transportation) initiative was launched by MoP&NG. It is aimed at setting up Compressed Biogas (CBG) production plants and make it available in the market for use in automotive fuels.

GOBAR-DHAN (Galvanizing Organic Bio-Agro Resources) Scheme has been launched to convert cattle dung and solid waste in farms to Compressed Biogas (CBG) and compost.

REN21 is the global renewable energy policy multi-stakeholder network that connects a wide range of key actors from governments, international organizations and industry associations.

It is an international non-profit association and its secretariat is based at UN Environment in Paris, France.

International Energy agency (IEA) was founded in 1974 to help countries collectively respond to oil supply disruptions. It is an autonomous body within OCED.

Only OCED member states can become members of IEA. Accordingly, India is not a member of IEA but is an associate member.

Indian Renewable Energy Development Agency Limited (IREDA) is a Public Limited Government Company. It was established as a Non-Banking Financial Institution in 1987 and lies under the administrative control of MNRE. It is engaged in promoting, developing and extending financial assistance for renewable energy and energy efficiency/conservation projects with the motto "ENERGY FOR EVER".

National Policy on Biofuels, 2018 was made by MNRE. Its major points include:

1. It categorizes biofuels into:
    a. Basic Biofuels: First Generation (1G) bioethanol and biodiesel
    b. Advanced Biofuels: Second Generation (2G) ethanol, Municipal Solid Waste (MSW) to drop-in fuels, Third Generation (3) biofuels, bio-CNG etc.

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2. Viability Gap Funding (VGF) scheme for 2G ethanol bio refineries.
3. Expands the scope of raw materials for ethanol production by allowing use of sugarcane juice, sugar containing materials like sugar beet, starch containing materials like corn and cassava, damaged food grains like wheat and rotten potatoes unfit for human consumption for ethanol production.
4. Allows use of surplus food grains for production of ethanol.
    a. However, it needs the approval of National Biofuel Coordination Committee headed by the Minister, Petroleum and Natural Gas.

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CHAPTER 5

BIODIVERSITY

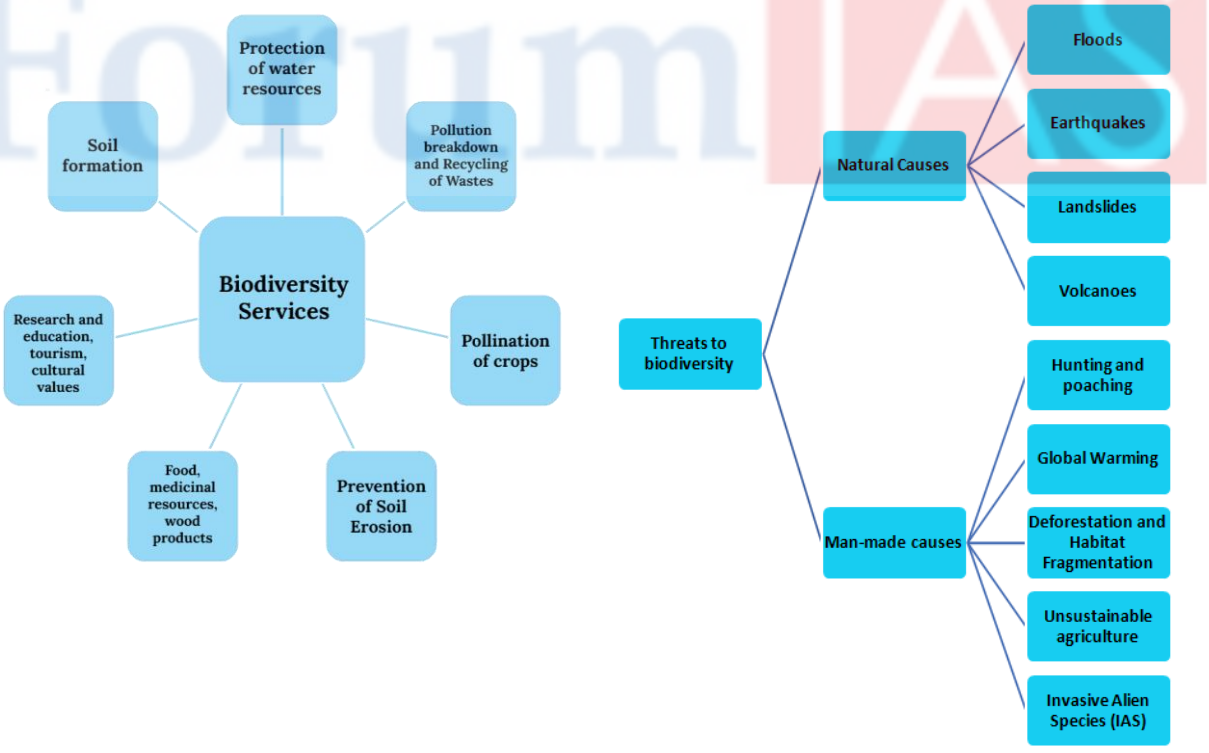
Biodiversity is a term used to describe the enormous variety of life on Earth. It is a measure of variation at the genetic, species and ecosystem level. **Terrestrial biodiversity is usually greater near the equator, which is the result of the warm climate and high primary productivity**. Mountains have high range of species at the low altitude as they can support larger number of species due to climatic condition.

There are **three levels of biodiversity**:

1. **Genetic diversity**- It is concerned with the variability of genes within a particular species. Genetic diversity allows species to adapt to changing environments and survive drastic changes. This ensures survival of the population.
2. **Species diversity**- It refers to the variety of living organisms on Earth.
3. **Ecosystem diversity**- It refers to different types of habitats like grasslands, desert, mangroves etc.

Biodiversity is measured using species richness. Species richness is the number of different species represented in an ecological community, landscape or region.

1. **Alpha diversity**- It refers to diversity within a particular area or ecosystem.
2. **Beta diversity**- It is a comparison of diversity between ecosystems.
3. **Gamma diversity**- It is a measure of overall diversity for the different ecosystems within a region.



As per **World Wildlife Fund's (WWF) Living Planet Report**, species extinction rate is 100-1000 times higher than a few hundred years ago. There are several constrains in biodiversity conservation like:

1. Low priority for conservation in policies.
2. Exploitation of biodiversity for monetary gains.
3. Limited knowledge regarding biodiversity and its importance.

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4. Unplanned urbanization resulting in destruction of wetlands, deforestation etc.

Considering the threats to biodiversity, there are two modes of conservation of the same:

1. **In-situ conservation**- It aims to enable biodiversity to maintain itself within the natural habitats in which it is found. E.g., National parks, sanctuaries, Biosphere reserves, reserved forests and protected forests.
2. **Ex-situ conservation**- It aims at conserving biodiversity outside the areas where they naturally occur. E.g., Seed banks and botanical gardens.
   Reintroduction of Gangetic gharial in Chambal river flowing through Uttar Pradesh, Rajasthan and Madhya Pradesh where it had become extinct is an example of Ex-situ conservation.

A **botanical garden or botanic garden** is a garden dedicated to the collection, cultivation, preservation and display of a wide range of plants labelled with their botanical names.

It is an ex-situ mode of conservation.

Zoo is 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**.

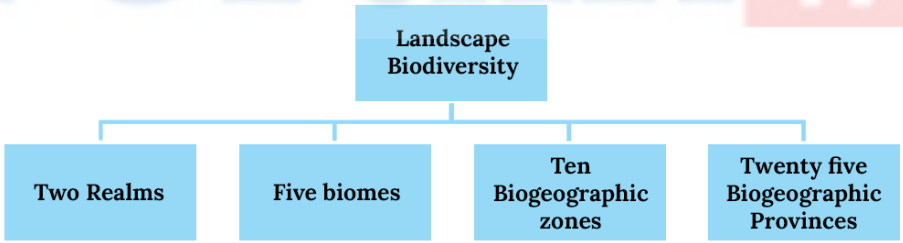
It is an ex-situ mode of conservation.

5.1 Indian Biodiversity

With just 2.4% of the land area, India accounts for nearly 7% of the recorded species. The varied climatic, edaphic and topographic conditions have resulted in a wide array of ecosystems and habitats in India with enormous biodiversity.

5.1.1 Landscape Biodiversity

A landscape is a "mosaic of heterogeneous landforms, vegetation types and land uses."



1. **Realms**: Realm is a continent or subcontinent sized area with unifying feature of geography, flora and fauna.

   The Indian region is composed of two realms-
   a. The Himalayan region represented by **Palearctic Realm**.
   b. Rest of subcontinent represented by **Malayan Realm**.

2. **Biomes**: A biome is a collection of plants and animals that have common characteristics for the environment they exist in. They can be found over a range of continents. The five biomes of India are Tropical Humid Forests, Tropical Dry or Deciduous Forests, Warm Deserts or Semi-deserts, Coniferous Forests and Alpine Meadows.

3. **Biogeographic Zones**: Biogeography deals with the geographical distribution of plants and animals. The Himalayan range is very rich in species diversity due to confluence of different bio-geographical zones.

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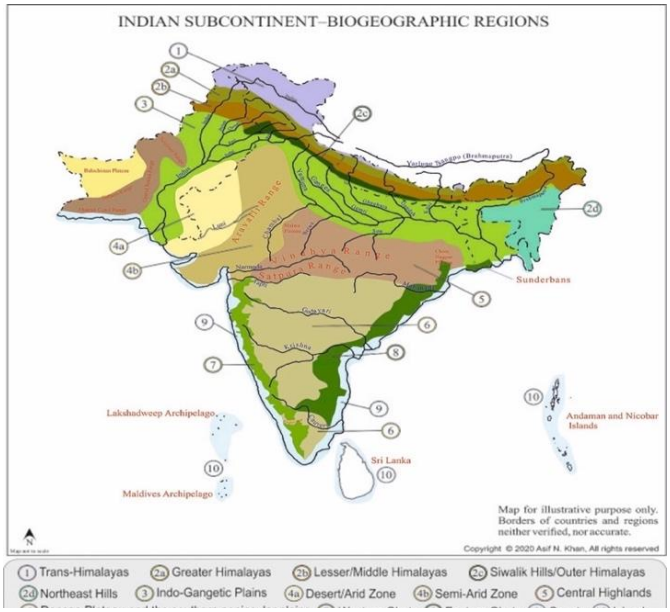

Picture Credits: Wikipedia

4. **Biogeographic provinces**- It is an Eco systematic or biotic subdivision of realms.

Sl. No	Biogeographic zones	Biogeographic provinces
1	Trans Himalaya	1. Himalayan-Ladakh Mountains 2. Himalaya-Tibetan Plateau 3. Trans-Himalaya Sikkim
2	The Himalaya	1. Himalaya-North West Himalaya 2. Himalaya- West Himalaya 3. Himalaya- Central Himalaya 4. Himalaya- East Himalaya
3	The Indian Desert	1. Desert- Thar 2. Desert- Kutch
4	The Semi-Arid	1. Semi- Arid- Punjab Plains 2. Semi- Arid- Gujarat Rajputana
5	The Western Ghats	1. Western Ghats- Malabar Plains 2. Western Ghats- Western Ghats Mountains
6	The Deccan Peninsula	1. Deccan Peninsular- Central Highlands 2. Deccan Peninsular- Chhota Nagpur 3. Deccan Peninsular- Eastern highlands 4. Deccan Peninsular- Central Plateau 5. Deccan Peninsular- Deccan South
7	The Gangetic Plains	1. Gangetic Plain- Upper Gangetic Plains 2. Gangetic Plains- Lower Gangetic Plains
8	The Coasts	1. Coasts- West Coast 2. Coasts- East Coast 3. Coasts- Lakshadweep
9	Northeast India	1. North- East- Brahmaputra valley 2. North- East- North East hills
10	Islands	1. Andaman and Nicobars

5.1.2 Fauna

India accounts for about 6.45% of the faunal species known world-wide.

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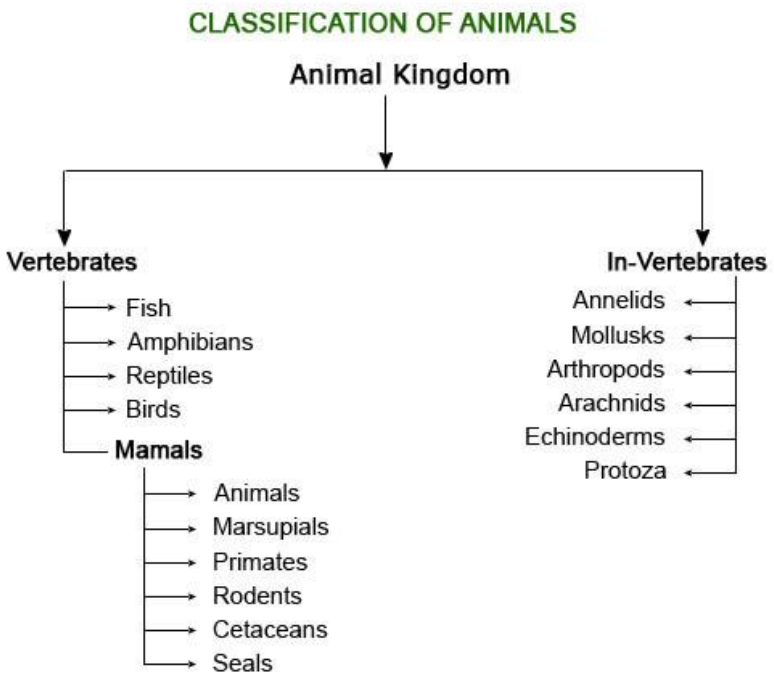
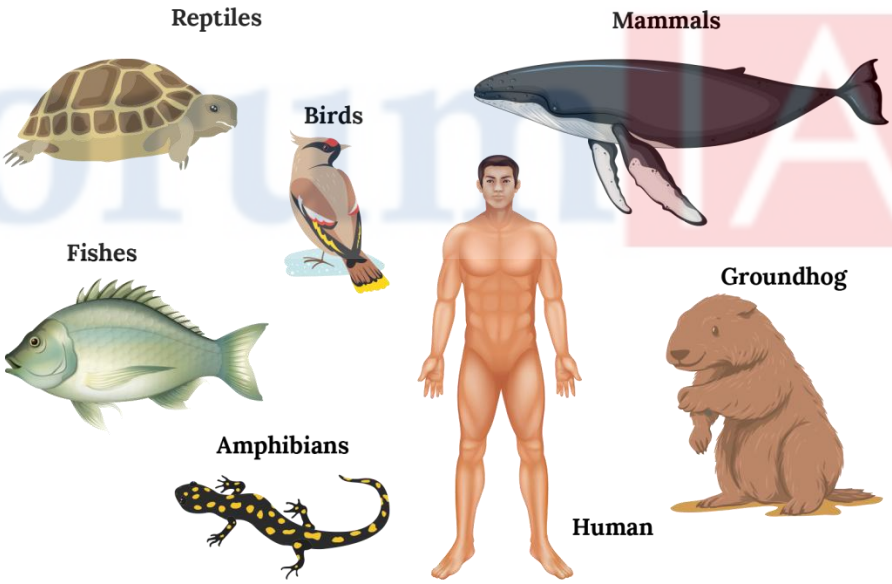


1. **Vertebrates**: These are animals with backbones and spinal columns.



Basic facts:

1. Fishes and Reptiles are cold blooded.
2. Amphibians are cold blooded animals. They live on both land and water and breathe with lungs and gills.
3. Birds and Mammals are warm blooded.

2. **In-vertebrates**: These animals do not have backbones. More than 98% animal species in the world are invertebrates.

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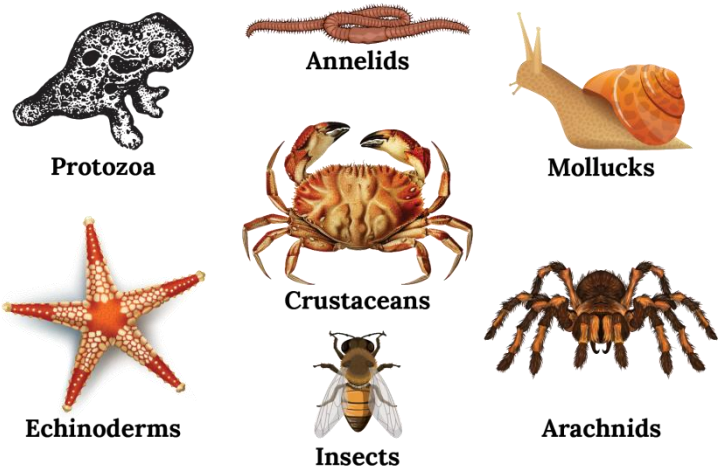
Animals without backbons



Basic facts:

1. **Annelids**
   a. Their bodies are divided into segments
   b. They do not have limbs
   c. E.g., earthworm
2. **Mollusks**
   a. They have a soft, skin like organ covered with a hard shell on the outside
   b. E.g., octopus, squid, oyster
3. **Echinoderms**
   a. Their bodies are covered in spikes or spine
   b. They live in water
   c. E.g., sea star, sea urchin
4. **Protozoa**
   a. They are the smallest of all animals
   b. Protozoa are simple, single celled animals
   c. E.g., Amoeba, flagellates
5. **Arthropods**
   a. They have limbs with joints that allow them to move
   b. They also have an exoskeleton
   c. Crustaceans, insects and arachnids are examples of arthropods
6. **Crustaceans**
   a. They have a hard external shell protecting their body
   b. E.g., crab, lobster
7. **Insects**
   a. They consist of 3 body parts and 6 legs and an antenna
   b. E.g., beetle, butterfly, bee
8. **Arachnids**
   a. They have 2 body parts and 4 pair of legs
   b. They do not have an antenna
   c. E.g., spider, scorpions, tick and mites

5.1.3 Flora

India represents about 11% of the world's known floral diversity.

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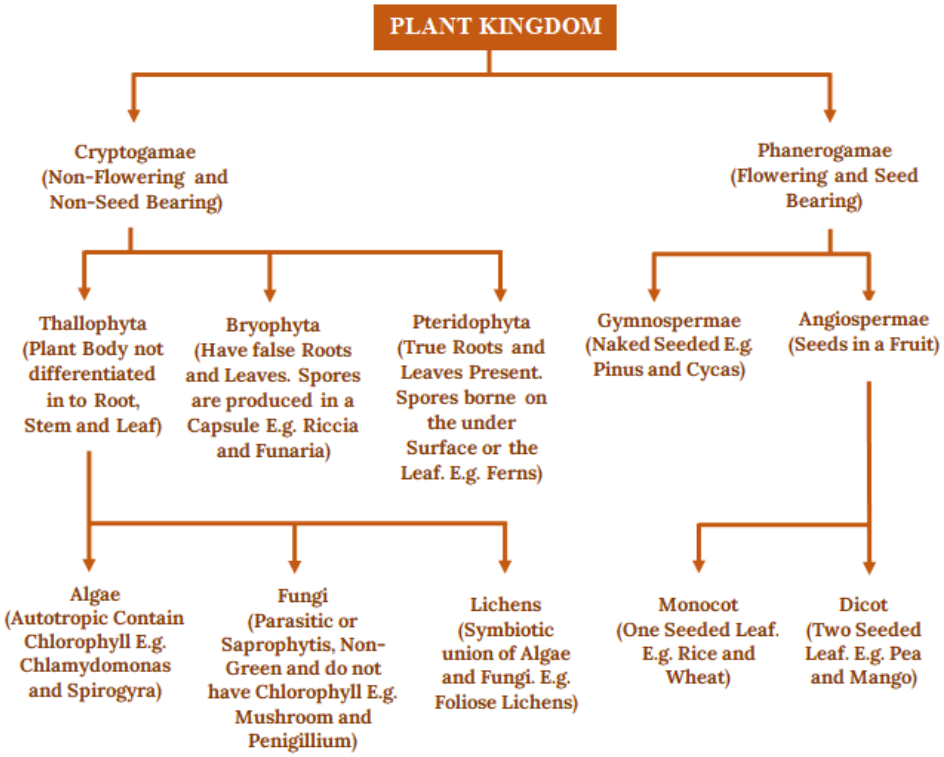

The **National Gene Bank** at National Bureau of Plant Genetic Resources (NBPGR), New Delhi; is the nodal organization in India for the management of plant genetic resources.

Floral biodiversity of India:

1. **Himalayan mountain system**:
    a. Flora includes evergreen and semi-evergreen forests like rhododendrons, oak, pines, junipers, lichens and mosses.
2. **Peninsular- Indian sub-region**: It includes peninsular India as well as the desert region of Rajasthan (Thar desert).
    a. Peninsular India has tropical moist deciduous to tropical dry deciduous and scrub vegetation like Sal in northern regions, teak in southern regions.
    b. Western ghats have evergreen vegetation. Threatened with deforestation, unchecked urbanization and invasive species, Gadgil Committee and Kasturirangan Committee were formed to recommend sustainable development of Western Ghats region.
    c. Indian desert of Rajasthan has flora like cacti and other succulents.
3. **Tropical rain forest regions**: They are distributed in the Western Ghat region and north-east India.
    a. Evergreen vegetation like ebony trees is found here. Epiphytes and orchids are also found in this region. Stratification in rain forests is very distinct with multiple horizontal layers of trees.
4. **Andaman and Nicobar Islands**:
    a. Tropical rainforests species are found in this region like Terminalia.

Pointers for prelims:

1. **Mycorrhizae** are symbiotic relationships that form between fungi and plants. The fungi colonize the root system of a host plant, providing increased water and nutrient absorption capabilities while the plant provides the fungus with carbohydrates formed from photosynthesis.
2. **Sandal tree** is a partial root-parasite, meaning that while it manufactures its own food, it also depends upon the host like other partial parasites for water and mineral nutrients.

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Basic facts:

1. **Effect of Intensity of light** on the growth of plants
    a. High light intensity favors plant growth while low intensity retards growth, flowering and fruiting.
    b. Out of the 7 colours in the visible spectrum, only red is effective in photosynthesis.
    c. Plant grown in blue light is small while red light causes elongation of cells resulting in etiolation.
    d. Plants grown in UV and violet light are dwarf.
2. **Frost** can lead to killing of young plants due to damage to cells and formation of canker.
3. **Snow** results in mechanical bending of trees. However, it can also act as a blanket and prevent further drop in temperature, thus protecting seedlings from excessive cold and frost.
4. Excessive temperature disrupts the balance between respiration and photosynthesis, thereby causing depletion on food. It also increases susceptibility to bacterial and fungal attack. Further, there is desiccation of plant tissues and loss of moisture.
5. **Die back phenomenon** in trees like Sal, wherein there is progressive dying usually backwards from the tip of any portion of plant. Reason for this may include frost, drought, grazing, dense over-head canopy etc.

Insectivorous plants specialize in trapping insects. They have several attractions to lure insects like bright colours and sweet secretions. They hunt for insects despite having normal roots as they are usually found in nutrient poor soils. As a result, they have to hunt in order to replenish themselves.

Some of the insectivorous plants found in India are Drosera/Sundew, Aldrovanda/Pitcher plants, Nepenthes, Utricularia/Bladderworts and Pinguicula/Butterworts. Insectivorous plants have great medicinal properties like treating cholera, urinary tract infections, blisters. Some are also capable of curdling milk.

Invasive Alien Species (IAS) are species whose introduction and/or spread outside their natural past or present distribution threatens biological diversity.
Some **invasive fauna** found in India are crazy ant, giant African snail, myna, goldfish and pigeon. Likewise, **invasive flora** of India includes Prosopis juliflora, water hyacinth, lantana camara, palmyra/toddy palm, black mimosa and black wattle.

Some **important medicinal plants** of India are as follows:

1. Kuth is used as an anti-inflammatory drug as well as making perfumes.
2. Ladies Slipper Orchid is used to treat insomnia/anxiety.
3. Sarpagandha is used for treating various central nervous system disorders.

5.1.4 IUCN Red Data Book

IUCN Red Data Book contains the complete list of threatened species, including both plants and animals. The pink pages in this book include the critically endangered species. Green pages are used for species that were formerly endangered but have now recovered to a point where they are no longer threatened.

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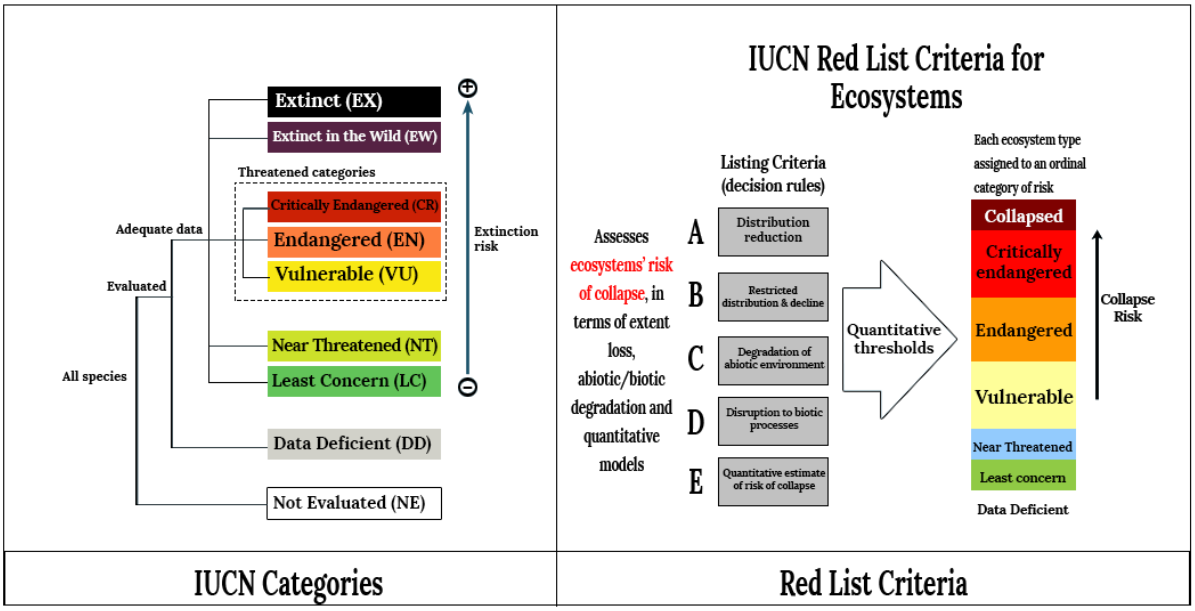

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SUMMARY OF THE FIVE CRITERIA (A-E) USED TO EVALUATE IF A TAXON BELONGS IN AN IUCN RED LIST THREATENED CATEGORY (CRITICALLY ENDANGERED, ENDANGERED OR VULNERABLE).[1]

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) *[(a) cannot be used for A3]*.

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation *[except A3]*

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality

(d) actual or potential levels of exploitation

(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)

	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented **OR** Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals			
(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals			

C. Small population size and decline

	Critically Endangered	Endangered	Vulnerable
Number of mature individuals	< 250	< 2,500	< 10,000
AND at least one of C1 or C2			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) **(i)** Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(a) **(ii)** % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			

D. Very small or restricted population

	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	**D1.** < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	**D2.** typically: AOO < 20 km² or number of locations ≤ 5

E. Quantitative Analysis

	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

1 Use of this summary sheet requires full understanding of the *IUCN Red List Categories and Criteria* and *Guidelines for Using the IUCN Red List Categories and Criteria*. Please refer to both documents for explanations of terms and concepts used here.

Picture Credits: IUCN

IUCN **Species Survival Commission (SSC)** is a science-based network of more than 7500 volunteer experts from almost every country of the world.

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5.1.5 Schedule Animals of Wildlife Protection Act 1972 (WPA)

Wildlife Protection Act 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.

1. **Schedule 1 and part II of Schedule 2**
    a. Animals listed under these have absolute protection.
    b. Examples of animals listed in Schedule 1 include lion tailed macaque, great Indian bustard, black buck, rhinoceros, dugong etc.
    c. Animals under Schedule 2 are dhole, flying squirrel etc.
2. **Schedule 3 and Schedule 4**
    a. These animals are also protected but the penalties for offenses against them are lower.
    b. Schedule 3 animals include hyena, nilgai, barking deer, hog deer etc.
    c. Schedule 4 animals include vultures etc.
3. **Schedule 5**
    a. Animals under Schedule 5 are called "vermin" and can be hunted.
    b. Mice, rat, common crow and flying fox are few examples
4. **Schedule 6**
    a. Cultivation, collection, extraction and trade of plants and its derivatives listed in Schedule 6 are prohibited.
    b. Plants under this include Red Vanda, Blue Vanda, Kuth, Pitcher plant, Laddies Slipper Orchid and Beddomes Cycad

Few important animals listed in Schedule 1 to 4 of WPA, 1972			
Sl. No	Name	Category	Range
1	Binturong	Vulnerable	Sikkim
2	Brow Antlered Deer/Sangai	Endangered	Keibul Lamjao National Park, Manipur
3	Swamp Deer	Vulnerable	Wide distribution
3	Cheetah	Vulnerable (Asiatic Cheetah is critically endangered and found in Iran only)	Extinct in India
4	Chinese Pangolin Indian Pangolin	Critically Endangered Endangered	Himalayan foothills
5	Clouded Leopard	Vulnerable	Himalayan foothills like Sikkim, W.B., North-east region etc.
6	Indian Gazelle (Chinkara)	Least Concern	Western and Central India
7	Dugong (Herbivorous marine mammals also known as Sea Cow)	Vulnerable	Coastal water belt
8	Fishing Cat	Endangered	Mangrove forests of Sundarbans
9	Ganges River Dolphin	Endangered	Indus, Ganga, Brahmaputra Meghna river system
11	Irrawaddy Dolphin (live in both fresh and salt water)	Endangered	Ganga, Brahmaputra, Irrawaddy and Mekong Rivers
10	Golden Langur	Endangered	North-east India
11	Hispid Hare	Endangered	West Bengal, UP, Assam, Bihar
12	Hoolock Gibbon	Endangered	Found in North-east India
13	Red Panda	Endangered	North-east India
14	Lion tailed macaque	Endangered	Western Ghats (Kerala, Tamil Nadu, Karnataka)
15	Malabar Civet	Critically Endangered	Western Ghats

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16	Marbled Cat	Vulnerable	Eastern Himalayas to Southeast Asia
17	Himalayan Musk Deer	Endangered	Northeast India
18	Nilgiri Tahr	Endangered	Western Ghats
19	Greater One Horned Rhinoceros (Javan Rhino is known as Lesser One Horned Rhino)	Vulnerable	Assam is home to largest number of greater one horned rhinoceros, with more than 90% in Kaziranga National Park
20	Chiru (Tibetan antelope known for "Shantosh wool")	Endangered	Steppes and semi-arid desert areas of cold high mountains (e.g., Jammu and Kashmir)
21	Kiang (Wild Ass)	Least Concern	Cold Deserts of India
22	Tiger	Endangered	13 Tiger range countries
23	Indian Buffalo	Endangered	MP, Assam, Meghalaya
24	Northern River Terrapin (Batagur Baska)	Critically Endangered	Sundarbans, river estuaries
25	Olive Ridley Turtle Leatherback Turtle Loggerhead Turtle Hawksbill Turtle Green Turtle Indian Star Tortoise	Vulnerable Vulnerable Vulnerable Critically Endangered Endangered Vulnerable	Territorial and Fresh waters
26	Bengal Florican	Critically Endangered	Indian Subcontinent (UP, Assam)
28	Chital	Least Concern	Sikkim region
29	Hogdeer	Endangered	North and Northeast India
30	Nilgai	Least Concern	Widely distributed in India
31	Barking Deer (Muntjac)	Least Concern	
32	Dhole	Endangered	Western Ghats, Eastern Ghats, Northeast India etc.
33	Great Indian Bustard	Critically Endangered	Central and Western India (e.g., Desert National Park, Rajasthan)
34	Mouse Deer	Least Concern	Deciduous and Evergreen Forests
35	Asiatic Lion (found in India only)	Endangered	Limited to only 5 protected areas in Gujarat-Gir National Park, Gir Sanctuary, Pania sanctuary, Mitiyala Sanctuary, Girnar Sanctuary
36	Elephant	Endangered	Wide range throughout India
37	Eurasian Otter (carnivorous animals)	Near Threatened	Western Ghats
38	Ganges Shark	Critically Endangered	River Hooghly in West Bengal, as well as river Ganges, Brahmaputra and Mahanadi
39	Indian Ocean Humpback Whale	Endangered	Shallow water of Indian Ocean
40	Snow Leopard	Vulnerable	J&K, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh
41	Saltwater Crocodile	Least Concern	Bhitarkanika, Odisha houses 70% of these species.

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Pointers for prelims:

1. **Irrawaddy Dolphins** are included in Schedule I of WPA 1972.
    a. They are found in large numbers in Chilika Lake.
2. **Chinnar Wildlife Sanctuary**, Kerala is the only rehabilitation center for star tortoises in the country.
3. **Great Indian Bustard**, locally known as Godawan in Rajasthan, is the heaviest of all flying birds found in arid and semi-arid grasslands.
    a. It is the state bird of Rajasthan listed under Schedule I of WPA and CMS or Bonn Convention.
    b. It is endemic to the Indian Sub-continent and is found in only six states: MP, Gujarat, Maharashtra, Andhra Pradesh, Rajasthan and Karnataka.
4. **Amur Falcon** is a migratory bird that stays every year at Doyang Lake (Nagaland) during their flight from Mongolia to South Africa.
5. **Nilgiri Tahr** is the state animal of Tamil Nadu, listed under Schedule 1 of WPA. It is endemic to Western Ghats.
    a. Majority of Nilgiri Tahr are found at the Eravikulam National Park in Munnar, Kerala.
6. **Asiatic Lion** is listed under Schedule I of WPA and Appendix-I of CITES is found in India only.
    a. Several Asiatic Lions died due to Canine Distemper Virus (CDV) and tick borne Babesiosis in Gir Forest, Gujarat.
    b. Considering this, MoEFCC has launched Asiatic Lion Conservation Project under the Centrally Sponsored Scheme-Integrated Development of Wildlife Habitat (CSS-IDWH).
    c. There was also a proposal to translocate lions from Gujarat to Kuno-Palpur Wildlife Sanctuary, Madhya Pradesh.
7. **Spider Monkey**, found in Central and South America, are called so as they look like spiders hanging upside down from their tails with their arms and legs dangling.
8. **Sarus Crane**, the state bird of UP has been classified as Vulnerable by IUCN.
    a. It generally inhabits natural wetlands.
    b. They are large non-migratory crane and India's only resident breeding crane and world's tallest flying bird.
9. **Tamil Yeoman**, a butterfly species endemic to Western Ghats has been declared as the state butterfly of Tamil Nadu while Maharashtra declared Blue Mormon as its state butterfly.
10. **Kharai camels**, found in the Kutch region of Gujarat, can swim up to three kilometers in the sea in search of mangroves. Many Jatt families in the region are traditional rearers of Kharai camels.
11. **Purple Frog (Nasikabatrachus Sahyadrensis)** is listed as Endangered by IUCN. It is endemic to Western Ghats and can be called as 'living fossil' as its evolutionary roots suggest it could have shared space with dinosaurs.
12. **Orangutans** are one of the world's three surviving species of great apes and are native to Indonesia and Malaysia.
    a. It has been classified as Critically Endangered by IUCN.
13. **Chinkara gazelles** have been classified as Least Concern by IUCN.
    a. Karnataka has notified Bukkapatna Chinkara Wildlife Sanctuary as the southernmost tip in the distribution range of Chinkara in India.
14. **Flame Throated Bulbul** is the State Bird of Goa and is endemic to the southern peninsular India.
15. **Pangolins** are the most trafficked wildlife species.
    a. They are known as scaly anteaters and are toothless animals.
    b. They are the only mammal wholly covered in scales.

The **hump-backed mahseer**, found in the waters of the Cauvery has been added to the IUCN Red List as Critically Endangered.

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Gangetic Dolphins, also known as 'susu' is the national aquatic animal and has been granted non-human personhood status by the government. It is also called a blind dolphin.

1. It is listed under Schedule I of WPA 1972.
2. It is among the four freshwater dolphins found in the world.
3. Its population is declining due to poaching, construction of dams, getting trapped in fishing nets and agricultural run-off from fields.
4. Vikramshila Gangetic Dolphin Sanctuary in Bihar is India's only sanctuary for the Gangetic Dolphin.

Indus Dolphins, also known as 'bhulan' are endangered, freshwater and functionally blind species of dolphins.

1. A very small population is found in India's Beas river.
2. Punjab has recently declared it as its state animal.
3. Indus dolphins rely on echolocation to navigate, communicate and hunt down their prey.

India is home to nine species of vulture. Some of the important ones facing extinction include:

1. Critically Endangered Species- Slender Billed Vulture, Indian Long Billed Vulture, Oriental White-backed Vulture, Red Headed Vulture.
2. Endangered Species- Egyptian Vulture.

Accordingly, Vulture Care Centre (VCC) was set up at Pinjore, Haryana. Later, it was upgraded to become the first Vulture/Jatayu Conservation and Breeding Centre (VCBC) in India.

Bird Conservation:

1. **Important Bird Area (IBA)** is an area identified by BirdLife International as being globally important for the conservation of bird populations. Sites under IBA does not ensure that it gets legal protection or becomes inaccessible to people.

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2. **Salim Ali Centre for Ornithology and Natural History (SACON)** is registered as a society and Union Environment Minister is the president.
3. **Draft Visionary Perspective Plan to Conserve Birds** has been placed in the public domain. Key highlights of the plan include:
    a. Bird Surveys will be conducted in selected landscapes.
    b. Species recovery programme of critically endangered birds is envisaged.
    c. Aims at conservation of migratory birds.
    d. SACON will be the nodal institution for this purpose.

Thousands of migratory birds recently died at Sambhar lake in Rajasthan due to **Avian Botulism**. Avian Botulism is caused by Clostridium botulinum bacteria which affects the nervous system of birds leading to paralysis.

Olive Ridley Turtles are one of the smallest and most abundant of all sea turtles found in the world.

1. Gahiramatha marine sanctuary, located in Odisha, is known as world's largest Olive Ridley rookery.
2. They are known for their mass nesting called Arribada.
3. They are carnivores in nature.
4. Operation Olivia has been launched by Indian Coast Guard to ensure the safety of Olive Ridley Sea Turtles.

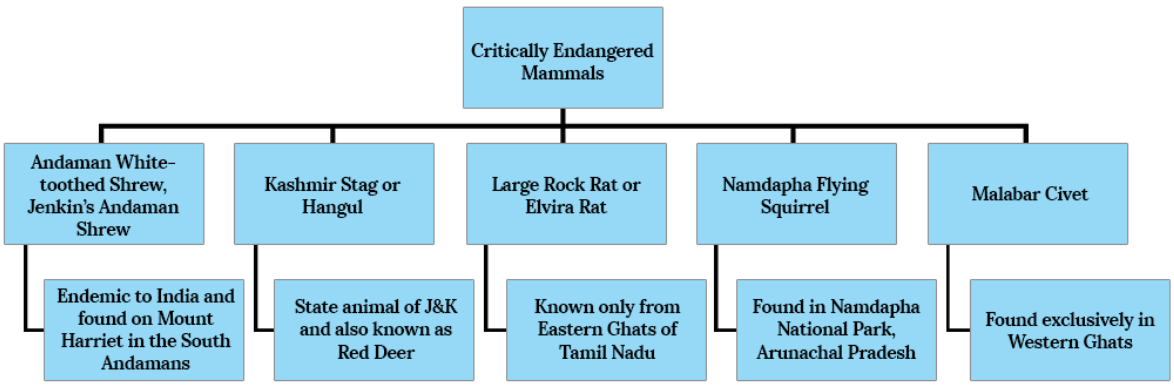
WCCB and UN Environment India launched an awareness campaign '**Not all animals migrate by choice**' to garner public support for the protection and conservation of wildlife, prevention of smuggling and reduction in demand for wildlife products.

Integrated Development of Wildlife Habitats (IDWH) is a Centrally Sponsored Scheme where government provides financial and technical assistance to State/UT governments for wildlife conservation. The Scheme has following components:

1. Support to Protected Areas like National Parks and Wildlife Sanctuaries.
2. Protection of Wildlife Outside Protected Areas.
3. Recovery Programme for saving Critically Endangered Species and Habitats.

It covers 17 species, some of which are Snow Leopard, Bustard (including floricans), Dolphin, Hangul, Nilgiri Tahr, Dugongs, Manipur Brow Antlered Deer, Malabar Civet, Indian Rhinoceros, Asiatic Lion, Swamp Deer, Jerdon's Courser etc.

5.1.6 Animal Diversity of India



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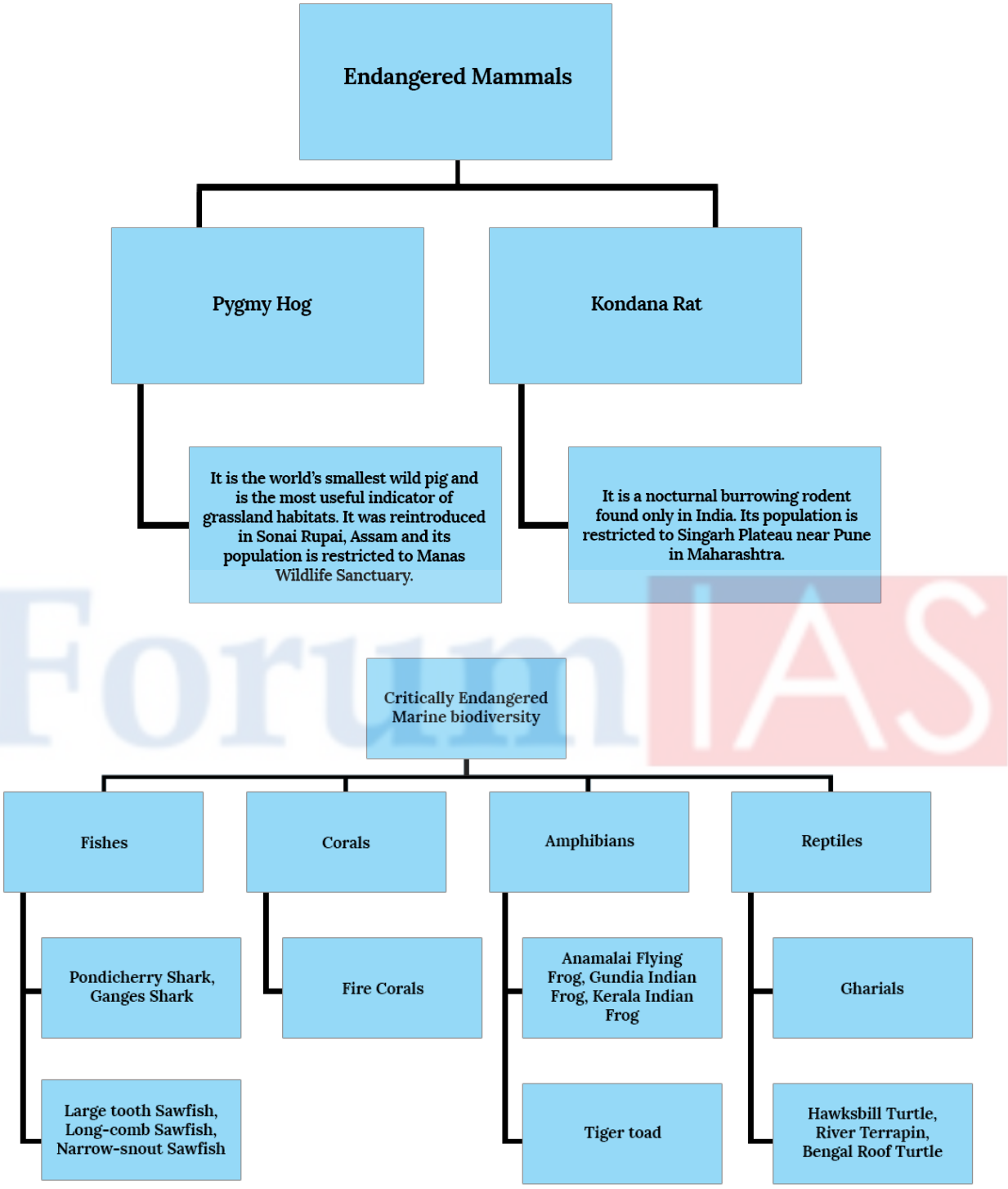
Endangered Mammals



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Some recent changes to IUCN status:

1. **Forest Owlet's** status has been changed from Critically Endangered to Endangered.
    a. It is found in dry deciduous forests of MP and Maharashtra.
2. **Sispara Day Gecko's** status has been changed from Critically Endangered to Near Threatened.
3. **Knife-tooth Sawfish's** status has been changed from Critically Endangered to Endangered.

Duck-billed platypus and some species of anteaters are few exceptions as despite being mammals, they lay eggs rather than giving birth to young ones. All of them are found only in Australia and New Guinea.

5.1.7 Marine Organisms

1. **Plankton**: It refers to both microscopic plants like algae (phytoplanktons) and animals like crustaceans and protozoans (zoo-planktons) found in all aquatic ecosystems except certain swift moving waters.

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   a. Locomotory power of planktons is limited and their distribution is largely controlled by water current.
2. **Phytoplankton**: Phytoplankton are the autotrophic components of the plankton community and a key part of ocean and freshwater ecosystems. All phytoplankton have chlorophyll and carry out photosynthesis. Thus, they also act as a Carbon Sink by removing CO_2 naturally during photosynthesis.
   a. Common kinds of phytoplankton are cyanobacteria, protists and green algae.
   b. They are present throughout the lighted regions of all the seas and oceans including the Polar Regions and their total biomass is greater than that of total plants on land. However, their distribution is limited to the uppermost layers of the oceans where light intensity is sufficient for photosynthesis.
   c. The highest concentration of phytoplanktons is found at higher latitudes, while the tropics and subtropics have 10 to 100 times lower concentrations.
3. **Zooplanktons**: They are the animal component of the planktonic community. They are heterotrophic, meaning they cannot produce their own food and must consume instead other plants or animals as food. In particular, this means they eat plankton.
   a. Examples of zooplankton include tiny flagellates and giant jellyfish.
4. **Sea-grass**: They are marine flowering plants that resemble grass in appearance. They grow in shallow coastal waters with sandy or marshy bottoms and require comparatively calm areas. Sea-grass beds serve variety of purposes like:
   a. Reducing wave energy.
   b. Filtering sediments and nutrients from water.
   c. Controlling erosion.
   d. Serves as habitat for marine fauna.
5. **Seaweeds**: They are microscopic algae, meaning that they have no differentiation of true tissues such as roots, stems and leaves. Functions of seaweeds include:
   a. They are important as food for humans.
   b. They are used as a drug for goitre treatment.
   c. Commercial products like agar-agar, alginates and iodine can be extracted from them.
   d. Biodegradation of seaweeds can produce methane.
   e. They serve as indicators of marine pollution.
   f. Other general functions are similar to sea-grass.

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CHAPTER 6

CONSERVATION EFFORTS IN INDIA

6.1 Project Tiger

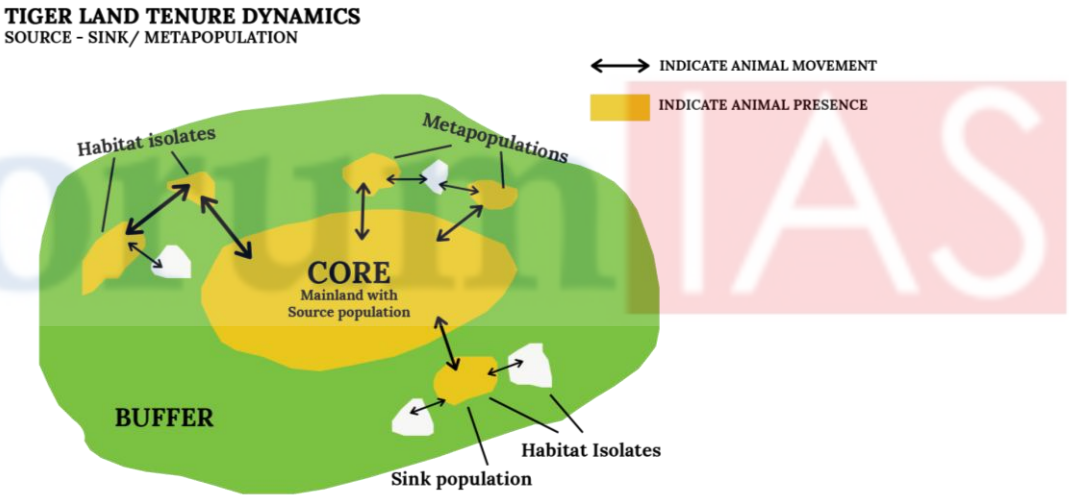
Project Tiger is a Centrally Sponsored Scheme launched in Jim Corbett National Park in 1973 with the following objectives:

1. To ensure maintenance of available population of tigers in India for scientific, economic, aesthetic, cultural and ecological value.
2. To preserve, for all times, the areas of such biological importance as a national heritage for the benefit, education and enjoyment of people.

Aim of Project Tiger was the conservation of endangered species as well as harmonizing the rights of tribal people living in and around the tiger reserves.

Under Project Tiger, Tiger Reserves are constituted on a 'core-buffer' strategy. The State Governments shall, on the recommendation of the National Tiger Conservation Authority (NTCA) notify an area as a tiger reserve.

Tiger Reserve includes:



1. **Core zone**:
    a. The core area is kept free of biotic disturbances and forestry operations. Activities like collection of minor forest produce, human disturbances, grazing etc. are not allowed.
    b. These areas are required to be kept inviolate for the purpose of tiger conservation, without affecting the rights of the Scheduled Tribes or such other forest dwellers.
    c. These areas are notified by the State Governments in consultation with an Expert Committee.

2. **Buffer Zone**:
    a. The Act defines Buffer Zone as the area peripheral to the core area. It provides supplementary habitat for dispersing tigers as well as offering scope for existence of human activity.
    b. The limits of such areas are determined by consultation with the concerned Gram Sabha and an Expert Committee constituted for that purpose.

Modification in the boundaries of a Tiger Reserve can be done only on a recommendation of the NTCA and it should also be approved by the National Board of Wildlife (NBWL).

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National Tiger Conservation Authority (NTCA) is a statutory body under the MoEFCC. It was established in 2005 following the recommendation of the Tiger Task Force.

NTCA was constituted under enabling provisions of the Wildlife Protection Act 1972, as amended in 2006, for strengthening tiger conservation, as per powers and functions assigned to it.

The **four-year tiger census** is led by NTCA and the Wildlife Institute of India (WII), in collaboration with state forest departments. Some of the technologies used in estimating the number of tigers include:

1. M-STrIPES (a software-based tiger monitoring system launched by NTCA).
2. CaTRAT (Camera Trap Data Repository and Analysis Tool).
3. ExtractCompare.
4. Spatially explicit capture-recapture (SECR) method.
5. Cytochrome-b marker.
6. Maximum-Entropy Models (MaxEnt).

13 **tiger range countries** that are a part of Global Tiger Recovery Programme include Bangladesh, Bhutan, Nepal, India, China, Lao PDR, Cambodia, Myanmar, Malaysia, Indonesia, Thailand, Vietnam and Russian Federation.

6.2 Project Elephant

Project Elephant was launched in February 1992 as Centrally Sponsored Scheme to assist states having free ranging populations of wild elephants and to ensure long-term survival of identified viable populations of elephants in their natural habitats.

States are being given financial as well as technical assistance in achieving the following objectives of the project:

1. To protect elephants, their habitats and corridors.
2. To address issues of man-animal conflict.
3. Welfare of domesticated elephants.

Monitoring of Illegal Killing of Elephants (MIKE) Programme is mandated by COP resolution of CITES as an international collaboration that tracks trends in information related to the illegal killing of elephants from across Africa to Asia and to monitor effectiveness of field conservation efforts.

Hathi Mere Saathi is a campaign launched by MoEFCC in partnership with Wildlife Trust of India (WTI) to improve conservation and welfare prospects of elephants.

E-8 countries with significant population of elephants include India, Botswana, the Republic of Congo, Indonesia, Kenya, Sri Lanka, Tanzania and Thailand.

E-50:50 forum is held by the E-8 countries for adopting a common global vision on conservation, management and welfare of elephants across all range countries.

6.3 Vulture Conservation

India has nine species of vultures in the wild. However, there has been a constant decline in their population pushing them to the brink of extinction. Diclofenac Sodium, a non-steroidal anti-inflammatory drug administered to reduce inflammation and to reduce pain in certain conditions, is a probable cause for the decline.

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Diclofenac Sodium is associated with kidney failure in vultures who are unable to break down the chemical diclofenac when they eat the carcass of animals administered with the drug. Considering this, Meloxicam is being used as a replacement for Diclofenac.

Saving Asia's Vultures from Extinction (SAVE) is a consortium of like-minded, regional and international organizations, created to oversee and coordinate conservation, campaigning and fundraising activities to help the plight of South Asia's vultures.

Partners involved in this consortium are Bird Conservation Nepal, Bombay Natural History Society, International Centre for Birds of Prey (UK), National Trust for Nature Conservation (Nepal), Royal Society for the Protection of Birds (UK).

6.4 Sea Turtle Project

Sea Turtle Conservation Project was launched in collaboration with UNDP in November, 1999. Wildlife Institute of India (WII) is the implementing agency of the project. While the project is being implemented in 10 coastal states of the country, special emphasis is laid on the State of Odisha.

6.5 Project Hangul

The Kashmir stag, also called as Hangul is a subspecies of Central Asian Red Deer. In Kashmir, it is found in the Dachigam National Park. To counter its declining population, Project Hangul was launched by the government of Jammu and Kashmir along with IUCN and WWF.

6.6 Captive Breeding

Captive Breeding, also known as "captive propagation", is the process of maintaining plants or animals in controlled environments, such as wildlife reserves, zoos, botanical gardens, and other conservation facilities.

E.g., captive breeding of lion tailed macaque in Arignar Anna Zoological Park, Chennai.

6.7 Biodiversity Conservation Measures

Tiger Conservation:

1. **Global Tiger Initiative**, 2008 is an alliance of governments, international organizations like World bank and civil society. It aims to save wild tigers from extinction and its scope was recently broadened to include snow leopards. The initiative is led by 13 tiger range countries including India, China, Russia, Nepal, Bhutan.
2. **St. Petersburg Declaration on Tiger Conservation** was adopted in 2010 under Global Tiger Initiative and TX2 was endorsed. TX2 aims at doubling the number of wild tigers.
3. **Conservation Assured Tiger Standards (CA|TS)** is a set of criteria which allows tiger sites to check if their management will lead to successful tiger conservation. It is a part of TX2.
4. First inter-state tiger translocation took place from Bandhavgarh Tiger Reserve in MP to Satkosia Tiger Reserve in Odisha.

NTCA is the nodal authority for **Cheetah reintroduction program**. Cheetah is a keystone species of the grasslands and its reintroduction will help dryland ecosystems of India to return to their natural state.

Elephant Conservation is our national heritage animal, protected under Schedule I of WPA and Appendix I of CITES.

1. **Gaj Yatra** is a nationwide campaign led by Wildlife Trust of India (WTI) and International Fund for Animal Welfare (IFAW), both NGOs protect elephants.
2. **Project Elephant** is a Centrally Sponsored Scheme launched in 1992 for elephant conservation.

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3. **Asian Elephant Alliance**, launched in 2015 in London is an umbrella of five NGOs- Elephant Family, IFAW, IUCN Netherlands, World Land Trust and WTI.

Rhino Conservation

1. "**New Delhi Declaration on Asian Rhinos 2019**" for the conservation and protection of the species was signed by five Asian Rhino Range Countries- India, Nepal, Bhutan, Indonesia and Malaysia.
2. **Indian Rhino Vision 2020** is implemented by the Assam government with the support of WWF-India. The goal was set to populate potential rhino habitat areas identified- Manas National Park, Dibru Saikhowa WLS, Laokhowa WLS, Bura Chapori WLS and Orang with a viable population of rhinos through translocations from Kaziranga National Park and Pobitora Wildlife Sanctuary. Accordingly, a Special Rhino Protection Force (SPF) has been established from people living in the fringe areas of the Kaziranga National Park.

Snow Leopard Conservation:

1. **Global Snow Leopard and Ecosystem Program (GSLEP)** is an inter-governmental alliance of 12 Snow Leopard Range Countries.
2. **Project Snow Leopard** is a Centrally Sponsored Scheme launched for protection and preservation of snow leopards and is operational in five Himalayan states- J&K, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh.
3. The **SECURE Himalaya project** is a part of "Global Partnership on Wildlife Conservation and Crime Prevention for Sustainable Development" (Global Wildlife Program) funded by the Global Environment Facility (GEF).

The project promotes sustainable management of alpine pastures and forests in the high range Himalayan ecosystems to secure conservation of globally significant wildlife, including endangered snow leopard and their habitats to ensure sustainable livelihoods and socio-economic benefits for communities in the selected high-altitude landscapes in the Trans and Greater Himalayan regions.

Operation Save Kurma was conducted by Wildlife Crime Control Bureau (WCCB) to combat the rising illegal trade in live turtles and its parts from the country.

India's first **wildlife conservation reserve dedicated exclusively to blackbuck** will be set up in the trans-Yamuna region of Allahabad in UP. Blackbucks are native to the Indian subcontinent and has been classified as Least Concern by IUCN. Few National Parks and Sanctuaries inhabited by blackbucks include Velavadar WLS in Gujarat and Ranibennur Blackbuck Sanctuary in Karnataka.

Crocodile Conservation and Breeding Project was initially launched in Odisha in 1975 and subsequently in other States with technical help from the Food and Agricultural Organization (FAO) and UNDP.

1. India is home to three species of Crocodile i.e., Gharial (Critically Endangered), Mugger (Vulnerable) and Saltwater Crocodile (Least Concern).
2. Bhitarkanika Mangroves is said to house 70% of India's estuarine or saltwater crocodile conservation whose conservation started in 1975.

6.8 Miscellaneous

South Asia Wildlife Enforcement Network (SAWEN) is a regional intergovernmental wildlife law enforcement support body launched in 2011 in Paro, Bhutan. Its secretariat is located in Kathmandu, Nepal.

SAWEN's regional network comprises of eight South Asian Countries- Afghanistan, India, Pakistan, Nepal, Bhutan, Bangladesh, Sri Lanka and Maldives.

Central Asian Flyway (CAF) is among the nine flyways in the world. It encompasses overlapping migration routes over 30 countries for different waterbirds linking their northernmost breeding

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grounds in Siberia to the southernmost non-breeding (wintering) grounds in West and South Asia, the Maldives and the British Indian Ocean Territory.

India has a strategic role in the flyway as it provides critical stopover sites to birds known to use this migratory route. Birds from three different flyways (CAF, The East Asian-Australasia Flyway and Asian East African Flyway) are reported to visit the Indian subcontinent.

Cultural Model of Conservation is a concept which respects the rights of indigenous peoples and other bearers of traditional knowledge and prevents social conflicts. Under this mode, human presence is not considered a threat to nature, rather both co-exist and support each other.

Some of the application of cultural model of conservation by different tribes include:

1. Bishnoi tribe of Rajasthan who consider trees as sacred.
2. Chenchu tribe of Andhra Pradesh who are involved in tiger conservation in Nagarjunasagar Srisailam Tiger Reserve (NSTR).
3. Maldhari tribes of Gujarat living in peaceful coexistence with lions.
4. Bugun tribe of Arunachal known for protecting the Critically Endangered bird Bugun Liocichla.
5. Nyishi tribe in Arunachal conserving hornbills in Pakhui/Pakke Tiger Reserve.

Government of India, in partnership with UNDP India initiated the **Indian Biodiversity Awards**. The award is conferred by the National Biodiversity Authority (NBA), which is a statutory body established under the Biological Diversity Act 2002 (BDA).

Asian Waterbird/Waterfowl Census is a part of International Waterbird Census and was held recently in India. It was jointly coordinated by the Bombay Natural History Society and Wetlands International.

Bombay Natural History Society (BNHS) is an NGO in India engaged in conservation and biodiversity research.

It is a partner of BirdLife International and has been designated as a 'Scientific and Industrial Research Organization' by Department of Science and Technology.

Its logo is the Great Hornbill.

Wetlands International is a global not-for-profit organization dedication to the conservation and restoration of wetlands.

It is headquartered at Netherlands.

BirdLife International is a global partnership of non-governmental organizations that strives to conserve birds and their habitats. It identifies "Important Bird and Biodiversity Areas".

It is headquartered at Cambridge, UK.

India recently hosted the **Global Wildlife Program** during which India's National Wildlife Action Plan (NWAP) for the period 2017-2031 was released.

Global wildlife Program was launched with the aim of working towards wildlife conservation and sustainable development by fighting against illicit trafficking in wildlife. Implementing agencies include World Bank, UNDP, UNEP and Asian Development Bank (ADB).

NWAP launched during Global Wildlife Program has several components like following landscape approach towards conservation, increasing role of private sector through Corporate Social responsibility (CSR) and preserving our genetic diversity. It is the third action plan that comes after the first plan in 1983 and second from 2002 till 2016.

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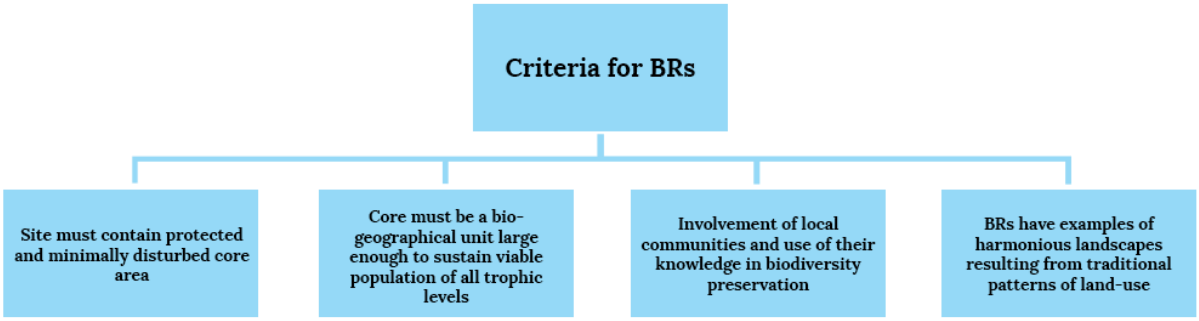
Laboratory for Conservation of Endangered Species (LaCONES) is a dedicated laboratory of CSIR, Hyderabad. It is the only institute in the country working towards conservation of endangered wildlife using modern biotechnology.

6.9 Biosphere Reserves

Biosphere Reserve (BR) is an international designation by the UNESCO for representative parts of natural and cultural landscapes extending over large areas of terrestrial or coastal /marine ecosystems or a combination of both.

Biosphere Reserves tries to balance both economic and social development and maintenance of associated cultural values along with preservation of nature. In a way, BRs are living examples that nature and human beings can co-exist while respecting each others' needs.



Structure of Biosphere Reserves includes a Core Area, Buffer Zone and a Transition Zone.

1. **Core Area**: It is the most protected area of a Biosphere Reserve and may contain endemic plants and animals. A Core Zone is kept free from human interference.
2. **Buffer Zone**: The Buffer Zone surrounds the Core Zone and activities in this zone are managed in a way that the Core Zone is protected in its natural conditions. Research and Educational activities are encouraged in this zone.
3. **Transition Zone**: It is the outermost part of the Biosphere Reserve where human ventures and conservation are done in harmony. This area includes human settlements, croplands and other areas for intensive recreation.

Functions of Biosphere Reserves include **Conservation, Development and Logistics Support**. Presently, there are 18 Biosphere Reserves in India. BRs are not intended to replace existing protected areas, rather it widens the scope of environmental protection and strengthens the Protected Area Network. Existing legally protected areas like National Parks, Wildlife Sanctuaries and Tiger Reserves may also become a part of BRs without change in their legal status.

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Man and Biosphere Programme (MAB) is UNESCO's intergovernmental scientific programme launched in 1971 that aims to establish a scientific basis for the improvement of relationships between people and their environments.

MAB combines natural and social sciences, economics and education to improve human livelihoods and the equitable sharing of benefits, and to safeguard natural and managed ecosystems.

12 out of 18 Biosphere Reserves are a part of World Network of Biosphere Reserves (WNBR), based on UNESCO Man and Biosphere (MAB) Programme list.

6.10 Biodiversity Hotspots

A Biodiversity Hotspot is a biogeographic region with significant levels of biodiversity that is threatened by human habitation. These are found throughout the world and not just confined to tropics. As per Conservation International, to qualify as a Biodiversity Hotspot, a region must qualify two strict criteria:

1. **Species Endemism**: It must contain at least 1500 species of vascular plants.
2. **Degree of threat**: It has to have lost at least 70% of its original habitat.

Indian Biodiversity Hotspots are:

1. The Himalayas
2. Indo-Burma
3. The Western Ghats
4. Sunderland

Some hotspots are much richer than others in terms of their biodiversity. They are classified as '**The Hottest Hotspots**'. Factors taken into consideration while defining Hottest Hotspots include endemic plants, endemic vertebrates, endemic plants/area ratio, endemic vertebrates/area ratio and remaining primary vegetation as a percentage of original extent.

Madagascar, Philippines, Sundaland, Indo-Burma, Western Ghats/Sri Lanka, Brazil's Atlantic Forest, Caribbean, Eastern Arc and Coastal Forests of Tanzania/Kenya are examples of The Hottest Hotspots.

6.11 Biodiversity Coldspots

Areas that have relatively low biological diversity but are also experiencing a high rate of habitat loss are considered as Biodiversity Coldspots. Although a Biodiversity Coldspot is low in species richness, it is also important to conserve, as it may be home to rare flora and fauna.

6.12 World Heritage Sites

World Heritage Sites is a place that is listed by UNESCO for its special cultural or physical significance. The list of World Heritage Site is maintained by the international 'World Heritage Programme', administered by the UNESCO World Heritage Committee. India has 38 World Heritage Sites that include 30 Cultural properties, 7 Natural properties and 1 Mixed site.

6.13 Eco-Sensitive Zones (ESZ)/Eco-Sensitive Areas (ESA)

The Environment Protection Act, 1986 does not mention the word "Eco-Sensitive Zones". However, the Section 3(2)(v) of the Act says that the Central government can restrict areas in which any industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards.

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Besides, Section 5(1) of this Act says that Central government can prohibit or restrict the location of industries and carrying on certain operations or processes on the basis of considerations like biological diversity of an area, maximum allowable limits of concentrations of pollutants for an area, environmentally compatible land use and proximity to protected area.

The above two clauses have been effectively used by the government to declare **Eco-Sensitive Zones/Eco-Sensitive Areas**. The same criteria have been used by the government to declare **No Development Zones**.

The Supreme Court has recently directed the Union Environment Ministry to declare 10 km area around 21 National Parks and Wildlife Sanctuaries across the country as ECZs. Activities prohibited in these ECZs include commercial mining, polluting industries, major hydroelectric projects etc. On the other hand, rain water harvesting, organic farming, ongoing agricultural practices etc. are permitted.

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CHAPTER 7

ENVIRONMENTAL LEGISLATIONS AND INSTITUTIONAL MEASURES

7.1 Environmental Legislations

7.1.1 Wildlife Protection Act, 1972

The Wild Life Protection Act, 1972 is an Act of the Parliament of India enacted for safeguarding our floral and faunal diversity. It is aimed towards protecting wild animals and plants; and for matters connected there with or ancillary or incidental thereto. The Act covers the whole of India under its ambit.

Salient Features of the WPA includes:

1. It provides for the establishment of National Parks, Wildlife Sanctuaries etc.
2. It paved the way for the formation of Central Zoo Authority.
3. The Act lists six schedules which give varying protection to the flora and fauna of the country. Those under Schedule I and Schedule II (Part II) get absolute protection.
4. The Act provides for licenses for the sale, transfer and possession of some wildlife species. Scheduled animals are prohibited from being traded as per the provisions of the Act.
5. The Act also prohibits hunting of endangered species.

There are **five types of Protected Areas under WPA, 1972**:

1. **Wildlife Sanctuaries (WLS)**: The WPA provides for the declaration of WLS by the State Government if the area was thought to be of adequate ecological, geomorphological and natural significance.
2. **National Parks**: The WPA provides for the declaration of National Parks by the State Governments in addition to the declaration of WLS. However, within the law, the difference in conservation value of a National Park and WLS is not specified.

Difference between National Parks (NPs) and Wildlife Sanctuaries (WLS):

1. NPs enjoy a greater degree of protection than WLS.
2. Certain activities which are permissible in WLS (e.g., grazing) are prohibited in NPs.
3. WLS can be created for a particular species while a NP is not primarily focused on a particular species.
4. While boundaries of NPs are fixed and defined, it is not the case with WLS.
5. NPs cannot be downgraded to the status of WLS but WLS can be upgraded to the status of NP.

The Chief Wildlife Warden may grant permission to persons for entry or residence in the sanctuary for the study of wildlife, scientific research, photography etc.

Both Central and State Governments can declare WLS and NPs. Also, territorial waters can be included in areas to be declared as WLS or NPs for the protection of off-shore marine flora and fauna. No alteration of boundaries of a WLS or NP can be made except on the recommendation of the National Board of Wildlife (NBWL).

3. **Conservation Reserves and Community Reserves**: Both are the outcome of Amendments to the Wildlife Protection Act, 1972.
    a. **Conservation Reserve**: The State Government may declare an area (particularly those adjacent to sanctuaries or parks) as Conservation Reserves after consulting the local communities.
    b. **Community Reserve**: The State Government may declare any private or community land as a Community Reserve after consultation with the local community or an individual who has volunteered to conserve the wildlife.

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Gogabeel has been declared as Bihar's first 'Community Reserve'. It is an ox-bow lake in Bihar's Katihar district and is formed from the flow of the rivers Mahananda in the north and Ganga in the south and east.

4. **Tiger Reserves**: Tiger Reserves are declared on the recommendation of the National Tiger Conservation Authority (NTCA) for the protection and conservation of tigers.

Management Effectiveness Evaluation (MEE) is the assessment of how well protected areas such as national parks, wildlife sanctuaries, conservation reserves, community reserves and tiger reserves are being managed and their effectiveness in conserving flora and fauna.

7.1.2 Environment (Protection) Act, 1986

The Environment (Protection) Act, 1986 authorizes the central government to protect and improve environmental quality, control and reduce pollution from all sources and prohibit or restrict the setting and /or operation of any industrial facility on environmental grounds. The Act was enacted in 1986 with the objective of providing for the protection and improvement of the environment. It empowers the Central Government to establish authorities charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. The Act was last amended in 1991.

In this Act, "Environment" is defined to include water, air and land and the inter-relationships which exist amongst them. The purpose of this Act is to implement the decisions of the United Nations Conference on Human Environment of 1972 which relate to the protection and improvement of human environment and the prevention of hazards to human beings, other living creatures, plants and property.

The Act has relaxed the rule of "locus standi" and because of such relaxation, even a common citizen can approach the Court with prior legal notice. The Environment Protection Act grants immunity to officers of the government for any act done under the provisions of this Act. It further debars the Civil Courts from having any jurisdiction to entertain any suit or proceeding in respect of an action, direction, order issued by the Central Government or other statutory authority under this Act.

7.1.3 Biological Diversity Act, 2002

The Biological Diversity Act, 2002 was born out of India's attempt to realize the objectives enshrined in the United Nations Convention on Biological Diversity (CBD) which recognizes the sovereign right of states to use their own biological resources.
The Act is aimed at the conservation of biological resources, managing its sustainable use and enabling fair and equitable sharing of benefits arising out of the use and knowledge of biological resources with the local communities.
The Act envisaged a **three-tier structure**:

1. National Biodiversity Authority (NBA) as a statutory body.
2. State Biodiversity Boards (SBBs).
3. Biodiversity Management Committees (BMCs) at local level.

The Act prohibits the following activities without the prior approval from the NBA:

1. Any person or organization (either based in India or not) obtaining any biological resource occurring in India for its research or commercial utilization.
2. The transfer of the results of any research relating to any biological resources occurring in, or obtained from India.
3. The claim of any intellectual property rights on any invention based on the research made on the biological resources obtained from India.

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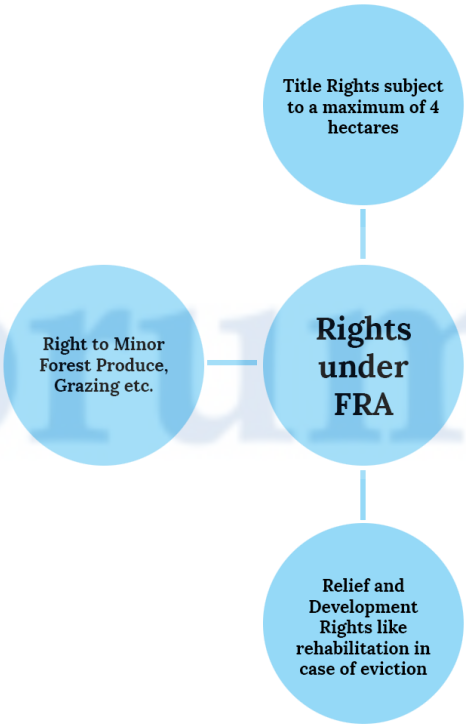
Any grievances related to the determination of benefit sharing or order of the NBA or SBB under this Act shall be taken to the National Green Tribunal (NGT).

As per National Biodiversity Authority, following Acts and Rules are related to Biodiversity:

1. The Fisheries Act, 1897
2. The Destructive Insects and Pests Act, 1914
3. The Agricultural Produce (Grading and Marketing) Act, 1937
4. Import and Export (Control) Act, 1947
5. Indian Forest Act, 1927
6. Mines and Mineral Development (Regulation) Act, 1957

7.1.4 The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

Forest Rights Act (FRA) deals with the rights of forest dwelling communities over land and other resources. The Act grants legal recognition to the rights of traditional forest dwelling communities. Ministry of Tribal Affairs (MoTA) is the nodal agency for implementing the Act.



Eligibility to get rights under the Act is confined to those who "primarily reside in forests" and who depend on forests and forest land for a livelihood. Further, the claimant must be a member of STs scheduled in that area or must have been residing in the forest for 75 years prior to 13 December, 2005.

Gram Sabha or the village assembly is the initial authority which passes a resolution recommending whose rights to which resources should be recognized.

National Parks and Wildlife Sanctuaries have been included along with Reserve Forest and Protected Forests for the recognition of rights. The rights conferred under the Act shall be heritable but not alienable or transferrable.

The Act has also defined the term "minor forest produce" to include all non-timber forest produce of plant origins including bamboo, brush wood, stumps, cane, tussar, cocoons, honey, wax, lac, tendu leaves etc.

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7.1.5 National Forest Policy, 1988

Salient features of the policy are:

1. Maintenance of environmental stability through preservation and restoration of ecological balance.
2. Conservation of natural heritage of country by preserving remaining forests.
3. Checking soil erosion and extension of sand dunes.
4. Increasing forest cover by afforestation.
5. Afforestation and development of wastelands.
6. Meeting basic requirements of people (fuel, timber, food) and encouraging wood substitutes.
7. Efficient utilization of forest produce.
8. Conservation of biological diversity, a network of national parks, sanctuaries, biosphere reserves and other protected areas should be extended and properly managed.

Joint Forest Management (JFM) is an approach and program initiated in the context of the National Forest Policy, 1988 wherein state forest departments support local dwelling communities to protect and manage the forests and share the costs and benefits from the forests with them.

Draft National Forest Policy, 2018 aims at sustainable forest management by incorporating elements of ecosystem security, climate change, forest hydrology and robust framework to monitor and develop forest cover and strengthening an overall environmental balance. Its important provisions are:

1. It envisages a **Community Forest Management Mission**.
2. Proposes **Private Intervention** in forests for maintaining its quality.
3. Emphasises the importance of **Urban Forestation**.
4. Proposes setting up a **National Board of Forestry** for better management of the country's forests.

Under Gre**en Highways (Plantation, Transplantation, Beautification and Maintenance) Policy-2015**, Ministry of Road Transport and Highways has decided all existing National Highways and 40000 km of additional roads in the next few years as Green Highways.

1% of the total project cost of all highway's projects will be kept aside for the highway plantation and its maintenance.

7.1.6 Coastal Regulation Zone (CRZ)

CRZ area is classified into CRZ-I, CRZ-II, CRZ-III, CRZ-IV.

1. **CRZ-I**: These areas are environmentally most critical and further classified into:
    a. CRZ-I A: The ecologically sensitive areas like Mangroves, Corals, Sand Dunes, Turtle Nesting Grounds, Protected Areas etc.
    b. CRZ-II B: These include the intertidal zone.
2. **CRZ-II**: The developed land areas up to or close to the shoreline, within the existing municipal limits or in other existing legally designated urban areas.
3. **CRZ-III**: Land areas that are relatively undisturbed (viz rural areas etc.) and those do not fall under CRZ-II. CRZ-III is further classified as:
    a. CRZ-III A: Areas with population density more than 2161 sq. km as per 2011 Census.
    b. CRZ-III B: Areas with population density of less than 2161 sq. km as per 2011 Census.
4. **CRZ-IV**: It constitutes the water area and is further classified into:
    a. CRZ-IV A: The water area and the sea bed area between the LTL up to 12 Nm on the seaward side.
    b. CRZ-IV B: The water area and the bed area between LTL at the bank of the tidal influenced water body to the LTL on the opposite side of the bank, extending from the mouth of the water body at the sea up to the influence of tide.

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Recently, the Government has approved the **CRZ Notification, 2018** (under the Environment Protection Act, 1986) based on the recommendations of **Shailesh Nayak Committee report**. Salient features of the notification are:

1. **Floor Space Index (FSI)** norms have been eased and restrictions imposed on it has been de-froze.
2. **No Development Zone (NDZ)** of 20 meters have been stipulated for all islands.
3. NDZ has been reduced for densely populated areas under CRZ-III:
    a. CRZ-III A areas shall have a NDZ of 50 meters from HTL on the landward side.
    b. CRZ-III B areas shall have a NDZ of 200 meters from the HTL.
4. All **Ecologically Sensitive Areas** have been accorded special importance.
5. **Defence and Strategic Projects** have been accorded necessary dispensation.
6. **Pollution abatement** has been given due importance by permitting construction of treatment facilities in CRZ-I B areas with due safeguards.
7. **CRZ clearance have been streamlined**. Now, CRZ clearances are needed only for CRZ-I and CRZ-IV projects while States will have the power to grant clearances for CRZ-II and CRZ-III projects.
8. **Temporary Tourism infrastructure** amenities will be promoted. Such temporary tourism facilities will also be permissible in the No Development Zone (NDZ) of the CRZ-III areas.

7.1.7 Wetland (Conservation and Management) Rules, 2017

Wetland (Conservation and Management) Rules, 2017 have been made for the effective conservation and management of wetlands in our country. Key features of the Rules are:

1. Decentralization of wetland management with delegation of powers to the State Governments.
2. **Central Wetlands Regulatory Authority (CWRA)** has been replaced with **National Wetlands Committee**.
3. The **State or UT Wetlands Authority** will have to prepare a list of all wetlands and also develop a comprehensive list of activities to be regulated and permitted within notified wetlands and their zone of influence.
4. The Rules prohibit encroachment on wetlands, solid waste dumping, discharge of untreated waste and effluents from industries and human settlements, poaching etc.
5. On the other hand, regulated activities include subsistence level biomass harvesting, sustainable culture fisheries practices, plying of non-motorized boats and construction of temporary nature.
6. It prescribes that the conservation and management of wetlands should be on the principle of 'wise use' as defined by the Ramsar Convention.

However, there is no provision of appealing to the National Green Tribunal (NGT). Also, the definition of wetland does not include river channels, paddy fields, man-made water bodies/tanks specifically for drinking water purposes and structures specifically constructed for aquaculture, salt production, recreation and irrigation purposes.

MoEFCC has notified guidelines for implementation of **Wetlands (Conservation and Management) Rules, 2017**:

1. Wetlands to be regulated include:
    a. Wetlands designated to the list of Wetlands of International Importance under the Ramsar Convention.
    b. Wetlands notified under the rules by the Central Government, State Government and UT administration.
    c. All wetlands, irrespective of their location, size, ownership, biodiversity or ecosystem values, can be notified under the Wetland Rules, except river channels, paddy fields and certain categories human-made water bodies among others.
    d. Protected Areas and areas falling within the purview of Coastal Regulation Zone

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have been excluded from notification under the Wetland Rules.

2. State Wetland Authority will be set up with the minister in charge of environment in the state acting as the chairperson of the authority.
3. The list of wetlands is developed on wetlands definition of the Ramsar Convention.
4. For each wetland to be notified, a zone of influence is to be defined.

7.1.8 Solid Waste Management Rules, 2016

These rules replace the Municipal Solid Waste (Management and Handling) Rules, 2000. Its salient features include:

1. The rules are now applicable beyond municipal areas and include urban agglomerations, census towns, notified industrial townships etc.
2. The source segregation of waste has been mandated.
3. Generator will have to pay "**User Fee**" to waste collector and "**Spot Fine**" for littering and non-segregation.
4. Rules mention time-frame for setting up solid waste processing facilities by all local bodies.
5. Every waste generator shall segregate and store the waste generated by them in three separate streams namely biodegradable, non-biodegradable and domestic hazardous wastes.
6. Ministry of Urban Development (MoUD) shall formulate **National Policy and Strategy on Solid Waste Management**.
7. The Department of Fertilizers, Ministry of Chemicals shall promote marketing and utilization of compost.
8. They also promote setting up of **Waste to Energy (WtE) plants**.

7.1.9 Hazardous and Other Wastes (Management and Transboundary Movement) Amendment Rules, 2019

MoEFCC has amended the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. Salient features of the amended rules include:

1. Solid Plastic Waste has been prohibited from import into the country including in Special Economic Zones (SEZ) and by Export Oriented Units (EOU).
2. Exporters of silk waste have now been given exemption from requiring permission from the MoEFCC.
3. Electric 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 MoEFCC.
4. Industries which do not require consent under Water (Prevention and Control of Pollution) Act 1974 and Air (Prevention and Control of Pollution) Act 1981, are now exempted from requiring authorization under the Hazardous and Other Wastes (Management and Transboundary 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.

7.1.10 Construction and Demolition Waste Management Rules, 2016

Salient features of the Rules are:

1. Prescribes duties of waste generator like segregating construction and demolition waste and depositing it at collection centre.
2. It also provides duties of service providers and contractors.
3. It prescribes timeframe for implementation of the rules.

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7.1.11 Bio-medical Waste Management Rules, 2016

Salient features of the Rules are:

1. The ambit of the rules has been expanded to include vaccination camps, blood donation camps, surgical camps or any other healthcare activity.
2. It calls for phasing-out the use of chlorinated plastic bags, gloves and blood bags within two years.
3. It calls for pre-treatment of laboratory waste, microbiological waste, blood samples and blood bags.
4. It seeks to provide training to all its health care workers and immunize all health workers regularly.
5. It seeks to establish a Bar-Code System for bags or containers containing bio-medical waste for disposal.
6. As per the rules, bio-medical wastes have been classified into 4 categories- Untreated Human Anatomical Waste, Animal Anatomical Waste, Soiled Waste and Biotechnology Waste.
7. As per the rules, the State Government shall provide land for setting up common bio-medical waste treatment and disposal facility.

7.1.12 E-Waste Management Rules, 2016

The MoEFCC notified E-Waste Management Rules, 2016 to supersede E-Waste (Management and Handling) Rules, 2011.

Salient features of the Rules are:

1. The new E-Waste Rules include Compact Fluorescent Lamp (CFL) and other mercury containing lamps, as well as other equipment.
2. For the first time, the rules brought the producers under **Extended Producer Responsibility (EPR)** making them responsible for the collection of E-Waste and for its exchange.
3. Various producers can have a separate **Producer Responsibility Organization (PRO)** and ensure collection of E-Waste as well as its disposal in an environmentally friendly manner.
4. **Deposit Refund Scheme** has been introduced as an additional economic instrument under which the producer charges an additional amount as a deposit at the time of sale of the electrical and electronic equipment and returns it to the consumer along with interest when the end-of-life electrical and electronic equipment is the returned.
5. Phase-wise Collection Target for E-Waste has been introduced.
6. The roles of State Government have also been introduced in the rules to ensure safety, health and skill development of workers involved in dismantling and recycling operations.
7. Urban Local Bodies has been assigned the duty to collect and channelize the orphan products to authorized dismantler or recycler.

The Amendment Rules 2018 has added the **Reduction of Hazardous Substances (RoHS) provision**, under which, cost of Sampling and Testing shall by borne by the Government for conducting the RoHS test. If the product does not comply with the RoHS provisions, then the cost of the test will be borne by the producers.

7.1.13 Plastic Waste Management Rules, 2016

Salient features of the rules are:

1. Increase the **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 recycling of plastic waste.
2. Expand the applicability jurisdiction from **municipal area to rural areas**.

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3. To promote the use of plastic waste for **road construction** as per Indian Road Congress guidelines or energy recovery, or waste to oil etc. for general utilization of waste and also address the waste disposal issue.
4. First time, responsibility of waste generators like individuals and bulk generators like offices have been introduced.
5. To introduce collection of plastic waste management fee through pre-registration of producers, importers of plastic carry bags/multi-layered packaging and vendors selling the same for establishing the waste management system.
6. **Extended Producer Responsibility** has been introduced.
7. Central Pollution Control Board (CPCB) has been mandated to formulate guidelines for thermoset plastics.

The 2016 Rules were Amended in 2018, laying emphasis on phasing out of "**Multi-layered Plastic (MLP)**" which are "non-recyclable, or non-energy recoverable, or with no alternate use."

1. The Amended Rules also prescribe a **Central Registration System** for the registration of the producer/importer/brand owner.
2. The amendment provided that registration should be automated and take into account Ease of Doing Business for producers, recyclers and manufacturers.
3. While a National Registry has been prescribed for producers with a presence in more than two states, a State-level Registration has been prescribed for smaller producers/brand owners operating within one or two states.

7.1.14 Miscellaneous

Indian Forest Act, 1927 was enacted to consolidate all the previous laws regarding forests and extend state's control over forests as well as diminishing the status of people's right to forest use. The Act regulated movement and transit of forest produce and duty leviable on timber and other forest produce. It also defined forest offences. The Act classified forests into Reserved Forest, Protected Forest and Village Forest.

1. Amending the Indian Forest Act, bamboo grown in non-forest areas have been exempted from the definition of trees to promote its commercial cultivation.

The Mines and Mineral Development (Regulation) Act, 1957 was enacted to regulate the mining sector in India. This Act is applicable to all minerals except minor minerals and atomic minerals. Mining minor minerals (e.g., river sand) comes under the purview of state governments. For mining in forest lands, prior permission of Environment Ministry is required.

Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) is aimed at mitigating the adverse impacts, during and after mining, on the environment, health and socio-economic conditions of people in mining districts and also to ensure a sustainable livelihood for the affected people.

It is implemented by the **District Mineral Foundations (DMFs)** of the respective districts that use the funds collected by the DMF from the miners. 60% of the funds will be utilized for high priority areas such as drinking water supply while 40% of the fund will be utilized for areas like physical infrastructure, irrigation, energy and watershed development.

DMF is a trust set up under Mines and Minerals (Development & Regulation) Amendment Act (MMDRA) 2015 as a non-profit body in those districts affected by the mining operations.

National Green Tribunal (NGT) is a statutory body created in 2010 to handle the expeditious disposal of cases pertaining to environmental issues. It was enacted in consonance with the Right to Healthy Environment under Article 21 of Constitution.

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7.2 Institutional Measures

7.2.1 National Afforestation and Eco-Development Board

MoEFCC constituted the National Afforestation and Eco-development Board (NAEB) in 1992. National Afforestation Programme (NAfP), a flagship programme of NAEB, was launched in 2002 and involves plantation in degraded lands across the country.

7.2.2 Compensatory Afforestation Fund Management and Planning Authority (CAMPA)

To compensate the loss of forest area and to maintain environmental sustainability, government announced a well-defined act known as CAMPA.

Provisions of the Act are as follows:

1. The law establishes a **National Compensatory Afforestation Fund** under the Public Account of India and a **State Compensatory Afforestation Fund** under the Public Account of each State.
2. These funds will receive payments for
    a. Compensatory Afforestation
    b. Net Present Value (NPV) of forest
    c. Other project specific payments
3. The National Fund will receive 10% of these funds and the State Funds will receive the rest.
4. According to the Act, a company diverting forest land must provide alternative land to take up compensatory afforestation.

7.2.3 National Clean Energy Fund

The National Clean Energy Fund (NCEF) has been created out of cess on coal produced/imported under the "polluter pays" principle. The Fund lies under the Public Account with its secretariat in Department of Expenditure, Ministry of Finance.

An Inter-Ministerial Group which is chaired by the Finance Secretary recommends projects eligible for funding under NCEF.

7.2.4 Forest Survey of India (FSI)

FSI is an organization set up under MoEFCC. It was established in 1981 and is headquartered at Dehradun. FSI is responsible for **assessment and monitoring of the forest resources** of the country regularly. Indian State of Forest Report (ISFR) is a biennial publication of FSI.

7.2.5 Botanical and Zoological Survey of India

Botanical Survey of India (BSI) is an institution set up by the Government of India in 1890. The objective is to identify the plant resources of this country.

Zoological Survey of India (ZSI) is an institution set up by the Government of India in 1916 **to explore and research the fauna**. The history of ZSI goes back to Asiatic Society of Bengal founded by Sir William Jones in 1784. It is the mother of institutions like Indian Museum, ZSI and Geological Survey of India.

BSI and ZSI are **headquartered at Kolkata** and comes under the jurisdiction of MoEFCC.

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7.2.6 Central Ground Water Authority (CGWA)

CGWA was constituted under Environment (Protection) Act, 1986. However, it is not a statutory body. CGWA has the mandate of regulating groundwater development and management in the country.

India is the largest user of groundwater in the world which in turn has led to overexploitation. Hence, CGWA has notified **guidelines for groundwater extraction**:

1. **For industries**
    a. Introduction of Water Conservation Fee (WCF).
    b. Mandatory requirement of digital flow meter, piezometers.
    c. Mandatory water audit by specified industries extracting groundwater.
    d. Mandatory roof top rainwater harvesting except for specified industries.

Exemptions from requirement of NOC have been granted to sectors like agricultural users, users employing non-energized means to extract water, individual households using less than 1 inch diameter delivery pipe and armed forces during operational deployment.

7.2.7 Central Water Commission (CWC)

CWC is a premier technical organization of India in the field of water resources and is presently functioning as an **attached office** of the Ministry of Water Resources, River Development and Ganga Rejuvenation.

The Commission is entrusted with the general responsibilities of initiating, coordinating and furthering in consultation of the State Governments concerned, schemes for control, conservation and utilization of water resources throughout the country, for the purpose of flood control, irrigation, navigation, drinking water supply and water power development. It also undertakes the investigations, construction and execution of any such schemes as required.

7.2.8 Animal Welfare Board of India

The Animal Welfare Board of India was established in 1962 under The Prevention of Cruelty to Animals Act. It is a statutory advisory body on animal welfare laws which promotes animal welfare in the country.

It works to ensure that animal welfare laws are followed in the country and provides grants to Animal Welfare Organizations. The Board comes under the jurisdiction of Ministry of Fisheries, Animal Husbandry and Dairying and is headquartered at Ballabhgarh in Haryana.

7.2.9 Central Zoo Authority

Central Zoo Authority has been constituted under the Wildlife Protection Act and is responsible for the oversight of zoos. Every zoo in the country is required to obtain the recognition from the authority for its operation.

Powers of the authority include:

1. Recognize and derecognize zoos.
2. Permission for acquisition of wild animals.
3. Cognizance of offences.
4. Grants of licenses, certificate of ownership, recognition etc.

Central Zoo also provides technical and financial assistance to such zoos which have the potential to attain the desired standard in animal management.

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7.2.10 National Biodiversity Authority

National Biodiversity Authority (NBA) was established in 2003 to implement India's **Biological Diversity Act (BDA)**. It is a statutory, autonomous body and it performs regulatory and advisory functions for the Government of India on issues of conservation, sustainable use of biological resources and fair and equitable sharing of benefits arising out of the use of biological resources.

NBA checks biopiracy and protects the indigenous and traditional genetic resources. Anybody seeking any kind of IPR (Intellectual Property Rights) on a research based upon biological resource or knowledge obtained from India requires prior approval of NBA. No person who has been granted approval, shall transfer any biological resource or knowledge associated to others except with the prior permission of the NBA.

The **State Biodiversity Boards (SSBs)** also regulate, by granting approvals or otherwise requests for commercial utilization or bio-survey and bio-utilization of any biological resource by Indians.

7.2.11 Wildlife Crime Control Bureau (WCCB)

Wildlife Crime Control Bureau (WCCB) is a statutory multi-disciplinary body established by the Government of India under MoEFCC, to combat organized wildlife crime in the country. The Bureau has its headquarters in New Delhi and five regional offices at Delhi, Kolkata, Mumbai, Chennai and Jabalpur.

It is mandated to collect and collate intelligence related to wildlife crimes, establish a centralized wildlife crime data bank, coordinate with foreign authorities for wildlife crime control and assist the governments in wildlife policy making.

WCCB also assists and advises the customs authorities in inspection of the consignments of flora and fauna as per the provisions of Wildlife Protection Act, CITES and Export Import (EXIM) Policy governing such an item.

7.2.12 Wildlife Trust of India (WTI)

It is an NGO founded in 1998 with the aim of conserving nature, especially endangered species and threatened habitats, in partnership with communities and governments.

The WTI is committed to the protection of India's wildlife and it achieves this by working in partnership with the local communities and governments.

7.2.13 National Board for Wildlife

National Board of Wildlife (NBWL) is a "statutory organization" constituted under Wildlife Protection Act 1972. It is chaired by Indian Prime Minister.

It advises the Central Government on framing policies and measures for wildlife conservation. No alteration of boundaries in national parks and wildlife sanctuaries can be done without its approval.

7.3 Other Government Initiatives

Ganga Conservation measures:

1. **National Ganga Council** under the chairmanship of the Prime Minister replaced the erstwhile National Ganga River Basin Authority.
2. Empowered Task Force on river Ganga was set up under the chairmanship of Union Minister of Water Resources, River Development and Ganga Rejuvenation.
3. **National Mission for Clean Ganga (NMCG)** will have a two-tier structure with a Governing

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Council and an Executive Committee.
    a. The NMCG will exercise powers under The Environment Protection Act. It can also fine polluters. However, NMCG will only take action in case of non-compliance if CPCB does not do so.
4. Namami Ganga Programme is an integrated conservation mission under NMCG with a budget outlay of 20,000 crore to accomplish the twin objectives of effective abatement of pollution along with conservation and rejuvenation of Ganga. Initiatives under Namami Ganga include:
    a. Ganga Gram Yojana under which 1600 villages situated along the banks of river Ganga will be developed.
    b. Ganga Task Force will be created.
5. Swachh Yug Campaign has been launched to make villages located along Ganga open defecation free.
6. The Uttarakhand High Court declared Ganga as a 'living entity', meaning that it will enjoy all the rights, duties and liabilities of a 'living person'. The move by the High Court is a step towards generating awareness on the increasing issue of water pollution. It is for the first time in India that a natural element has been declared a legal person. However, the concept of nature having legal rights in not new and is already being practiced in countries like Ecuador and New Zealand.

The **Green Skill Development Programme (GSDP)** of the MoEFCC is an initiative for skill development in the environment and forest sector to enable India's youth to get gainful employment and/or self-employment.

All courses are National Skills Qualifications Framework (NSQF) Compliant.

Environmental Information system (ENVIS) is a Central Sector Scheme being implemented by MoEFCC since 1982-83.

The focus of ENVIS since inception has been on providing environmental information to decision makers, policy planners, scientists and engineers, research workers etc.

Green Good Deeds Campaign launched by MoEFCC is a social movement to protect the environment and promote healthy living.

National Bamboo Mission (NBM) will be a sub-scheme of **National Mission on Sustainable Agriculture (NMSA)** under the umbrella scheme **Krishonnati Yojana**. The Mission envisages promoting holistic growth of bamboo sector by adopting area-based, regionally differentiated strategy and to increase the area under bamboo cultivation and marketing.

7.4 Miscellaneous

Lighting a Billion Lives (LABL) is a campaign by TERI to promote the use of solar lanterns which are specially designed and manufactured on a decentralized basis.

Urban Services Environmental Rating System (USERS) is a project funded by UNDP, executed by MoEFCC and implemented by TERI. It is aimed at improving basic services like water supply and sewerage.

Eco-mark is a certification mark issued by Bureau of Indian Standards to products conforming to a set of standards aimed at the least impact on the ecosystem.

The **Indo-French Centre for Promotion of Advanced Research (CEFIPRA)** launched a multi-disciplinary Indo-French research project titled "Adaptation of Irrigated Agriculture for Climate Change (AICHA)." It aims at developing an integrated model for analyzing the impact of climate change on ground water-irrigated agriculture in South India.

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Forest (Conservation) Act, 1980 was enacted to counter India's rapid deforestation and resulting environmental degradation. Under the provisions of this Act, prior approval of the Central Government is required for diversion of forestlands for non-forestry purposes.

Critical Wildlife Habitats (CWH) are envisaged under Forest Rights Act (FRA), 2006. They are defined under the Act as "areas of national parks and sanctuaries that are to be kept as inviolate for the purposes of wildlife conservation."

While Ministry of Tribal Affairs is the implementing authority for FRA, the Act identifies MoEFCC as the agency to notify the guidelines. Baiga tribe of Madhya Pradesh became the first to get habitat rights under the Act.

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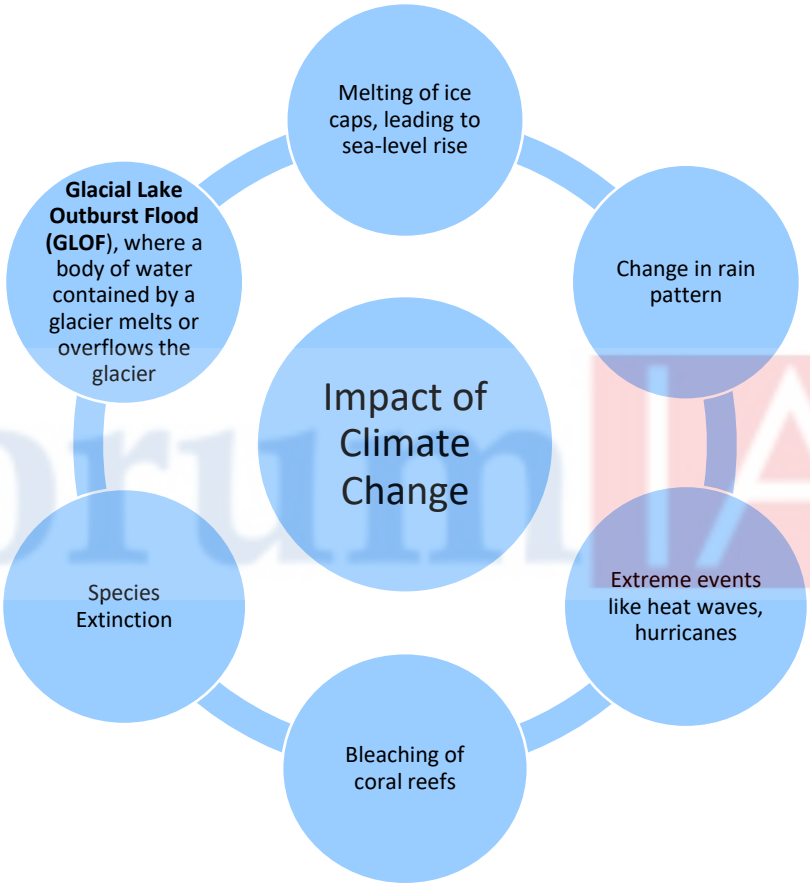
CHAPTER 8

CLIMATE CHANGE

'Climate change' represents a change in the long-term weather patterns. Intergovernmental Panel on Climate Change (IPCC) recently in its report stated that climate change is real and anthropogenic factors are its main cause.

8.1 Global Warming

Global Warming is a gradual heating of the earth's surface, oceans and atmosphere. The increase in temperature is often a result of the Greenhouse Effect caused by increased levels of gases like Carbon Dioxide, CFCs and other pollutants. As per IPCC report, the world is 1.2°C warmer than pre-industrial levels.



Greenhouse Effect involves following steps:

1. High energy **short wavelength** solar radiation reaches the earth's atmosphere.
2. About 30% of the sun's energy is reflected directly back into the space by the atmosphere, clouds and surface of the earth. The rest of the energy is absorbed into the earth's system.
3. The Earth re-emits energy in the form of infrared radiation back into the atmosphere, at wavelengths longer than incoming solar energy.
4. Greenhouse gases in the atmosphere like **Water Vapor, Carbon Dioxide, Methane, Nitrous Oxide, Fluorinated Gases like HFCs and SF_6, Black Carbon and Brown Carbon**, absorb much of the **long wave energy (infrared radiation)** emitted from the earth's surface. Thus, these gases prevent the energy from escaping the earth's surface, leading to warming of the atmosphere.

The term '**Carbon Fertilization**' is often used in the context of Greenhouse Gas emissions, which

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means high rate of plant growth due to increased concentration of CO_2 in the atmosphere.
A **heat budget** is the balance between incoming heat absorbed by the earth and the outgoing heat escaping it in the form of radiation. If the balance is disturbed, the earth would get progressively warmer or cooler with each passing year.

Human activities like deforestation, vehicular emissions have disturbed the heat budget. Greenhouse gas emissions have increased exponentially thus trapping more of the energy emitted by the earth due to greenhouse effect. This in turn has resulted in the earth's temperature to increase leading to Global Warming.

Fighting global warming is a challenge as we do not have appropriate alternative technologies. Also, developing countries like India lacks funds to spend on climate-related research and technology development.

Black Carbon, commonly known as soot, is a solid particle or aerosol produced from incomplete combustion. It is released from biomass burning, cooking with solid fuels, vehicular emissions etc.

Black Carbon warms the earth by absorbing heat in the atmosphere and reducing albedo when deposited on snow. This is turn accelerates the melting of glaciers. Further, it also disrupts precipitation patterns.

Black Carbon is a **Short-Lived Climate Pollutant (SLCP)**.

Brown Carbon is brown smoke released by the combustion of organic matter. It co-exists with Black Carbon when released in the atmosphere.

Black Carbon is primarily released by high temperature combustion (diesel engines etc.) and Brown Carbon is mainly released by biomass combustion.

Fluorinated Gases like HFCs, PFCs, SF_6 are emitted through a variety of industrial processes like aluminum and semi-conductor manufacturing, substitution for ozone depleting substances, electrical transmission equipment etc.

Fluorinated Gases have **much longer lifetime** compared to gases like Methane and Nitrous Oxide in the following order: SF_6/PFCs>HFCs>Nitrous Oxide>CO_2>CH_4

Nitrous Oxide is naturally present in the atmosphere as a part of earth's Nitrogen Cycle. Natural sources include bacteria breaking down nitrogen in soils while human induced factors include agriculture, transportation and industry (fertilizers industry and in the production of adipic acid used to make fibers like nylon).

Poultry industry also releases active nitrogen compounds into atmosphere.

Methane is emitted from natural sources like wetlands as well as human activities like agriculture (anaerobic conditions associated with rice cultivation), livestock, industry and wastes from home. It is much more harmful GHG than CO_2.

Global Warming Potential (GWP) for a gas is a measure of the total energy that a gas absorbs over a period of time, compared to carbon dioxide. Gases with high GWP absorbs more energy than gases with lower GWP, thus contributing more to warming earth.

GHG	GWP for 100 years
CO_2	1
CH_4	23
N_2O	296
HFC – 23	12000
HFC – 134a	1300
SF_6	22200

Mankind's over-exploitation/misuse of natural resources, fragmentation/loss of natural habitats, destruction of ecosystems, pollution and global climate change is leading us towards the "**sixth mass extinction**" at a much faster pace than before.

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8.2 Ocean Acidification

Ocean Acidification is called the "evil twin of global warming" and "the other CO_2 problem". It refers to the ongoing decrease in the pH of the earth's oceans, caused by the uptake of CO_2 from the atmosphere.

Other **contributors to ocean acidification** are:

1. Acid Rain can lower the pH of the oceans.
2. Eutrophication leads to large plankton blooms and when these blooms collapse and sink to the bottom of the oceans, the subsequent respiration of bacteria decomposing the algae leads to a decrease in sea water oxygen and increase in CO_2 (a decline in pH).

Impacts of ocean acidification are as follows:

1. Increase in acidity depresses metabolic rates and immune response in some organisms.
2. Survival of some animals having phytoplanktonic larvae will be adversely affected.
3. Increased acidity leads to coral bleaching.
4. As the pH of the ocean declines, the concentration of Carbonate ions decreases. This makes it more difficult for marine calcifying organisms like corals and some plankton to form biogenic calcium carbonate.
5. Commercial fishing is threatened because acidification harms calcifying organisms which form the base of marine food webs.
6. Cloud Seeding and formation of clouds will also be adversely affected.

Artificial Cloud Seeding is the process of spreading either dry or more commonly, silver iodide aerosols, into the upper parts of the clouds to stimulate the precipitation process and form rain.

8.3 Ozone Depletion

Ozone is a natural gas and an allotrope of oxygen consisting of three atoms of oxygen bound together. Ozone is found in two different layers of atmosphere; Ozone in the troposphere is bad as it leads to smog formation while stratospheric ozone is good because it protects the life on earth from the harmful UV rays of the sun.

Impacts of Ozone Depletion:

1. Due to Ozone depletion, more and more UV rays are able to reach Earth. These harmful rays can cause cataracts, skin cancer and impaired immune systems.
2. UV rays can also damage sensitive crops, such as soyabeans and reduce crop yields. This in turn can impact food supplies.
3. Marine phytoplanktons, which are at the base of the ocean food chain, are also under stress from UV radiation and their productivity is declining.

Sources of Ozone depletion include:

1. **Chlorofluorocarbons (CFCs)**: These are used as refrigerants, propellants in aerosol sprays, foaming agents in plastic manufacturing, fire extinguisher agents, solvents for cleaning electronic components, for freezing foods etc.

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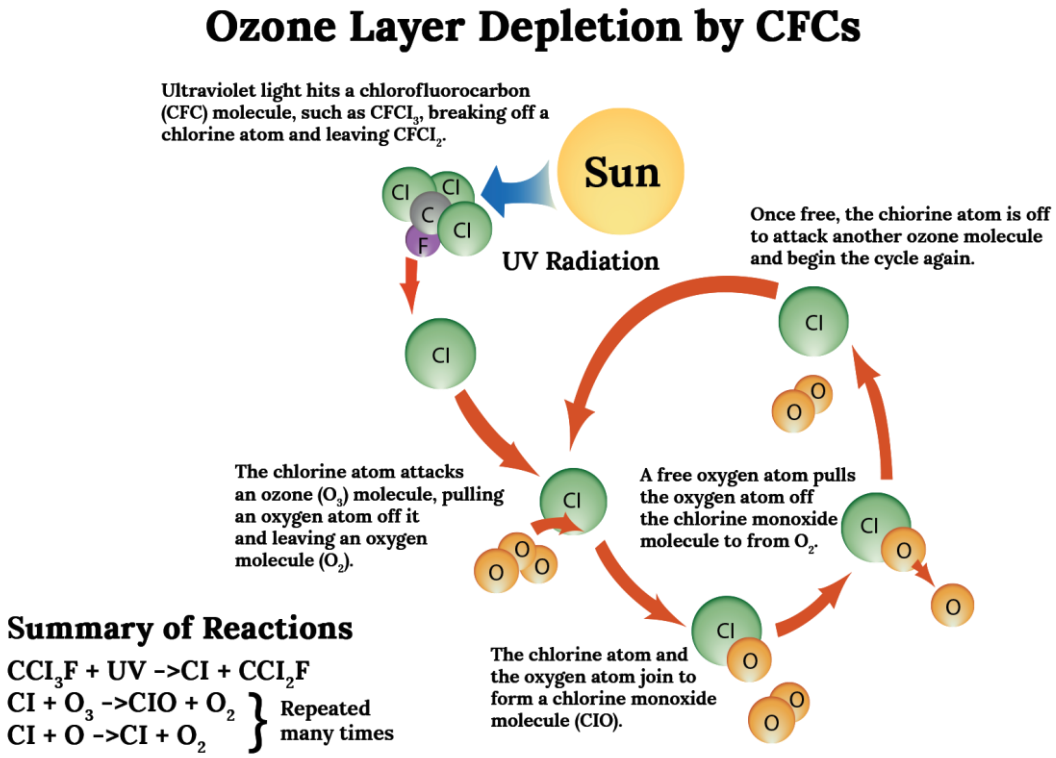
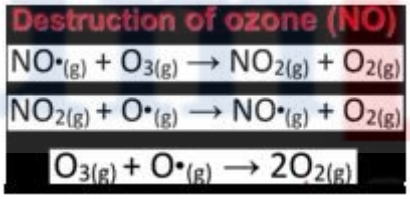


2. **Nitrogen Oxides**: The source of Nitrogen Oxides are mainly explosions of thermonuclear weapons, industrial emissions and agricultural fertilizers.



3. Other substances like **Bromine containing compounds** called halons (used in fire extinguisher), HBFCs (Hydrobromofluorocarbons) and Methyl Bromide (used as pesticide/fumigant) also destroy Ozone. Each Bromine atom destroys hundred times more Ozone molecules than what a Chlorine atom does.
4. **Polar Stratospheric Clouds (PSCs): These are nacreous clouds containing water, nitric acid and/or sulphuric acid. They are formed mainly during the event of polar vortex in winter and are more intense at the South Pole/Antarctica. PSCs are a source of Ozone depletion because they support chemical reactions that produce active Chlorine which catalyses Ozone depletion**.

Ozone depletion is more over Antarctica than Arctic because the very low winter temperatures in the Antarctica Stratosphere cause Polar Stratospheric Clouds (PSCs) to form.

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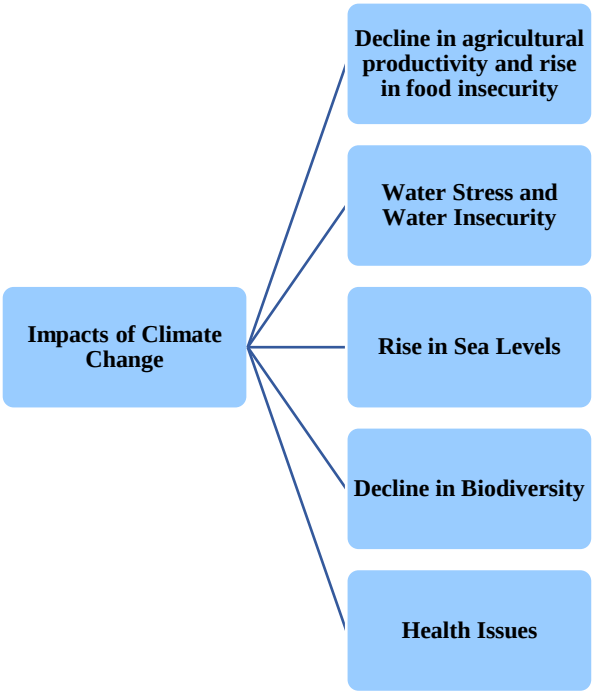

8.4 Climate Change Mitigation Strategies

8.4.1 Carbon Capture and Storage

Carbon Capture and Storage is the process of capturing waste carbon dioxide, transporting it to a storage site, and storing it where it will not enter the atmosphere. Captured CO_2 is stored into

1. **Artificial Sinks**: Depleted oil and gas reservoirs, coalbeds, deep saline aquifers and underground mines.
2. **Natural Sinks**: Oceans, forests, soil etc.

8.4.2 Carbon Sink

A Carbon Sink is any natural or artificial reservoir that absorbs and stores some carbon-containing chemical compound for an indefinite period, thus lowering the concentration of CO_2 in the atmosphere.

Carbon Sinks include:

1. **Blue Carbon**: It refers to coastal, aquatic and marine carbon sinks like tidal marshes, mangroves and seagrasses. These ecosystems are found all over the continent except Antarctica.
2. **Green Carbon**: It refers to the Carbon removed by photosynthesis and stored in the plants and soil of natural ecosystems.

Blue Carbon Initiative is an international cooperation between Conservation International (CI), IUCN and the Intergovernmental Oceanic Commission (IOC) of UNESCO focused on mitigating climate change through the conservation and restoration of coastal marine ecosystems.

8.4.3 Carbon Credit

A Carbon Credit is a tradeable certificate or permit representing the right to emit one tonne of Carbon or Carbon Dioxide equivalent (tCO_{2e}). The value of Carbon Credit varies according to market

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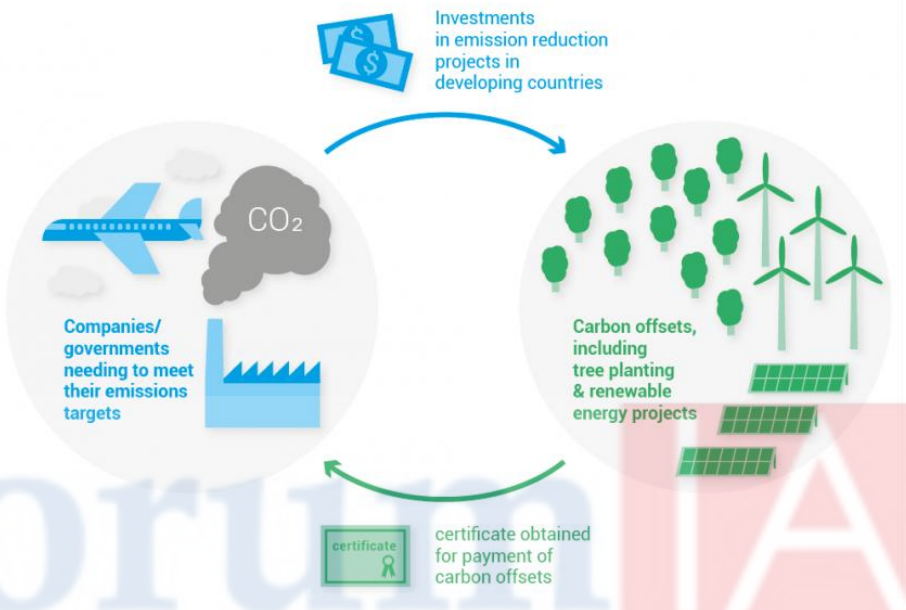
conditions. One Carbon Credit is equal to one tonne of Carbon Dioxide. The concept of Carbon Credit originated in the Kyoto Protocol of UNFCCC.

An organization which produces one tonne less of Carbon or Carbon Dioxide equivalent than the standard level of Carbon Emissions allowed for its outfit or activity earns a Carbon Credit. Developing Countries like India and China are emerging as the biggest sellers of Carbon Credit.

8.4.4 Carbon Offsetting

Carbon Offsets 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. Carbon Offsets are sold in metric tonnes of Carbon Dioxide equivalent.



8.4.5 Carbon Pricing

A Carbon Price is the cost applied to carbon pollution to encourage polluters to reduce the amount of greenhouse gases they emit into the atmosphere. There are two major types of Carbon Pricing:

1. **Carbon Tax**: It is a fee imposed on the burning of carbon-based fuels (coal, oil, gas etc.). Carbon Taxes intend to reduce Carbon Dioxide emissions by increasing the price of fossil fuels and reducing their demand. Carbon Tax is highly beneficial due to its predictability, easier to implement, understandable, lack of manipulation and option of rebates.
2. **Emission Trading System (ETS)**: ETS, also known as "cap and trade" system, caps the total level of Green House Gases (GHGs) and allows those industries with low emissions to sell their extra allowances to large emitters.

Other **mechanisms to price the Carbon Emissions**:

1. **Results Based Climate Finance (RBCF)**: It is a funding approach where payments are made after pre-defined outcomes related to managing climate change, such as emission reductions, are delivered and verified.
2. **Internal Carbon Pricing**: It is a tool an organization uses to internally guide its decision-making process in relation to climate change impacts, risks and opportunities.

Carbon Pricing Leadership Coalition (CPLC) is a voluntary initiative of 34 national and sub-national governments, over 163 businesses from a range of sectors and regions and over 82 strategic partners representing civil society organizations, NGOs and academic institutions etc.

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The CPLC Secretariat is administered by the World Bank Group. From India, Delhi Metro Rail Corporation and Indian Railways are the government level partners.

Climate and Clean Air Coalition (CCAC) to Reduce Short Lived Climate Pollutants (like Methane, Black Carbons and HFCs) is a voluntary partnership of governments, intergovernmental organizations, businesses etc. committed to reduce short lived pollutants with over 120 state and non-state partners. It was initiated in 2012 by governments on Bangladesh, Canada, Ghana, Mexico, Sweden and USA (no India) along with UNEP.

BioCarbon Fund Initiative for Sustainable forest Landscapes (ISFL) is a multilateral fund, supported by donor governments and managed by the World Bank. It promotes and rewards reduced greenhouse gas emissions and increased carbon sequestration.

Global Climate Change Alliance (GCCA) is a European Union Initiative which helps mainly Small Islands Developing States (SIDS) and Least Developed Countries (LDCs) increase their resilience to climate change.

8.4.6 Geo-engineering

Climate geo-engineering refers to large scale schemes for intervention in the earth's oceans, soils and the atmosphere with the aim of reducing the effects of climate change, usually temporarily.

Examples of Geo-engineering include:

1. **Copying a volcano**: A volcanic eruption releases sulphur into the atmosphere, which in turn could block sun's radiation and cool the earth.
2. **Shooting mirrors into space**: This would deflect sunlight, thus reducing temperature.
3. **Seeding the sea with iron**: It will stimulate the growth of phytoplankton as they prefer iron. Phytoplanktons will then pull CO_2 out of the atmosphere through photosynthesis.
4. **Whitening the clouds**: These clouds will then reflect the solar radiation and cool the earth.
5. **Cirrus Cloud Thinning** and **injection of Sulphate aerosol particles** which are good reflectors of sunlight.
6. **Building fake trees**: Artificial trees essentially would be a series of sticky, resin-covered filters that would convert captured CO_2 to a carbonate called soda ash. Periodically, the soda ash would be washed off of the filters and collected for storage.

8.5 India and Climate Change

India's per capita GHG emissions is less than one-third of the world's per capita emissions and far below many developing and developed countries. As per 2nd India's Biennial Update Report to UNFCCC, out of the total emissions, energy sector accounted for 73%, agriculture 16%, Industrial Processes and Product Use (IPPU) 8% and waste sector 3%. Also, about 12% of the emissions were offset by carbon sink of forestland, cropland and settlements.

India has proposed the following targets under **Intended Nationally Determined Contributions (INDC)**:

1. Reduce emissions intensity of its GDP by 33 to 35% by 2030 from 2005 level.
2. Achieve about 40% electric power installed capacity from non-fossil fuel-based energy resources by 2030.
3. Create an additional carbon of 2.5 to 3 billion tonnes of CO_2 equivalent through additional forest and tree cover by 2030.

INDC are non-binding national plans highlighting climate measures governments aims to implement in response to climate change and as a contribution to achieve the global targets set out in the Paris Agreement of UNFCCC.

Countries party to the UNFCCC were asked to publish their INDC at the 2013 United Nations Climate Change Conference held in Warsaw, Poland in 2013.

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Some of the observed climate and weather changes in India include rising surface temperature, changing precipitation patterns and extreme weather events like heat waves, droughts and floods. Further, there has been an increase in Himalayan glacial melting leading to rise in sea level.

The '**Hindukush Himalayan Assessment**' report has been released by Kathmandu based intergovernmental body, International Centre for Integrated Mountain Development (ICIMOD). As per the report, two third of Himalayan Glaciers, the world's Third Pole", could melt by 2030 if global emissions are not reduced.

8.5.1 National Action Plan on Climate Change (NAPCC)

To counter the emerging threats from climate change, India released its National Action Plan to Combat Climate Change (NAPCC).

8.5.1.1 National Solar Mission

Objective of the mission is to establish India as a global leader in solar energy by creating the policy conditions for its deployment across the country. Mission had set a target of deploying 20,000 MW of grid connected solar power by 2022, which has been revised to 1,00,000 MW in 2015.
The target will principally comprise of 40 GW Rooftop Solar Power Projects and 60 GW through Large and Medium Scale Grid Connected Solar Power Projects.

The mission adopted a 3-phase approach:

1. Phase 1 (2012-13)
2. Phase 2 (2013-17)
3. Phase 3 (2017-22)

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8.5.1.2 National Water Mission

The Mission has the following goals:

1. Increasing the water use efficiency by 20%.
2. Promotion of basin level integrated water resources management.
3. Creation of a comprehensive water data base in public domain and assessment of the impact of climate change on water resources.
4. Special attention to vulnerable and over-exploited areas.
5. Involving citizens and the state for water conservation and preservation.

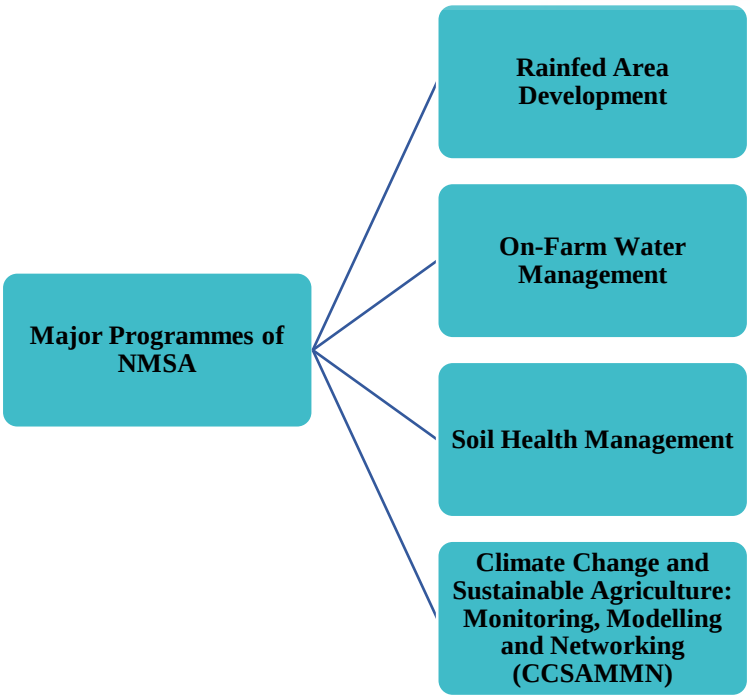
8.5.1.3 National Mission for a Green India

Objectives of the Mission include:

1. **Increased** forest/tree cover on 5 million hectares (ha) of forest/non-forest lands and improved quality of forest cover on another 5 million hectares (ha) of non-forest/forest lands (a total of 10 million).
2. **Improved** ecosystem services including biodiversity, hydrological services and carbon sequestration from the 10 million ha of forest/non-forest lands mentioned above.
3. **Increased** forest-based livelihood income of about 3 million households living in and around forests.
4. **Enhance** annual CO_2 sequestration by 50 to 60 million tonnes in the year 2020.

8.5.1.4 National Mission for Sustainable Agriculture (NMSA)

The Mission aims at promoting sustainable agriculture through a series of adaptation measures focussing on ten key dimensions encompassing the Indian agriculture, mainly: 'Improved crop seeds, livestock and fish cultures', Water Use Efficiency', 'Pest Management', 'Improved Farm Practices', 'Nutrient Management', 'Agricultural Insurance', 'Credit Support', 'Markets', 'Access to Information' and 'Livelihood diversification'.



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8.5.1.5 National Mission on Strategic Knowledge for Climate Change

Objectives of Mission include:

1. Funding of high quality and focussed research into various aspects of climate change.
2. Measuring socio-economic impacts of climate change including impact on health, demography, migration patterns and livelihoods of coastal communities.
3. Supporting the establishment of dedicated climate change related academic units in universities and other academic and scientific research institutions in the country which would be networked.
4. Establishing Climate Science Research Fund.

8.5.1.6 National Mission for Sustaining the Himalayan Ecosystem

1. It is a multi-pronged, cross-cutting mission across various sectors. It contributes to the sustainable development of the country by enhancing the understanding of climate change, its likely impacts and adaptation actions required for the Himalayas- a region on which a significant proportion of India's population depends for sustenance.
2. It seeks to facilitate formulation of appropriate policy measures and time-bound action programmes to sustain ecological resilience and ensure the continued provisions of key ecosystem services in the Himalayas. It intends to evolve suitable management and policy measures for sustaining and safeguarding the Himalayan ecosystem along with developing capacities at the national level to continuously assess its health status.
3. Recognizing the importance of scientific and technological inputs required for sustaining the fragile Himalayan Ecosystem, the Ministry of Science and Technology has been given the nodal responsibility of coordinating this mission. However, the mission involves valuable cooperation of Indian Himalayan States and the MoEFCC.

8.5.1.7 National Mission on Sustainable Habitat

The Mission seeks 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.

The Mission will promote energy efficiency as an integral component of urban planning and urban renewal through three initiatives:

1. The Energy Conservation Building Code
2. Recycling of Material and Urban Waste Management
3. Better Urban Planning and Modal Shift to Urban Transport

It aims to address the need to adapt to future climate change by improving the resilience of infrastructure, community-based disaster management and measures or improving the warning system for extreme weather events. Capacity building would be an important component of the mission.

8.5.1.8 National Mission for Enhanced Energy Efficiency (NMEEE)

NMEEE aims to strengthen the market for energy efficiency through implementation of innovative business models in the energy sector. NMEEE consists of four initiatives to enhance energy efficiency in energy intensive industries which are as follows:

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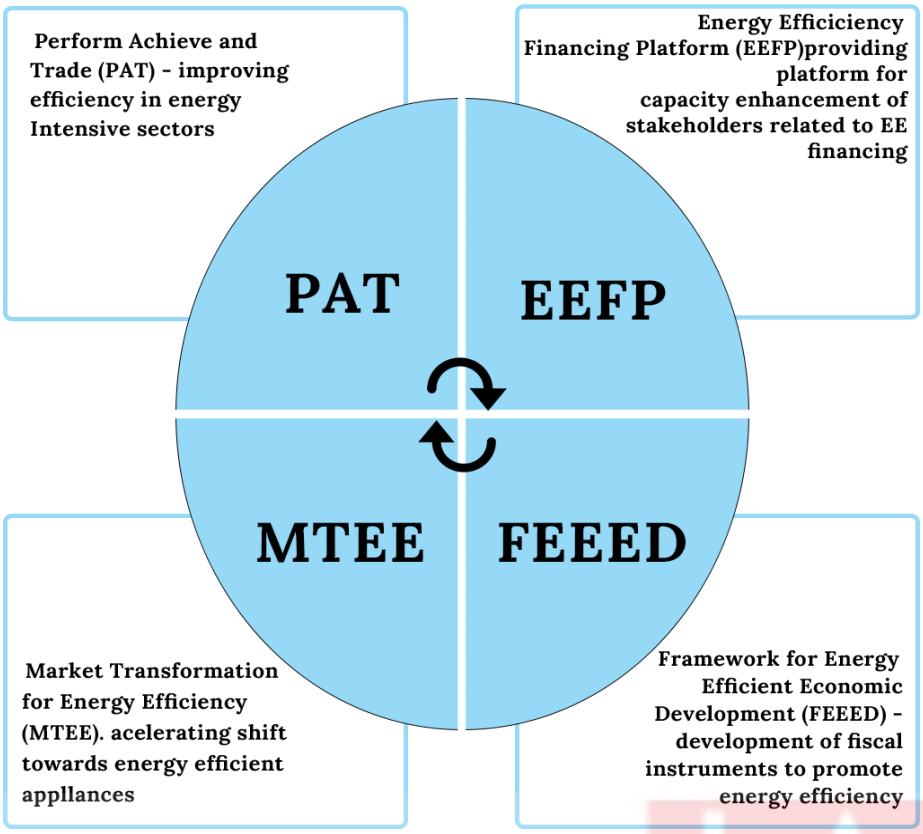

8.5.2 Indian Network on Climate Change Assessment (INCCA)

INCCA was launched in October 2009 by the MoEFCC in an effort to promote domestic research on climate change, and build on country's climate change expertise. Reports prepared by the INCCA will form a part of India's National Communication (NATCOM) to the UNFCCC.

India's initial **NATCOM** to the UNFCCC has been initiated in 2002 funded by the Global Environment Facility (GEF) under its enabling activities programme through the United Nations Development Programme, New Delhi

INCCA-Second Assessment '**Climate Change and India: A 4×4 Assessment**' examines the implications of the climate change scenario in 2030s using a regional climate model (PRECIS).

1. **4 Regions were assessed**: Western Ghats, Himalayan Region, Coastal India and North-East.
2. **4 thrust areas were focussed upon**: Agriculture, Water, Forests, Human Health.

Some of the possible impacts of climate change as analysed by the Assessment Report include warmer seasons, increased cyclonic disturbance, sea level rise and changed precipitation patterns.

8.5.3 Labelling Program for Appliances

Standards and Labelling Programme for appliances was launched in 2006 and comparative star-based labelling has been introduced by Bureau of Energy Efficiency (BEE). These star ratings are given out of 5 and they provide information regarding energy efficiency of a product.

1. Appliances requiring **mandatory energy labelling**: Frost-free refrigerator, Tubular Fluorescent Lamps, Room Air-Conditioners, Distribution Transformer, Colour TV, CST AC, Direct Cool Refrigerator and Electric Geyser.

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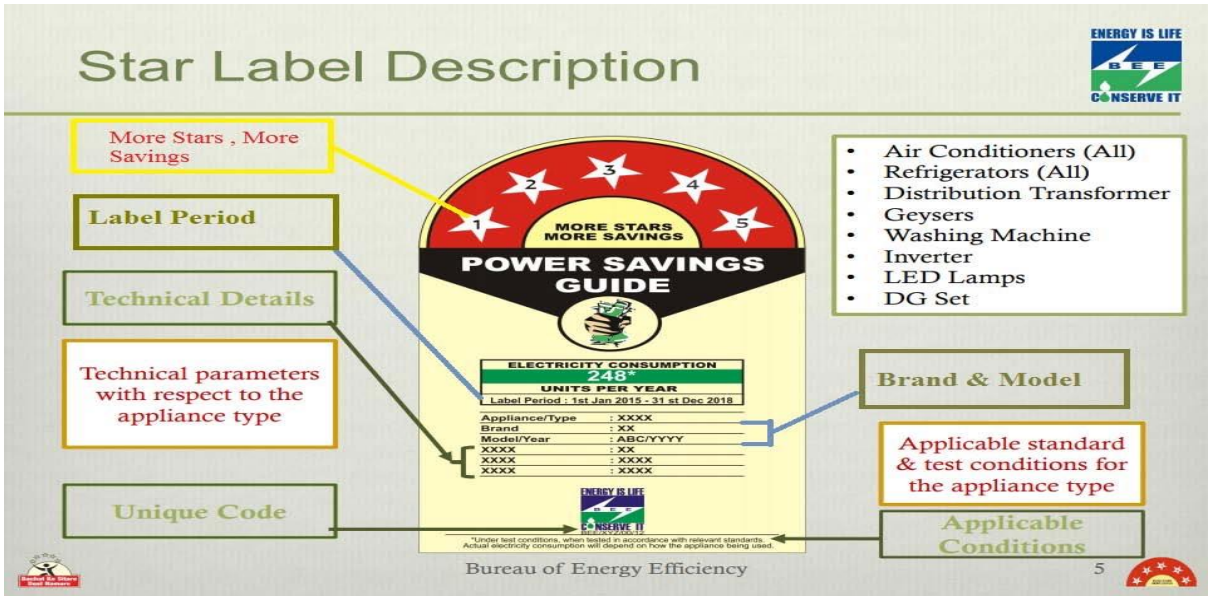

Bureau of Energy Efficiency (BEE) is a statutory body set up under the Energy Conservation Act, 2001.

It assists the government in developing policies and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act with the primary objective of reducing the energy intensity of the Indian economy.

8.5.4 Energy Conservation Building Code (ECBC)

An ECBC 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 the Code has been incorporated into the mandatory Environmental Impact Assessment requirements for large buildings. Building intended for private residential purposes only are not covered under the Code.

In March 2007, the conduct of energy audit was made mandatory in large energy-consuming units in nine industrial sectors.

Ministry of Power launched **ECO Niwas Samhita 2018**, an Energy Conservation Building Code for Residential Buildings (ECBC-R). However, it addresses only energy efficiency of buildings. Water and other aspects are not covered under it.

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Other initiatives that promote energy efficiency in buildings:

1. **LEED (Leadership in Energy and Environmental Design)** is a green building certification programme worldwide developed by non-profit US Green Building Council (USGBC).
2. **GRIHA (Green Rating for Integrated Habitat Assessment)** is a national rating system for Green Buildings developed by TERI.
3. **Indian Green Building Council (IGBC)**, a part of Confederation of Indian Industry (CII), developed the Green Building Rating System.
    a. IGBC also organizes the annual Green Building Congress, its flagship event on Green Buildings.
4. BEE along with Alliance for an Energy Efficient Economy (AEEE) recently released the '**State Energy Efficiency Index 2019**'. It tracks the progress of energy efficiency initiatives in States and UTs based on 97 significant indicators.
    a. BEE launched **UNNATEE (Unlocking National Energy Efficiency Potential)** in 2019 for accelerating energy efficiency in India.
5. **India Cooling Action Plan (ICAP)** was launched by MoEFCC.
    a. ICAP aims at reducing cooling demand across sectors by 20% to 25% by 2037-38 and cooling energy requirements by 25% to 40% within the same time period.

8.5.5 Electric Vehicles

To promote Electric Vehicles in India, Government launched the following initiatives:

1. India's **Electric Vehicle Mission 2030** aims to have all-electric fleet of vehicles by 2030.
2. **National Electric Mobility Mission:**
    a. It aims to have national fuel security by promoting hybrid and electric vehicles in the country.
    b. It targets 6-7 million sales of hybrid and electric vehicles year on year from 2020 onwards.
3. **FAME India (Faster Adoption and Manufacturing of (hybrid &) Electric Vehicles in India) Scheme:**
    a. It is a part of National Electric Mobility Mission Plan and has been launched by Department of Heavy Industries, the Ministry of Heavy Industries and Public Enterprises.
    b. The Scheme has four focus areas: technology development, demand creation, pilot projects and charging infrastructure.
4. **Automotive Mission Plan 2026** aims at bringing Indian Automotive Industry among the top three of the worlds in engineering, manufacturing and exports of vehicles and components, growing in value to over 12% of India's GDP and generating additional 65 million jobs.

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Recently, Government of India launched **FAME India Phase II**. It will be implemented over a period of 3 years from 2019-20 to 2021-22. The main objective of the scheme is to encourage faster adoption of electric and hybrid vehicle by the way of market creation and indigenization. FAME Phase II aims to achieve the target of more than 30% electric vehicles by 2030.

Government released **charging infrastructure guidelines** for electric vehicles. Its major provisions are:

1. Promoting **private participation** in charging infrastructure.
2. **No license** will be required for setting up a public charging station by an individual or entity.
3. It will be rolled out in **two phases**:
    a. Phase I (1-3 years) will cover all megacities with population above forty lakhs and the associated expressways and highways.
    b. Phase II (3-5 years) will cover state and UTs.
4. **Central or State Electricity Regulatory Commissions** will determine the tariff for supply of electricity to the public charging stations.
5. Charging stations have been allowed to source electricity from any power generation company through **open access**.

8.5.6 National Initiative on Climate Resilient Agriculture (NICRA)

The ICAR has launched NICRA during 2010-11 with an outlay of 350 crores. The initiative will primarily enhance the resilience of Indian Agriculture covering crops, livestock and fisheries.

The initiative will involve strategic research on adaptation and mitigation. Accordingly, sponsored and critical research grants will be provided to fill the critical research gaps.

Protection of Plant Varieties and Farmer Rights Act (PPV&FR) 2001 aims at an effective system for IPR protection of plants varieties and rights of breeders, including farmers. The protection period is 15 years and 18 years in case of trees and vines.

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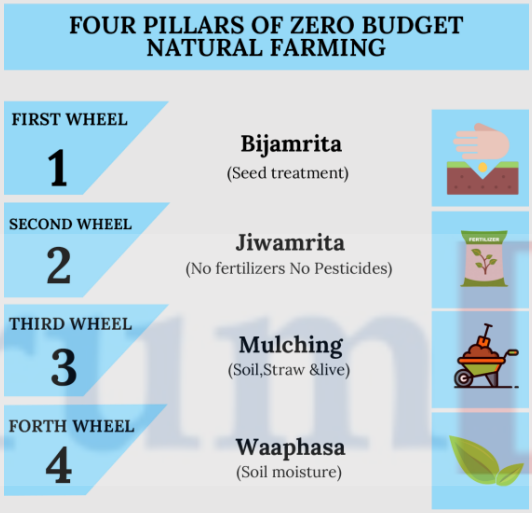
Objectives of the Act are:

1. To recognize and protect the rights of farmers in respect of the contributions made by them at any time in conserving, improving and making available plant genetic resources for the development of new plant varieties.
2. To accelerate agricultural development in the country, protect plants breeders' rights, stimulate investment for research and development in both public and private sector or the development of new plant varieties.
3. Facilitate the growth of seed industry in the country.

A farmer is entitled to save, use, sow, resow, exchange, share or sell his farm produce including seed or variety protected under PPV&FR Act 2001 **without the brand name**.

Zero Budget Natural Farming (ZBNF) is a natural farming developed by Subhash Palekar. It is a type of farming in which there is no use of chemical pesticides and agriculture is carried out in an eco-friendly manner. This helps in restoring soil fertility and organic matter. ZBNF reduces the cost of production down to zero due to utilization of all the natural resources available in and around the crops.



The **International Treaty on Plant Genetic Resources for Food and Agriculture**, also known as **Seed Treaty**, aims at guaranteeing food security through conservation, exchange and sustainable use of world's plant genetic resources for food and agriculture. It was adopted by the 31st session of the Conference of Food and Agricultural Organization (FAO) of the UN in 2001.

Climate-Smart Agriculture involves farming practices that improve farm productivity and profitability, help farmers to adapt to the negative effects of climate change and mitigate climate change effects.

Global Alliance for Climate Smart Agriculture (GACSA) was launched in September 2014 as a multi-stakeholder platform on Climate Smart Agriculture. India though a signatory of the alliance was not involved in its creation.

Examples of Climate Smart Agriculture include:

1. Increasing the organic content of soil through conservation tillage.
2. Engaging in **Conservation Agriculture** like adopting minimum tillage, using crop residues to cover soil surface and adopting crop rotations.
3. Following a landscape approach in agriculture, like integrated planning of land.

Adaptation for Smallholder Agriculture Program is administered by the International Fund for Agricultural Development (IFAD). The Program aims to channel climate and environmental finance to small-holder farmers, scale up climate change adaptation in rural development programmes and mainstream climate adaptation into IFAD's work.

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Svalbard Global Seed Vault located in Norway is a state of art seed protection facility, famously called 'Doomsday' or the 'Apocalypse Seed Bank' or the 'Noah's Ark for Seeds'.

1. **India's Seed Vault** is located at Chang La, Ladakh. It has been built jointly by Defense Institute of High-Altitude Research (DIHAR) and the National Bureau of Plant Genetic Resources (NBPGR) under the aegis of DRDO.

8.5.7 National Adaptation Fund for Climate Change (NAFCC)

NAFCC is a Central Sector Scheme set up in 2015-16 with the aim to promote adaptation activities which mitigate the adverse effects of climate change.

The projects related to adaptation in sectors like agriculture, animal husbandry, forestry, tourism etc. are eligible for funding under NAFCC.

National Bank for Agriculture and Rural Development (NABARD) is the implementing agency for the scheme.

The **Clean Energy Cess (or Coal Cess)** was abolished in 2017 with the introduction of Goods and Service Tax. A new Cess on coal production, called the GST Compensation Cess of Rs 400 per tonne is put in place. The Cess is used to raise revenues for the National Clean Energy Fund.

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CHAPTER 9

INTERNATIONAL CONVENTIONS AND ORGANIZATIONS

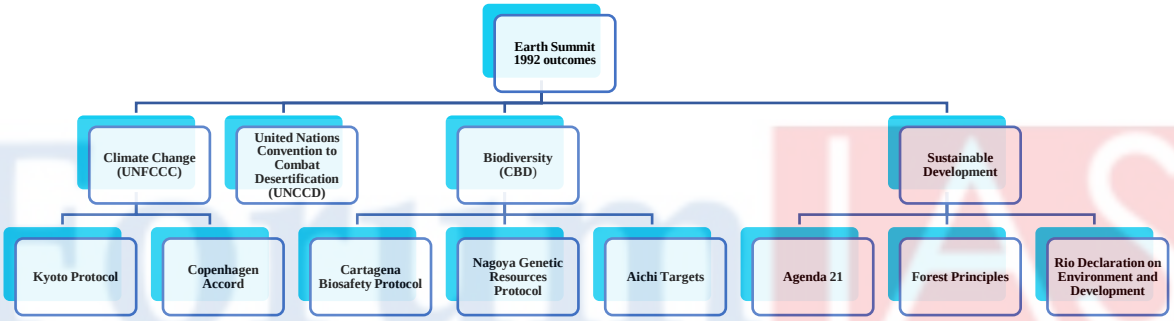
9.1 International Conventions

9.1.1 United Nations Conference on Environment and Development (UNCED)

United Nations Conference on Environment and Development (UNCED) is also known as the Rio Summit, Rio Conference or Earth Summit held in Rio de Janeiro in June 1992.

The issues addressed included:

1. Systematic scrutiny of patterns of production- primarily the production of toxic components, such as lead in gasoline, or poisonous wastes including radioactive chemicals.
2. Alternative sources of energy to replace the use of fossil fuels which are linked to global climate change.
3. New reliance on public transportation systems in order to reduce vehicle emissions, congestion in cities and health problems caused by polluted air and smog.
4. The growing scarcity of water.



Convention on Biological Diversity (CBD) and **United Nations Framework Convention on Climate Change (UNFCCC)** were the two legally binding agreements reached upon during the Earth Summit.

Agenda 21 is a non-binding action plan of the United Nations related to sustainable development. The number 21 signifies the agenda for the 21st Century. It aims to achieve global sustainable development.
Since 2015, Sustainable Development Goals are included in the Agenda 2030.

Forest Principle is a non-legally binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests.

It makes several recommendations for conservation and sustainable development forestry.

9.1.1.1 UNFCCC

UN Summit Conference on Environment and Development (UNCED) or **Earth Summit** 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.

As a follow-up, the **World Summit on Sustainable Development (Rio +10)** was held in 2002 in Johannesburg, South Africa. In 2012, the **United Conference on Sustainable Development (Rio+20)** was held in Rio and is commonly known as Rio Earth Summit 2012.

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UNFCCC provides a framework for negotiation of specific international treaties (called "protocols") that aim to set binding limit on emission of Green House Gases (GHGs). As of March 2019, UNFCCC has 197 parties.

9.1.1.2 Convention on Biological Diversity (CBD)

CBD is an international legally binding convention which recognized for the first time, the need for conservation of biological diversity for the welfare of humankind. The agreement covers all ecosystems, species as well as genetic resources.

Objectives of the Convention include:

1. Conservation of biological diversity
2. Sustainable use of its components
3. Fair and equitable sharing of benefits

In the 10th meeting of the Conference of Parties (COP) to the Convention on Biological Diversity (CBD) held in 2010, in Nagoya, Aichi Prefecture, Japan, "Aichi Biodiversity Targets" were adopted for the period 2011-20.

Aichi Biodiversity Targets

Picture Credits: hpbiodiversity.gov.in

The year 2020 is referred to as "Super Year for Biodiversity" because the strategic plan for with 20 global Aichi targets adopted in 2010 ends in 2020 and all the countries together are in the process of preparation of post 2020 global biodiversity framework.

COP 11 to the CBD was held in Hyderabad, India. One of the most important outcomes of the COP was the commitment of the parties to double the international financial flows for biodiversity by 2015.

India instituted together with the UNDP "Biodiversity Governance Awards" at the COP.

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Cartagena Protocol on Biosafety: CBD covers the rapidly expanding field of biotechnology through its "Cartagena Protocol on Biosafety". It addresses technology development and transfer, benefit-sharing and biosafety issues.

The biosafety protocol seeks to protect biological diversity from the potential risks posed by "**Living Modified Organisms (LMOs)**" resulting from modern biotechnology.

There are two main sets of procedures under the Protocol, one for LMOs intended for direct introduction into the environment, known as "**Advance Informed Agreement (AIA)**" procedure and another for **LMOs intended for direct use as food or feed, or for processing (LMOs-FFP)**.

1. AIA: Under AIA procedure, a country intending to export LMO for intentional release into the environment must notify in writing the Party of import before the first processed export takes place.
2. LMOs-FFP: Under the procedure for LMOs-FFP, Parties that decide to approve and place such LMOs on the market are required to make their decision and relevant information, including risk assessment reports, publicly available through the Biosafety Clearing House (BCH).

Nagoya Kuala Lumpur Supplementary Protocol on Liability and Redress: It reinforces the Cartagena Protocol.

The Supplementary Protocol specifies response measures which must be taken in the case of damage to biodiversity resulting from Living Modified Organisms.

Nagoya Protocol is a 2010 supplementary agreement to the 1992 Convention on Biological Diversity (CBD).

The Nagoya Protocol is about "**Access to Genetic Resources**" and the "**Fair and Equitable Sharing of Benefit**" arising from their utilization.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is an independent intergovernmental body established by member states in 2012. The objective of IPBES is to strengthen the science policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development.

9.1.1.3 UNCCD (United Nations Convention to Combat Desertification)

Established in 1994, UNCCD is the sole legally binding international agreement which links environment and development to sustainable land management. UNCCD is one of the Rio Convention that focusses on desertification, land degradation and drought (DLDD) in regions like Africa, Asia, Latin America and Caribbean.

Desertification is a type of land degradation in which the biological productivity of land is lost due to natural processes or by induced human activities whereby fertile areas become increasingly arid. UNCCD launched Land Degradation Neutrality (LDN) to conserve, sustainably manage and restore land

14th COP of UNCCD held in New Delhi adopted the New Delhi Declaration. Several initiatives were launched at UNCCD COP 14:

1. International Coalition for action on Sand and Dust storms (SDS)
2. Initiative of sustainability, stability and security (3S)
3. Youth Caucus on desertification and land

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9.1.2 Ramsar Convention

Ramsar Convention is an intergovernmental treaty that provides framework for national action and international cooperation for the conservation through ecosystem approach and simultaneous sustainable use of wetlands and their resources. However, it is to be noted that under Ramsar Convention, there is no binding provision related to conservation of wetlands.

It was adopted in the Iranian city of Ramsar in 1971 but came into force in 1975. It is the only global environmental treaty dealing with a particular ecosystem. Ramsar is however not affiliated with the United Nations System, but it works very closely with it.

Parties to the Ramsar Convention commit to:

1. Working towards the "wise use" of wetlands
2. Identifying suitable wetlands to be listed under Wetlands of International Importance (the "Ramsar List") and ensure their effective management
3. Ensuring international cooperation on transboundary wetlands, shared wetlands and shared species

Montreux Record is maintained as a part of the Ramsar List. It is a register of wetlands of international importance where changes in ecological character have occurred, are occurring or are likely to occur as a result of human interference. Loktak lake, Manipur and Keoladeo National Park, Rajasthan are the two Montreux Record sites in India

Changwon Declaration on human well-being and wetlands highlights positive action for ensuring human well-being and security in the future.

9.1.3 CMS (Convention on the Conservation of Migratory Species)

CMS, also known as the **Bonn Convention**, aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty concluded under the aegis of UNEP, concerned with the conservation of wildlife and habitats on a global scale.

CMS is the only global Convention specializing in the conservation of migratory species, their habitats and migration routes.

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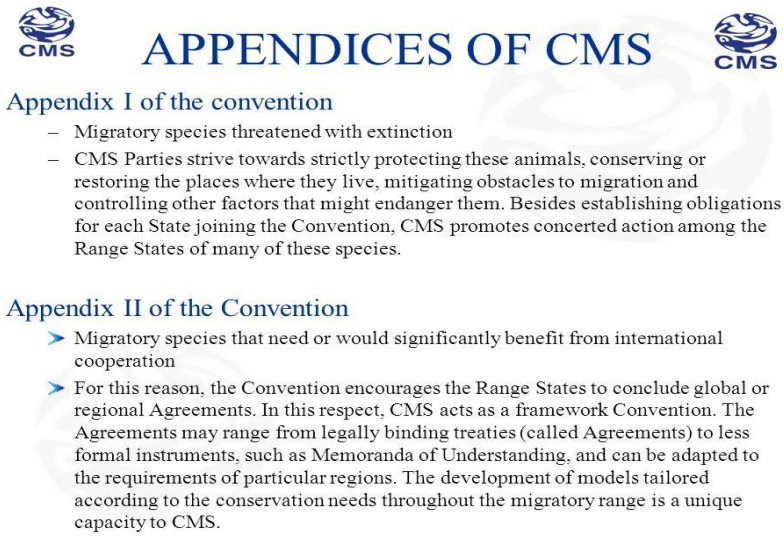

Indian Government signed the "**Raptor MOU**" on Conservation of Migratory Birds of Prey in Africa and Eurasia, with the CMS. However, the MOU is not legally binding.

Coalition Against Wildlife Trafficking (CAWT) is a unique voluntary public private coalition of like-minded governments and organizations sharing a common purpose, i.e. focussing public as well as political attention and resources on ending the illegal trade in wildlife and wildlife products.

The **13th Conference of Parties (COP) to the Convention on the Conservation of Migratory Species of Wild Animals (CMS COP)** concluded in Gandhinagar. India hosted the CMS COP for the first time.

CMS COP 13 adopted the **Gandhinagar Declaration**, which calls for migratory species and the concept of 'ecological connectivity' to be integrated and prioritized in the new framework, which is expected to be adopted at the UN Biodiversity Conference in October.

The theme of the CMS COP 13 was "**Migratory species connect the planet and we welcome them home**". Mascot for the COP was '**Gibi- The Great Indian Bustard**'.

9.1.4 CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna)

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. It is legally binding on states that have joined it.

CITES is administered through the United Nations Environment Program (UNEP). A Secretariat located in Geneva, Switzerland oversees the implementation of the treaty.

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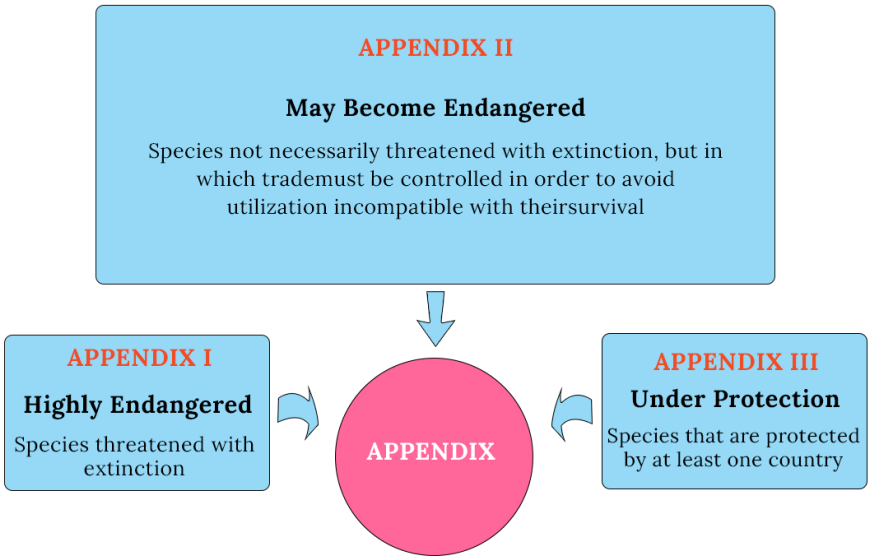

Appendices of CITES

9.1.5 Vienna Convention

Vienna Convention was adopted in the year 1985 and entered into force in 1988. It acts as a framework for international efforts to protect the ozone layer. However, it does not include legally binding goals for the use of CFCs. The Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer are dedicated to the protection the earth's ozone layer.

With 197 parties, they are the first and only global environmental treaties to achieve universal ratification.

MoEFCC established an Ozone Cell and a Steering Committee on the Montreal Protocol to facilitate implementation of the Indian Country Programme for phasing out ODS (ozone depleting substances) production by 2010.

Kigali Amendment to the Montreal Protocol is a legally binding agreement under which parties are expected to reduce the use and manufacture of Hydrofluorocarbons (HFCs) by roughly 80-85% from their respective baselines, till 2045. HFCs, though a Greenhouse Gas, is not dealt with under the Paris Agreement but under the Montreal Protocol.
Kigali Agreement for HFC reduction is legally binding on countries from 2019. However, developed and developing countries have different targets regarding reduction in the use of HFCs.

9.1.6 Minamata Convention

The Minamata Convention on Mercury is a global treaty to protect human health and the environment from the adverse effects of mercury and its compounds. It was agreed in the fifth session of the Intergovernmental Negotiating Committee in Geneva, Switzerland and entered into force on August 2017.

Controlling the anthropogenic release of mercury throughout its lifecycle is one of the key obligations under the Convention. The Convention also addresses the interim storage of mercury and its disposal once it becomes a waste, sites contaminated with mercury as well as health issues.

More than 140 countries including India have ratified the Convention.

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9.1.7 Rotterdam Convention

It was adopted in September 1998 and came into force in 2004. The Convention is jointly administered by UNEP and FAO.

It creates legally binding obligation for the implementation of **Prior Informed Consent (PIC) procedure**.

Objectives of the Convention are:

1. 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
2. To contribute to environmentally sound use of these hazardous chemicals, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to parties.

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 Annex III for the purpose of PIC procedure.

Recently, two chemicals, the **pesticide phorate** and the industrial chemical **hexabromocyclododecane (HBCD)** were added to Annex III of the Convention, making them subject to PIC procedure, through which countries can decide on future imports of these chemicals.

9.1.8 Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted in 1989 and came into force in 1992. The objective of the Convention is 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.

The guiding principle of the Convention are that transboundary movements of hazardous wastes should be:

1. Reduced to a minimum
2. Minimized at the source
3. Managed in an environmentally sound manner
4. Treated and disposed of as close as possible to their source of generation

The regulatory system is the cornerstone of the Basel Convention. Based on the concept of Prior Informed Consent (PIC), it requires that, before an export may take place, the authorities of the State of export notify the authorities of the prospective State of import and transit, providing them with detailed information on the intended movement. The movement may only proceed when all States concerned have given their written consent.

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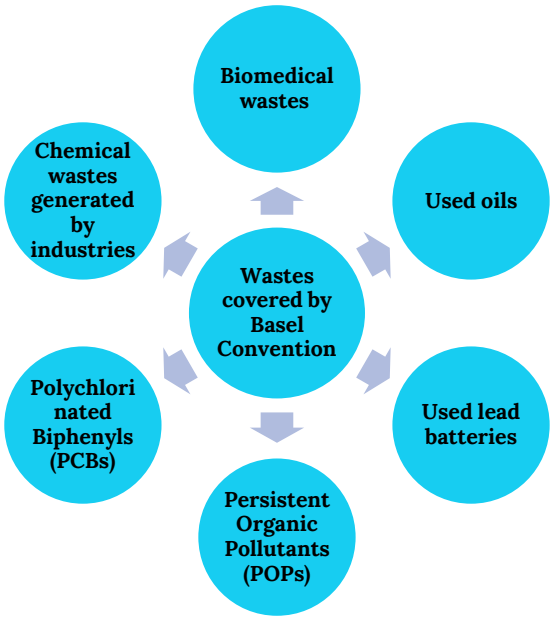

The **Basel Ban Amendment** prohibits all export of hazardous wastes, including electronic wastes and obsolete ships from 29 wealthiest countries of the Organization of Economic Cooperation and Development (OCED) to non-OCED countries.

India is yet to ratify the ban.

During the **Conference of Parties to the Basel Convention (COP 14)**, following decisions were taken:

1. Adoption of an amendment to include unsorted, mixed and contaminated plastic waste under Prior Informed Consent (PIC) and improve the regulation of its transboundary movement.
    a. Establishment of a **Partnership on Plastic Waste** to encourage member countries to manage plastic wastes in an environmentally sound manner.
2. Provisional adoption of Technical Guidelines on Transboundary Movement of E-Waste and Used Electrical and Electronic Equipment.

9.1.9 Stockholm Convention

Stockholm Convention on Persistent Organic Pollutants (POPs) was adopted in May 2001 and entered into force in 2004. It is a global treaty to protect human health and the environment from chemicals (POP) that remain intact in the environment for long periods, become widely distributed geographically, accumulate in fatty tissues of humans and animals and have harmful impact on human health or environment.

It calls for international action on three categories of POPs: pesticides, industrial chemicals and unintentionally produced POPs.

1. POPs under Annex A of the Convention are to be eliminated.
2. POPs under Annex B of the Convention are to be restricted.
3. Unintentionally produced POPs under Annex C of the Convention are to be restricted or eliminated.

The Convention requires parties to prevent the development of new POPs and promote best available techniques (BAT) and best environmental practices (BEP) for replacing existing POPs.

The Convention initially addressed 12 POPs (also known as “the dirty dozen”), but as of now, 30 chemicals of global concern are listed under it.

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During the Conference of Parties to the Stockholm Convention (COP 9), it was decided to list **dicofol** (used as a miticide on a variety of field crops) and **perfluorooctanoic acid/PFOA** (used in the production of non-stick cookware), its salts and PFOA related compounds under Annex A of the Convention.

9.2 International Organizations

9.2.1 TRAFFIC

TRAFFIC is a wildlife trade monitoring network established in 1976 by WWF and IUCN. It was established principally as a response to the entry into force during the previous year of the CITES.

TRAFFIC serves as an international network, consisting of TRAFFIC International, based in Cambridge, UK with offices in five continents.

TRAFFIC undertakes its activities in close collaboration with governments and CITES.

9.2.2 International Tropical Timber Organization (ITTO)

It is an intergovernmental organization under the UN, promoting the conservation and sustainable management, use and trade of tropical forest resources. Its members represent about 80% of the world's tropical forests and 90% of the global tropical timber trade.

United Nations Forum on Forests (UNFF) was established by the Economic and Social Council of the United Nations (ECOSOC) with the objective of promoting "the management, conservation and sustainable development of all types of forests and to strengthen long-term political commitments to this end". UNFF was based on the outcome of the Intergovernmental Forum on Forests (IFF) established by the ECOSOC in 1997.

The Forum has universal membership and comprises all member states of the United Nations.

9.2.3 IUCN

IUCN was founded in 1948 as the International Union for the Protection of Nature (IUPN). The organization changed its name to IUCN in 1956 with its headquarters in Gland, Switzerland.

"Just world that values and conserves nature" is the vision of IUCN. Its members include both states and non-governmental organizations.

9.2.4 Global Tiger Forum (GTF)

GTF is an intergovernmental organization and international body working exclusively for the conservation of tigers in the wild. Members from willing countries embark on a worldwide campaign and develop common approach to save the remaining five sub-species of tigers in the wild distributed over 14 tiger range countries of the world.

The GTF was formed in 1994 with its secretariat at New Delhi. It is the only intergovernmental and international body campaigning to save tigers worldwide. The General Assembly of the GTF meets once in three years.

9.2.5 International Whaling Commission (IWC)

International Whaling Commission is the global intergovernmental body which works towards the conservation of whales and the management of whaling. IWC's headquarters are located in Cambridge, UK and India is a member.
It was established under the International Convention for the Regulation of Whaling signed in Washington DC in 1946. The Commission introduced zero catch limits for commercial whaling in 1986. Japan recently pulled out of the IWC.

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9.3 Other Global Initiatives

Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change. It was established in 1988 by UNEP and WMO (World Meteorological Organization) to provide policymakers with regular scientific assessments related to climate change. India is also a member of IPCC. IPCC itself does not conduct any research nor does it monitor climate related data or parameters. Instead, thousands of scientists from all over the world contribute to the work of IPCC on a voluntary basis.

IPCC has so far published five Assessment Reports (AR) and will publish the sixth report (AR6) in 2021-22. IPCC also publishes special reports like "IPCC Special Report on Global Warming of 1.5°C". For its outstanding work, it has also received Nobel Peace Prize in 2007.

IPCC established **National Green House Gas Inventories Program (NGGIP)** to provide methods for estimating national inventories of greenhouse gas emissions to and removals from the atmosphere. The guidance produced by the NGGIP is used by countries that are party to the UNFCCC to estimate the emissions and removals that they report to the UNFCCC.

The **Petersburg Climate Dialogue** series was launched in 2010, following the Copenhagen Climate Change Conference and has been hosted annually by Germany. The dialogue facilitates open discussions in small groups on key issues in international climate policy.

The XI Petersburg Climate Dialogue was held virtually for the first time in the wake of COVID-19. It was co-chaired by Germany and United Kingdom (UK). 30 countries including India attended the dialogue.

Climate Action Summit was convened in New York on the theme, 'Climate Action Summit 2019: A Race We Can Win, A Race We Must Win' by the UN Secretary General. The focus of the Summit was to accelerate the implementation of Paris Agreement by raising our ambitions.

Countries were asked to prepare realistic plans to enhance their Nationally Determined Contributions by 2020, and to achieve net zero emissions by 2030.

3 percent club was formed in this summit which is a coalition of countries, businesses and international organizations that have committed to achieve a 3 percent global increase in energy efficiency each year. India is a member of this club.

C40 World Mayors' Summit was held in Copenhagen, Denmark. C40 is a network of world's megacities started in 2005 and supports cities to collaborate effectively and share knowledge and experiences in their fight against climate change.

Indian cities like Delhi, Chennai and Jaipur are also a part of the network.

Climate Vulnerability Forum is an international partnership of countries highly vulnerable to a warming planet. The forum also serves as a South-South cooperation platform for participating governments to deal with global climate change.

Coalition for Disaster Resilient Infrastructure (CDRI) is an international coalition of countries, UN agencies, multilateral development banks, private sectors and academic institutions to promote research and knowledge sharing in the field of disaster resilient infrastructure. CDRI was launched by the Indian Prime Minister at the 2019 UN Climate Action summit held in September 2019.

South Asia Cooperative Environment Programme (SACEP) is an international organization established in 1982 and headquartered at Colombo. Its member countries include Afghanistan, Bangladesh, Bhutan, India, Nepal, Maldives, Nepal, Pakistan and Sri Lanka.

SACEP aims to promote and support protection, management and enhancement of environment in

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the region.

SACEP also serves as the Secretariat for the **South Asia Seas Program (SASP)**, which comes under the purview of the UNEP Regional Seas Program.

During the Conference of the Parties (COP15) held in December 2009 in Copenhagen developed countries pledged to provide new and additional resources, including forestry and investments, approaching USD 30 billion for the period 2010 - 2012 and with balanced allocation between mitigation and adaptation. This collective commitment has come to be known as "**fast-start finance**".

REDD (Reducing Emissions from Deforestation and Forest Degradation) is the global endeavour 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. Three UN agencies- UNEP, UNDP and FAO have collaborated in the establishment of UN-REDD programme.

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+ incentivises developing countries to keep their forests conserved by offering result-based payments for actions to reduce and remove forest carbon emissions. Thus, it can play a big role in protection of biodiversity, strengthening the resilience of forest ecosystems and reducing poverty.

Globally Important Agricultural Heritage Systems (GIAHS):

The Food and Agricultural Organization (FAO) recognizes GIAHS as "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".
India has two GIAHS as recognized by FAO:

1. Traditional Agricultural System, Koraput, Odisha
2. Below Sea Level Farming System, Kuttanad, Kerala

Pointers for prelims:

1. **One Trillion Trees Initiative (1t.org)**, an initiative by World Economic Forum (WEF) and led by UNEP and FAO, was launched to ensure the conservation and restoration of one trillion trees within this decade.
2. UN General Assembly declared the **United Nations Decade on Ecosystem Restoration 2021-30** with an aim to massively scale-up the restoration of degraded and destroyed ecosystems in order to fight the climate crisis and enhance food security, water supply and biodiversity.
3. **Tropical Forest Alliance** was launched in Rio+20 as a global public-private partnership with the aim of halving deforestation by 2020 and ending it by 2030 in tropical rainforest countries. The secretariat of the Alliance is hosted by the World Economic Forum.
4. **Global Carbon Project**, established in 2001, is a Global Research Project of Future Earth and a research partner of the World Climate Research Programme. It seeks to quantify GHG emissions and their causes.
5. Recently, New Zealand passed the "**Zero Carbon Law**" which seeks to reduce GHG emissions to net zero by 2050.
    a. Likewise, European Union launched "**Green Deal**", which aims to achieve Carbon Neutrality by 2050 and increasing emission reduction by 2030 to at least 50%.
6. UNFCCC secretariat launched its "**Momentum for Change: Climate Neutral Now**", an initiative aimed at encouraging and supporting all levels of the society to take climate action to achieve a climate neutral world by the mid-century, as enshrined in the Paris Agreement.

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CHAPTER 10

UNFCCC SUMMITS

10.1 Conference of Parties (COP)

The COP is the decision-making body of the UNFCCC. All States that are party to the Convention are represented at the COP. They review the implementation of any legal instrument that the Convention adopts.

List of UNFCCC summits		
COP	**Year**	**Place**
COP 1	1995	The Berlin Mandate
COP 2	1996	Geneva, Switzerland
COP 3	1997	Kyoto, Japan (Kyoto Protocol was adopted)
COP 4	1998	Buenos Aires, Argentina
COP 5	1999	Bonn, Germany
COP 6	2000	Hague, Netherlands
COP 6	2001	Bonn, Germany
COP 7	2001	Marrakech, Morocco
COP 8	2002	New Delhi, India
COP 9	2003	Milan, Italy
COP 10	2004	Buenos Aires, Argentina
COP 11/CMP 1	2005	Montreal, Canada (Kyoto Protocol was ratified in 2005)
COP 12/CMP 2	2006	Nairobi, Kenya
COP 13/CMP 3	2007	Bali, Indonesia
COP 14/CMP 4	2008	Poznan, Poland
COP 15/CMP 5	2009	Copenhagen, Denmark
COP 16/CMP 6	2010	Cancun, Mexico
COP 17/CMP 7	2011	Durban, South Africa
COP 18/CMP 8	2012	Doha, Qatar
COP 19/CMP 9	2013	Warsaw, Poland
COP 20/CMP 10	2014	Lima, Peru
COP 21/CMP 11	2015	Paris, France
COP 22/CMP 12/CMA 1	2016	Marrakech, Morocco
COP 23/CMP 13/CMA 1-2	2017	Bonn, Germany
COP 24/CMP 14/CMA 1-3	2018	Katowice, Poland
COP 25/CMP 15/CMA 2	2019	Madrid, Spain

CMP: Conference of Parties Serving as the Meeting of the Parties to the Kyoto Protocol

CMA: Conference of Parties Serving as the Meeting of the Parties to the Paris Agreement.

10.2 Kyoto Protocol (COP 3; UNFCCC Summit 1997)

The Kyoto Protocol was adopted in Kyoto, Japan in 1997 and came into force in 2005. It aimed at cutting GHG emissions across the developed world by about 5% by 2012 compared with 1990 levels. While India ratified the Protocol in 2002, USA never ratified it and Canada withdrew from it in 2012.

Kyoto Protocol is based on the principle of "**common but differentiated responsibility**" and is the only global treaty with binding limits on GHG emissions.

"**Common but Differentiated Responsibility**" means that while every country (both developing and developed) must take part in the fight against climate change, historically biggest polluters like USA, UK, Russia should contribute more to reduce GHG emissions compared to recent polluters like India, China, Brazil etc.

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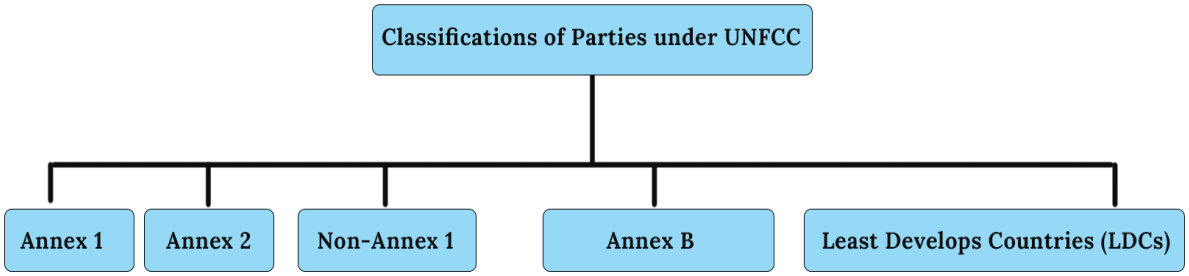
10.2.1 Parties under the Kyoto Protocol



1. Annex 1: Developed countries like USA, UK and Russia + Economies in Transition (EIT) like Ukraine, Turkey and some East European countries are a part of Annex 1 countries.
2. Annex 2: Developed countries are a part of Annex 2 (Annex 2 is a subset of Annex 1 countries). These countries are required to provide financial and technical support to EITs and developing countries to assist them in reducing their GHG emissions.
3. Annex B: Annex 1 countries with first or second round Kyoto GHG emissions targets come under Annex B. The first-round targets apply over 2008-12 and the second-round targets apply over 2013-20. Countries under Annex B have **compulsory binding targets** to reduce GHG emissions.
4. Non-Annex 1: Parties to the UNFCCC not listed under Annex 1 of the Convention come under this. These include mostly the low-income developing countries and have no binding emission reduction targets.
5. LDCs: These refer to the least-developed countries and have no binding GHG reduction targets.

The Kyoto Protocol has two commitment periods: 2008-12 and 2013-20. The second commitment period was agreed on in 2012, known as **Doha Amendment to the Protocol**. As of January 2019, 124 states have accepted the Doha Amendment. Japan and Russia did not sign the second Kyoto term as it would impose restrictions on it not faced by its competitors like India and China.

Each commitment period has its own set of binding GHG emission reduction targets for developed countries to achieve. Nations that miss their Kyoto target will have to incur a penalty like getting banned from participating in the 'cap and trade' program.

Kyoto Protocol **binds only the developed countries** because it recognizes that they are largely responsible for the current high levels of GHG emissions in the atmosphere, which are the result of more than 150 years of industrial activity.

Kyoto Protocol emission target gases include CO_2, SF6, CH_4, HFCs, N_2O and PFCs.

10.2.2 Flexible Market Mechanisms

Countries bound to the Kyoto targets can meet a part of their targets through three "market based mechanisms".

1. **Clean Development Mechanism (CDM)**
2. **Emission Trading/Cap and Trade**
3. **Joint Implementation**

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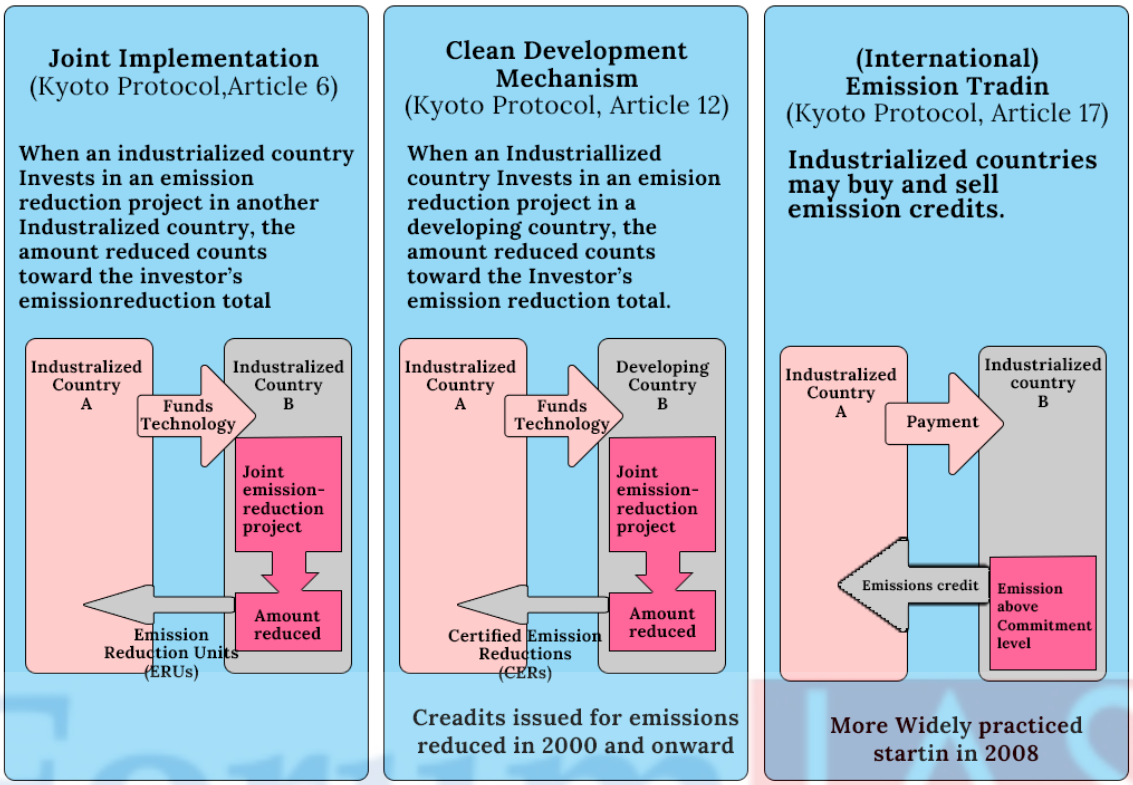
The Kyoto Protocol's flexible mechanism for fulfillingemission reductions commitments



Source: Japan's Ministry of Environment

Under the **Clean Development Mechanism (CDM), the projects handled pertain only to Annex 1 countries**.

Note that **Carbon Tax** (tax on fossil fuels in proportion to Carbon Dioxide emissions) **is not related to Kyoto Protocol**.

10.3 Important UNFCCC Summits post Kyoto

COP	Name of Summit	Important decisions
COP 13/CMP 3	Bali Meet	Governments adopted the Bali Road Map which included reviewing the financial mechanism to fund climate change initiatives.
COP 14/CMP 4	Poznan (Poland) Summit	**Adaptation Fund** was launched in this Summit. The Fund is financed in part by government and private donors and also from a 2% share of proceeds of Certified Emission Reduction (CERs) issued under Clean Development Mechanism projects. Adaptation Fund is supervised and managed by the Adaptation Fund Board (AFB). The Global Environment Facility (GEF) provides secretariat services to the AFB and the World Bank serves as the trustee of the Adaptation Fund on an interim basis.
COP 15/CMP 5	Copenhagen Summit	A legally binding agreement could not be arrived at in this Summit due to disagreement between developed and developing nations. The Summit thus concluded with the COP taking a note of the **Copenhagen Accord-a five nation accord**

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		between US and BASIC countries (India, China, Brazil and South Africa). Developed countries promised to provide $30 billion for the period 2010-12 and to mobilize long term finance of further $100 billion a year by 2020 from a variety of sources.
COP 16/CMP 6	Cancun Summit	Parties agreed to establish a **Green Climate Fund (GCF)** to provide financing to projects, programmes, policies and other activities in developing countries. GCF is based in Incheon, South Korea and World Bank was invited to serve as its interim trustee. GCF is intended to be the centrepiece of efforts to raise climate finance of $ 100 billion by 2020. A **Technology Mechanism** was also established in this Summit. It was expected to facilitate the implementation of enhanced action on technology development and transfer in order to support action on mitigation and adaptation to climate change.
COP 17/CMP 7	Durban Summit	Governing instrument for the GCF was approved in this Summit.
COP 18/CMP 8	Doha Summit	Government agreed to work towards a Global Climate Change Agreement. The Conference also reached an agreement to extend the life of the Kyoto Protocol. It was also decided that UNEP-led consortium will be the host of **Climate Technology Centre (CTC)**. The CTC is the implementing arm of the UNFCCC Technology Mechanism.
COP 19/CMP 9	Warsaw Summit	The term **Intended Nationally Determined Contributions (INDC)** was coined in this Summit. Governments also decided to close the "pre-2020 ambition gap"- the gap between what has been pledged to date and what is required to keep the global temperatures below a maximum average of 2 degrees Celsius.
COP 20/CMP 10	Lima Summit	Some key outcomes were: 1. **National Adaptation Plans (NAPs)** were to be prepared. 2. **NAZCA Climate Action Portal** was launched with the support from the UNFCCC. 3. **Lima Work Programme** on Gender was initiated to advance gender balance in climate related measures. 4. UNFCCC NAMA Day (Nationally Appropriate Mitigation Actions) was a special event that took place.
COP 21/CMP 11	Paris Summit	Some key outcomes of Paris Agreement were: 1. Paris Agreement entered into force in 2016 after ratification by 55 countries that account for at least 55% of the global emissions. India signed and ratified the agreement in 2016 and as of 2019, 180+ countries have ratified it. 2. INDC commitments were made by the major polluters. 3. The objective of the Agreement was to hold the increase in global average temperature to well below 2 degrees Celsius above pre-industrial levels. Further, countries should pursue to limit temperature increase to 1.5 degrees Celsius above pre-industrial levels.

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		4. Developed countries reaffirmed their commitment to mobilize $**100 billion a year** in climate finance by 2020 to help developing countries cope with climate change. 5. It was also decided that there will be a **Global Stocktake every 5 years** to assess the collective progress towards achieving the purpose of the Agreement and to inform further individual action by Parties. 6. Earlier, USA has announced its withdrawal from the Paris Agreement, but has re-joined recently.
COP 22/CMP 12/CMA 1	Marrakech Summit	Some key outcomes were: 1. COP 22 was also called as "Action COP" or "Agricultural COP". Accordingly, **Adaptation of African Agriculture (AAA)** was launched at the Conference. 2. There were deliberations on "**Orphan Issues**" that are referenced in the Paris Agreement but not assigned to another body for further reconsideration. 3. Directions were given to conduct an early stocktake through a "Facilitative Dialogue". 4. Few nations submitted "Mid-Century Strategies" to combat climate change. In line with this, a new initiative called the '**2050 Pathway Platfor'** was launched to help other countries develop their own mid-century strategies.
COP 23/CMP 13/CMA 1-2	Bonn Summit (Chaired by Fiji)	Some key outcomes were: 1. Fiji became the first small-island state to host the UNFCCC climate talks. 2. **Gender Action Plan**, highlighting the role of women in climate action, was launched. 3. **Local Communities and Indigenous People's Platform (LCIPP)**, aimed at bringing together people and their knowledge systems to build a climate resilient world, was launched. 4. **Ocean Pathway Partnership** was launched, thus formally recognizing the links between oceans and climate change. 5. **Talanoa Dialogue**, a process aimed at helping countries implement and enhance their Nationally Determined Contributions by 2020, was launched. 6. **Powering Past Coal Alliance** was also launched in COP 23, led by UK and Canada. The Alliance is aimed at accelerating clean growth and achieving rapid phase-out of traditional coal power. 7. **InsuResilience Global Partnership** is a joint initiative of G7, G20 and V20 (group of 49 most vulnerable countries including small islands). It was launched in COP 23 to strengthen the resilience of developing countries and protect the lives and livelihoods of poor and vulnerable people against the impact of disasters and other climate risks.
COP 24/CMP 14/CMA 1-3	Katowice Summit	The Conference agreed on the "**work programme for implementation" (guidelines/rulebook)** for reaching the targets mentioned to implement the Paris Agreement, which will come into force in 2020. The rulebook will prescribe how governments will measure and report on their emission cutting efforts.

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COP 25/CMP 15/CMA 2	Madrid Summit (It was held under the presidency of Chile)	Owing to its original location in Chile- a nation with around 4000 miles of coastline- the leadership dubbed this year's event as the "**blue COP**", laying out its intention to focus on oceans. The COP also highlighted the fact that it is no longer a climate crisis but a "climate emergency". Recently, UK and Ireland became the first and second countries respectively to declare a climate emergency. The "**Santiago Network**" was established to catalyse the technical assistance required by the most vulnerable countries.

The Warsaw International Mechanism (WIM) on **Loss and Damage (L&D)** came into being in 2013 (COP 19). Under L&D, rich countries who have historical responsibility for climate change are asked to be liable to the developing countries who are already facing climate change impacts.

The Suva Expert dialogue on Loss and Damage was held under the aegis of UNFCCC, which discussed risk assessment, risk transfer, risk reduction and retention and comprehensive risk management approaches to extreme weather events and slow onset climatic processes.

Carbon Markets under the Paris Agreement:

1. **Market Mechanism 1**: It sets up a Carbon Market which allows countries to sell any extra emission reductions {called as **Internationally Transferred Mitigation Outcomes (ITMO)**} which they have achieved compared to their Nationally Determined Contributions (NDCs) target.
    a. This is a voluntary direct bilateral cooperation between countries aiming to promote sustainable development.
2. **Market Mechanism 2**: The second mechanism will create a new international carbon market for the trading of emissions reduction created anywhere in the world by the public or the private sector.
    a. This new market is referred to as the "**Sustainable Development Mechanism (SDM)**" which seeks to replace the "Clean Development Mechanism (CDM)" of Kyoto Protocol.
    b. The delivery of "**Overall Mitigation in Global Emissions (OMGE)**" is a key requirement of SDM.

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CHAPTER 11

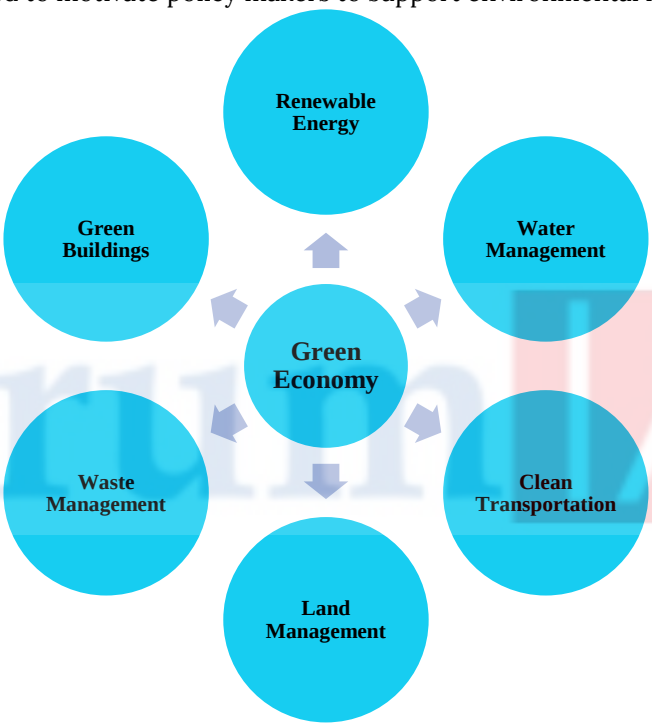
ENVIRONMENTAL FINANCE

11.1 Green Economy

The concept of Green economy lacks an internationally agreed definition or universal principles. The Rio+20 outcome document identifies green economy in the context of sustainable development and poverty eradication and it affirms that approach will be different in accordance with the national circumstances and priorities for each country.

In simpler terms, Green Economy is an economy that aims at reducing environmental risks and ecological scarcities and that aims for sustainable development without degrading the environment.

In 2008, UNEP launched the **Green Economy Initiative**, a program of global research and country level assistance designed to motivate policy makers to support environmental investments.



The **Greenhouse Gas Protocol (GHG Protocol)** is the most widely used international accounting tool for governments and business leaders to understand, quantify and manage Greenhouse Gas emissions.

Renowned environmental economist **Pavan Sukhdev** was awarded the 2020 **Tyler Prize** for his work in the domain of Green Economy. Established in 1973, Tyler Prize is one of the oldest environmental awards.

Pawan Sukhdev is known for his ground-breaking 2008 report on "**The Economics of Environment and Biodiversity (TEEB)**", which was hosted by UNEP and became the foundation of Green Economy Movement.

TEEB is an initiative to draw attention to the global economic benefits of biodiversity. Its objective is to highlight the growing cost of biodiversity loss and ecosystem degradation.

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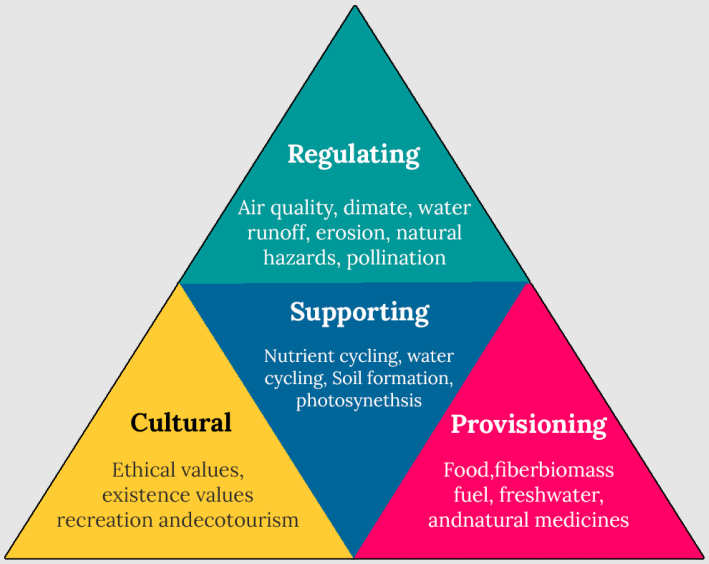
Payment for Ecosystem Services (PES) are incentives offered to farmers or landowners in exchange for managing their land to provide some sort of ecological service.

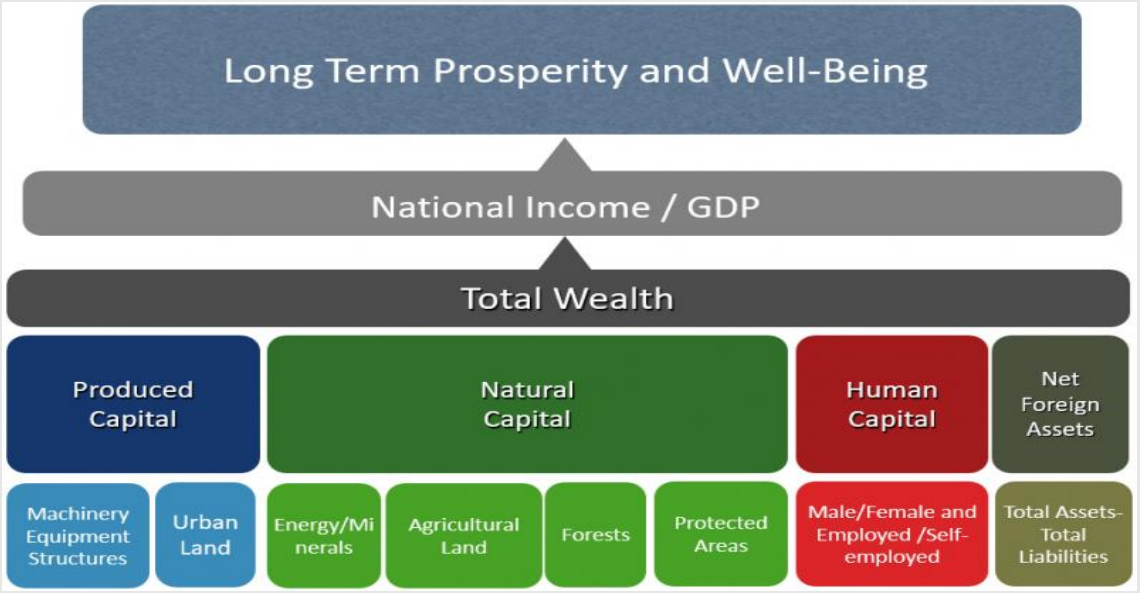
Ecosystem Services simply means "the benefits of nature to households, communities and to economies".



Ecosystem Services

Partnership for Action on Green Economy (PAGE) was launched in 2013, in a direct response to the Rio+20 declaration "The Future We Want". PAGE supports nations in framing economic policies and practices around sustainability and seeks to assist countries in achieving Sustainable Development Goals (SDGs).

Natural Capital is the stock of renewable and non-renewable resources (e.g., plants, animals, air, water etc.) that combine to yield a flow of benefits to people.



Natural Capital Accounting is a tool that can help measure the full extent of a country's natural assets. It can give us an insight on the link between economy, ecology and our environment. UN Statistical Commission has adopted the System for Environmental and Economic Accounts (SSEA) as a statistical standard to measure a country's natural capital.

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Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES) is a project funded by the European Union and jointly implemented by the United Nations Statistics Division (UNSD), United Nations Environment Program (UNEP) and the Secretariat of the Convention of Biological Diversity (CBD). NCAVES project is aimed at encouraging the practice of ecosystem accounting.

India is one of the five countries, others being Brazil, China, South Africa and Mexico, taking part in the project. Ministry of Statistics and Programme Implementation (MoSPI) is implementing the project along with Environment Ministry and the National Remote Sensing Centre (NRSC) under the Department of Space.

11.2 Sustainable Development

The **Brundtland Commission Report**, also known as "**Our Common Future**", was published in 1987 by the United Nations through the Oxford University Press. The report developed the most widely used definition of sustainable development as "development which meets the needs of current generations without compromising the ability of future generations to meet their own needs".

Accordingly, 17 Sustainable Development Goals (SDGs) were set in 2015 by the United Nations General Assembly and are intended to be achieved by the year 2030. They are included in a UN Resolution called the Agenda 2030.

The **Club of Rome** stimulated considerable attention with its first report to the club, "**The Limits to Growth**". Published in 1972, its computer simulations suggested that economic growth could not continue indefinitely because of resource depletion.

Seabed 2030 project has been launched by the Nippon Foundation of Japan and the General Bathymetric Chart of the Oceans (GEBCO) at the UN Conference in 2017 with the aim of achieving SDG 14 (conserve and sustainably use the oceans, seas and marine resources).
The project aims to bring together all available bathymetric data to produce a definitive map of the world ocean floor by 2030. This will help us understand several natural phenomena related to oceans like ocean circulation, tides and biodiversity hotspots. Further, Seabed 2030 project will also promote better understanding of the impact of climate change on oceans.

11.3 Global Environment Facility (GEF)

The GEF was established in 1991 by the World Bank in consultation with UNDP and UNEP, to provide funding to protect the global environment. World Bank serves as the GEF trustee, administering the fund.

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GEF Funds are available to developing countries and countries with economies in transition to meet the objectives of the international environmental conventions and agreements.

GEF serves as a "financial mechanism" to five Conventions:

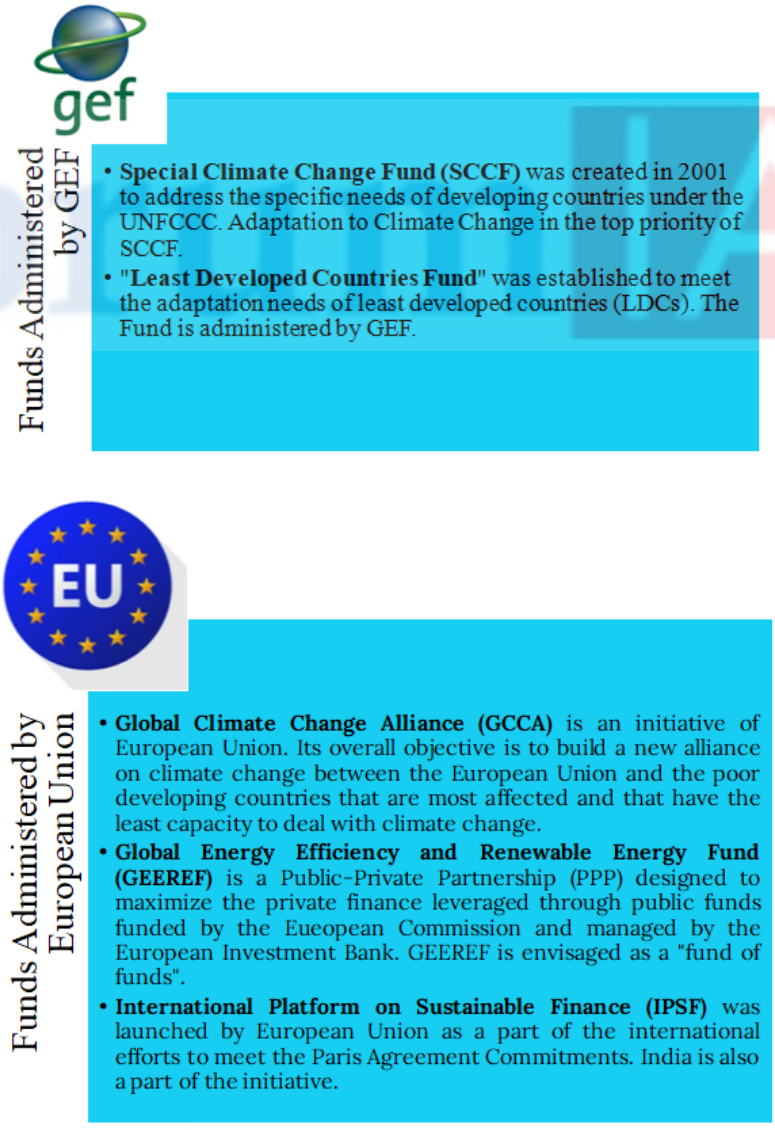
1. Convention on Biological Diversity (CBD)
2. United Nations Framework Convention on Climate Change (UNFCCC)
3. Stockholm Convention on Persistent Organic Pollutants (POPs)
4. UN Convention to Combat Desertification (UNCCD)
5. Minamata Convention on Mercury

11.4 Green Climate Fund (GCF)

Parties agreed to establish a Green Climate Fund (GCF) to provide financing to projects, programmes, policies and other activities in developing countries. GCF is based in **Incheon, South Korea** and World Bank was invited to serve as its interim trustee. GCF is intended to be the centrepiece of efforts to raise climate finance of $ 100 billion by 2020.

GCF has decided to give 50:50 balance between mitigation and adaptation. It also aims for a floor of 50 percent of the adaptation allocation for particularly vulnerable countries, including Least Developed Countries (LDCs), Small Island Developing States (SIDS) and African States.

11.5 Global Climate Finance Architecture



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Funds Administered by World Bank

- "**BioCarbon Fund Initiative for Sustainable forest Landscapes (ISFL)**" is a multilateral fund, supported by donor governments and managed by the World Bank. It promotes and rewards reduced greenhouse gas emissions and increased carbon sequestration.
- "**Forest Carbon Partnership Facility**" is a global partnership of governments, businesses, civil society and indigenous peoples. It assists the countries in their REDD+ efforts by providing them with financial and technical assistance.
- "**Partnership for Market Readiness**" is a partnership of developed and developing countries administered by the World Bank, established to use market instruments to scale up mitigation efforts in middle income countries.

Funds Administered by World Bank

- **Climate Investment Funds (CIFs)**, administered by World Bank, has following two multi-donor Trust Funds:
- **Strategic Climate Fund (SCF)** which focusses on areas like Adaptation, Mitigation-general and Mitigation-REDD. SCF serves as an overarching framework for the following three programs:
  - **Forest Investment Program (FIP)** which supports developing countries efforts to reduce deforestation nad forest degradation and promotes sustainable forest management.
  - **Pilot Program for Climate Resilience (PPCR)** which aims to pilot and demonstrate ways in which climate risks and resilience may be integrated into core development planning and implementation
  - **Scaling-Up Renewable Energy Program for Low Income Countries (SREP)** which aims to demonstrate the economic, social and environmental visibility of low carbon development pathways in the energy sector in low-income countries.
- **Clean Technology Fund (CTF)** which aims at promoting scaled-up financing for demonstrations, deployment and transfer of low carbon technologies with significant potential for long term greenhouse emissions savings.

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GLOSSARY

1. **Warm Blooded Animals**: Animal species which have a relatively higher body temperature. E.g., mammals and birds
2. **Cold Blooded Animals**: Animals which cannot regulate their internal body temperature with the change in the environment. E.g., reptiles, insects, amphibians and fish
3. **Stenothermal Animals**: An animal that is capable of living only at a certain temperature or within a very narrow range of temperature. E.g., reptiles, crustaceans, insects, penguin, crocodile and python
4. **Eurythermal Animals**: Animal species which are able to tolerate a wide range of temperature levels. E.g., cat, dog, man, tiger
5. **Aestivation**: It is a state of animal dormancy which is characterized by inactivity and a lowered metabolic rate and is entered in response to high temperatures and arid conditions.
6. **Hibernation**: It is a state of animal dormancy, characterized by inactivity and a lowered metabolic rate that is entered in response to low temperatures. E.g., bears, bat, rodents
7. **Agroforestry**: It is an integrated approach of using interactive benefits from combining trees and shrubs with crops and livestock.
8. **Ecotopes**: Smallest ecologically-distinct landscape features in a landscape mapping and classification system.
9. **Ecozones**: Large areas of the Earth's surface within which organisms have been evolving in relative isolation over long periods of time. Ecozones are separated from one another by geographic features like oceans, broad deserts or high mountain ranges that constitute barriers to migration.
10. **Carrying Capacity**: Carrying Capacity of an environment is the maximum population size of a biological species which the given environment can sustain, considering the food, habitat, water and other resources available.
11. **Ocean de-oxygenation**: A term used to describe the expansion of oxygen minimum zones in the world's oceans as a consequence of anthropogenic emissions of Carbon Dioxide.
12. **Bioterrorism**: Terrorism involving intentional release or dissemination of biological agents.
13. **Bioleaching**: Extraction of specific metals from their ores though the use of living organisms.
14. **Bioprospecting**: Bioprospecting means exploring natural sources for small molecules, macromolecules and biochemical and genetic information that has the potential to be developed into commercially valuable products for the agricultural, aquaculture, bioremediation, cosmetics, nanotechnology or pharmaceutical industries.
15. **Biopiracy**: Theft of genetic materials especially plants and other biological materials by the patent process. Biopiracy is a practice where indigenous knowledge of nature, originating with indigenous people, is used by others for profit, without authorization or compensation to the indigenous people themselves.
16. **Ecological Footprint**: Measure of human demand on the earth's ecosystems.
17. **Carbon Footprint**: Measure of all Greenhouse Gases we individually produce in units of tonnes of Carbon Dioxide equivalent. A Carbon footprint is made up of the following two parts:
    a. **Primary Footprint**: Measure of our direct emissions of CO_2 like burning of fossil fuels
    b. **Secondary Footprint**: Measure of indirect CO_2 emissions from the whole lifecycle of products we use.
18. **Carbon Diet**: Reducing the impact on climate change by reducing GHG emissions, without lowering the standard of living.
19. **Biocapacity**: Capacity of an area to provide resources and absorb wastes.
    a. **Global Hectare**: Measure of biocapacity of the entire earth.
20. **Earth Hour**: It 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 on the need to take action on climate change.
21. **Earth Overshoot Day**: The day when humanity's demand for ecological resources (like fish and forest) and services in a given year exceeds what earth can replenish in that year.

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22. **Alliance of Small Island States (AOSIS)**: It is an ad-hoc coalition of low-lying and island countries. These nations are highly vulnerable to rising sea levels and share common positions on climate change.

AOSIS Countries

23. **Coalition of Rainforest Nations**: A voluntary group of largely developing nations with rainforests which addresses issues surrounding environmental sustainability specific to rainforests.
24. **Fugitive Fuel Emissions**: GHGs which are emitted as by-product or waste or lost in the process of fuel production, storage or transportation, such as methane given off during oil and gas drilling and refining etc.
25. **Hot air**: Concerns that some government will be able to meet their targets for GHG emissions under the Kyoto Protocol with minimal effort and could then flood the market with emission credits, thus reducing the incentive for other countries to cut off their own domestic emissions.
26. **Registries/registry system**: These are electronic databases that tracks all transactions under the Kyoto Protocol's Greenhouse Gas Emissions Trading System
27. **Spill-over effects**: Reverberations in developing countries caused by actions taken by developed countries to cut Greenhouse Gas emissions.
28. **Umbrella Group**: A loose coalition of non-European Union developed countries formed following the adoption of the Kyoto Protocol.
29. **International Standards and Environment**: ISO 14000 environmental management standards exist to help organizations minimize how their operations negatively affect the environment and to enable them comply with applicable laws, regulations and other environmentally oriented requirements.
    Certification is performed by a third-party organization rather than being awarded by ISO directly and it is based on the process of how a product is produced, rather than the product itself.
30. **Bioassay**: Bioassay is test in which organisms are used to detect the presence or effects of any other physical factor, chemical factor or any other type of ecological disturbance. Bioassays are very common in pollution studies.
31. **Flagship species**: A species chosen to represent an environmental cause, such as an ecosystem in need of conservation. These species are chosen for their attractiveness, vulnerability or distinctiveness on order to engender support and acknowledgement from the public at large.

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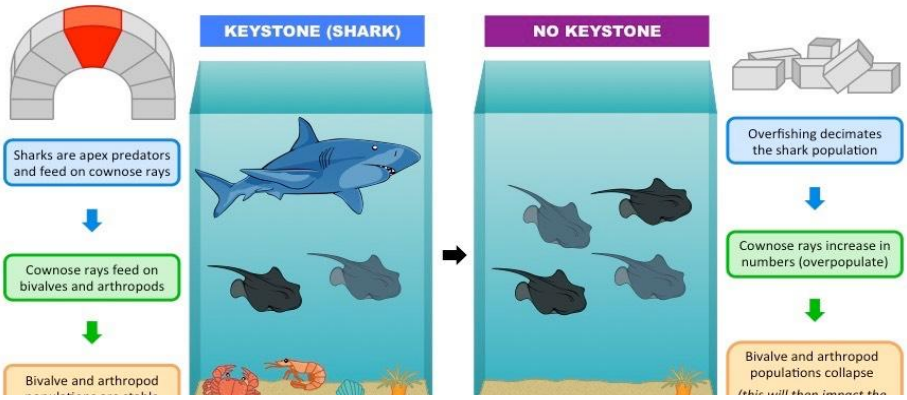
a. **Keystone species**: A species which when added or lost from an ecosystem causes major changes in the occurrence of at least one other species. Keystone species are important from the conservation point of view because conservation of keystone species encourages conservation of all other relevant species associated with it.

All top predators like lions are considered as keystone species.



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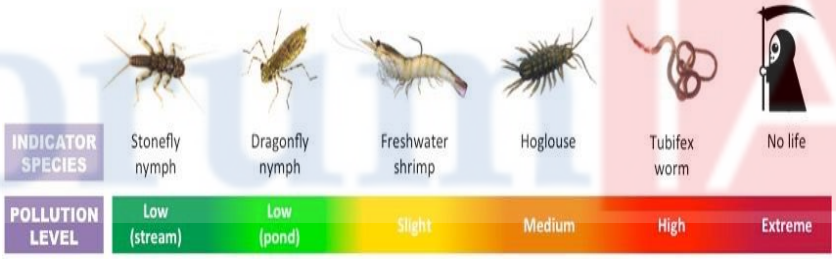
b. **Indicator species**: Animals, plants, or microorganisms used to monitor changes in the environment. For e.g., amphibians indicate chemicals, global warming and air pollution. Lichens are indicators of air quality and are sensitive to Sulphur Dioxide.



Picture Credits: Bio Ninja

c. **Foundation species**: These are dominant primary producers in an ecosystem, both in terms of abundance and influence. E.g., kelp and corals
d. **Umbrella species**: These are wide-ranging species whose requirements include those of many other species. The protection of umbrella species automatically extends protection to other species.

32. **Chipko Movement**: It is a socio-ecological movement that utilized the Gandhian methods of non-violent resistance through the act of hugging trees in order to protect them from falling. The first recorded event of Chipko took place in Khejarli village, Jodhpur district, in 1730 AD, when Bishnois led by Amrita Devi sacrificed their lives while protecting Khejri trees. However, the modern Chipko movement started in the early 1970s in the Garhwal Himalayas of Uttarakhand, aims to grow awareness towards rapid deforestation.
    a. **Appiko Movement**: The Chipko Movement in Uttarakhand inspired the villagers of Karnataka to launch a similar movement to save their forests.
33. **National Plan for Conservation of Aquatic Ecosystems (NPCA)**: NPCA is a single program for the conservation of both lakes and wetlands. It is a Centrally Sponsored Scheme under the MoEFCC. The Plan was formulated in 2015 by merging of the National Lake Conservation Plan and National Wetlands Conservation Program.
34. **National Wastelands Development Board (NWDB)**: It was set up in 1985 with the objective of formulating nodal policies, plans and programmes for the management and development of wastelands in the country. The Board comes under the Ministry of Rural Development.

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APPENDIX

1. Tiger Reserves

There are 50 Tiger Reserves in India which are governed by Project Tiger. National Tiger Conservation Authority (NTCA) is the administering body.

Sl. No	Tiger Reserve	State
1	Dudhwa	Uttar Pradesh
2	Pilibhit	Uttar Pradesh
3	Rajaji	Uttarakhand
4	Corbett	Uttarakhand
5	Valmiki	Bihar
6	Sunderbans	West Bengal
7	Buxa	West Bengal
8	Namdapha	Arunachal Pradesh
9	Pakke/Pakhui	Arunachal Pradesh
10	Kamlang	Arunachal Pradesh
11	Orang	Assam
12	Manas	Assam
13	Nameri	Assam
14	Kaziranga	Assam
15	Dampa	Mizoram
16	Ranthambore	Rajasthan
17	Sariska	Rajasthan
18	Mukandra Hills	Rajasthan
19	Kanha	Madhya Pradesh
20	Pench	Madhya Pradesh
21	Bandhavgarh	Madhya Pradesh
22	Panna	Madhya Pradesh
23	Satpura	Madhya Pradesh
24	Sanjay-Dubri	Madhya Pradesh
25	Melghat	Maharashtra
26	Tadoba-Andhari	Maharashtra
27	Pench	Maharashtra
28	Sahyadri	Maharashtra
29	Nawegaon-Nagzira	Maharashtra
30	Bor	Maharashtra
31	Udanti-sitanadi	Chhattisgarh
32	Achanakmar	Chhattisgarh
33	Indravati	Chhattisgarh
34	Palamau	Jharkhand
35	Simlipal	Odisha
36	Satkosia	Odisha
37	Bandipur	Karnataka
38	Bhadra	Karnataka
39	Dandeli-Anshi	Karnataka
40	Nagarhole	Karnataka
41	BiliRanganatha Temple	Karnataka
42	Nagarjunsagar Srisailam (part)	Andhra Pradesh
43	Nagarjunsagar Srisailam (part)	Telangana
44	Kawal	Telangana
45	Periyar	Kerala
46	Parambikulam	Kerala
47	Kalakad-Mundanthurai	Tamil Nadu

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48	Mudumalai	Tamil Nadu
49	Sathyamangalam	Tamil Nadu
50	Anamalai	Tamil Nadu
51	Srivilliputhur Meghamalai	Tamil Nadu

Pointers for prelims:

1. Nagarjunasagar Srisailam is the largest tiger reserve.
2. Bandipore was the first tiger reserve of India.
3. India hosts around 70% of all the tigers in the world.
4. States like Gujarat, Punjab, Haryana, Himachal Pradesh and UTs like J&K and Ladakh have no tiger reserves.

4th All India Tiger Estimation 2018:

1. Tiger population has grown from 1400 in 2014 to 2967 in 2018.
2. Corbett Tiger Reserve has the highest number of tigers.
3. State wise, Madhya Pradesh has the highest number of tigers followed by Karnataka.
4. No tiger has been found in Buxa (West Bengal), Palamau (Jharkhand) and Dampa (Mizoram) reserves.

In addition to existing reserves, **in-principle approval** has been granted by NTCA for the creation of following new tiger reserves:

1. Ratapani Tiger Reserve (Madhya Pradesh)
2. Sunabeda Tiger reserve (Odisha)
3. Guru Ghasidas (Chhattisgarh)

Final approval has been accorded to Kudremukh National Park to be declared as a tiger reserve.

Amrabad Tiger Reserve in Telangana has been in news for uranium exploration.

1. It lies in the Nallamala hills
2. In 2017, endangered species of mouse deer was reintroduced here.
3. Chenchus tribe are present in the reserve.

2. Elephant Reserves

Project Elephant was launched in 1992 with the objective of protecting elephants and their habitat.

Sl. No	Elephant Range	Location	Elephant Reserve
1	East-Central landscape (South-West Bengal-Jharkhand-Orissa)	West Bengal Jharkhand Odisha Chhattisgarh	Mayurjharna ER Singhbhum ER Mayurbhanj ER Mahanadi ER Sambalpur ER Baitami ER South Odisha ER Lemru ER Badalkhol-Tamorpingla ER
2	Kameng-Sonitpur Landscape (Arunachal-Assam) Total	Arunachal Pradesh Assam	Kameng ER Sonitpur ER
3	Eastern-South Bank Landscape (Assam-Arunachal Pradesh)	Assam Arunachal Pradesh	Dihing-Patkai ER South Arunachal ER

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4	Kaziranga-Karbi Anglong-Intanki Landscape (Assam-Nagaland)	Assam Nagaland	Kaziranga-Karbi Anglong ER Dhansiri-Lungding ER Intanki ER Singphan ER
5	North Bengal-Greater Manas Landscape (Assam-West Bengal)	Assam West Bengal	Chirang-Ripu ER Eastern Dooars ER
6	Meghalaya Landscape	Meghalaya	Garo Hills ER Khasi Hills ER
7	Brahmagiri-Nilgiri-Eastern Ghat Landscape (Karnataka-Kerala-Tamilnadu-Andhra)	Karnataka Kerala Tamil Nadu Andhra Pradesh	Mysore ER Wayanad ER Nilambur ER Nilgiri ER Coimbatore ER Rayala ER
8	Anamalai-Nellianpathy-High Range Landscape (Tamil Nadu-Kerala)	Tamil Nadu Kerala	Anamalai ER Anamudi ER
9	Periyar-Agasthymalai Landscape (Kerala-Tamilnadu)	Kerala Tamil Nadu	Periyar ER Srivilliputhur ER
10	North-Western Landscape (Uttarakhand-Uttar Pradesh)	Uttar Pradesh Uttarakhand	Uttar Pradesh ER Shivalik ER

Pointers for prelims:

1. The oldest female is the leader of an elephant group.
2. A breeding pair remains together for around 3 weeks.
3. Elephants have a life expectancy of around 70 years.
4. As of 2017 Census, India is home to 27,312 elephants. It accounts for 55% of the total world elephant population.
    a. South India has the highest number of wild elephants- 14,612.
    b. Among the south Indian states, **Karnataka leads** the table followed by Kerala.

3. Biodiversity Heritage Sites in India

"Biodiversity Heritage Sites" (BHS) are well defined areas that are unique, ecologically fragile ecosystems - terrestrial, coastal, inland waters and marine, having rich biodiversity comprising of any one or more of the following components: richness of wild as well as domesticated species or intra-specific categories, high endemism, presence of rare and threatened species, keystone species, species of evolutionary significance, wild ancestors of domestic/ cultivated species or their varieties, past pre-eminence of biological components represented by fossil beds and having significant cultural, ethical or aesthetic values. They are important for the maintenance of cultural diversity, with or without a long history of human association with them.

Sl. No	Name	State
1	Nallur Tamarind Grove	Karnataka
2	Hogrekan	Karnataka
3	University of Agricultural Sciences, GKVK Campus, Bengaluru	Karnataka
4	Ambaraguda	Karnataka
5	Glory of Allapalli	Maharashtra
6	Tonglu BHS under the Darjeeling Forest Division	West Bengal

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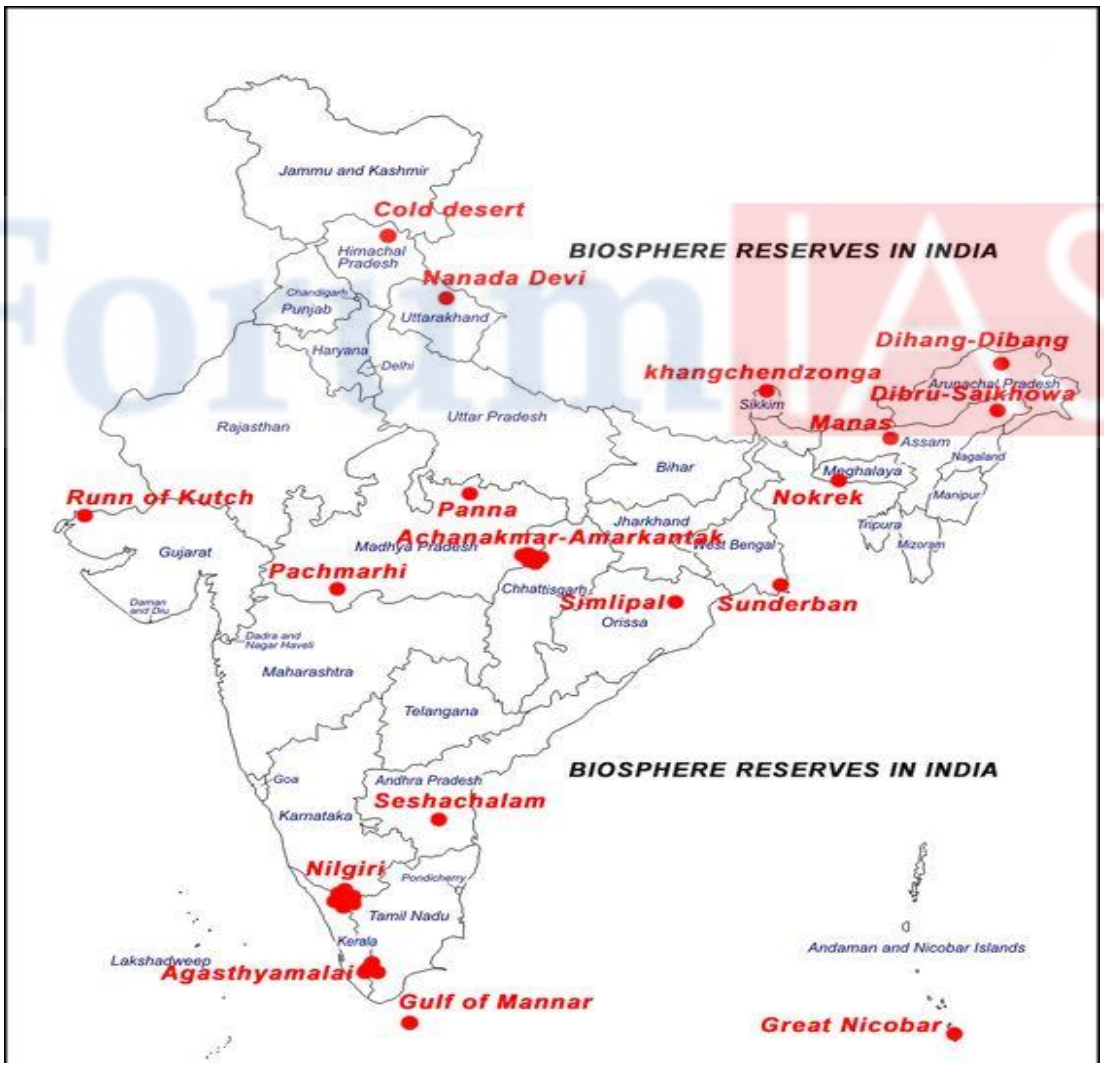
7	Dhotrey BHS under the Darjeeling Forest Division	West Bengal
8	Dialong Village	Manipur
9	Ameenpur Lake	Telangana
10	Majuli	Assam
11	Ghariyal Rehabilitation Centre	Uttar Pradesh
12	Chilkigarh Kanak Durga	West Bengal
13	Khlaw Kur Syiem Kmielng	Meghalaya
14	Mandasaru	Odisha
15	Purvatali Rai	Goa
16	Naro Hills	Madhya Pradesh
17	Patalkot	Madhya Pradesh
18	Asramam	Kerala

4. Biosphere Reserves

UNESCO initiated the program of Biosphere Reserves in 1971 under its Man and Biosphere (MAB) Programme.



Sl. No	Name	Location (State)	Key fauna
1	Achnakamar-Amarkantak	M.P. and Chhattisgarh (Maikal Hills)	Sarus crane, white rumped vulture

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2	Agasthyamalai	Neyyar, Peppara and Shendurney Wildlife Sanctuaries in Kerala	Nilgiri tahr, Asian elephant
3	Cold Desert	Pin Valley National Park, Chandratal and Sarchu & Kibber Wildlife Sanctuary in Himachal Pradesh	Snow Leopard
4	Dehang-Dibang	Arunachal Pradesh	Musk deer, mishmi takin
5	Dibru-Saikhowa	Assam	Water buffalo, white-winged wood duck
6	Great Nicobar	A&N Islands	Saltwater crocodile
7	Gulf of Mannar	Tamil Nadu	Dugong
8	Kachchh	Gujarat	Indian wild ass
9	Khangchendzonga	Sikkim	Snow leopard, red panda, Tibetan Wild Ass
10	Manas	Assam	Asiatic elephant, tiger, Assam roofed turtle, hispid hare, golden langur, pygmy hog
11	Nanda Devi	Uttarakhand	Snow Leopard
12	Nilgiri (India's first Biosphere Reserve)	Parts of Wayanad, Nagarhole, Bandipur and Madumalai, Nilambur, Silent Valley and Siruvani hills (Tamil Nadu, Kerala, and Karnataka)	Nilgiri tahr, tiger, lion tailed macaque
13	Nokrek	Garo hills (Meghalaya)	Red panda
14	Pachmarhi	M.P.	Giant squirrel, flying squirrel
15	Seshachalam Hill	Andhra Pradesh	Slender loris
16	Simlipal	Odisha	Royal Bengal tiger, Asian elephant
17	Sunderbans	West Bengal	Royal Bengal tiger
18	Panna	M.P.	

Pointers for prelims:

1. **Gulf of Kachchh**, Gujarat is the largest Biosphere Reserve while **Dibru-Saikhowa**, Assam is the smallest.
2. **Rann of Kachchh:**
    a. Tropic of Cancer passes through it.
    b. Luni river drains into it.
    c. Known for Banni Grasslands and Chari-Dhand Wetland Conservation Reserve.
3. **Nanda Devi peak** is drained by Rishi Ganga.
4. **Dibru-Saikhowa:**
    a. Drained by Brahmaputra river, Lohit river and Dibru river.
5. **Pachmarhi:**
    a. Satpura National Park, Bori Sanctuary and Pachmarhi Sanctuary are present.
6. **Achanakamar-Amarkantak:**
    a. Drained by Narmada, Johilla and Son river.
    b. Maikal ranges together with Vindhya and Satpura lies within the reserve.
7. **Simlipal:**
    a. "Mugger Crocodile Management Programme" was started here.
    b. Famous for Gaurs and Chausingha.
8. **Great Nicobar:**
    a. Cambell Bay National Park and Galathea National Park are present.

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5. World Network of Biosphere Reserves (WNBR)

12 out of 18 Biosphere Reserves are a part of World Network of Biosphere Reserves, based on UNESCO Man and Biosphere (MAB) Programme list.

Sl. No	Name (Year)	State
1	Nilgiri (2000)	Tamil Nadu, Kerala, Karnataka
2	Gulf of Mannar (2001)	Tamil Nadu
3	Sunderbans (2001)	West Bengal
4	Nanda Devi (2004)	Uttarakhand
5	Nokrek ((2009)	Meghalaya
6	Pachmarhi (2009)	Madhya Pradesh
7	Similipal (2009)	Odisha
8	Achanakmar-Amarkantak (2012)	Chhattisgarh
9	Great Nicobar (2013)	A&N Islands
10	Agasthyamalai Biosphere Reserve (2016)	Kerala and Tamil Nadu
11	Khangchendzonga National Park (2018)	Sikkim
12	Panna (2020)	M.P.

Khangchendzonga National Park is one of the highest ecosystems in the world located at the trijunction of Sikkim, Nepal and Tibet. It was inscribed as India's first '**Mixed World Heritage Site**'.

6. Sacred Groves

Sacred groves are patches of primeval forest that some rural communities protect as abodes of deities. Sacred Groves have been legally protected under 'community reserves' in the Wildlife (Protection) Amendment Act, 2002.

Sl. No	Name	State
1	Pavithravana	Andhra Pradesh
2	Gumpa Forests	Arunachal Pradesh
3	Gamkhap, Mauhak	Manipur
4	Ki Law Lyngdoh	Meghalaya
5	Orans, Jogmaya	Rajasthan
6	Deorai	Goa
7	Sarana	Jharkhand
8	Devara Kadu	Karnataka
9	Kavu, Sara Kavu	Kerala
10	Devrai, Devrahati, Devgudi	Maharashtra
11	Jahera, Thakuramma	Odisha
12	Kovil Kadu	Puducherry
13	Swami shola, Koilkadu	Tamil Nadu
14	Deo Bhumi, Bugyal	Uttarakhand
15	Garamthan, Harithan, Jahera, Sabitrithan, Santalburithan	West Bengal

Maharashtra accounts for the highest number of sacred groves followed by Karnataka.

7. Natural World Heritage Sites

They are listed by UNESCO for their cultural or physical significance.

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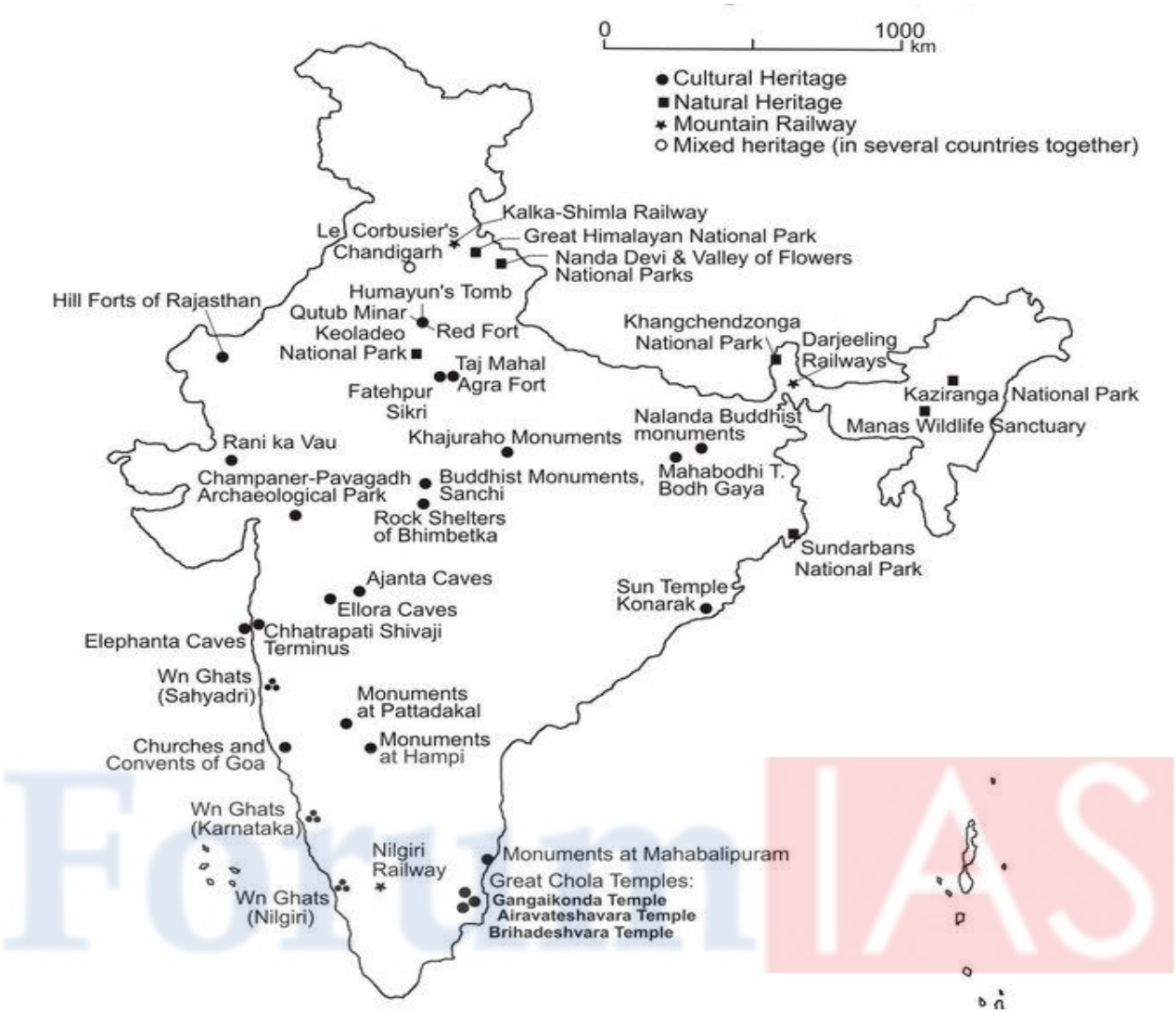

Sl. No	Name	State
1	Kaziranga national Park	Assam
2	Manas Wildlife Sanctuary	Assam
3	Sunderbans National Park	West Bengal
4	Keoladeo Ghana National Park	Rajasthan
5	Nanda Devi National Park	Uttarakhand
6	Western ghats	Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala
7	Great Himalayan National park	Himachal Pradesh

Kaziranga National Park is also recognized as an 'Important Bird Area' by Birdlife International.

8. Mangrove sites in India

Sl. No	Name	State
1	Sunderbans	West Bengal
2	Bhitarkanika Mahanadi Subernarekha Chilika	Odisha
3	Coringa East Godavari Krishna	Andhra Pradesh

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4	Pichavaram Pulicat	Tamil Nadu
5	North Andamans Nicobar	A&N Islands
6	Vembanad	Kerala
7	Karwar	Karnataka
8	Goa	Goa
9	Ratnagiri Vaitarna Malvan	Maharashtra
10	Gulf of Kutchh Gulf of Khambat	Gujarat

Pointers for prelims:

1. Godavari Mangroves at **Coringa Wildlife Sanctuary (CWLS)** are touted to be the second largest mangroves in India. The largest mangrove forest in the world is Sunderbans, West Bengal.
2. The mangrove forests in Andhra Pradesh are located in the estuaries of Godavari and Krishna rivers.
3. CWLS, located in Andhra Pradesh is home to several endangered species like fishing cat, flamingoes, pelicans, heron among others.
4. **Hope Island** too comes under the purview of CWLS.

9. Marine National Park and Wildlife Sanctuaries

Sl. No	Name	State
1	Gulf of Kutch Marine National Park	Gujarat
2	Mahatma Gandhi Marine National Park (also known as Wandoor National Park)	Andaman Islands
3	Gahirmatha Wildlife Sanctuary	Odisha
4	Gulf of Mannar Marine National Park	Tamil Nadu
5	Malvan Marine Wildlife Sanctuary	Maharashtra

Gahirmatha Marine Wildlife Sanctuary is the biggest nesting ground for Olive Ridley Turtles in the world. **Olive Ridley Turtles** are the most abundant of all sea turtles found in the world. They are known for their unique mass nesting called **arribada**. They are predominantly carnivorous in nature. IUCN has classified them as 'Vulnerable'.

10. National Parks and Wildlife Sanctuaries in news

Sl. No	Name	State
1	Hemis National Park	Ladakh
2	Keibul Lamjao National Park	Manipur
3	Namdapha National Park	Odisha
4	Neora Valley National Park	West Bengal
5	Gumti	Tripura
6	Trishna Wildlife Sanctuary	Tripura
7	Sukhna Wildlife Sanctuary	Chandigarh
8	Dalma Wildlife Sanctuary	Jharkhand
9	Eaglenest Wildlife Sanctuary Mouling National Park	Arunachal Pradesh
10	Kishtewar National Park	Jammu and Kashmir

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11	Tipeshwar Wildlife Sanctuary Painganga Wildlife Sanctuary	Maharashtra
12	Desert National Park	Rajasthan
13	Nauradehi Sanctuary	Madhya Pradesh
14	Tally Valley Wildlife Sanctuary	Arunachal Pradesh
15	Atapaka bird sanctuary	Andhra Pradesh
16	Nalbana bird sanctuary	Odisha
17	Singphan Wildlife sanctuary Intanki National Park Puliebadze Wildlife Sanctuary Fakim Wildlife Sanctuary Rangapahar Wildlife Sanctuary	Nagaland
18	Valley of Flower National Park	Temperate Alpine Zone of Uttarakhand
19	Kanhargaon Sanctuary	Maharashtra

Pointers for prelims:

1. **Namdapha National Park**
    a. This region is famous for its Diterocarp forests.
    b. Its climate varies from tropical to subtropical, temperate and arctic.
    c. **Hoolock Gibbons**, only ape in India, is found here.
    d. This protected area is India's only national park credited with providing a haven to all the three top types of cat- snow leopard, clouded leopard and Bengal tiger.
2. **Nauradehi Sanctuary** is the potential site for Cheetah reintroduction.
a. It spreads across two river basins: Ganges and Narmada
3. **Atapaka bird sanctuary** in Kolleru is a breeding ground for pelicans and painted stork.
4. **Nalbana bird sanctuary** is the core area of Chilka lake.
5. **Keibul Lamjao National Park**
    a. Loktak Lake present in this park is known for '**floating phumdis**'.
    b. **Sangai**, an endemic and endangered subspecies of brow-antlered deer is found only in this park.

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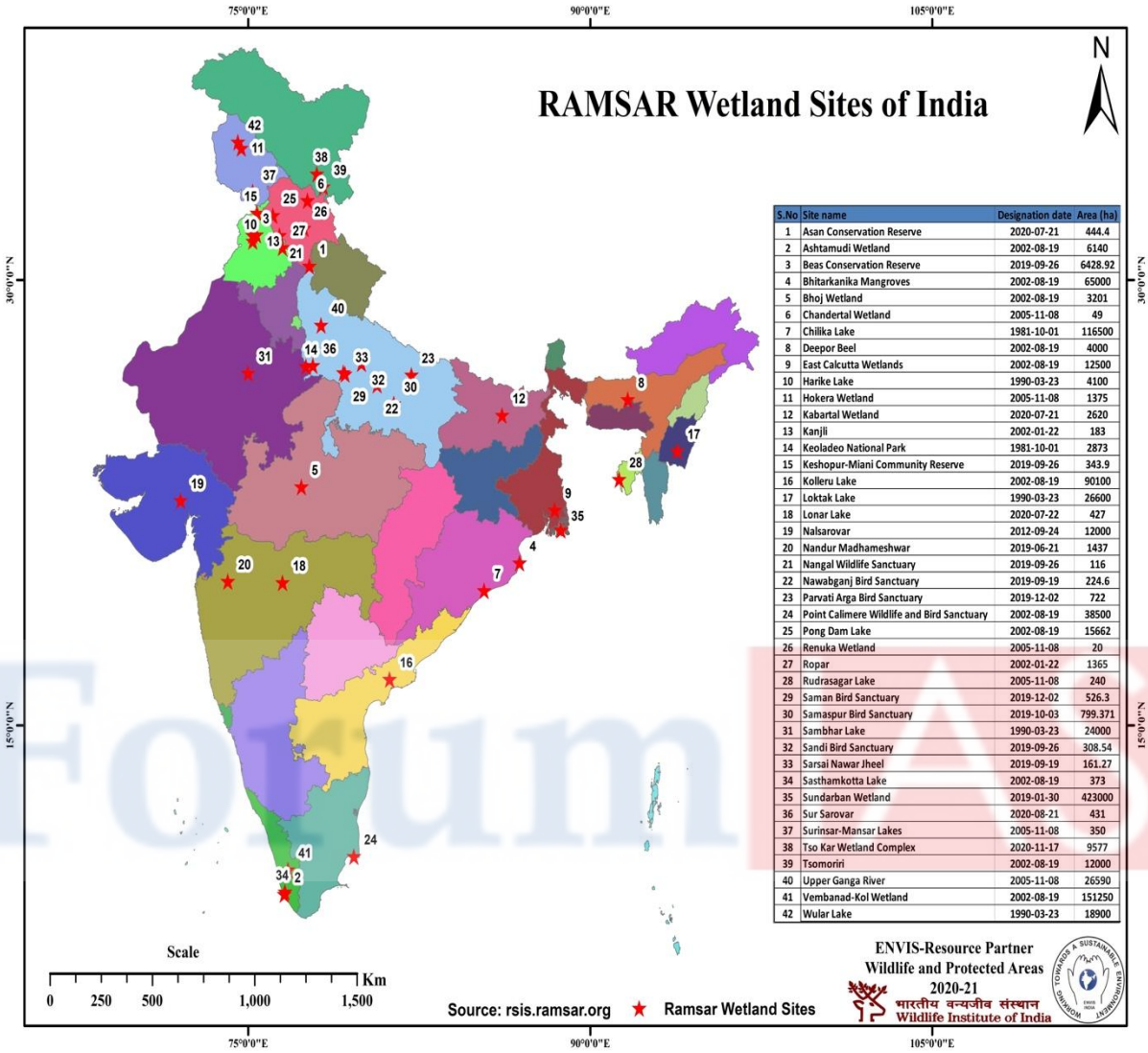
11. Ramsar sites

Ramsar convention is an international treaty for the conservation and sustainable use of wetlands.



S.No	Site name	Designation date	Area (ha)
1	Asan Conservation Reserve	2020-07-21	444.4
2	Ashtamudi Wetland	2002-08-19	6140
3	Beas Conservation Reserve	2019-09-26	6428.92
4	Bhitarkanika Mangroves	2002-08-19	65000
5	Bhoj Wetland	2002-08-19	3201
6	Chandertal Wetland	2005-11-08	49
7	Chilika Lake	1981-10-01	116500
8	Deepor Beel	2002-08-19	4000
9	East Calcutta Wetlands	2002-08-19	12500
10	Harike Lake	1990-03-23	4100
11	Hokera Wetland	2005-11-08	1375
12	Kabartal Wetland	2020-07-21	2620
13	Kanjli	2002-01-22	183
14	Keoladeo National Park	1981-10-01	2873
15	Keshopur-Miani Community Reserve	2019-09-26	343.9
16	Kolleru Lake	2002-08-19	90100
17	Loktak Lake	1990-03-23	26600
18	Lonar Lake	2020-07-22	427
19	Nalsarovar	2012-09-24	12000
20	Nandur Madhameshwar	2019-06-21	1437
21	Nangal Wildlife Sanctuary	2019-09-26	116
22	Nawabganj Bird Sanctuary	2019-09-19	224.6
23	Parvati Arga Bird Sanctuary	2019-12-02	722
24	Point Calimere Wildlife and Bird Sanctuary	2002-08-19	38500
25	Pong Dam Lake	2002-08-19	15662
26	Renuka Wetland	2005-11-08	20
27	Ropar	2002-01-22	1365
28	Rudrasagar Lake	2005-11-08	240
29	Saman Bird Sanctuary	2019-12-02	526.3
30	Samaspur Bird Sanctuary	2019-10-03	799.371
31	Sambhar Lake	1990-03-23	24000
32	Sandi Bird Sanctuary	2019-09-26	308.54
33	Sarsai Nawar Jheel	2019-09-19	161.27
34	Sasthamkotta Lake	2002-08-19	373
35	Sundarban Wetland	2019-01-30	423000
36	Sur Sarovar	2020-08-21	431
37	Surinsar-Mansar Lakes	2005-11-08	350
38	Tso Kar Wetland Complex	2020-11-17	9577
39	Tsomoriri	2002-08-19	12000
40	Upper Ganga River	2005-11-08	26590
41	Vembanad-Kol Wetland	2002-08-19	151250
42	Wular Lake	1990-03-23	18900

Sl. No	Name of Site	State
1	Asan Conservation Reserve	Uttarakhand
2	Asthamudi Wetland	Kerala
3	Beas Conservation Reserve	Punjab
4	Bhitarkanika Mangroves	Orissa
5	Bhoj Wetlands	Madhya Pradesh
6	Chandertal Wetland	Himachal Pradesh
7	Chilka Lake	Orissa
8	Deepor Beel	Assam
9	East Kolkata Wetlands	West Bengal
10	Harike Lake	Punjab
11	Hokera Wetland	Jammu and Kashmir
12	Kabartal Wetland	Bihar
13	Kanjli Lake	Punjab
14	Keoladeo Ghana NP	Rajasthan
15	Keshopur-Miani Community Reserve	Punjab
16	Kolleru Lake	Andhra Pradesh

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17	Loktak Lake	Manipur
18	Lonar Lake	Maharashtra
19	Nalsarovar Bird Sanctuary	Gujarat
20	Nandur Madhameshwar	Maharashtra
21	Nangal Wildlife Sanctuary	Punjab
22	Nawabganj Bird Sanctuary	Uttar Pradesh
23	Parvati Agra Bird Sanctuary	Uttar Pradesh
24	Point Calimere Wildlife and Bird Sanctuary	Tamil Nadu
25	Pong Dam Lake	Himachal Pradesh
26	Renuka Wetland	Himachal Pradesh
27	Ropar Lake	Punjab
28	Rudrasagar Lake	Tripura
29	Saman Bird Sanctuary	Uttar Pradesh
30	Samaspur Bird Sanctuary	Uttar Pradesh
31	Sambhar Lake	Rajasthan
32	Sandi Bird Sanctuary	Uttar Pradesh
33	Sarsai Nawar Jheel	Uttar Pradesh
34	Sasthamkotta Lake	Kerala
35	Sunderbans Wetland	West Bengal
36	Surinsar-Mansar Lakes	Jammu and Kashmir
37	Sur Sarovar	Uttar Pradesh
38	Tso Kar Wetland Complex	Ladakh
39	Tsomoriri Lake	Jammu and Kashmir
40	Upper Ganga River (Brijghat to Narora Stretch)	Uttar Pradesh
41	Vembanad Kol Wetland	Kerala
42	Wular Lake	Jammu & Kashmir

Pointers for prelims:

1. **Kolleru Lake**
    a. Freshwater Lake
    b. Located between Krishna and Godavari rivers.
    c. Supports Spot-billed Pelicans, Painted Storks as well as the critically endangered Spoon-billed Sandpiper.
2. **Wular Lake**
    a. Largest freshwater lake in India.
    b. Situated on the Jhelum river.
3. **Tsomoriri**
    a. Brackish lake.
4. **Pong Dam Lake**
    a. It is a manmade wetland.
5. **Chilka Lake**
    a. Mouth of Daya river.
6. **Ropar and Kanjli Wetland**
    a. A manmade wetland
7. **Bhitarkanika Mangroves**
    a. Known for salt-water crocodiles, olive ridley.
    b. Brahmani and Baitrani river delta.
    c. This is an important site of wildlife and biodiversity and a protected area.
8. **Bhoj Wetland**
    a. Manmade reservoir
    b. Largest bird of India, Sarus Crane is found here.
9. **Keoladeo Ghana National Park**
    a. Also known as Bharatpur Bird Sanctuary.

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b. Home of rare Siberian Cranes.

10. **Lonar Lake**:
    a. It is situated in **Deccan Plateau's volcanic basalt rock** and was created by the impact of a meteor 35,000 to 50,000 years ago.
    b. The lake is a part of Lonar Wildlife Sanctuary which falls under the unified control of Melghat Tiger Reserve.
    c. It is a notified **National Geo-heritage Monument.**
    d. The water in the lake is highly saline, containing special micro-organisms like anaerobes, cyanobacteria and phytoplankton.
11. **Sur Sarovar Lake**:
    a. It is also known as **Keetham Lake.**
    b. The lake is situated alongside river Yamuna in Agra, Uttar Pradesh.
    c. It has a **Beer Rescuing Centre** for rescued dancing beers.

Pulicat lake is not a Ramsar site. But it is an important lake near Chennai. Flamingo festival is a major attraction here.

12. Reports and indices

Sl. No	Report	Publisher
1	Emissions Gap Report, Our Planet, Tunza, Atlas of Our Changing Environment, Global Environment Outlook, Adaptation Gap Report	UNEP
2	Greenhouse Gas Bulletin	WMO
3	Climate Change Performance Index	Germanwatch, New Climate Institute and Climate Action Network
4	Global Climate Risk Index	Germanwatch
5	Living Planet Report	WWF
6	Hindu Kush Himalayan Assessment Report	International Centre for Integrated Mountain Development
7	State Energy Efficiency Preparedness Index	Alliance for Energy Efficient Economy (AEEE) along with Bureau of Energy Efficiency (BEE)
8	Comprehensive Environmental Pollution Index (CEPI)	CPCB
9	EnviStats Report	Ministry of Statistics and Programme Implementation (MoSPI)

UNEP (United Nations Environment Program) is the leading environmental authority that sets the global environmental agenda. It is headquartered in Nairobi, Kenya and depends on voluntary contributions for 95% of its funding.

Awards by UNEP for environmental work include:

1. **SEED Awards**
2. **Champions of the Earth Award**
3. **Sasakawa Prize**

UNEP has also launched initiatives like:

1. **Faith for Earth Initiative** to strategically engage with faith-based organizations and partner with them to collectively achieve SDGs.
2. **UNEP Finance Initiative (UNEP FI)** to develop global partnership between UNEP and the financial sector.

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