

L1 Syllabus, Ecosystem

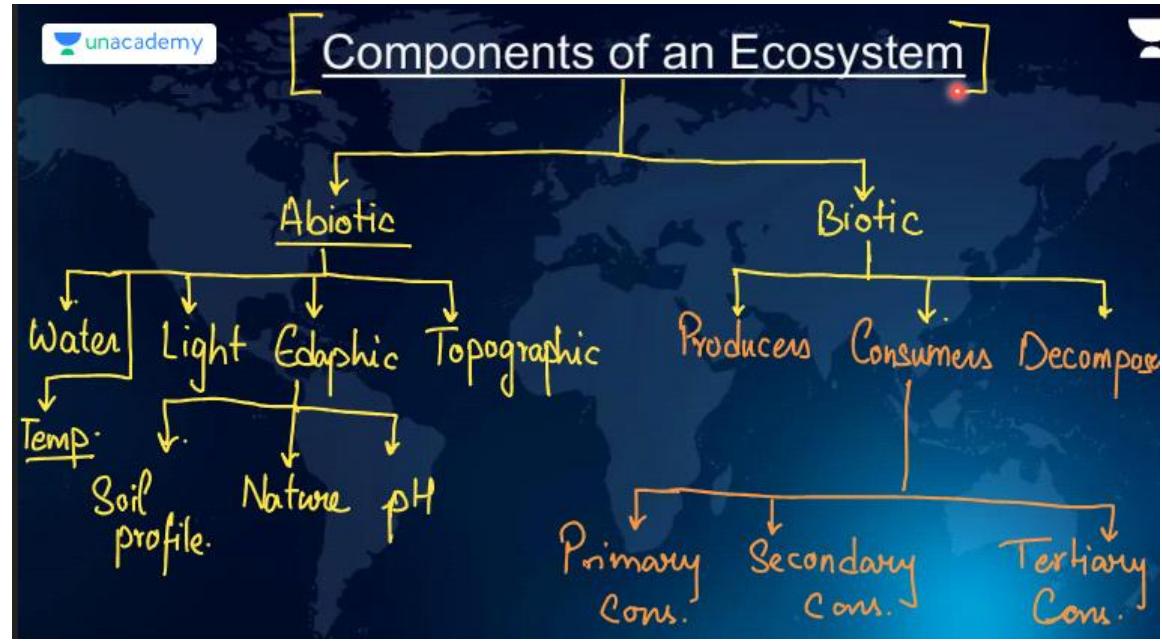
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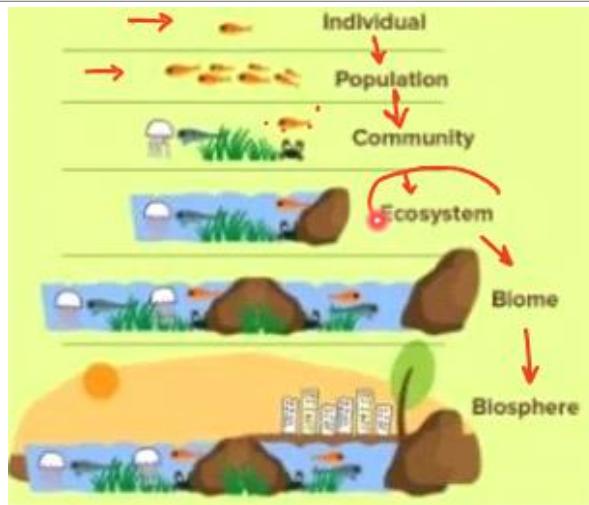
Environment weightage	<p>Importance & Approach</p> <pre> graph LR Prelims[Prelims → 12-15 questions] --> Conceptual[Conceptual → 8] Prelims --> CurrentAffairs[Current Affairs → 3-4] Prelims --> Factual[Factual → 3-4] Mains[Mains → 45-50 marks GS III] --> Conceptual Mains --> CurrentAffairs Mains --> Factual Conceptual --> CurrentAffairs Conceptual --> Factual </pre>			
Syllabus	<pre> graph TD Sources[Sources] --> CurrentAffairs[Current Affairs] Sources --> DTE[Down to Earth] CurrentAffairs --> Agri[Agni.] CurrentAffairs --> Env[Env.] DTE --> Documentaries[Documentaries] Documentaries --> OurPlanet[Our Planet] Documentaries --> LifeOnEarth[Life on Earth] Sources --> Static[Static → VA books] Sources --> AnnotatedPDFs[Annotated PDFs] Sources --> Class12NCERTs[Class 12 NCERTs (Biology)] Sources --> Chapter1316[Chapter 13-16] </pre>			
Topics	<table border="0"> <thead> <tr> <th style="text-align: center;"><u>Topics</u></th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;"> <u>Static</u> <ul style="list-style-type: none"> → Ecosystem → Biomes → Biogeochemical Cycles → Biodiversity → Pollution → Species' Interaction → Principles of Cons. </td> <td style="vertical-align: top;"> <u>Dynamic</u> <ul style="list-style-type: none"> → Climate Change → Conventions → National legislations & Amendments → Environmental bodies → Initiatives for protected areas </td> </tr> </tbody> </table>	<u>Topics</u>	<u>Static</u> <ul style="list-style-type: none"> → Ecosystem → Biomes → Biogeochemical Cycles → Biodiversity → Pollution → Species' Interaction → Principles of Cons. 	<u>Dynamic</u> <ul style="list-style-type: none"> → Climate Change → Conventions → National legislations & Amendments → Environmental bodies → Initiatives for protected areas
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ECOSYSTEM

- The living community of plants and animals in any area together with the non-living components of the environment such as soil, air and water, constitute the ecosystem.



Groups of Ecosystem



BIOTIC FACTORS	
Producers	<ul style="list-style-type: none"> • Producers : Autotrophs • GPP Gross Primary Productivity : Total amount of energy and biomass generated by the primary Producers (Include the energy required for consumption by plant itself) • NPP Net Primary Productivity : total energy available for consumers <ul style="list-style-type: none"> • $NPP = GPP - \text{Energy require for respiration / Metabolism}$ • Photoautotrophs <ul style="list-style-type: none"> • In presence of light • PAR Photosynthetically Active Radiation : Wavelength within the solar rays which is utilizable by plants • Chemotrophs <ul style="list-style-type: none"> • In utilization of chemical (like salt, saline, etc) -> carrying out oxidation to produce carbohydrates and Energy • Mostly presence in areas where lights is not present (Deep sea, Deep Soil, Deep Saline) • Ex : Nitrobacter , Nitrosomonas
Consumers	<ul style="list-style-type: none"> • Herbivorous, Carnivorous, Omnivorous, Detritivorous • Diversity of species is maximum in Tropical region (more than Temperate and polar region) <ul style="list-style-type: none"> • Greater solar insolation : more photosynthesis -> more NPP

	<ul style="list-style-type: none"> • Temperate region freeze during Ice age (coming every 10 years)
Decomposers	<ul style="list-style-type: none"> • 5 Steps Process of Decomposition <ul style="list-style-type: none"> ◦ Fragmentation : <ul style="list-style-type: none"> ◦ breaking down of organic component into smaller subparts ◦ By insects and species ◦ Leaching : <ul style="list-style-type: none"> ◦ Microbial action carried out to remove the liquids from the dead organic matter to which seeps into the soils ◦ This further reduces the size of dead organic matter ◦ Catabolism : <ul style="list-style-type: none"> ◦ Further break down of organic matter by bacterium and other microbes by secretion of enzymes and chemicals ◦ Humification : <ul style="list-style-type: none"> ◦ Left over organic compound is then decomposed to produce dark brown amorphous (No shape) soil like substance known as Humus ◦ This layer increases the fertility of soil ◦ Mineralization : <ul style="list-style-type: none"> ◦ Humus is also decomposed ◦ Organic components -> broken down -> return to the soil as inorganic elements • Requirement for Decomposition <ul style="list-style-type: none"> ◦ Oxygen ◦ Moisture ◦ Warmer Temperature <ul style="list-style-type: none"> ◦ Rate of decomposition : Equatorial Rainforest > temperate coniferous forest • During the process of decomposition release <ul style="list-style-type: none"> ◦ Gases : like CH₄, CO₂ ◦ Heat

Equatorial Rainforest

→ (Rate of decomposition) ↑↑

→ Mineralization will be carried out much quicker.

→ Soil is infertile.

Temperate Zone coniferous forest.

→ Decomposition is a slow process.

→ Humus would be present.

→ Soil is more fertile.

Biosphere

- Confluence of Lithosphere + Hydrosphere + Atmosphere

L2 Abiotic Factors, Habitat, Food Chain

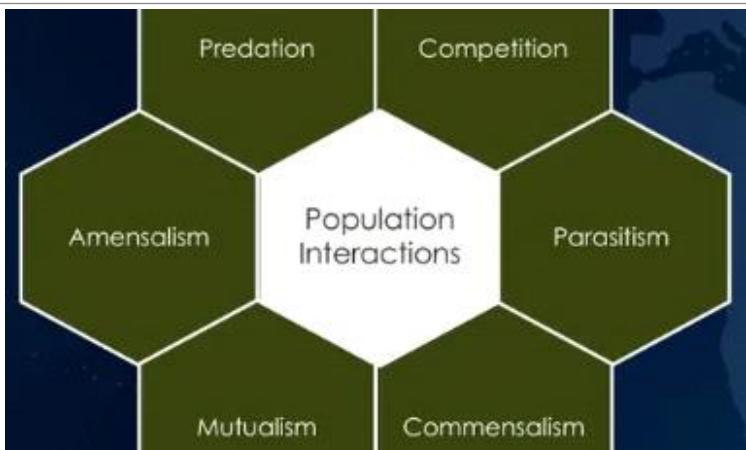
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ABIOTIC FACTORS	<ul style="list-style-type: none">Non-living components such as water, air, nutrients, rocks, heat and solar energy.Temperature / Water / Light
Temperature	<ul style="list-style-type: none">Temperature is the most ecologically relevant environmental factor. The levels of thermal tolerance of different species determine to a large extent their geographical distribution.Thermoregulation : Ability to regulate the internal temperature of the body , helps in adjusting to change in temperatureConsistency of temperature is an important determining factor of speciation (Evolution of newer species)<ul style="list-style-type: none">More diverse organism in equatorial region
	<p>Eurythermal and Stenothermal</p> <p>→ Eurythermal organisms are organisms those who can tolerate wide range of temperature. For instance, cow, human, monkey, sheep,etc.</p> <p>→ Stenothermal organisms are organism those who can tolerate narrow range of temperature. For instance, seals, salmons, reptiles.</p>
	<ul style="list-style-type: none">Aquatic Ecosystem : Temperature tends to remain consistentDue to global warming, many aquatic species move towards the temperate region/ away from tropics
Water	<ul style="list-style-type: none">Next to temperature, water is the most important factor influencing the life of organisms.Life on Earth originated in water and is unsustainable without water.Osmoregulation : ability of the body to regulate internal fluids requirements
Chemical	<ul style="list-style-type: none">Euryhaline : Species having a water tolerance for salinity condition<ul style="list-style-type: none">Ex : SalmonStenohaline : Species having can't tolerate variation in salinity condition<ul style="list-style-type: none">Ex : Coral, Hilsa Fish
Light	<ul style="list-style-type: none">Since plants produce food through photosynthesis, a process which is only possible when sunlight is available as a source of energy, we can quickly understand the importance of light for living organisms, particularly autotrophs.Global Dimming : Reducing of amount of solar insolation reaching the earth because of particle present in the atmosphere<ul style="list-style-type: none">Affects the producer communityHappen at time of Dinosaurs asteroid accidentCan occur because of population
Soil	<ul style="list-style-type: none">Edaphic Factor : Nature / Profile / pH<ul style="list-style-type: none">The nature and properties of soil in different places vary; it is dependent on the climate, the weathering process, whether soil is transported or sedimentary and how soil development occurred.

Changes in Abiotic factors	<ul style="list-style-type: none">Regulate : Changing ability to thermoregulate and osmoregulationConform : Go Extinct (99%)Migrate : move to better and favourable circumstances
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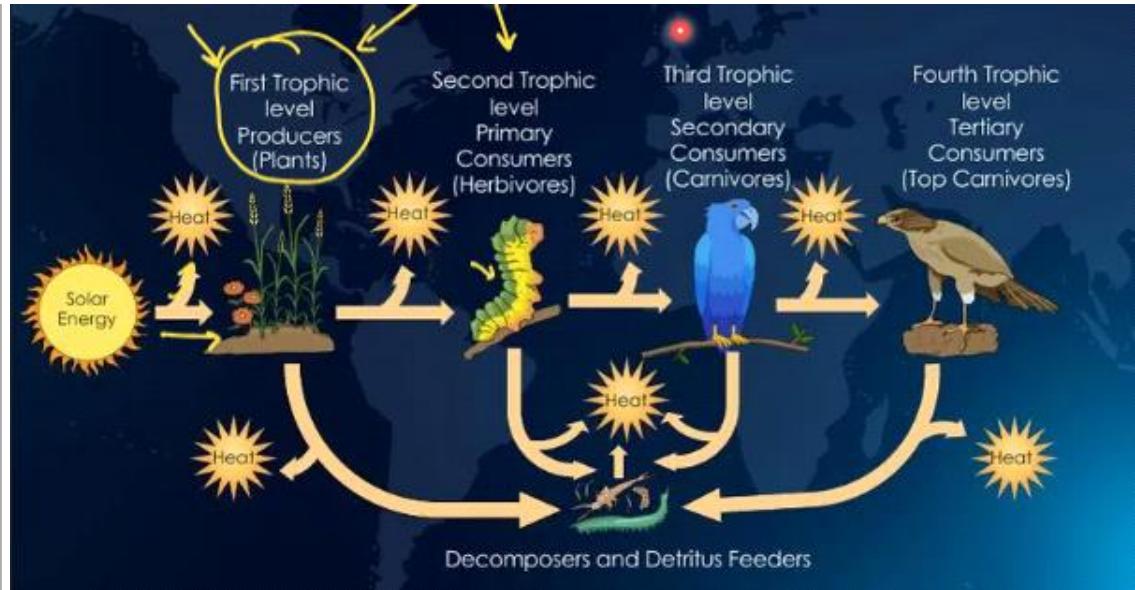
	<ul style="list-style-type: none"> • Suspension : Hibernate
Regulate	<ul style="list-style-type: none"> • Some organisms are able to maintain <u>homeostasis</u> by physiological (sometimes behavioral also) means which ensures constant body temperature, constant osmotic concentration, etc. • All birds and mammals, and a very few lower vertebrate and invertebrate species are indeed capable of such regulation (thermoregulation and osmoregulation).
Confirm	<ul style="list-style-type: none"> • An overwhelming majority (99%) of <u>animals</u> and nearly all plants cannot maintain a constant <u>internal environment</u>. Their body temperature changes with the ambient temperature.
Migration	<ul style="list-style-type: none"> • Bonn Convention : Convention on Migratory Species (CMS) • Flyways : Fixed route or path chosen by the birds in order to migrate from one region to the other <ul style="list-style-type: none"> • India has 3 flyways
Suspend	<ul style="list-style-type: none"> • In higher plants, seeds and some other vegetative reproductive structures serve as means to tide over periods of stress besides helping in dispersal – they germinate to form new plants under favorable moisture and temperature conditions. • Hibernation : Winter sleep to escape the harsh conditions <ul style="list-style-type: none"> ◦ Ex : Polar bear • Aestivation : Summer sleep, to escape shortage of water and high temperature <ul style="list-style-type: none"> ◦ Ex : Snails, repletes etc • Diapause : Suspension of metabolism for as long as harsh conditions exists <ul style="list-style-type: none"> ◦ Ex : Spores
Ecotone	<ul style="list-style-type: none"> • Ecotone : Boundary of two different Ecosystem <p>• An ecotone is an area that <u>acts as a boundary</u> or a transition between two <u>ecosystems</u>. A common example could be an area of marshland between a river and its riverbank.</p> <p>• Ecotones are of great environmental importance.</p> <p>• Examples of ecotones include <u>marshlands</u> (between dry and wet ecosystems), <u>mangrove forests</u> (between terrestrial and marine ecosystems), grasslands (between desert and forest), and estuaries (between saltwater and freshwater). Mountain ranges can also create ecotones due to the changes in the climatic conditions on the slopes.</p> <h3>Characteristics of Ecotones</h3> <ul style="list-style-type: none"> → It may be wide or narrow. • It could contain species that are entirely different from those found in the bordering systems. → Ecotones can be natural or man-made. For example, the ecotone between an <u>agricultural field</u> and a <u>forest</u> is a man-made one
Edge Effect	<ul style="list-style-type: none"> • Edge effects refer to the changes in population or community structures that occur at the boundary of two habitats. Generally, there is a greater number of species found in these regions (ecotones) and this is called the edge effect. The species found here are called edge species. • Ex: Elephants

Habitat	<ul style="list-style-type: none"> The area where an animal lives or its home, usually an ecosystem or an area within an ecosystem. Habitat relates mostly to the non-living physical or chemical conditions of the area such as temperature, rainfall, salinity, sunlight, soil and elevation. 				
Niche	<ul style="list-style-type: none"> A species niche is composed of its habitat, plus the biological or living things found the habitat. <ul style="list-style-type: none"> The living component (plants and animals) of a habitat is called a community. Biological factors include location on the food chain (producers, herbivores, carnivores, etc.) Predator/prey relationships and reproductive requirements. Interrelationships and interactions are important aspects of niche. Specialized Niche : Ex :Dugong These species are always more prone to extinction Specialized niches apply to species which have very well-defined or narrow physical, biological or chemical requirements for survival. If an organism can only be found within very limited or specific conditions, it is considered to have a very specialized niche. 				
Comparison	<p style="text-align: center;">Habitat Versus Niche</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 10px; vertical-align: top;"> A place or part of an ecosystem, occupied by a particular organism Physical place </td> <td style="padding: 10px; vertical-align: top;"> The role of an organism within its environment or ecosystem Function or activity </td> </tr> <tr> <td style="padding: 10px; vertical-align: top;"> Reflects the living place of an organism </td> <td style="padding: 10px; vertical-align: top;"> Reflects its biotic and abiotic association with the environment in terms of its diet, reproduction, and other activities </td> </tr> </table>	A place or part of an ecosystem, occupied by a particular organism Physical place	The role of an organism within its environment or ecosystem Function or activity	Reflects the living place of an organism	Reflects its biotic and abiotic association with the environment in terms of its diet, reproduction, and other activities
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Reflects the living place of an organism	Reflects its biotic and abiotic association with the environment in terms of its diet, reproduction, and other activities				
Population Interaction	 <ul style="list-style-type: none"> Commensalism : One benefit without or negligibly effecting the host Mutualism : Both species benefit Mentalism : Host is getting damaged at the cost of parasite 				

Predation	<ul style="list-style-type: none"> Act as 'conduits' for energy transfer across trophic levels Keeps prey populations under control. Help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species. If a predator is too efficient and over exploits its prey, then the prey might become extinct and following it, the predator will also become extinct for lack of food. <p>Ex : Orca whales</p>
Competition	<ul style="list-style-type: none"> Competition is best defined as a process in which the fitness of one species is significantly lower in the presence of another species. A species whose distribution is restricted to a small geographical area because of the presence of a competitively superior species, is found to expand its distributional range dramatically when the competing species is experimentally removed.
Parasitism	<ul style="list-style-type: none"> In evolutionary biology, parasitism is a relationship between species, where one organism, the parasite, lives on or in another organism, the host, causing it some harm, and is adapted structurally to this way of life.  <p>• Ex : Exigua consumes tongue of fish</p>
Commensalism	<p>This is The Interaction in which one Species Benefits and the other is Neither Harmed nor Benefited.</p>  <p>• Ex : Egrets consume cow dungs, sharks and sucker fish • Whales and Barnacles : need movement</p> 
Mutualism	<ul style="list-style-type: none"> Ex : Corals and zooxanthellae Bee (Nectar) and flower (Pollination)
Amensalism	<p>Amensalism is any relationship between organisms of different species in which one organism is inhibited or destroyed while the other organism remains unaffected.</p> <ul style="list-style-type: none"> Onbeserevd in invasive alien species Ex: Senna Spectabilis, Kerela, grows very quickly and harms other species Lantana Camara, grows quickly and is not consumed by herbivores <ul style="list-style-type: none"> Growing high in Madhya Pradesh -> reduce deer count -> Count of tiger reduce

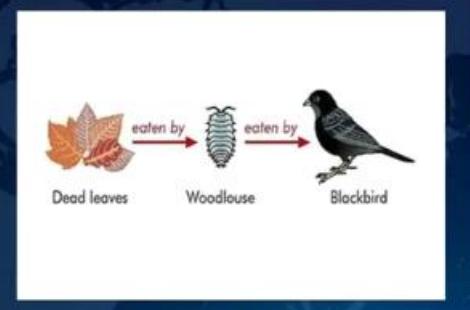
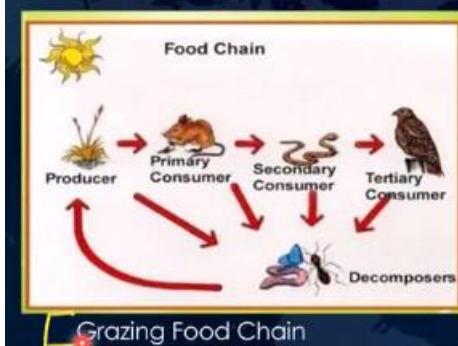
- Eucalyptus : endless stretch of plant because of high growth rate
 - Effect Nilgiris Cows count decline
- Water Hyacinth : Terror of Bengal
 - floating plants in ponds and lake, block the sunlight -> no underwater plant
 - -> No oxygen in water -> water organism is effected

Flow of Energy	<ul style="list-style-type: none"> • Food Chain • Food Web 																					
Trophic Levels	<ul style="list-style-type: none"> • Position in Food Chain <ul style="list-style-type: none"> • The levels of a food chain is called trophic levels. • The sun is the source of all the energy in food chains. Green plants absorb some of the sun's light energy to make their own food by photosynthesis. Green plants (autotrophs) are therefore known as 'producers' in a food chain. • The second level of the food chains is called the primary consumer. These consume the green plants. Animals in this group are usually herbivores. • The third in the chain are secondary consumers. These usually eat up the primary consumers and other animal matter. 																					
	<table border="1"> <thead> <tr> <th>Trophic Levels</th> <th>Source of Energy</th> <th>Examples</th> </tr> </thead> <tbody> <tr> <td>Producers</td> <td>Source of Energy</td> <td>Green plants, photosynthetic protists and bacteria</td> </tr> <tr> <td>Herbivores</td> <td>Producers</td> <td>Grasshoppers, water fleas, antelope, termites</td> </tr> <tr> <td>Primary Carnivores</td> <td>Herbivores</td> <td>Wolves, Spiders, Some snakes, warbles</td> </tr> <tr> <td>Secondary Carnivores</td> <td>Primary carnivores</td> <td>Killer whales, tuna, falcons</td> </tr> <tr> <td>Omnivores</td> <td>Several trophic levels</td> <td>Humans, rats, opossums, Bears, raccoons, Crabs</td> </tr> <tr> <td>Detritivores and decomposers</td> <td>Wastes and dead bodies of other organisms</td> <td>Fungi, many bacteria, Earthworms, vultures</td> </tr> </tbody> </table>	Trophic Levels	Source of Energy	Examples	Producers	Source of Energy	Green plants, photosynthetic protists and bacteria	Herbivores	Producers	Grasshoppers, water fleas, antelope, termites	Primary Carnivores	Herbivores	Wolves, Spiders, Some snakes, warbles	Secondary Carnivores	Primary carnivores	Killer whales, tuna, falcons	Omnivores	Several trophic levels	Humans, rats, opossums, Bears, raccoons, Crabs	Detritivores and decomposers	Wastes and dead bodies of other organisms	Fungi, many bacteria, Earthworms, vultures
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Food Chain	<ul style="list-style-type: none"> • A food chain shows how energy is transferred from one living organism to another via food. • A food chain describes how energy and nutrients move through an ecosystem. At the basic level there are plants that produce the energy, then it moves up to higher-level organisms like herbivores. After that when carnivores eat the herbivores, energy is transferred from one to the other. 																					



Types in Food Chain

- Based on source of energy

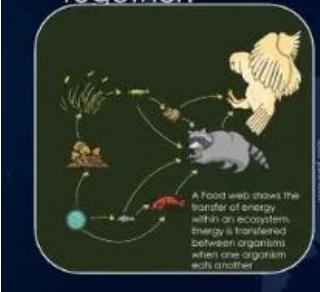


- Grazing : Plant / Producer source of energy
- Detrital : Dead organic matter is source of energy

Food Web

- Diversification of food source increase chance of Survival

- Food web represents feeding relationships within a community. Normally, food webs consist of a number of food chains mashed together.

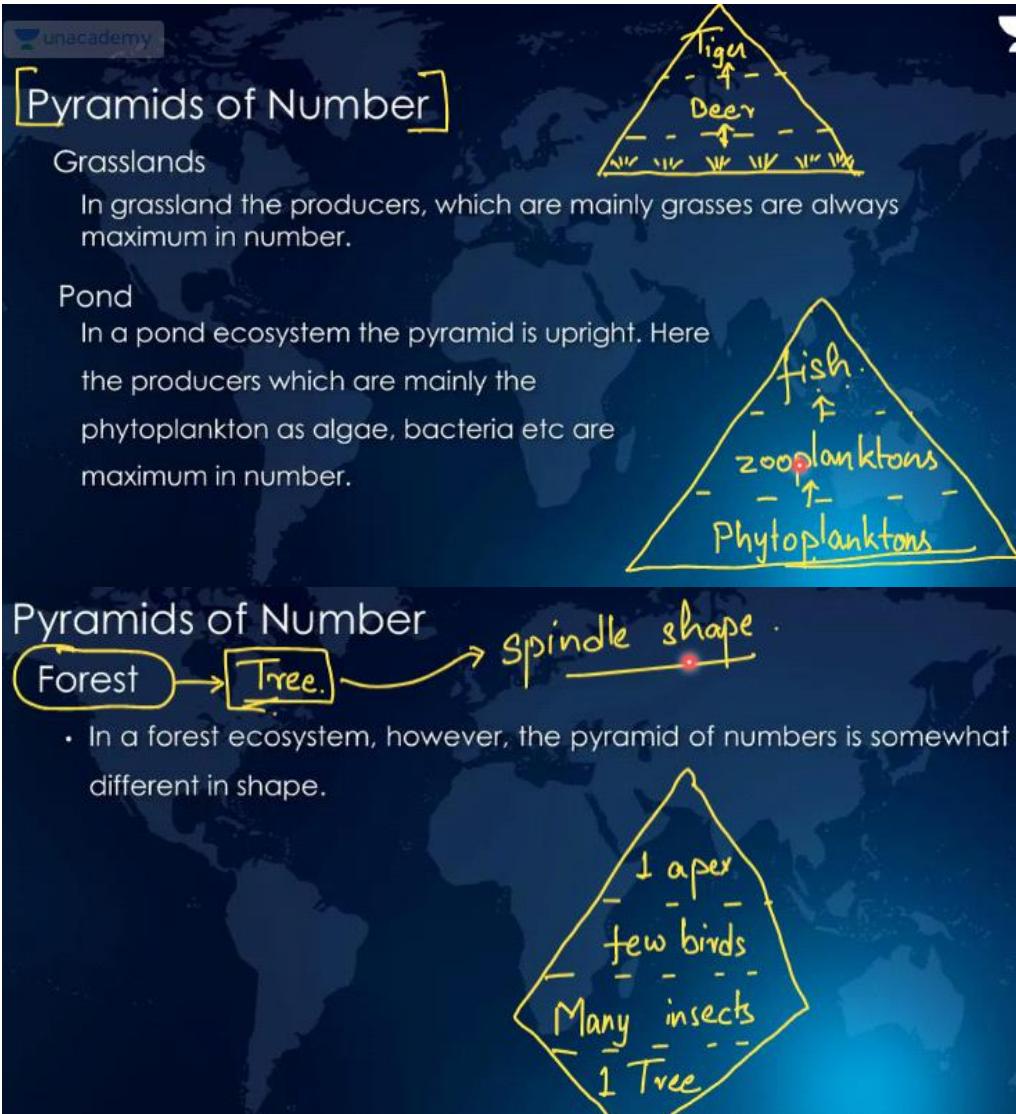


L3 Eco Pyramid, Succession

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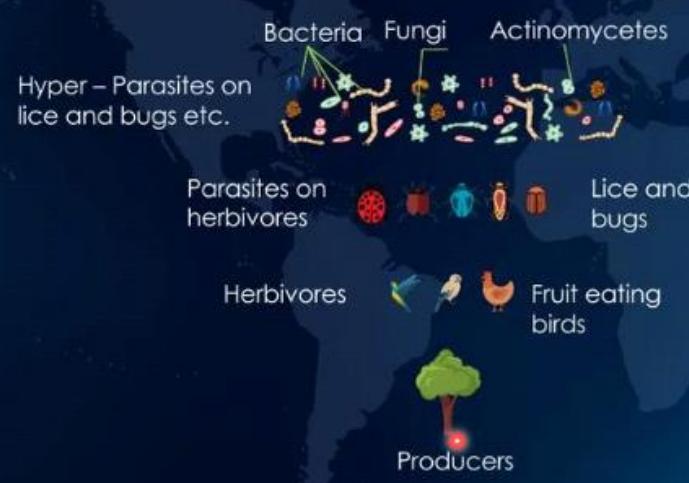
Contamination	<ul style="list-style-type: none"> Transfer of contaminant through the food chain / web Contaminant / Pollutant should be <ul style="list-style-type: none"> Water insoluble : do not pass out by digestive system Fat soluble : Persistent : Maintain integrity for long time
Bioaccumulation	<p>Bioaccumulation</p> <p>TIME</p> <p>Contaminant levels</p> <ul style="list-style-type: none"> Building up of contaminant concentration with time
Biomagnification	<p>Biomagnification</p> <p>Contaminant levels</p> <ul style="list-style-type: none"> Slow build of contaminant or pollutants in the body of organism The build up happens across the same trophic level, as one move up the food chain
Ecological Pyramid	<ul style="list-style-type: none"> The trophic structure and function at successive trophic levels, that is producers → herbivores → carnivores, may be shown graphically by means of ecological pyramids where the first or producer level constitutes the base of the pyramid and the successive levels, the tiers making the apex. Pyramid of numbers Pyramid of biomass : weight of organism Pyramid of energy
Types	<ol style="list-style-type: none"> 1. Pyramid of numbers, showing the number of individual organisms at each level 2. Pyramid of biomass, showing the total dry weight and other suitable measure of the total amount of living matter 3. Pyramid of energy, showing the rate of energy flow and/or productivity at successive trophic levels. The pyramids of numbers and biomass may be upright or inverted depending upon the nature of the food chain in the particular ecosystem, whereas pyramids of energy are always upright

Pyramid of Numbers



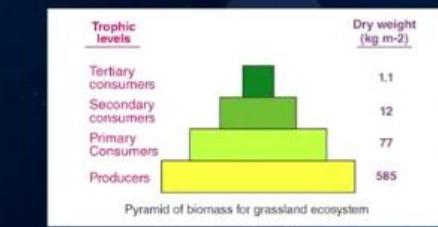
- Parasitic food chain is inverted

Pyramids of Number - In a parasitic food chain

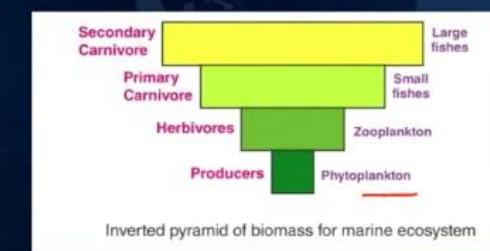


Pyramid of Biomass

- They are comparatively more fundamental.
- In grassland and forest there is generally a gradual decrease in biomass of organisms at successive levels from the producers to the top carnivores. Thus pyramids are upright.



- However, in a pond as the producers are small organisms, their biomass is least, and this value gradually shows an increase towards the apex of the pyramid, thus making the pyramid inverted in shape.

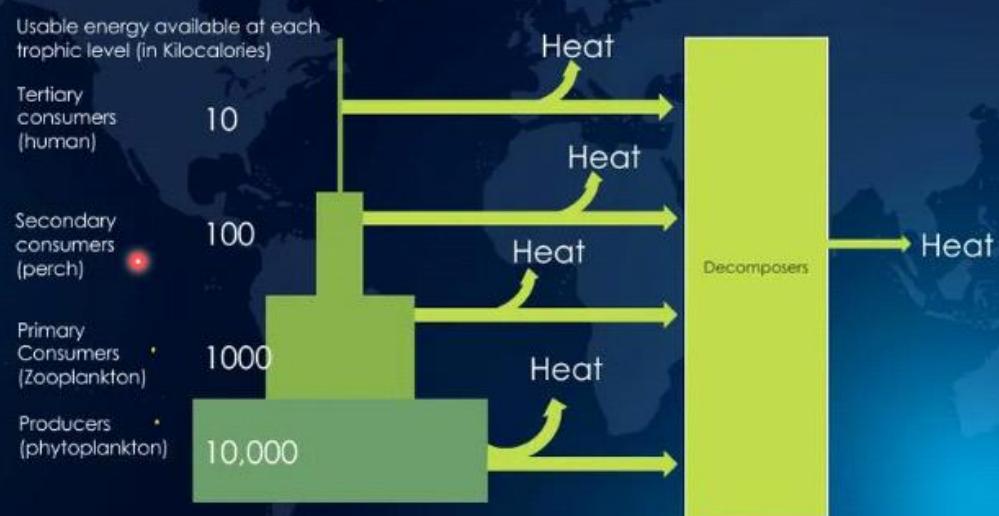


Pyramid of Energy

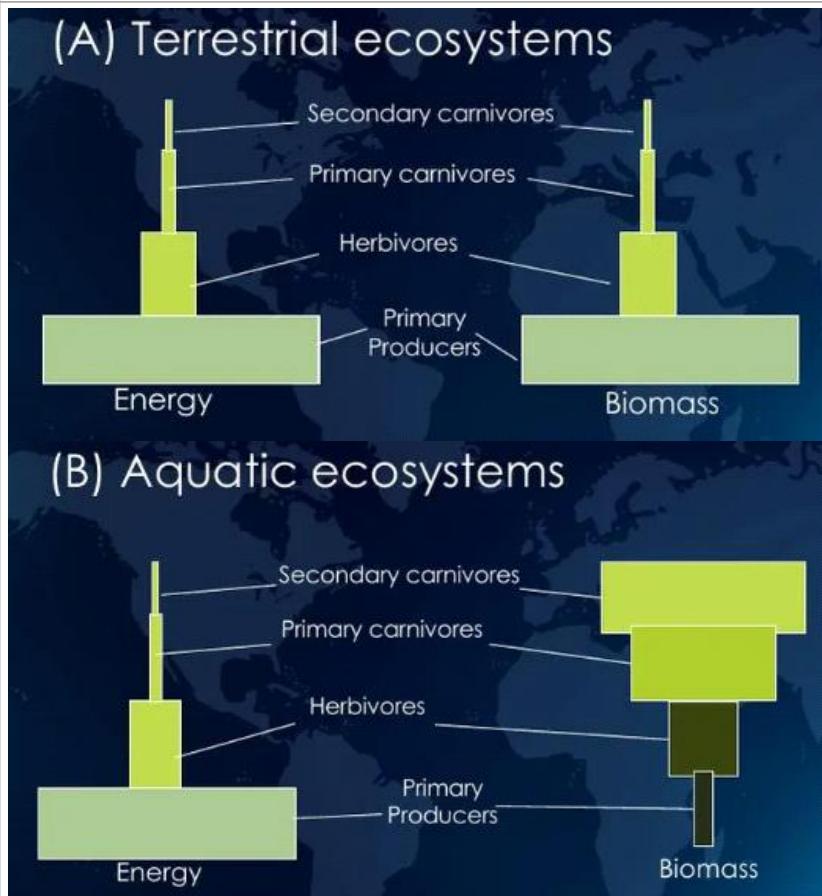
Pyramids of Energy

- Of the three types of ecological pyramids, the energy pyramids give the best picture of overall nature of the ecosystem.
- Here number and weight of organisms at any level depends not on the amount of fixed energy present at any one time in the level just below but rather on the rate at which food is being produced.

Pyramids of Energy



- It is always upright
- 10% rule -> Transfer of 10% energy from one trophic level to the next

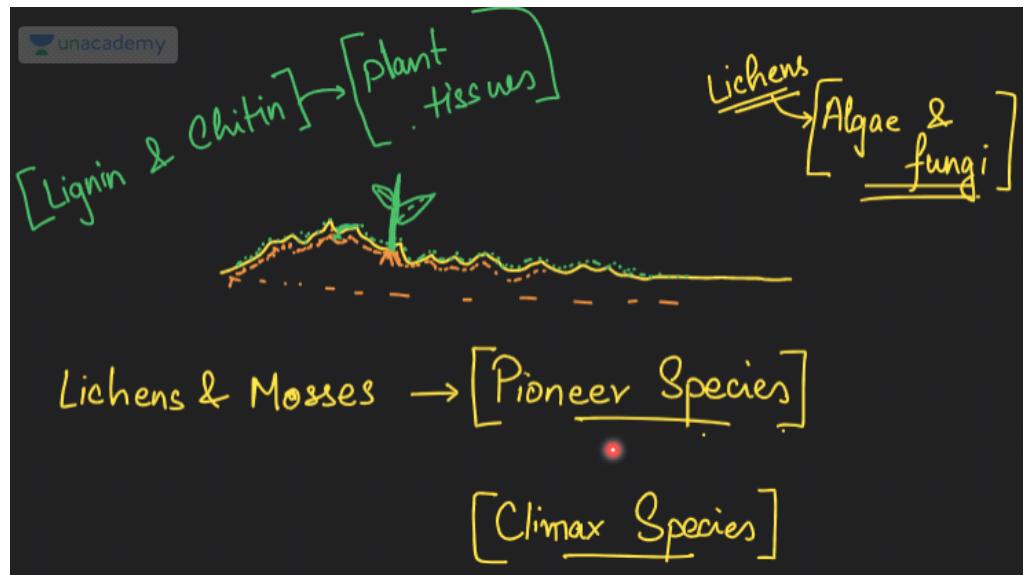


Ecological Succession

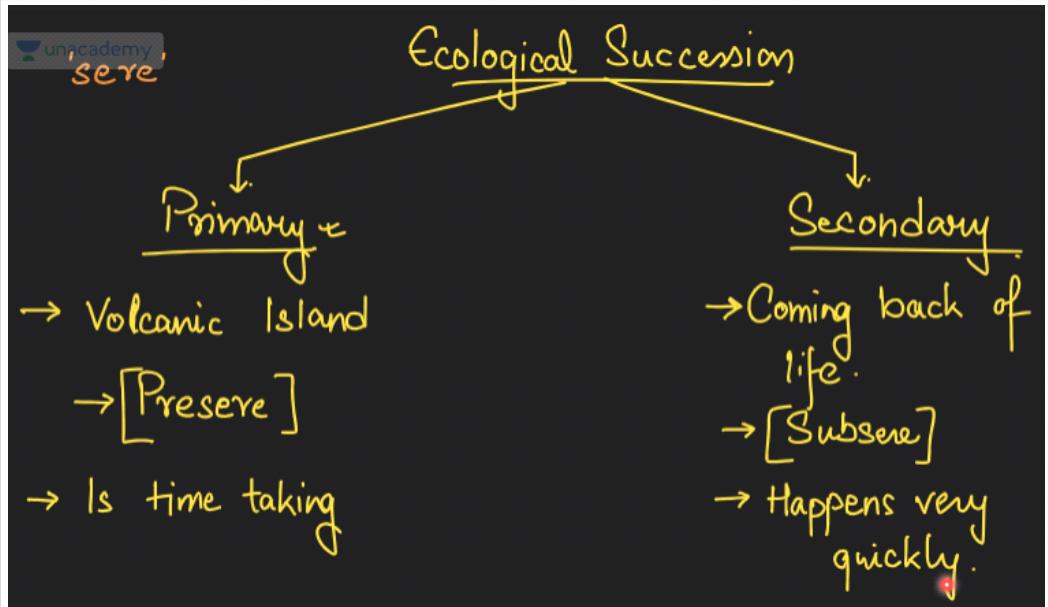
- Ecological succession is the steady and gradual change in a species of a given area with respect to the changing environment. It is a predictable change and is an inevitable process of nature as all the biotic components have to keep up with the changes in our environment.
- The ultimate aim of this process is to reach equilibrium in the ecosystem. The community that achieves this aim is called a climax community. In an attempt to reach this equilibrium, some species increase in number while some others decrease.

- In an area, the sequence of communities that undergo changes is called sere. Thus, each community that changes is called a seral stage or seral community.
- It may be
 - Autogenic- By living inhabitant of that community itself.
 - Allogenic- By outside factor.

- Pioneer Species : Modified the ecosystem
- Climax Species : After organisms



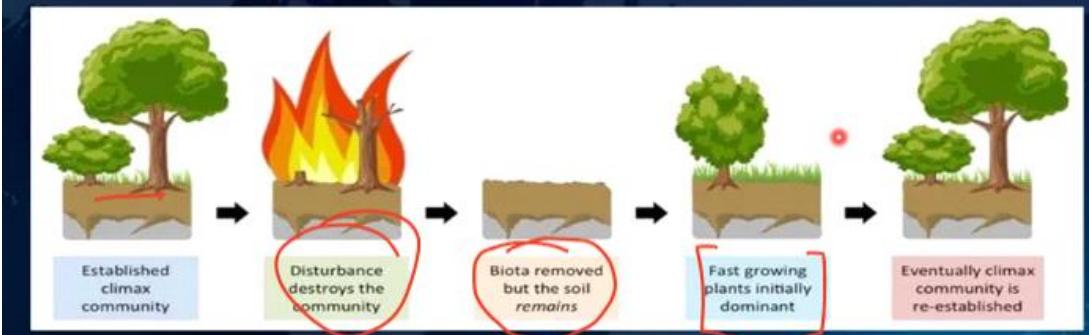
Types



- Primary Succession - "presere"
- Primary succession is the succession that starts in lifeless areas such as the regions devoid of soil or the areas where the soil is unable to sustain life.
- When the planet was first formed there was no soil on earth. The earth was only made up of rocks. These rocks were broken down by microorganisms and eroded to form soil. The soil then becomes the foundation of plant life. These plants help in the survival of different animals and progress from primary succession to the climax community.



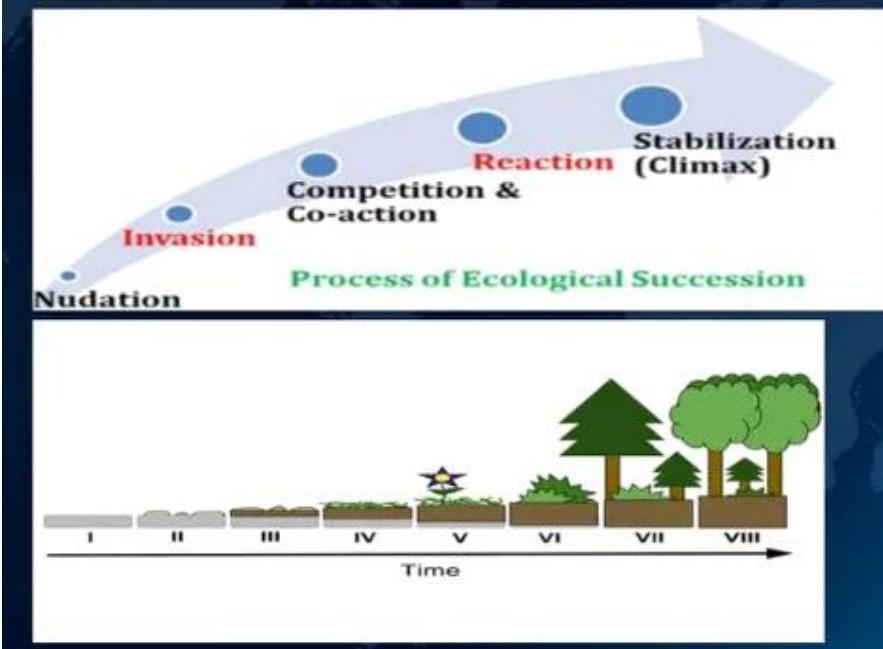
Secondary Succession- “Old field Succession” – “subsere”



Types of Seres	Explanation
Hydrosere	Succession in aquatic habitat.
Xerosere	Succession in dry habitat.
Lithosere	Succession on a bare rock surface.
Psammosere	Succession initiating on sandy areas.
Halosere	Succession starting in saline soil or water.
Senile	Succession of microorganism on dead matter.
Eosere	Development of vegetation in an era.

Process

Process of Succession



Terms	<ol style="list-style-type: none"> 1. Nudation - Creation of bare area, either by destruction of existing ecosystem or newly created area (volcanic activity, earthquake etc.) 2. Invasion - Entry of first successful reproductive species on bare area created. It is referred as "Pioneer". 3. Co-operation & Competition – Initially there exist cooperation, later when species increases, competition for food, space etc. (Inter-species & Intra- species). 4. Stabilization – It is also referred as "Climax community". More stable community.
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Canopy cover		Classification of vegetation on the basis of canopy cover
> 70 %		Very dense forest
40-70 %		Moderately dense
10-40 %		Open Forest
< 10 %		Scrublands / Grasslands

L4 Ecosystem

12 December 2024 09:33 PM

BIOMES	<ul style="list-style-type: none"> • Grouping of biological communities and ecosystems into categories based on climate and dominant plant form. 											
	<h3 style="color: yellow;">Difference Between Biome & Ecosystem</h3> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 10px;"> <p>→ A biome is a large naturally occurring community of flora and fauna occupying a major habitat</p> </td><td style="padding: 10px;"> <p>An ecosystem is all biotic and abiotic factor of a particular environment that interact with each other</p> </td></tr> <tr> <td style="padding: 10px;"> <p>→ Consists of many ecosystems that share similar climate conditions</p> </td><td style="padding: 10px;"> <p>Consists of biotic factors and abiotic factors</p> </td></tr> <tr> <td style="padding: 10px;"> <p>A large geographical area</p> </td><td style="padding: 10px;"> <p>A small geographical area</p> </td></tr> </table>		<p>→ A biome is a large naturally occurring community of flora and fauna occupying a major habitat</p>	<p>An ecosystem is all biotic and abiotic factor of a particular environment that interact with each other</p>	<p>→ Consists of many ecosystems that share similar climate conditions</p>	<p>Consists of biotic factors and abiotic factors</p>	<p>A large geographical area</p>	<p>A small geographical area</p>				
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5 Temperate rainforest ✓												

Tropical Rainforest Biome	<ul style="list-style-type: none"> • Present around equator, Avg Temp > 18°C, Avg rains > 250 cm • Evergreen vegetation • Ex : Amazon rainforest : Selvas • Canopy : Very tall trees + dense canopy cover + lack of vegetation on forest floor • Insects population + Amphibians (Frogs) + Reptiles (Snake) + Arboreal species (Monkey) • Aviary species
Savanna Biome	<ul style="list-style-type: none"> • Tropical grassland • High population of herbivores -> high carnivores



Savannas are grasslands with scattered trees found in dry tropics, such as East Africa's modest altitudes.



The annual rainfall ranges from 90 to 150 cm, with a dry spell of 3 to 4 months with rainfall of less than 5 cm.



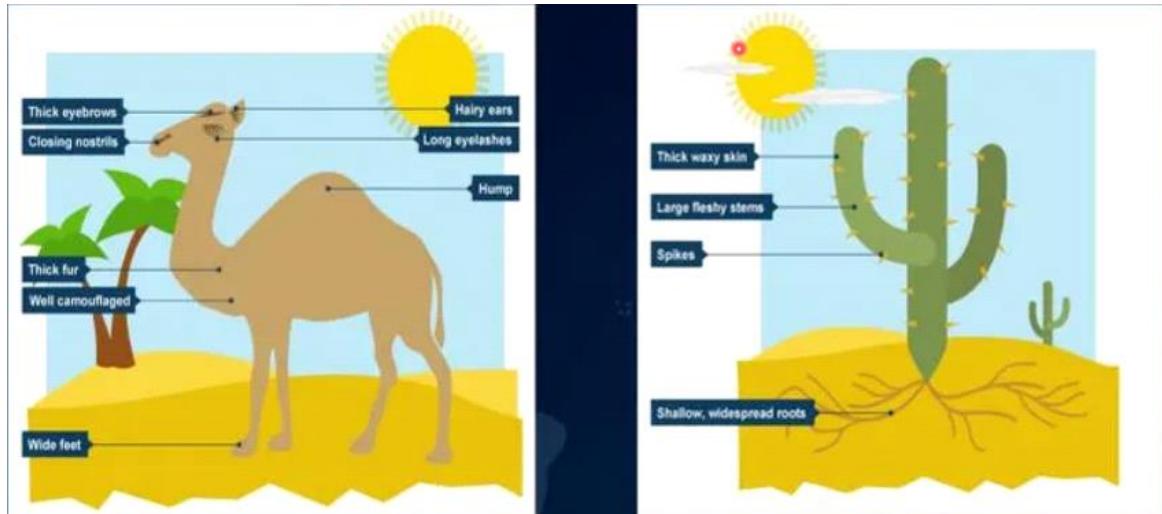
Biome is highly influenced by forest fires and human activity.



The fauna include a great diversity of grazers and browsers such as antelopes, buffaloes, zebras, elephants and rhinoceros; the carnivores include lion, cheetah, hyena; and mongoose, and many rodents.

Desert Biome

- Evaporation > Precipitation
 - Moisture deficiency
- Xerophytes : Desert plants
 - Green pigments the stem
 - Waxy leaves
- Desert Animals :
 - Nocturnal (Active during night) / Crepuscular (Active at the time of dawn and dusk)
 - Have thick fur coating (Night time temperature are very low)



Temperate Grassland

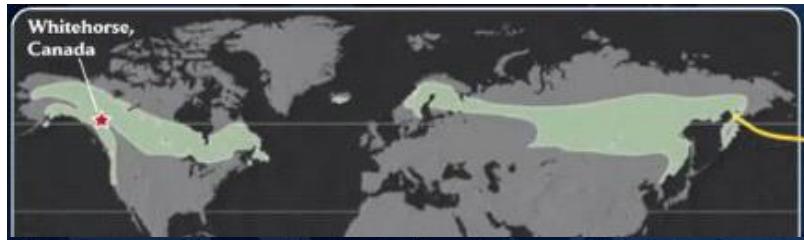
- Central Asia : Steppes, North America : Prairies, South America : Pampas, South Africa : Velds, Hungry : Pastas, Australia : Downs, New Zealand : Canterbury

Because rainfall is infrequent, organic waste does not degrade quickly, and the soils are rich in organic materials.

The fauna include large herbivores like bison, antelope, cattle, rodents, prairie dog, wolves, and a rich and diverse array of ground nesting bird.

Boreal Forest Biome

- Closer to polar, In higher latitudes of northern hemisphere and also in higher altitudes
- Coniferous trees+ Needle shaped leaves :Withstand snowfall
- Taiga type of climate : Winters very cold



The boreal forest biome is found about 50°N in North America and around 60°N in Europe and Asia.

The average annual precipitation is between 40 and 100 cm.

Evaporation is minimal, soils remain moist all year.

These locations are known as Taiga forest because the vegetation is made up of evergreen needle-leaved trees.

Tundra Biome

- In Polar areas and regions of very high altitudes



It is a treeless expanse underlain by permafrost to the north of the boreal forests.

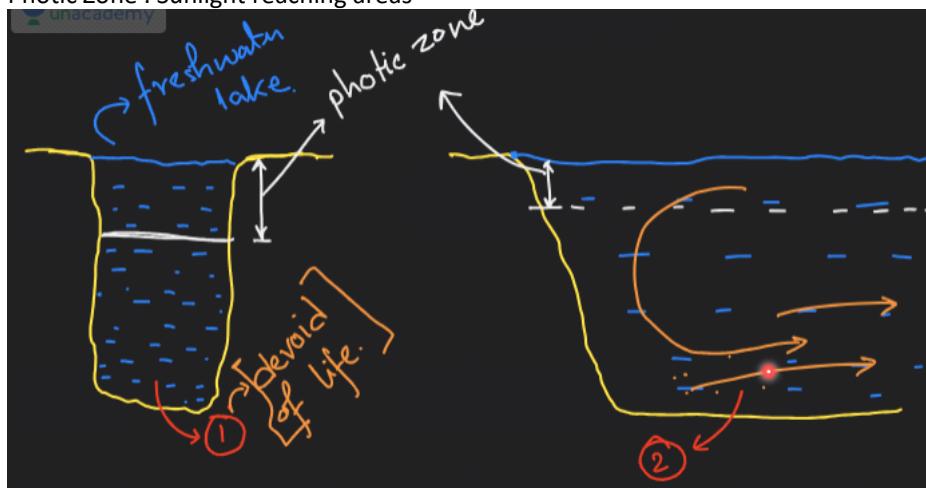
Alpine tundra is a similar habitat that may be found at high elevations in lower latitudes.

Mosses and Lichens are found to be growing during the summers.

The typical animals are reindeer, arctic fox, polar bear, snowy owl, lemming, arctic hare. Reptiles and amphibians are almost absent.

Aquatic Biome

- Factors : Sunlight (More productivity in photic zones) + Dissolved oxygen + Temperature
- Photic Zone : Sunlight reaching areas



Freshwater Ecosystem	<ul style="list-style-type: none"> The Flowing freshwater are referred as to Lotic System Too much sediment -> Murky water -> organism uses echolocation (Navigation with help of emission of sound waves).
Standing water	<ul style="list-style-type: none"> Lakes and Ponds <p> The stationary fresh Water systems are referred to as lentic systems.</p> <p> The depression might have formed as a result of glacial activity, fault zones, meteor impact, or human excavation.</p> <p> With greater sedimentation, the aquatic system transitions to wet meadows, which then transition to the region's native terrestrial biomes.</p> <ul style="list-style-type: none"> Eutrophication : Overloading of nutrient in water body <ul style="list-style-type: none"> Nitrate and Phosphate addition Lead to harmful algal bloom HAB -> explosion in algal population <ul style="list-style-type: none"> Blocks sunlight -> Aquatic plants die -> Supply oxygen reduces -> Life end Decomposition by Aerobic microbes -> creates Hypoxic water (Without Oxygen) Farm runoff + Industrial Waste + Untreated Sewage <h3>Harmful Algal Blooms and Red Tides</h3> <p>Harmful algal blooms are the rapid growth of algae or cyanobacteria that can cause harm to people, animals, or the local ecology. Harmful algae or cyanobacteria can look like foam, scum, paint, or mats on the surface of water and can be different colors.</p> 
Wetlands	<ul style="list-style-type: none"> Utility -> Serve as ecotone (Between two different ecosystem) <ul style="list-style-type: none"> lots of organism (Rich areas of biodiversity) Natural Sponges : Absorb excessive water and recharge ground water Serve as source of drinking water, Lead to purification of water by trapping heavy contaminants by deposition Photosynthesis -> also stores carbon atm CO₂, methane -> Teal carbon <p>"Wetlands" means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.</p> <p>Wetlands generally include swamps, marshes, bogs, and similar areas.</p>



It protects the coastline by decreasing the effects of tropical cyclones and other natural calamities such as tsunamis.

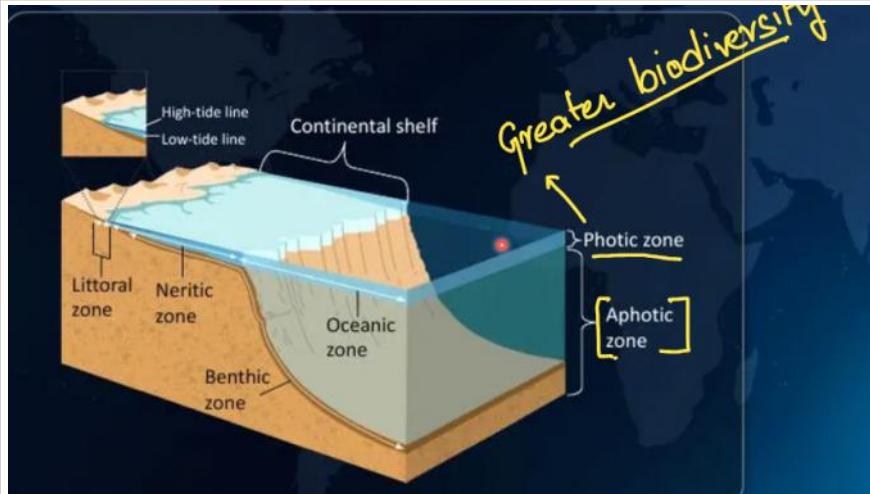


It works as a natural filter, immobilizing potentially hazardous or contaminating chemicals that are dissolved in water.



In wetlands, aquatic and terrestrial ecosystems frequently coexist.

Marine Aquatic System



- Maximum bio diversity in the photic zones
- Benthos : Organism living in Benthic zone, High pressure, low light
 - Hardened skin. Large eyes, Bioluminescence



Temperature, salinity, depth, currents, substrata, and tides near the ocean's edge all contribute to variance in the marine ecology.



The marine aquatic system is split into photic (with light) and aphotic (without light) zones based on light penetration.



The marine environment accounts for the majority of the earth's surface.

Ramsar Convention

- Decided in 1962 MAR Conference
- To raise awareness of conservation of wetlands

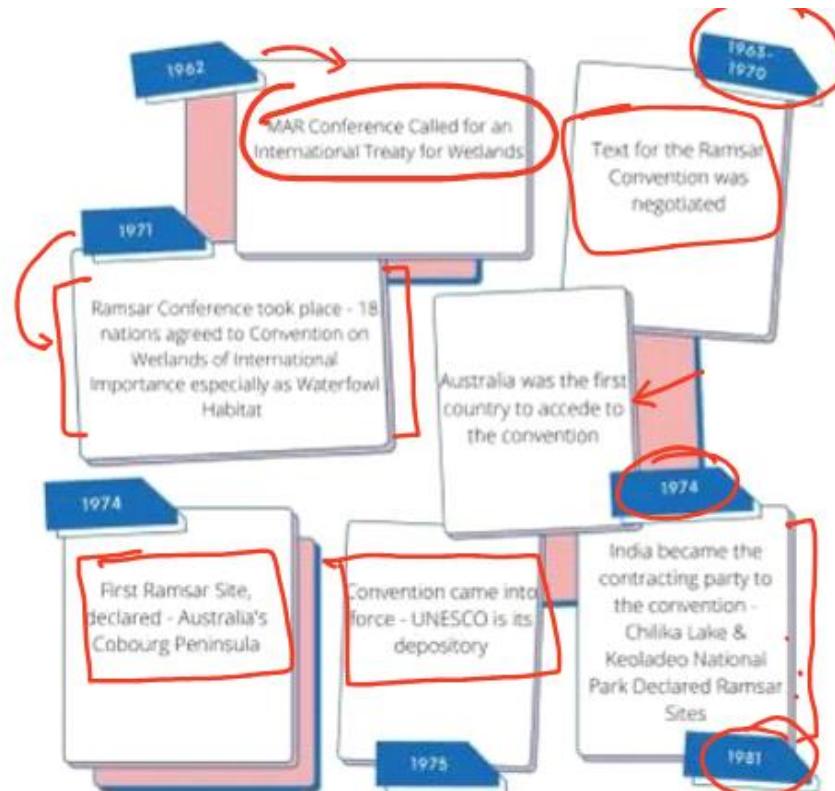
Ramsar Convention is a convention on wetlands that was signed in 1971 in the Iranian city of Ramsar. The negotiations for the convention started in the 1960s by the different countries and NGOs for the protection of wetlands and their resources. Finally, it came into force in 1975.

Ramsar Convention is not a regulatory regime.

Ramsar Convention was modified by the Paris Protocol in 1982 and by the Regina Amendments in 1987.

Montreux Record – It is a mechanism that was launched in 1990 and is associated with the Ramsar Advisory Mission. It is a register of the list of those Ramsar Sites that need urgent attention.

- Wise use principles of Ramsar Convention
 - Sustainable Utilization of ecosystem by the local population
 - Use of wetlands by the local population for drinking water, irrigation, fisheries etc
 - Without destroying the wetlands



World Wetlands Day – It was first celebrated in 1997. It is celebrated each year on 2nd February to mark the anniversary of the Ramsar Convention and promote its mission.

A conference of the contracting parties (COP) to the convention meets every three years. 14th Meeting of the Conference of the Contracting Parties (COP14) to the Ramsar Convention on Wetlands was co-hosted by Wuhan, China and Geneva, Switzerland in November 2022.

India Scheme	<ul style="list-style-type: none"> • Amrit Dharohar Capacity • This initiative, launched in June 2023, aims to revolutionize tourism practices at ecologically-sensitive wetlands, particularly Ramsar sites like Odisha's Chilika Lake and Haryana's Sultanpur Bird Sanctuary
Ramsar Sites	<ul style="list-style-type: none"> • UK has highest number of Ramsar sites • India has 85 Ramsar Sites

- Group A of the Criteria. Sites containing representative, rare or unique wetland types
- **Criterion 1** : A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

Group B of the Criteria. Sites of international importance for conserving biological diversity

- Criteria based on species and ecological communities
- **Criterion 2:** A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.
- **Criterion 3:** A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.
- **Criterion 4:** A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Specific criteria based on waterbirds

- **Criterion 5:** A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.
- **Criterion 6:** A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Specific criteria based on fish

- **Criterion 7:** A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.
- **Criterion 8:** A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

The Ramsar Convention has six international organization partners:

- Birdlife International
- IUCN
- Wetlands International
- WWF
- International Water Management Institute
- Wildfowl and Wetlands Trust

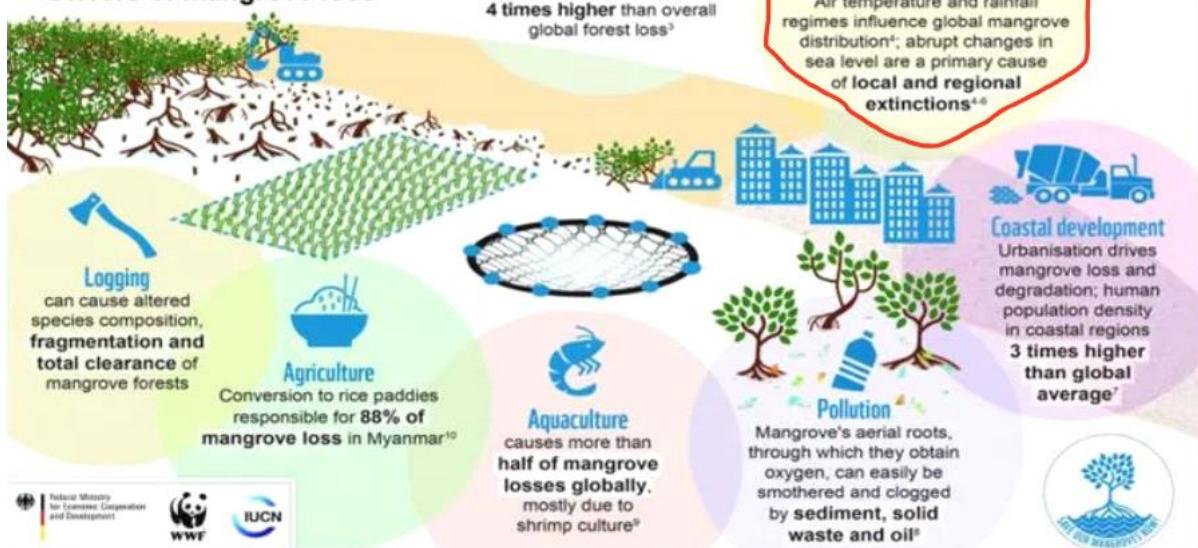
L5 Mangroves, Coral, Bio Cycle

16 December 2024 07:30 PM

Mangroves	<ul style="list-style-type: none"> Grow in water saturated soil Sundarbans (Largest Extent), Coastal area, islands, In land region (reservoir) Adaptation <ul style="list-style-type: none"> Pneumatophores : Developed for access of oxygen, upward moving roots, moving out of soil to air Viviparity : Sapling grow while still attached to the parent tree. They fall thereafter on the ground to increase the chances of survival Salt Secreting Glands : To ensure that pores do not get blocked during transpiration Adventitious roots : Provide support and access to oxygen
	<p>ECOSYSTEM SERVICES The benefits people derive from mangroves</p> <ul style="list-style-type: none"> Wood Its density makes mangrove wood a valued source of timber and fuel Coastal protection Restoring mangroves for coastal defence up to 5 times more cost-effective than "grey infrastructure" such as breakwaters⁶ Livelihoods 120 million people living near mangroves⁷ Mangrove ecosystem services Worth US\$ 33,000–57,000 per hectare per year¹ x 14 million hectares² = up to US\$ 800 billion per year Climate regulation Carbon storage potential of mangroves is 3–5x higher than that of tropical upland forest due to strong carbon storage in the soil³; CO₂ released by global mangrove loss annually could be as high as the annual emissions of Australia^{4,5} Water filtration 2–5 hectares of mangroves may treat the effluents of 1 hectare of aquaculture⁸ Tourism There are over 2,000 mangrove-related attractions globally, such as boat tours, boardwalks, kayaking and fishing⁹ Fisheries More than 3000 fish species are found in mangrove ecosystems¹⁰ <p>Sources: ¹ UNEP, 2014 • ² Gil et al., 2011 • ³ In the Indo-Pacific region: Donato et al., 2011 • ⁴ Up to 450 million t CO₂: Pendleton et al., 2012 • ⁵ In 2015: EDGARv4.3.2, 2018 • ⁶ Sheaves, 2017 • ⁷ Spalding et al., 2016 • ⁸ Prinsen et al., 2007 • ⁹ In Vietnam: Nairayan et al., 2016</p>

THREATS

Drivers of mangrove loss



Mishti Scheme

Mangrove Initiative for Shoreline Habitats & Tangible Incomes (MISHTI))

envisage to comprehensively explore the possible area for development of Mangroves covering approximately 540 Sq. Kms. spreading across 11 States and 2 Union Territories during five years commencing FY 2023-24 onwards.

The sharing of best practices on plantation techniques, conservation measures, management practices and resources mobilization through Public Private Partnership are objectives of the MISHTI scheme.

Mangrove Alliance for Climate

- Initiated by UAE and Indonesia post COP27, held in Egypt
- To increase carbon storage
- India is also a member

Coral Reef

- Made of Individual coral polyps, living species of Animal, attached to ground surface, eat via tentacles
- Symbiotic relationship with zooxanthellates (Algae)
 - Carry out photo synthesis, absorb carbon, produces oxygen
 - Provide food for corals as well
 - Provide unique colours to coral
- Warm water coral :
 - Shallow depth of tropics, greater abundance,
 - stony white exoskeleton and have zooxanthellates on tentacles,
 - known as rainforest of marine ecosystem (provide oxygen, carbon absorb and shelter)
 - Condition :
 - Availability of shallow depth for sunlight
 - Clear saline water
 - Consistent temperature condition
 - Lack of pollution
- Cold water coral :
 - Ocean bottom or high latitudes, prolonged life cycle

Coral Bleaching

- When coral polyps lose their symbiotic algae, the zooxanthellae. Without it, the living tissues are nearly transparent, Stony skeleton can be seen, It is called coral bleaching.



- Rise in sea surface temperature
- Pollution : Oil spills / Solid waste dumping / Acidification dumping,
- Bottom Trawling
- Zoonotic Diseases

Bio rock technology

- Concrete structure with mesh to create coral growth environment
 - Repairing a damaged coral ecosystem
- Cryomesh Tech :
 - Purpose os to preserve the diversity of coral population
 - Coral in their larval stage are frozen in a suitable substrate which can be then be reintroduced later

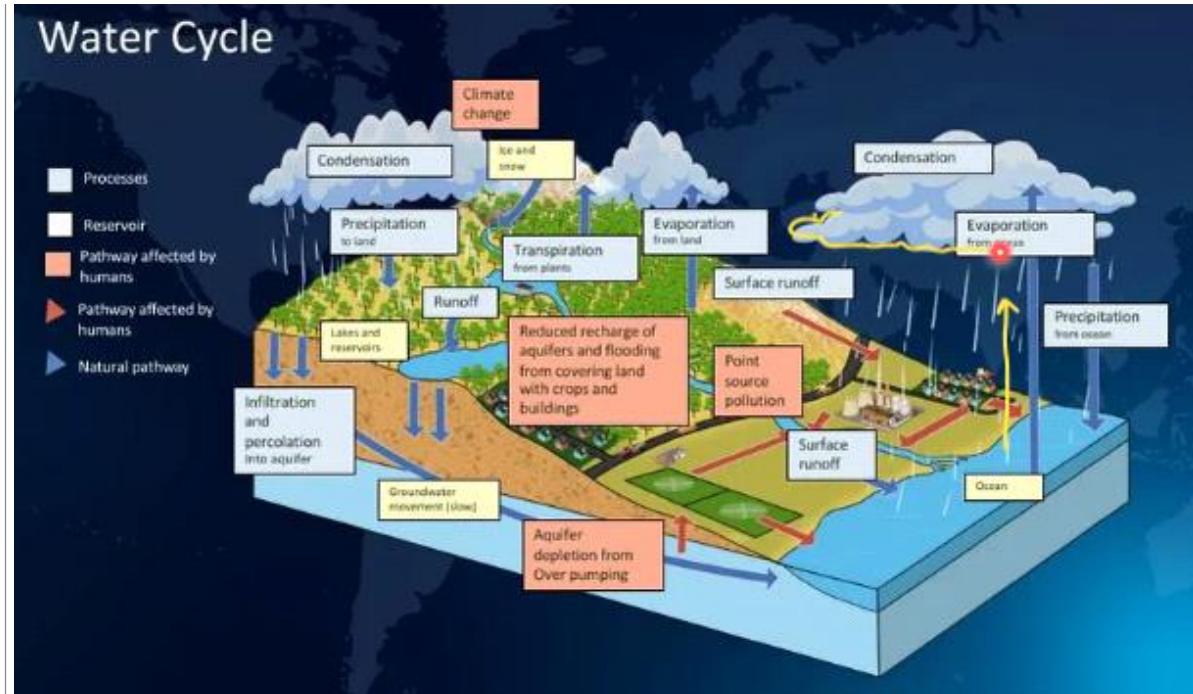
Biogeochemical Cycle

The term biogeochemical is derived from “bio” meaning biosphere, “geo” meaning the geological components and “chemical” meaning the elements that move through a cycle.

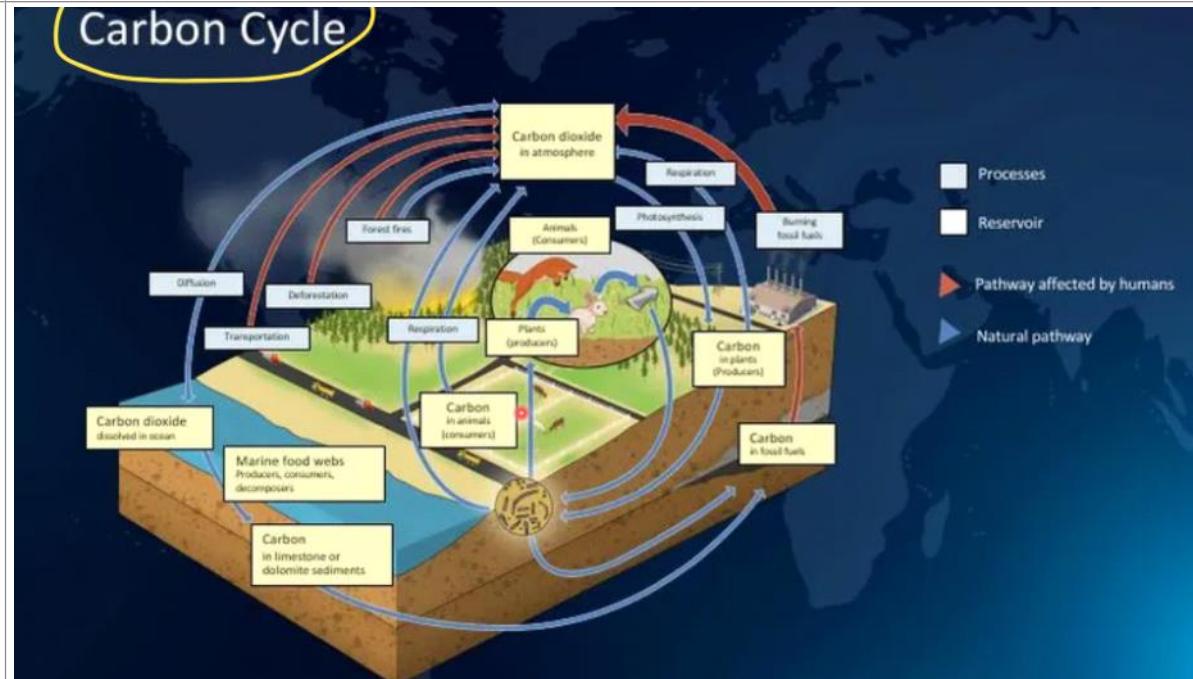
Biogeochemical cycles are basically divided into two types:

- Gaseous cycles – Includes Carbon, Oxygen, Nitrogen, and the Water cycle.
- Sedimentary cycles – Includes Sulphur, Phosphorus, Rock cycle, etc.

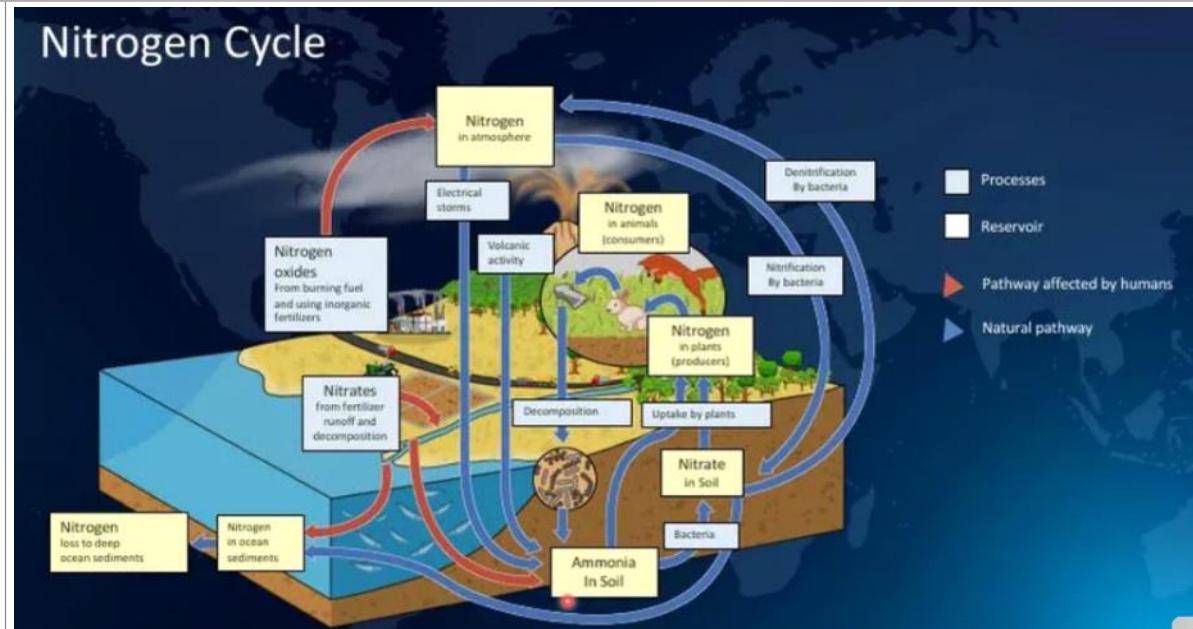
Water Cycle



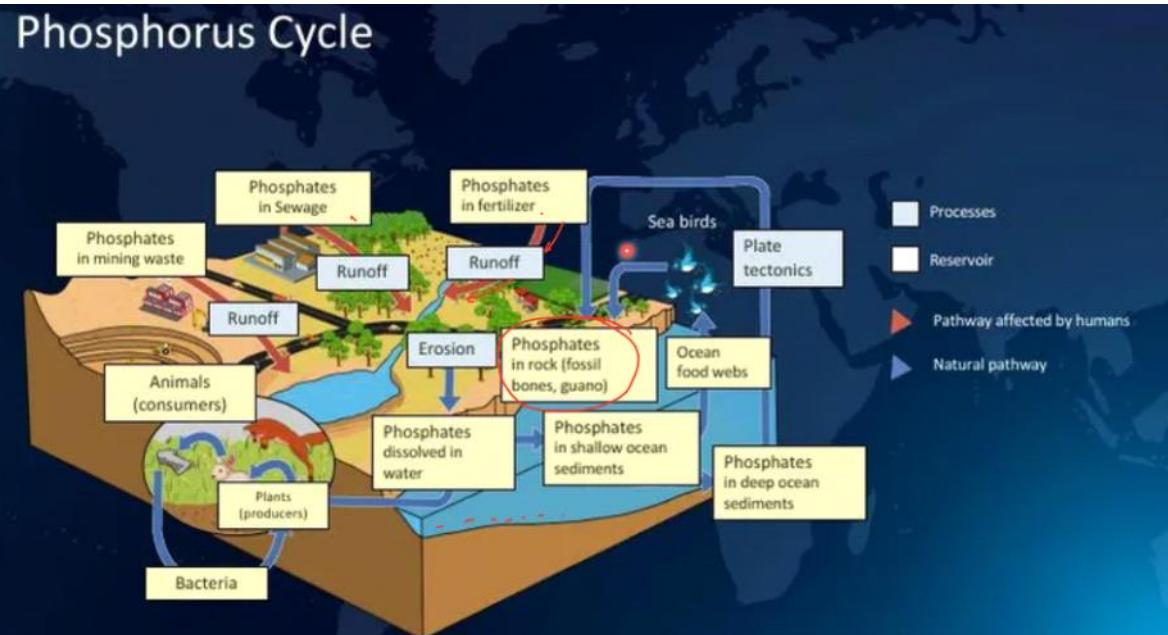
Carbon Cycle



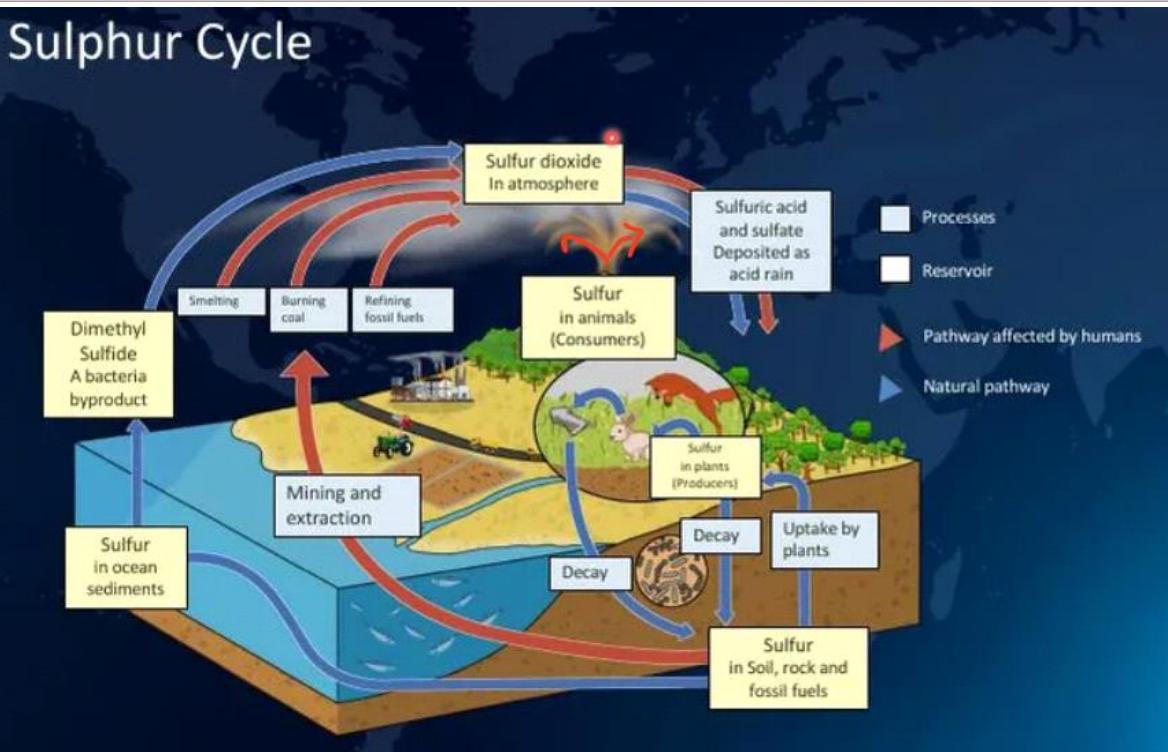
Nitrogen Cycle



Phosphates Cycle



Sulphur Cycle



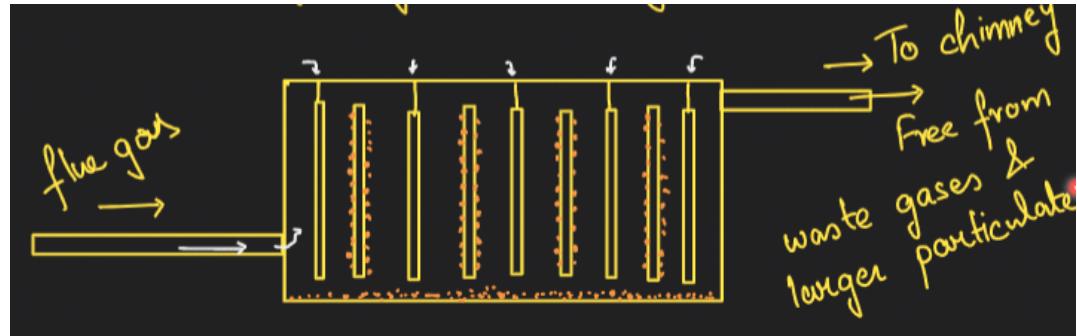
Nitrogen Fixation

Certain microorganisms are capable of fixing atmospheric nitrogen into ammonium ions. These include free living nitrifying bacteria (e.g. aerobic Azotobacter and anaerobic Clostridium) and symbiotic nitrifying bacteria living in association with leguminous plants and symbiotic bacteria living in non leguminous root nodule plants (e.g. Rhizobium) as well as blue green algae (e.g. Anabaena, Spirulina).

L6 Air Pollution

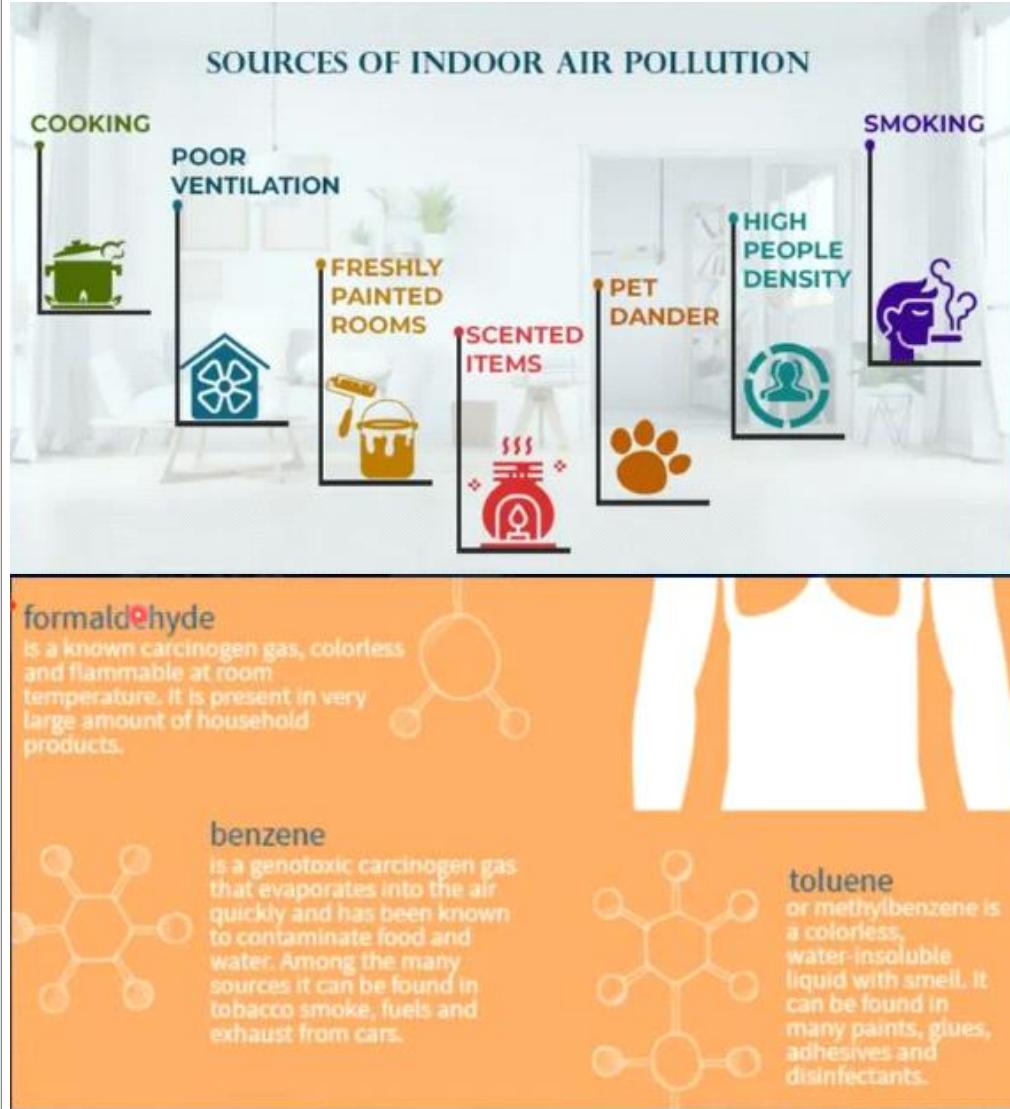
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Atmosphere	<p>About [75 to 80%] of the Earth's air mass is found in the <u>Troposphere</u>. The layer extends only about 16 km above sea level over the equator and 8 km above sea level over the poles. About 99% of volume of air consists of two gases – nitrogen (78%) and oxygen (21%). The remainder consists of water vapour, argon, carbon dioxide, and trace amounts of dust and soot particles as well as other gases including Methane, Ozone, and nitrous oxide.</p>																
Outdoor Pollution Sources	<p>Sources of Outdoor Air Pollution</p> <table border="1"><caption>Source Distribution (%)</caption><tr><th>Source</th><th>Percentage</th></tr><tr><td>Industry</td><td>52%</td></tr><tr><td>Transportation</td><td>27%</td></tr><tr><td>Agriculture</td><td>10%</td></tr><tr><td>Consumer and Commercial Products</td><td>8%</td></tr><tr><td>Other</td><td>2%</td></tr><tr><td>Commercial and Residential Heating</td><td>1%</td></tr><tr><td>Biomass Burning</td><td>1%</td></tr></table>	Source	Percentage	Industry	52%	Transportation	27%	Agriculture	10%	Consumer and Commercial Products	8%	Other	2%	Commercial and Residential Heating	1%	Biomass Burning	1%
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Biomass Burning	1%																
Electrostatic Precipitators	<ul style="list-style-type: none">Purpose : To trap the heavy pollutants from the flue gases (Waste gas)Using charged plates (particle gain charge) and uncharged plates (particles stick)Pollutant then settle down																



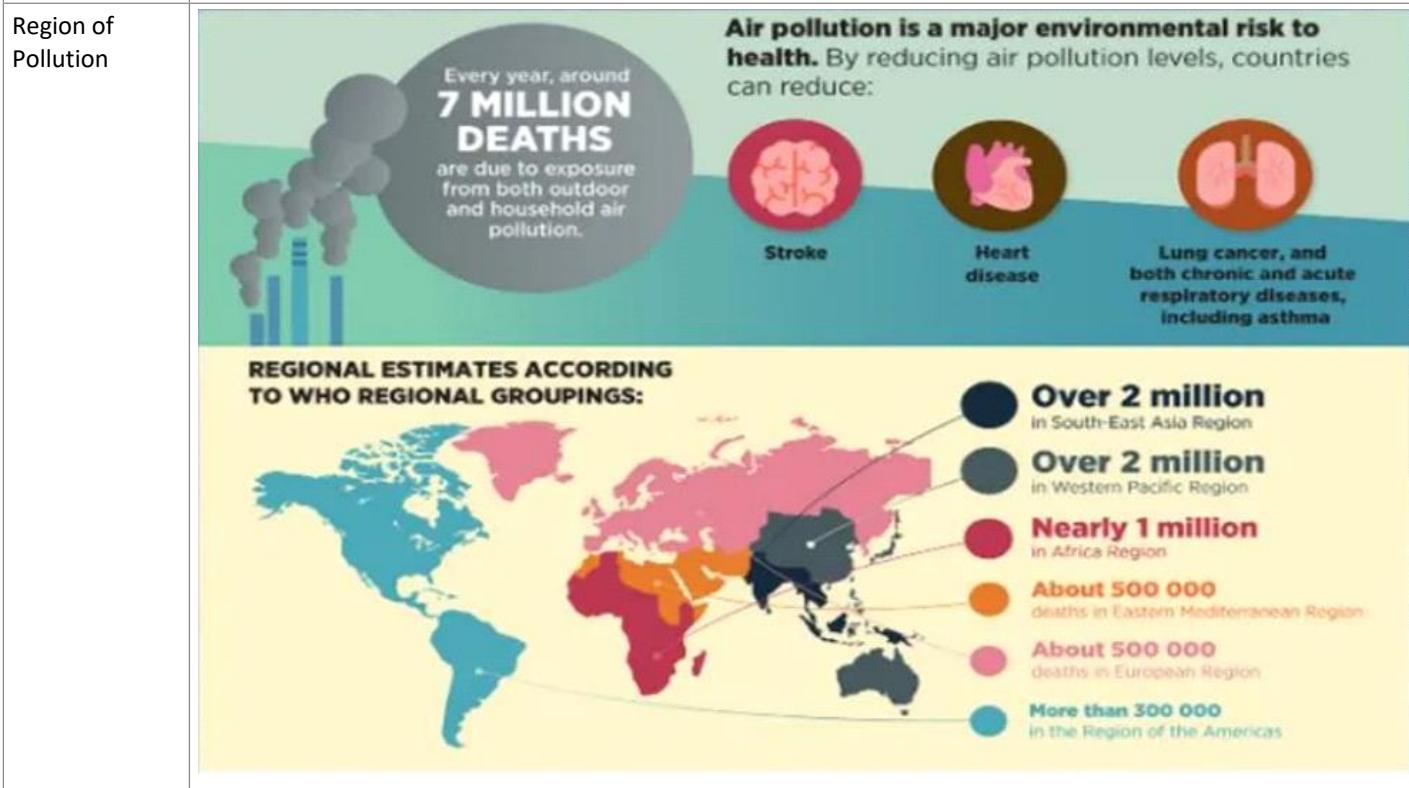
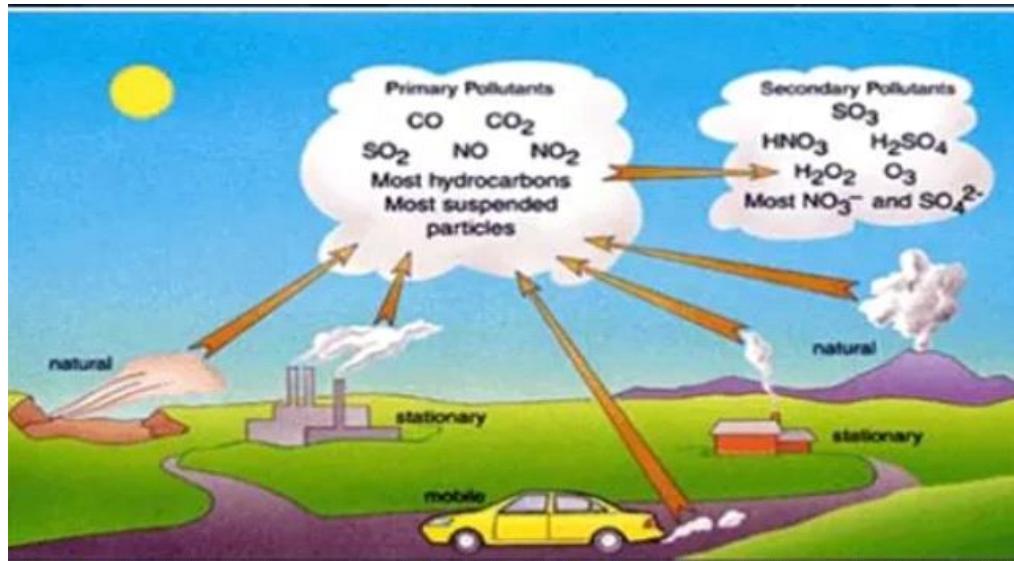
- Working principle : Intermittent charge provided to the plates. -> Waste gases develop the charge and particle stick to the metallic plates -> withdrawal of charge -> particles get de energized -> Fall on the surface

Indoor Pollution Sources



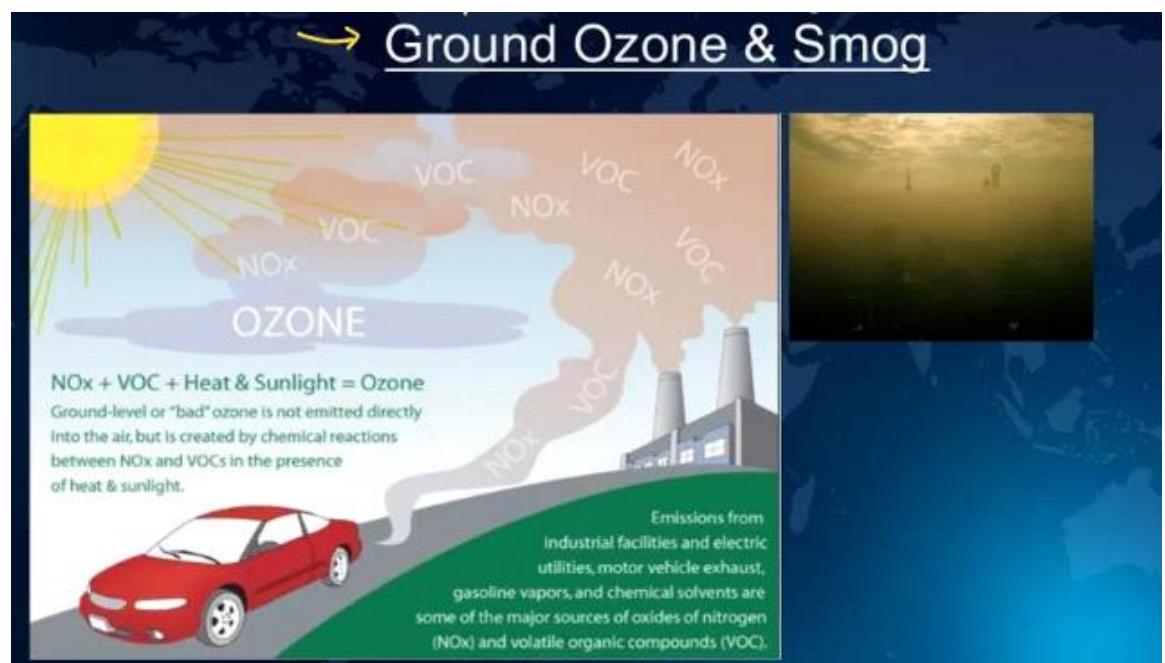
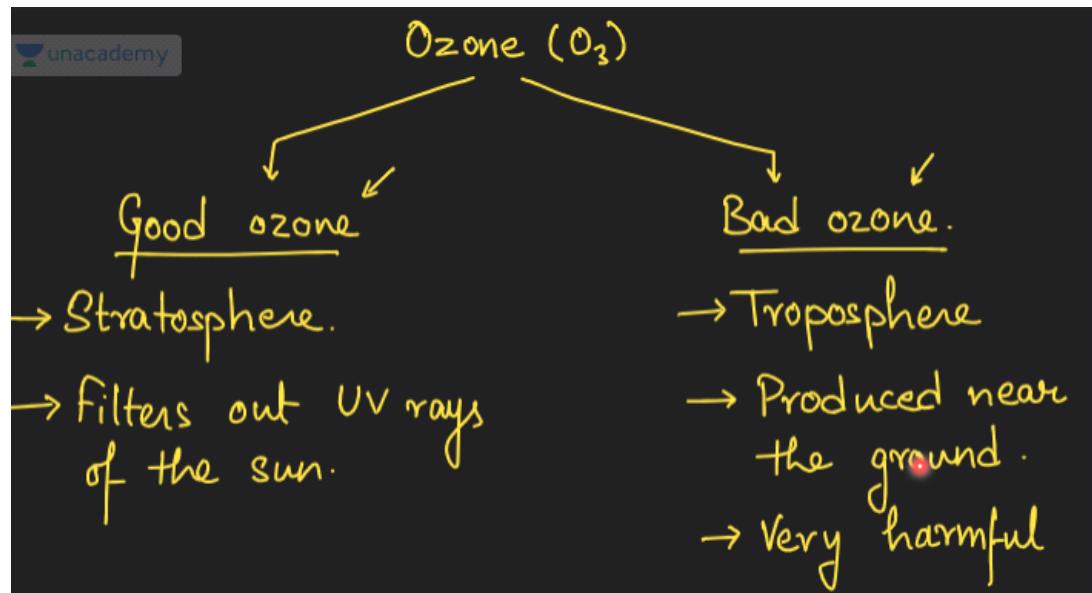
Types of Pollutant

- Primary : Pollutant directly from Source, Ex : Oxides after burning
- Secondary : Interaction of primary pollutants -> Change in composition



Issues of Pollutant	Outdoor pollutant	Pollutant sources	Health problem
	Carbon Monoxide	Burning diesel, petroleum and wood	Increases confusion, sleepiness, low blood oxygen level, slow reflexes
	Carbon dioxide	Burning oil, coal and natural gases	Lowers oxygen levels, vision defects, reduces respiratory and brain functions,
	Nitrogen dioxide (NO ₂)	Burning fuels, electricity generation plus vehicle engines,	defect in lung function and causes bronchitis in asthmatic children, toxic
	Sulphur dioxide (SO ₂)	industrial processes, and Burning fossil fuels	eye irritation and respiratory inflammation, asthma attacks, mucus secretion, decreases pulmonary function.
	Ozone (O ₃)	photochemical smog produced by the interaction of sunlight and air pollutants	breathing difficulties and asthma, colds, pneumonia
	Suspended particulate matter (PM ₁₀ , PM _{2.5} , SPM)	Mixture of solid and liquid organic plus inorganic materials including nitrates, sulphate, carbon ,sodium chloride, ammonia, mineral dust and water	Disrupts lung's gas exchange function and respiratory illness

Ground Ozone • Secondary Pollutant



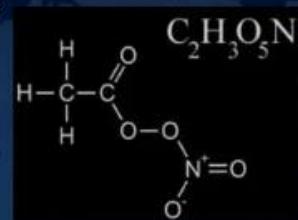
{ Ground-level ozone is a colorless and highly irritating gas that forms just above the earth's surface. It is called a "secondary" pollutant because it is produced when two primary pollutants react in sunlight and stagnant air. These two primary pollutants are nitrogen oxides (NO_x) and volatile organic compounds (VOCs).

- NO_x and VOCs come from natural sources as well as human activities.
- About 95 percent of NO_x from human activity come from the burning of coal, gasoline and oil in motor vehicles, homes, industries and power plants.
- VOCs from human activity come mainly from gasoline combustion and marketing, upstream oil and gas production, residential wood combustion, and from the evaporation of liquid fuels and solvents. Significant quantities of VOCs also originate from natural (biogenic) sources such as coniferous forests.

Photochemical smog is a mixture of pollutants that are formed when nitrogen oxides and volatile organic compounds (VOCs) react to sunlight, creating a brown haze above cities.

It tends to occur more often in summer, because that is when we have the most sunlight.

How is it formed?



Harmful products, such as PAN, are produced by reactions of nitrogen dioxide with various hydrocarbons (R), which are compounds made from carbon, hydrogen and other substances



The main source of these hydrocarbons is the VOCs. Similarly, oxygenated organic and inorganic compounds (ROx) react with nitric oxide to produce more nitrogen oxides:



The significance of the presence of the VOCs in these last two reactions is paramount.

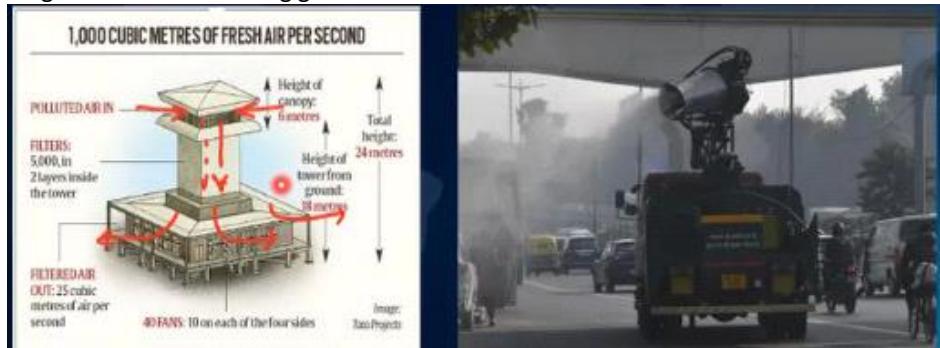
L7 Acid rain, Ozone

17 December 2024 08:47 PM

ACID RAIN	<ul style="list-style-type: none"> It is Defined as Rain, Fog, Sleet or snow that is Acidic by Pollutants in the Air Mostly emits Nitrogen Oxides (NO_x) and Sulphur Dioxide (SO_2). Acidity is Determined on the basis of the pH level of the water droplets. Normal Rainwater is slightly Acidic with a pH range of 5.3-6.0. When these gases react with water molecules and oxygen in Atmosphere Mildly Acidic Sulphuric and Nitric acid are formed resulting in acid rain. <ul style="list-style-type: none"> Wet Deposition : H_2SO_4 and HNO_3 are carried by the rains / any form of precipitation to fall on the surface Dry Deposition : H_2SO_4 and HNO_3 are carried by the wind to get deposited
Causes of Acid rain	
Effect of Acid rain	<ul style="list-style-type: none"> Soil : Increase acidity -> limits the kind of plants which can grow -> Lower primary productivity Forests : Damage leaf, yellowing of leaves Biodiversity Public Health : Skin cancer, allergic reaction Monuments : Corrosion and damage
Pollution in Northern India	<ul style="list-style-type: none"> High Population Density <ul style="list-style-type: none"> Municipal solid waste Dry Condition Vehicles, Industries, Power Plants and refineries, Construction Activities Stubble Burning Topography and location <ul style="list-style-type: none"> Sub tropic : Dry Region, Extreme Continentality : lack of regular winds and rain Locked by the Himalayas Cold Winters : Induce thermal inversion, cold air in down -> no movement -> reduced mixing of air Lack of vegetation
Solution	<ul style="list-style-type: none"> Decomposer capsule : Accelerates microbial action on the stubble -> degradation and softening of stubble

- Can then be easily mixed with soil

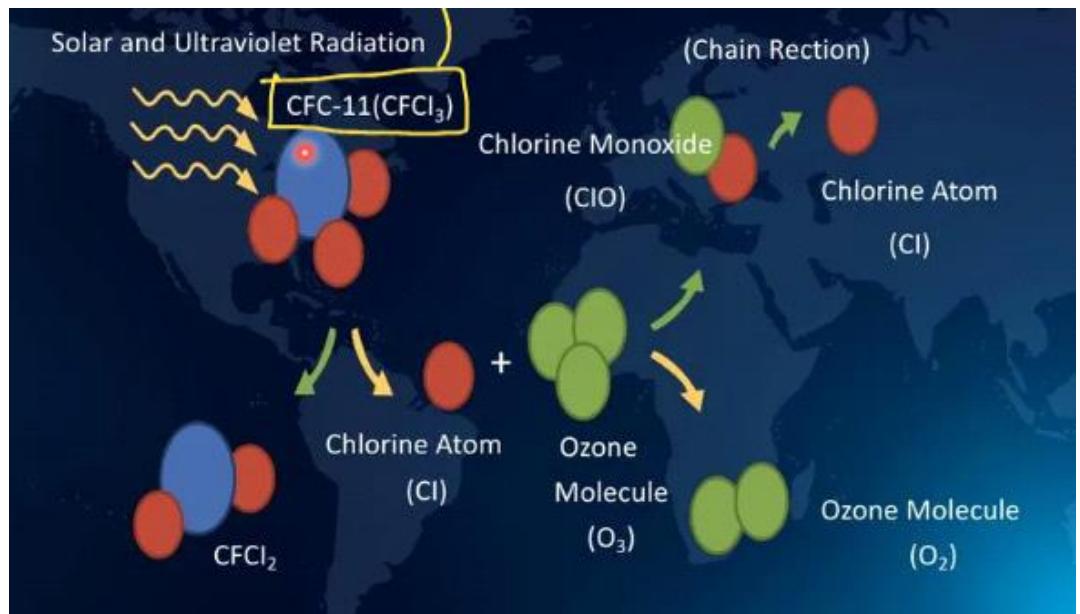
- Anti-smog Tower and Anti-smog guns



- Hydrogen based fuel technology
 - Cleaner fuel
- Vehicle Policy
 - Better emission standard, currently using BS VI Norms (Bharat Stage 6)
 - Vehicle Scrappage policy
- Graded Response Action Plan GRAP
 - Policy measures taken keeping in mind the increase in pollution levels

OZONE LAYER

- Good Ozone
- Rate of formation of O_3 from free radical O is very slow
- Ozone Depleting Substances : destroy ozone layer



Substances such as CFCs that deplete the Ozone layer do not directly destroy Ozone.

- $Cl + O_3 \rightarrow ClO + O_2$
- $ClO + O \rightarrow Cl + O_2$
- Net effect: $O_3 + O \rightarrow 2 O_2$

Causes of

- ODS Ozone Depletion Substances

Depletion	Ozone-Depleting Substances	Sources
	Chlorofluorocarbons (CFCs) ✓	Refrigerators, air-conditioners, solvents, dry-cleaning agents, etc.
	Halons	Fire-extinguishers
	Carbon tetrachloride	Fire extinguishers, solvents
	Methyl chloroform	Adhesives, aerosols
	Hydrofluorocarbons	Solvent cleaning, fire extinguishers, solvent cleaning
	• Natural factors : Volcanic Eruptions (Ash cloud punctures a hole in ozone layer, large Forest fire	
Impact	<ul style="list-style-type: none"> • Attributes to UV rays exposures • Animal life : reproductive cycle, gender of offspring , • Human life : Skin cancer and diseases, • Marine life, • Aquatic life : yellowing of leaves and reduces productivity 	
Montreal Protocol	<ul style="list-style-type: none"> • First held in Vienna, around 1985 • Protocol -> Montreal -> Mentioned the gases which need to be controlled <ul style="list-style-type: none"> • Most successful protocol, we achieved the target • Reason of success : Principle of common but Differentiated Responsibility • Kigali Amendment : phasing out of HFCs 	
<p>Vienna Convention</p> <p>Formalized International cooperation on Ozone issue by creating framework for protection of Ozone layer.</p> <p>Entered into force on 22nd Sept 1988.</p> <p>In 2009 it became first convention of any kind to achieve universal ratification.</p> 		

Montreal Protocol

On substances that depletes Ozone layer.

Phasing out production & consumption of man made ODS in phased manner.

Multilateral Fund was established in 1991 for implementing Montreal Protocol. It provided financial & technical assistance to developing countries, parties to Montreal protocol whose annual per capita consumption & production of ODS is less than 0.3kg.

Fund is implemented by UNEP, UNDP, WORLD BANK & UNIDO.

"International Ozone Day" – September 16

Amendment to
Montreal

Amendments to the Montreal Protocol

The **London Amendment (1990)** changed the ODS emission schedule by requiring the complete phase-out of CFCs, Halons, and carbon tetrachloride by 2000 in developed countries, and by 2010 in developing countries. Methyl chloroform was also added to the list of controlled ODSs, with phase out in developed countries targeted in 2005, and in 2015 for developing countries.

The **Copenhagen Amendment (1992)** significantly accelerated the phase-out of ODSs and incorporated an hydrochlorofluorocarbons (HCFC) phase-out for developed countries, beginning in 2004. Under this agreement, CFCs, Halons, carbon tetrachloride, and methyl chloroform were targeted for complete phase-out in 1996 in developed countries. In addition, methyl bromide consumption of methyl bromide was capped at 1991 levels.

The **Montreal Amendment (1997)** included the phase out of HCFCs in developing countries, as well as the phase out of methyl bromide in developed and developing countries in 2005 and 2015, respectively.

The **Beijing Amendment (1999)** included tightened controls on the production and trade of HCFCs. Bromochloromethane was also added to the list of controlled substances with phase out targeted for 2004.

Kigali

Kigali Amendment_2016

Amendment

Entered into force on Jan 1, 2019, following ratification by 65 countries. Goal is to achieve over 80% reduction in HFC consumption by 2047.

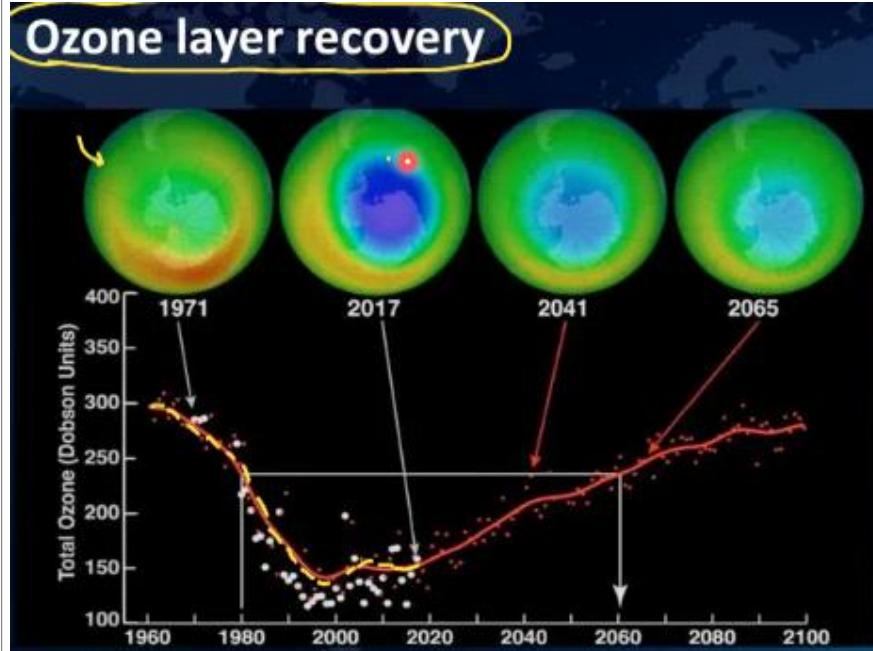
Help reduce the production & consumption of HFC, potent GHG & thus avoid global warming of up to 0.4 degree this century.



It divided the signatory parties into three groups.

1. The first group consists of rich and developed economies like USA, UK and EU countries who will start to phase down HFCs by 2019 and reduce it to **15% of 2012 levels** by 2036.
2. The second group consists of emerging economies like China, Brazil as well as some African countries who will start phase down by 2024 and reduce it to **20% of 2021 levels** by 2045.
3. The third group consists of developing economies and some of the hottest climatic countries like India, Pakistan, Iran, and Saudi Arabia who will start phasing down HFCs by 2028 and reduce it to **15% of 2024-2026 levels** till 2047.

Ozone Recovery



- The UN-backed Scientific Assessment Panel to the Montreal Protocol on Ozone Depleting Substances quadrennial assessment report, published every four years, confirms the phase out of nearly 99% of banned ozone-depleting substances.
- If current policies remain in place, the ozone layer is expected to recover to 1980 values (before the appearance of the ozone hole) by around 2066 over the Antarctic, by 2045 over the Arctic and by 2040 for the rest of the world.

L8 Government Initiative, Water Pol

18 December 2024 09:16 AM

Government Initiative	<ul style="list-style-type: none">• CPCB : Statutory body, passed under Act <p>CPCB (Central Pollution Control Board)</p> <ol style="list-style-type: none">1. Established under Water Act 1974.2. Entrusted with the powers and functions under the Air (Prevention and Control of Pollution) Act, 1981.3. Provides technical services to MoEFC under the provision of Environment (Protection) Act 1986.4. Co-ordinates activities of SPCB.5. Apex organization in India in the field of pollution control (technical wing of MoEFC). <p>Ambient Air Quality - The quality of outdoor air in our surrounding environment. It is typically measured near ground level, away from direct sources of pollution.</p>  <p>22nd September 1974</p>
Air Act	<h3>Air (Prevention and Control of Pollution) Act, 1981</h3> <ul style="list-style-type: none">• The 1987 amendment strengthened the enforcement machinery and introduced stiffer penalties.• The boards may close down a defaulting industrial plant or may stop its supply of electricity or water. A board may also apply to the court to restrain emissions that exceed prescribed limits.• The 1987 Amendment introduced a citizen's suit provision into the Air Act and extended the Act to include noise pollution. <p>• 1984 – NAAQM (National Ambient Air Quality Monitoring) was started.</p> <p>• Renamed as NAMP [National Air Monitoring Programme].</p> <p>Four air pollutants were monitored – SO₂, NO₂, SPM & RSPM₁₀.</p> <ul style="list-style-type: none">• 1985 extended to 28 stations. (By 2012 extended to 26 states).• 1994 – NAAQS (National Ambient Air Quality Standards) were introduced.

2009 NAAQS was revised:

- a) 12 Pollutants were introduced.
- b) Instead of land use classification it included
 1. Industrial area / Residential area.
 2. Ecological sensitive area.
- c) Real time monitoring was started.

Sulphur Dioxide (SO_2), $\mu\text{g}/\text{m}^3$	✓
Nitrogen Dioxide (NO_2), $\mu\text{g}/\text{m}^3$	✓
Particulate Matter (size less than $10 \mu\text{m}$) or PM_{10} $\mu\text{g}/\text{m}^3$	✓
Particulate Matter (size less than $2.5 \mu\text{m}$) or $\text{PM}_{2.5}$ $\mu\text{g}/\text{m}^3$	✓
Ozone (O_3) $\mu\text{g}/\text{m}^3$	✓
Lead (Pb) $\mu\text{g}/\text{m}^3$	✓
Carbon Monoxide (CO) mg/m^3	✓
Ammonia (NH_3) $\mu\text{g}/\text{m}^3$	✓
Benzene (C_6H_6) $\mu\text{g}/\text{m}^3$	✓
Benzo(a)Pyrene (BaP)- particulate phase only, ng/m^3	✓
Arsenic(As), ng/m^3	✓
Nickel (Ni), ng/m^3	✓

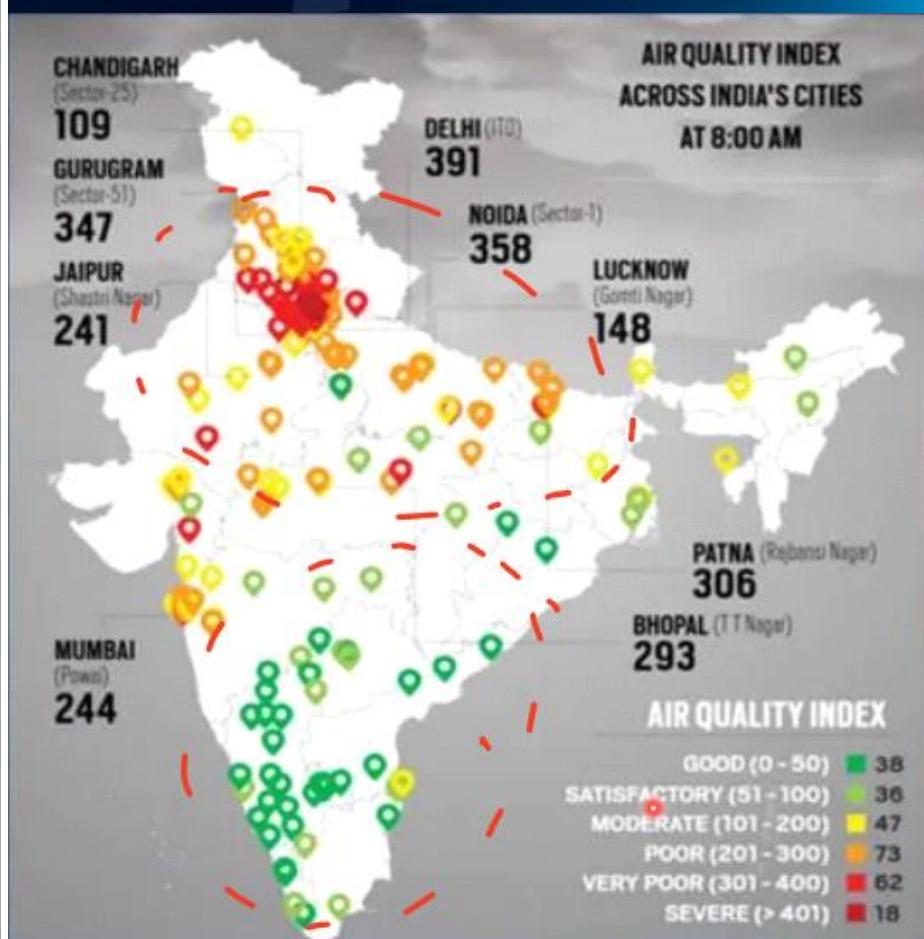
Air Quality Index

- 2014 Ambient Air Quality Index (AQI) was introduced.
 - Tool for effective communication of air quality status to people in terms, which are easy to understand.
 - It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and colour.

AQI Category, Pollutants and Health Breakpoints								
AQI Category (Range)	PM_{10} 24-hr	$\text{PM}_{2.5}$ 24-hr	NO_2 24-hr	O_3 8-hr	CO 8-hr (mg/m^3)	SO_2 24-hr	NH_3 24-hr	Pb 24-hr

“One Number- One Colour – One Description”

AQI	Remark	Color Code	Possible Health Impacts
0-50	Good	Green	Minimal impact
51-100	Satisfactory	Light Green	Minor breathing discomfort to sensitive people
101-200	Moderate	Yellow	Breathing discomfort to the people with lungs, asthma and heart diseases
201-300	Poor	Orange	Breathing discomfort to most people on prolonged exposure
301-400	Very Poor	Red	Respiratory illness on prolonged exposure
401-500	Severe	Dark Red	Affects healthy people and seriously impacts those with existing diseases



SAFAR

- Forecasting tool / Methodology

SAFAR

- “System of Air Quality & Weather Forecasting & Research”.
- India's first Air quality checking model.
- Provide current & advanced forecast for air quality.
- Developed by IITP (Indian Inst of Tropical Meteorology).
- Pollutants monitored: PM2.5, PM10, Ozone, Carbon Monoxide (CO), Nitrogen Oxides (NOx), Sulphur Dioxide (SO2), Benzene, Toluene, Xylene, and Mercury.



SAFAR

National Clean

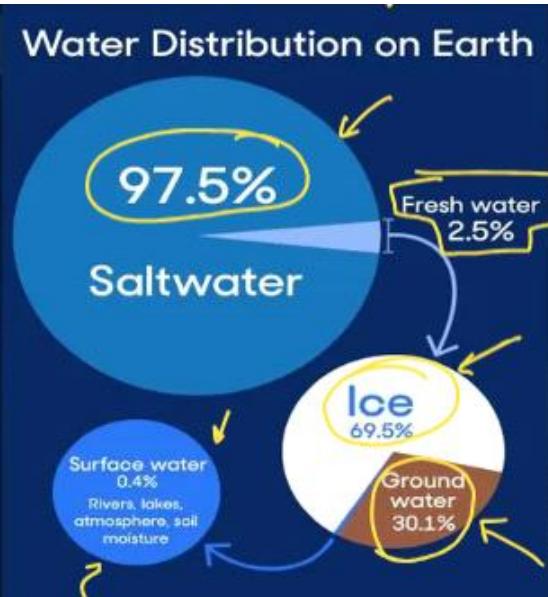
- The National Clean Air Programme (NCAP) is a long-term, national-level strategy

to improve air quality in India. The program was launched by the Ministry of Environment, Forest and Climate Change in January 2019.

- When the Indian government launched the National Clean Air Programme (NCAP) in 2019, it was to cut the concentration of atmospheric Particulate Matter (PM) by 20-30% by 2024, from 2017 levels. This was later revised to 40% by 2026.
 - It seeks to cut the concentration of coarse (particulate matter (PM) of diameter 10 micrometer or less, or PM₁₀) and fine particles (particulate matter of diameter 2.5 micrometer or less, or PM_{2.5}) by at least 20% in the next few years, with 2017 as the base year for comparison.
 - The country's current, annual average prescribed limits for PM_{2.5} and PM₁₀ are 40 (ug/m³) and 60 (ug/m³).
 - There is a target of a 40% reduction in particulate matter concentration, by 2026.
- 2017 : Base year

- Non-attainment cities are those that have fallen short of the National Ambient Air Quality Standards (NAAQS) for over five years.
 - PRANA" – Portal for Regulation of Air-pollution in non-attainment cities, is a portal for monitoring of implementation of National Clean Air Programme (NCAP).
 - It will support tracking of physical as well as financial status of city air action plan implementation.
 - It will disseminate information on air quality management efforts under NCAP to the public.
- NCAP aimed for 150 Continuous Ambient Air Quality Monitoring Stations (CAAQMS), but 531 stations are currently operational, indicating very good progress.
- The rural monitoring network consists of 26 manual stations covering limited areas.
- Efforts to set up 100 monitoring stations by 2024 in rural areas are yet to be fully realized and seem difficult to achieve.

WATER POLLUTION



Water Pollution



Ground Water

- When the polluted water seeps into the ground and enters an aquifer it results into ground water pollution.

NEW THREATS

Punjab's groundwater samples had 8 of the 10 new contaminants

Manganese

Health effects: Toxicity to the nervous system, producing a syndrome that resembles Parkinson

Top states with contaminated habitations:
West Bengal (13,346); Assam (1,041); Andhra Pradesh(23)

Copper

Health effects: Liver damage and kidney disease

Top states with contaminated habitations:
Andhra Pradesh (3); Jammu & Kashmir (1); West Bengal (1)

Aluminium

Health effects: Alzheimer's disease

Top states with contaminated habitations:
Punjab (510); Andhra Pradesh (3); Madhya Pradesh (2)

Mercury

Health effects: Damage to the gastrointestinal tract, nervous system, and kidneys

Top state with contaminated habitations:
Punjab (24)

Uranium

Health effects: Kidney and lifetime risk of cancer

Top states with contaminated habitations:
Punjab (473); Jammu & Kashmir (2); Sikkim (1)

Lead

Health effects: Slows brain development and nervous system

Top states with contaminated habitations:
Punjab (430)

Cadmium

Health effects: Liver injury, convulsions, shock and renal failure

Top states with contaminated habitations:
Punjab (27)

Chromium

Health effects: Cancer and reproductive harm, eye and respiratory irritation and asthma attacks

Top state with contaminated habitations:
Punjab (10)

Selenium

Health effects: Hair and fingernail changes; damage to the peripheral nervous system; fatigue and irritability

Top 3 States with contaminated Habitations:
Punjab (317)

Zinc

Health effects: Stomach cramps and vomiting

Top state with contaminated habitations:
Punjab (2)



Reasons for Groundwater Pollution.

→ Pollution of land

↳ Mining

→ Agriculture

→ Waste dumping

Pollutants seep underground.

→ Pollution of surface water

→ Overextraction of water.



Causes of Water Pollution

- Oil Spills and accident
- Sewage & Wastewater : Eutrophication
- Mining
- Agriculture
- Marine Dumping : Hypoxic Water -> Dead zone
- Leakage from landfill : Chemical seeps to ground water
- Industrial Effluents
- Radioactive waste

Completed Chart

Type of Water Pollution	Cause of Pollution	Symptoms of Pollution	Effect of Pollution	Source of Pollution
Biodegradable waste	Humans and animals	Decreasing numbers of fish and other aquatic life, increasing number of bacteria	Increased number of bacteria, decreased oxygen levels, death of aquatic life	Run-off, improperly treated effluent,
Nutrients	Nitrates and phosphates	Green, cloudy, slimy, stinky water	Algae blooms, eutrophication of water	Over use of fertilizers, run-off from fields, improper

Completed Chart				
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Nutrients	Nitrates and phosphates	Green, cloudy, slimy, stinky water	Algae blooms, eutrophication of water source	Over use of fertilizers, run-off from fields, improper disposal of containers, wastewater treatment
Heat	Increased water temperature	Warmer water, less oxygen, fewer aquatic organisms	Decrease in oxygen levels, death of fish and plants	Industrial run-off, wastewater treatment
Sedimentation	Suspended particles settling out of water	Cloudy water, increased amount of bottom	Warms up water, decreases depth of water source, deposits toxins	Construction sites, farming and livestock operations, logging, flooding, city run-off, dams
Chemicals	Toxic and hazardous chemicals	Water colour changes, develops an odour, aquatic life die out	Kills aquatic life, can enter human food chain, leads to birth defects, infertility, cancer and other diseases in humans and animals	Human-made, improper disposal, run-off, dams, landfill leachate, industrial discharge, acid rain
Radioactive pollutants	Radioactive isotopes	Increased rates of birth defects and cancer in human and animal populations.	Kills aquatic species and leads to cancer and death in humans and other animals	Waste water discharges from factories, hospitals and uranium mines
Medical	Medicines, antibiotics	Infertility in aquatic organisms, and other unknown symptoms	Unknown	Humans dumping medicines into water systems, wastewater treatment
Microbiological	Bacteria, viruses, protozoa	People and animals become ill with gastrointestinal disorders	Undrinkable water	Improper treatment of water/effluent, can occur naturally

Health Cost	<p>Flouride: Brittle bones/teeth, joint impairment and possible damage to the thyroid gland</p> <p>Arsenic: Skin cancer, lungs, bladder and kidney</p> <p>Iron: Hemochromatosis, which can lead to liver, heart and pancreatic damage, as well as diabetes</p> <p>Salinity: Raised Blood Pressure and hypertension</p> <p>Nitrate: Methemoglobinemia, where blood is unable to give enough oxygen to the body</p> <p>Metal: Reduced growth and development, cancer, organ damage, nervous system damage</p>
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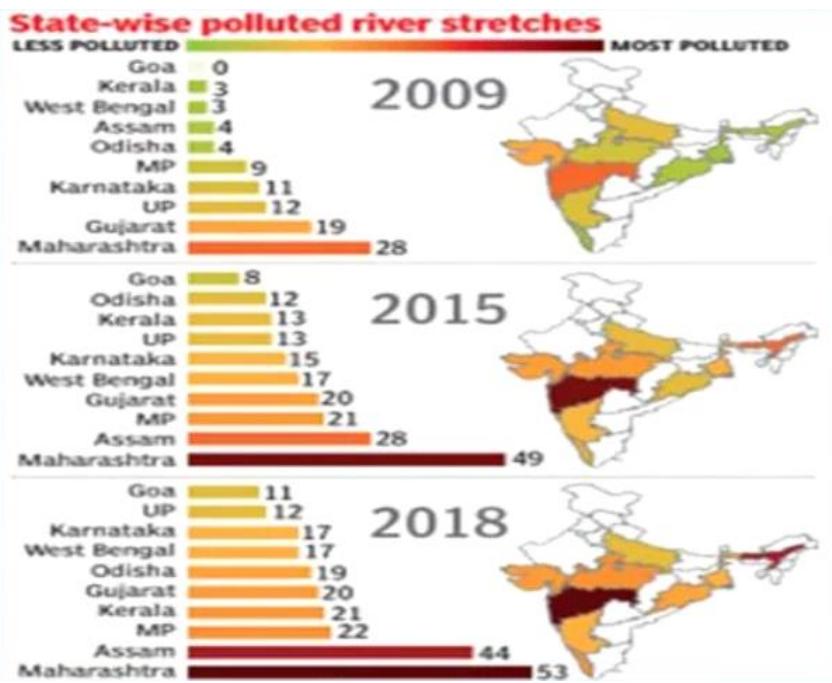
River Pollution	<ul style="list-style-type: none"> Non Point Sources : Agriculture + Sewage + Settlement + Dumping of waste Point Source : <ul style="list-style-type: none"> Industries : Leathers + Oil Refineries + Iron and Steel (To cool down hot objects) + Power plants Mining : Discharge waste, Coal Washeries, Textile Industries (Dyeing Process) Chemical Industries
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RIVER CONTAMINATION

42 rivers in India are polluted with at least two neuro-toxic heavy metals. Ganga, the national river, is polluted with five heavy metals—chromium, copper, nickel, lead and iron. Six rivers—Arkavathi, Orsang, Rapti, Sabarmati, Saryu and Vaitarna—have unacceptable levels of four pollutants. This is of concern because a majority of Indians still use water directly from rivers for their domestic use. And with an increase in population, the pressure on these rivers will only increase

MOST CONTAMINATED SITES





Water Act 1974 • Under Central Pollution Control Board

The Water (Prevention and Control of Pollution) Act, 1974

- The Water (Prevention and Control of Pollution) Act, 1974 represented India's first attempts to comprehensively deal with water pollution issues and creation of institutional set up in the country. The Act prohibits the discharge of pollutants into water bodies beyond a given standard and lays down penalties for non-compliance.
- The Act vests regulatory authority in State Pollution Control Boards and empowers these Boards to establish and enforce effluent standards for factories discharging pollutants into water bodies.
- Central Pollution Control Board (CPCB) was constituted in 1974 as per the provisions of the Water (Prevention and Control of Pollution) Act, 1974.
- The Act grants power to the Board to ensure compliance with the Act by including the power of entry for examination, testing of equipment and other purposes and power to take the sample for the purpose of analysis of water from any stream or well or sample of any sewage or trade effluents.
- The 1988 amendment strengthened the Act's implementation of the pollution provisions.
- Board may close a defaulting industrial plant or withdraw its supply of power or water by an administrative order; the penalties are more stringent, and a citizen's suit provision supports the enforcement machinery.

India's Legislative measures

- 1972 Stockholm Conference : 5th June (Celebrated as World Environment Day)
 - United Nations Environment Programme
 - Triple Threats
 - Loss of Biodiversity
 - Pollution of ecosystem

- Climate Change

- 1972 : India -> Immediately after conference -> : Wildlife protection Act
 - 1974 : Water Act (prevention of pollution), Setup CPCB, Amendment in 1988
 - 1980 : Forest Conservation Act
 - 1981 : Air Act (prevention of pollution), Include noise pollution, Amendment in 1987
 - 2002 : Biodiversity Act

Governmental Initiatives

- Ganga Action Plan (GAP) – 1986.
- 1991 included its tributaries – Yamuna, Gomati & Damodar.
- 1995 “National River Conservation Plan” (NRCP) was launched.
- “National Ganga River Basin Authority” (NGRBA) constituted under Environment (Protection) Act 1986 in 2009 to strengthen NRCP.
- 1986 : TSC Total Sanitation Campaign : To clean Ganga (Stop defecation in river)

Namami Gange

National Mission for Clean Ganga (NMCG) established in 2011.

Some of the major objectives of the Nation Mission for Clean Ganga are:

1. The mission incorporates rehabilitating and boosting the existing STPs and instant short-term steps to curb pollution at exit points on the riverfront in order to check the inflow of sewage.
2. To maintain the continuity of the water flow without changing the natural season variations.
3. To restore and maintain the surface flow and groundwater.
4. To regenerate and maintain the natural vegetation of the area.
5. To conserve and regenerate the aquatic biodiversity as well as the riparian biodiversity of the river Ganga basin.
6. To allow participation of the public in the process of protection, rejuvenation and management of the river.

(National Ganga Council NGC was created in 2016).

- Morphed into Namami Gange 2016

National Ganga Council

The full name of the Council is ‘National Council for Rejuvenation, Protection and Management of River Ganga’.

- It was formed under the River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016.
- This Order dissolved the National Ganga River Basin Authority and replaced it with the National Ganga Council.
- This Council has the overall responsibility of preventing pollution and rejuvenating the Ganga River Basin, including the River Ganga and its tributaries.
- Its jurisdiction extends to the states which comprise of the Ganga River Basin namely, Uttar Pradesh, Himachal Pradesh, Uttarakhand, Bihar, Madhya Pradesh, Chhattisgarh, West Bengal, Rajasthan, Haryana, Jharkhand and Delhi-NCR, and any other states having the major tributaries of the Ganga.
- It is chiefly responsible for the implementation of the National Mission for Clean Ganga.

Diseases due to Contaminants

Nitrate contamination → Blue baby syndrome

Cadmium contamination → Itai-Itai disease.

Mercury contamination → Minamata disease.

Arsenic contamination → Black foot disease

Fluoride contamination → Fluorosis

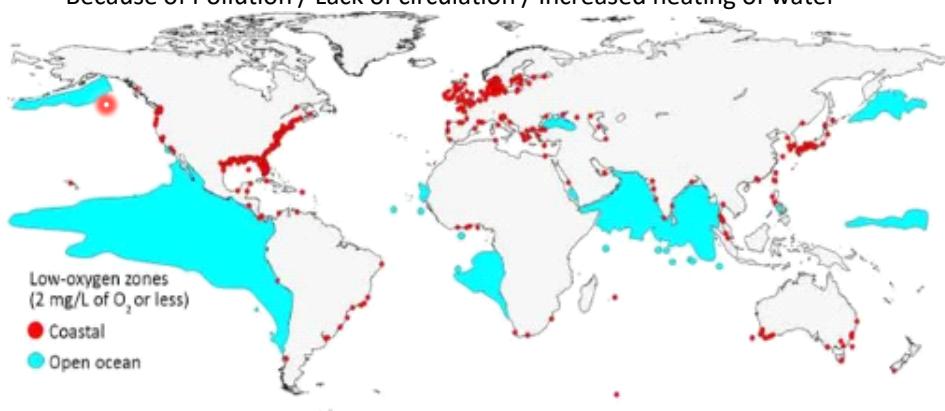
L9 Marine and Land Pollution

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Marine Pollution	<ul style="list-style-type: none">Pollution in Oceans <p>"The introduction by man, directly, or indirectly, of substances or energy to the marine environment resulting in deleterious effects such as: hazards to human health, hindrance to marine activities, impairment of the quality of seawater for various uses and reduction of amenities."</p>
Types	<ul style="list-style-type: none">Eutrophication : Costal waters, Creates Hypoxic watersAcidification : Increase in CO₂ gas in water -> pH value decreasesToxins : Industries / Oil spills / Municipal Solid WastePlasticsUnderwater Noise : Shipping Industries
Garbage Patch	 <p>The map illustrates the North Pacific Ocean with the Subtropical Convergence Zone highlighted. Two large areas of marine debris are shown: the Western Garbage Patch near Japan (labeled Kuroshio) and the Eastern Garbage Patch or N. Pacific Subtropical High near the California coast. The map also shows the North Equatorial Current and the North Pacific.</p> <p>Great Pacific Garbage Patch]</p> <ul style="list-style-type: none">The Great Pacific Garbage Patch is a collection of marine debris in the North Pacific Ocean. Marine debris is litter that ends up in oceans, seas, and other large bodies of water.The Great Pacific Garbage Patch, also known as the Pacific trash vortex, spans waters from the West Coast of North America to Japan.The patch is actually comprised of the Western Garbage Patch, located near Japan, and the Eastern Garbage Patch, located between the U.S. states of Hawaii and California.These areas of spinning debris are linked together by the North Pacific Subtropical Convergence Zone, located a few hundred kilometers north of Hawaii.This convergence zone is where warm water from the South Pacific meets up with cooler water from the Arctic. The zone acts like a highway that moves debris from one patch to another.

Dead Zones

- “Dead zone” is a more common term for hypoxia, which refers to a reduced level of oxygen in the water.
- Areas with low-oxygen conditions – known as hypoxia – have dissolved oxygen concentrations of just 2 mg/L or less.
- Because of Pollution / Lack of circulation / Increased heating of water



Land Pollution

Physical or Chemical alteration to land causing land use change

Addition of foreign elements to such an extent that it can no longer sustain the ecosystem that depended on it.

Majorly caused due to dumping and improper disposal of industrial and domestic waste along with semi-solid waste resulting from agriculture

- Reduces Natural growing ability -> Soil become barren -> top osil is eroded -> Can lead to desertification

Difference

Difference Between Land and Soil Pollution

Land Pollution

The degradation of the earth's land surfaces, both above and below ground level.

Soil Pollution

Pollution of top most layer of earth or contamination of soil with anomalous concentrations of toxic substances.

1. Agricultural Activities-

1. Use of Pesticides

Common types of pesticides include:

- Herbicides - e.g. -Triazines, Carbamates , Phenoxyalkyl acids, Aliphatic acids
- Insecticides – e.g.- Organophosphates, Chlorinated hydrocarbons, Arsenic-containing compounds, Pyrethrum
- Fungicides – ex- Mercury-containing compounds, Thiocarbamates, Copper sulfate

2. (Mining and Extraction activities)

- The movement of rocks due to mining activities and overburden in case of surface mining effects can result in erosion, sinkholes, loss of biodiversity, or the contamination of soil.

- Metals frequently associated with mining include

- Mercury
- Arsenic
- Lead
- Antimony
- Cadmium



3. Urbanisation

- Increase in the number of cities, population, and industrialization which directly or indirectly affects our ecosystems
- It occurs due to the mixing of toxins in the soil by industries or other sources.
- As the waste is disposed of directly to water & soil from various sources that have arisen many diseases.
- Excessive consumption of Plastic bags, accumulate in soil and prevents germination of seeds.

Effect of Lead Pollution

Agriculture

- Reduced nitrogen fixation
- Reduced soil fertility
- Pesticides kill the nutrient of soil
- Reduced crop yield

Health

- Breathing disorders
- Skin diseases
- Release of lead in soil impact a child's cognitive development
- Landfills and waste dumping lead to air pollution.



iii) Environment

- Reduced vegetation leads to barren land
- Ecological imbalance
- Imbalance in soil fauna and flora
- Water pollution
- Loss of top soil
- Habitat loss
- Risk of wildfire
- Biomagnification

Solid Waste in India

The total quantity of Solid waste generated in the country is around 150761 TPD.

-Efficiency of waste collection works out to 96.8%.

- 47.01 % of waste is treated & 25.8% of the total waste generated remains unaccounted.

-As per the World Bank report "What a Waste 2.0: A Global Snapshot of Solid Waste" - India is the third largest generator of Solid waste in the World.

Solid waste are classified depending on their source :

a) Municipal Waste

b) Industrial/Hazardous Waste

c) Bio-medical Waste



Fig. 1: Solid Waste Generation Per Capita (gm/day)

Municipal Waste

- Municipal solid waste consists of household waste, construction and demolition debris, sanitation residue, and waste from streets.
- Municipal waste comprises both liquid and solid wastes.
- Toxic and greenhouse gases are released from the decay of organic matter in landfills and open dumps, and from burning of municipal waste.

• Types : Biodegradable / Non Biodegradable

Industrial Waste

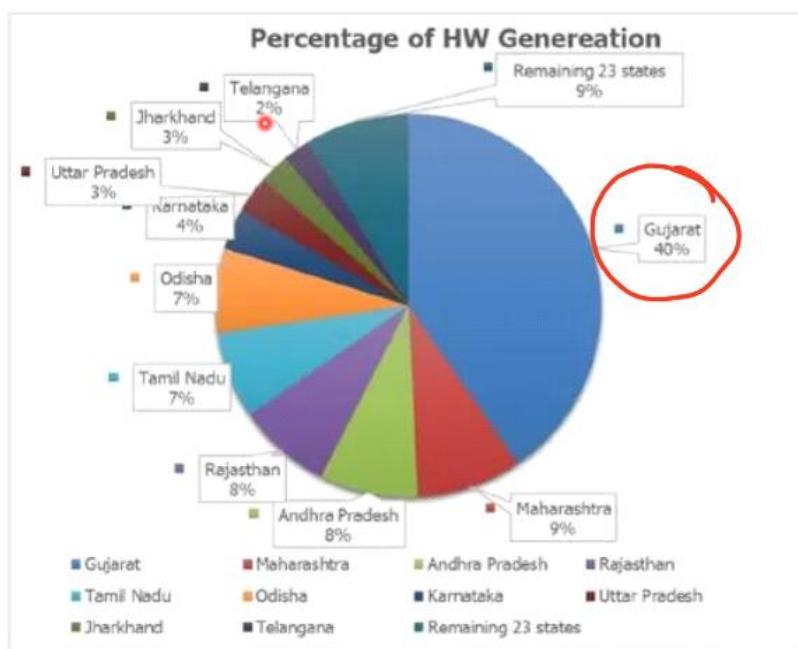
Industrial waste is characterized as waste generated by fabrication or industrial processes. Cafeteria refuse, dirt and gravel, masonry and mortar & etc. It includes fly ash, metallic residues, mercury, lead, copper, zinc, cadmium, cyanides, chromates, acids, alkalies, organic substances, nuclear wastes

As per CPCB, During 2020-21, 10.92 Million MT and during 2022 -23 15.6 Million MT , of hazardous waste (including quantity imported and previous stock) has been generated.



- Fly ash mostly by coal based power plants -> Fly ash bricks (Construction and pavement)

Top 10 HW generating States are Gujarat (40.39%), Maharashtra (8.84%), Andhra Pradesh (8.26%), Rajasthan (7.92%), Tamil Nadu (7.28%), Odisha (7.12%), Karnataka (3.47%), Uttar Pradesh (3.14%), Jharkhand (2.55%) and Telangana (2.28%) which together contributes about 91.24% of total generation.



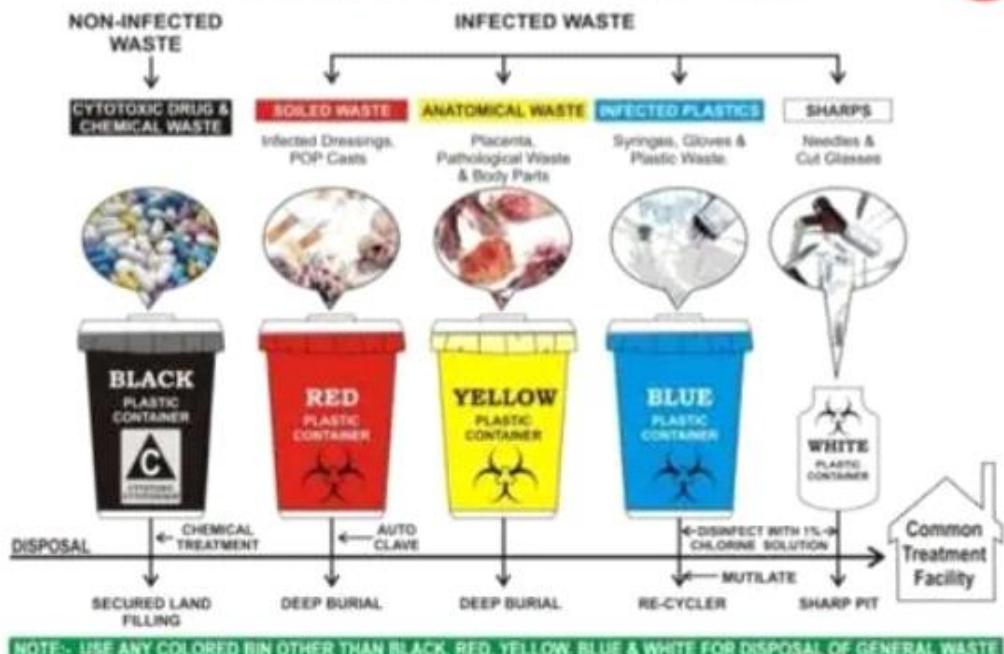
- Gujrat highest :
 - More industrialization
 - Types of waste generating industries (oil exploration / Ship breaking / heavy Chemical / Automobiles / Textiles
 - Better account of waste generated

Bio Medical waste

As per Biomedical waste management rule, "bio-medical waste" means any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or research activities pertaining thereto or in the production or testing of biological or in health camps



SEGREGATION OF SOLID BIO-MEDICAL WASTE



- Leads to better waste management -> Ensures reduced impact on biodiversity

As reported by State Boards, about 619 tons/day of biomedical waste was generated during the year 2018-2019 by 3,22,425 numbers of Healthcare Facilities.

But only 544 tons/day of biomedical waste is treated and disposed off.

74 tons/day get disposed off through deep burials located at isolated places

Plastic and Microplastic

Plastic waste, or plastic pollution, is 'the accumulation of plastic objects (e.g.: plastic bottles, plastic bags,) in the Earth's environment that adversely affects wildlife, wildlife habitat, and humans.'

Microplastics, small pieces of plastic, less than 5 mm (0.2 inch) in length, that occur in the environment as a consequence of plastic pollution

As per UNEP Baseline report, India is the fifth highest generator of plastic waste.

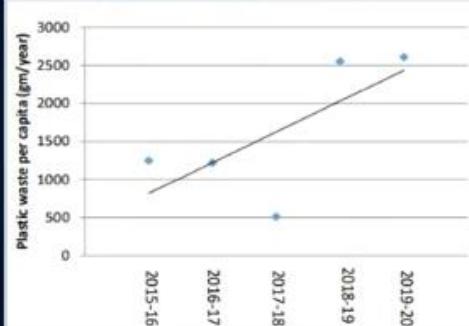
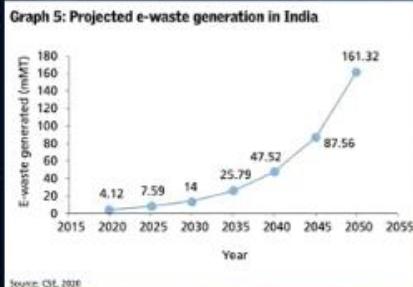


Fig.2: Per capita Plastic waste generation

E Waste

- E-waste means electrical and electronic equipment, whole or in part discarded as waste by the consumer or bulk consumer as well as rejects from manufacturing, refurbishment and repair processes
- It is a source of toxic and hazardous pollutants, including polyvinylchloride (PVC), lead and mercury.

95% of e-waste in India is recycled by the informal sector and scrap dealers unscientifically dispose it off by burning or dissolving it in acids.



- Issues with e waste

- Generation of waste is very high -> very limited scope for recycle
- Majority of waste processing centres are from formal sector (>90%)
 - Inefficient utilization of waste
 - Greater pollution
 - Impact on the worker's health is very large

Prevention and control measure



Methods of Handling garbage

OPEN DUMPS

- Open dumps are uncovered sites where solid waste of various types is dumped.
- The waste isn't handled, it's left out in the open, and it isn't separated.

Landfills

A landfill site is a site for the disposal of waste materials by burial and is the oldest form of waste treatment.

Land filling are done for the following types of waste:

- (i) Commingled waste (mixed waste) not found suitable for waste processing;
- (ii) Pre-processing and post-processing rejects from waste processing sites;
- (iii) Non-hazardous waste not being processed or recycled.

Adverse pedoclimatic conditions in the landfill cover soil such as problems, shallow soil, nutrient deficiency, elevated temperature, leachate contamination.

gas
and

Sanitary landfills:

Sanitary landfills are more sanitary and are constructed in a methodical manner to eliminate the problem of leaching.

These are constructed on impermeable soil and lined with impermeable materials such as plastics and clay.

Major limitation of this method is the costly transportation of MSW to far away landfill sites.

Incineration plants:

- Incineration is the process of burning garbage in massive furnaces at high temperatures.
- It is used to utilize energy or minimize landfill area without energy recovery.
- The products formed in the combustion process include hot combustion gas, which consists of N₂, CO₂, H₂O, flue gas, oxygen, and noncombustible residues.=
- Mostly for handling inorganic waste
- Need filtering before being discharged into atmosphere

Pyrolysis

- It is a process of burning material in the absence of oxygen or in a controlled atmosphere of oxygen.
- The resulting gas and liquid can be utilised as fuel.
- Carbonaceous wastes such as firewood, coconut, palm trash, corn combs, cashew shell, paddy straw, and sawdust are pyrolyzed to produce charcoal, as well as fuel gas.
- Partial Combustion due to limited oxygen supply -> left over residue are carbon rich substance
- Can be utilized as charcoal pellets (Fuel)

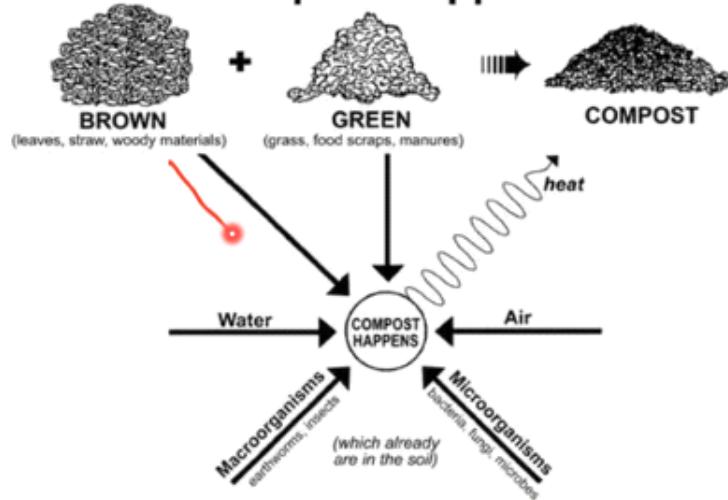
Composting

Benefits the soil.
fertility

- Composting is a biological process in which degradable organic waste is decomposed into a humus-like substance. → Rich in organic comp.
- It is done in the presence of oxygen by microorganisms, primarily fungi and bacteria.
- Final product is high in carbon and nitrogen
- It aids in the retention of more plant nutrients in the soil.

- Very Fine texture -> greater water and air retention -> promotes soil biology -> fertility ↑

Compost Happens



Organic waste → Process of decomposition
is accelerated by addition of earthworms

It is also known as earthworm farming. In this method, Earthworms are added to the compost.

These worms break the waste, and the added excreta of the worms makes the compost very rich in nutrient



L10 Plastic Waste, Govt on Solid, Noise

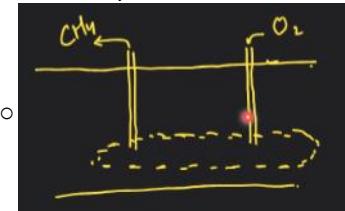
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Bioremediation

Bioremediation

Process that uses mainly microorganisms, plants, or microbial or plant enzymes to detoxify contaminants in the soil and other environments.

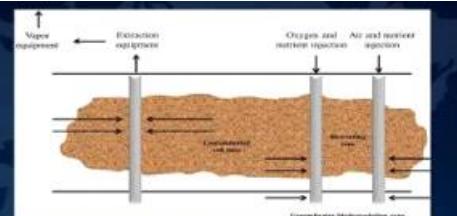
- Biological Process to cater to soil, surface water, ground water contamination
- Accelerate the process of natural decomposition



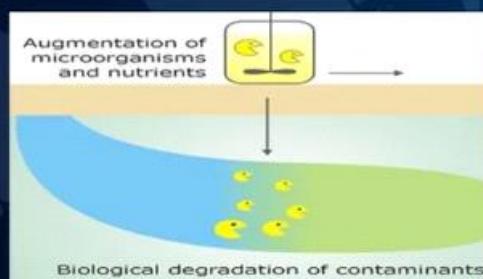
- Requirement for decomposition
 - Microbes, Moisture, Air, Warm Temperature

1. Bioventing

Bioventing is a process of stimulating the natural in situ biodegradation of contaminants in soil by providing air or oxygen to existing [soil microorganisms.]



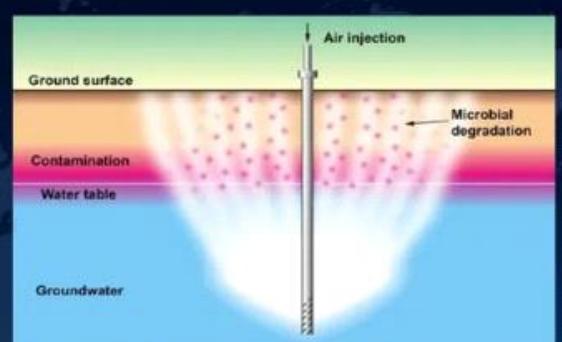
2. Bio-augmentation



- Disadvantages : Microbial action continues even after contaminant is removed

2. Biosparging

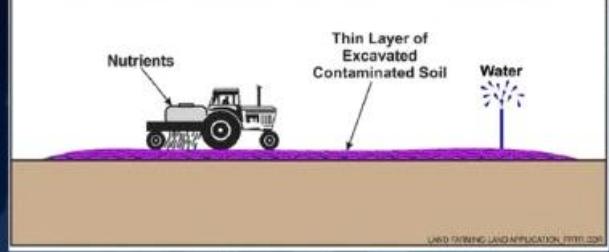
Biosparging involves the injection of air under pressure below the water table to increase groundwater oxygen concentrations and enhance the rate of biological degradation of contaminants by naturally occurring bacteria.



- Increase oxygen in ground water and also in the layer of soil above water

4. Land farming.

[Ex-situ process]



5. Composting Bioremediation-

Bringing together contaminated soil with non-hazardous organic materials such as manure or agricultural wastes.

Government Initiative

Legal measures

- ✓ Solid Waste Management Rules, 2016
 - ✓ Plastic Waste Management Rules, 2016 and Amendment Rules, 2018
 - ✓ Bio-Medical Waste Management Rules, 2016 and Amendment 2018
 - E-Waste Management Rules, 2016 and Amendment Rules 2018
 - Hazardous and Other Wastes (Management & Movement) Rules, 2016
 - Hazardous and Other Wastes (Management & Movement) Amendment Rules, 2019
 - Battery Waste Management Rules 2020
- Trans-boundary
Transboundary
- deepakdc1910@gmail.com
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EPR Extended Producer Responsibility

Concept of Extended Producer Responsibility [EPR]



- Producers are given target : depending upon sales they carried out
- Let's say PepsiCo / Cococola has to recover bottles of coldrink, or any other plastic
- Benefit:
 - Improve treatment and effective disposal of waste
 - Reduced cost on local bodies
 - Circular economy of reduce / reuse / recycle
 - Job creation in the process
 - Reduce cost of production
 - Responsible production : Eco Friendly Alternate packaging / Tech is used

Plastic Waste Management

Plastic Waste Management (Amendment) Rules, (2022)

Ministry of Environment, Forest, and Climate Change announced the Plastic Waste Management (Amendment) Rules, 2022, which notified the instructions on Extended Producer Responsibility (EPR) for plastic packaging.

- Plastic Waste Management Rules 2016 has been amended to fast-track the elimination of single-use plastics and promote alternatives.

- Issue : Amount of waste generated would keep on increasing
 - Majority of organisation were unable to fulfil the EPR targets
 - Different types of plastic with different features of recycle
- Market Mechanism was introduced : Tradeable EPR Certificate
 - To improve the rate of reuse and recycle

What are the Provisions under the New Rules?

Classification of Plastics:

- Category 1: Rigid plastic packaging will be included under this category.
- Category 2: Flexible plastic packaging of single layer or multilayer (more than one layer with different types of plastic), plastic sheets and covers made of plastic sheet, carry bags, plastic sachet or pouches will be included under this category.
- Category 3: Multi-layered plastic packaging (at least one layer of plastic and at least one layer of material other than plastic) will be included under this category.
- Category 4: Plastic sheet or like used for packaging as well as carry bags made of compostable plastics fall under this category

Plastic Packaging: Reuse of rigid plastic packaging material has been mandated in the guidelines to reduce the use of fresh plastic material for packaging.

Extended Producer Responsibility Certificates: In a significant first, the guidelines allow for sale and purchase of surplus extended producer responsibility certificates. This will set-up a market mechanism for plastic waste management.

Centralised Online Portal: The government has also called for establishing a centralised online portal by Central Pollution Control Board (CPCB) for the registration as well as filing of annual returns by producers, importers and brand-owners, plastic waste processors of plastic packaging waste

- Benefit of Market Mechanism
 - Better compliance by companies
 - Greater and more efficient waste management
 - More job Creation
 - Reduced load on the Local Bodies

E-waste Management Rules 2016:

1. It includes CFLs or Compact Fluorescent Lamps as well as other lamps with mercury, and similar equipment.
 2. The Rules for the first time, bring producers under the ambit of the Extended Producer Responsibility or EPR, together with the targets.
 3. Producers have been made accountable for e-waste collection and e-waste exchange as well.
 4. Additional stakeholders included are:
 1. Manufacturers
 2. Dealers
 3. Refurbishers and Producer Responsibility Organizations.
1. Additional stakeholders included are:
1. Manufacturers
 2. Dealers
 3. Refurbishers and Producer Responsibility Organizations.
2. Compact Fluorescent Lamp (CFL) and other mercury-containing lamps have been brought under the purview of the rules.

India's Environment Ministry has notified rules targeting the wide range of groups like hotels, residential colonies, bulk producers of consumer goods, ports, railway stations, airports, and pilgrimage spots. This is to ensure that the solid waste generated in their facilities is treated and recycled.

Ministry has notified the E-Waste (Management) Rules, 2022 on 2nd November, 2022. These rules will replace E-waste (Management) Rules, 2016 and will be effective from 1st April, 2023. These rules will launch a new Extended Producer Responsibility (EPR) regime for e-waste recycling. The salient feature of new rules is as under:

- All the manufacturer, producer, refurbisher and recycler are required to register on portal developed by CPCB.
- No entity shall carry out any business without registration and also not deal with any unregistered entity.

- Authorization has now been replaced by Registration through online portal and only manufacturer, producer, refurbisher and recycler require Registration.
- Producers of notified EEE, have been given annual E-Waste Recycling targets based on the generation from the previously sold EEE or based on sales of EEE as the case may be. Target may be made stable for 2 years and starting from 60% for the year 2023-2024 and 2024-25; 70% for the year 2025-26 and 2026-27 and 80% for the year 2027-28 and 2028-29 and onwards.
- Management of solar PV modules /panels/ cells added in new rules.

- The quantity recycled will be computed on the basis of end products, so as to avoid any false claim.
- Provision for generation and transaction of EPR Certificate has been introduced.
- Provisions for environment compensation and verification & audit has been introduced.
- Provision for constitution of Steering Committee to oversee the overall implementation of these rules.

Under the E-Waste Management Rules, provision for reduction of hazardous substances in manufacturing of Electrical and Electronic Equipment (EEE) has been provided. It mandates that every producer of EEE and their components shall ensure that their products do not contain lead, mercury and other hazardous substances beyond the maximum prescribed concentration.

The E-Waste (Management) Rules also provide for recognition and skill development, monitoring and ensuring safety and dismantling and recycling of e-waste.

Key Points of Solid Waste Management Rules, 2016

- Segregation at Source
- Collection and disposal of sanitary waste
- Collect Back scheme for packaging waste
- User fees for collection - Formalization
- Waste processing and treatment & Promoting use of compost
- Promotion of waste to energy

Noise Pollution

Area code	category	Limits in dB	
		Day	Night
A	(Industrial area)	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence zone	50	40

An area comprising not less than 100 metres around hospitals, educational institutions and courts may be declared as silence area / zone .

- Silence Zone : Hospitals, Education institute, Judiciary

Types of Noise Pollution



Causes

- Industrialization
- Poor Urbanization
- Social Events
- Transportation
- Construction activities
- Fireworks & Loudspeakers
- Agricultural machines
- Defence equipments
- Explosives
- Others

Effect

- Hypertension & Sleeping Disorders.
- Hearing Loss, Cardiovascular issues.
- Effect on animals.
- Dementia & Alzheimer's Disease etc.

Important Convention	
Minamata Convention	<ul style="list-style-type: none"> • Mercury -> Minamata Diseases (Sensory loss) <ul style="list-style-type: none"> • "International treaty designed to protect human health & environment from anthropogenic emission & release of Mercury & Mercury compounds". • Signed in 2013, entered into force on August 16, 2017.

- The Convention covers all aspects of the life cycle of mercury, controlling and reducing mercury across a range of products, processes and industries. This includes controls on:
 - mercury mining
 - the manufacture and trade of mercury and products containing mercury
 - disposal of mercury waste
 - emissions of mercury from industrial facilities.
- Countries that have ratified the Convention are bound by international law to put these controls in place.
- India ratified it in 2018 as 93rd member.
- Minamata Disease:** A disorder caused by methylmercury poisoning that was first described in the inhabitants of Minamata Bay, Japan and resulted from their eating fish contaminated with mercury industrial waste.
 - The disease is characterized by peripheral sensory loss, tremors, and both hearing and visual loss.

Basel Convention

- Stopping Moving garbage to Poor Country
 - Tech Assistant in waste management
 - On control of transboundary movement of hazardous wastes & their disposal.
 - The Basel Convention directs a "Prior Consent Approval" method to control the transboundary movements of harmful and other wastes to reduce their adverse effects on the environment.
 - Protect human health & environment against adverse effect of Hazardous wastes.
 - Entered into force on 5th May 1992.
- The main focus of the Basel Convention is to prevent the movement of hazardous waste from developed nations to developing or underdeveloped countries and reduce the transfer of hazardous waste among countries across the globe.
- This international treaty has aimed to reduce the movement of dangerous waste, such as toxic, flammable, explosive, and corrosive waste, between countries.
 - Nevertheless, the movement of radioactive waste is not covered or controlled by this Basel Convention.

- The Basel Convention also assists LDCs in the environmentally sound management of their generated hazardous and other disposable wastes.
- Another objective of the Basel Convention is to ensure the environmentally sound management of other countries by minimizing the amount and toxicity of waste that each country generates.
- The chief organ of the Basel Convention is the COP. It is accountable for making decisions about the actions and management of the Convention. It meets twice a year.

List of Wastes under Basel Convention

Some of the examples of waste that are considered hazardous under the scope of the Basel Convention:

- ➡ Consumed or exhausted lead-acid batteries
- ➡ All Biomedical wastes
 - Stubborn Organic Pollutant wastes
 - Explosive wastes and Utilized Oils
 - Polychlorinated Biphenyls (PCBs) compounds
 - Heat exchange fluids, paint extract, sealants, copy papers free from carbon and used plastics.
 - Harmful chemicals and insecticides persist in the environment for years.
 - Including chemical wastes generated by industries and consumers.
 - Electronic and Electrical waste
 - Ships intended for dismantling
 - Mercury wastes

Stockholm
Convention

- Bio Chemical Waste / POP Persistent organic Pollutant
 - Global treaty that aims to protect human health and the environment from the effects of persistent organic pollutants (POPs).
 - Effective from May 2004.
 - It divides POP into three Annexes.
 - a. Annex 1 – List of POP to be **eliminated**.
 - b. Annex 2 – List of POP to be **restricted**.
 - c. Annex 3 – List of POP **produced & released un-intentionally**.

Persistent organic pollutants (POPs) are a group of chemicals possessing the following characteristics:

- They are highly toxic to humans and wildlife (harmfulness).
- They can last for many years in the environment before degrading into less dangerous forms (persistence).
- They bio-accumulate in the food chain (bio-accumulation).
- They are transported over large distances through air and water and can be found worldwide (long-range transport).

Stockholm Convention – 12 POPs

Category	Persistent Organic Pollutant
Pesticide	1. Aldrin 2. Chlordane 3. DDT 4. Dieldrin 5. Endrin 6. Heptachlor 7. Hexachlorobenzene 8. Mirex 9. Toxaphene
Industrial Chemicals	1. Hexachlorobenzene 2. Polychlorinated biphenyls (PCBs)
By-Products	1. Polychlorinated dibenzo-p-dioxins and Polychlorinated dibenzofurans (PCDD/PCDF)

- The Global Environmental Facility (GEF) is the designated interim financial mechanism for the Stockholm Convention.
- The United Nations Industrial Development Organization (UNIDO) takes the responsibility for developing nations and transitioning economies to help them implement Stockholm Convention measures.

Rotterdam Convention

- Banned Chemical and Pesticides
 - Prior informed consent procedure for certain Hazardous chemicals & pesticides in International trade.
 - Administered by FAO & UNEP.
 - Entered into force on 24th February 2004.
 - It has Annex 3 list, which includes pesticides & industrial chemicals that have been banned or severely restricted.

The following are the provisions covered under the Rotterdam Convention:

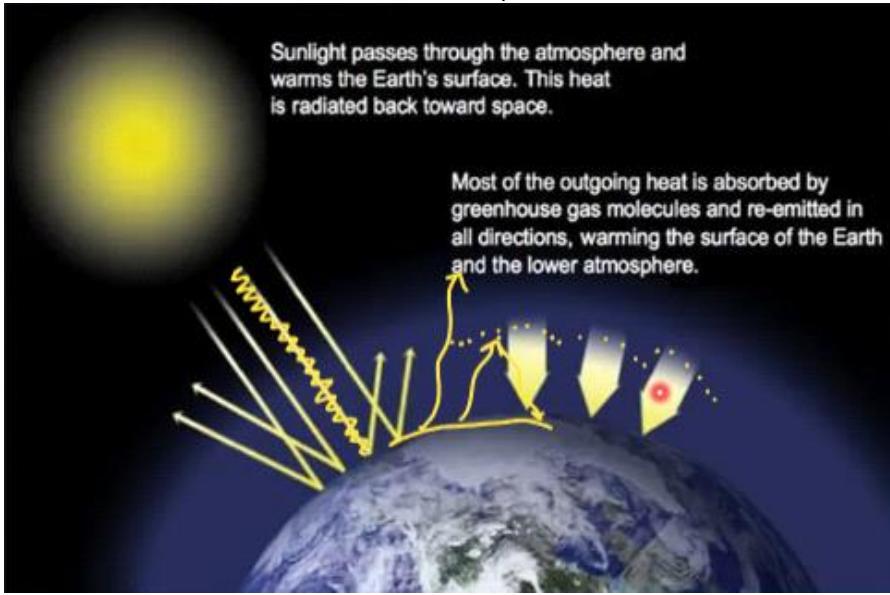
1. The convention covers those pesticides and industrial chemicals that are banned or severely restricted.
2. Any concern related to pesticides and industrial chemicals promotes their inclusion on Annex III of the convention.
3. Annex III other than comprising chemicals that need PIC, also may contain those chemicals and pesticides that present a risk under conditions of use in developing countries or countries with economies in transition.

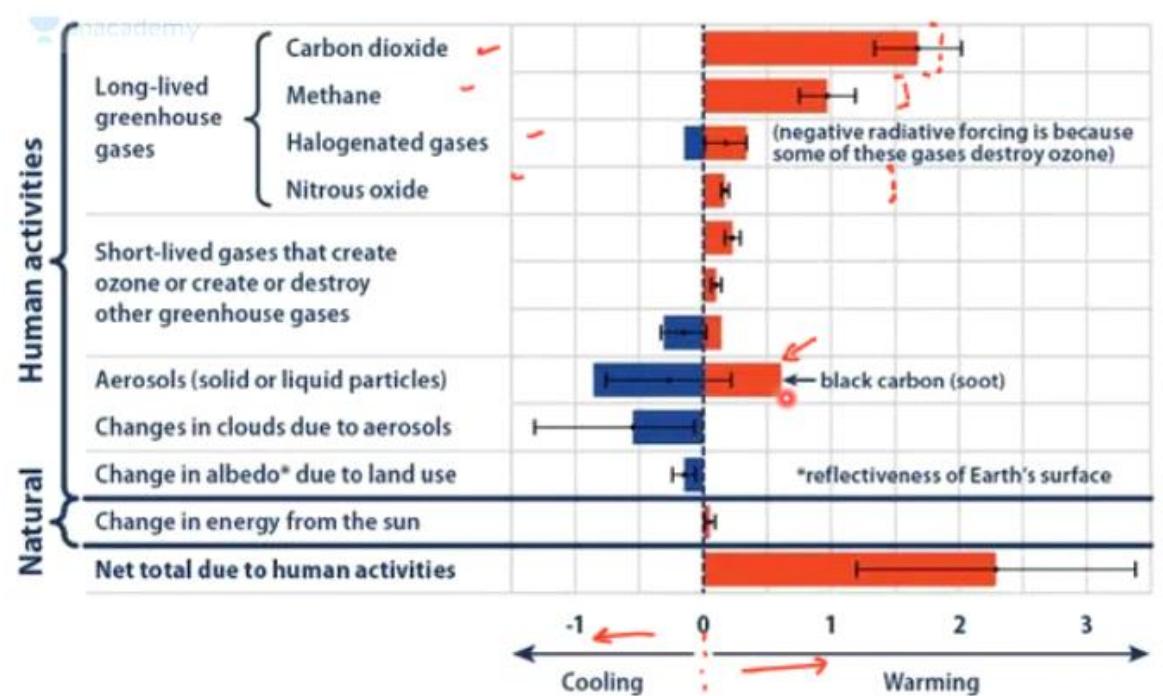
The following are the provisions covered under the Rotterdam Convention:

4. A decision guidance document (DGC) contains all the information regarding the chemicals mentioned under Annex III.
5. With respect to the chemicals under Annex III, the member parties have the following choices:
 - To allow its import
 - To disallow its import
 - To allow its import with some conditions
6. A country that imports chemicals has to formulate decisions that are trade-neutral.

L11 Climate Change, Global Warming

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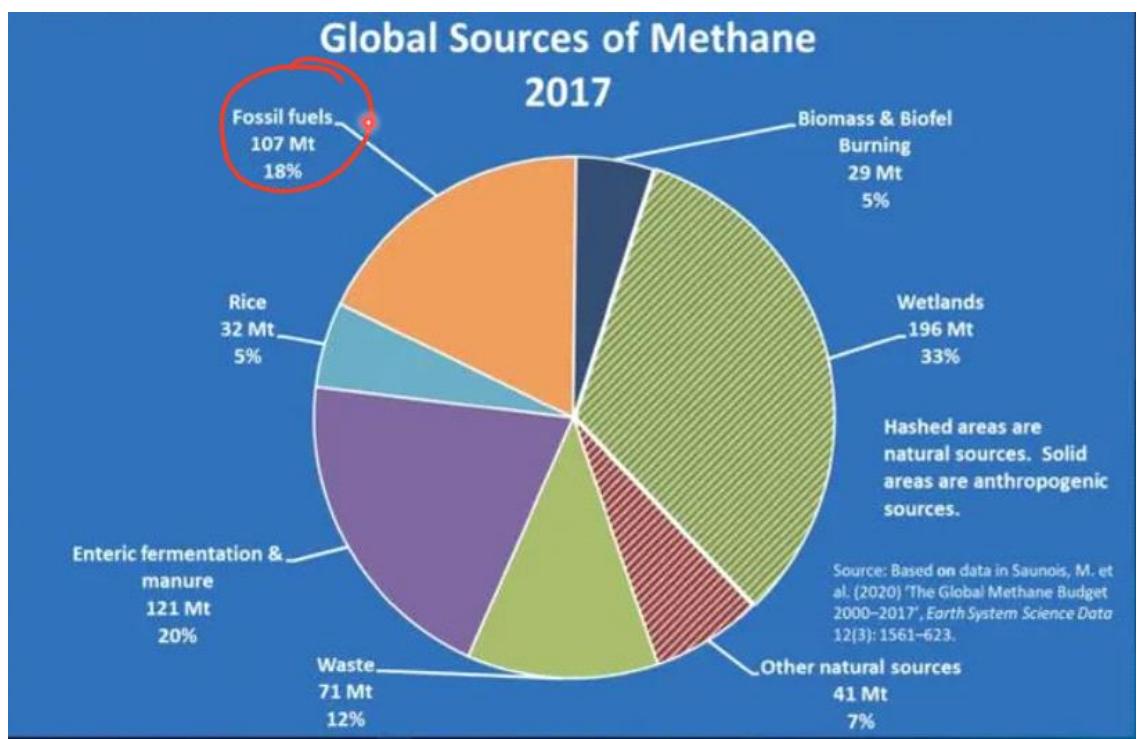
Climate Change	
Global Warming	<ul style="list-style-type: none">• Global warming is the phenomenon of increasing average air temperatures near the surface of Earth over the past <u>one to two centuries</u>.• The influence of human <u>activities</u> since at least the beginning of the Industrial Revolution has been deeply woven into the very fabric of climate change.
Greenhouse Effect	<ul style="list-style-type: none">• Gases Like CO₂, H₂O Etc absorb the outgoing terrestrial radiation from the surface and re radiate it back to the surface -> Maintain the heat and temp of the surface  <p>Sunlight passes through the atmosphere and warms the Earth's surface. This heat is radiated back toward space.</p> <p>Most of the outgoing heat is absorbed by greenhouse gas molecules and re-emitted in all directions, warming the surface of the Earth and the lower atmosphere.</p>
Radiative Forcing	<ul style="list-style-type: none">• Radiative forcing is a measure of the influence a given climatic factor has on the amount of <u>downward-directed radiant energy impinging upon Earth's surface</u>.• "Positive forcing" is exerted by climatic factors that contribute to the warming of Earth's surface, whereas "negative forcing" is exerted by factors that cool Earth's surface. <ul style="list-style-type: none">• Positive Forcing : Heating• Negative Forcing : Cooling, aerosols, albedo



Green House Gas

- Water Vapour
 - Water vapour is the most potent of the greenhouse gases in Earth's atmosphere.
 - The primary role of water vapour is not as a direct agent of radiative forcing but rather as a climate feedback.
 - The warmer the surface, the greater the evaporation rate of water from the surface.
- Carbon Dioxide
 - Natural sources of atmospheric CO₂ include outgassing from volcanoes, the combustion and natural decay of organic matter, and respiration by aerobic organisms.
 - These sources are balanced by a set of physical, chemical, or biological processes, called "sinks," that tend to remove CO₂ from the atmosphere.
- Methane (Highest warming potential)

- Methane (CH_4) is the second most important greenhouse gas. CH_4 is more potent than CO_2 because the radiative forcing produced per molecule is greater. It is responsible for around 30% of the rise in global temperatures since the Industrial Revolution.
- However, CH_4 exists in far lower concentrations than CO_2 in the atmosphere, and its concentrations by volume in the atmosphere are generally measured in parts per billion (ppb) rather than ppm. CH_4 also has a considerably shorter residence time in the atmosphere than CO_2 .
- Natural sources of methane include wetlands, methane-oxidizing bacteria, volcanoes, seepage vents of the seafloor in regions rich with organic sediment, and methane hydrates trapped along the continental shelves of the oceans and in polar permafrost.
- The primary natural sink for methane is the atmosphere itself, as methane reacts readily with the hydroxyl radical ($\cdot\text{OH}$) within the troposphere to form CO_2 and water vapour (H_2O). When CH_4 reaches the stratosphere, it is destroyed.
- Another natural sink is soil, where methane is oxidized by bacteria.



- Global methane Tracker
 - The IEA's latest update of its Global Methane Tracker found that the global energy industry was responsible for 135 million tonnes of methane released into the atmosphere in 2022, only slightly below the record highs seen in 2019. Today, the energy sector accounts for around 40% of total methane emissions attributable to human activity, second only to agriculture.

- Other Component

- Surface O₃
- Nitrous oxide (N₂O)
- Fluorinated gases (halocarbons including sulphur hexafluoride, hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).
- Aerosols

• Aerosols

- Aerosols are extremely small solid particles, or very small liquid droplets, suspended in the atmosphere.
- Aerosols consisting of solid particles can be placed in the atmosphere primarily by large dust storms, volcanic eruptions, or the soot particles from large fires.
- Liquid aerosols in the atmosphere primarily consist of water droplets, in which active chemical species may be found.
- Wave action in the oceans may actually send water droplets and small particles of sea salt into the atmosphere as well.

Sulphur based aerosols → whitish colour



↓ Reflect solar rays

↓ Induces cooling.

[Released mostly during
volcanic eruptions.]

Black Carbon/Soot

→ Increases the rate
of absorption of heat

Increases the rate of warming.

Global Dimming

- Global dimming is defined as the decrease in the amounts of solar radiation reaching the surface of the Earth.
- Various regions observe different levels of global dimming. Southern Hemisphere has seen very small amounts of global dimming while Northern Hemisphere has witnessed more significant reductions, to the tune of 4-8%.
- Regions such as parts of Europe and North America has observed partial recovery from dimming while parts of China and India have experienced increase in global dimming.

Effects of Global Dimming

- Water in the northern hemisphere has become colder. This leads to slower evaporation and generation of lesser water droplets. This further causes reduction in the amount of rain reaching certain parts of the globe, resulting in drought and famine situations.
- Decrease in sunlight or solar radiation will negatively impact process of photosynthesis in plants.

• Impacts the net primary productivity of the ecosystem

Deforestation

- Sources of green house gas, release CO₂, CH₄ etc -> inc level of warming
 - Deforestation is the permanent destruction of forests in order to make the land available for other uses.
 - About 300 billion tons of carbon, 40 times the annual greenhouse gas emissions from fossil fuels, is stored in trees.
 - The deforestation of trees not only lessens the amount of carbon stored, it also releases carbon dioxide into the air.
 - Deforestation releases nearly a billion tonne of carbon into the atmosphere per year, though the numbers are not as high as the ones recorded in the previous decade.
 - Deforestation is the second largest anthropogenic source of carbon dioxide to the atmosphere (after fossil fuel combustion), ranging between 6 percent and 17 percent.
 - The impact of deforestation on the exchange of water vapour and carbon dioxide between the atmosphere and the terrestrial land surface is the biggest concern with regard to the climate system.
 - Deforestation has decreased global vapour flows from land by 4 percent. Even this slight change in vapour flows can disrupt natural weather patterns and change current climate models.

Effect of Deforestation

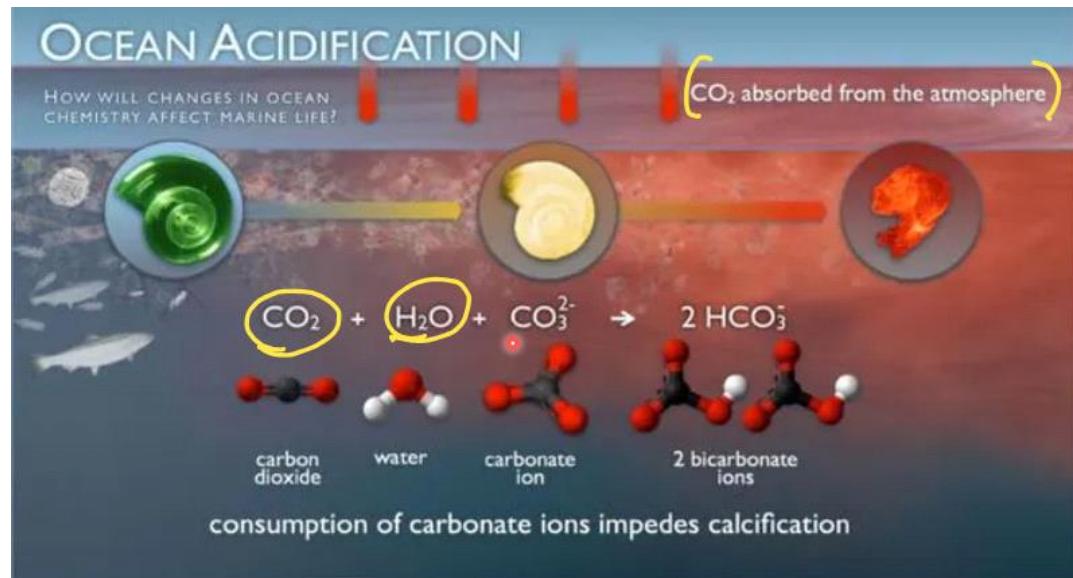
- Loss of species
- Water cycle
- Soil erosion
- Life quality
- The disturbance of native people
- Effect on Carbon Sequestration

Role of Oceans

- Absorb a lot os CO₂
 - The world's oceans help to moderate the earth's average surface temperature and thus its climate by removing about 25–30% of the CO₂ pumped into the lower atmosphere by human activities.
 - The oceans also absorb heat from the lower atmosphere and use currents to slowly transfer some CO₂ to the deep ocean, where it is buried in bottom sediments for several hundred million years.
 - The solubility of CO₂ in ocean water decreases with increasing temperature. Thus, as the oceans warm up, some of their dissolved CO₂ is released into the lower atmosphere—like CO₂ bubbling out of a warm carbonated soft drink.

Acidification

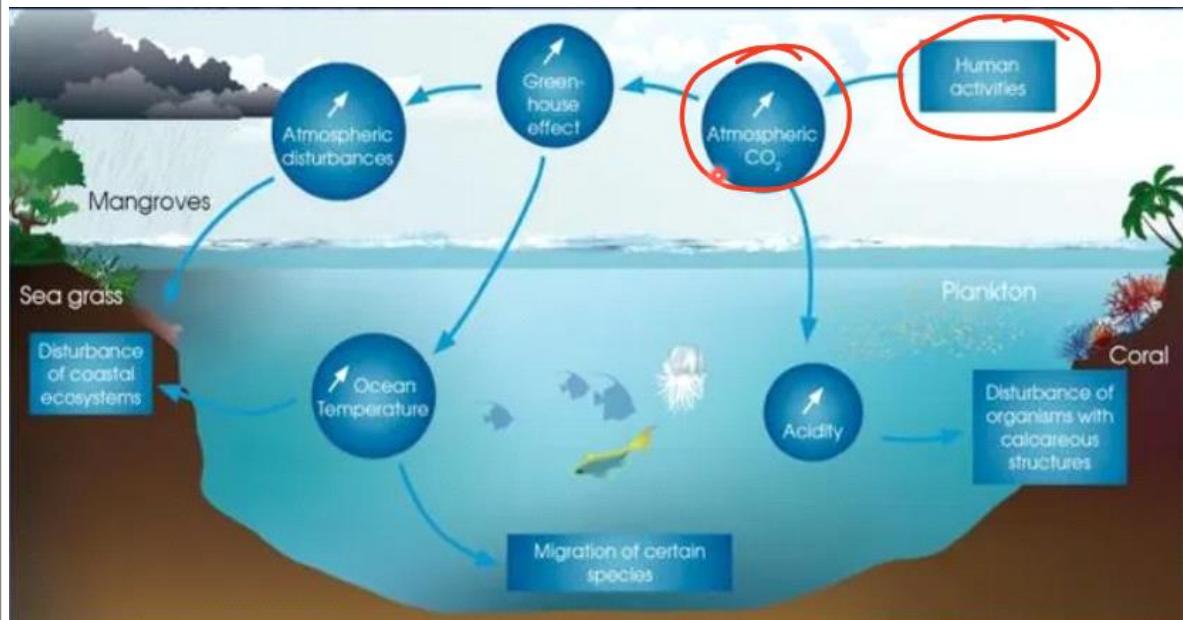
- pH value is declining, water is not acidic in nature
 - In the 200-plus years since the industrial revolution began, the concentration of carbon dioxide (CO₂) in the atmosphere has increased due to human actions. During this time, approximately 142 billion tonnes of anthropogenic CO₂ has been absorbed by the oceans, resulting in ocean acidification at a rate far faster than any time in the last 650 000 years as a result of which the pH of surface ocean waters has fallen by 0.1 pH units. The ocean's average pH is now around 8.1, which is basic (or alkaline), but as the ocean continues to absorb more CO₂, the pH decreases and the ocean becomes more acidic.



A pteropod shell is shown dissolving over time in seawater with a lower pH. When carbon dioxide is absorbed by the ocean from the atmosphere, the chemistry of the seawater is changed. (Image credit: NOAA)

Effect of Acidification

Changes in ocean chemistry can affect the behavior of non-calcifying organisms as well. The ability of some fish, like clownfish, to detect predators is decreased in more acidic waters. Studies have shown that decreased pH levels also affect the ability of larval clownfish to locate suitable habitat.



L12 Impact of Climate Change

20 December 2024 08:44 AM

Effect of Climate Change

- According to the IPCC, a warming of 2°C and its effects on global climate appears to be inevitable because we have waited too long to prevent some degree of change.
- Even if greenhouse gas emissions are stopped now, some effects such as increased drought and a sea level rise will be felt for at least 1,000 years.

Impact of climate change on India



- Extreme Heat
- Changing Rainfall Patterns
- Droughts
- Groundwater
- Glacier Melt
- Sea level rise
- Agriculture and food security
- Energy Security
- Water Security
- Health
- Migration and Conflict

Precipitation Pattern

- Increased precipitation is predicted in the polar and subpolar regions, whereas decreased precipitation is projected for the middle latitudes of both hemispheres.
- Precipitation near the Equator is predicted to increase.
- Changes in precipitation patterns are expected to increase the chances of both drought and flood conditions in many areas.

Droughts	<ul style="list-style-type: none"> Long-term climate change can contribute to prolonged droughts. As drought increases and spreads, the growth of trees and other plants declines, which reduces the removal of CO₂ from the atmosphere. Forest and grassland fires increase, which adds CO₂ to the atmosphere. Climate scientists project that these combined effects from increased drought will speed up the warming of the atmosphere.
Rise Sea Levels	<p>• State of Ocean Report 2024, by UNESCO</p> <p style="text-align: center;">Global Sea-Level Rise & Implications - WMO report 2022</p> <ul style="list-style-type: none"> Sea-level rise threatens several low-lying small island The impacts of average sea-level rise are boosted by storm surges and tidal variations Global mean sea-level increased by 0.20m between 1901 and 2018. <ul style="list-style-type: none"> The average rate of sea level rise was 1.3 mm/yr between 1901 and 1971, increasing to 1.9 mm/yr between 1971 and 2006, increasing to 3.7 mm/yr between 2006 and 2018. WMO has reported that 2013-22 sea level rise has been 4.5 mm/yr

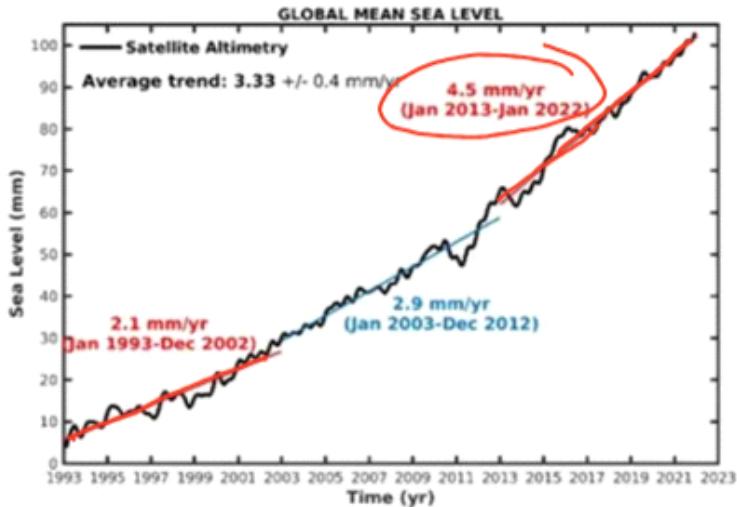


Figure 1. Sea-level rise since 1993 based on satellite measurements
(WMO State of the Global Climate Report).

- Reason for rise :

- Thermal Expansion due to heating
- Melting of ice

Thermal expansion explained 50% of sea level rise during 1971–2018, while ice loss from glaciers contributed 22%, ice sheets 20%.

The rate of ice-sheet loss increased by a factor of four between 1992–1999 and 2010–2019.

Together, ice-sheet and glacier mass loss were the dominant contributors to global mean sea level rise during 2006–2018.

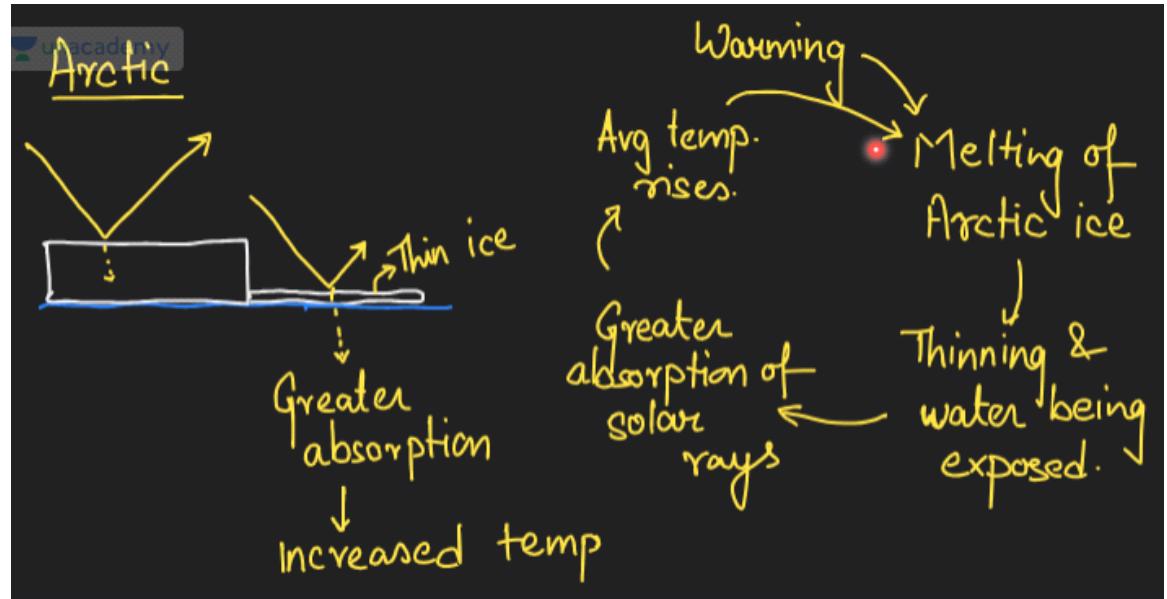
- Future (As Per WHO)

Over the next 2000 years, global mean sea-level will rise by about 2 to 3 m if warming is limited to 1.5°C, 2 to 6 m if limited to 2°C and 19 to 22 m with 5°C of warming, and it will continue to rise over subsequent millennia.

The past :

Projections of multi-millennial global mean sea-level rise are consistent with reconstructed levels during past warm climate periods: likely 5–10 m higher than today around 125,000 years ago, when global temperatures were very likely 0.5°C– 1.5°C higher than 1850–1900; and very likely 5–25 m higher roughly 3 million years ago, when global temperatures were 2.5°C–4°C higher.

Food Production	<ul style="list-style-type: none"> Crop productivity is projected to increase slightly at middle to high latitudes with moderate atmospheric warming, but decrease if warming goes too far. According to the IPCC, food will be plentiful for a while because of the longer growing season in northern regions. But the scientists warn that by 2050, some 200–600 million of the world's poorest and most vulnerable people could face malnutrition and starvation due to the effects of climate change on agricultural systems. <ul style="list-style-type: none"> Health <ul style="list-style-type: none"> Diseases : Vector Borne Diseases : Spreading in expanse to the regions of higher latitudes <ul style="list-style-type: none"> Due to warmer temp -> breeding ground for mosquitos, flies expands Natural Disaster and epidemic Extreme Heat : heatwaves -> Heat strokes Variable Rainfall
Tropical Cyclone	<ul style="list-style-type: none"> It appears likely that rising tropical ocean temperatures associated with global warming will lead to an increase in the intensity of tropical cyclones. <ul style="list-style-type: none"> Cyclone forms because of extreme heating of sea surface -> create intense low pressure Marine heat waves -> Cyclone get stronger + Spread to high latitudes
Coral Bleaching	<ul style="list-style-type: none"> Sudden occurrence of marine heatwaves Impact -> reduced oxygen supply, increase impact on biodiversity
Migration	<ul style="list-style-type: none"> Large scale migration in species Tropicalisation : Marine species is migrating towards the Temperate region (Away from the tropics) Humans migrating because of natural disasters and impact of climate change on farming <ul style="list-style-type: none"> Coastal communities Small islands Regions experiencing drought cycle
Climate Tipping Points	<ul style="list-style-type: none"> Those events which are triggered due to increases warming / breach of threshold temperature then fuels a self-feeding cycle of temperature increase <ul style="list-style-type: none"> Permafrost region : Melting of permafrost -> emission of gases like CH₄, CO₂ -> increase level of warming -> Temp further rise up -> accelerate melting of permafrost



- Expansion of forest in Higher Latitudes : Siberia, Northern Canada
 - Region becoming ice free for longer periods -> Spread of vegetation and forest
 - Supply more moisture -> Vapour retain heat -> more heating -> more vegetation

Mitigation Strategies

CARBON SINK

Green and Blue carbon

- Green carbon is carbon removed by photosynthesis and stored in the plants and soil of natural ecosystems and is a vital part of the global carbon cycle
- Blue Carbon refers to coastal, aquatic and marine carbon sinks held by the indicative vegetation, marine organism and sediments.

Carbon Sequestration

CARBON SEQUESTRATION:

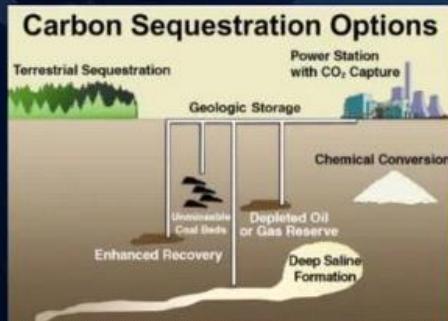
Carbon sequestration describes long-term storage of carbon dioxide or other forms of carbon at power stations, industrial sites or even directly from the air and permanently storing it underground.

It is carried out by pumping carbon into 'carbon sinks'— an area that absorbs carbon.

- Natural sinks - Oceans, forests, soil etc.
- Artificial sinks - Depleted oil reserves, unmineable mines, etc.

Types of Sequestration:

- Ocean Sequestration: carbon capture in oceans
- Geologic Sequestration- in earth's deep subsurface
- Terrestrial Sequestration: in vegetation and soil within few feet of earth's surface



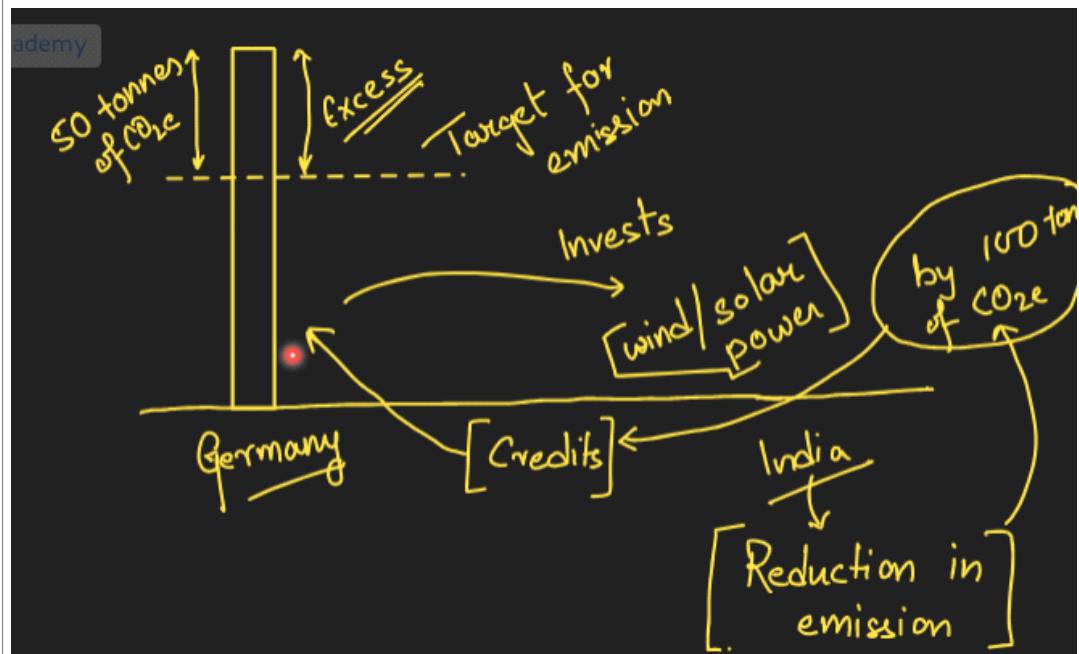
- Quarden, Norway -> first carbon storage started
- Green Carbon : Stored in trees
- Teal carbon : Stored in wetlands

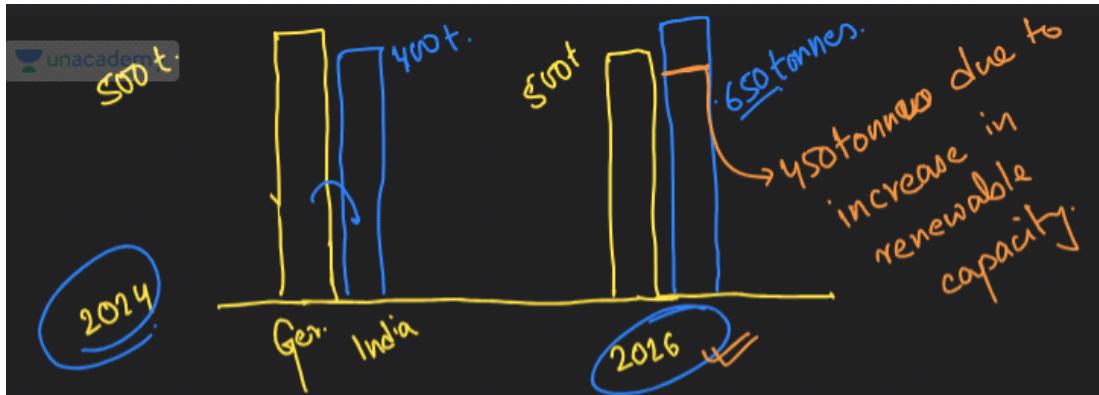
Carbon Offsetting

CARBON OFFSETTING:

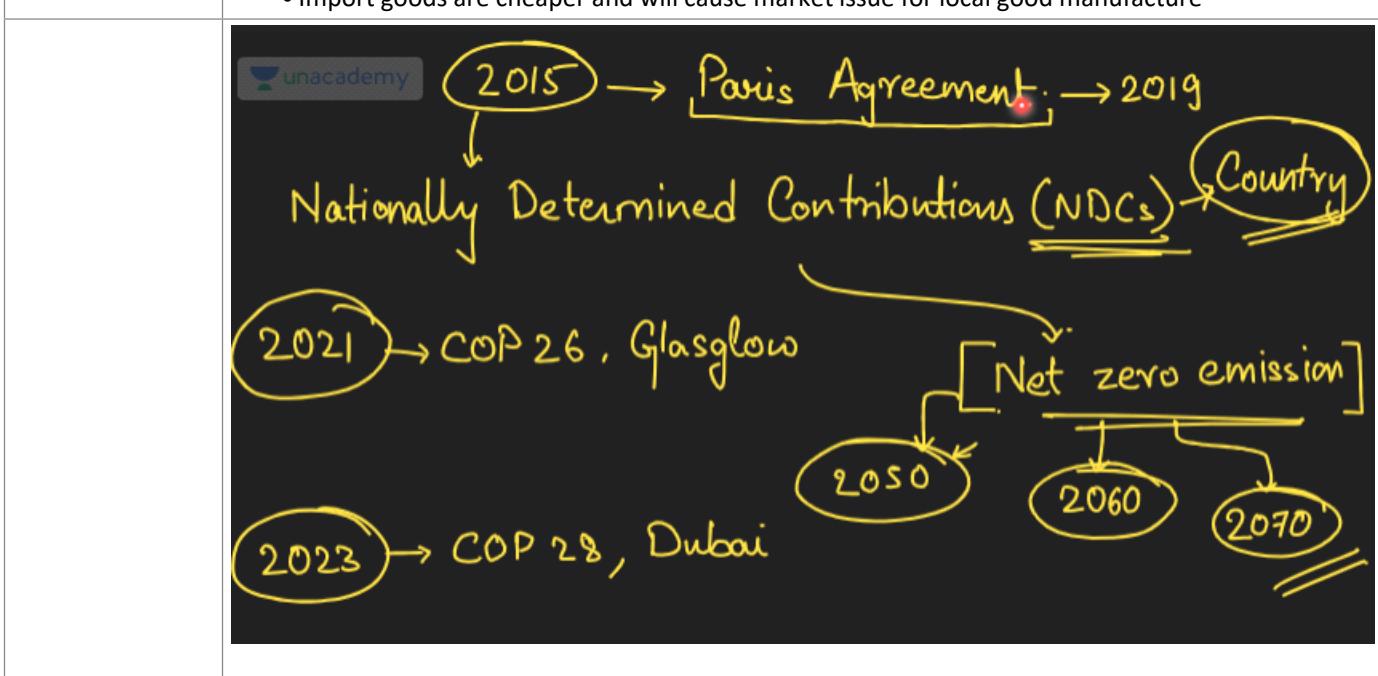
Carbon offsets are credits for reductions in greenhouse gas emissions made at another location, such as wind farms which create renewable energy and reduce the need for fossil-fuel powered energy.

Carbon offsets are quantified and sold in metric tonnes of carbon dioxide equivalent (CO₂e).





Carbon Tax	<p>Carbon tax is the potential alternative to the 'cap and trade' (Carbon Offsetting) method currently used by the Kyoto protocol.</p> <p>The aim of this tax is to cause less fossil fuel use and hopefully cause an incentive to use other sources of energy.</p>
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Geo Engineering	<p>Geo-engineering primarily aims at modifying and cooling Earth's environment defeating the environmental damage and ensuing climate changes to make the planet more habitable.</p> <p>Modes are</p> <ul style="list-style-type: none"> • Hoisting parasols • Placing mirrors in space • Whitening the stratosphere with sulfate aerosols • Whitewashing building roofs to reflect sunlight • Flinging iron filings into the ocean to promote...
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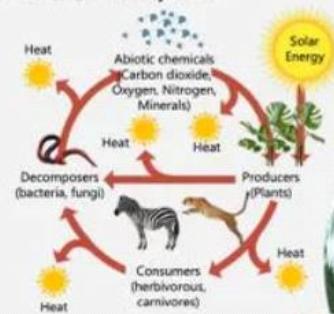
- Parasols : Will reflect greater amount of solar energy -> reduced heating



- Iron filling into ocean -> provide nutrition for growth of phytoplankton -> population ↑
 - Rate of photosynthesis ↑↑ -> Absorption of CO₂ ↑↑ -> Warming ↓↓

L13 Biodiversity

20 December 2024 10:20 AM

Elements of Biodiversity	<p>Functional Diversity The biological and chemical processes such as energy flow and matter recycling needed for the survival of species, communities, and ecosystems.</p>   <p>Ecological Diversity The variety of terrestrial and aquatic ecosystems found in an area or on the earth.</p> <p>Genetic Diversity The variety of genetic material within a species or a population.</p> <ul style="list-style-type: none">• Higher the ecological diversity -> greater the number of species• CDV : Canine Distemper Virus<ul style="list-style-type: none">◦ 1000 African lions died in Tanzania in 1994 (because of no Genetic Diversity)◦ Ideally geographical Diversity is important
Scales of Diversity	<p>• Measures to assess diversity between different region</p> <h3>Scales of Diversity</h3> <ul style="list-style-type: none">• <u>Alpha diversity</u> - It is defined as the mean diversity of species in different sites or habitats within a local scale.• <u>Beta Diversity</u> - Beta diversity describes the species diversity between two communities or ecosystems.• <u>Gamma Diversity</u> - It is the total species diversity in a landscape. <p>Landscape AB</p> <p>Site A</p> <p>Site B</p> <p>β- Diversity</p> <p>Landscape CD</p> <p>Site C</p> <p>Site D</p> <p>α- Diversity</p>
Important Species Types	<ul style="list-style-type: none">• Indicator Species : Health of the ecosystem Ex : Lichens, Corals is only present with no pollution environment Lichen park -> Munsiyari Park, Uttrakhand

Examples include crayfish as indicators of freshwater quality; corals as indicators of marine processes such as siltation, seawater rise and sea temperature fluctuation; peregrine falcons as an indicator of pesticide loads and lichens can be used as air pollution indicators, especially of the concentration of sulphur dioxide in the atmosphere.

- Keystone Species : Balance ecosystem

Ex : Like Tiger balance Population of Herbivores, Elephants

- A keystone species is an organism that helps define an entire ecosystem.
- Without its keystone species, the ecosystem would be dramatically different or cease to exist altogether.
- If the species were to disappear from the ecosystem, no other species would be able to fill its ecological niche.

- Flagship Species : Special symbolic species like Tiger, Panda, Elephants

A flagship species acts as a symbol for an environmental habitat, movement, campaign, or issue.

They can be mascots for entire ecosystems.

- Foundation Species : Extremely required to sustain or start biodiversity

Foundation species play a major role in creating or maintaining a habitat.

Corals are a key example of a foundation species across many islands in the South Pacific Ocean. These tiny animals grow as a colony of thousands and even millions of individual polyps. The rocky exoskeletons of these polyps create enormous structures around islands: coral reefs.

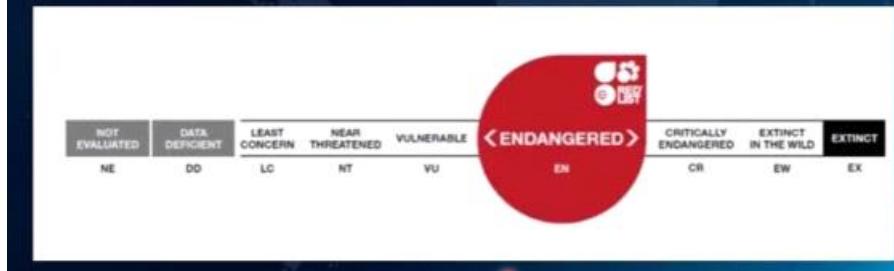
Ecosystem Engineer

- Ecosystem engineers modify, create, and maintain habitats.
 - Ecosystem engineers modify their habitats through their own biology or by physically changing biotic and abiotic factors in the environment.
 - Autogenic engineers modify their environment by modifying their own biology.
 - Allogenic engineers physically change their environment from one state to another.
 - Invasive species are often ecosystem engineers.
- Autogenic : Plant grow to become Tree to provide assistance to ecosystem
 • Allogenic : Beaver -> Build dams on riverstreams -> static water and modify the ecosystem

Loss of Biodiversity

- Habitat loss,
 - Fragmentation : Mostly due to infrastructure build up
 - Degradation : Lowering of quality of the ecosystem
- Invasive Alien Species
- Pollution
- Climate change
- Diseases
- Anthropogenic factors

Established in 1948, the International Union for Conservation of Nature's Red List of Threatened Species has evolved to become the world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species.



IUCN also played a fundamental role in the creation of key international conventions, including the Ramsar Convention on Wetlands (1971), the World Heritage Convention (1972), the Convention on International Trade in Endangered Species, (1974) and the Convention on Biological Diversity (1992).

In 1980, IUCN – in partnership with the UN Environment Programme (UNEP) and the World Wildlife Fund (WWF) – published the World Conservation Strategy, a ground-breaking document which helped define the concept of 'sustainable development' and shaped the global conservation and sustainable development agenda.

IUCN List

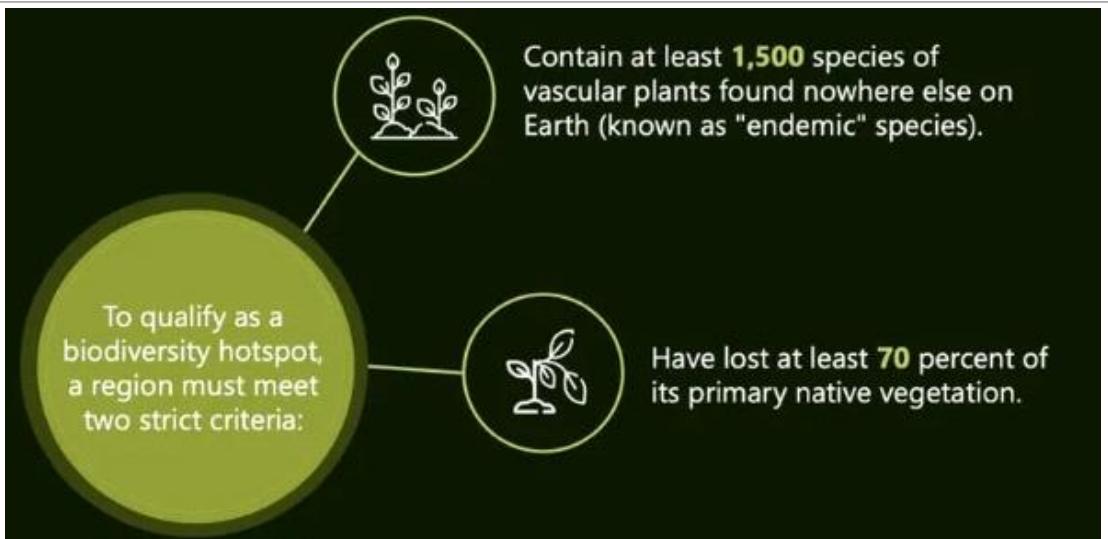
- Critically Endangered (CR) : Population decline of 80 to more than 90 percent over the previous 10 years (or three generations, whichever is longer), a current population size of fewer than 50 individuals, or other factors.
- Endangered (EN) : Population decline of 50 to more than 70 percent over the previous 10 years (or three generations), a current population size of fewer than 250 individuals, or other factors.
- Vulnerable (VU) : A population decline of 30 to more than 50 percent over the previous 10 years (or three generations), a current population size of fewer than 1,000 individuals, or other factors.

Indian List

- Seventy-three species in India are critically endangered, as per the Union environment ministry citing a report of the International Union for Conservation of Nature (IUCN), up from 47 in 2011.
- The 73 species include 9 species of mammals, 18 birds, 26 reptiles and 20 amphibians.

- Rat: Large Rock Rat or Elvira Rat.
- Squirrel: Namdapha Flying Squirrel.
- Civet: Malabar Civet.
- Rhinoceros: Sumatran Rhinoceros and Javan Rhinoceros.
- Shark: Pondicherry Shark and Ganges Shark.
- Hawksbill Turtle, Four-toed River Terrapin or River Terrapin, Red-crowned Roofed Turtle or the Bengal Roof Turtle.

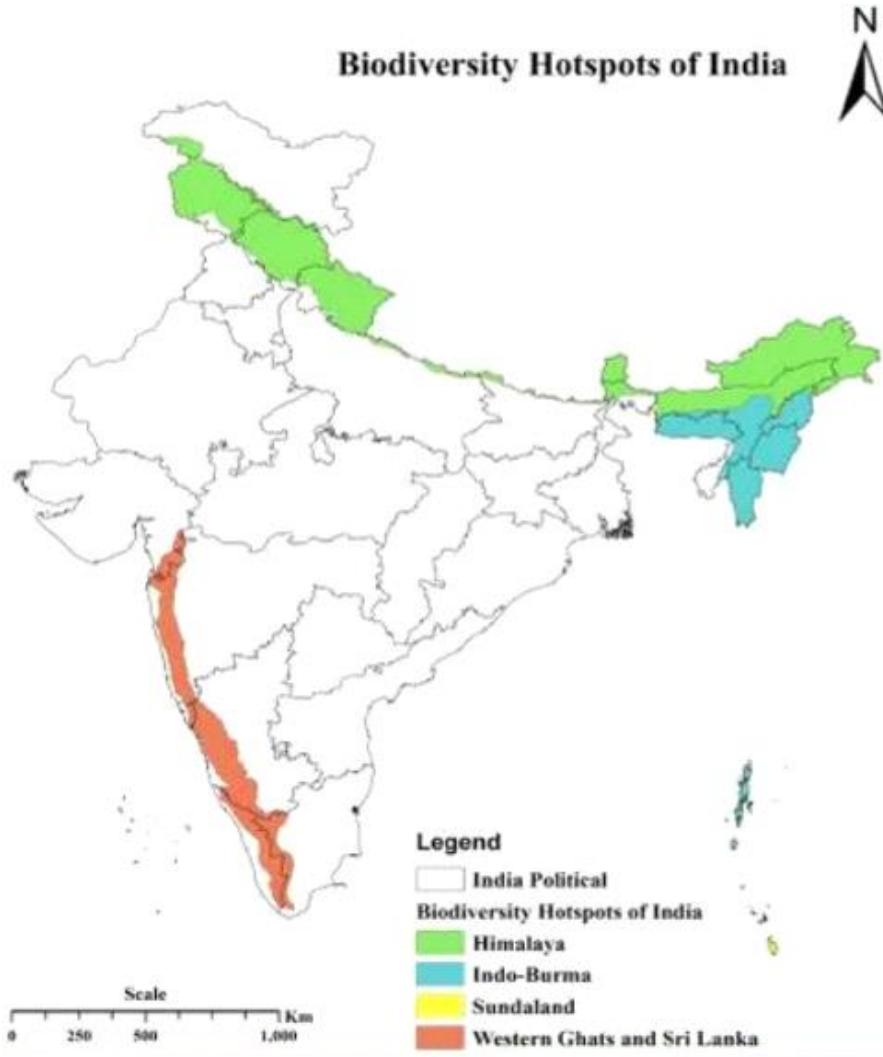
Biodiversity Hotspot



- Vascular plants : have presence of Xylem and Phloem
- Extent of Vulnerability
- Create awareness for conservation

- Around the world, 36 areas qualify as hotspots.
- They represent just **2.4%** of Earth's land surface, but they support more than half of the world's plant species as endemics- i.e., species found no place else and nearly 43% of bird, mammal, reptile and amphibian species as endemics.





- Himalayan
- Indo Burma
- Western Ghats and Srilanka
- Sundaland : Great Nicobar Islands

Megadiverse Countries

Megadiversity Countries is a term used to refer to the world's top biodiversity-rich countries.

This country- focused method raises national awareness for biodiversity conservation in nations with high biological diversity, with many species unique to a specific country.

Criteria

- Have at least 5000 of the world's plants as endemics.
- Have marine ecosystems within its borders.
- Other secondary criteria have also been taken into consideration, such as animal and invertebrate endemism, species diversity, higher-level diversity, ecosystem diversity and presence of tropical rainforest ecosystems.

- Brings Accountability in conservation

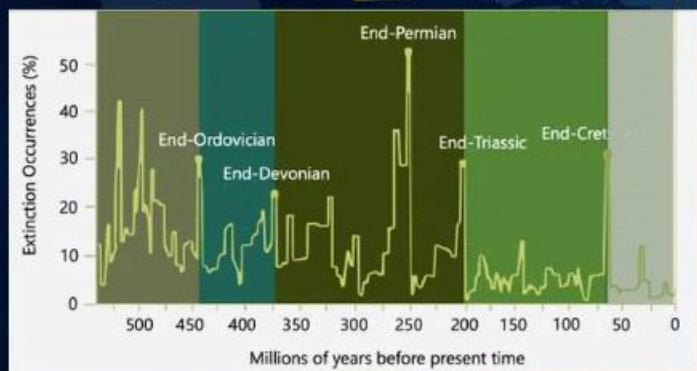


Extinction

- The overall change in biodiversity results from the difference between rates of speciation (adding species) and rates of extinction (taking species away).
- Over the history of life on Earth, in excess of 90% of all species (and perhaps closer to 99%) are estimated to have become extinct.
- Compared with the duration of life on Earth, no genus survived for very long. The longest-lived persisted for about 160 million yrs, or about 5% of the history of life.

Mass Extinction

A “mass extinction” can be defined as a time period in which a large percentage of all known species living at the time goes extinct or is completely wiped out.



- 5 mass extinction till this point
- Human is going to be the reason for 6th Mass extinction

Major Mass Extinction

- 1st major mass extinction : 440-450 million years ago, 60-70% of all living species at the time were eliminated ; probably caused due to Continental Drift and subsequent climate change.
- 2nd major mass extinction : 375 million years ago, more than 70% of all living species at the time were wiped out ; probably caused due to lack of oxygen in the oceans, quick cooling of air temperatures, possibly volcanic eruptions and/or meteor strikes.
- 3rd major mass extinction : 250 million years ago , an estimated 96% of all species living on Earth at the time ; cause is not known definitively.
- 4th major mass extinction : 200 million years ago, Suspected Cause : Major volcanic activity with basalt flooding, global climate change, and changing pH and sea levels of the oceans.
- 5th major mass extinction : 65 million years ago, 75% of all known species living at the time ; caused due to asteroid impact.

Tardigrade

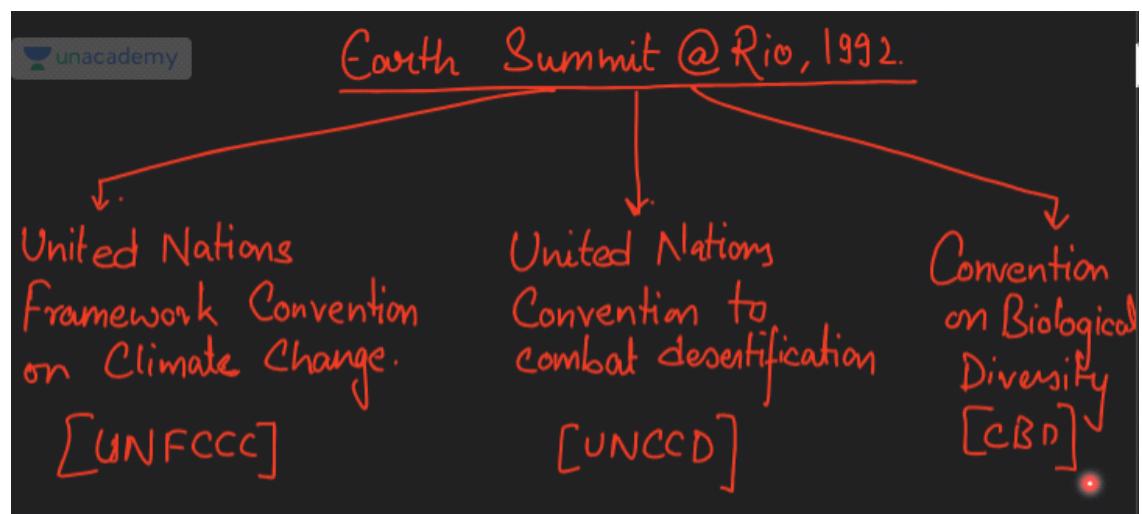
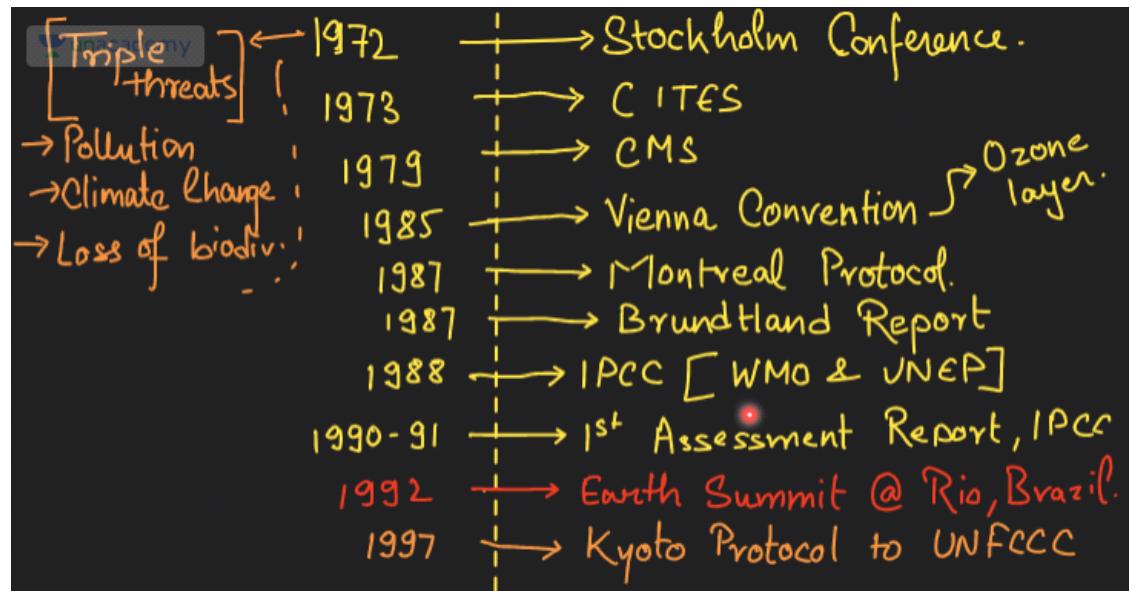
Tardigrade (Water Bear)

The water bear is the only animal to have survived all five extinctions known to man. It can survive in temperatures as low as -200°C without food or water, even the extreme radiation of space for over a hundred years without any evident discomfort.



International Convention

- CITES 1973 : Convention on International Trade in Endangered Species
- CMS 1979 : Conservation of Migratory Species : Bonn Convention
- CBD 1992: Conservation of Biological Diversity : Cartagena Protocol + Nagoya Protocol
- Timeline



Bonn Convention

- Convention on Migratory Species
 - Conservation at source area, Middle path (range Countries) and destination area
- The Convention entered into force in 1983 and aims to conserve terrestrial, marine and avian migratory species and their habitat as well throughout their range.

The objectives of the Bonn Convention are:

- The adoption of strict protection measures for endangered migratory species.
- The multilateral agreements for the conservation and management of migratory species, and co-

The Convention has two appendices:

- Appendix I lists migratory species that are classified as endangered. With high risk of extinction and urgent international cooperation is required.

The Convention has two appendices:

- Appendix I lists migratory species that are classified as endangered with high risk of extinction and urgent international cooperation is required.
- Appendix II lists other species that would benefit significantly from international agreements.
- The convention has legally binding agreements and non-legally binding Memorandum of Understandings (MoUs) which are tailored according to conservation needs.

India has been a part of the Bonn Convention since 1983. Some of the important migratory species in India are:

→ Amur Falcons

- Bar-headed Geese
- Black-necked cranes
- Marine turtles
- Dugongs
- Humpback Whales



Convention on Biological Diversity

The Convention on Biological Diversity is an international treaty that was adopted at the Earth Summit in 1992.

The convention recognized for the first time in international law that the conservation of biological diversity is "a common concern of humankind" and is an integral part of the development process.



The Convention has three main goals:

- 1) Conservation of biological diversity (or biodiversity).
- 2) Sustainable use of its components.
- 3) Fair and equitable sharing of benefits arising from genetic resources.

- Cartagena Protocol : For living modified organism
- Nagoya Protocol : Sharing Genetic material

It also covers the rapidly expanding field of biotechnology through **Cartagena Protocol on Biosafety**, addressing technology development and transfer, benefit-sharing and biosafety issues.

Importantly, the Convention is legally binding; countries that join it are obliged to implement its provisions.

- India also passed Bio Diversity Act 2002, to adhere to the norms of CBD

Cartagena Protocol

- For genetically modified animals : LMOs (Living Modified Animals)
- For safe introduction into ecosystem
- Bio Safety Clearing house : Document all the details related to ecosystem, which is studied upon
 - Prior Informed agreement : species is safe to move

The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international agreement which aims to ensure the safe handling, transport and use of living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on biological diversity, taking also into account risks to human health.

It establishes an advance informed agreement (AIA) procedure for ensuring that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into

The Protocol also establishes a **Biosafety Clearing-House** to facilitate the exchange of information on living modified organisms and to assist countries in the implementation of the Protocol.

It was adopted on 29 January 2000 and entered into force on 1 September 2003.

Nagoya Protocol

It is an international agreement which aims at sharing the benefits arising from the utilization of genetic resources in a fair and equitable way, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies.

The Strategic Plan consists of 20 new biodiversity targets for 2020, termed the 'Aichi Biodiversity Targets'.

It was adopted by the Conference of the Parties to the Convention on Biological Diversity at its tenth meeting on 29 October 2010 in Nagoya, Japan.

Five Aichi Strategic Goals

Strategic Goal A

Address the underlying causes of biodiversity loss

by mainstreaming biodiversity across government

CBD strategic goal Aichi Target

A. Address underlying causes

- 1 Improve awareness of biodiversity
- 2 Mainstream biodiversity
- 3 Reform incentives
- 4 Implement plans for sustainability

Strategic Goal B

Reduce the direct pressures on biodiversity and promote sustainable use.

B. Reduce pressures and promote sustainable use

- 5 Reduce habitat loss and degradation
- 6 Fish sustainably
- 7 Make farming and forestry sustainable
- 8 Reduce pollution
- 9 Tackle invasive species
- 10 Minimise climate change impacts

COP 15 Kunming
Montreal
agreement

Convened under UN auspices, chaired by China, and hosted by Canada, the 15th Conference of Parties to the UN Convention on Biological Diversity adopted the “Kunming-Montreal Global Biodiversity Framework” (GBF), including four goals and 23 targets for achievement by 2030.

Targets

- Reducing threats to Biodiversity
- Meeting people's needs through sustainable use and benefit-sharing
- Tools and solutions for implementation and mainstreaming

Goals set by this agreement

- Goal A -
 - Halt in human induced extinction ;
 - Increasing area of natural ecosystem by 2050
 - Maintaining the genetic diversity
- Goal B -
 - Sustainably restoring the ecosystems
- Goal C -
 - Fair and Equitable sharing of benefits from genetic resources
- Goal D -
 - Aligning financial flows with the GBF the 2050 Vision for Biodiversity.

CITES	<ul style="list-style-type: none">• 3 Appendices• Framing of own laws by every countries to adhere norms of CITES<ul style="list-style-type: none">• Hence Wildlife Protection Act Amendments• Convention on International Trade in Endangered Species of Wild Fauna and Flora.• Global agreement among governments to regulate or ban international trade in species under threat.• It came into force in 1975 and consists of 183 member-countries till date.• It is a legally binding on the Parties, it does not take the place of national laws.• India is a CITES Party since 1976.
Appendix	<p>They are listed under the three CITES Appendices that are mentioned below:</p> <p>Appendix-I</p> <ul style="list-style-type: none">→ Species that are in danger of extinction.→ Commercial trade is prohibited.• Permits are required for import and export.• Trade permitted just for research only if the origin country ensures the trade won't harm the species' chance of survival.

Appendix - II

- Species that aren't facing imminent extinction but need monitoring.
- Trade permits obtained legally.

Appendix - III

- Species protected in at least one country.
- Regulations for these species vary, but typically the country that requested the listing can issue export permits.

COP

Conference of the Parties

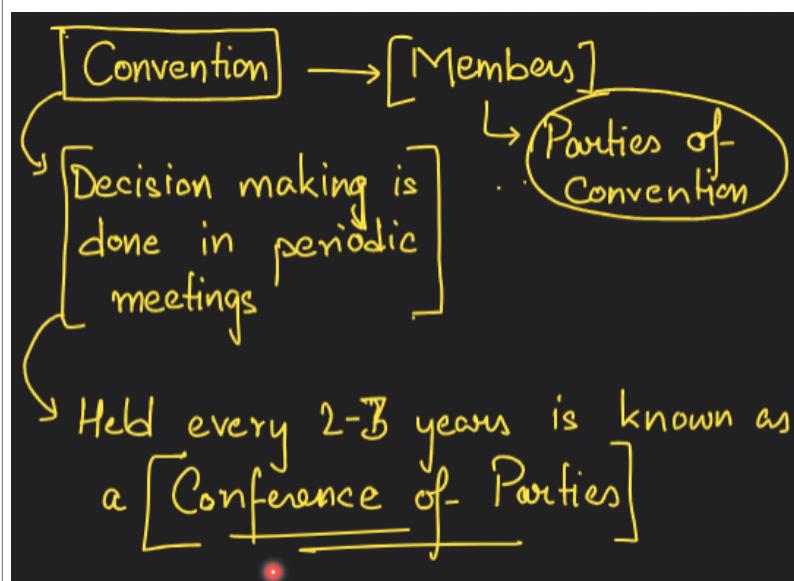
Every two to three years, the Conference of the Parties meets to review the implementation of the Convention.

The 19th Meeting of the Conference of the Parties [CoP19] to the CITES was held in June 2022 at Panama City.

- CoP19 was also known as the World Wildlife Conference.

The 19th Conference of Parties (COP19) to the Convention on International Trade in Endangered Species (CITES) in Panama City has accepted a proposal to include sea cucumbers in Appendix II of the Convention.

India's Shisham (*Dalbergia sissoo*) is included in Appendix II of the convention, thereby requiring it to follow CITES regulations for the trade of the species.



It is a joint program of World Wildlife Fund (WWF) and the International Union for Conservation of Nature (IUCN). Established in 1976.

Focus on species trade. Issues such as tiger parts, elephant ivory and rhino horn.

- Support international wildlife trade treaties.
- TRAFFIC India's study includes Leopard and Tiger peacock feather trade, owl trade, dynamics of hunting community poaching.
- South Asia Wildlife Enforcement Network (SAWEN)- collaboration among South Asian countries.

L14 Conservation Measure

21 December 2024 10:41 AM

Reducing threats to Biodiversity	<p>2. To bring the loss of areas of high biodiversity importance close to zero by 2030</p> <p>↳ [30 by 30] [To bring 30% of the planet under conservation by 2030]</p> <p>↳ Halt human induced extinction</p> <p>↳ Impact of invasive alien species</p> <p>↳ Reduce pollution risks</p> <p>↳ Minimize the impact of climate change</p> <p>To zero by 2030, Reducing the impact by 50% by the yr. 2030</p>
Global High Seas Treaty	<ul style="list-style-type: none">• To Bring conservation of High Sea (beyond EEZs of the Countries) by the responsible action and global cooperation• Help achieve CBD target of 30X30 (To bring 30% of planet under conservation by 2030)• Involve impact assessment of any economic activity carried out in Maritime region
Responsibility to big companies	<p>Large and transnational companies and financial institutions:</p> <ul style="list-style-type: none">• Regularly monitor, assess, and transparently disclose their risks, dependencies and impacts on biodiversity;• Provide information needed to consumers to promote sustainable consumption patterns;• Report on compliance with access and benefit-sharing regulations and measures
Additional Features	<ul style="list-style-type: none">• Request for a Special Trust Fund to support the implementation of the Global Biodiversity Framework ("GBF Fund").• The agreement also obligates countries to monitor and report every five years or less.• By 2030 mobilizing at least US\$ 200 bn per year, including by:<ul style="list-style-type: none">• International financial resources to at least US\$ 20 bn/year by 2025, and to at least US\$ 30 bn/year by 2030;• Domestic resource mobilization, by national biodiversity plans• Leveraging private finance

Critically Endangered in India

- Rat: Large Rock Rat or Elvira Rat.
- Squirrel: Namdapha Flying Squirrel.
- Civet: Malabar Civet.
- Rhinoceros: Sumatran Rhinoceros and Javan Rhinoceros.
- Shark: Pondicherry Shark and Ganges Shark.
- Hawksbill Turtle, Four-toed River Terrapin or River Terrapin, Red-crowned Roofed Turtle or the Bengal Roof Turtle.

Protected Area	<ul style="list-style-type: none"> • National Policy for Wildlife Conservation - 1970 • Wildlife (Protection) Act - 1972
Methods	<ul style="list-style-type: none"> • In Situ Conservation : Conservation of species in their natural environment, <ul style="list-style-type: none"> • Ex : National parks, WLS, Biosphere Reserves • Ex Situ Conservation : Zoos, Botanical Gardens, Aquariums, Seed bank, Gene bank, Cryo Banks
Wildlife Sanctuaries	<ul style="list-style-type: none"> • Mostly oriented toward a certain Species • Greater freedom for human activity as Compared to National Park <p>Sanctuaries are naturally occurring areas that are meant to protect the endangered species from hunting, poaching and predation. Human activities like harvesting of timber, collecting minor forest products and private ownership rights are allowed as long as they do not interfere with well-being of animals.</p> <p>The Wildlife (protection) Act 1972 provided for the declaration of certain areas by the State Government as Wildlife sanctuaries.</p> <p>There are 567 existing wildlife sanctuaries in India covering an area of 122,564.86 km², which is 3.73% of the geographical area of the country (National Wildlife Database, Jan. 2023).</p>
Rhinos Wildlife	<ul style="list-style-type: none"> • Pobitora Wildlife Sanctuary : Rhinos

Sanctuary

On the southern bank of the Brahmaputra, lies the incredibly spectacular Pobitora plains and Burha Mayong that make up the Pobitora Wildlife Sanctuary. The realms are home to gorgeous migratory birds, wild boars, golden jackals, rhesus macaque, barking deer, Indian leopard and most prominently, the one-horned rhinos (with its highest population in the whole world).

Under the Indian Rhino Vision 2020 (IRV 2020) which is a joint programme of the Department of Environment & Forests, Government of Assam, WWF-India, the International Rhino Foundation and the US fish & wildlife service, six rhinos were translocated from Pobitora and re-introduced into the Manas National Park between December 2010 and January 2011. Earlier, under the same programme, two rhinos were similarly translocated from Pobitora to Manas National Park in 2008.

Indian Rhino Vision 2020

- Launched in 2005, Indian Rhino Vision 2020 was an ambitious effort to attain a wild population of at least 3,000 greater one-horned rhinos spread over seven protected areas in the Indian state of Assam by the year 2020.
- Seven protected areas are Kaziranga, Pobitora, Orang National Park, Manas National Park, Laokhowa wildlife sanctuary, Burachapori wildlife sanctuary and Dibru Saikhowa wildlife sanctuary.

Coringa Wildlife Sanctuary

Coringa Wildlife Sanctuary

Coringa wildlife sanctuary is a stunning mangrove forest and estuary located 22km away from Kakinada Beach in Andhra Pradesh, India. This mangrove is developed at the confluence of river Godavari and the Bay of Bengal.

It is the home of 24 species of mangrove trees and over species of 120 birds, making it the 2nd largest mangrove formation after Sundarbans. Among numerous bird breeds, the critically endangered long-billed vulture and the white-backed vulture are the main attractions of this sanctuary.

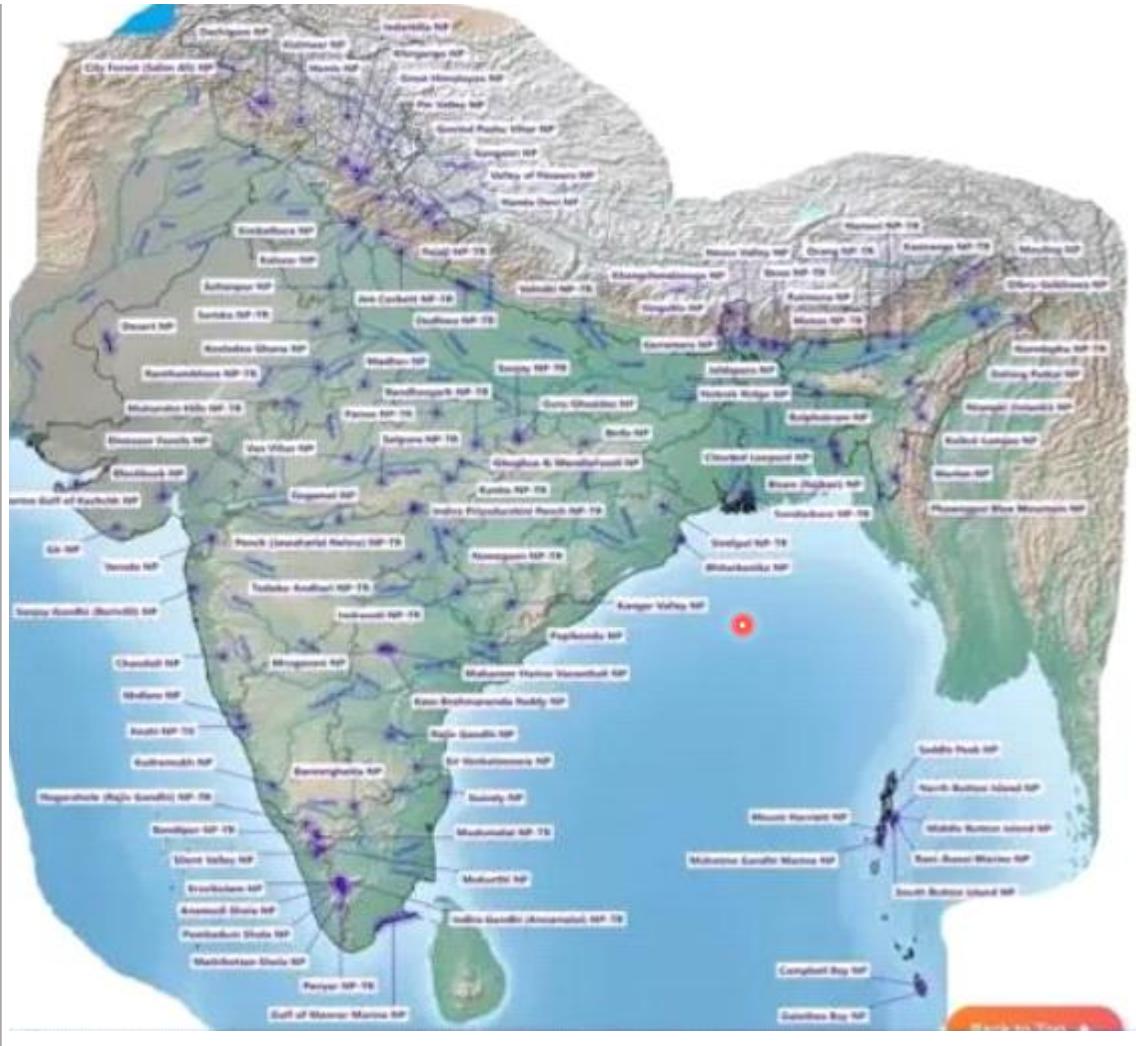
Dandeli Wildlife Sanctuary

It is located in Uttara Kannada District of Karnataka. The sanctuary covers an area of 866.41 km².

Along with neighboring Anshi National Park, the sanctuary was declared part of the Anshi Dandeli Tiger Reserve in 2006.

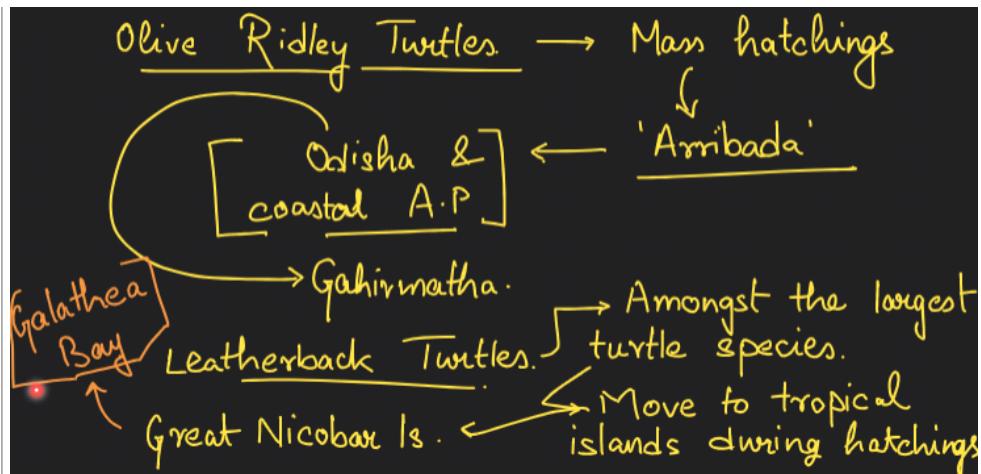
Dandeli Wildlife Sanctuary is most famous for the great hornbill and the Malabar pied hornbill. It is also the only known tiger reserve in India to report frequent sightings of the elusive black panther. It is also known to house the Indian sloth bear, the Indian pangolin, the giant Malabar squirrel, dhole, the Indian jackal and the muntjac (barking deer).

National parks	<ul style="list-style-type: none">• Conservation of entire Ecosystem• Greater restrictions for human activities <p>National parks are areas that aim to protect the natural environment. They are also involved in public recreation and enjoyment activities. In a national park, the landscapes and its flora and fauna are present in their natural state.</p> <p>The Wildlife (protection) Act of 1972 provided for the declaration of certain areas by the State government as National Parks.</p> <p>The degree of protection is greater here than in wildlife sanctuaries and activities such as grazing of livestock etc is prohibited.</p> <p>Both can be declared by the central government as well.</p>
Indian NP	<p>The Hailey National Park is the first national park in India. Few other national parks in India include:</p> <ol style="list-style-type: none">1. Bandipur National Park in Karnataka2. Bandhavgarh National Park in Madhya Pradesh3. Bhadra Wildlife Sanctuary in Karnataka4. Chinnar Wildlife Sanctuary in Kerala5. Corbett National Park in Uttarakhand6. Dandeli Wildlife Sanctuary in Karnataka7. Dudhwa National Park in Uttar Pradesh8. Gir National Park and Sasan Gir Sanctuary in Gujarat9. Hemis National Park in Jammu & Kashmir10. Kanha National Park in Madhya Pradesh11. Kaziranga National Park in Assam12. Keoladeo Ghana National Park in Bharatpur, Rajasthan13. Manas National Park in Assam14. Nagarhole National Park in Karnataka15. Panna National Park in Madhya Pradesh16. Periyar National Park in Kerala.17. Pench National Park in Madhya Pradesh18. Ranthambore National Park in Rajasthan19. Sariska National Park in Rajasthan20. Tadoba Andhari Tiger Reserve in Maharashtra21. The Great Himalayan National Park in Himachal Pradesh



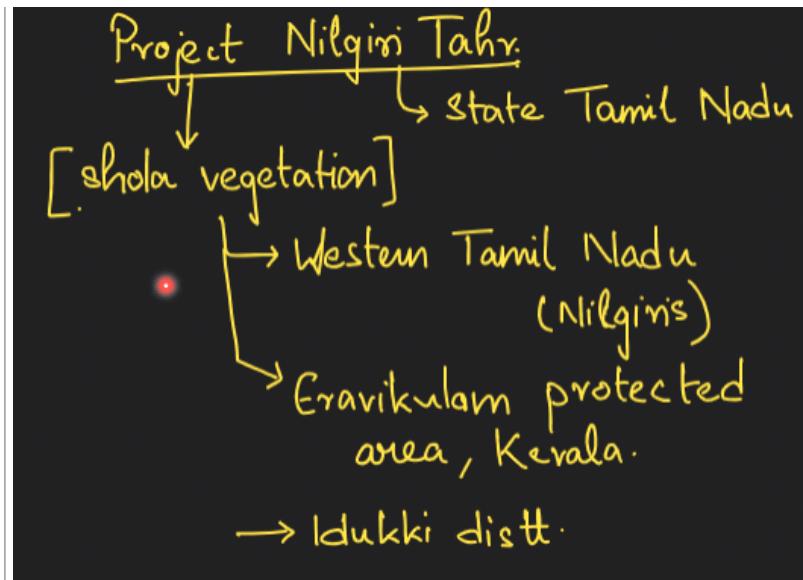
Kaziranga National Park	<ul style="list-style-type: none">Largest Rhino Population <p>This UNESCO <u>World Heritage</u> site is located in northeast India along the floodplains of the Brahmaputra River. It features <u>wetlands</u>, <u>grasslands</u>, and forests, allowing visitors to experience great biodiversity. The park is famous for its great one-horned rhinos, but wildlife enthusiasts can also find tigers, elephants, water buffalo, swamp deer and leopards.</p><p>Based on the latest census conducted by Assam's forest department, there are 2,413 rhinoceros in the park. In 1905, the rhino population of the park stood at 12 individuals.</p>
Bandhavgarh	<ul style="list-style-type: none">White Tigers (Albino Tigers : Lack of melanine secretion)

National Park	<p>Bandhavgarh National Park, also known as the Bandhavgarh Tiger Reserve, is located in Madhya Pradesh, an epicentre for India's tiger population. Apart from tigers, the park's extensive biodiversity includes a large healthy population of leopards as well as several deer species such as chital, sambar, and barking deer. Visitors might also come across sloth bears, wild boar, chital, chinkara, barking deer, sambar, nilgai, and common langur. Additionally, it has over 300 bird species, including some as beautiful and unique as Indian roller and the white-throated kingfisher.</p>
Bandipur National Park	<ul style="list-style-type: none"> • Private Tiger Hunting area for king of Mysore <p>Located in the southern state of Karnataka, Bandipur National Park was once the hunting grounds of the Maharaja of Mysore. In 1974, the Indian government initiated Project Tiger that helped to establish this park and put tiger conservation at the forefront.</p> <p>It is a part of Nilgiri Biosphere Reserve making it largest protected area in Southern India and largest habitat of Wild Elephants in South Asia.</p> <p>Bandipur National Park shares its boundary with 3 other National park namely Nagarhole National Park, Wayanad National Park and Mudumalai National park.</p> <p>Tigers, Indian Elephants, Leopard, Dhole, Sambar, Sloth bear, Chital many more animals and Birds can be spotted in the Bandipur National park</p>
Marine Protected Area	<p>As per IUCN; "any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features which has been reserved by law or other effective means to protect part or all of the enclosed environment."</p> <p>They are divided into three categories :</p> <p>Category I : National Parks/ Sanctuaries having entire areas in intertidal/ subtidal, mangroves, coral reefs, creeks, estuaries, lagoons etc.</p> <p>Category II : Island areas</p> <p>Category IIIA : Sandy beaches beyond intertidal line</p> <p>Category IIIB : Include evergreen or semi evergreen forests of islands</p>



Indian Marine Protected Area	Marine Sanctuary in India
Odisha	Bhitarkanika
Gujarat	Gulf of Kachchh
West Bengal	Sundarbans
Tamil Nadu	Gulf of Mannar
	Marine Sanctuary in India
Maharashtra	Thane Creek Flamingo Sanctuary
West Bengal	West Sundarbans
Dadra & Nagar Haveli	Dadra & Nagar Haveli Wildlife Sanctuary
Odisha	Gahirmatha
Daman & Diu	Fudam
Andhra Pradesh	Krishna
Goa	Chorao Island
Maharashtra	Malvan Marine Wildlife Sanctuary
Odisha	Chilika (Nalabana)
Odisha	Balukhand Konark
Gujarat	Khijadia
Andhra Pradesh/Tamil Nadu	Pulicat Lake
Andhra Pradesh	Coringa
West Bengal	Haliday Island
West Bengal	Sajnakhalia
West Bengal	Lothian Island
Odisha	Bhitarkanika
Tamil Nadu	Point Calimere
Kerala	Kadalundi-Vallikkunnu (Community Reserve)

Biosphere Reserve	<p>Biosphere Reserve is an international designation by UNESCO comprising terrestrial, marine and coastal ecosystems. A biosphere reserve is divided into core, buffer and transition zone in decreasing order of protection.</p> <p>There are 18 biosphere reserves in India, of which 11 are part of the World Network of Biosphere Reserves, based on the <u>UNESCO Man and the Biosphere (MAB) Programme</u>.</p>
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Criteria for selection of biosphere reserve	<p>Primary Criteria :</p> <p>A site must contain an <u>effectively protected</u> and minimally disturbed <u>core area</u> of value of nature <u>conservation</u> and should include <u>(additional land and water)</u> suitable for research and demonstration of sustainable methods of management of biosphere.</p>																				
Structure	<p>Biosphere reserves have three unified zones that aim to fulfill three harmonizing and mutually reinforcing functions:</p> <ol style="list-style-type: none"> 1. The <u>core area</u>: It involves an <u>entirely secured and protected</u> ecosystem that contributes to the <u>preservation of landscapes</u>, ecosystems, species and genetic variation. 2. The <u>buffer zone</u>: It encompasses or adjoins the core areas. It is utilized for activities compatible with sound ecological practices that can fortify scientific research, monitoring, training, and education. 3. The <u>transition area</u>: It is the part of the reserve where the greatest activity is permitted to promote economic and human development that is sustainable. 																				
Indian Biosphere reserve	<table> <tbody> <tr> <td>Cold desert</td> <td>Simlipal</td> </tr> <tr> <td>Nanda Devi</td> <td>Achanakmar Amarkantak</td> </tr> <tr> <td>Kangchendzonga</td> <td>Panna</td> </tr> <tr> <td>Manas</td> <td>Panchmarhi</td> </tr> <tr> <td>Nokrek</td> <td>Rann of Kutchch</td> </tr> <tr> <td>Dehang Dibang</td> <td>Nilgiri</td> </tr> <tr> <td>Dibrugarh</td> <td>Sheshachalam</td> </tr> <tr> <td>Sundarbans</td> <td>Agasthyamalai</td> </tr> <tr> <td></td> <td>Gulf of Mannar</td> </tr> <tr> <td></td> <td>Great Nicobar</td> </tr> </tbody> </table>	Cold desert	Simlipal	Nanda Devi	Achanakmar Amarkantak	Kangchendzonga	Panna	Manas	Panchmarhi	Nokrek	Rann of Kutchch	Dehang Dibang	Nilgiri	Dibrugarh	Sheshachalam	Sundarbans	Agasthyamalai		Gulf of Mannar		Great Nicobar
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L15 Indian Projects, Intl Protocols

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Project Tiger	<p>The Government of India launched the Project Tiger with the aim of saving the steadily declining population of tigers in India in 1973.</p> <p>The chief objectives of the project are:</p> <ul style="list-style-type: none">• Reduce factors that cause the diminishing of tiger habitats and manage them.• Ensure a viable tiger population for scientific, ecological, economic, aesthetic and cultural values. <p>The administrating body for the project is the National Tiger Conservation Authority (NTCA). The NTCA was formed in 2005 as per the recommendations of the Tiger Task Force. The Wildlife Protection Act of 1972 was amended in 2006 to provide for constituting the NTCA.</p> <ul style="list-style-type: none">• NTCA : National Tiger Conservation Authority
Tiger reserves	<p>These are the areas that are notified generally by the state government on recommendation of NTCA and are governed by Project Tiger.</p> <p>Consists of :</p> <ul style="list-style-type: none">→ Core Zone→ Buffer Zone

Indian Tiger reserves



St Petersburg Declaration

- The St. Petersburg Declaration on tiger conservation is a global commitment to doubling the number of wild tigers worldwide by 2022, which was signed by the governments of the 13 tiger range countries (TRCs) at the International Tiger Conservation Forum held in St. Petersburg, Russia, in 2010.
- The declaration aims to promote a coordinated, comprehensive approach to tiger conservation across all 13 TRCs and to secure long-term funding for tiger conservation efforts.
- 13 Tiger range countries are Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Russia, Thailand, and Vietnam.

Project Elephants

Project Elephant is a Central Government sponsored scheme launched in February 1992.

It ensures the protection of elephant corridors and elephant habitat for the survival of the elephant population in the wild.

This elephant conservation strategy is mainly implemented in 16 of 28 states or union territories in the country which includes Arunachal Pradesh, Assam, Andhra Pradesh, Chhattisgarh Jharkhand, Kerala, Karnataka Meghalaya, Maharashtra, Nagaland, Orissa, Tamil Nadu, Uttaranchal, Uttar Pradesh, and West Bengal.

The species is included in the list of protected species according to the
the Indian Wildlife (Protection) Act, 1972 and in the Convention
Trade in Endangered Species of Flora and Fauna (CITES).

Schedule I of
on International

- Largest : Mysore Elephant Reserve
- Latest : Terai Elephant Reserve, UP

MIKE

MIKE the abbreviation of the Monitoring of Illegal Killing of Elephants program was started in South Asia in 2003 after the conference of parties a resolution of CITES.

The aim of MIKE was to provide the information required by the elephant range countries for proper management and long-term protection of their elephant populations.

The objectives of the MIKE program is as follows:

- To measure the levels and trends in the illegal poaching and ensure changes in the trends for elephant protection.
- To determine the factors responsible for such changes, and to assess the impact of decisions by the conference of parties to CITES.

Chirang - Ripu Elephant Reserve
Deomali Elephant Reserve
Dihing Patkai Elephant Reserve
Garo Hills Elephant Reserve
Eastern Dooars Elephant Reserve
Mayurbhanj Elephant Reserve
Shivalik Elephant Reserve
Mysore Elephant Reserve
Nilgiri Elephant Reserve
Wayanad Elephant Reserve

Lion Introduction

- We only have Asiatic Lion, Mallari coexisted with lions
- Moving Lion from Gujurat to other location

Lion Reintroduction

The six new sites identified for possible lion relocation in the future include:

- Madhav National Park, Madhya Pradesh
- Sitamata Wildlife Sanctuary, Rajasthan
- Mukundra Hills Tiger Reserve, Rajasthan
- Gandhi Sagar Wildlife Sanctuary, Madhya Pradesh
- Kumbhalgarh Wildlife Sanctuary, Rajasthan
- Barda Wildlife Sanctuary, Gujarat

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- Barda Wildlife Sanctuary, Gujarat
- Jessor-Balaram Ambaji WLS and adjoining landscape, Gujarat

Cheetah Introduction

Twelve cheetahs from South Africa arrived at Madhya Pradesh's Kuno National Park on February 18, 2023 ; the second batch to arrive from Africa as part of Project Cheetah – which aims to introduce the big cat in India.

Stockholm Conference

- 1972 : <other of all environment acts across the globe
 - The United Nations Conference on the human environment held at Stockholm on 5th and 6th June 1972.
 - This was the first declaration of international protection of the environment.
 - Including India 113 States participated and accepted the declaration.
 - The United Nations Environment Programme has been established by the United Nations General Assembly in pursuance of the Stockholm Conference.

Principle of Stockholm declaration

Stockholm Declaration

- Human rights must be asserted, apartheid and colonialism condemned.
- Natural resources must be safeguarded.
- The Earth's capacity to produce renewable resources must be maintained.
- Wildlife must be safeguarded.
- Non-renewable resources must be shared and not exhausted.
- Pollution must not exceed the environment's capacity to clean itself.
- Development is needed to improve the environment & developing countries therefore need assistance.
- Developing countries need reasonable prices for exports to carry out environmental management.
- Integrated development planning is needed.
- Damaging oceanic pollution must be prevented.

Result of Stockholm Conference of 1972.

Role: To establish Global Environmental agenda.

Promote the efficient implementation of Sustainable Development Goals.

Formulates treaties and guidelines in the domain of International trade in harmful Chemicals.

International waterways pollution and Transboundary pollution of air.

Engages with National Governments, NGOs, etc.

India is a member.

Brundtland report

- 1987 : Sustainable Development and its aspect

The concept of 'sustainable development' was crystallized in the 1987 report of the United Nations World Commission on Environment and Development.

The Brundtland Commission's characterization of 'sustainable development' is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The concept of sustainable development focused attention on finding strategies to promote economic and social development in ways that avoided environmental degradation, over-exploitation or pollution, and side lined less productive debates about whether to prioritize development or the environment.

Earth Summit

- IPCC 1988 -> WMO and UNEP

- Intergovernmental Panel on Climate Change
- Scientific Panel, Generate assessment reports climate change

- Earth Summit in 1992 (Rio Summit)

The United Nations Conference on Environment and Development (UNCED), also known as the Rio de Janeiro Earth Summit.

The Earth Summit was a major United Nations conference held in Rio de Janeiro from 3 to 14 June in 1992.

It discussed global and environmental problems very widely and 117 heads of state and representatives of 178 nations in all attended the conference.

- 3 Defining Documents Faliity



3 Documents

The Declaration on Environment and Development, or **Rio Declaration**- This laid down 27 broad, non binding principles for environmentally sound development.

Agenda 21-

It outlined global strategies for cleaning up the environment and encouraging environmentally sound development.

The Forest principle-

It is formally called Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable development of all types of forests.

- 3 Convention

3 Convention
(Global Env Facility)

- CBD

The Convention on Biological Diversity - It is a binding treaty requiring nations to take inventories of their plants and wild animals and protect their endangered species.

- UNFCCC

The United Nations Framework Convention on Climate Change (UNFCCC) - It is a binding treaty to reduce their emission of carbon dioxide, methane, and other "greenhouse" gases.

Framework Convention on Climate Change [UNFCCC]

- The UNFCCC is an international environmental treaty produced at the Earth Summit in 1992.
- The treaty aims at reducing emissions of greenhouse gas in order to combat global warming.
- Its stated objective is "to achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system."
- The treaty as originally framed set no mandatory limits on greenhouse gas emissions for individual nations and contained no enforcement provisions; it is therefore considered legally non-binding.

- UNCCD

UNCCD is a United Nations convention aimed at addressing desertification and droughts - It legally binding convention;
India ratified the Convention.

The convention's 2018 – 2030 Strategic Framework is a comprehensive international commitment to attain Land Degradation Neutrality (LDN).

- LDN : Land Degradation Neutrality

- 100 units land degraded -> Ensuring reclamation of 100 units of degraded land from some other area

Rio 2012, Rio+20, or Earth Summit 2012

Rio de Janeiro, Brazil on 20 to 22 June 2012.

"United Nations Conference on Sustainable Development"

Main objectives.

- Securing renewed political commitment to sustainable development.
- Assessing the progress and implementation gaps in meeting already agreed commitments.
- Addressing new and emerging challenges.

Rio +20 Conference

By this conference UN wanted to bring together governments, international institutions and major (NGO) groups to agree on a range of smart measures for:

- Poverty reduction.
- Clean energy.
- Sustainable development and this sustainable development has three pillars.
 - Economic development. ✓
 - Social development.
 - Environmental protection.

Kyoto Protocol

- 1997 : To the UNFCCC
- Market Mechanism for ensuring lesser emission, Ex: carbon trade
- Principle of CBPR : Developed countries were given a target

Kyoto Protocol was the first international treaty to set legally binding targets to cut greenhouse gas emissions, was adopted on 11 December 1997, in Kyoto, Japan. The agreement, which entered into force in 2005 and was ratified by 192 Parties, has since been superseded by the Paris Agreement, but remains a historic landmark in the international fight against climate change.

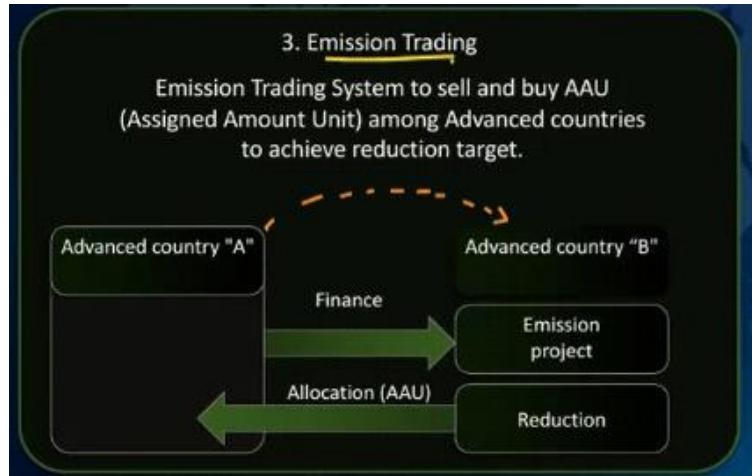
Countries that ratify this protocol commit to reduce their emissions of carbon dioxide and five other greenhouse gases (Methane, Nitrous Oxide, Sulphur Hexafluoride, Hydrofluorocarbons and Perfluorocarbons), or engage in emissions trading if they maintain or increase emissions of these gases.

Under the principle of "common but differentiated responsibility and respective capabilities," the Protocol mandated that 37 industrialized nations plus the European Community cut their greenhouse gas emissions by an average of 5 per cent below 1990 levels, and established a system to monitor countries' progress.

In December 2012, after the first commitment period of the Protocol ended, parties to the Kyoto Protocol met in Doha, Qatar, to adopt an amendment to the original Kyoto agreement. This so-called Doha Amendment added new emission-reduction targets for the second commitment period, 2012–2020, for participating countries.

- Action Post 2020 -> Paris Agreement

Categories	<p>Under the protocol, Governments are separated into Three general categories:</p> <ol style="list-style-type: none"> 1 The countries among the developed nations, referred to as Annex 1 countries-who have accepted GHG emission reduction obligations and must submit an annual greenhouse gas inventory. 2 Annex II Parties consist of the OECD members of Annex I, but not the EIT(Economics in transition) Parties. They are required to provide financial resources to enable developing countries to undertake emissions reduction activities. 3 The countries among developing or least developed nations, referred to as Non-Annex 1 countries- Who have no GHG emission reduction obligations but may participate in the Clean Development Mechanism. <ul style="list-style-type: none"> • OECD : Organisation for Economic Cooperation and Development
Outcomes of Kyoto	<ul style="list-style-type: none"> • Reduction Targets : 5% below 19910 levels <ul style="list-style-type: none"> • In case not met -> market Mechanism
Market Mechanisms	<ul style="list-style-type: none"> • Three Mechanism <ul style="list-style-type: none"> • Joint Implementation : Foreign investment in advanced countries to reduce emission • Clean Development Mechanism : Foreign investment in developing countries • Emission Trading : <p>System to utilize GHG emission overseas or initial allocation for achieving the GHG Emission target in each country.</p> <div data-bbox="366 990 1108 1522"> <p>1. Joint Implementation (JI)</p> <p>Joint Implementation (JI) Implement emission reduction project between Advanced country "A" and Advanced country "B" and utilize the ERU (Emission Reduction Units) to achieve target for each country.</p> <pre> graph LR A[Advanced country "A"] -- "Technology /Finance" --> B[Advanced country "B"] B -- "Emission project" --> C[Reduction] C -- "Reduction (ERU)" --> D[Reduction] </pre> </div> <div data-bbox="366 1534 1108 1994"> <p>2. Clean Development Mechanism (CDM)</p> <p>Clean Development Mechanism(CDM)Implement emission reduction project between Advanced country "A" and Developing country "B" and utilize the CERI (Certified Emission Reduction) for Advanced country.</p> <pre> graph LR A[Advanced country "A"] -- "Technology /Finance" --> B[Developing country "B"] B -- "Emission project" --> C[Reduction] C -- "Reduction (CER)" --> D[Reduction] </pre> </div>



- India was second largest issuer of CER credit from 2011-2020 (China Largest)

CDM & “Adaptation Fund”

Dual Objectives of CDM

- 1) Help developed countries fulfil their commitment to reduce emission.
- 2) Assist developing countries in achieving sustainable development.

“Adaptation Fund”- Finances projects & programmes that help vulnerable community in developing countries adapt to climate change.

Credit under Kyoto

1. **Carbon credit** – Tradable certificate or permit which has financial value. One carbon credit is equal to 1 ton of carbon dioxide or 1 ton of carbon dioxide equivalent. It is traded in International market. Holder of carbon credit has right to emit equal amount of carbon dioxide or carbon dioxide equivalent.
2. **Certified Emission Reduction (CER)** – It is a carbon credit which is traded in the Clean Development Mechanism (CDM). (Trade between Annex B country & Developing country under Kyoto protocol).
3. **Emission Reduction Unit (ERU)** – It is carbon credit which is traded in Joint Implementation (JI). (Trade between one Annex B country with another Annex B of Kyoto protocol).

Carbon Tarding

It is an exchange of credits between nations designed to reduce emission of carbon dioxide.

It allows countries to sell their carbon credits for money.

Under the Kyoto Protocol climate agreement, Carbon credit are used in market-based system.

The carbon trade also refers to the ability of individual companies to trade polluting rights through a regulatory system known as cap and trade.

Companies that pollute less can sell their unused pollution rights to companies that pollute more.

The Paris

- Countroes to declare theor own goals

Agreement	<ul style="list-style-type: none"> • Intended Nationally determined contribution INDCs • Mechanism of Global Stocktake • Every 5 years, new target to be declared, higher than the previous <p>The Paris Agreement</p> <ul style="list-style-type: none"> ➤ The Paris Agreement is not a treaty, and the Intended Nationally Determined Contributions (INDCs) are not binding. • The deal contains some binding elements, such as requiring countries to participate in a system for measuring their progress on achieving their goals. • The implementation of the agreement by all member countries together will be evaluated every 5 years. • Finance will be provided to poor nations to help them cut emissions and cope with the effects of extreme weather. Countries affected by climate-related disasters will gain urgent aid.
Outcomes	<p>Goals</p> <ul style="list-style-type: none"> • Keep warming "well below 2 degrees Celsius. Continue all efforts to limit the rise in temperatures to 1.5 degrees Celsius. • Rich countries must provide 100 billion dollars from 2020, as a "floor". Amount to be updated by 2025. • Developed countries must continue to "take the lead" in the reduction of greenhouse gases- Developing nations are encouraged to "enhance their efforts" and move over time to cuts. <p>➤ Aim for greenhouse gases emissions to peak "as soon as possible.</p> <p>From 2050: Rapid reductions to achieve a balance between emissions from human activity and the amount that can be captured by "sinks.</p> <p>Developed countries must provide financial resources to help developing countries-Other countries are invited to provide support on a voluntary basis.</p> <p>A review every five years First world review: 2023. Each review will inform countries in "updating and enhancing their pledges.</p>
	<ul style="list-style-type: none"> • It provides for the post Kyoto Protocol commitments to combat climate change • It commits 196 countries to work together to limit global warming to no more than 2 degrees Celsius above pre-industrial levels, with a stretch goal of keeping below 1.5 C. • It also calls for stopping the rise of greenhouse gas emissions as soon as possible.

COP26 Glasgow	<p>COP26: Glasgow</p> <p>Key announcements.</p> <ul style="list-style-type: none"> • By the end of the decade, countries pledged to stop deforestation. • Slash emissions of methane, the second-largest contributor to climate change after carbon dioxide - by 30% below 2020 levels by 2030. <p>• The Global Methane Pledge ○ India is not a member : India was not invited in discussion</p>
Panchamrit	<p>INDIA'S 'PANCHAMRIT' AT COP26 IN GLASGOW</p> <p>Reach non-fossil energy capacity of 500GW by 2030</p> <p>Fulfil 50% energy requirements via Renewable Energy by 2030</p> <p>Reduce 1 billion carbon emissions by 2030</p> <p>Reduce carbon intensity below 45% by 2030</p> <p>India will achieve the target of Net-Zero by 2070</p> <ul style="list-style-type: none"> • Contribution of carbon intensive industries to the GDP to be lower than 45% <ul style="list-style-type: none"> ○ Using Modern tech and cleaner fuel
COP27 Egypt	<ul style="list-style-type: none"> • The 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP27), that took place in the Egyptian coastal city of Sharm el-Sheikh, concluded with a historic decision to <u>establish and operationalize a loss and damage fund</u>. • The loss and damage fund is a global financial package to ensure the rescue and rehabilitation of countries facing the cascading effects of climate change. • The term refers to the compensation that rich nations, whose industrial growth has resulted in global warming and driven the planet into a climate crisis, must pay to poor nations, whose carbon footprint is low but are facing the brunt of rising sea levels, floods, crippling droughts, and intense cyclones, among others. <ul style="list-style-type: none"> • Rich Countries will pay poor countries that are sufferings because of climate change

- On the opening day of the COP28 climate conference in Dubai, a loss and damage fund to help vulnerable countries cope with the impact of climate change has been officially launched.
- The initial funding is estimated to be \$475 million — host UAE pledged \$100 million, the European Union promised \$275 million, \$17.5 million from the US, and \$10 million from Japan.
- On the occasion of the first Health Day at the 28th UN Climate Change Conference (COP28), the declaration expressed grave concern about the negative impacts of climate change on health.
- The declaration calls for climate action to achieve "benefits for health from deep, rapid, and sustained reductions in greenhouse gas emissions, including from just transitions, lower air pollution, active mobility, and shifts to sustainable healthy diets".

REDD+

- To make the local population as stakeholders
- Providing ecosystem services, Help in removing poverty

- REDD is the abbreviation for "reducing emissions from deforestation and forest degradation", followed by REDD+, with the "plus" referring to "the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries".
- Greenhouse gas emissions due to deforestation and forest degradation are the second-largest sector source of greenhouse gas emissions behind only the energy sector and ahead of the transport sector. Reducing deforestation would thus significantly reduce greenhouse gas emissions; and it would provide important secondary benefits, such as protecting biodiversity and producing rainfall.

L16 Indian Acts

21 December 2024 06:40 PM

Indian Acts	<p>1972 + Wildlife Protection Act.</p> <p>1974 + Water Act [CPCB]</p> <p>1980 + Forest Conservation Act</p> <p>1981 + Air Act</p> <p>1986 + Environment Protection Act</p> <p>2002+ Biodiversity Act.</p>
Wildlife Protection Act 1972	<ul style="list-style-type: none">• 1972• Absolute protection to Schedule I and II• Licence hunting to schedule III and IV <ul style="list-style-type: none">• On 5th June, 1972, Environment was first discussed in U.N. Conference of Human Environment in Stockholm.• Soon after India took substantive legislative steps for environment protection. In line with this, the Wildlife (Protection) Act was passed in 1972 <h3>Salient Features of the Act</h3> <ul style="list-style-type: none">• The Act provides for the formation of wildlife advisory boards, wildlife wardens, specifies their powers and duties, etc.• The Act created six schedules which gave varying degrees of protection to classes of flora and fauna.• Schedule I and Schedule II (Part II) get absolute protection and offences under these schedules attract the maximum penalties.• Hunting species, like those requiring special protection (Schedule II), big game (Schedule III), and small game (Schedule IV), is regulated through licensing.• A few species classified as Vermin (Schedule V), may be hunted. The Act empowers the State government to send a list of wild animals to the centre requesting it to declare them vermin for selective slaughter.

- The Schedule VI has been added to include specified plant species to be protected by the wildlife (Protection) Amendment Act, 1991.
- The Act provides for setting of National Parks, Wildlife, Sanctuaries, Central Zoo Authority etc.
- It supported launching a national component of UNESCO's 'Man and Biosphere programme (1971)'.

Wild Life
(Protection)
Amendment Bill
2022

Objective of Bill?

- Protection of Endangered Species: Bill seeks to enhance punishment for illegal Wildlife trade .
- Better Management of Protected Areas: It provides for certain permitted activities like grazing or movement of livestock and Bonafide use of drinking and household water by local communities.
- Protection of Forest Lands: It is so critical because it equally inculcates in itself the protection of rights of the people who have been residing there since ages.

What are the Amendments?

- This amendment proposed a new schedule for species listed in the Appendices under CITES.
- To allow the Central Government to appoint a Scientific Authority to provide guidance on matters relating to the impact on the survival of the specimens on being traded.
- The Bill also empowers Central government to regulate and stop the import, trade or possession of invasive plant or animal alien species.
- The Bill also enhances the penalties prescribed for violation of provisions of the Act.
- Schedule for vermin to be removed

Forest Act 1927	<p>The Indian Forest Act, 1927 was framed with the objective of managing timber and other forest resources. It provides for state governments to notify any forest land they own as reserved or protected forests. All land rights in such land are subject to the provisions of the Act.</p> <p>The Forest (Conservation) Act, 1980, was enacted to prevent large-scale deforestation. It requires the central government's approval for any diversion of forest land for non-forest purposes.</p> <ul style="list-style-type: none"> • By British to Limit availability of forest to local people • Power to state govt for notifying reserve Forest and Protected Forests • Post 1951 : State Denotified larger areas -> Rate of deforestation increases • In 1980 -> Govt create stricter ad penalties, before denotifying, approval from central govt.
Forest Act 1980	<ul style="list-style-type: none"> • States could notify regions as forests • States developed independent criteria for a region to be declared as a forest • 12th Dec 1996 : Godavarman Cases <ul style="list-style-type: none"> • Dictionary meaning of forests to be considered rather than legal provisions before carrying out deforestation • Impact : Control and ban on deforestation
Forest Amendment Act 2003	<h3 style="text-align: center;"><u>Forest (Conservation) Amendment Act 2023</u></h3> <p>→ It amends the Forest (Conservation) Act, 1980 to make it applicable to certain types of land. These include land notified as a forest under the Indian Forest Act, 1927 or in government records after the 1980 Act came into effect. The Act will not be applicable for land converted to non-forest use before December 12, 1996.</p> <p>It also exempts certain types of land from the purview of the Act. These include land within 100 km of India's border needed for national security projects, small roadside amenities, and public roads leading to a habitation.</p> <p>Exemption of certain categories from FCA 1980</p> <ul style="list-style-type: none"> • The state government requires prior approval of the central government to assign any forest land to a private entity. • The Act specifies some activities that can be carried out in forests, such as establishing check posts, fencing, and bridges. It also allows running zoos, safaris and eco-tourism facilities.

- The purpose of the Act is to implement the decisions of the United Nations Conference on the Human Environment held at Stockholm in June 1972, in which India participated, to take appropriate steps for the protection and improvement of human environment.
- The Act is an "umbrella" for legislations designed to provide a framework for Central Government, coordination of the activities of various central and state authorities established under previous Acts, such as the Water Act and the Air Act.

- The first environmental legislation to give the Central Government authority to issue direct orders, included orders to close, prohibit or regulate any industry, operation or process or to stop or regulate the supply of electricity, water or any other service to an industry, operation and process.
- The Act grants immunity to the officers of the government for any act done under the provisions of this Act or under the powers vested in them or functions assigned to them under this Act.

• Objectives

- The Biological Diversity Act 2002 was born out of India's attempt to realise the objectives enshrined in the United Nation Convention on Biological Diversity, 1992.
- The Act provides for conservation of biological diversity, sustainable use of its components and fair, and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected therewith or incidental thereto.

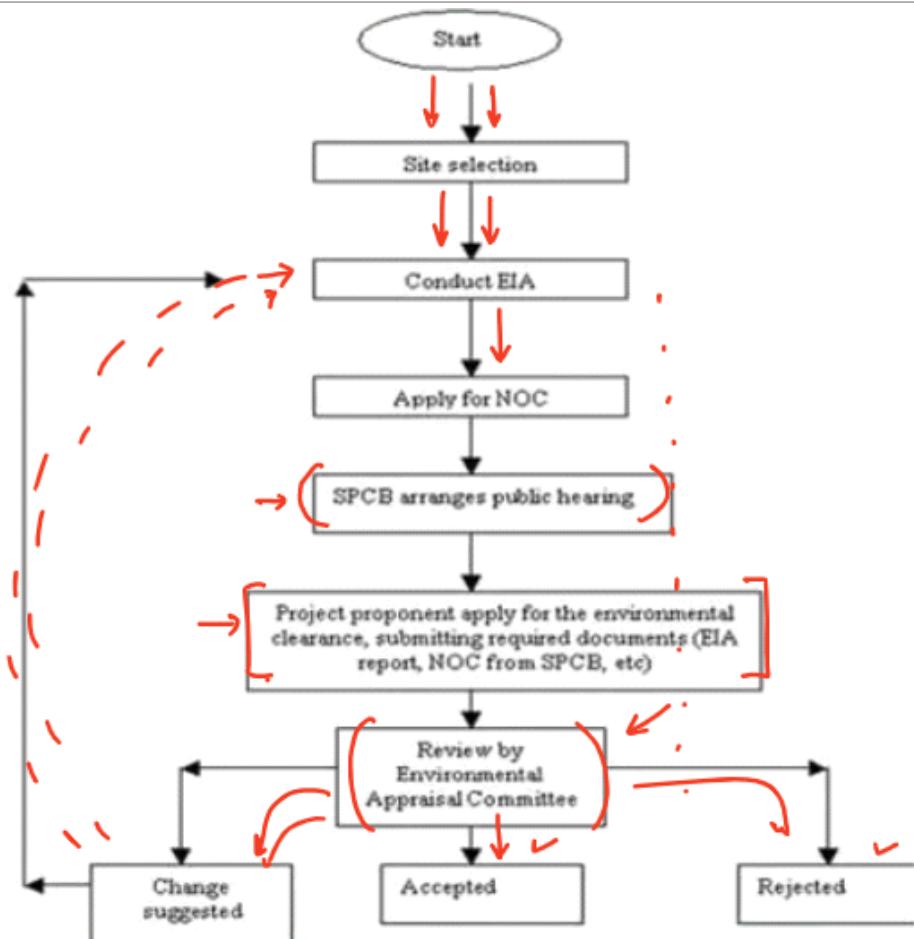
Salient features

- The main intent of this legislation is to protect India's rich biodiversity and associated knowledge against their use by foreign individuals and organizations without sharing the benefits arising out of such use, and to check biopiracy. The Act provides for setting up of a National Biodiversity Authority (NBA), State Biodiversity Boards (SBBs) and Biodiversity Management Committees (BMCs) in local bodies.
- All foreign nationals or organizations require prior approval of NBA for obtaining biological resources and associated knowledge for any use. Indian individuals entities require approval of NBA for transferring results of research with respect to any biological resources to foreign nationals/organizations.

Environment Impact Assessment

- Study to predict effect of proposed activity or project on Environment.
- “Decision Tool”
- ↓
- Suggest best combination of Economic & Environmental costs & benefits.
- Identify possible environmental effects & proposes measures to mitigate adverse effects.
- Lessens conflicts by promoting Community participation.

Procedure



Environmental Impact Assessment (EIA) Process

Process	Details in Brief
Screening	Which projects need a full or partial assessment study is decided in this stage
Scoping	<ul style="list-style-type: none"> • Which impacts are necessary to be assessed is decided in this stage. While doing so, legal requirements, international conventions, expert knowledge, and public engagement are also considered. • Alternative solutions that avoid or at least reduce the adverse impacts of the project are also studied in this stage • Investigation of alternate designs or sites that avoid or mitigate impact takes place
Assessment & Evaluation of Impacts and Development of Alternatives	Environmental impacts of the proposed project are analyzed and light is thrown upon the alternatives present to such projects
EIA Report also called Environmental Impact Statement (EIS)	An environmental management plan (EMP) and also a non-technical summary of the project's impact is prepared for the general public in this stage
Decision Making	The fate of the project is decided. Whether the project is to be given approval or not and if it is to be given, under what conditions
Monitoring, compliance, enforcement and environmental auditing	Monitoring whether the predicted impacts and the mitigation efforts happen as per the EMP
EIA Notification 2020	<p>EIA Notification 2020</p> <ul style="list-style-type: none"> • Reduced Time for Public Hearings. • The classification of projects, such as into A, B1, and B2, and a host of projects are exempted from public scrutiny. • Post-clearance compliance. • The new draft EIA, proposes the submission of compliance reports annually whereas as per the 2006 notification, the compliance report was to be submitted every six months. • Report Prepared Solely by Project Proponents. • The EIA Notification 2020 excludes reporting of violations and non-compliance by the public. • Another major proposal in the draft 2020 is granting 'post-facto clearance' where a project that has been operating without environmental clearance, can be regularised or allowed to apply for clearance. • Firms found violating the terms of their establishment, if they have to get the clearance, however, will have to pay a penalty. <p>→ 45 days from 60 days.</p>
Benefits	1. Protection of environment

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| | <ol style="list-style-type: none"> 2. Optimum utilization of resources. 3. Saving time & cost of project. 4. Lessens conflicts. |
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In 1991, the Government of India issued a notification under the Environment Protection Act, 1986 administered by the Ministry of Environment and Forests (MoEF) to protect and conserve the environment and ecosystem on the coastline of the country.

Accordingly to the notification, the coastal land up to 500m from the High Tide Line (HTL) and a stage of 100m along banks of creeks, estuaries, backwaters and rivers subject to tidal fluctuations, is called the Coastal Regulation Zone (CRZ).

Coastal Regulation Zones	<p> Category Reforms</p> <p>CRZ 1</p> <ul style="list-style-type: none"> • Exceptions on new construction <ul style="list-style-type: none"> • Construction of roads and trans-harbour sea links that don't affect the tidal flow, are between HTL & LTL, etc. • Projects related to the Department of Atomic Energy. • Other permissions granted for activities between HTL & LTL are: <ul style="list-style-type: none"> • Natural Gas Exploration & Extraction • Salt manufacturing • Desalination plants • Storage Facilities (non-hazardous cargo) within notified ports. <p>CRZ 2</p> <ul style="list-style-type: none"> • Permissions for building construction on the landward part of the hazardous line. • Other permissions granted for activities between HTL & LTL are: <ul style="list-style-type: none"> • Desalination plans, etc. • Some construction is permitted only as per guidelines specified by the notification. <p>CRZ 3</p> <ul style="list-style-type: none"> • Exceptions on new construction. <ul style="list-style-type: none"> • Construction of roads and trans-harbour sea links that don't affect the tidal flow, are between HTL & LTL, etc. • Projects related to the Department of Atomic Energy, petroleum products, salt manufacture & other public facility projects. • Construction of houses for local communities in some areas. <p>CRZ 4</p> <ul style="list-style-type: none"> • There is no restriction on the traditional fishing undertaken by local communities. • No untreated sewage or solid waste shall be let off or dumped in these areas. 	
Categories		

Coastal Regulation Zone Notification, 2018



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CRZ I A: Eco-sensitive areas

CRZ I B: Inter-tidal areas

CRZ II: Areas which have been developed up to or close to the shore

CRZ III A: CRZ-III areas, where the population density is more than 2,161 sq km as per 2011 Census

CRZ III B: Areas with population density of less than 2,161 per sq km, as per 2011 Census

CRZ IV A: 12 nautical miles from the Low Tide Line towards the sea

CRZ IV B: Tidal influenced waterbodies

NDZ: 50 metres from High Tide Line in CRZ III A areas, 200 m from HTL in CRZ-III B areas

Estuaries,
creeks etc.

Restriction

Only such projects/activities, which are located in the CRZ-I (Ecologically Sensitive Areas) and CRZ IV (area covered between Low Tide Line and 12 Nautical Miles seaward) will be required to be cleared by Ministry of Environment, Forest and Climate Change. For, the CRZ-II (urban) or CRZ III (rural) areas, the CRZ clearance will be considered at the state level by the Coastal Zone Management Authority (CZMA).

Temporary tourism facilities such as shacks, toilet blocks, change rooms, drinking water facilities etc. have now been permitted in Beaches. Such temporary tourism facilities are also now permissible in the "No Development Zone" (NDZ) of the CRZ-III areas as per the Notification. However, a minimum distance of 10 m from HTL should be maintained for setting up of such facilities.