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**SUBJECT: ENVIRONMENT**

**(HANDWRITTEN NOTES)**

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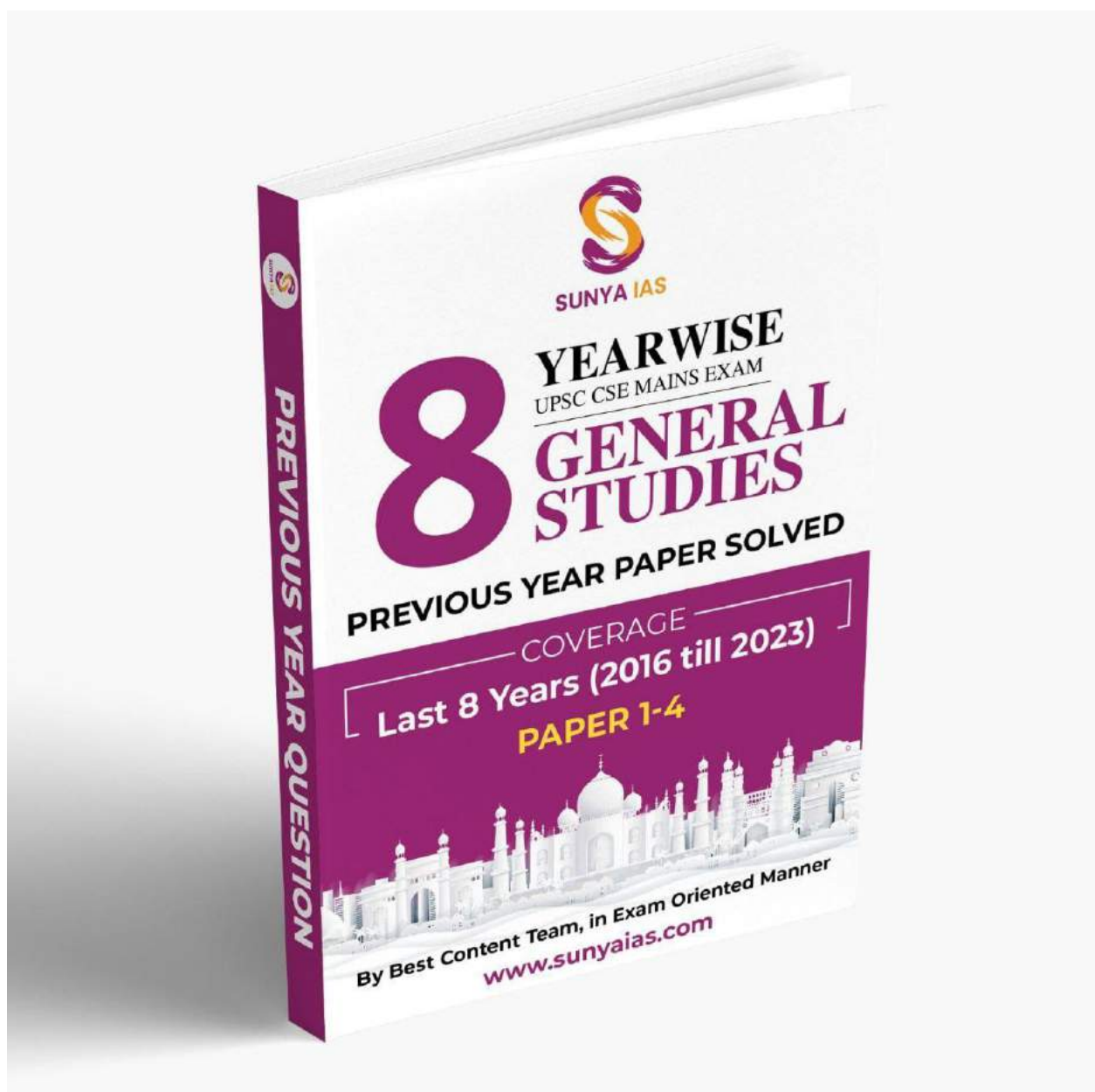
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**FOR OTHER SUBJECT NOTES, DROP US  
A WHATSAPP ON 9311077443**

## **Lecture - 1 to 3 (Basic of Environment)**



- Ecology
- Biotic & Abiotic Factors
- Levels of Organisation
- Ecotone
- Niche
- Major Abiotic factors like temperature etc.
- Effect of these factors on Plants

• "We won't have a society if we destroy the environment" — Margaret Mead.

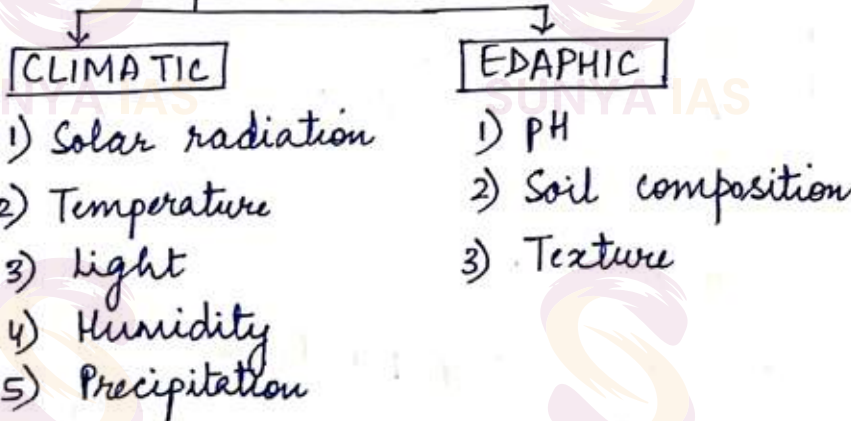
• Climate, nature and pollution are all linked. Addressing the 'triple planetary crises' now means a better future for all.

### Environment

- Surroundings or conditions in which an organism lives or operates.
- It is the sum total of all conditions & influences that affect the development & life of all organisms on earth. Thus, it can be said as one's surrounding.

#### Components

- (i) Biotic - living (bacteria, fungi, <sup>→ autotrophs</sup> plants, protists, animals, archae)
- (ii) Abiotic - non living (air, temp<sup>r</sup>, salinity, soil, light, water, minerals, pH, [humidity])



Ecology - Study

- Ecology studies the relationship b/w organisms & their environment. Term was 1<sup>st</sup> used by Ernst Haeckel in 1869.
- A scientific study of the interactions of organism with their physical environment & with each other.
- Types:

- 1) Autecology - Study of individual organism or individual species. Eg- Great Indian Bustard in Desert NP, Raj.
- 2) Synecology - Study of group of organisms of diff. species which are associated together as a unit in form of a community.

Habitat & Environment

- Habitat: has life
- Env - may or may not have life.
- All habitats are environment, but not all env. <sup>are/</sup> have habitats.

Levels of Organisation

- 1) Individual / Organism - survival & reproduction, unit of natural selection.
  - ↓
  - Population - single organism + capable of inter breeding
  - ↓
  - Community - change in distribution of organisms  
Named after dominant PLANT
  - ↓
  - Ecosystem - Energy flux & cycling of nutrients
  - ↓
  - Biome
  - ↓
  - Biosphere - Global processes

**COMMUNITY** - Interactions among populations

- (i) Major - large sized & they are relatively independent  
- they are only dependent on the light of the sun.

(ii) Minor - small sized

Telegram Channel: t.me/sunyanotes50

- they are dependent on neighbouring communities.

**POPULATION** is a community of interbreeding organisms. <sup>unit of evolution</sup>

↳ Population pyramid & interactions. <sup>specific time</sup>  
↳ grp of org. usually of same species, occupying defined area during

**ECOSYSTEM** is the structural as well as the functional part of a biosphere, consisting of living beings & physical env, both interacting & exchanging material b/w them.

**BIDME** are large, naturally occurring community of flora & fauna, which is occupying a major habitat.

↳ A large biological community where diff. types of living organisms incl. plants, animals, birds, insects, humans etc. <sup>are</sup> used to living in a certain type of climate.

↳ Eg - Thar desert & Sunderbans (Mangroves)

**BIOSPHERE** - Aka Ecosphere

↳ Sum of all ecosystems

↳ Zone of life on Earth, a closed system & largely self-regulating.

### Ecological Niche

- A Niche refers to the unique functional role or place of a species in an ecosystem.
- A niche is unique for a species, which means no 2 species have exact identical niches.
- Diff. types of niches are :- Habitat niche, Food niche, Reproductive niche, Physical & Chemical niche.
- Each species occupies a niche in the community. A niche is the role the species plays & includes the type of food it eats, where it lives, where it reproduces & its relationships with other species.

### The Indian Vulture Crisis: A Niche Disrupted

- Vultures, nature's scavengers - vital role in disposing of dead animals, thus preventing the spread of diseases.

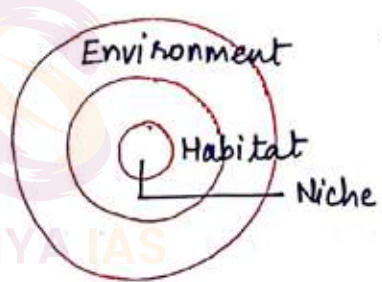
• Crisis: In 1990s, vulture population in India saw a drastic decline by over 90%. Cause - drug Diclofenac, used as painkiller in cattle. Vultures feeding on carcasses of animals treated with this drug suffered kidney failure & died.

• Consequences:

- ↳ Rapid ↑ in population of feral dogs, which led to a ↑ in rabies cases.
- ↳ An imbalance in the ecosystem due to missing scavenger role.

• Conclusion:

This crisis underlines the importance of each organism's niche & how human activities, even unintentional ones, can disrupt the natural balance.



• In nature, many species occupy the same habitat but they perform diff. functions. The functional characteristics of a species in its habitat = 'Niche'.

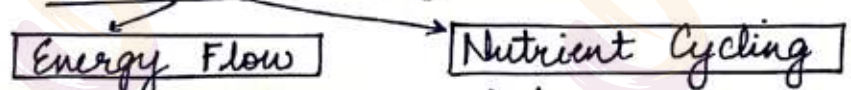
• While habitat of a species is like its 'address' (where it lives), niche can be thought of as its 'profession' (activities & responses specific to the species).

Ecosystem

• Structural & functional unit of Biosphere.

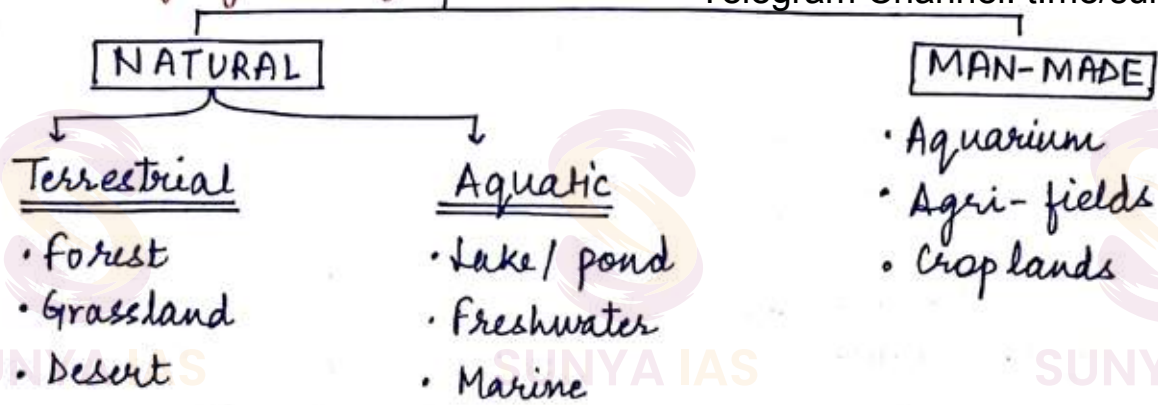
↳ Arrangement of trees in forest

• Functional - Ecological succession



- 1) Pyramids
- 2) Food Chain / web

- 1) Gaseous
- 2) Sedimentary



## Components of Ecosystem

1) Abiotic

2) Biotic — Autotrophs → Plants (primary producers)  
— Primary Consumers  
— Scavengers / Decomposers

## Ecosystem Services

1) Regulating: Air quality, climate, water runoff, erosion, natural hazards, pollination, water purification, waste treatment, disease & pest control, extreme events moderation  
↳ Services nature provides that regulate the env.

2) Provisioning: <sup>→ tangible</sup> Products humans obtain from ecosystems. to provide food, Raw Materials eg. wood, fuel, fibre; Medicine, Freshwater, biomass

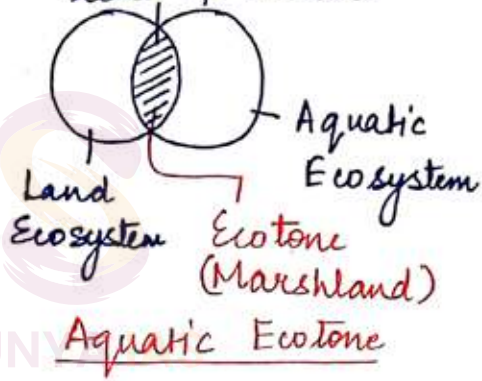
3) Cultural: <sup>Aesthetic</sup> Non-material benefits of nature for humans. Intangible Recreation eg. tourism, aesthetic values, religious & spiritual values, mental & physical health, education, ethical values, existence values, ecotourism.

4) Supporting: The underpinning services that enable all other services to function - encompasses both human & ecosystem needs.

Photosynthesis, Nutrient cycling, water cycling, soil formation



## Ecotone zone of Tension



• Ecotone - boundary b/w 2 ecosystems. Hence, it is a zone of tension.

• Habitat of greater genetic diversity & serve as bridges of 'gene flow' from 1 population to another.

- Halophytes
- Eg- Mangroves (salt tolerant plants), river bank, grassland, estuaries (where river meets sea), wetland.
  - Edge Effect: A higher density of organisms & variety of species can be found within an ecotone.
  - Edge Species: Organisms which occur primarily or most abundantly in this zone.

## Western Ghats

- Mt. range that runs parallel to the western coast of India, is a UNESCO WHS & one of the 8 'hottest hotspots' of biological diversity in the world.
- Ecotone Significance: transition from tropical rainforests in the lower regions to montane grasslands at higher elevations. This transition zone - rich biodiversity.
- Threats - deforestation, mining, illegal poaching. So, need for conservation efforts.

Q) Which one of the following is the best description of the term 'ecosystem'?

- a) A community of organisms interacting with one another.

- b) That part of the earth which is inhabited by living organisms.
- c) A community of organisms together with the environment in which they live.
- d) Flora & fauna of a geographical area.

8) Which one of the following term describes not only the physical space occupied by an organism but also its functional role in the community of organisms?

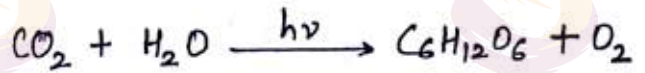
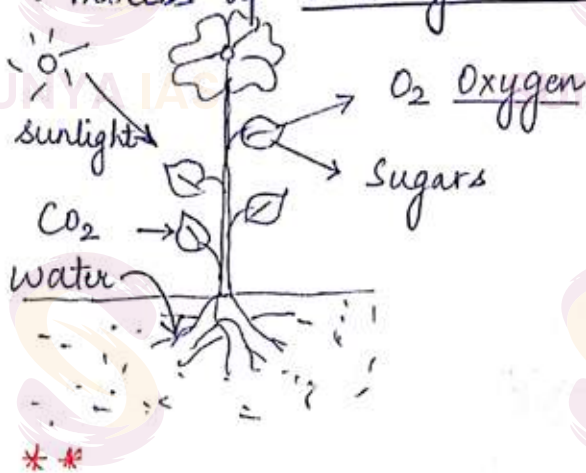
- a) Ecotone  
 b) Ecological niche  
 c) Habitat  
 d) Home range.

Major limiting factors

• light, Temperature, Wind, Nutrient, pH (soil), Snow/frost

Light

• Process of Photosynthesis



• Photosynthetically Active Radiation (PAR) < 50%.

• Non - Etiolated

↓  
with proper light

(vs)

Etiolated Plants

↓  
w/o proper light →  
Etiolation (patches)

Temperature

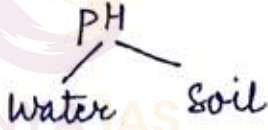


• Stenothermal: Organisms withstand small variation in temp.  
 Typically live in open ocean.

• Eurythermal :- Organisms withstand large variation in temp. Telegram Channel: t.me/sunyanotes50

Typically live in coastal waters

## Buffering Capacity of Earth



• 'What we are doing to the forests of the world is but a mirror reflection of what we are doing to ourselves & to one another.' - Mahatma Gandhi

• 'If every person made one change in their daily life for the environment, what kind of impact would that have?'

\* \*

• In a high extreme intensity of light, it favours root growth than the shoot growth. + ↑ transpir<sup>n</sup>.

• low intensity of light - retard the growth. ↓  
↳ ↓ flower growth  
↳ ↓ fruits  
Thicker leaves,  
less stem growth  
Eg- Cactus.

• Of the visible part of the spectrum, it is only the red & blue light - which is effective in photosynthesis

• Plants which grow in blue light → are small.  
Red light → elongation  
↳ Phytochromatids activate only in red light.

In UV and Violet light - dwarf plants

- Major abiotic factors like temperature etc.
- Effect of these factors on Plants & Animals. → Adaptations
- Population Interactions
- Population dynamics
- Earth Overshoot day

### Impact of Abiotic Factor - Light

- Effect on plants - Req'd. for photosynthesis.
- Effect on Animals - Determines feeding & migration patterns
- Case Study - Plants in dense forests. Understory plants have adapted to survive with less light by having larger leaves to capture more sunlight.

### Impact of Abiotic Factor - Water

- Effect on Plants - Too much water cause root rot, while too little cause wilting.
- Effect on Animals - Dehydration or water-logging
- Case Study - Camels in the Thar Desert, India. Camels can drink upto 40 gallons of water at once & then survive for weeks w/o it.

### Impact of Abiotic Factor - Frost

- Frost leads to the freezing of soil moisture. Here the plants are killed due to higher transpiration.
- Leaves consist of 70%  $H_2O$  - frost leads to freezing of intercellular spaces → ↑ issues.
- Also salt content will not be balanced

### Impact of Abiotic factor - Snow

- +ve → blanket - prevent pest  
→ fir, spruce, deodar - helps in regeneration
- -ve → mechanical bending / breaking

## Impact of Abiotic factors - Temperature

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- Effect on Plants - Reduced growth in extreme temp<sup>r</sup>, photosynthesis is temp<sup>r</sup> dependent.
- Effect on Animals - Extreme cold can cause Hypothermia, while extreme heat can cause heat stress.
- Case Study - Penguins in Antarctica. How do they survive in freezing temp<sup>r</sup>? Their body structure, feathers & huddling behaviour all help them combat the cold.

## Impact of Abiotic Factors - Light / Temp<sup>r</sup>

- DIEBACK - The progressive dying <sup>usually</sup> from the tip of the shoot <sup>(twigs)</sup> to conserve moisture.
  - Roots can remain alive whereas the shoot may die off.
  - Adaptative mechanism.

Vegetation in any area are determined by - Soil Composition, porulation & grain size, water holding capacity.

Aggregation of soil are determined by - pH, mineral composition, topography.  
↳ Aspect / slope

## Warning and Species Loss - Report

- Report released by Intergovernmental Science Policy Platform on Biodiversity & Ecosystem Services (IPBES) → not UN org<sup>n</sup>.
- Shows ~ 1 in 6 species worldwide faces extinction at the current rate of global warming.

## Global Warming threat to key areas for Biodiversity

- World Wildlife fund for Nature (WWF) has identified 33

'Priority Places' - that host some of the world's richest ecosystems, warning that up to half the species in these spots face extinction if climate change is left unchecked.

### A Variety of Responses

- 1) Shifting habitats
- 2) Predator declines as prey declines → Co-existence <sup>extinction</sup>
- 3) Shifting migration patterns → Siberian Crane - comes to
- 4) Entire Ecosystem changes → Koaladeo NP, Raj during  
→ CE winter
- 5) Adaptation

### Adaptations

- 1) Regulate
- 2) Conform
- 3) Migrate
- 4) Suspend

### 3 types of animal adaptations are:

- 1) Structural = a body part or coloring that aids survival  
Eg - protective coloration (camouflage) mimicry.
- 2) Physiological = jobs of body parts controlling life processes that aids survival.  
Eg - Snake making venom, storage of food in <sup>bullb.</sup>
- 3) Behavioural = an action that aids survival  
Eg - Hibernation or Migration

### Regulate

- Homeostatic (maintaining constancy of internal body) by physiological (sometimes behavioural also) like ensuring constant body temp<sup>r</sup> (Thermoregulation).
- Eg - In summer outside temp<sup>r</sup> is more than our body temp<sup>r</sup>, we sweat profusely.  
In winter we shiver, which produces heat & raises body temp<sup>r</sup>.
- Constant osmotic concentration (osmoregulation)
- Success of mammals - ∴ ability of mammals to maintain

a constant body temp.

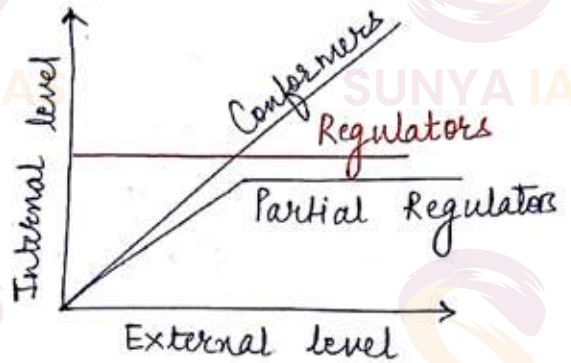
Warm Blooded Cold Blooded



- 1) Mammals
- 2) Birds

### Conformers

- Regulators - Warm blooded
- Conformers - Cold blooded
- 99% of animals & nearly all plants can't maintain constant internal environment.
- Thermoregulation - energetically expensive for many organisms. Eg - Shrews & humming birds.
- Heat loss & gain is a function of surface area



Organism Response

- Q) Why are small animals NOT found in Polar regions?
- Small animals have larger surface area relative to their volume so they tend to lose body heat very fast when it is cold outside.
  - They have to expend much energy to generate body heat through metabolism.

### Migration

- The organism moves away temporarily from the stress habitat to more hospitable area & return when stressful period is over. Eg - Keoladeo NP (Bharatpur), Raj, host thousands of migratory birds from Siberia during winter months. ↳ Ramsar Wetland ↳ Part of Montreux Record
- Eg - Siberian Crane, Amur Falcon, Greater Flamingo

Doyang lake, Nagaland

Suspend - reduce their metabolic rate

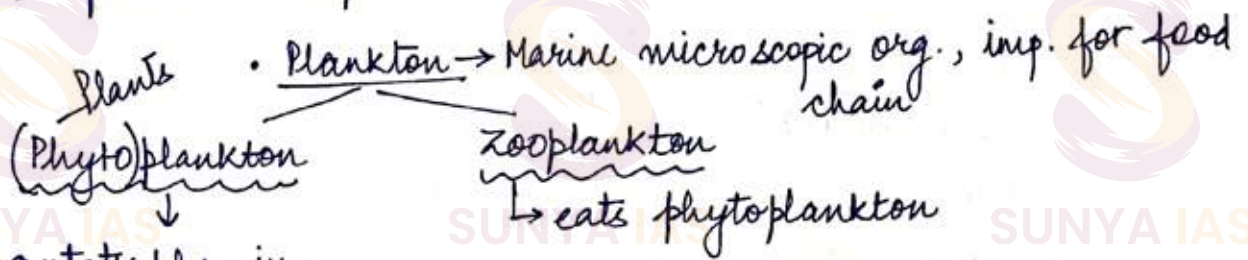
- Thick walled spores formation in bacteria, fungi & lower plants. ↳ blanket

• Dormancy plants: Reduction of metabolic activity in higher plants in stressful environment. (Not Active)

• Hibernation - when an animal slows its heart rate to save energy & survive the winter w/o eating much. Eg- bear, bat, ~~rodents~~ mouse etc. Helps avoid damage from low temp<sup>r</sup> in winter.

• Aestivation - animal dormancy ~ hibernation, although taking place in summer rather than winter. Aquatic animals like snail, fish. Helps avoid damage from high temp<sup>r</sup> in summer.

• Diapause - a zooplankton species in lakes & ponds; a stage of suspended development.



• Animals that hibernate :- box turtles, wood frogs, snails, common poorwills, hedgehogs, fat-tailed dwarf lemur, ground hogs, snakes, skunks, bumblebees.

• Cactus - thick waxy skin / cuticle

- large fleshy stems
- spikes
- shallow, widespread roots

• Camel - Thick eyebrows

- Closing nostrils
- Hairy ears
- long eyelashes
- hump
- Thick fur
- well camouflaged
- wide feet (grip)



• Kangaroo Rat - desert :

↳ meets their water requirement from oxidation of fat.

↳ excrete very concentrate urine to conserve water.

Allen's Rule - Animals in cold climates usually have min. of exposed surface area. Eg- short legs, short tails, short ears.

↳ black-tailed jack rabbit, gray fox }  
hot-dry climate }  
arctic fox, }  
arctic hare }  
cold climate ←

Q) Which of the following leaf modifications occur(s) in the desert areas to inhibit water loss?

1. Hard & waxy leaves
2. Tiny leaves
3. Thorns instead of leaves

Select the correct answer :

- a) 2 and 3 only
- b) 2 only
- c) 3 only
- d) 1, 2 and 3

At high altitude → Nausea or Vomiting, Shortness of  
(Hills vs Plains) Breath, Insomnia, Rapid pulse,  
Dizziness

Ecological Amplitude → Every species has a specific range within which it can tolerate ecological changes. This range is ecological amplitude.

Ex- narrow range - cold blooded animals; wide range - warm blooded

Ecophene → Aka ecads or morphologically changed forms, ecophenes are variation in phenotypes (observable physical characteristics). Eg- A European living in Africa will have diff. feature (eg. higher melanin in skin) than one living in Europe.

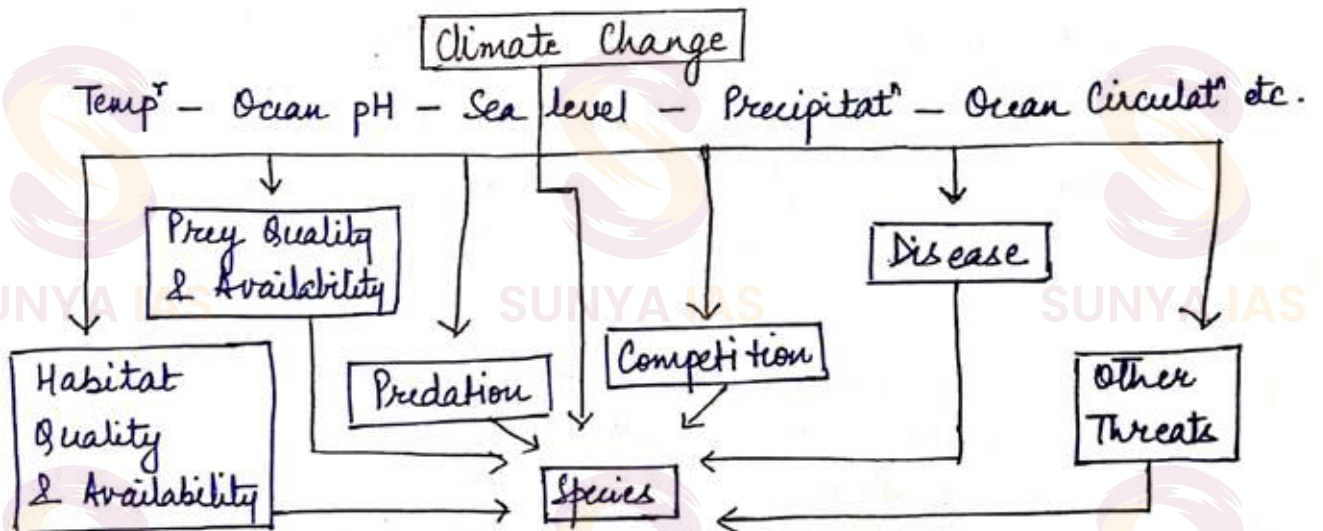
• The differences among ecophenes are just temporary

morphological variation & is reversible as there is no change in genetics of 2 separate ecophenes. Telegram Channel: t.me/sunyanotes50

Eco type - occur when ecophenes remain in their new env. for too long as a result morphological changes become genetically fixed. So, these are permanent. However, interbreeding among 2 ecotypes to produce a viable offspring is possible.

Ecospecies:- Among animal or plant of some species are kept separate env. for a very long time, the adaptations become permanent part of the genes. As a result, both morphological & genetic variation is now permanent.

- Conc<sup>n</sup> of GHGs → ↑ CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O
- Global means temp<sup>r</sup> ↑.



- Abundance
- Distribution
- Phenology
- Reproductive success
- Survival
- Genetic Diversity

Eg- Lake Baikal

# Population Interactions

Telegram Channel: t.me/sunyanotes50

(A)	(B)	
+	+	Mutualism
-	0	Amensalism
+	0	Commensalism
-	-	Competition
-	+	Predation
-	+	Parasitism

- ⊕ benefit
- ⊖ harm
- 0 unaffected

- Biological community in an area or ecosystem is a complex of network of interactions.
- The interactions that occur among diff. individuals of the same species is called Intra-specific interaction, while the interaction among individuals of diff. species in a community → Inter-specific interaction → can be +, - or neutral.
- Interactions b/w organisms belonging to same trophic level often involve competition.  
↳ for food, space, mates.

## Mutualism

- close association b/w 2 species in which both the species benefit. Some interacting species can no longer live w/o each other as they depend totally on each other for survival.
- Eg- pollination of flowers where flowering plants are cross-pollinated by bees which benefit by getting nectar from plants. Both can't survive w/o the other.

- Coral species incl. imp. reef builders that inhabit tropical oceans & secrete  $\text{CaCO}_3$  to form a hard skeleton.

- Zooxanthella: yellowish brown symbiotic dinoflagellate in cytoplasm of many marine invertebrates.

- (Mycorrhiza): Symbiotic relation b/w mycorrhizal fungi & plant's root system,  
fungus → provide Carbohydrates  
→ provide water & nutrients

- fig tree & wasp  
↓  
fig flower → lay eggs in fig fruit  
pollinated by wasp.

- Lichens: algae & fungus
- Rhizobium, a nitrogen fixing bacteria forms symbiotic relationship with the roots of plant.

### Commensalism

• Relationship - one species benefits while the other is neither harmed nor benefitted.

• Eg - sucker fish, remora often attaches to a shark by sucker, which is present on the top of its head.

- Trees & epiphytic plants: Epiphytes live on the surface of other plants like ferns, mosses & orchids & use surface of trees for support & for obtaining sunlight & moisture. Tree gets no benefit from this relationship. Epiphytes are the characteristic feature of rainforest

### Competition

• Interaction b/w 2 population in which both species are harmed to some extent.

• Occurs when 2 populat<sup>n</sup>/species, both need a vital resource that is in short supply.

• Types:

a) Inter-specific Competition :- b/w individuals of 2 diff. species occurring in a habitat.

b) Intra-specific Competition :- b/w individuals of same species so it's very intense.

• Eg - Goats & insects

• Gause's Exclusion - species adopts to new niche, due to competition.

## Parasitism

Telegram Channel: t.me/sunyanotes50

- One species is harmed & other benefits.
- Involves small sized organisms or parasites living in or on another living species called host from which parasite gets its nourishment & shelter. Parasite is benefitted & host is harmed.
- Organisms → bacteria & viruses are parasites of plants & animals.
- Plants → Dodder plant (*Cuscuta*) & mistletoe (*Loranthus*) are parasites that live on flowering plants.
- Parasites of Humans → Tape worm, round worm, malarial parasite, bacteria, fungi, viruses.

### Types of Parasites :-

- 1) Ectoparasites :- live on outside or skin of the host  
- usually insects or arachnids (ticks, mites or spiders)
- 2) Endoparasites :- Parasites found within the body of the host.  
- Can be in blood, tissue or gastro-intestinal tract.  
- Nematodes, Trematodes, Cestodes, Protozoa
- 3) Brood Parasitism :- related Koel or Cuckoo

Q) Consider the following kinds of organisms:-

- 1) Copepods
- 2) Cyanobacteria
- 3) Diatoms
- 4) Foraminifera

Which of the above are primary producers in the food chains of oceans? → phytoplanktons

- a) 1 and 2
- b) 2 and 3
- c) 3 and 4
- d) 1 and 4

\* Diatom - the largest type of phytoplankton algae - declining  
↳ in mixed layer (uppermost) - take nutrients. ↳ absorb  $\text{CO}_2$  from ocean

Predation

- Predator captures, kills & eats an animal of another species called prey.
- one species benefits, other is harmed.  
 ↳ predator ↳ prey
- Eg - leopard, tiger, cheetahs etc.

+/- Predation	+/- Parasitism
1) + Big / Strong	1) + weaker / smaller
2) Death	2) usually slow death

Amensalism

- -ve association b/w 2 species in which one species harms or restricts the other species w/o itself being adversely affected or harmed by the presence of the other species.
- eg - Organisms that secrete antibiotics & the species that get inhibited by the antibiotics  
 - Fungus called bread mould or Penicillium produces penicillin, an antibiotic.  
 ↳ inhibits the growth of variety of bacteria  
 ↳ benefits by availability of food when in the competition bacteria are removed.
- small & big tree.

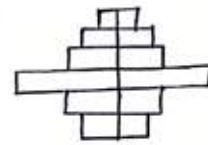
Population Dynamics



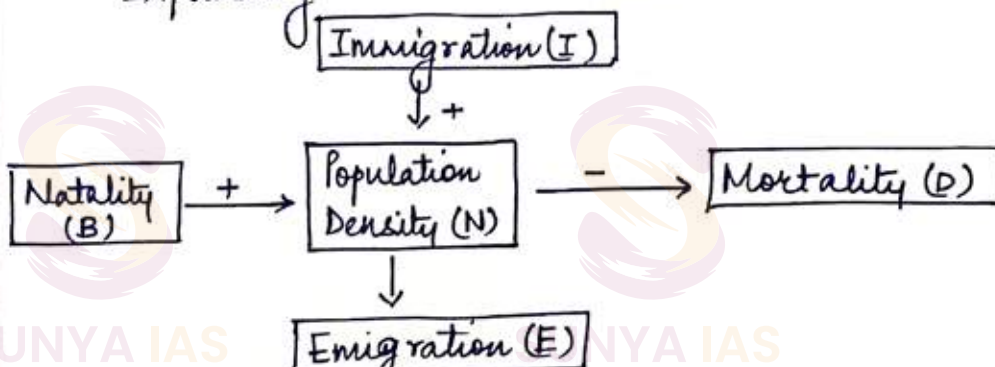
Expanding

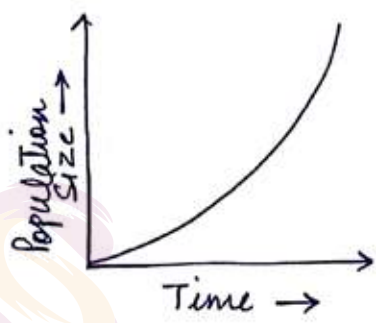


Stable

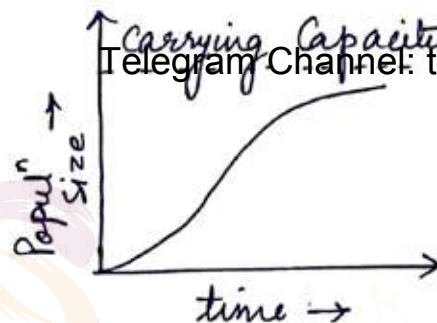


Declining





Exponential Growth



logistic growth

### Earth Overshoot Day

- Date when humanity's demand for ecological resources in a given year exceeds what Earth can regenerate in that year.
- by Global Footprints Network
- coming sooner & sooner
- 2022 → July 28



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## Topics

- Ecosystem functions
- Ecological Succession
- Energy Flow - Food Chain  
- Food web
- Biogeochemical Cycles
  - Gaseous Cycles
  - Sedimentary Cycles

## Functions of Ecosystem

Ecosystems are complex dynamic system. Function:-

- Homeostasis (or Cybernetic) or feedback control mechanism.
- Ecological Succession or ecosystem dev.
- Energy flow through food chain
- Nutrient cycling (biogeochemical cycles)

## Ecological Succession

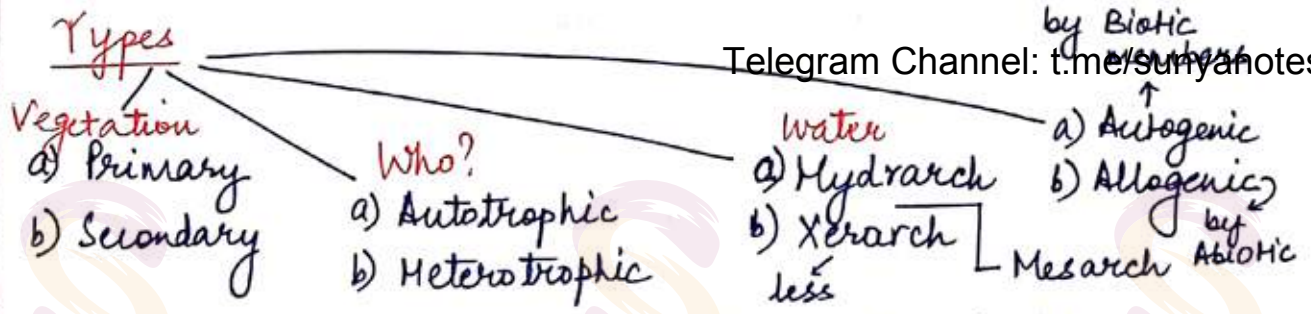
- Succession - series of progressive changes in the composition of ecological community over time.

Process by which structure of a biological community evolves over time.

- Succession is directional.
- Diff. stages in a particular habitat succession can usually be accurately predicted. These stages, characterised by the presence of diff. communities are known as SERES.

- Communities change gradually from one serere to another. The seres are not totally distinct from each other & one will tend to merge gradually into another, finally ending up to with a 'Climax' community.

- Succession will not go any further than the climax community. This is the final stage.



- The process by which plants & animals in an area are replaced or changed with another over a period of time is known as Ecological Succession?
- Succession is a universal process of directional change in vegetation on an ecological time scale
- When large organisms in the climax community, such as trees, die & fall down, then new openings are created in which Secondary Succession will occur.
  - ↓
  - quicker than primary succession

Pioneer Community vs Climax Community

- The first species to colonise or invade a barren area are pioneer community. Eg- lichens, mosses
- Final stage is Climax Community. Most Stable stage.

**PRIMARY SUCCESSION**

- Occurs in an area where no community had existed before.
- lichens are the 1<sup>st</sup> one to appear.
- Takes a very long time i.e abt 1000 yrs to reach the climax community.
- Begins on sand dunes, volcanic islands, lava flows etc.

**SECONDARY SUCCESSION**

- Occurs in an area where a community had existed before.
- Grasses, shrubs & weeds are the 1<sup>st</sup> organisms to appear.
- Takes a shorter time of 50-100 yrs for a grassland & abt 200yrs for a clear forest to reach climax community.
- Begins on area devastated

## Stages - Ecological Succession

Nudation

Invasion

Competition  
& Co-action

Reaction

Stabilization  
(Climax)

### STABLE

- 1) High Species diversity
- 2) Low variation in ecological productivity
- 3) High disease & pest resistance

Q) Lichens, which are capable of initiating ecological succession even on a bare rock, are actually a symbiotic association of -

- 1) Algae & bacteria
- 2) Algae & fungi
- 3) Bacteria & fungi
- 4) Fungi & mosses

Q) In nature, which of the following is / are most likely to be found surviving on a surface w/o soil?

1. Fern
2. Lichen -
3. Moss -
4. Mushroom

Select the correct answer using correct code:

- a) 1 and 4 only
- b) 2 only
- c) 2 and 3
- d) 1, 3 and 4

## Ecological Efficiency

• Energy flow through diff. Tropic levels

• Sun  $\rightarrow$  1st trophic level - Producers (Plants)  $\rightarrow$  2nd - Primary consumers (Herbivores)  
4th - Tertiary Cons. (Top Carnivores)  $\leftarrow$  3rd - Secondary Cons. (Carnivores)  $\leftarrow$

- Energy moves life. Cycle of energy is based on the flow of energy through diff. trophic levels in an ecosystem.
  - At 1st trophic level - primary producers use solar energy to produce organic material through photosynthesis.
  - Herbivores, at the 2nd trophic level - uses plants as food, which gives them energy. A large part of this energy is used for the metabolic functions of these animals such as breathing, digesting food, supporting growth of tissues, maintaining blood circulation & body temp<sup>o</sup>.
  - Carnivores, at 3rd trophic level - feeds on herbivores & derive energy for their sustenance & growth.
  - Decomposers which include bacteria, fungi, moulds, worms & insects break down wastes & dead organisms & return the nutrients to the soil, which is then taken up by the producers. Energy is not recycled during decomposition, but it is released.
  - At each trophic, a part of available energy is lost in respiration or used up in metabolism.
  - It is ratio b/w the amt of energy acquired from the lower trophic level & the amt of energy transferred from higher trophic level is called Ecological efficiency.
  - Lindman in 1942 defined these for the 1<sup>st</sup> time & proposed 10% rule.
- Eg- Autotrophs (100 Cal) → Herbivores (10 Cal) → Carnivores (1 Cal)

### Food Chain

- A linear representation of species in diff. trophic levels is a food chain.

- The more complex & inter-connected it is, the better it is.  $\Rightarrow \uparrow$  stable.
- Grazing Food Chain - The consumers which start the food chain with plants
  - $\hookrightarrow$  large biological community or ecosystem where diff. types of living organisms incl plants, animals, birds, insects, humans are used to living in a certain type of climate.

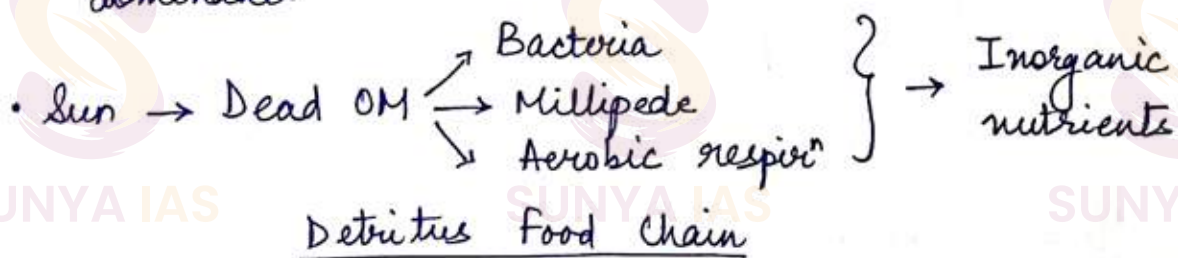
• (Detritus) Food Chain - starts with a dead OM. or detritus

feeding organisms eat up the OM.

$\hookrightarrow$  Dead remains  $\left\{ \begin{array}{l} \text{plants} \\ \text{animals} \end{array} \right.$

Sun

- In an aquatic ecosystem, the grazing food chain is the major conduit of energy flow.
- In a terrestrial ecosystem - detritus food chain is dominant.



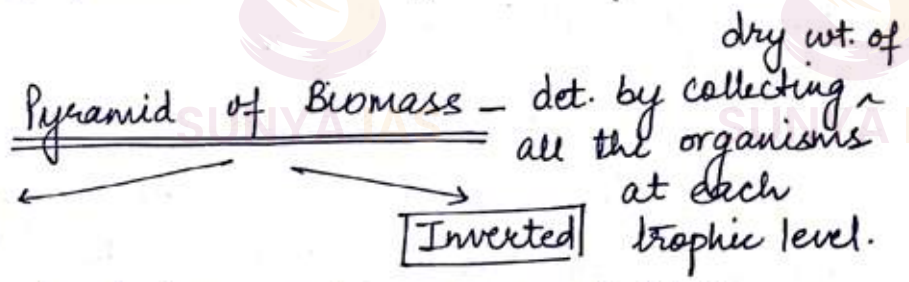
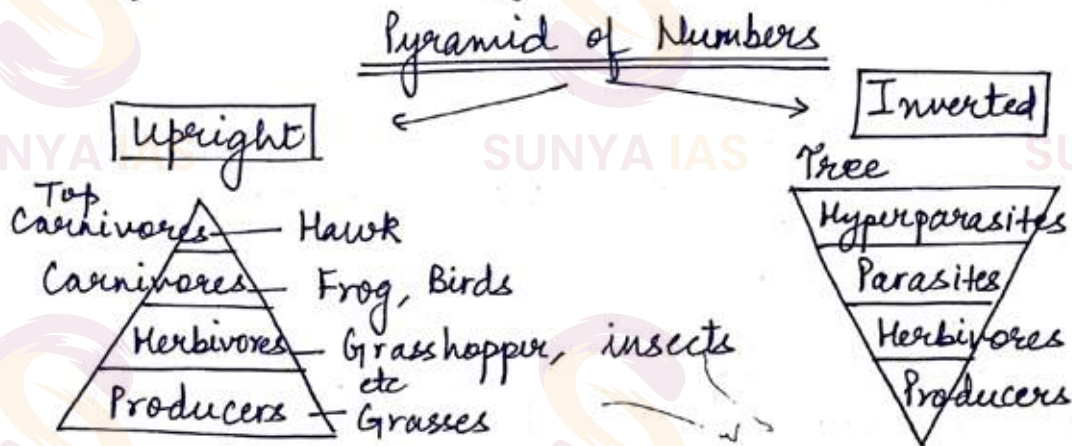
- Parasite  $\rightarrow$  Bacteria, fungus, Virus
- Decomposers  $\rightarrow$  Bacteria, fungus

### Ecological Pyramids

- Graphical representat<sup>n</sup> of relationship b/w diff. organisms in an ecosystem.
- Consists of no. of horizontal bars representing specific trophic levels which are arranged sequentially from producer to Top level consumers.
- length of each horizontal bar depicts the total no. of individuals at each trophic level in an ecosystem.

• 3 types:

- (i) Pyramid of numbers
- (ii) Pyramid of biomass
- (iii) Pyramid of energy



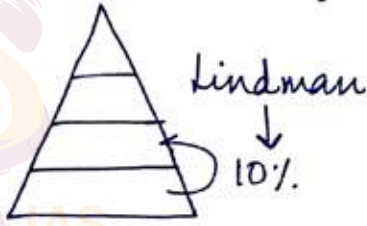
- Each trophic level has certain mass of living material at a particular time = Standing Crop.  
↓  
Mass of living organisms (biomass)

Pyramid of Energy

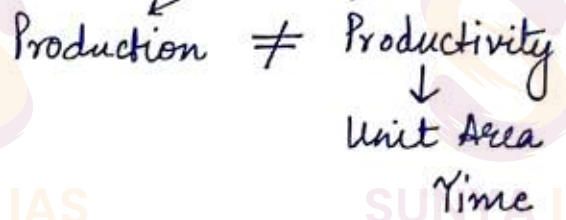
- Upright
- Unidirectional
- Each level in pyramid  $\sim 1/10$  the size of preceding level as energy transformations are 10% efficient.
- Reflects 'law of Thermodynamics' - with conversion of solar energy to chemical energy & heat energy at each trophic level & with loss of energy being depicted at each transfer to another trophic level.

Limitations → ① Not take into acc same species belonging to 2 or more trophic levels. ② Assumes simple food chain. Never exists. Not acc. food web. ③ Saprophytes not given any place.

Ecological efficiency



Ecological Productivity



Productivity

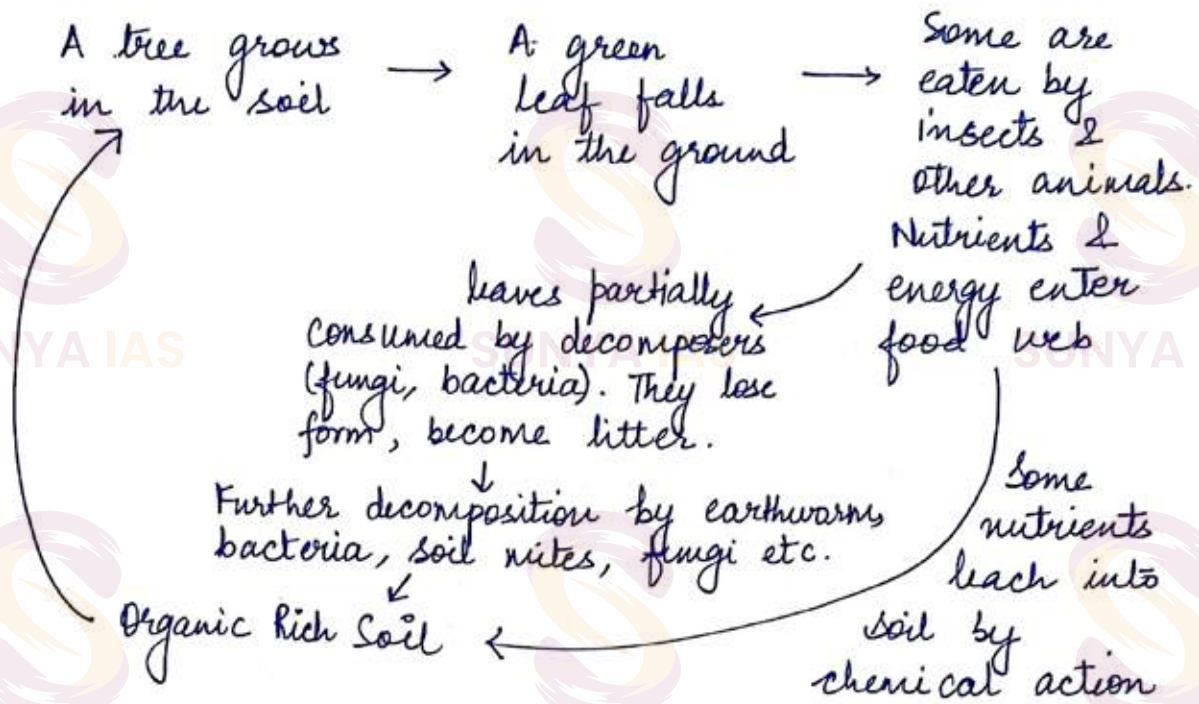
- Rate of biomass production.
- Primary production - Amt. of biomass or OM produced per unit area over a time period by plants during photosynthesis. (GPP)
- Gross Primary productivity - Rate of production of OM during photosynthesis.   
 Respiration ← Metabolism
- Net Primary Productivity (NPP) = GPP - Respiration loss (R)
- Secondary productivity - Rate of formation of new OM by consumers.

Types of Ecosystems

Estuaries
Swamps & Marshes
Tropical Rainforest
Temperate Rainforest
Northern Coniferous Forest (Taiga)
Savanna
Agricultural land
Woodland & Shrubland
Temperate grassland
Lakes & Streams
Continental Shelf
Tundra (Arctic & Alpine)
open Ocean
Desert scrub
Extreme desert

Average Net Primary Productivity (Kcal/m<sup>2</sup>/yer)

$$= \frac{\text{Product}^n}{\text{Area}}$$



- Detritivores - function similar as decomposers.
- Decomposers do not need to digest OM internally in order to break it down. Eg- fungus, bacteria, slime moulds
- Scavengers - 1<sup>st</sup> to arrive at a dead organism's remains - lions, jackals, wolves, raccoons, opossums, vultures; Cleaning up.

### Important steps:

a) Fragmentation - Detritivores (earthworm) break down ~~into~~ detritus into smaller particles.

b) Leaching - By leaching, water-soluble inorganic nutrients go down into soil horizon & get precipitated as unavailable salts.

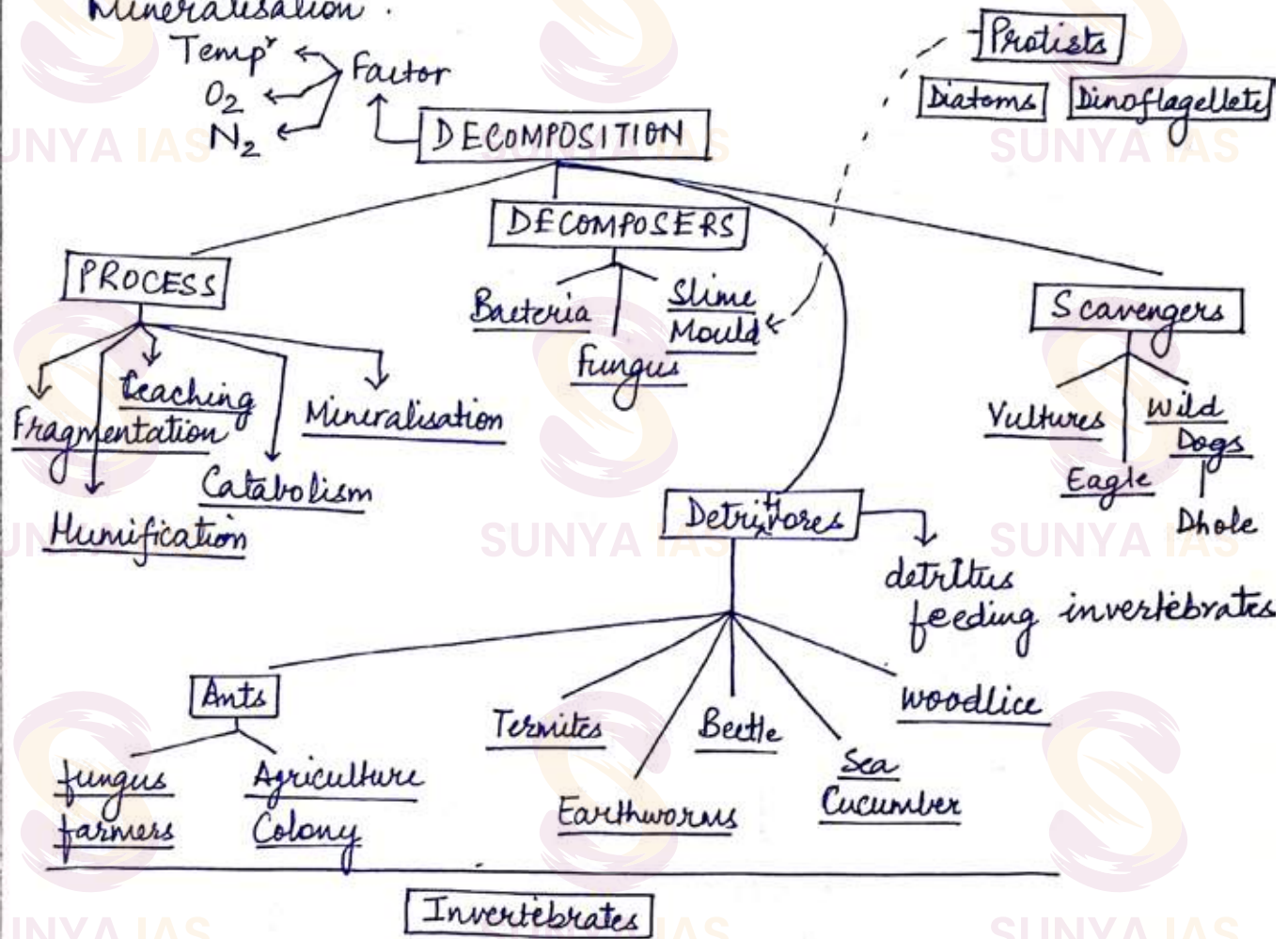
c) Catabolism - Bacterial & fungal enzymes degrade detritus into simpler inorganic substances.

\* All the above steps operate simultaneously on detritus.

d) Humification - Accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action & undergoes decomposition at an extremely slow rate. It's



e) Mineralization:- Humus further degraded by some microbes & releases of inorganic nutrients occur by mineralisation.



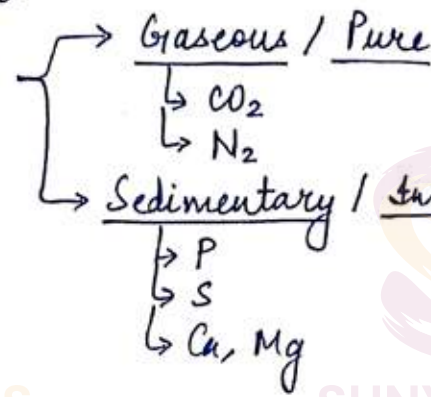
- Decomposition is the process in which OM is converted to inorganic minerals / matter.
- The process of decomposition is dependent on:-
  - 1) Temp - Fast decomposition in warm temp & vice-versa. Eg- in Arctic Tundra, very cold - slow decompos.
  - 2) O<sub>2</sub> - Sufficient O<sub>2</sub> leads to good decomposition & in anaerobic cond<sup>n</sup>, slow decompos.
  - 3) N<sub>2</sub> - Better decomposition in abundant nitrogen.

### Biogeochemical Cycles

- Bio - means living, Geo - means atmosphere.
- It is the circulation of essential elements & minerals from living to non-living & back in a circular

fashion:

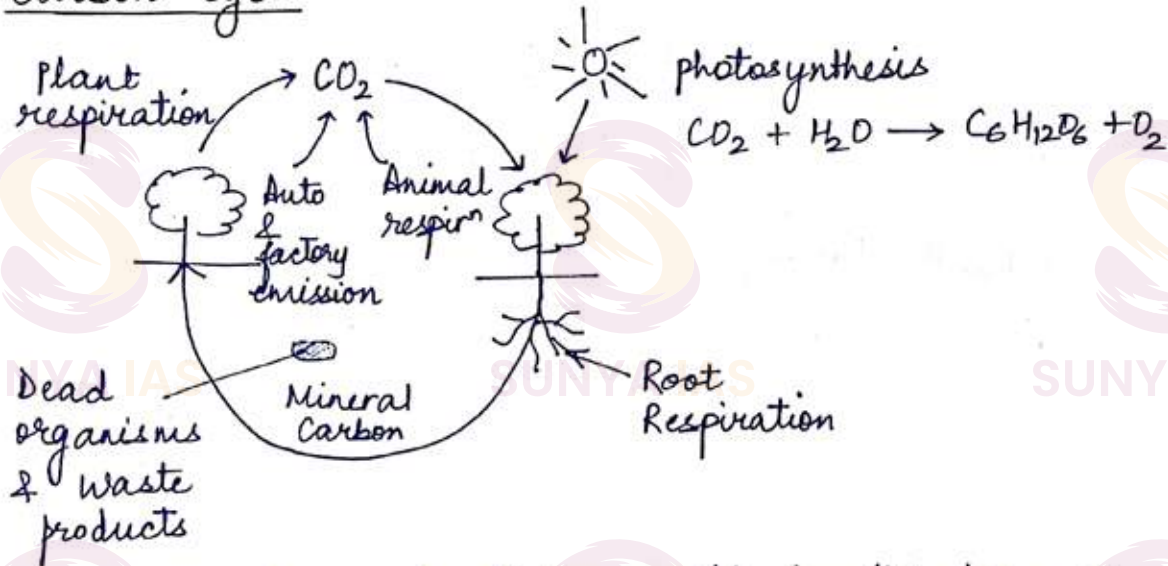
• Types



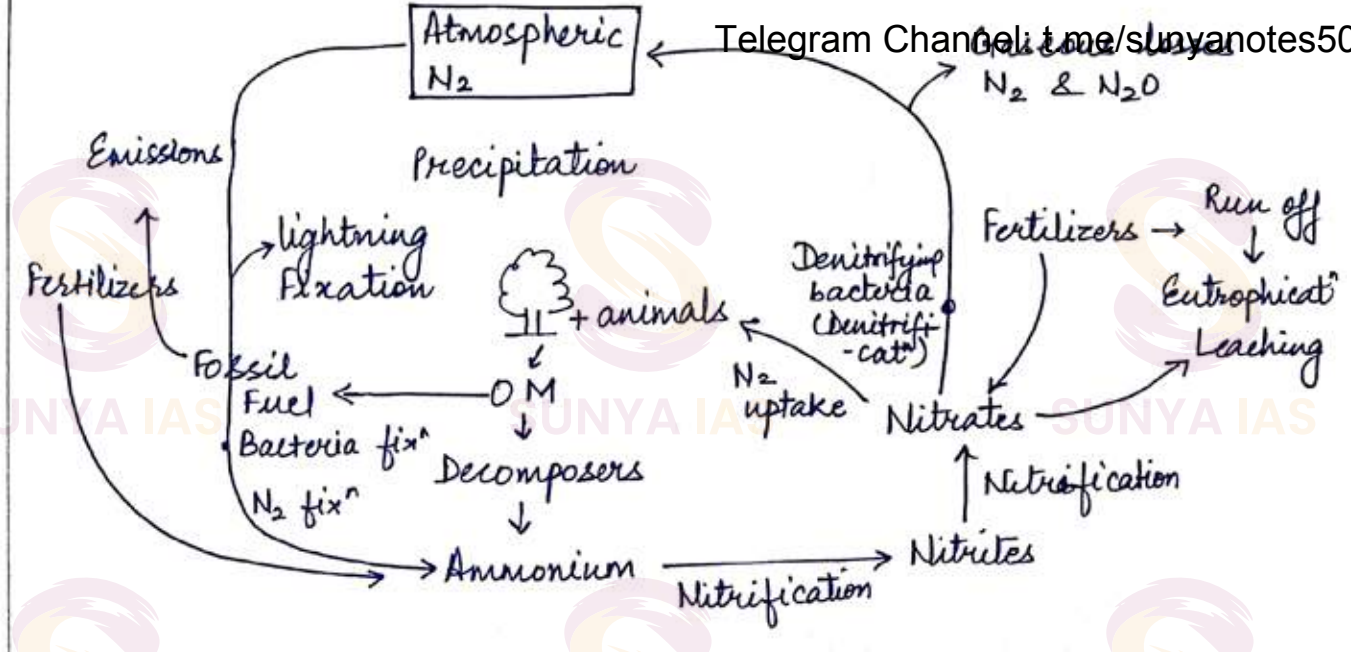
Telegram Channel: [t.me/sunyaiaotes50](https://t.me/sunyaiaotes50)  
These are elements are used & replenished in the cycle

→ Here, elements can stay in the crust for a long time.

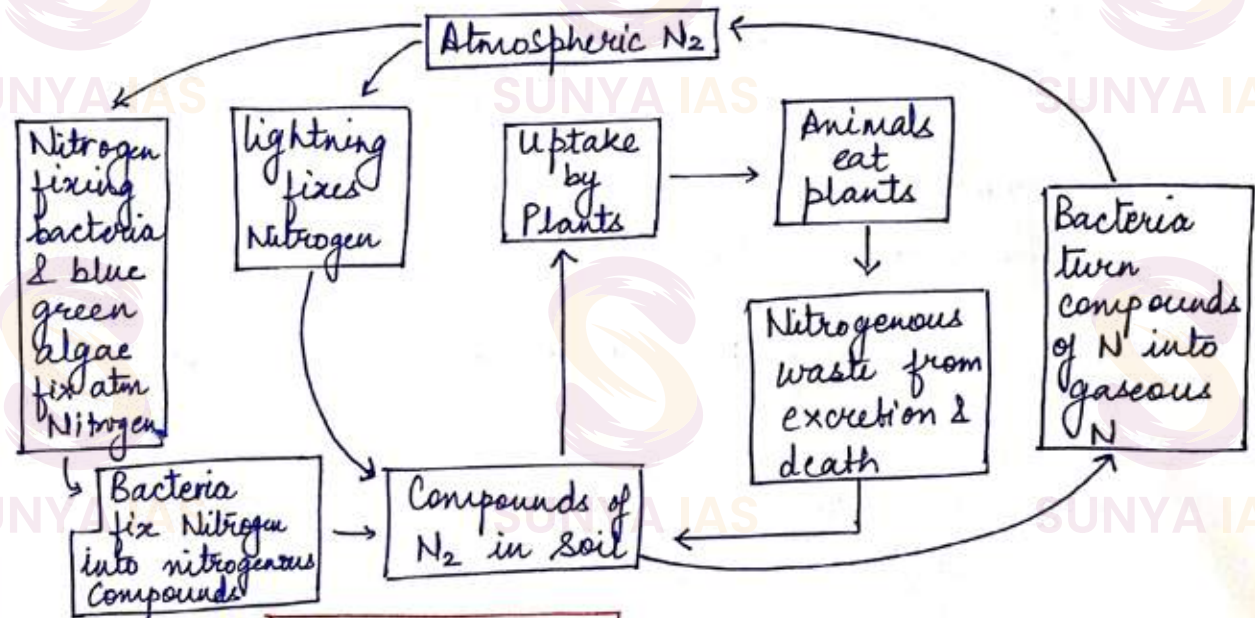
## Carbon Cycle



- Carbon enters into living world in the form of CO<sub>2</sub> through photosynthesis as carbohydrates.
- Ocean - 2nd largest Carbon sink. Dissolved inorganic carbon - stored at depth. The surface layer holds large amount of dissolved carbon that is rapidly exchanged with the atmosphere.
- CO<sub>2</sub> - GHG, traps heat in the atmosphere.  
↳ w/o it & other GHGs, Earth would be a frozen world.  
↳ Most abundant anthropogenic GHG.
- It's a imp. element present in organic subs.
- By respiration & decomposition, CO<sub>2</sub> returns to the atm.  
↳ of dead OM produces CO<sub>2</sub> & N<sub>2</sub>
- Sometimes, undecomposed OM can go into peaty layers of marshy soil (bottom sediments of aquatic ecosystem) & this takes a long time to release.
- Most of the C is in short-term cycle.

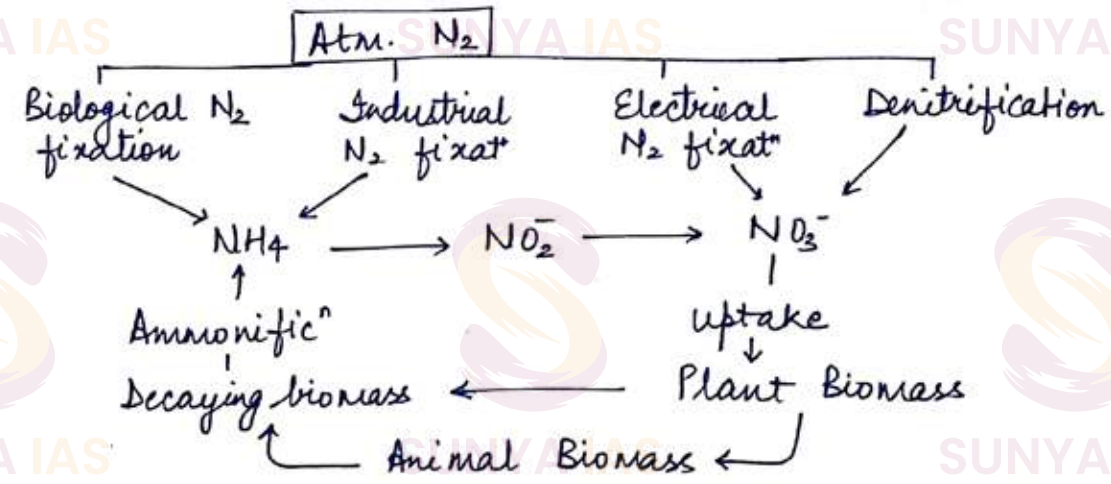


OR



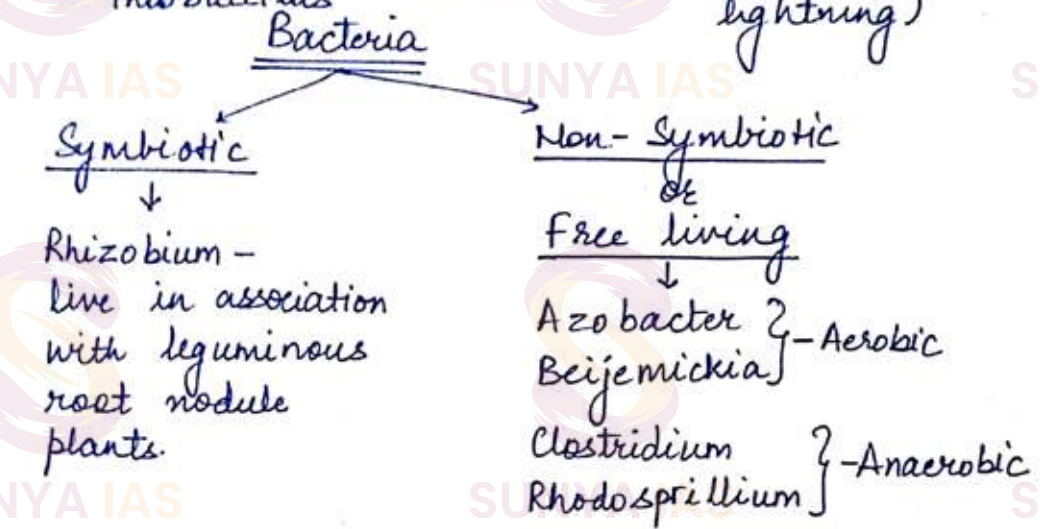
**Nitrogen Cycle.**

- \* Nitrogen Fixation
- Micro-organisms (Micro-org, Blue green <sup>Algae</sup>)
  - Atmosphere - thunderstorm, lightning
  - Industrial processes (fertilizer factories)

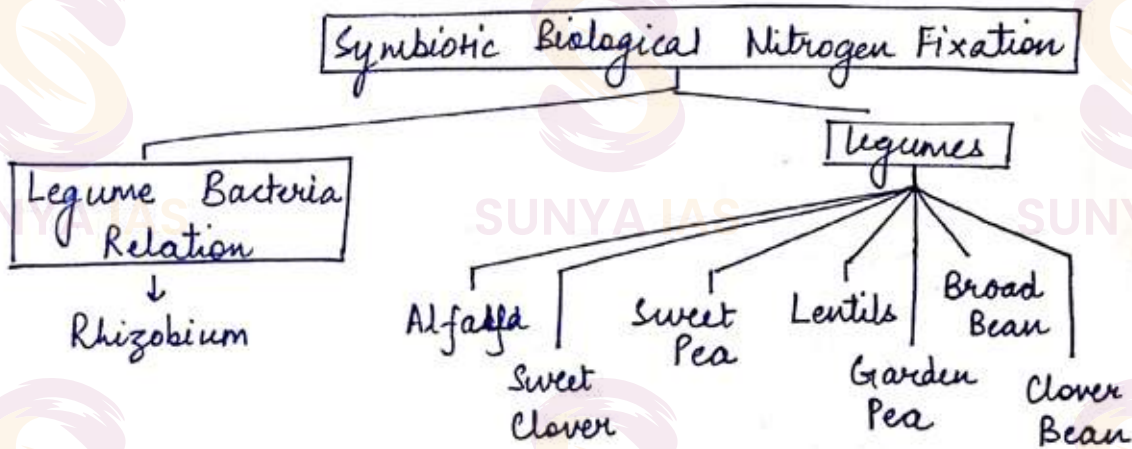


Steps:

- 1) Nitrogen fixation - 3 ways: (i) Microorganisms (bacteria, blue-green algae)
  - 2) Ammonification
  - 3) Nitrification  $\xrightarrow[\text{Nitrosomonas}]{\text{Nitrite}}$  Nitrite
  - 4) Denitrification  $\xrightarrow[\text{Nitrobacter}]{\text{Nitrate}}$  Nitrate
- (ii) Industrial processes (fertilizer factories)  
 (iii) Atm. (thunder/lightning)



- Cyanobacteria, blue-green algae (Nostoc, Anabaena, Spirulina) - major sources of N fixing in oceans.



\* Eutrophication - nutrient enrichment like Nitrogen & Phosphorus → leads to abundance of algae.

\* Abundant atm.  $N_2 = 78\%$ . But this is not useful. It has to be converted to useful form.

Methane Cycle

- Methane is the main constituent of natural gas. It is odourless, colourless and tasteless. + lighter than air.
- Sources of emission of Methane - Methanotrophs, landfills, digestive process of termites, methanogens,

paddy cultivation, livestock rearing, wetlands, burn the biomass, digestive process in animals - Enteric fermentation, permafrost melting, decomposition of animal waste & biological matter

→ When methane burns in air, it has a blue flame.

→ Methane is a short lived climate pollutant. It lives in the atm. from 10 to 20 years.

→ Methane is a GHG.

→ The global warming potential of methane is 84 times than CO<sub>2</sub>.

\* Wetlands provide a suitable habitat to methanogens & contribute to abt 80% to global methane emissions from natural sources.

→ Methane emissions from man-made sources :- landfills, waste water treatment, burning of biomass, fossil fuels, agriculture, livestock & paddy cultivat<sup>n</sup>.

\* Global Carbon Project

\* In Ruminants, there are 4 stages to Methane production.

- occurs in mouth 1. Hydrolysis - polymers convert to monomers such as sugars, fatty acids when then travels into acidogenesis process.
- occurs in 4 gas chambers 2. Acidogenesis - Monomers converts to alcohols. Eg- fermentation in flour gas chambers.
- 3. Acetogenesis - alcohols transforms to acetate in the rumen, which produce methane as by product.
- 4. Methanogenesis - acetate transforms to methane which creates CO<sub>2</sub> as by-product.

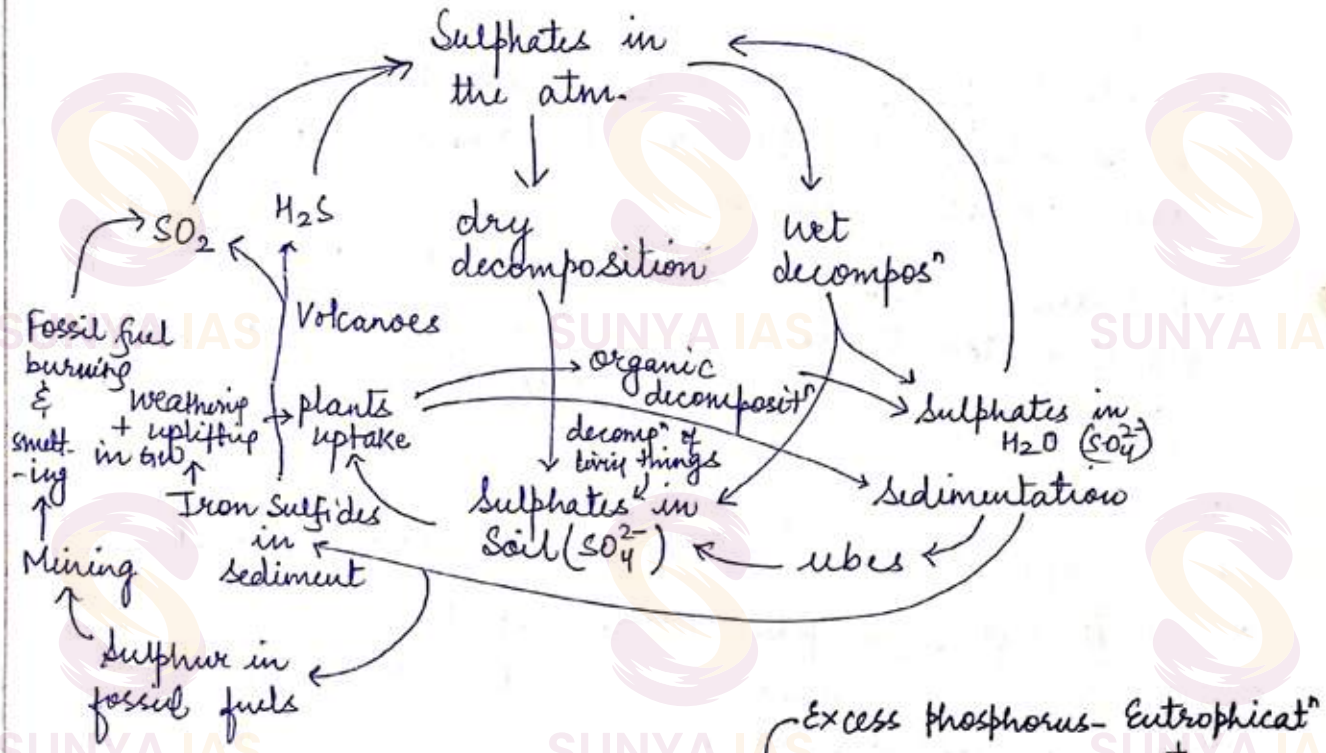
Sulphur Cycle

→ imp for functioning of proteins & enzymes in plants & animals that depend upon plants for Sulphur.

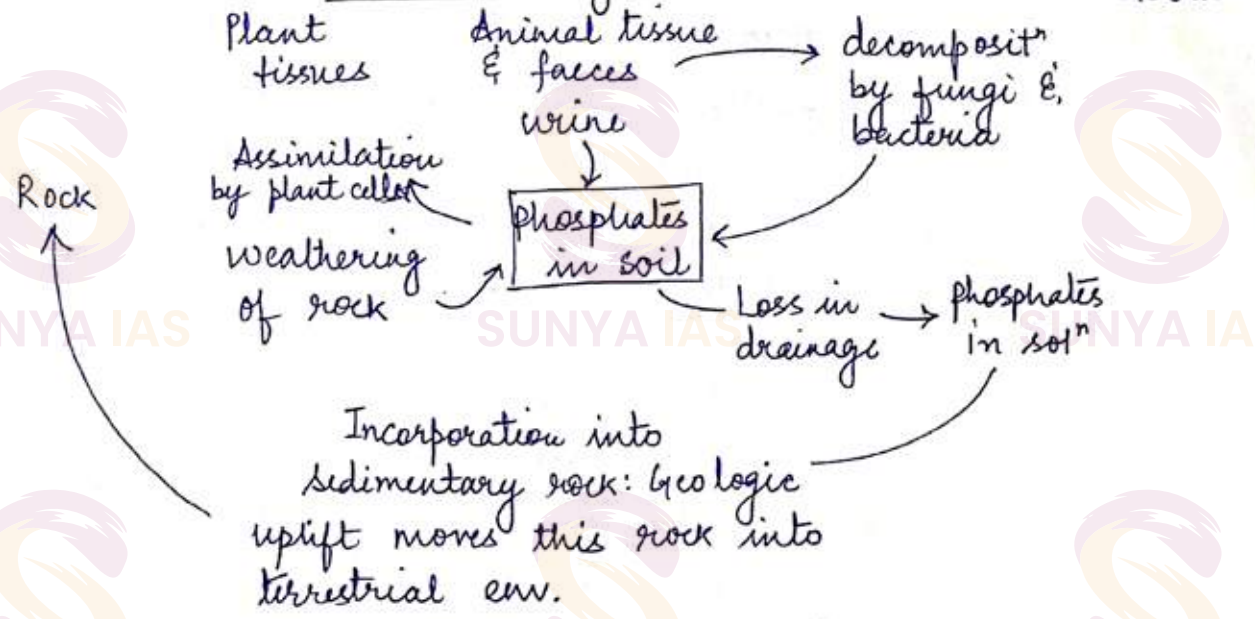
- Plants absorb sulphur & when it is dissolved in H<sub>2</sub>O.
- Animals consume these plants.

→ Most of the Earth's sulphur is tied up in rocks & salts or buried deep in ocean in oceanic sediments.

- Also found in atmosphere, in the form of  $SO_2$  which enters the atm. in 3 ways:-
  - decomposition of organic molecules
  - volcanic activity & geothermal vents
  - burning of fossil fuels by humans.
- on land, Sulphur is deposited in 4 major ways: precipitation, direct fall out, from the atmosphere, rock weathering & geothermal vents.



Phosphorus Cycle



- Major component of nucleic acids & phospholipids.
- limiting nutrient (necessary for growth) in aquatic, esp. freshwater ecosystems.

1. In the case of which of the following biogeochemical cycles, weathering of rocks is the main source of release of nutrients to enter the cycle?

- a) Carbon cycle
- b) Nitrogen cycle
- c) Phosphorus cycle
- d) Sulphur cycle.

2. Certain species of which one of the following organisms are well known as cultivators of fungi?

- a) Ant
- b) Cockroach
- c) Crab
- d) Spider

3. Human activities in the recent past have caused the increased concentration of  $\text{CO}_2$  in the atm., but a lot of it does not remain in the lower atm becoz of

- a) Its escape into the outer stratosphere.
- b) The photosynthesis by phytoplankton in the oceans.
- c) Trapping of air in the polar ice caps.

Which of the following statements are correct?

- (i) a and b
- (ii) b only
- (iii) b and c
- (iv) c only

4. Which of the following adds/add  $\text{CO}_2$  to the carbon cycle on planet Earth?

- 1. Volcanic action ✓
- 2. Respiration ✓
- 3. Photosynthesis
- 4. Decay of OM ✓

Select the correct code.

- a) 1 and 3 only
- b) 2 only
- c) 1, 2 and 4 only
- d) 1, 2, 3 and 4

5. Which of the following adds/add nitrogen to the soil?

- 1. Excretion of urea by animals.

2. Burning of coal by man
3. Death of Vegetation

Select the correct answer:

- a) 1 only
- b) 2 and 3 only
- c) 1 and 3 only
- d) 1, 2 and 3.

6. Consider the following -

1.  $CO_2$
2. Oxides of Nitrogen
3. Oxides of Sulphur

Which of the above is/are the emission/emissions from coal combustion at thermal power plants?

- a) 1 only
- b) 2 and 3 only
- c) 1 and 3 only
- d) 1, 2 and 3

7. What can be the impact of excessive/inappropriate use of nitrogenous fertilizers in agriculture?

1. Proliferation of nitrogen-fixing microbes in soil can occur.  $\times$
2. Inc. in acidity of soil can take place.
3. Leaching of nitrate to the groundwater can occur.

Select the correct answer.

- a) 1 and 3 only
- b) 2 only
- c) 2 and 3 only
- d) 1, 2 and 3.

8. Which of the foll. are nitrogen fixing plants?

1. Alfalfa
2. Amaranth
3. Chickpea
4. Clover ~~5~~
5. Purslane (Kulfa)
6. Spinach  $\times$

Select the correct ans.

- a) 1, 3 and 4 only
- b) 1, 3, 5 & 6 only
- c) 2, 4, 5 and 6 only
- d) 1, 2, 4, 5 and 6



**FOR OTHER SUBJECT NOTES, DROP US  
A WHATSAPP ON 9311077443**

## **Lecture - 4 (Territorial Ecosystem)**

**REVISE ENTIRE  
PRELIMS  
SYLLABUS**

**THROUGH  
3000+MCQS**



**Modern History**  
(400+ MCQs)



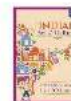
**Indian Polity**  
(400+ MCQs)



**Geography**  
(300+ MCQs)



**Indian Economy**  
(400+ MCQs)



**Art & Culture**  
(200+ MCQs)



**Environment &  
Ecology**  
(400+ MCQs)



**Ancient and  
Medieval History**  
(200+ MCQs)



**Current Affairs**  
(700+ MCQs)



**Science &  
Technology**  
(200+ MCQs)

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Topics

- Economics of Ecosystem Services
- Ecosystem related Terms
- Types of Ecosystem
- Terrestrial Ecosystem
- Diff. Biomes

Nitrogen Cycle

→ Nitrification: Ammonia to nitrates

↳ is essential in agricultural system + also plays a very imp. role in the removal of Nitrogen from Municipal waste water

↳ Ammonium ions oxidised to nitrate by Nitrosomonas Nitrococcus bacteria.

↳ Nitrite to Nitrate by Nitrobacter (Chemoautotrophs)

↳ Plants absorb these nitrates & convert them into amino acids.

→ Ammonification: urea, uric acid to ammonia

↳ living org. produce nitrogenous waste products like urea & uric acid.

↳ These waste products & dead remains of organisms are converted back into inorganic ammonia & ammonium ions by bacteria by ammonification.

→ Denitrification: Nitrate to Nitrogen

↳ The process of reducing nitrate in the soil to nitrogen is called denitrification.

↳ Soil & oceans have denitrifying bacteria like Pseudomonas & Thiobacillus which convert nitrate/nitrites to elemental nitrogen.

↳ Nitrogen is released into atm. completing the cycle.

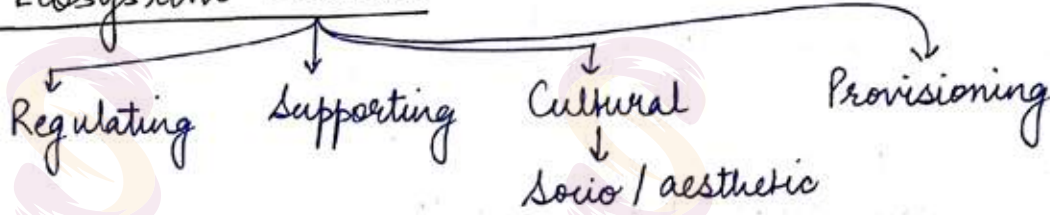
\* Excess nitrogen can lead to - Eutrophication

- Algal blooms

- Acid rain ( $SO_x$ ,  $NO_x$ )

Sulphur Cycle

- Sulphur is a reservoir found in the soil & in the sediments.
- Found in:
  - organic components - oil, coal
  - inorganic components - pyrite rock
- Acid rain
- DMS - Dimethyl Sulphide surface of Sulphur can also enter from oceans & forms DMS.

Ecosystem ServicesAccounting of Ecosystem ServicesTEEB - The Economics of Ecosystems & Biodiversity

- TEEB was a study led by Pavan Sukhdev from 2007 to 2011. It is an international initiative to draw attention to the global economic benefits of biodiversity.
- Its obj. is to highlight the growing cost of biodiv. loss & ecosystem degradation & to draw together expertise from the fields of sci, eco & policy to enable practical actions.
- It is a global initiative focussed on 'making nature's values visible'. Its principal obj is to mainstream the values of biodiversity & ecosystem services into decision-making at all levels.

IPBES

- IPBES is an independent intergovernmental body estd. by 134 states to strengthen the science-policy interface for biodiversity & ecosystem

services for the conservation & sustainable use of biodiversity, long term human well being & sustainable dev.

- It is NOT a UN body.
  - However, at the request of the IPBES Plenary & with the authorization of the UNEP Governing Council in 2013, the UNEP provides secretariat services to IPBES.
  - Work of IPBES - grouped into 4 complementary areas:
    - a) Assessments
    - b) Policy support
    - c) Building capacity & knowledge
    - d) Communication & outreach.
- \* IPBES = Intergovernmental Science-Policy Platform on Biodiversity & Ecosystem Services  
Sci. & Policy for People & Nature  
HQ = Bonn, Germany

### WAVES

- It is a World Bank led global partnership that aims to promote sustainable dev. by ensuring that natural resources are mainstreamed in development planning & national economic accounts.
- WAVES is now part of broader World Bank umbrella initiative, the Global Program for Sustainability (GPS).
- WAVES are launched at 2010 Convention on Biological Diversity meeting in Nagoya, Japan.

### ELD = The Economics of Land Degradation

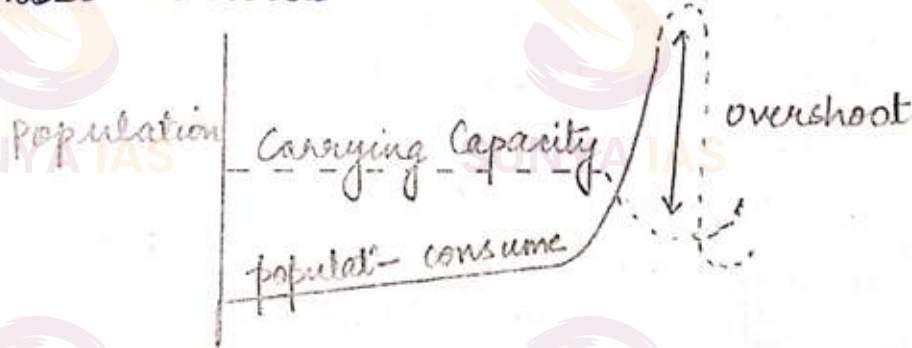
- Global initiative for Sustainable Land Management
- The partners' vision of ELD initiative is to transform global understanding of the value of land & create awareness of the economic case for sustainable land management that prevents loss of natural capital, secures livelihoods,

preserves ecosystem services, combat climate change & addresses food, energy & water security & to create capacity for the utilisation of economic info. for sustainable land management.

- Publishes State of Finance for Nature. - 2022; Nature is the essential algorithm for the future of humanity, yet significantly underfinanced. It is time to act by doubling investment in nature-based sol<sup>n</sup> by 2025 & eliminating nature-negative finance flows.

Biotic Potential - Max rate at which a population can inc. when resources are unlimited & env. cond<sup>n</sup> are ideal.

Carrying Capacity - max. no. of individuals of a given species that an areas resources can sustain indefinitely w/o significantly depleting those resources.



\* Global Footprint Network

\* 2023 - Earth Overshoot Day - July 28

Gaia Hypothesis - Earth is a complex living entity, with the sustenance of life dependent on the self-regulating interactions among organisms & their inorganic surroundings.

↳ Earth is more than just a home. It's a living system & we are part of it.

Ecological Footprint - resource accounting tool which measures how fast we consume

resources & produce waste in comparison to how fast nature generate new resources & absorb our waste. It is the only metric that measures nature we humans have & how much nature we use.

Q) The term '6<sup>th</sup> mass extinction / 6<sup>th</sup> extinction' is often mentioned in news in context of -

- a. Widespread monoculture practices in agriculture & large scale commercial farming with indiscriminate use of chemicals in many parts of the world that may result in loss of good native ecosystems.
- b. Fears of possible collision of a meteorite with the Earth in the near future in the manner it happened 65 million years ago that caused the mass extinction of many species including those of dinosaurs.
- c. Large scale cultivation of GM crops in many parts of the world & promoting their cultivation in other parts of the world which may cause disappearance of good native crop plants & the loss of food biodiv.
- d. Mankind's over-exploitation / misuse of natural resources, fragmentation / loss of natural habitats, destruction of ecosystems, pollution & global climate change.

\* We are in the midst of a 6<sup>th</sup> mass extinction. Approx 75% of the species inhabiting Earth will go extinct.

→ Anthropocene epoch

### Carbon vs Ecological Footprint

#### Carbon Footprint

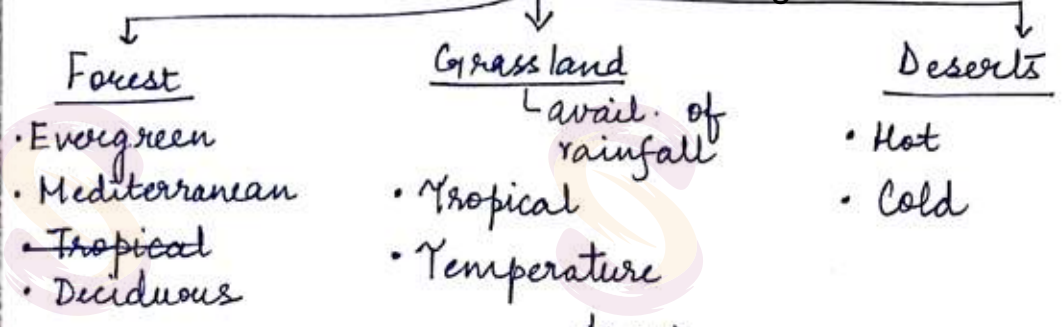
- Measures CO<sub>2</sub> generated by activities.
- Only includes carbon emission numbers.
- Can be used for Carbon credit marketplace.
- Directly impacts climate change.

#### Ecological Footprint

- Measures renewable & non-renewable resources.
- Includes both carbon emissions & env. impact.
- Used to gauge global consumption.
- Directly impacts continuing life on Earth.

# Natural Vegetation

Telegram Channel: t.me/sunyanotes50



→ Evergreen - these species <sup>do not</sup> have a particular season for shedding. They shed leaves throughout the yr.

→ Deciduous - They have a specific season for shedding.

→ Mediterranean - vineyard of the world  
 - has lot of ~~st~~ citrus fruits (vetc)  
 - <sup>additional</sup> small winter rainfall

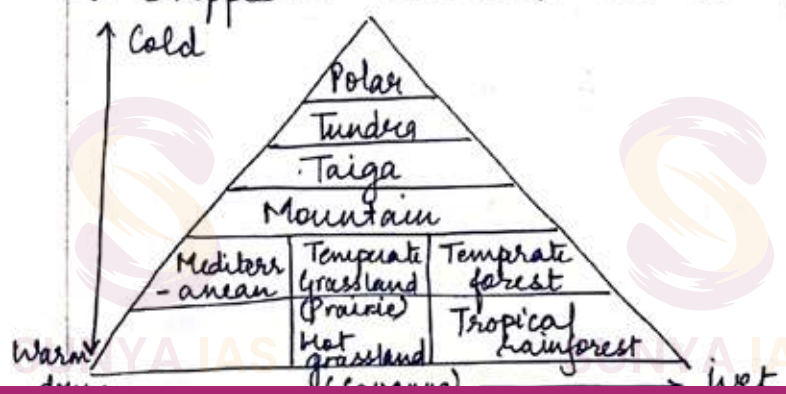
## The main biomes in the world

- Ice sheet & polar desert
- Mixed & deciduous forest
- Savannas
- Tundra
- Taiga
- Tropical rainforest
- Desert
- Steppe
- Mediterranean vegetation
- Montane (alpine tundra & montane forest)

→ Around the tropics, max. biodiversity

→ Tropics to poles - biodiv. decreases. (latitudinal)

→ Steppes - nomad, herds, grasslands



	Equatorial, Polar, or Mid-latitude	"Precipitation" (High, Low, Seasonal)	Avg. Temp. (High, Low, Seasonal)	Eg- Animal & Plant Adaptation
Tropical Desert	Equatorial	Low	High	Coyote, Kangaroo rat
Temperate Desert	Mid-latitude	Low	Seasonal	African elephants
Polar d.	Polar	Low	Low	Polar bear, wildflowers
Tropical grasslands	Equatorial	Seasonal	High	Owls, grass
Temperate grasslands	Mid-latitude	Low	Seasonal	Bison, perennial forbs
Polar grasslands	Polar	Low	High	Arctic hares, shrubs
Chaparral	Mid-latitude	Low	Seasonal	Cacti, rabbits
Tropical rainforest	Equatorial	Low	High	Kapok tree, mosquitoes
Deciduous forest	Mid-latitude	High	Seasonal	Oaks, prunrose
Coniferous forest (Taiga)	Polar	Seasonal	Seasonal	Beavers, trees
Temperate rainforest	Mid-latitude	High	Seasonal	Elk
Mountains	Mid-latitude	Seasonal	Low	Mt. lion

### Tundra

→ Tundra means 'barren land'

→ Tundra ecosystems are treeless regions where env. cond<sup>n</sup> are very severe.

→ Precipitation: Scanty rainfall, ppt is mainly in the form of snow.

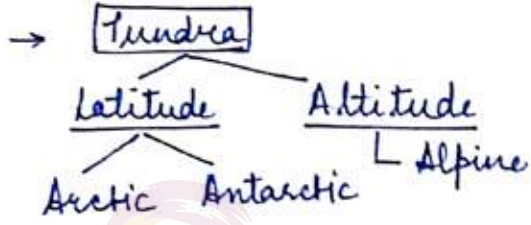
→ Soil: permafrost / soil that remains frozen all year round. scarce of nutrients.

→ Low biotic diversity

→ There are diff. types of Tundra - 3:

- (i) Arctic tundra (ii) Antarctic tundra (iii) Alpine tundra





### → Arctic Tundra

- Distribution - Continuous belt below polar ice cap & above tree line in the northern hemisphere. In Southern hemi, it is limited to some parts of Antarctica & Falkland island.
- Eg - Alaska, Canada, Russia, Greenland, Iceland, Scandinavia.
- Flora - Mosses, lichens, sedges, cotton grass, dwarf heath, willows, birches.
- Fauna - Arctic foxes, polar bear, caribou, musk-ox.

### → Alpine Tundra

- Distribution - any latitude in high altitude area.
  - Eg - The Himalayas, the Alps, Tibetan plateau, The Caucasus, Mt, American Cordillera.
  - Flora - Mosses, sedges, liverworts, grassy vegetation.
  - Fauna - Pikas, marmots, mt. goat, reindeer, musk ox, arctic hare, caribous, lemmings & squirrel.
- Reptiles & amphibians are almost absent.  
↳ crocodile    ↳ frog
- Animals & plants protected by thick cuticle & epidermal hair. Animals have long life.
- Allen's Rule - Mammals that have large body size & small tail & ears to minimise the heat loss.

### Taiga

- Cold regions with high rainfall, strong seasonal climates with long winters & short summers are characterised by boreal coniferous forest.
- Evergreen plant species - spruce fir, pine trees etc.

→ Animals - lynx, wolf, bear, red fox, porcupine, squirrel;  
Amphibians - Hyla, Rana.

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→ Boreal forest soils - thin podzols, poor ∵ weathering of rocks proceeds slowly in cold env. + litter derived from conifer needle (leaf) is decomposed very slowly & is not rich in nutrients.

Acidic soils, mineral deficient. Productivity & community stability of boreal forests are lower than those of any other forest ecosystems.

→ There are no boreal forests in Southern Hemisphere.

→ Distribution - great continuous belt across North America, Europe & Asia. Absent in South ∵ of narrowness of southern continents in high altitudes.

→ Abiotic Components -

- well defined seasons - prolonged bitterly cold winter, short cool summer. Presence of local winds like blizzards of Canada & Buran of Eurasia.

- Precipitation - well distributed throughout the year

- Soil type - podzolized soil (acidic, excessively leached & mineral deficient)

→ Biotic Components

- Natural veget<sup>n</sup>/flora - conifers, evergreen, conical in shape, thick, leathery & needle shaped leaves.

- Eg - pine, fir, spruce, larch

- fauna - ~~my~~ mink, silver fox, lynx, wolf.

## Temperate

→ Broad leaved trees, which shed their leaves in autumn & grow new foliage in autumn.

→ Classification - Temperate Deciduous (Northern hemi)  
- Temperate Evergreen (Mediterranean)  
- Temperate Rainforest (in both hemis, coastal region)

→ Distribution - in mid-latitude areas, b/w polar region

(grade into boreal forest) and tropics (grade into Tropical rainforest)

→ found in both northern & southern hemi.

→ Abiotic Components - moist, warm summer & frosty or rainy winter.

- presence of distinct seasons

- Soil type - Alfisol or brown forest soil.

→ Biotic Component

• Flora - broadleaf trees (oaks, maples, beeches), shrubs, perennial herbs, mosses.

• Fauna - Squirrels, marsupials, brown bear, bats, rodents.

birch, poplar

Tropical Rainforest - Max. biodiv.

→ Most luxuriant with diverse array of communities & makes up one of the earth's largest biome.

→ Distribut<sup>n</sup> - wet tropical uplands & lowlands around the equator.

→ Abiotic Comp.

- High humidity & temp<sup>r</sup> (~uniform)

- Precipitation > 200cm, evenly distributed throughout the year.

- Soil type - Red latosol (high rate of leaching makes it agriculturally useless, but can rejuvenate with nutrients when left undistributed)

→ Biotic Components formed due to decomposition, compensate for the natural poverty of soil.

- Flora: diverse angiosperms, few gymnosperms.

Liverworts, creepers, ferns, mosses, lichens, algae.

- Presence of dense upper canopy & thick undergrowth.

- Fauna: monkeys, rhinos, insects, birds.

→ Importance of Rainforest

- Amazon known as lungs of the world

- Carbon sinks: store a lot of Carbon so helps to sequester climate change

- Provide abundant  $O_2$
- A lot of bio div. : flora & fauna
- Abundant precipitation
- Helps in regulating micro-climate
- They are source to many rivers Eg- Amazon, Mekong
- Influence climate
- Source of timber & non-timber forest products
- Commercial agr. : plantations of cocoa, coffee, palm.
- Socio-cultural / aesthetic services
- Ppl / tribes dependent on these.



Emergent layer  
Canopy  
understorey  
shrub layer  
Ground Layer

→ Epiphytes - commensalism - Epiphytes benefit w/o troubling the host.

Eg- climbers, <sup>only</sup> take support of the bigger trees

→ Extreme dense vegetation of tropical rainforest remains vertically stratified with tall trees often covered with vines, creepers, lianas, epiphytic orchids & bromeliads.

→ The lowest layer is an understorey of trees, shrubs, herbs, like ferns & palms.

→ Soils: red latosols, thick [High rate of leaching]

→ undergrowth is restricted by lack of sunlight at ground level.

→ Evergreen trees - mahogany, Ebony, mangroves (in coastal)

→ Threats to the rainforests:

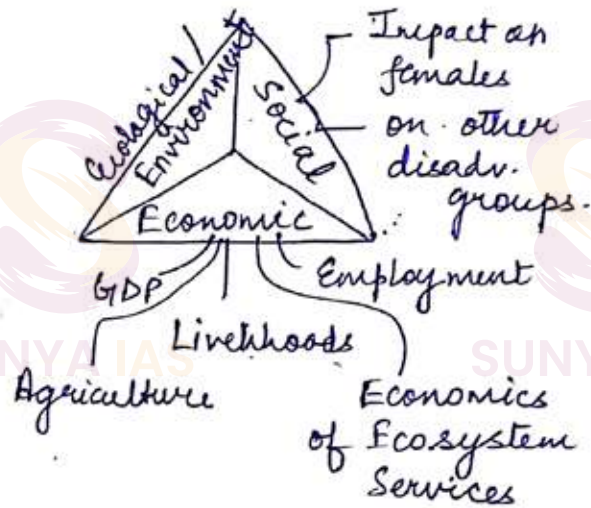
- Rampant deforestation
- Unplanned urbanisation
- Global warming & climate change
- Forest fires.

- Agricultural practices like slash & burn [Thinning & shifting in N-E], plantation.
- Population explosion
- Unplanned urbanisation

→ Effects

- Soil degradation
- Prey/ Predator dies
- No perennial source of river
- Ppl who are dependent
- Droughts/ Famines

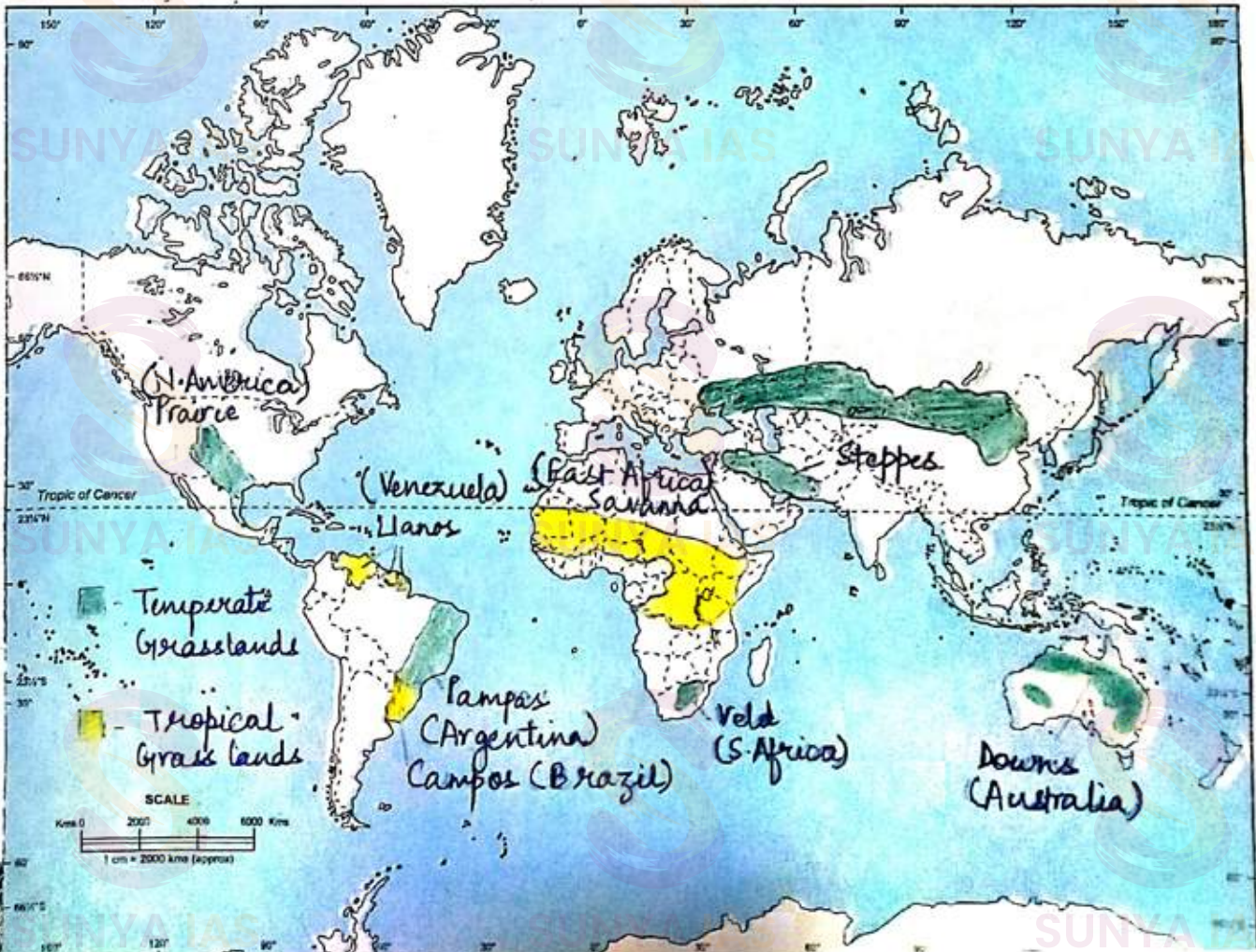
- Social - sacred plants
- religious values
  - migration
  - females
    - marginalisation
    - Eco-feminism



Grassland { Tropical  
Temperate

**WORLD - POLITICAL**

संसार - राजनैतिक



## Tropical Grassland

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- Distribution: transitional b/w equatorial forests & trade wind hot deserts.  
Eg- Savanna of Africa, Campos of Brazilian highland, Llanos of Orinoco basin.
- Abiotic Comp.: Alternate hot rainy season & cool dry season.
  - Local wind - Harmattan in Guinea coast.
  - Soil - Alfisols & Ultisols
- Biotic: Flora:- tall elephant grass & short trees that has long roots & H<sub>2</sub>O storing devices. Eg- Baobabs & bottle trees.  
Fauna:- Grass eating herbivores & flesh eating carnivores.

## Temperate Grassland

- They are practically treeless & grasses are much shorter.
- Do not have much animal diversity.
- Major diff. b/w steppes & savanna is that all the forage in the steppe is provided only during the brief wet season whereas in savanna - forage is largely from grasses that not only grow during wet season but also from the smaller amt of regrowth in the dry season.
- Steppe formation occupy large areas of sandy & saline soil; in western Raj, where the climate is semi-arid, avg. rainfall is < 200mm a yr with dry season of 10 to 11 months & a large variation in rainfall.
- Distribution: in interiors of continents, away from maritime influence.  
Eg Prairies of N. America, Pampas of Argentina, Downs of Australia etc.
- Abiotic Comp.: Continental climate, not severe in the Southern Hemisphere.
  - Local wind: Chinook in Canada & America, Föhn in Switzerland
  - Soil: Chernozem soil

→ Biotic Comp. : Flora :- Short steppe type of grass, practically treeless [used for extensive wheat cultivation]

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Fauna :- domesticated animals - cattle, sheep, pig

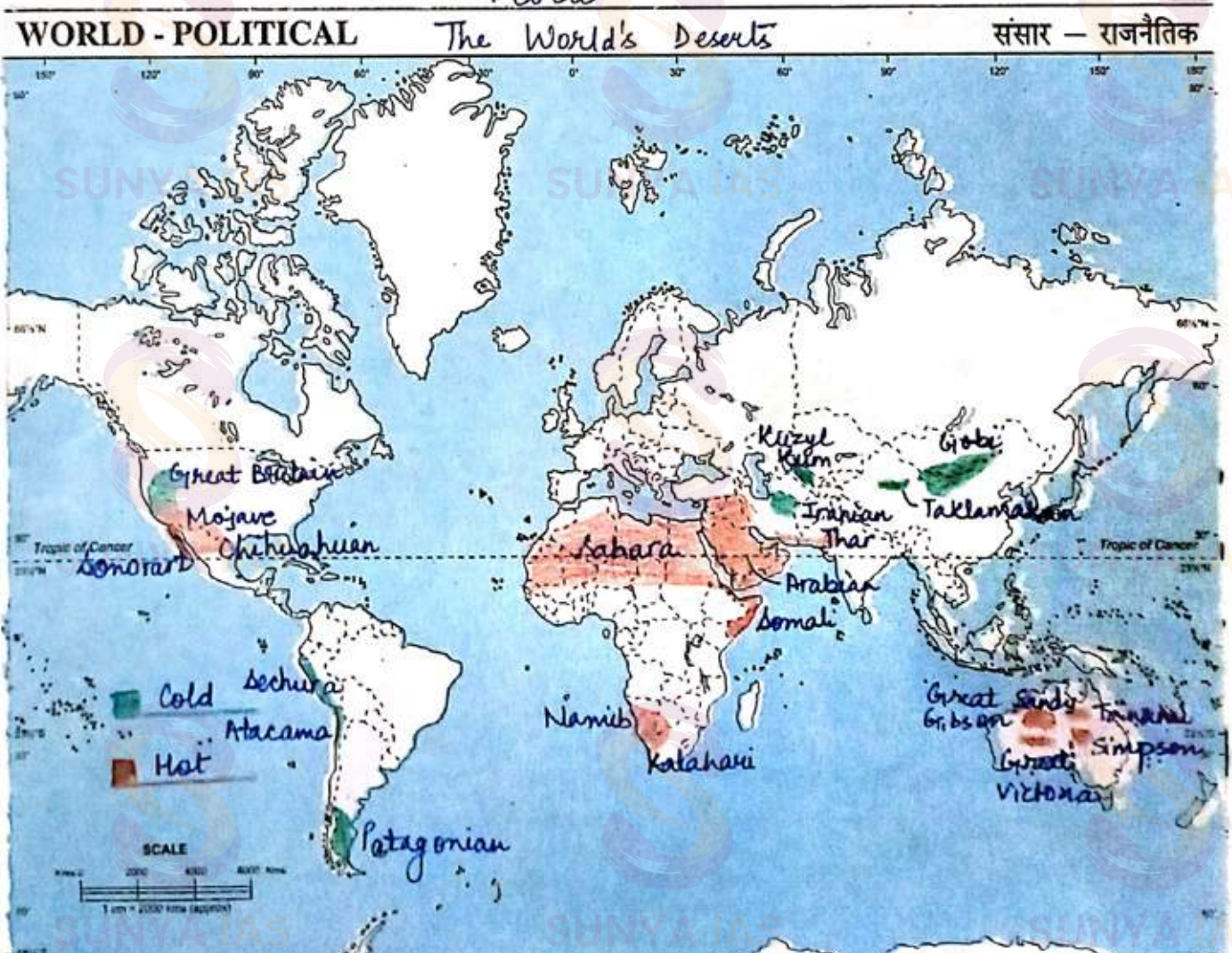
**Steppe**

- Temperate grassland
- Grasses are fresh & nutritious.

**Savanna**

- tropical grassland
- More rain so tall grass. + deciduous trees Eg- Acacias.
- Trees have broad trunk & water storing devices
- More animal diversity
- Many trees are umbrella shaped so a small portion is exposed to strong winds.

The World's Deserts - Hot - Margin Interior Cold

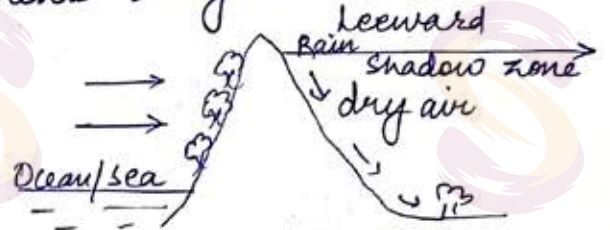


→ Eg- Desert Box wood, Desert Cypress, Desert Palm Bush  
Desert Thorn, Desert Green Bush, Desert Grass.

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## Factors leading to the formation of Desert:

1. Offshore areas of trade wind & falling under the rain shadow area.
2. Anti-cyclonic cond<sup>n</sup>: Area b/w  $20^{\circ}$ - $30^{\circ}$  latitude on western margins of continents are regions of descending air.
3. Formation of rain shadow zone
4. Presence of cold ocean currents along the western coast of continents.



## Hot desert (Margins)

→ Distribution: western coasts of continents b/w  $15^{\circ}$  and  $30^{\circ}$  N & S (lie in the region of Horse latitudes).

→ Abiotic Comp.

- Extreme diurnal range of temp<sup>r</sup>. < 25cm of <sup>annual</sup> rainfall.
- Soil - saline, sandy with low  $H_2O$  holding capacity.

→ Biotic Comp.

- Flora - xerophytic or drought resistant scrub, date palms, acacia etc.
- Fauna - diverse array of reptiles, marsupials, mammals [camels, hedgehog, Hyenas].

## Hot desert (Interiors)

→ Distribution: Located interior of the continent, sheltered by high mt. all around them.

→ Abiotic Comp.: Annual range of temp<sup>r</sup> is much greater than that of hot deserts. Continentality accounts for these extremes in temp<sup>r</sup> [severe winter with cold wind]

→ Biotic Comp.:  
• Flora:- Alpine mesophytic, grasses, bushes, shrubs, trees like junipers, birch.  
• Fauna:- Bactrian camel, Asiatic ibex, snow leopard, Tibetan wolf, Tibetan wild ass (kiang).



- Overgrazing
- Deforestation
- Farming practices
  - Slash & burn agr. exposes state to soil erosion hazards
  - Heavy tilling & over irrigation disturbs mineral composition of soil.
- Urbanisation
- Climate Change - exacerbate desertification through alteration of spatial & temporal patterns in temp<sup>r</sup>, rainfall, solar radiation & winds.
- Overexploitation of resources - inc. demand for land resources due to issues like overpopulation leaves & land vulnerable to desertification.

### Natural Causes :-

- Natural Disasters - Floods, droughts, landslides result into → soil erosion, displacement of fertile soil.
- Water erosion - results into Badland Topography which is initial stage of desertification.
- Wind erosion - sand incroachment by wind reduces fertility of soil making the land susceptible to desertification.

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## Lecture - 5 to 7 (Aquatic Ecosystem)

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**Most Probable  
Questions**



**Evaluation with  
in 24-48 hrs**



**Quality Model  
Answers**

Q) Which of the following is/ are unique characteristic/s of equatorial forests?

- 1) Presence of tall, closely set trees with crowns forming a continuous canopy.
- 2) Coexistence of a large no. of species.
- 3) Presence of numerous varieties of epiphytes.

Select the correct answer using the code:

- a) 1 only
- b) 2 and 3 only
- c) 1 and 3 only
- d) 1, 2 and 3

Q) 'Each day is more or less the same, the morning is clear & bright with a sea breeze; as the sun climbs high in the sky, heat mounts up, dark clouds form, then rain comes with thunder & lightning. But the rain is soon over.'

Which of the following regions is described in the above passage?

- (a) Savannah
- (b) Equatorial
- (c) Monsoon
- (d) Mediterranean

Q) 'Climate is extreme, rainfall is scanty & the people used to be nomadic herders' (2013)

The above statement best describes which of the foll. region

- (a) African Savannah
- (b) Central Asian Steppe
- (c) North American Prairie
- (d) Siberian Tundra

Q) Which of the following leaf modifications occur/ occurs in desert areas to inhibit water loss?

- 1) Hard & waxy leaves
- 2) Tiny leaves or no leaves
- 3) Thorns instead of leaves

Select the correct answer using the codes given:

- (a) 1 and 2 only
- (b) 2 only
- (c) 1 and 3 only
- (d) 1, 2 and 3.

Q) The vegetation of Savannah consists of grassland with scattered small trees. The forest development in such areas is generally kept in check by one or more or a combination of some cond<sup>n</sup>.

Which of these are such cond<sup>n</sup>?

1. Burrowing animals & termites
2. Fire
3. Grazing herbivores
4. Seasonal rainfall ✓
5. Soil properties

Select the correct answer:

- (a) 1 and 2
- (b) 4 and 5
- (c) 2, 3 and 4
- (d) 1, 3 and 5

Mediterranean / Biome / Climate / Scrub

✓ Unique for its distinctive seasonal patterns: wet, mild winters & hot, dry summers. This biome primarily exists in 5 regions: the Mediterranean Basin, California, Central Chile, the Western Cape of South Africa & Southwestern Australia.

✓ Climate & Physical features:

1. Temperature - mild, wet winters & hot, dry summers
2. Precipitation - varies, but most rain falls during the

- winter months, with summers often being drought prone.
- ✓ Flora (Plant life): good for citrus fruits (Vitis) - Orchards
1. Adaptations: plants have evolved to survive long dry spells. Many are sclerophyllous (hard-leaved) & drought-resistant.
  2. Species: incl. cork oak, olive trees & shrubs like rosemary & lavender. Grasses go dormant during dry summer months.
  3. Fire-resistance - Many plants, such as chaparral shrubs in California, have adapted to freq. fires. Some even require fire for their seeds to germinate.
- ✓ Fauna (Animal life):
1. Adaptations: Animals here have adapted to the hot, dry summers & variable food availability.
  2. Species: includes creatures like Iberian lynx, California mountain lions & various reptiles & birds adapted to open, shrubby environment.
- ✓ Biodiversity Hot spot:
- Despite covering < 2% of surface, it houses approx. 20% of world's known plant species.
  - This rich biodiversity is under threat due to human activities, making conservation efforts crucial.
- ✓ Human impact & conservation:
- Agriculture: <sup>soil</sup> Supported agriculture, esp. vineyards & olive orchards.
  - Urbanisation: Rapid urban expansion, esp. in regions like California, has fragmented habitats.
  - Conservation: Efforts are underway to protect this biome, from setting up protected areas to restoring habitats & promoting sustainable agricultural practices.
- ✓ Ecological Significance:
- Carbon Sequestration: The forests & vegetat<sup>n</sup> play a role in capturing CO<sub>2</sub>, thus helping in climate regulation.
  - Soil conservation: Vegetation, esp. deep seated rooted trees, prevent soil erosion & maintain soil health.
  - Water Regulation: vital role in water catchment, providing freshwater resource for many regions of the delicate balance of ecosystems & the need to champion conservation efforts.

Case Study

Background: The Atacama Desert in Chile - one of the driest places on Earth. Despite its harsh cond<sup>n</sup>, it's rich in mineral resources like Cu & lithium.

Exploitation: There's been extensive mining activity in the Atacama, driven by global demand for batteries (lithium) & electronics (Copper).

Environmental Consequences:

1. Water use: Mining consumes vast amt of  $H_2O$  in a region where it's already scarce. This affects local communities & the fragile ecosystem.
2. Pollution: Mining can lead to soil & water contamination, impacting both human health & local wildlife.
3. Landscape orientation: Open-pit mining can drastically change the desert landscape, leading to erosion & habitat destruction.

\* Lithium Triangle - Bolivia, Argentina, Chile

\* The mining activities in NE part of India which is very much detrimental to biodiversity.

Cold Desert

- ✓ Arid habitat with annual rainfall  $< 25\text{cm}$ .
- ✓ They have temperate climate with scorching summers & chilly winters becoz they are situated at a high latitude in the interior of continent.
- ✓ Here, weather & soil are not suitable for plant growth. Hence, land is bereft of vegetation except for isolated, scattered & overgrazed herbaceous shrubs.
- ✓ The grazing period  $< 3-4$  months & it is mainly during hot season only.
- ✓ It generally occurs in Ladakh, Leh & Kargil areas of Kashmir & the spiti valley of Himachal Pradesh.

### ✓ Characteristics:

- Temp  $< 0^{\circ}\text{C}$  - which prevents plants from absorbing water.
- Due to extremely dry atmosphere & low mean annual rainfall ( $< 400\text{mm}$ ), the area has a desert-like characteristic.
- Snowfall is heavy & occurs b/w late November & early April.
- Wind erosion is more common.
- Soil is sandy to sandy loam & neutral to slight alkaline in nature.
- Soil has poor Organic Matter & low water retention capacity.
- The growing period is narrow which is mostly during summer season.

### Seabuck thorn

- ✓ It's a shrub that produces an orange-yellow coloured edible berry.
- ✓ In India, it is found to have above the tree line in Himalayan region, gen. in dry areas, such as cold deserts of Ladakh & Spiti.
- ✓ In Himachal P., it's locally called chharma & grows in the wild in Lahaul & Spiti & parts of Kinnaur.
- ✓ In Himachal P., Ladakh, Uttarakhand, Sikkim & Arunachal P.
- ✓ Benefits:-

1. Ecological benefits - prevents soil erosion, supports biodiversity & offers an ecological alternative to dying willow trees in Lahaul valley. Thriving in dry regions, it's crucial for areas with reduced Himalayan glacier water flow.

2. Medicinal benefits - traditionally used for various ailments, seabuckthorn offers vitamins, carotenoids & omega acids, aiding high-altitude acclimatization.

3. Economical Benefits: Seabuckthorn's commercial potential lies in products like juices & jams & as a source of fuelwood & fodder, though sustainable cultivation, like in China, is essential for industry demand.

### Snow Leopard Conservation

- Background - Snow leopard is an elusive & endangered big cat native to the mountainous regions of Central & South Asia, including Ladakh region of India.
- Human-Animal Conflict - As local communities expand their agricultural activities & livestock numbers, snow leopards occasionally prey on domesticated animals, leading to conflict.
- Conservation efforts - Several initiatives have been launched to conserve snow leopard in Ladakh. These include:
  - a) Community-based conservation programs that involve locals in monitoring snow leopard movement & numbers.
  - b) Compensation schemes for livestock losses to reduce retaliatory killings of the big cats.
- Promoting ecotourism, which boosts local economies while increasing awareness & appreciation for the snow leopard.

### World's Famous Cold desert - Antarctica

- Antarctica holds about 90% of world's freshwater ice. Its melting has dire implications for global sea levels.
- Due to global warming, Antarctica has been losing ice at an accelerating rate. The melting of this ice contributes to rising sea levels, which can

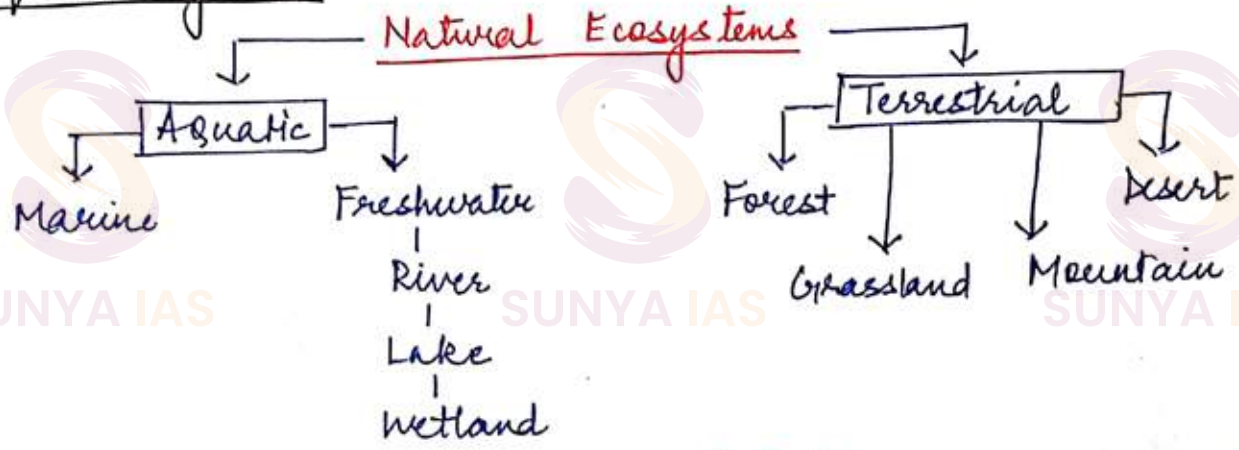


inundate coastal areas around the world.

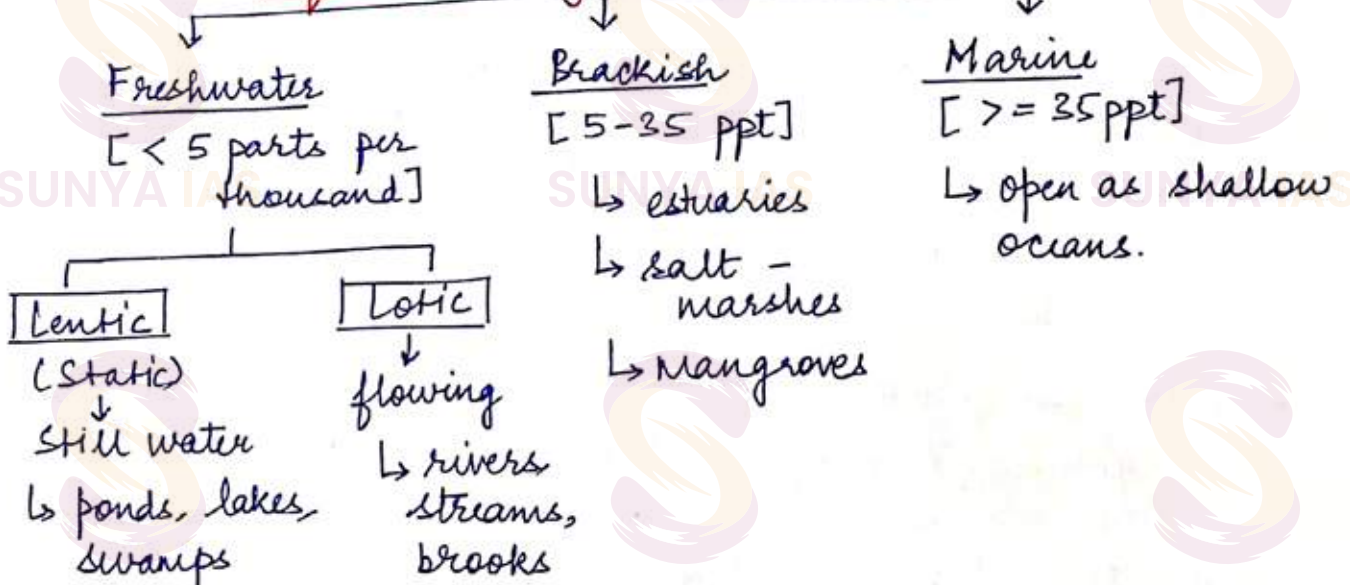
→ Impact -

- a) A rise in sea levels means that coastal cities, many of which are major global hubs, are at risk of flooding.
- b) The changing water levels & temp<sup>r</sup> affect marine ecosystems, incl. Krill populations, which many marine species in Antarctica rely upon.

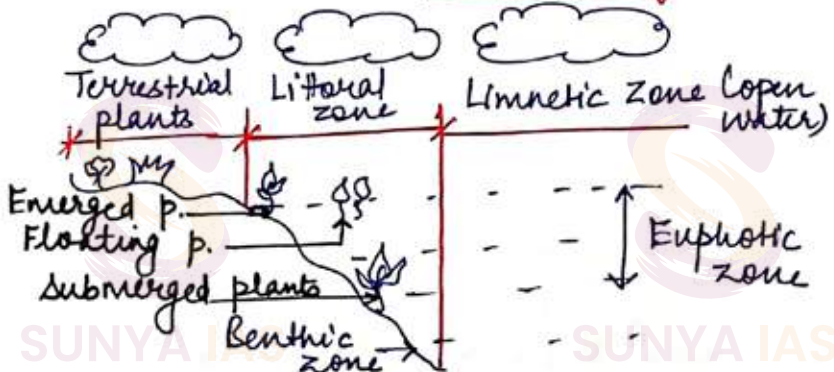
Aquatic Systems



Aquatic Ecosystem - Salinity

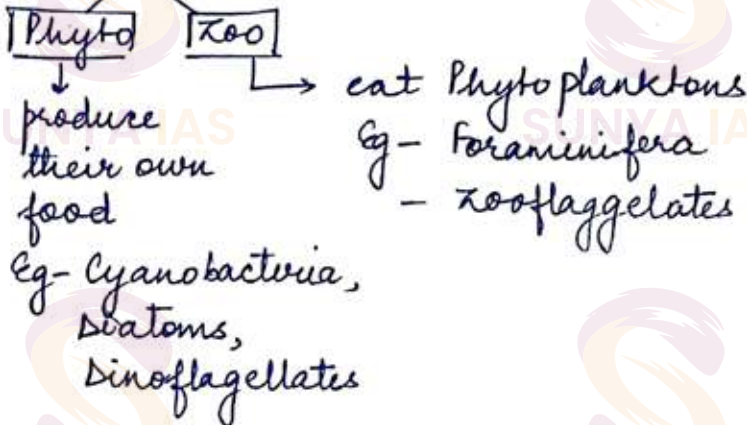


Productivity



Photic Zone: Light available  
Aphotic Zone: No light  
Benthic Zone: Bottom most region of the area

- Benthos in Benthic zone - living in bottom of water mass.
- Nekton - like fish, turtle; powerful swimmers that can overcome water currents
- Plankton - marine microscopic organisms - floating



- Neuston - These are unattached organisms present at air-water interface.
- Peri-phyton - attached organisms - to stems & leaves of rooted plants or substances emerging above bottom mud

### Factors affecting productivity

1. Sunlight - affects photosynthesis which affects productivity.
  2. Photic zone
  3. Aphotic zone
  4. Dissolved oxygen (DO)
  5. Temperature.
- Turbidity limits the extent of light penetration & overall photosynthetic activity.

\* Photic Zone - The depth of this zone depends on transparency of water. Photosynthetic activity is done in this region.

Both photosynthesis & respiration takes place in this region.

\* Aphotic Zone - Profundal Zone

No photosynthesis happens here.

Only respiration takes place here.

\* DO - In freshwater ecosystem, the DO concentration is 10ppm by weight. Oxygen is less soluble in water.

of decomposers. When the  $DO$  level falls below 3-5 ppm, the organisms will die. Rate of depletion of Oxygen is directly proportional to the temp<sup>r</sup>.  
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\* water based animals have low ecological amplitude [with - stand small range of temp<sup>r</sup>] compared to land based animals.

\* Winter kill - An icelayer at the top of water body can effectively cut off light. Photosynthesis stops but respiration continues in such water body. If the water body is shallow,  $O_2$  gets depleted & the fish die.

### The Great Oxygenation Event

→ Around 2.4 billion years ago, Earth's atmosphere & shallow seas saw a significant inc. in Oxygen levels, known as the Great Oxygenation Event (GOE).

→ Role of Phytoplankton - Cyanobacteria, responsible. By conducting photosynthesis, they released Oxygen as a by-product. As these bacteria became abundant, the amount of oxygen they released significantly changed the planet's atmosphere & its chemistry.

→ Impact - Sudden inc. in Oxygen caused extinction of many anaerobic organisms. But it also paved the way for the evolution of aerobic org., eventually leading to diverse life we see today.

\* Phytoplankton - microscopic org. that live in both salty & fresh watery env. Some ~~are~~ are bacteria & some are protists & most are single-celled org. Eg - Cyanobacteria, silica-coated diatoms, dino flagellates (Noctiluca), green algae & chalk-coated coccolithophores.

Cladocera is a zooplankton & Pistia is a floating plant.  
↳ Neuston

### Bio-luminescence

This is a bluish glow which you can see in the night. Eg - in beaches of Juhu.

This is caused due to phytoplankton called Noctiluca

Scintillans (a dinoflagellates).

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- Microscopic plants like algae are phytoplanktons becoz these are primary producers.
- Animals like crustaceans & protozoans are zooplanktons.
- The locomotory power of planktons is limited. Nektons are able to overcome water currents but planktons' distribution is controlled by currents.

### Sea Cow / Dugongs

- Herbivorous marine animals that feed primarily on seagrass meadows.
- Threats: In India, along Gulf of Mannar & Andaman & Nicobar islands, dugongs face threats from boat strikes, entanglement in fishing nets & habitat degradation. The loss of seagrass meadows, due to pollution & coastal dev., is especially detrimental to their survival.
- Conservation Efforts - India has recognised dugongs as a protected species, & efforts are underway to conserve their habitats & raise awareness abt their plight.

### Sea Horse

- Tiny fish named for the shape of their head, which looks like the head of a tiny horse. They are classified as fish, in the genus Hippocampus.
- There are 46 species of seahorse reported worldwide. Coastal ecosystems of India house 9 out of 12 species found in Indo-Pacific.
- They are found in shallow coastal waters in latitudes from abt  $52^{\circ}\text{N}$  to  $45^{\circ}\text{S}$ .
- The male gives birth to child as the female uses an ovipositor (egg duct) to place her eggs into a brood pouch located at the base of male's tail where the eggs are later fertilised.

Sea Weed - Cryptogams

- They are the primitive, marine non-flowering marine algae w/o root, stem & leaves, play a major role in marine ecosystem.
- Large seaweeds form dense underwater forests known as kelp forests, which act as underwater nurseries for fish, snails & sea urchins.
- Some species of sea weeds - Gelidium acerosa, Gracilaria edulis, Gracilaria crassa, Gracilaria verrucosa, Sargassum spp. and Turbinaria spp.

Benefits

1. Nutrition - Seaweeds are nutrient rich, offering vitamins, minerals & fiber while being delicious
2. Medicinal purpose - Seaweeds have anti-inflammatory & anti-microbial properties & potential cancer-fighting agents.
3. Economic Growth - Seaweeds boost economies as binding agents in products like toothpaste & as softeners in cosmetics.
4. Bioindicator - Seaweeds absorb excess nutrients, signalling & mitigating marine chemical damage.
5. Iron sequester - Seaweeds capture excess iron & other heavy metals, safeguarding marine ecosystems.
6. Oxygen & Nutrient Supplier - Through photosynthesis, seaweeds provide  $O_2$  and organic nutrients to marine life.

Seagrass

- These are flowering plants that grow submerged in shallow marine waters like bays & lagoons.
- These have tiny flowers & strap-like or oval leaves.
- Seagrass beds support thousands of marine species, store carbon, improve water quality, protect coastlines, cycle nutrients & create habitat corridors b/w coral reefs & mangroves.
- Support biodiversity + provides diverse food, shelter +

## Seaweed (vs) Seagrass

### Basis

	<u>Seaweed</u>	<u>Seagrass</u>
1. Definition	Microalga.	Marine flowering plant.
2. Kingdom	Protista	Plantae
3. Vascular Tissue	Non-vascular algae	Vascular plant
4. True stem, root & leaves.	Lacks true stems, roots & leaves.	Has true stems, roots & leaves.
5. Flowers	Not produce flowers.	Produce flowers.
6. Seeds	Not produce seeds.	Produce seeds
7. Fruits	No fruits	Produces fruits.

### Threats faced by Seagrass

#### Natural

- Storms
- excessive grazing
- too much of drying off.

#### Man-made

- Eutrophication
- overfishing

→ The distribution of sea grasses is impacted by the turbidity. The depth to which sea grasses are found is limited by turbidity.

→ These are ecosystem engineers

→ Sea weeds can help reduce algal blooms.

→ Many heavy metals found in marine ecosystem are removed by seaweeds. (Bio-Remediation)

→ Ocean Macro Algal Afforestation - If seaweeds exhibit highest photosynthetic efficiency (50% of photosynthesis of the world). Seaweed farming helps in ~~to~~ ocean macro algal afforestation.

→ Sea weed can be used to produce biomethane by anaerobic processes. They can be used as fertilizer in aquaculture. They help to combat coastal erosion.

### Challenges to Seaweed

- 1) Labour shortages
- 2) Lack of incentives bcoz forward & backward linkages are missing. So, infra. needs to be updated.
- 3) Lack of awareness
- 4) Lack of technology
- 5) Overexploitation
- 6) Risky project
- 7) Lack of livelihood security

### Sea Cucumber

- Marine invertebrates that live on the seafloor found generally in tropical regions.
- crucial to maintain the balance of ocean habitats.
- In 2020, Lakshadweep islands administration created the world's 1st conservation area - 239 sq. Km - for sea cucumbers.

### Kelp - Microalgae

- Kelp forests are underwater ecosystems formed in shallow water by dense growth of several different species known as kelps.
- Threats: climate change, which warms the oceans & disrupts the habitats kelps thrive in. + Inc. in sea urchins (due to decline in their natural predators) can decimate kelp forests.
- Importance - coastal protection, biodiv. support, carbon sequestration.

Keystone species → Sea Otter

↳ feed on Sea urchins → feed on Kelp

### Pollutants & Trophic levels

- Pollutants, esp. non-biodegradable ones move through the various trophic levels in an ecosystem.

→ Non-biodegradable pollutants mean materials which cannot be metabolised by the living organisms.

Ex- Chlorinated Hydrocarbons.

→ Most of these non-biodegradable pollutant involves

2 main processes:

- a) Bioaccumulation
- b) Bio-magnification

Ganges River Dolphin - Bio indicator species

→ It is native to the freshwater river systems in the Ganges - Brahmaputra - Meghna & Karnaphuli - Sangu river systems of Nepal, India and Bangladesh.

→ Threats - water pollution, accidental by-catch in fishing nets, & reduced water flow due to dams & irrigation projects.

→ Conservation Efforts - Recognising their endangered status, efforts like the establishment of protected areas & awareness campaigns have been initiated to save these freshwater mammals.

Bioaccumulation - refers to how pollutants (metals) enter a food chain & relates to the accumulation of contaminants, in biological tissues by aquatic organisms, from sources such as water, food & particles of suspended sediment.

Biomagnification - across diff. trophic levels.

Eg- Magnification of  $\frac{\text{DDT}}{\text{PoP}}$  concentration

→ For biomagnification, a pollutant must be:

- a) long lived
- b) mobile
- c) soluble in fats
- d) biologically active



→ Bioaccumulation is the process by which toxins enter the food web by building up in individual organisms, while biomagnification is the process by which toxins are passed from one trophic level to the next (inc. in conc<sup>n</sup>) within a food web.

### Effects of Biomagnification

1. High concentrat<sup>n</sup> of DDT in some bird species caused failure of eggs by thinning the shells.
2. PCBs can affect the immune system, fertility, child development and possibly inc. the risk of certain cancers.
3. Mercury poisoning interferes with the nervous system development in foetuses & young children.

### Mercury in fish

- Mercury is a heavy metal that, in high concentrations, can be toxic to many organisms, including humans.
- Biomagnification - Mercury in its methylated form (methyl mercury) can be absorbed by small aquatic organisms, which are then consumed by bigger fish. As we go up the food chain, the conc<sup>n</sup> of mercury incr. This is biomagnification.
- Human impact - When humans consume fish that are high up the food chain, like tuna or swordfish, they are ingesting higher concentrat<sup>n</sup> of mercury, which can have detrimental health effects, esp. on nervous system.

Topics

- Eutrophication
- Algal bloom
- Sea Snot in Turkey
- Marine Plastic Pollution
- Wetlands
- Mangroves
- Coral reefs

Eutrophication

- water body overly enriched with nutrients, leading to plant life growth.
- Nitrates & phosphates leached into water bodies from fertilizers, industrial waste, sewage etc., resulting in algal bloom.
- Nutrient enrichment of the lakes promotes the growth of algae, aquatic plants & various fauna. This is natural eutrophication.

$$* DO \propto \frac{1}{BOD}$$

\* Hypoxia  $\longrightarrow$  Dead zone  
 less DO

\* Eutrophication  $\longrightarrow$  Algal Bloom  $\longrightarrow$  DO  $\downarrow$   $\longrightarrow$  Hypoxia  $\longrightarrow$  Dead Zone.

Algal Bloom

- Algal Bloom - Excessive multiplying of algae or phytoplankton due to favourable environmental cond<sup>n</sup>.
- Harmful algal bloom - When such algal bloom produces toxins, it affects marine org. thus making it difficult to breathe. Produces - diatoms, cyanobacteria, dino flagellates, filamentous algae.
- Blooms can be due to a number of reasons. 2 common causes are nutrient enrichment & warm waters.

- Mechanical disturbance
- Shading
- Clogging water & overgrowth
- Mucus & foam formation

Producing Toxins / 'Red Tides'

- Shellfish poisoning
- Direct lethal toxicity
- Ambush predation

Basis

BOD

COD

1. Definition

A measurement of consumed oxygen by aquatic microorganisms to decompose or oxidise organic matter.

Requirement of DO for oxidation of organic & inorganic constituents both.

2. Breakdown of organic matter

by aerobic microbes

by chemical reagents.

3. Complete breakdown of pollutants

does not happen

Happens

4. Breakdown materials

Organic Matter

Both organic & inorganic constituents

5. Strong oxidising reagents

No

Yes

6. Time

A few days. Approx 5 days

Takes only few hours to complete.

7. Value

< COD

> BOD

→ BOD helps you in pollution measurement in an ecosystem. However, COD is more comprehensive in

nature bcoz it covers both biodegradable & chemical pollutants where BOD covers only biodegradable pollutants.  
→ BOD indicates level of pollution in a water body.

### Harmful Algal Bloom

- Are HABs dangerous to fish and humans?
- O<sub>2</sub> levels drop, fish suffocate & die.
  - O<sub>2</sub> levels drop due to decomposition of dead algae.
  - Potent neurotoxins that are produced can enter food web thus reaching animals, fish & even humans.
  - Some toxins become airborne.
  - People tend to breathe aerosolized HAB toxins near the beach.
  - Changes in climate can change severity & impact of HAB events.

### New Report Addresses Re-eutrophication & Hypoxia in Lake Erie.

- Lake Erie, one of the Great Lakes of North America, has experienced severe eutrophication due to agricultural run off rich in Phosphorus & nitrogen as well as urban waste. This has led to toxic algal blooms that not only affect the water quality but also harm aquatic life & pose health risk to humans & animals. Despite efforts to reduce nutrient run off, the problem persists, highlighting the need for more comprehensive & collaborative approaches.

### 'Sea Snot' outbreak in Turkey

- In Turkey's Sea of Marmara, which connects Black Sea to Aegean Sea.
- Sea Snot - Marine mucilage formed when algae are overloaded with nutrients as a result of water pollution + climate change. Nutrient overload occurs when algae feast on warm weather caused by global warming.

- Concerns
- Threat to marine ecosystem - mass death of fish, corals
  - livelihood of ~~for~~ fishermen affected - break <sup>nets</sup>
  - water-borne diseases - like Cholera in Istanbul.

→ Steps Taken

- ↳ Sea of Marmara turned into protected area
- ↳ ↓ pollution + improvement. treatment of waste water
- ↳ Maritime clean-up operation

Eutrophication - Solutions

- Replacing older forms of detergents with high phosphate contents with low-phosphate detergents can help impede the flow of phosphate nutrients into streams & lakes.
- Reducing the overuse of fertiliser on lawns & farmland can reduce its impact on waterways & algae bloom.
- Increasing the size & diversity of wetlands, estuaries & riverside natural areas can help manage the run off of nutrient-rich water into streams & oceans.
- Regulating sewage treatment facilities & septic tanks can greatly reduce nutrient flow, which can result in fewer algal blooms.

Marine Plastic Pollution

- Plastic Pollution in Aquatic may triple by 2040. UNEP.
- ↳ in Water Pollution by plastics and microplastics.

1. Impact on Marine Wildlife - Hundreds of marine species suffer from ingestion, suffocation &

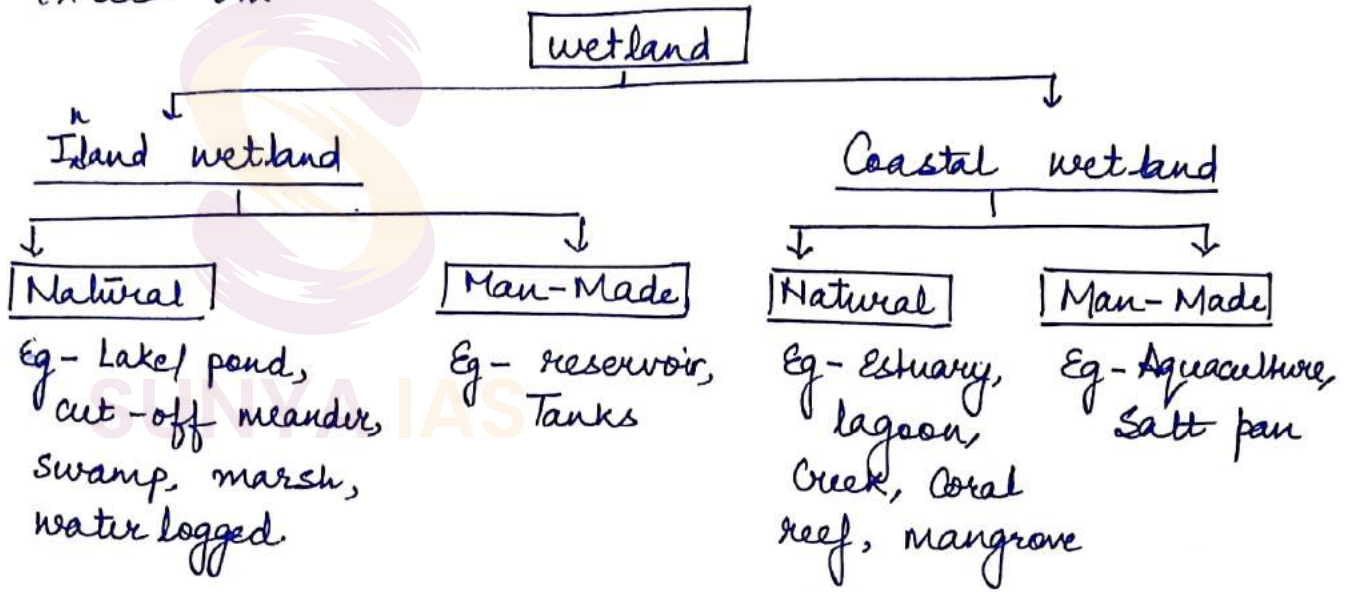
entanglement due to marine plastics, which is distressing & noticeable impact. Telegram Channel: t.me/sunnyaiaies50

2. Spread of Invasive Organisms: Floating plastics facilitate the transportation of invasive marine organism & bacteria, leading to ecosystem disruption. [Invasive Species - Water Hyacinth]   
 Terror of Bengal
3. Effect on Food & Health: Toxic substances accumulate on plastic surfaces after extended exposure to seawater. These toxins enter the digestive sys of marine org. that ingest plastic debris, ultimately accumulating throughout the food web.
4. Health Hazard: Transfer of toxins from marine species to humans via seafood consumption is health risk, although comprehensive research is still lacking.
5. Contribution to Climate Change: Being a derivative of petroleum, plastic contributes to global warming. Incinerating plastic waste releases CO<sub>2</sub>, inc. Carbon emissions.
6. Effect on Tourism: The aesthetic appeal of tourist destinations is marred by plastic waste, resulting in reduced tourism related income & significant economic costs for cleaning & maintenance.

Wetlands → 75 Ramsar sites

- Transition zones b/w deep-water & terrestrial habitats. Ex - lake littorals, marshy or ~~marshy~~ swampy areas.
- World Wetland Day - 2nd Feb. [Ramsar Conv<sup>n</sup> in Iran in 1971]
- Wetlands - areas of marsh or peatland with water that is static or flowing, fresh, brackish or saline, incl areas of marine water, the depth of which at low tide does not exceed 6m. These are transition zones (ecotone) b/w terrestrial & aquatic ecosystems.
- Ramsar Convention - defines wetland as - 'areas of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or

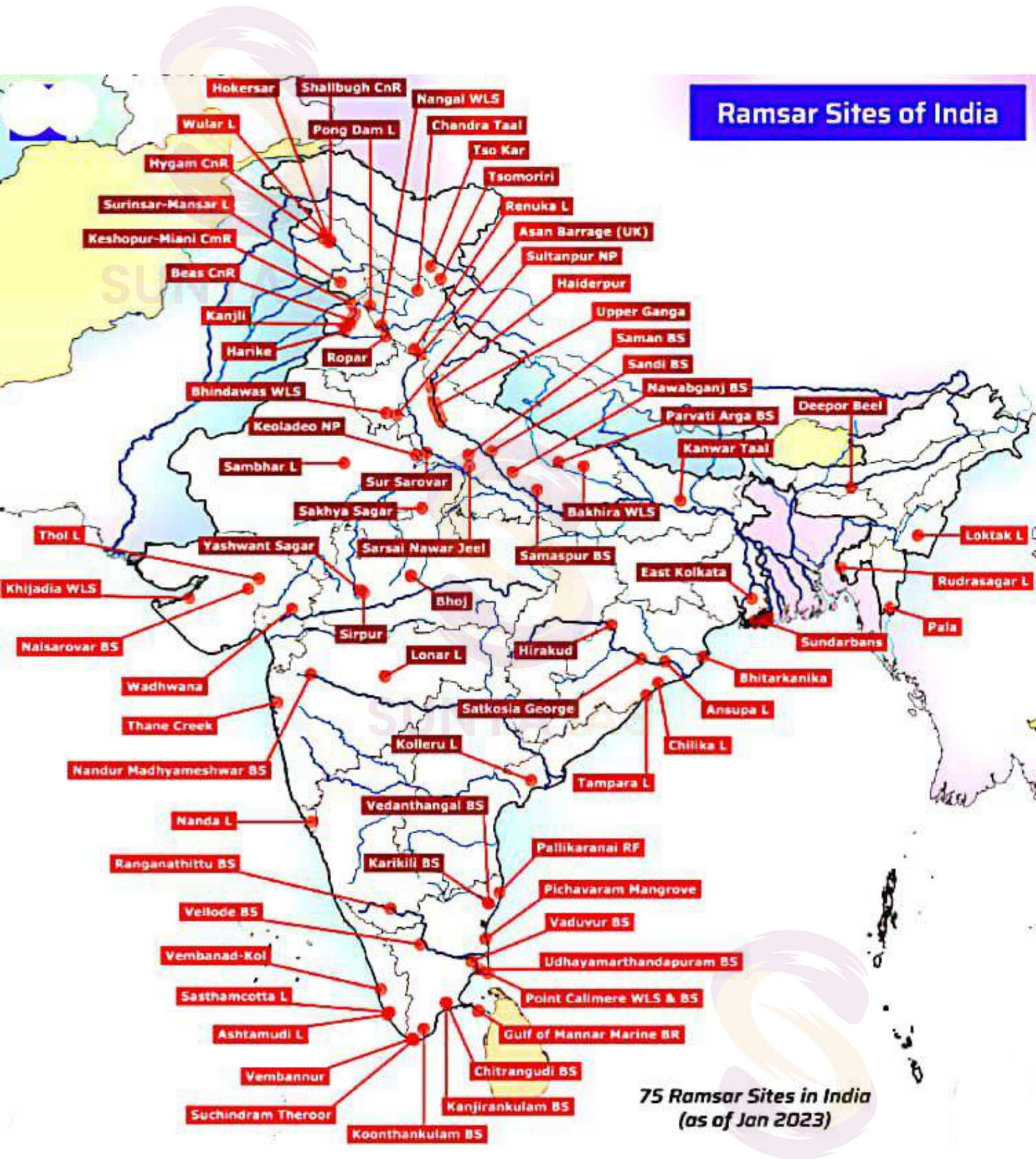
flowing, fresh, brackish or salt, incl. areas of marine water, depth of which at low tides, does not exceed 6m. Telegram Channel: t.me/sunyanotes50



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- ✓ India's longest lake & a designated Ramsar site (a wetland of international importance).
- ✓ Threats - pollution, invasive species, unsustainable sand mining. Unregulated effluents from nearby towns & industries, as well as excessive pesticides & fertilizer runoff from farms, have led to water quality deterioration.
- ✓ Ecological Impact - affected local biodiversity + livelihoods of communities relying on lake's resources.

### Benefits of Restoring Wetlands

1. Revive biodiversity - 40% of world's species live or breed in wetlands. Restoring wetlands power the local food chain & attracts wildlife.
2. Replenish & filter water supply - Wetlands naturally filter water, remove pollutants & boost local water supply.
3. Store Carbon (Blue Carbon): Specific types of wetlands, esp. peatlands, mangroves, intertidal marshes & seagrass beds are exceptionally efficient carbon sinks.
4. Blunt the impact of floods & storms - restored wetlands act as sponges agt excess rainfall & flooding, buffer coastal storm surges & can shield communities in extreme weather.
5. Improve livelihoods - in fishing & aquaculture + provide goods like reeds & grasses. These benefit indigenous popul.
6. Boost eco-tourism - sustainable magnet for visitors.
7. Enhance well-being - a place to relax, experience nature & enjoy sense of satisfaction at their resurgence.
8. For climate & biodiversity  
↳ 30% of land based carbon is stored in peatlands.

- ↳ Role in flood mitigation by controlling the rate of runoff.
- ↳ Riparian buffer aqt erosion & pollutants.
- ↳ Habitat to aquatic flora & fauna, numerous species of native & migratory birds.

9. For clean water

- ↳ Swaps & rewards remove pollutants
- ↳ Water purification, filtration of sediments, & nutrients from surface water.
- ↳ Nutrients recycling, groundwater recharging & stabilisation of local climate.

10. For jobs

- ↳ 1 billion people depend on wetlands for their livelihoods.

11. For economies

- ↳ Wetlands provide USD 47 trillion in essential services annually.
- ↳ Imp. resource for sustainable tourism.
- ↳ Genetic reservoir for various species of plants (esp. rice).

Ramsar Convention works with collaboration of the following organisations:

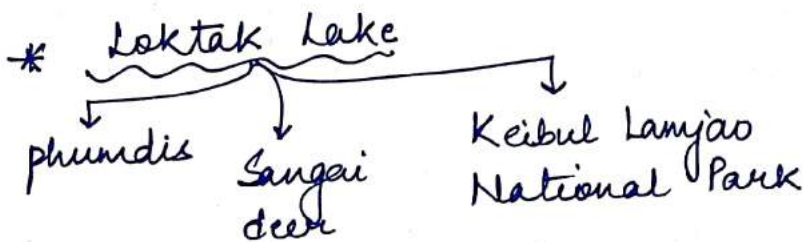
1. International Union for Conservation of Nature (IUCN)
2. Birdlife International
3. International Water Management Institute (IWMI)
4. Wetland International
5. Wildfowl & Wetlands Trust (WWT)
6. WWF International

## Montreux Record

- A register of wetland sites of international importance where changes of ecological character have occurred, are occurring or likely to occur in future due to pollution or other human interference, etc.
- Estd by Recommendation of the Conference of Contracting Parties (1990).
- Sites may be added or removed only with approval of Contracting Parties.

## Montreux Record Sites in India :

- Chilika lake, Orissa - Placed in 1993 due to choking at mouth. Removed in 2002. Won <sup>Ramsar</sup> Wetland Conservation Award for 2002.
- Loktak lake, Manipur - Placed in 1993 due to deforestation in area & pollution. Currently in Montreux Record as per 2020.
- Keoladeo National Park, Raj - Placed in 1990 due to water shortage & unbalanced grazing around. Currently in Montreux Record as per 2020.



## Keoladeo National Park - Bharatpur, Raj

- Man-made wetland developed as a duck hunting reserve by the maharaja of Bharatpur in 1850s. It was later declared as national park & WHS.
- The park hosts thousands of birds, both migratory & resident & is a key area for biodiversity.
- It showcases the importance of wetlands in supporting wildlife & maintaining ecological balance

1. Tampara lake: freshwater lake; Ganjam district, Odisha
  - Depression on ground gradually filled with rainwater from catchment flow & was called 'Tamp' by the British & subsequently called 'Tampara' by the locals.
  - Imp. habitat for vulnerable species - Cyprinus carpio, common pochard (*Aythya ferina*), and river tern (*Sterna aurantia*).
2. Habitat Reservoir - the largest earthen dam in Odisha
  - Started operating in 1957.
  - Out of 54 species, 1 is endangered, 6 Near Threatened & 21 fish species of eco. importance.
3. Ansupa Lake: largest freshwater lake of Odisha situated in Banki subdivision, Cuttack district.
  - Scenic beauty, biodiversity, natural resources
  - Oxbow lake formed by R. Mahanadi.
4. Yashwant Sagar: One of the 2 Imp. Bird Areas (IBA) in the Indore + imp. birding sites in Malwa region of MP.
  - Presently, it is mainly used for water supply to the city of Indore, + fish culture on commercial scale.
5. Chitragudi Bird Sanc.: Aka 'Chitragudi Kannonli' - located in Ramanathapuram district, Tamil N.
  - Ideal habitat for winter migratory birds.
6. Suchindram Theroor Wetland Complex: Part of Suchindram Theroor Menakudi Conservation Reserve.
  - Imp. Bird Area
  - lies at the southern tip of Central Asian flyway of migratory birds.
7. Vaduvur Bird Sanctuary: large human-made irrigation tank & shelter for migratory birds as it provides a suitable env. for food, shelter & breeding ground.

- Potential to harbour good populations of resident & wintering water birds.
8. Kanjirankulam Bird Sanctuary - Protected area near Mudukulathur Ramanathapuram district, Tamil N.
- Nesting site for several migratory heron species that roost in the prominent growth of babul trees there.
9. Thane Creek: in Maharashtra.
- There are several sources of fresh water to the creek, of which Ulhas river is the largest, followed by many drainage channels from various suburban areas of Mumbai, Navi Mumbai & Thane.
  - Declared as Thane Creek Flamingo Sanctuary.
10. Hygam Wetland Conservation Reserve: falls within river Thelum + role as a flood absorption basin, biodiversity conservation site, eco-tourism site, & livelihood security for the local communities.
- Abode to many resident & migratory bird species. It's an Imp. Bird Area (IBA).
11. Shalbugh Wetland Conservation Reserve: in Srinagar, UT of J&K.
- Abode to > 4 lakh resident & migratory birds of atleast 21 species.
  - Role in natural control, amelioration or prevention of flooding.
  - Seasonal water retention for wetlands + conservation importance downstream.

### Reason for Wetland Destruction

1. Habitat destruction
2. Overexploitation / Encroachment
3. Pollution
4. Invasive Alien Species
5. ↑ population / Changing land use pattern

1. Better policies
2. Treatment of Effluent
3. Afforestation
4. Technology- Remote sensing
5. Better governance
6. to stop the intro of alien invasive species
7. Stopping Eutrophication, pollution
8. Incl. local population.

## Amit Dharohar Scheme

- unique conservation values of wetlands incl. their optimal use of for enhancing wetlands biodiversity, carbon stock, ecotourism opportunities & income generation for local communities.
- Objectives: integrated management of such wetlands for green growth, developing nature & culture-based tourism at the sites, ~~comm~~ community stewardship for wetland based livelihood, heritage & culture, building convergence with diff. ministries & departments, state govt., research & academic institution & industrial sector, over the next 3 yrs across the country.

## Mangroves

- India holds around 3% of South Asia's mangrove population.
- Besides Sunderbans in West Bengal, the Andamans region, the Kachch & Jamnagar areas in Gujarat too have substantial mangrove cover.
- West Bengal has the highest %age of mangrove cover in India.
- Sunderbans in West Bengal is the largest mangrove forest in the world.

coastal protection, timber, pollution control, cultural values, fuelwood.

- Mangroves - Halophytes
- Salt tolerant
- evergreen trees
- ecotone

Sundarban Mangroves: largest mangrove forest in the world

- ↳ Spread across India & Bangladesh.
- ↳ protecting coastal regions from storms & cyclones.
- ↳ Faces threats from deforestation, shrimp farming, & rising sea levels due to climate change.
- ↳ Conservation efforts are ongoing to protect this vital ecosystem & the communities that depend on it.

Terrestrial Ecosystem

Sediment →  
Nutrients →

Fresh water discharge →

Mangrove Ecosystem

Shoreline protection from high wave & storm

- ← Sediment binding →
- ← Organic matter export →
- ← Storm buffering →
- ← Nutrient cycling →
- ← Habitat for diverse species →
- ← Nursing habitat for fish & invertebrates →

Marine Ecosystem

- ← Storm buffering
- ← Nutrient cycling
- ← Organic matter export
- ← Habitat for diverse species

Mangrove Adaptations

- O<sub>2</sub> diffuses through spongy tissue of pneumatophores (aerial breathing roots) to the rest of the plant.
- Salt glands in the surface layers of leaves secrete salt (salt excretors).
- Salts may accumulate in older leaves before they fall.

- ~~Pneumo~~ Pneumatophores (breathing roots) arise from the cable roots.
- Cable roots axis radiate from the trunk. Fine feeding roots grow off these radial roots & create a stable platform.
- Specialized root membranes in some mangroves prevent salt from entering their roots (salt excluders).
- Prop roots descend from trunk to provide additional support.
- Mangroves exhibit vivipary in which the seeds germinate in the tree itself.
- Stomata - regulates the opening & closing of pores, controls evapotranspiration.
- Mangroves exhibit varied morphological (shape & structure) & physiological (functions) evolutionary adaptations to survive the limiting factors - lack of  $O_2$ , high salinity & diurnal tidal inundation.
- Succulent leaves - thick leaves adapted to store  $H_2O$  & reduce evapotranspiration.
- Sunken stomata - to protect from drying winds.
- Leaves with salt-secreting glands - to flush out the excess salt.
- Aerial breathing roots called 'pneumatophores'
- vivipary
- stilt roots
- buttresses (large, wide support roots on all sides of a shallowly rooted (mangrove) tree)

Ecosystem Services - Benefits people derive from mangroves

- Wood - its density makes mangroves wood a valued source of timber & fuel.
- Livelihoods - 120 million ppl living near mangroves
- Coastal protection - Restoring mangroves for coastal defence up to 5 times more cost-effective than

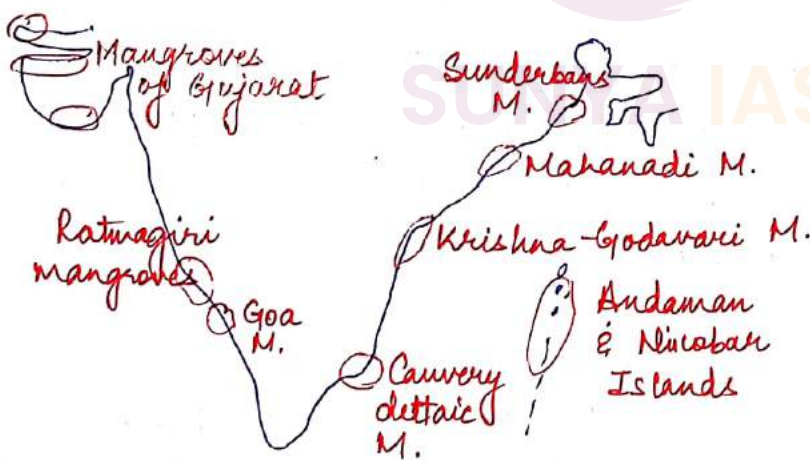


'grey infrastructure' such as breakwaters.

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- Water filtration
- Mangrove ecosystem services - Worth US \$ 33,000 - 57,000 per hectare per year × 14 million hectares = up to US \$ 800 billion per year.
- Climate regulation - Carbon storage of potential of mangroves is 3-5x higher than that of tropical upland forest due to strong carbon storage in the soil. CO<sub>2</sub> released by global mangrove loss annually could be as high as the annual emissions of Australia.
- Tourism
- Fisheries - >3000 fish species are found in mangrove ecosystem.

The State of the World's Mangroves 2022 → B/W 2010 & 2020, around 600 sq. km of mangroves were lost of which > 62% was due to direct human impacts, the Global Mangrove Alliance said in its 2022 report.



### Threats to Mangroves

1. Anthropogenic activities - Urbanisation, industrialization & the accompanying discharge of industrial effluents, domestic sewage & pesticide residues from agricultural lands threaten these fragile ecosystems.
2. Saltpan & aquaculture - cause huge damage to the mangroves. Shrimp fishing alone destroyed 35,000 hectares of mangroves worldwide.
3. Destruction for farming : 40% of mangroves on the west

Coast has been converted into farmlands & other settlements in just 3 decades.

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4. Sea-level rise - esp. on Bay of Bengal coast.

### Conservation of Mangroves

- Coastal Regulation Zone Rules
- SMART (Special Monitoring And Reporting Tool) monitoring in Sundarbans empowers local adm<sup>n</sup> contributing to a more effective management of natural resources.
- Gujarat uses direct seed sowing, raised bed plantations & fishbone channel plantations to restore degraded mangroves.
- Andhra P. has estd. Eco-Development Committees & Van Samsakshan Samithi to implement conservation projects in mangrove areas.
- Maha - implementing restoration, protection, regeneration & maintenance techniques to conserve mangroves.
- Mangroves for future initiative - to promote investment in coastal ecosystem conservation for sustainable dev. to promote an integrated ocean-wide approach to coastal management & to building the resilience of ecosystem-dependent coastal communities.

### MISHTI Scheme

- promotes dev. of 540 sq. Km mangroves across 11 states & 2 UTs.
- MISHTI - Mangrove Initiative for Shoreline Habitats & Tangible Incomes
- It envisages to comprehensively explore the possible area for dev. of Mangroves covering approx. 540 sq. Km spreading across 11 states & 2 UTs during 5 yrs commencing FY 2023-24 onwards.
- Sharing of best practices, plantation techniques, conservation measures, management practices & resources mobilization through PPP.

→ Budget states that MISHTI will be implemented through convergence b/w —  
Telegram Channel: t.me/sunyaiofs50

a) MGNREGS

b) CAMPA (Compulsatory Afforestation Fund Management & Planning Authority) Fund & other sources.

### SAIME - Sustainable Agriculture in Mangrove Ecosystem Initiative

- This initiative has been done in 30 hec in West Bengal
- Under this, they are planting mangrove trees around the shrimp pond.

### Mangrove Alliance for Climate

- India joined at COP27.
- to educate & spread awareness worldwide on the role of mangroves in curbing global warming & its potential as a 'sol' for climate change.
- An international mangrove research centre will be estd. in Indonesia.
- Aims
  - To strengthen conservation & restoration of mangrove ecosys. worldwide
  - Raise awareness abt the role of mangroves as a 'nature-based sol' to climate change.

\* Names of few varieties of mangroves — avicennia, rhizophora

### Mangroves on the

#### East Coast

- Sundarbans Δ — only mangrove forest in the world inhabited by tigers.
- Bhitarkanika, Odisha — 2nd largest in Indian subcontinent.
- K-G Δ, Andhra P. — These intertidal mud flats etc. are present in creeks.
- Mangroves of Pichavaram & vedavanyam degraded due to aquaculture, brackish water & salt intrusion.

#### West Coast

- Gulf of Kutch
- Rann of Kutch
- \* Destruction of mangroves in Kutch leads to threat to Kharai camel.
  - ↳ swim upto 3km in sea water + it survives by grazing on mangroves.

\* Telegram Channel: [sunyanotes50](https://t.me/sunyanotes50)  
region - have dev.  
tolerant breeds of  
Kharai camel -  
Kharai camel Khamarich  
& Burray buffalo.



SUNYA IAS



SUNYA IAS



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Topics

- coral reefs
- Oil pollution
- UN treaty to protect High Seas
- Marine Protected Areas

Coral Reefs

→ Symbiotic  $\left\{ \begin{array}{l} \text{coral polyp} \\ \text{zooxanthellae} \end{array} \right.$

→ Coral reefs are made up of calcareous skeletons of thousands of marine organisms - coral polyps. The polyps extract the calcium salts & they form hard skeletons.

→ Zooxanthellae live symbiotically with a coral polyps. They provide food bcoz of photosynthesis.

→ Types of polyps:

- a) Fringing reefs
- b) Barrier reefs
- c) Atolls

→ How are they formed?

Coral polyps are tiny & fleshy sea anemones that live in tropical & subtropical oceans & seas. They live in shallow waters along with microscopic algae called Zooxanthellae, with which they share a symbiotic relationship.

↳ Coral reefs are formed when the freely moving larvae of corals attach themselves to sedimentary rocks or hard surfaces near the coastlines.

→ Coral Reefs - "Cond" for growth

1. Shallow water - Surface of reef shouldn't be more than 80m from the water surface. Zooxanthellae need adequate sunlight for their photosynthesis process.
2. Semi hard @ hard surface - "precond" for compaction, cementation & solidification of the coral polyps skeletons.
3. Clear water - Beautiful coral polyps perish in areas filled with sediment filled waters. They cease to exist in opaque waters. Bcoz the presence of sediments & opaque water limits the passage of sunlight to the algae that sustains

their life.

4. Warm Water - Temp<sup>r</sup> of water must be around 20°

5. Saline-filled waters - Slight  $\&$  salt in ocean waters is extremely imp. for the dev. of coral polyps. Polyps extract Calcium from the waters to protect their skeletons. Hence, mild salinity is a necessity for coral reefs to flourish.

6. Rich supply of nutrients - So coral reefs flourish in sea waters. Coral polyps multiply faster when supplied with nutrients.

### Coral Reef Benefits $\rightarrow$ Rainforest of the Sea

1. Biodiversity - Home to a quarter of the world's marine species.

2. Food Source - Provides food to  $>$  500 million people that live near the coast. (1 billion people)

3. Tourism - provide a livelihood for millions of individuals in the tourism industry.

4. Protection - They serve as natural marine barriers that protect coastal communities from high impact waves.

5. Medicine - imp. medicinal components have been found in several marine species that inhabit coral reefs.

6. Economic Impact - Reefs generate \$ 36 billion dollars  $\&$  create millions of jobs in the tourism sector alone.

7. Natural Protection - Healthy corals protect coastlines from tsunamis, hurricane  $\&$  floods.

8. Ecosystem Services - provide nearly \$ 400 billion a year to millions of people in economic goods  $\&$  ecosystem services.

### Great Barrier Reefs

$\rightarrow$  located off the coast of Queensland, Australia, is the world's largest coral reef system.

$\rightarrow$  It is home to a diverse range of marine life  $\&$  is a major tourist attraction. However, it faces threats from

climate change, leading to coral bleaching, water pollution from agr. runoff & sewage discharge & overfishing. Telegram channel: t.me/sunyaiaotes50  
→ Various conservation efforts ongoing - reducing pollution, managing fishing activities & restoring damaged corals.

### Stages of Coral Bleaching :-

- Healthy: Corals + Zooxanthellae
  - Stress: Zooxanthellae leaves coral, it becomes toxic.
  - Bleached: Corals leave white - vulnerable to starvation, disease & death
  - Death
- \* Healthy Coral - Coral & algae depend on each other to ~~stress~~ survive.  
Corals have a symbiotic relationship with microscopic algae called zooxanthellae that live in their tissues. These algae are coral's primary food source & give them their colour.
- \* Stressed Coral - If stressed, algae leaves the coral.  
When the symbiotic relationship becomes stressed due to increased ocean temp<sup>r</sup> or pollution, the algae leave the coral's tissue.
- \* Bleached Coral - Coral is left bleached & vulnerable.  
Without the algae, the coral loses its major source of food, turns white or very pale, & is more susceptible to disease.

### What causes Coral Bleaching?

1. Change in Ocean Temp<sup>r</sup> - inc. ocean temp<sup>r</sup> caused by climate change is the leading cause of coral bleaching.
2. Runoff & Pollution - storm generated precipitation can rapidly dilute ocean water & runoff can carry pollutants - these can bleach near-shore corals.
3. Overexposure to sunlight - When temp<sup>r</sup> are high, high solar irradiance contributes to bleaching in shallow-water corals.
4. Extreme low tides - Exposure to the air during extreme low tides can cause bleaching in shallow corals.

### How Corals become Bleached?

# Measures for Coral Polyps

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1. Technological : - Bioreock technology  
- Artificial reefs  
- Satellite oceanography
2. Environment - Ban bottom trawling  
- Fishing regulation  
- Invasive species  
- Checking polluted water
3. Governance - Awareness  
- Climate action National  
International  
- Implementation of laws
4. Economic - Sustainable fishing  
- Eco tourism  
- Marine parks

## Coral Restoration

- 1) Bioreock
- 2) Cryomesh
- 3) Artificial reefs

## Bioreock Technology / Mineral Accretion Technology

- Zoological Survey of India is attempting to use this coral reef restoration which is bioreock or mineral accretion technology.
- It's a method in which low voltage electric currents are supplied through the sea water.
- It causes the dissolved minerals crystallized on the structures which then becomes a  $\text{CaCO}_3$ .
- Bioreock is the substance formed due to electro accumulation of dissolved minerals on the seafloor or in the sea water. This has strength similar to that of concrete. This helps to counter the challenges posed by global warming & climate change.

## Global Fund for Coral Reef (GFCR)

- GFCR has launched a fundraising campaign that will ~~not~~ culminate at the UN Climate Change Conference of the Parties (COP26) in Glasgow in Nov 2021.



→ Officially announced in 2020, GFCR is a 10-year, \$625 million blended finance vehicle estd. through coalition b/w UN agencies, financial institutions & private philanthropy sources.

→ Administered by UN Multi-Partner Trust Fund Office, it is the 1st UN trust fund specifically focussed on SDG14 ("Life Below Water").

SDG - 7 - Energy  
          - 13 - Climate Change  
          - 14 - Water  
          - 15 - Land

### Conservation Efforts in the Gulf of Mannar, India

→ Gulf of Mannar - b/w SE coast of India & the west coast of Sri Lanka. It is a designated Marine Biosphere Reserve & is home to a diverse range of marine species, incl. coral reefs, seagrasses & endangered species like dugong.

→ Threats: Overfishing, coral mining, pollution & habitat destruction.

→ Indian govt + local communities - Measures: Est. of Marine national parks & sanctuaries, regulation of fishing activities, promotion of sustainable fishing practices & community based conservation initiatives.

### Oil Pollution

• It is the release of crude oil or petroleum products into the environment.

• Devastating impact of on marine ecology.

• Sources:

- oil spills
- offshore drilling operation
- transportation exercises

• Impact on Env.

- Prevents incoming sunlight so reduces the productivity of lake or ocean.

- Issues in nutrient management.

- Threat to marine org. esp. planktons, thereby affecting food

chain.

- Global maritime trade routes.
- impact the coastal communities, who are dependent on fishing.
- Navigation routes will be choked.
- Crude oil has toxic subs. like polycyclic aromatic hydrocarbons, which can poison & kill marine org, disrupt the reproductive cycle.
- Cause prob. to existing coral reefs, mangroves, causing huge loss to the biodiversity.
- Biomagnification
- Economic loss

### • Tackling oil Pollution:

- Bioremediation
- There is marine pollution control cell to check for pollution in India's Exclusive Economic Zone.
- National ~~out~~ Oil Spill Disaster Contingency Plan - done to respond to the oil spills.
- Coastal Regulatory Zone Guidelines

Q) How do you clean up an oil spill?

A- Depends on - time it takes up for clean up crew to get to the site of the spill, weather cond<sup>n</sup>, type of oil, shoreline type & env. sensitivity.

- Containment & Skimming - done by mechanical means such as using booms & skimmers.

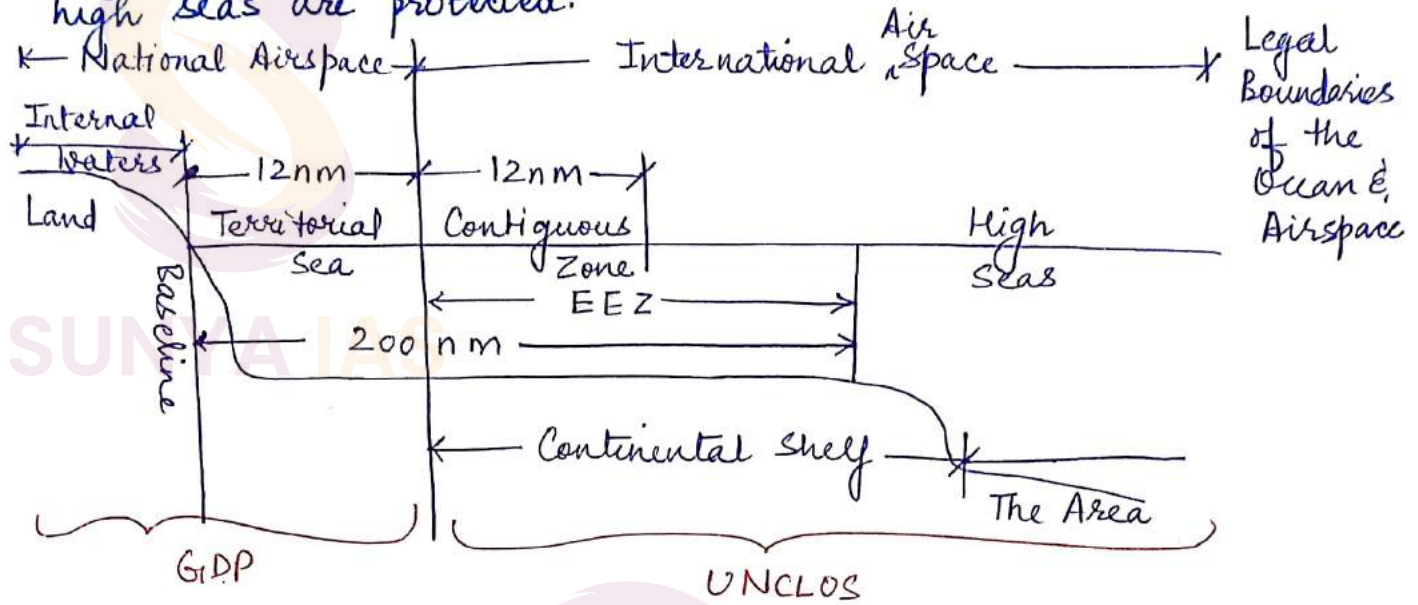
↳ are floating physical barriers that stop the oil spreading & skimmers, modified boats skim the oil off the top of the water.

- Once the oil reaches the shoreline or spreads out, it becomes harder to clean up. ↳ manual clean up campaigns are deployed to get wildlife away from the impacted area using floating dummies & balloons as a deterrent.
- However, no sol<sup>n</sup> completely removes the oil.

# UN Treaty to protect High Seas

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- They make up nearly 2/3 of the world's ocean & 95% of its vol.
- They represent 95% of Earth's occupied habitat. But < 1% of high seas are protected.



- High seas comprise 64% of ocean surface, & abt 43% of Earth.
- These areas are home to abt 2-2 million marine species & upto a trillion diff. kinds of microbes.
- Agreed under UNCLOS, this treaty is the agreement on biodiv. beyond national jurisdictions (BBNJ).
- It is an international agreement on the conservation & sustainable use of marine div.
- High Seas - hardly regulated & very less understood.
- A high ambition coalition on BBNJ was launched.
- Demarcation of Marine genetic resources & equitable sharing of benefits arising from them.
- Initiation of practice of Env. Impact Assessments for all major activities in the oceans.
- Capacity building & technology transfer.

Significance - Awareness  
Conserve  
International Cooperat<sup>n</sup>  
Coverage  
Consensus

Threats - Global Warming / Climate Change - Coral - fishing  
- Unsustainable  
- Pollution

- The 5<sup>th</sup> International Marine Protected Areas Congress IMA (IMPAC 5) - held in Canada to discuss the sol<sup>n</sup> to address the funding gap of MPAs.
- Min. of Earth Sci, GOI announced - India will support setting up 2 MPAs in Antarctica to protect marine life & its ecosystem services.

### What are MPAs?

- designated areas of the ocean that are set aside for the protection & conservation of marine ecosystem & their biodiv.
- Within the region, certain ~~low~~ activities are limited or entirely prohibited, to meet specific conservation, habitat protection, ecosystem monitoring or fisheries management objectives.
- MPAs do not necessarily exclude fishing, research or other human activities. Infact many MPAs are multipurpose areas.
- In India, 33 national parks & wildlife sanctuaries under Wildlife (Protection) Act of 1972 that make up the country's MPAs.
- MPA as defined by World Conservation Union (IUCN) as 'any area of intertidal or subtidal terrain, together with its overlying water & associated flora, fauna, historical & cultural features, which has been reserved & protected by law or other effective means to protect part or all of the enclosed env.

Benefits - Awareness, Legal Protection, Eco Community

- Challenges
- Legal definition
  - Legal protection
  - Funds
  - Research
  - Collaborative approach

## Need to establish MPAs

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- Help to conserve biodiv. esp the marine organisms.
- Help ensure sustainable fisheries
- Provide adequate livelihood & tourism opportunities contributing to GDP.
- opportunity for scientific & educational activities.
- Serve as carbon sink - store excess  $CO_2$  - helps in blue carbon & blue economy.
- Generates a lot of revenue!

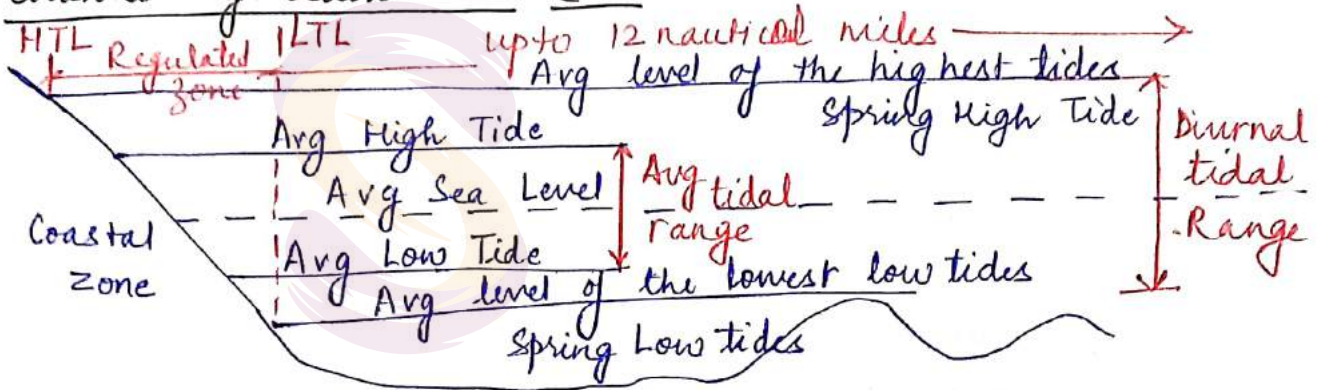


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## Coastal Regulation Zone (CRZ)



HTL - High Tide line

LTL - Low Tide line

### CRZ I

- Mangroves, coral reefs, sand dunes, mudflats, national parks, marine parks
- CRZ IA - Eco-sensitive areas
  - It is an ecological sensitive area b/w HTL and LTL.
  - No new construct<sup>n</sup> is permitted except for most essential activities like atomic power plant, defence requirement.
  - they are essential in maintaining the ecosystem of the coast.
  - Explorat<sup>n</sup> of natural gas & extraction of salt are permitted.

### CRZ II

- Areas developed up to or close to the shoreline.
- Buildings are permitted only on the landward side
- These are the urban areas located in the coastal areas. Now under new coastal zone regulations 2018, the floor space index norms have been de-frozed.

CRZ III - rural & urban areas which fall outside I & II.

- where popul<sup>n</sup> density > 2161 sq. Km as per 2011 census.
- Rural area: where popul<sup>n</sup> density < 2161 people / Km sq.
- No Dev. Zone: area upto 200m from HTL.
- Only certain activities related to agriculture even some public facilities are allowed in this zone.

- This lies in aquatic area upto 12 nautical miles. Fishing and allied activities are permitted in this zone. Solid waste shd not be let off in this zone. This zone has been changed from 1991 notification, which coastal stretches in islands of Andaman & Nicobar & Lakshadweep.
- Basic act. will be regulated except for traditional fishing & activities taken up by local communities.
- No untreated sewage, effluent of pollution from oil drilling shall be dumped in this.
- CRZ IVA - 12 nautical miles from LTL ~~for~~ towards the sea.
- CRZ IVB - Tidal influenced waterbodies.
- \* NDZ I - 50m from HTL in CRZ III A areas, 200m from HTL in CRZ III B areas.
- \* CRZ are given powers through EPA, 1986 - Sec 5.
- \* CRZ Rules are made by union Env. ministry.
- \* National coastal zone ~~mg~~ management authority & State Coastal Zone Management Authority are responsible for notification.

### Construction Norms for CRZ

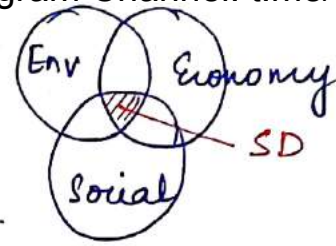
#### Prohibited activities in CRZ:

1. Setting up new industries & expanding existing ones. Exception in case of those that have a direct relation to the waterfront or require foreshore facilities & in case of projects involving the Dept of Atomic Energy.
2. Dumping of waste from cities for landfilling.
3. Land mining
4. Construct<sup>n</sup> activities in CRZ-1 areas.
5. Setting up & expanding units for the disposal of waste. Exception made in case of stormwater drains & discharge of treated effluents.

6. Dumping waste from thermal power plants.

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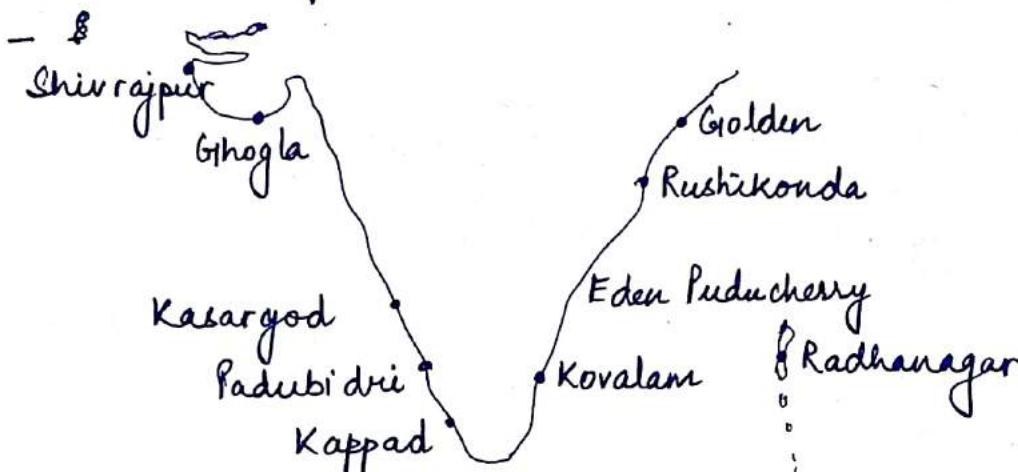
### CRZ Rules, 2019



- CRZ III A - in the densely populated (populat<sup>n</sup> density = 2161 per sq. km as per the 2011 census), NDZ reduced from 200m to 50m.
- NDZ of 20m for all islands close to mainland coast & backwater islands.
- Govt has de-frozeed the FSI (Floor Space Index)
- The new norms permit temporary tourism facilities such as shacks, toilet blocks, changing rooms & drinking water facilities.
- Clearance for CRZ I & 4 done by union min. while for 2 and 3 done by state min.
- \* Shailesh Nayak Committee - dealt with CRZ.

### Blue Flag Beaches

- Blue Flag: An env. award for beaches, marinas & boating tourism operators.
- 12 blue flag beaches
- Recently, Blue Flag Certification has been accorded to 2 new beaches - Minicoy Thundi Beach & Kadmat Beach - both in Lakshadweep.



- Blue Flag beaches are considered the cleanest beaches of the world. It is an eco-tourism model endeavouring to provide the tourists / beachgoers clean & hygienic bathing water, facilities, a safe & healthy env. & sustainable



- dev. of the area
- It's accorded by International jury composed of eminent members - UNEP, UN World Tourism Org' (UNWTO), Denmark-based NGO Foundation for Env. Education (FEE) & IUCN.
  - Blue Flag - one of the world's most recognised voluntary awards for beaches, marinas, & sustainable boating tourism operators.
  - Blue Flag certification is granted based on many criteria under 4 heads:
    - Env. education & info.
    - Bathing water quality
    - Env. management & conservation
    - Safety & services at the beaches.

BEAMS - Beach Env & Aesthetics Management Services

- On the lines of Blue Flag certification, India has also launched its own eco-label BEAMS
- BEAMS come under ICZM (Integrated Coastal Zone Management) Project.
- This was launched by Society of Integrated Coastal Management (SICOM) & the Union Min of Env, Forest & Climate Change (MoEFCC)
- Objective:
  - Abate pollution in coastal waters
  - Promote sustainable dev. of beach facilities.
  - Protect & conserve coastal ecosystems & natural resources.
  - Strive & maintain high standards of cleanliness.
  - Hygiene & safety for beachgoers in acc. with coastal env. & regulat'.

SICOM -

- It's the nodal agency for ICZM & Encore (Enhancing Coastal & Ocean Resource Efficiency Programme).
- Serves as secretariat to national coastal zone man. authority.

- ICZMP plan is a process for the management of the coast using an integrated approach, regarding all aspects of coastal zone, incl. geographical & political boundaries, in an attempt to achieve sustainability.
- Concept born in 1992 during Earth Summit of Rio De Janeiro.
- Specifics regarding ICZM is set out in the proceedings of the Summit within Agenda 21.
- It's a World Bank assisted project + implement by Dept of Forests & Env. with assistance from Union Min of Env., Forests & Climate Change (MoEFCE).
- The National Centre for Sustainable Coastal Management (NCSCM), Chennai, is providing scientific & technical inputs.
- Objective -
  - Formulation of ICZMP for the state.
  - lessen the coastal erosion
  - reduce vulnerability to disaster
  - Biodiv. conservation
  - Livelihood security
  - Pollution / env. quality management
  - Improvement & conservation of cultural/archaeological assets.
  - Components: SICOM implementing at national & state level.



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# Lecture - 8 (Biodiversity Basic)



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PYQ's  
Discussion

Topics to be covered

- What is biodiversity?
- Variation of Biodiversity
- Level and Measurement of biodiversity.
  - ↳ Specie richness
  - ↳ Specie evenness
- Types of species
- Biodiversity Loss

Triple Planetary Crisis

- ↳ Climate Change
- ↳ Biodiv. loss
- ↳ Air pollution

"The greatest threat to our planet is the belief that someone else will save it" — Robert Swan.

Biodiversity

→ Defined as 'variability among living organisms from all sources, incl terrestrial, marine & other aquatic ecosystems & the ecological complexes of which they are a part; this includes diversity within species, & of ecosystems' — UN Earth Summit (1992).

→ As per WHO, Biodiversity underpins all life on Earth & refers to biological varieties in all its forms from the genetic make up of plants & animals in all its variety to cultural diversity.

→ India recognized as one of the mega-diverse countries rich in biodiversity & associated traditional knowledge.

→ India has ~~23-34%~~ 24.62% of its geographical area under forest & tree cover. ↳ ISFR 2021

→ With just 2.4% of land area, India accounts for nearly 7% of the recorded species even while supporting almost 18% of the human population.

→ In terms of species richness, India ranks 7<sup>th</sup> in mammals, 9<sup>th</sup> in birds & 5<sup>th</sup> in reptiles.

→ In terms of endemism of vertebrate groups, India's pos<sup>n</sup>

is 10<sup>th</sup> in birds with 69 species, 5<sup>th</sup> in reptiles with 156 species & 7<sup>th</sup> in amphibians with 110 species.  
 → India's share of crops is 44% as compared to the world avg of 11%.

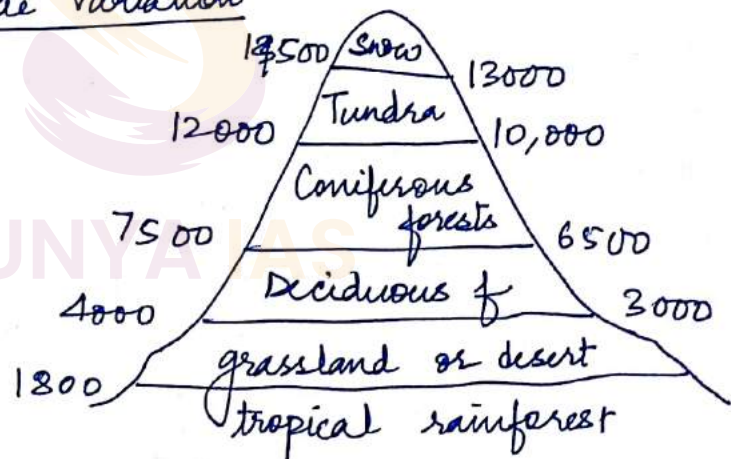
### Biodiversity Variation

- Latitudinal gradients: diversity of plants & animals is not uniform throughout the world.
- Species diversity dec. as we move away from the equator towards the pole.
- Tropic harbour more species than temperate or polar areas.

→ why?

- 1) Consistent sunlight & rainfall
  - 2) Frequent extreme / glaciation cycle
- } Not there

### → Biodiversity Altitude Variation



### Global Biodiversity / Biodiversity Overall

- Invertebrates - crustaceans, molluscs, insects, others
- Vertebrates - fish, mammals, birds, reptiles, amphibians
- Plants - fungi, mosses, ferns & allies, angiosperms, algae, lichens.
- More than 70% of all the species recorded are animals, while plants (incl. algae, fungi, bryophytes, gymnosperms & angiosperms) comprise no more than 22% of the total.
- Among animals, insects are the most species-rich

- taxonomic group, making up > 70% of the total.
- No. of fungi species in the world is the combined total of the species of fish, amphibians, reptiles & mammals.
  - The largely tropical Amazonian rainforest in South America has the greatest biodiv. on Earth.
  - There are around 8.7 billion total species on Earth. Out of this, 6.5 million live on land & 2.2 million in oceans.

### 3 Levels of Biodiversity

1. Genetic Diversity - Differences in DNA content among individuals within species and populations. Genetic div. is the total no. of genetic characteristics in the genetic make up of a species. Eg- rice, mango. These genetic diversity allows species to adapt to changing env. It helps the species to survive drastic changes & helps in drastic resilient growth. They do not interbreed.
2. Species Diversity - No. & variety of species in the world or in a particular area. It dec. from poles equator to poles.
3. Ecosystem Diversity - It refers to diff. kinds of habitat within a region i.e. rainforest vs cornfield.

#### Types:

- (i) Alpha div. - diversity within a particular area or ecosystem, expressed by no. of species in that ecosystem.
- (ii) Beta div. - Comparison of diversity b/w ecosystems, calculated as change in amt of species b/w the ecosystem.
- (iii) Gamma diversity - Measures overall diversity for diff. types of ecosystems within a region.

### Measurement of Biodiversity

- Parameters: Species richness & Species evenness.

- ① Simpson's Index

② Species diversity is combined measurement of richness & evenness. It is called 'Shannon' diversity index.

Species Richness - It is the no. of species found in a community. Tropical rainforest in the terrestrial ecosystem & coral reefs in the marine ecosystems have high degree of species richness.

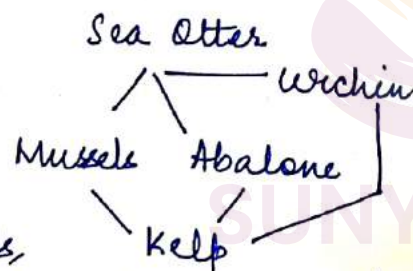
Species evenness - is a measure of relative abundance of diff. species making up the richness of an area. Less evenness indicates that few species dominate.

### Types of Species

1. Keystone s.
2. Endemic s.
3. Umbrella s.
4. Invasive s.
5. Foundation s.
6. Critical link s.

### Keystone Species

- Species whose addition or removal leads to major changes in other species.
  - A keystone species is a plant or animal that plays a unique & crucial role in the way an ecosystem works functions. W/o keystone species, ecosystem would be dramatically diff. or cease to exist altogether.
  - All top predators (lions, tiger, crocodile, bats) and key species like elephants, corals are considered as keystone species bcoz they regulate the population of all other organisms.
- Lion/ tiger  
→ Bats - imp for pollination  
→ Figs  
→ Sea otter - keeps animals (mussels, abalone, urchins) that eat the kelp forests in check. Even though sea otters have predators (white shark) the



health of the ecosystem depends on them.

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## Endemic Species

- found in particular geographical territory not political.
- aka 'precinctive' species means native to a geographical area.

1. North River Terrapin - Sunderbans

2. Indian Wild Ass - Rann of Kutchch

3. Asiatic Lions - Gir NP, Guj.

4. Nilgiri Tahr - Western Ghats

5. Lion Tailed Macaque - Western Ghats

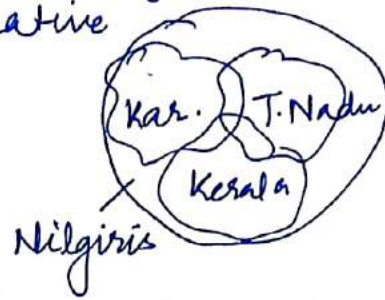
6. Hangul - Dachigam NP

7. Sangai deer - Keibul Lamjao NP, Loktak Lake, Manipur.

8. Red panda - eastern Himalayas

9. Civet, flying squirrel - Eastern Ghats

- Species not endemic - Indian Rhino, Great Indian Bustard



## Critical Link Species

1. Birds

2. Mycorrhiza

3. Decomposers

## Invasive Species

1. Eucalyptus - can treat waste water (filter)

2. Water Hyacinth - terror of Bengal [spread rapidly + consumed a lot of water] ⇒ agricultural stresses

3. Prosopis Juliflora - Nuisance in Delhi, Banni grasslands in Rann of Kutchch, South India incl. Tamil Nadu.

4. Russian Poplar - issue in J&K; health hazard - cause respiratory problems.

5. Lantana Camara - its removal under MGNREGA launched in Bandipur.



- It is a small perennial shrub, which forms extensive dense & impenetrable thickets + It is native to Central & South America + It is invasive species which was intro. in tropical regions as an ornamental plant (intro in India in 1807) + It is generally deleterious to biodiversity & is an agricultural weed  
 → The thickets covered vast tracts of land, stopping the natural light & nutrition for other flora & fauna + The toxic substance in its foliage & ripe berries affected the animals.

- Led to forest fires in Bandipur N.P.
- It creates a mat like structure & bcoz of this herbivores like Chital, Gaur & Sambhar are not able to take their food.

6. White Grub

7. Charcoal Mussels - Native to South & Central American coasts, is spreading quickly in the backwaters of Kerala. They <sup>may</sup> have reached Indian shores attached to ship hulls or as larval forms in ballast water discharges. Ballast is seawater that <sup>ships</sup> carry to improve stability. Ashtamudi lake - a Ramsar site in Kollam district is the worst-hit due to it.

8. Fall Army worm

9. Wattle

10. Woolly white fly

11. Physella Acuta.

→ These are non-native species that spread & interfere in a new ecosystem. Aka Invasive Alien Species, exotic species.

→ It leads to economic loss & an overall decline in the biodiversity. It is the 2nd biggest cause of

## Indicator Species / Sentinel Species

1. lichens = algae + fungus
2. Corals
3. Gangaic dolphins
4. Frogs
5. Salmon

→ These are the ones whose presence or absence reflects the env. cond<sup>n</sup>. They serve as early warning mechanisms as they give signals. They are sensitive to env. cond<sup>n</sup>.

Indicator Species	Stonefly nymph	Dragonfly nymph	freshwater shrimp	hoglouse	sludge worm	red-tailed maggot
Pollution Level	Low (stream)	Low (pond)	Slight	Medium	High	

Foundational Species - dominant primary producers in an ecosystem. + maintain ecosystem. Eg- kelp forests, coral reefs.

Pioneer Species - species which are first to invade or colonise like lichens, moss.

Umbrella species - these species are selected for conserving a entire ecosystem. Eg- tiger, elephant, giant pandas.

→ By protecting the area reqd to maintain a viable popul<sup>n</sup> of the umbrella species (typically the species requiring the largest area), managers expect to be able to conserve viable populations of other target species.

Flagship Species - these are the species which represent specific cause. The species are chosen for their attractiveness, distinctiveness & ~~are~~ their vulnerability becoz they help to create long term awareness & help to bring public support as well.  
Eg- tiger, elephant, bird, giant panda, kangaroos.

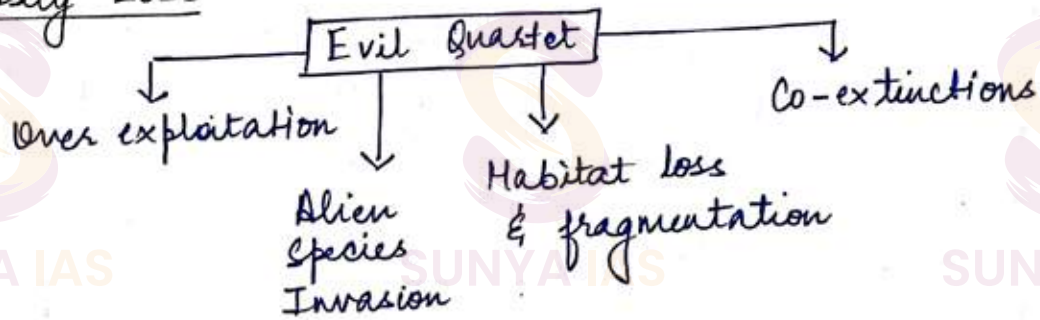
Topics

- Biodiversity loss
- Alien Invasive Species
- Man animal conflict
- Illegal Wildlife Trade

David Tillman Experiment → Ecological Succession

- Biodiversity & ecosystem stability in a decade-long grassland expt.
- David Tilman, Peter B. Reich, Johannes M. H. Knops.
  1. High biodiversity leads to ecosystem stability.
  2. With high biodiv., we have low year on year variations in ecosystem productivity.
  3. With high biodiv., there is high disease & pest resistance

Biodiversity Loss



- Living Planet Report 2022
  - Building a nature positive society
  - By WWF

The 5 Threats to Biodiversity

1. Land and Sea Use Change (including habitat loss & degradation)  
Eg- Agricultural Land use responsible for 80% of global deforestation.
2. Pollution - Make the env. unsustainable for survival directly & indirectly.
3. Species Overexploitation - Eg: overfishing may decimate global fish populations by 2050.
4. Climate Change - forcing the animal to shift range or

confounding the signals that trigger seasonal events & more. Telegram Channel: t.me/sunyanotes50

5. Invasive Species & disease - Compete with native species for space, food & other resources; sometimes spread disease that native species have no immunity of.

### Global Risk Report, 2020

- by World Economic Forum
- Biodiv. is declining faster than ever
- Although the world's 7.6 billion people represent just 0.01% of all living creatures.
- Humanity has already caused loss of 83% of all wild mammals & half of plants.

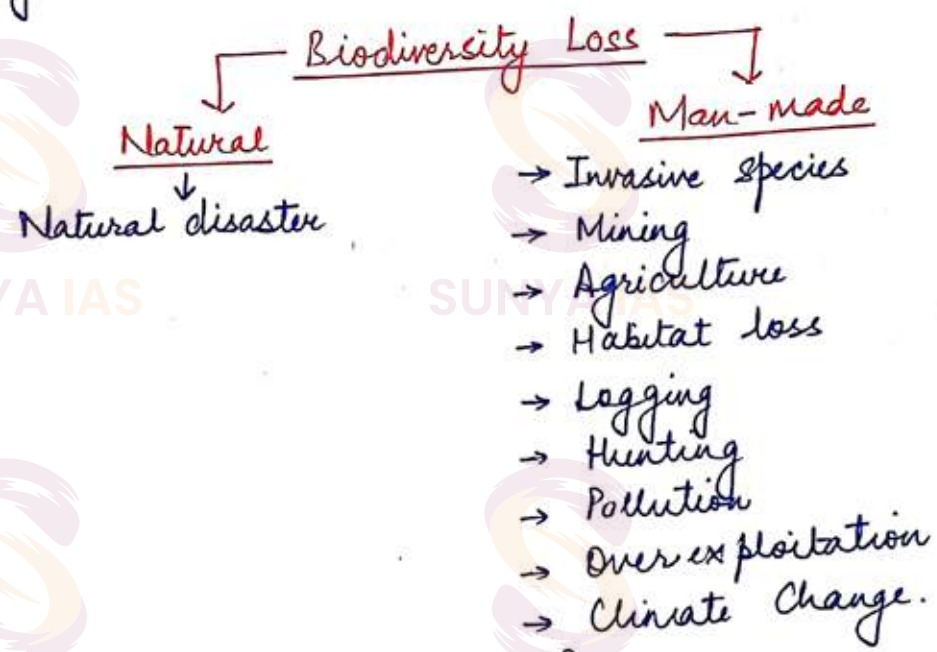
### Why are we losing nature?

- Biodiversity is essential for our health, well-being & economic success. It's essential to understand why nature is in decline in order to alter this path.
- 5 key drivers of biodiv. loss have been identified by intergovernmental Science-Policy Platform on Biodiv. & Ecosystem Services (IPBES). They are changes in the use of sea & land, direct exploitation of organisms, climate change, pollution & invasive non-native species.

### Living Planet Report 2022 - by WWF.

- Wildlife populations decline by 69% in 50 years (since 1970).
  - The highest decline (94%) was in the Latin America & the Caribbean region.
  - This report is a comprehensive study of trends in global biodiversity & the health of the planet.
  - While conservation efforts are helping, urgent action is reqd. if we are to reverse nature loss.
- WWF identified 6 key threats to biodiversity - agriculture, hunting, logging, pollution, invasive species and climate change - to highlight 'threat hotspots' for terrestrial vertebrates.

- The Living Planet Index (LPI), featuring about 32,000 populations of 5,230 species around the world, showed that vertebrate wildlife populations are plummeting at a particularly staggering rate ~~at~~ in tropical regions of the world.
- Mangroves continue to be lost to aquaculture, agriculture & coastal development @ 0.13% per year, acc. to the findings. Many mangroves also degraded by overexploitation & pollution, alongside natural stressors such as storms & coastal erosion.



What are Alien Invasive Species?

- Acc. to 2017 study on global extinction, invasive alien species are resp. for 25% of plant extinctions & 33% of animal extinctions.
- An invasive species, *Senna spectabilis*, an ~~ex~~ exotic tree has taken over b/w 800 and 1200 hac of the buffer zones of Mudumalai Tiger Reserve (MTR) esp. the Singara & Masinagudi forest ranges, as well as in Kargudi range in the core area of the reserve.
- Eg- House Gecko
  - Argemone
  - Forked fanwort: turned water bodies pink; this is perennial aquatic plant; belongs to central & South America.
  - In western ghats, shola grasslands (tropical montane forests) have invasive species - eucalyptus, lantana,

wattle + Toda tribes in Nilgiris (PVTGs - Particularly Vulnerable Tribal groups).

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- India has 75 PVTGs, max in Odisha. Dhebari Comm<sup>n</sup> associated.
- Bunny grasslands - Maldhari tribes.
- African Catfish: illegally traded & reared in portions of Kerala & Tamil Nadu
  - ↳ Carnivorous fish which poses threat to indigenous fish varieties.
  - ↳ Native to Africa, Middle east
- Indian bullfrog
- Prosopis juliflora: initially intro. to absorb salt but it multiplied rapidly.
  - ↳ Its wood has high carbon content. So charcoal derived has good market demand.

### Impact (source: IPBES # Global Assessment)

- Devastating impact on biodiversity.
  - ↳ for the native species
  - ↳ for assemblages on islands
  - ↳ for mainland assemblages
  - ↳ for assemblages in other settings with high proportions of endemic species.
- It out competes the native species for food & resources. It can cause diseases. It can even prevent the native species to reproduce. It can even kill native species. The food web also changes.
- They provide no value or food to wildlife.
- Can lead to monoculture.
- Dec. the biodiv. of an ecosystem.
- It can make natural habitats, agricultural systems, & urban areas less resilient to climate change.
- Climate change reduces the resilience of habitats to biological invasions.

1. Prevention
2. Early detection & response - using technology
3. Mechanical Control - using machines
4. Biological Control - using microbes
5. Chemical Control
6. Public Awareness.

### Man Animal Conflict

- 105 killed in 2022 as man animal conflict reaches its peak in Maha.
- Kerala forest officials captured a wild elephant code named Palakkad Tusker-7 (PT7), which had been terrorising several villages in Palakkad since 2 years.
- In 2020-21 (upto Dec 2020), 87 elephants & 359 people lost their lives in human- elephant conflict.

#### Steps taken to Mitigate Conflict:

- Elephant proof trenches
- Solar powered fences
- Elephant proof walls
- Stone pitched ~~pitched~~ trenches
- Boundary walls
- Bio-fences

#### Reasons / Factors Causing Human Animal Conflict

- urbanisation & dev.
- lack of protected areas
- Population explosion
- Deforestation
- Agricultural Expansion
- Climate change
- Invasive species
- Inc. in tourism.
- substantial inc. in the population of prolific breeders like wild boars & peacocks.

- Steps Taken:

1. WPA, 1972 (Wildlife Protect<sup>n</sup> Act) - legal
2. WCCB - operation Thunderbird - authority / Body (Wildlife Crime Control Bureau)
3. NBWL (National Board for Wildlife) - headed by PM  
↳ 15yr wildlife Action Plan.
4. Protected areas - Eco sensitive zones
5. Conservation Programs - Project Tiger  
- Project Elephant - MIKE
6. Project RE-HAB → Prevent elephants to come in contact with humans using honey bees (waggle dance)
7. Barriers - fences, nets, trenches
8. Deterrents & Repellents (sirens, lights, beehives)
9. Technological  
↳ Radio Collars  
↳ Early Warning Systems
10. Translocations - Corridors
11. Compensation as insurance

- Way Forward:

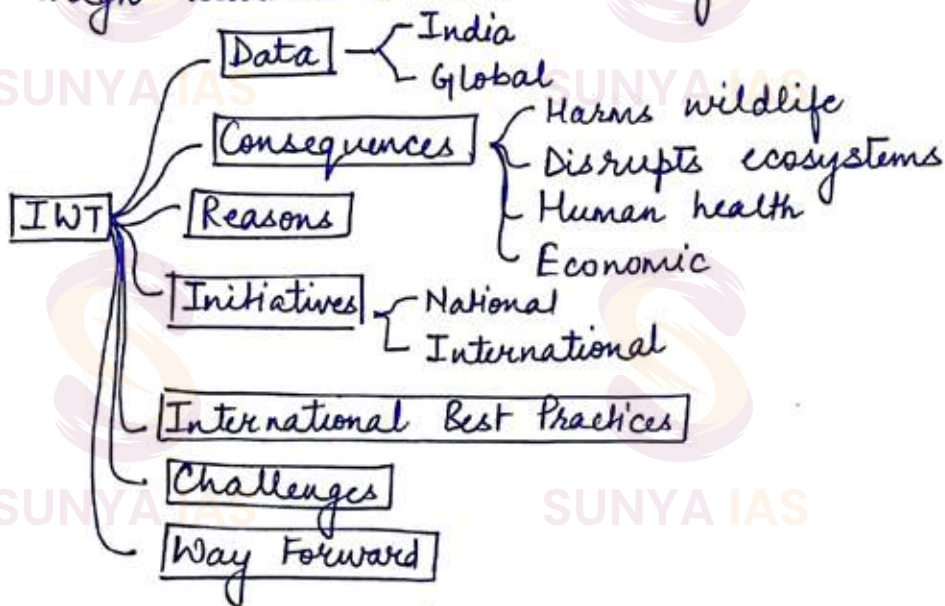
- ↳ Governance
- ↳ Technological
- ↳ Community Participation
- In order to promote sustainable coexistence, conservation plans for species that are prone to the conflict must take into ac both current cond<sup>n</sup> & potential future conflicts.
- Interdisciplinary approaches - crucial for comprehending the nature of a given dispute, identifying what is reqd. for its resolution, & ensuring access to the appropriate expertise & resources. (Human Wildlife Conflict)
- In order to generate synergies in HWC management & HWC risk prevention, strategic partnerships b/w govt.s, humanitarian & conservation organisations shd be developed.



# Illegal Wildlife Trade (IWT)

Telegram Channel: t.me/sunyanotes50

→ Value of illegal trade estimated at 6/10 \$ 7 and \$ 23 billion per year, making wildlife crime one of the most lucrative illegal businesses, often run by sophisticated, international & well-organised criminal networks seeking to exploit the high rewards & low risks of trade.



→ Pangolin - mammal

→ A Star attraction: the illegal trade in Indian star tortoises  
• Return of 12 Indian star tortoises back into the wild.

→ Reasons:

## A. Political

1. Weak implementation of laws
2. Lack of intelligence sharing
3. Organised crimes + nexus
4. Lack of inter-state coordination

## B. Economic

1. Luxury products - skin, horns
2. e-Commerce
3. Poverty

## C. Social

1. Cultural customs
2. Traditional medicine

"The Living Planet Report 2022 shows how climate change & biodiv. loss are not only env. issues but economic, development, security & social issues too - And they must therefore be

addressed together."

— Ravi Singh, Secretary General & CEO, WWF India

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**FOR OTHER SUBJECT NOTES, DROP US  
A WHATSAPP ON 9311077443**

# Lecture - 9 to 10 (Biodiversity Distribution & Conservation)

The banner features the SUNYA IAS logo in the top left corner. In the center, two men, Sugam Bansal and Kuldeep Singh Rathore, are shown from the chest up, smiling. The background is a collage of various mathematical and logical terms such as 'Measurement', 'Cubes', 'Number System', 'Mixture', 'Direction', 'Speed', 'Distance', 'Time', 'Logical Reasoning', 'Data Sufficiency', 'Probability', 'Permutation', 'Combination', 'Set Theory', 'Venn Diagram', 'Number Series', 'Algebra', 'Geometry', 'Trigonometry', 'Calculus', 'Integration', 'Differentiation', 'Limits', 'Continuity', 'Differentiability', 'Maxima and Minima', 'Area and Volume', 'Probability Distributions', 'Binomial Distribution', 'Normal Distribution', 'Poisson Distribution', 'Hypergeometric Distribution', 'Beta Distribution', 'Gamma Distribution', 'Exponential Distribution', 'Lognormal Distribution', 'Weibull Distribution', 'Rayleigh Distribution', 'Chi-Square Distribution', 'F-Distribution', 't-Distribution', 'Z-Distribution', 'Normal Distribution', 'Binomial Distribution', 'Poisson Distribution', 'Hypergeometric Distribution', 'Beta Distribution', 'Gamma Distribution', 'Exponential Distribution', 'Lognormal Distribution', 'Weibull Distribution', 'Rayleigh Distribution', 'Chi-Square Distribution', 'F-Distribution', 't-Distribution', 'Z-Distribution'. A red circular stamp with a scalloped edge is overlaid on the left side, containing the text 'NO FORMULAE ONLY CONCEPTS'. At the bottom, a black banner with white text reads 'BY IITians', and a purple banner below it reads 'SUGAM BANSAL (IIT DELHI) | KULDEEP SINGH RATHORE (IIT DELHI)'. The largest text at the bottom is 'CSAT 2024 BATCH' in white on a dark blue background.

**SUNYA IAS**

**NO FORMULAE ONLY CONCEPTS**

**BY IITians**

SUGAM BANSAL (IIT DELHI) | KULDEEP SINGH RATHORE (IIT DELHI)

**CSAT 2024 BATCH**

- Shannon Weiner Index to measure the diversity of species.
- Endemism - ecological state of species being unique to a defined geographic location.
- The indigenous species - species naturally available in a particular habitat. Not every indigenous species can be an endemic species. Eg - Indian elephant
- Opp. of endemic species is cosmopolitan species. Eg of endemic species - Koala bear is endemic to Australia; King Cobra & Nilgiri Tahr is endemic to Western Ghats.
- Indigenous species - found in multiple regions of the world. They have a broader range of distribution.
- Endemic species - found in specific range. They are at higher risk of extinction. Eg - Nilgiri Tahr in Western Ghats.

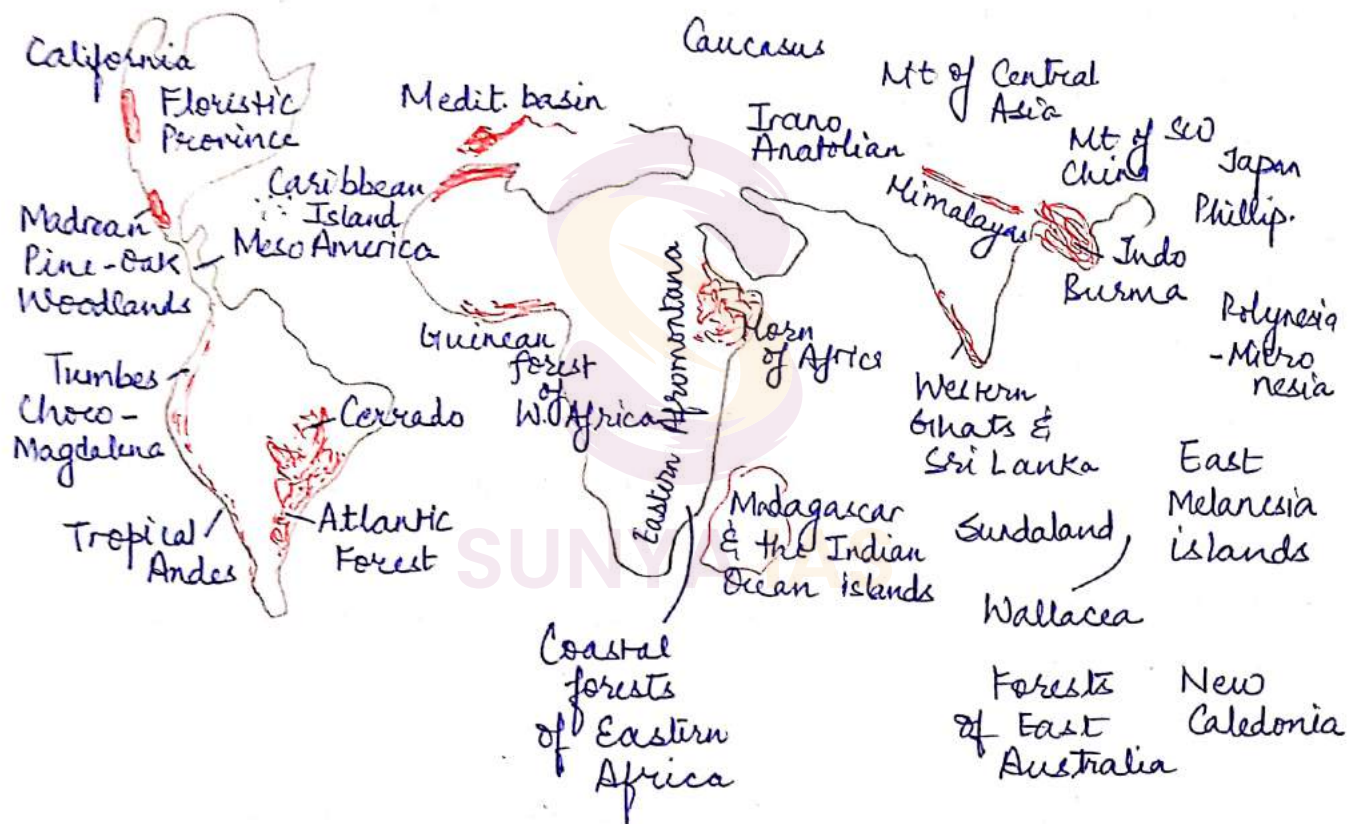
### Megadiverse Countries

- A select group of countries that account for 10% of the Earth's surface & house at least 70% of the Planet's terrestrial biodiversity. There are total of 17 mega-diverse countries in the world. India is one of them.
- To be qualified as mega-diverse country, it must:
  - have at least 5000 endemic species
  - have a marine ecosystem within its borders.
- Australia, Papua New Guinea, Malaysia, Indonesia, Philippines, China, India, Madagascar, DRC, South Africa, USA, Mexico, Brazil, Venezuela, Colombia, Ecuador and Peru.
- These countries have extra ordinary rich biodiversity + they support a lot of endemic species.
- World Conservation Monitoring Centre (WCMC) - body related to UNEP has classified 17 countries as mega diverse countries.
- India has 24.62% of its area under Forest & Tree Cover. However, the target is 33% as per the National Forest Policy. India has 2.4% of the world's land area & it

has 7-8% of the world's recorded species. India has 2 realms, 5 biomes & biogeographic zones. Telegram Channel: t.me/sunyanotes50

## Biodiversity Hotspots

- Currently 35 biodiversity hotspots
- Biodiv. hotspot as defined by Norman Myers - have high species richness, high degree of endemism & a severe habitat loss.
- As per NGO Conservation International, it must have 1500 vascular plants as endemic + it should have lost 70% of its original habitat.



- In 2011, Forests of East Australia became the 35<sup>th</sup> site
- In 2016, 36<sup>th</sup> site - North American Coastal Plains

## India's biodiversity Hotspots in Brief - ④ number

→ Total combined geographical area = 24.46%.

1. Himalayas - includes the entire Himalayan region & parts of Pak, Nepal, Bhutan, China & Myanmar.
2. Indo-Burma - incl. NE India & Andaman
3. Sundaland - incl. Nicobar

4. Western ghats & Sri Lanka  
 \* Western ghats is one of the hottest hotspots of the world.

HOTSPOTS

- Initiative of Mission Blue & IUCN.
- It's a Marine Protected Area that needs spl protection.
- 2 - Lakshadweep & Andaman & Nicobar islands.

Biogeographic Realm

- It is any of the large spatial regions of the Earth's land surface with ecosystems sharing similar biological evolutionary history & distributional patterns of terrestrial organisms.
- 8 biogeographic realms are recognised across the earth, each biogeographic realm shares similar processes and major vegetation types wherever they are found, & their species composition varies depending on the biogeographic realm in which they are found.

- Neoaestic
- Oceanic
- Neotropical
- Palearctic
- Indo Malay
- Australia
- Antarctic
- Afrotropical



Trans - Himalayas -

- high elevation, mountainous, cold cond<sup>n</sup>, low precipitation, limited vegetation (Ladakh), Lahaul & Spiti Valley, Northern Sikkim, Tibetan Antelope, Snow leopard, Kashmir Stag, black-necked crane.
- Hemis N.P. - snow leopard capital of the world.

→ Bugyals are grasslands of the Himalayas, vegetation varies from deciduous to coniferous to bugyals & alpines.

→ Himalayas, Thar, leopards, tigers, elephants.

→ Dachigam, Valley of flowers, Nanda devi NP.

### Gangetic Plain

→ Flat & riverine plains, highly fertile alluvial soil.

→ Moderate to heavy precipitation.

→ Moist & dry deciduous vegetation

→ Swamp deer (state animal of UP, MP); Gangetic dolphin (national aquatic animal of India); Hog deer; Gharial (Chambal).

→ Jim Corbett, Valmiki National P., Sundarbans

→ UP, Bihar, W. Bengal

### Desert

→ Very low precipitation, < 25cm per annum.

→ Hot & arid cond<sup>n</sup>, saline soil.

→ Xerophytic extensive grasslands & scrublands, diverse & specific fauna.

→ Great Indian Bustard, Kharai Camel, Asiatic wild ass, Flamingo.

→ Western part of Gujarat and northern Guj.

### Semi-Arid

→ Higher precipitation than deserts

→ Southern Guj & MP.

→ Vegetat<sup>n</sup> type: scrubland & a mixture of dry deciduous vegetation.

→ Life is richer than deserts.

→ Tiger, Lion, Leopard, Cheetah, Great Indian Bustard, Black buck. [Bishnoi Comm. worship khejri trees & black buck]

→ Kuno Pappur, Keoladeo, Sariska.

## Western Ghats

Telegram Channel: t.me/sunyanotes50

- High temp<sup>r</sup>, high precipitation
- Lion tailed macaque, Malabar civet, Malabar giant squirrel, Nilgiri Tahs, Great Indian hornbill, Mahseer, tigers, elephants, leopards.
- Wet evergreen, semi-evergreen
- Kudremukh, Nagarhole, Bandipur, Periyar, Anaimalais, Silent Valley.

## Deccan Plateau

- Dry deciduous, moist deciduous
- Fauna - tigers, elephants, sloth bears, blackbuck, monitor lizard, Great Indian bustard.
- Achanakmar Amarkantak, Andhra Satpura.
- Tamil Nadu, Jharkhand, Andhra P., Chattisgarh.

## North-East

- 17% of forest cover of India & 50% of vascular plant species.
- Temp<sup>r</sup> is high, precipitation is high, topography is mountainous & plain.
- evergreen & vegetation & moist deciduous.
- Nandapha, Kaziranga N.P.
- Pygmy hog, brow-antlered deer, golden langur, Bengal florican.
- Kaziranga, Manas, Keibul Lamjao N.P.

## Coastal area

- Coromandel coast, Utkal, Northern Circar, Konkan, Malabar.
- Olive Ridley turtles, Irrawaddy dolphins, dugong, the saltwater crocodile.
- Bhitarkanika, Sundarbans, Gulf of Mannar.

## Islands

- Andaman & Nicobar & Lakshadweep islands
- tropical evergreen rainforests, high temp<sup>r</sup>, high precipit<sup>n</sup>.
- Leather-backed turtles, dugong, megapode birds.



Biopiracy - when the genetic resources & traditional knowledge is taken from any biodiv. rich region w/o their permission/ consent. This knowledge is then used to derive profits. It's -ve so shd not be done.

Bioprospecting - is +ve. Exploring biodiversity for commercially valuable genetic resources.

## Biodiversity Conservation

### In-Situ Conservation

[on site conservation of genetic resources of plants and animals]

- Biosphere reserves
- National Parks
- Wildlife Sanctuaries
- Sacred forest
- Tiger reserves
- Reserve/ protected forests

• In India, in-situ conserv<sup>n</sup> is legally mandated.

Reserve/ Protected forests - They are declared through a declaration / notification by the state govt. under Indian Forest Act of 1927.

Reserve forest > Protected Forest > Revenue/ Village F.

↳ Highest degree of protection

\* Nat<sup>n</sup> Park > Wildlife Sanctuaries > Res. f. > P. F. > R. F.

→ The Res. forests are often upgraded to Wildlife Sanc. which in turn can be upgraded to N.P. However, the national park can't be degraded to a wildlife sanctuary.

→ Rights to all activities like hunting, grazing etc. in reserved forests are banned unless specified.

→ In protected forests, they are sometimes given to communities which are living on the fringe areas. Telegram Channel: t.me/sunyanotes50

### Wildlife Sanctuaries (WLS)

- Declared u/ WPA, 1972.
- Endangered species - safeguarded from extinction in their natural habitat.
- Designated by the respective state govt. u/ WPA, 1972.
- Chief Wildlife Warden - appointed by respective state govt.  
↳ controls, manages & maintains the wildlife sanctuaries.
- Certain rights of people permitted - grazing & firewood collection by tribals is allowed but strictly regulated; settlements not allowed <sup>sg</sup> but efforts are undertaken for their relocation.

### National Parks (NP)

- designated u/ WPA, 1972
- unlike WLS, no rights are granted here.
- No livestock grazing is permitted inside a N.P. but in WLS it may be permitted as per the chief wildlife warden
- Boundaries of a WLS are not clearly demarcated but they are clearly demarcated in case of NP by state govt.
- State govt has all the rights of the land but this can be done through the recommendation of National Board for Wildlife.

### Tiger Reserves (TR)

- Designated under WPA, 1972.
- Nat<sup>n</sup> Tiger Conserv<sup>n</sup> Authority (NTCA) - <sup>monitor TR +</sup> plays a key role.
- \* Project Tiger - launched in 1973 - completed 50 yrs  
↳ implemented by NTCA.

### Biosphere Reserves (BR)

- These are designated under UNESCO's - Man & Biosphere Reserve (MAB) Programme after the national govt. nominate them.
- They are administered under the sovereign jurisdiction

of a country.  
 → Designation of a BR does not affect the legal status of a ~~map~~ land etc & the ownership also does not change

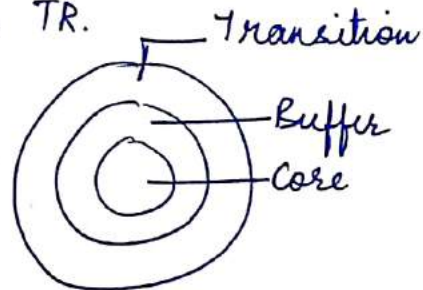
→ India - 18 BR.

↳ 12 recognised w/ MAB Prog.

↳ 6 not recognised.

→ BR - can have NP, WLS, Wetland, TR.

→ CORE - It's a strictly protected system. Here, the human activity is not allowed.



→ BUFFER - Limited human activity allowed. Research, education, training & limited recreation is allowed.

→ Transition - Human settlements & the economic activities are permitted.

→ BR - IUCN Category V Protected areas

↳ Criteria:

(i) ~~It~~ The site must <sup>contain</sup> effectively protected & minimally ~~distributed~~ core area.  
 disturbed

(ii) The core shd sustain viable populations representing all trophic levels in the ecosystem.

(iii) A management authority to ensure the cooperation of local ~~bodies~~ communities.

→ MAB Prog - 1971

- Secretariat

- Governing body

- Advisory bodies

→ World Network of BR

↳ Assess changes & their effects

↳ Inter-relationship b/w ecosystems & socio-economic processes.

↳ Human welfare

↳ Transfer of knowledge.

### 1. Nilgiris:

→ Other protected areas included

NP - Aralam, Mudumalai, Mukurthi, Nagarhole, Bandipur, Silent Valley.

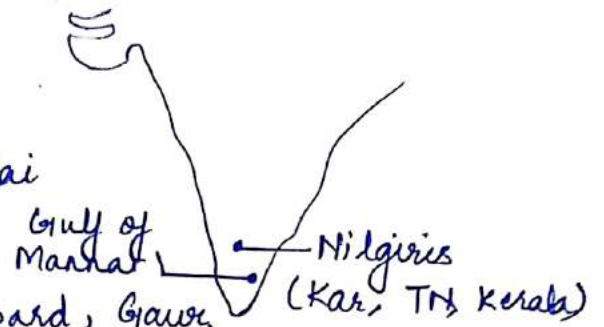
WLS - Wayanad, Karimpuzha, Sathyamangalam.

TR - Nagarhole, Bandipur, Mudumalai

→ Fauna

Mammals - Bengal tiger, Indian leopard, Gaur, Cheetal, Nilgiri Martin, Nilgiri Tahr, Sambar, Wild boar, barking deer.

Primates - lion tailed macaque, Nilgiri langur.



### 2. Gulf of Mannar:

NP - Gulf of Mannar ~~MPA~~ Marine NP.

Fauna - Dugong / Sea Cow, Balanoglossus, sea turtle, crustaceans, molluscs, echinoderms, fishes, turtles.

Other info

- Islets and coastal buffer zone
- Marine env.
- Pearl banks
- Inhabitants are mainly Marakayars.

### 3. Sunderbans:

NP - Sunderbans NP.

WLS - Sunderbans West, S. South, S. East

TR - Sunderbans

Fauna - Bengal tiger, salt water crocodile, river terrapin, olive ridley turtle, Ganges river dolphin, hawksbill turtle, mangrove horseshoe crab, leopard cats, macaques, wild boar, Indian grey mongoose, fox, jungle cat, flying fox, chital, Irrawaddy dolphins, Ganges river dolphins

Other info - largest delta & contiguous mangrove forest.

- Largest mangal diversity of the planet (81 plant & 1586

animal species).

- Rivers → Saptamukhi, Thakuran, Goasaba and Matla.
- Considered endangered.

#### 4. Nanda Devi: Uttarakhand

- NP - Nanda Devi & Valley of Flowers
- WLS - Nanda Devi
- Fauna - Snow leopard, Himalayan black bear, brown bear, musk deer, bharal / blue sheep, Himalayan Tahr.
- Other info
  - L WHS
  - L Rishi Ganga river
  - L Imp. peak - Nanda devi, Devistan I, II, Rishi Kot.

#### 5. Nokrek: Meghalaya

NP - Nokrek NP

Fauna - Red Panda, Asian elephant, Snow leopard, <sup>loris,</sup> giant flying squirrel, Hoolock gibbons.

Other info.

- L Nokrek - highest peak of Garo hills (1412m)
- L Rivers - Jantol, dareng & Simsang (longest & largest)
- L tribes - Garo, bantias, hajjoms
- L Saljong deity.

#### 6. Panchmari: MP

NP - Satpura NP

WLS - Bori, Panchmari

TR - Satpura TR

Fauna - Giant Squirrel, Flying Squirrel, Chinkara, Nilgai, wild dogs, bison, Indian wolf.

Other Info

- L semi-arid region
- L Highest peak - Dhoopgarh

- L Panch marhi plateau - aka Queen of Satpura.
- L Ecosystems - Tropical moist deciduous forests, tropical dry deciduous forests & central Indian sub-tropical hill forests.
- L Trees - teak, Sal
- L Tribes - Gond, Korkus

7. Similipal: Odisha

- NP - Similipal
- WLS - Madgarh, Kuldiha
- TR - Similipal
- Elephant reserve - Mayurbhanj

Fauna - Bengal tiger, asian elephant, gaur, Chausingha.

Other Info

- Highest peak: Khairiburu
- Rivers: Budhabalanga, Khairi, Salandi, Palpala
- Tribes: Erenga Kharias & the Mankardias (prominent);  
others:- Ho, Gunda, Munda
- Waterfalls: Toranda & Barehipani / Bafhai falls.

8. Achanaknas Amarkantak: Chattisgarh

WLS - Achanaknas

Fauna - One horned antelope, Indian wild dog, Saras crane, Asiatic white-backed vulture, Sacred grove, bush frog.

Other Info

- Major watersheds of peninsular India
- Source of 3 major rivers: Narmada, Tohilla, Son
- Ranges: Maikal hill ranges, Vindhya, Satpura.

9. Great Nicobar:

NP - Campbell Bay, Galathea

WLS - Galathea

Fauna - Nicobar scrub fowl, edible nest swiftlet, Nicobar long-tailed macaque, Nicobar tree shrew, dugong, nicobar megapode, serpent eagle, salt water crocodile, marine turtles, giant leatherback sea turtle, Malayan

Other info -

- L Tribe: Mongoloid Shompen, Nicobarese
- L Biome: Tropical & subtropical moist broadleaf forests biome.
- L Indira point.

10. Agasthyamalai: Kerala, T.N

WLS - Shendurney, Peppara and Neyyar

TR - Kalakad Mundanthurai

Fauna - Bengal tiger, Asian elephant, Nilgiri Tahr

Other info:

- Eco regions: tropical wet evergreen forests, South western ghats, moist deciduous forests, South western ghats, montane rain forests, Shola.
- Tribes: Kanikaran

11. Khangchendzonga: Sikkim

NP - Khangchendzonga

Fauna - Red panda, musk deer, snow leopard, Himalayan Tahr, dhole, sloth bear, viverrids, Himalayan black bear, Tibetan wild ass, Himalayan blue sheep, serow, boral & takin, Barking deer, Monal pheasants, Tragopan pheasants, blood pheasants (state bird).

Other info:

- Himalayan trans-axial belt
- Biodiv. hotspots & WHS
- Peaks: Mt. Khangchendzonga & Zemu Glacier
- Tholung monastery.

12. Panna: MP

NP - Panna

WLS - Gangau

TR - Panna



Critical Tiger Habitat Area : Panna NP + 3 parts of Ganga  
Sanctuary. Telegram Channel: t.me/sunyanotes50

Fauna: Bengal Tiger, Siyah ghosh, jungle cat, tiger, leopard, chital, chinkara, Nilgai, Sambhar, sloth bear, bar headed goose.

Other info:

L River - Ken

L Ethnic groups - Gond, Khairus, Yadavas.

L Sacrosanct pilgrimage of Pranani sect.

\* These 12 are protected u/ MAB Prog.

Others are (6):

1. Cold desert - MP

2. Great Rann of Kutch - Guj.

3. Seshachalam hills

4. Manas

5. Dibru ~~gash~~ - Saikhowa

6. Dihang - Dibang

1. Manas

• Manas NP, WLS, TR

• Fauna - Pygmy dog, Indian rhiceros, Assam roofed turtle, hispid hare, golden langur, wild water buffalo, slow loris, capped langur, sambhar, great hornbill, Malayan giant squirrel or black giant squirrel, Chinese pangolin, Asian golden cats, dholes, Bengal florican

• Other info:

- Eastern himalayan foothills

- Contiguous with Royal Manas NP, Bhutan

- River - Manas

- UNESCO WHS

2. Dihang - Dibang

• NP - Mouling

• WLS - Dibang

• Fauna - Mishmi takin, red assal, musk deer, red panda.



Asiatic black bear.

- Other info. - Eastern Himalaya & Western hills.

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### 3. Great Rann of Kutch

- WLS - Narayan Sarovar, Kutch Bustard sanctuary, Wild Ass sanctuary (Little Rann), Kachch Desert ~~WLS~~ (Great Rann).
- Wetland - Charai - Dhand
- Fauna - Indian wild ass, Grt Indian Bustard, Greater Florican, lesser Florican, f Chinkara & Indian Wolf, Caracal, Desert Cat, Desert fox.
- Other Info:
  - Extension of Thar desert
  - Great Rann of Kutch + Little Rann of Kutch is called Rann of Kutch
  - River - Luni, Rupen, West Banas River, Nara Canal / Puran river
  - Banni grasslands (Maldhari pastoralists)
  - Flamingo City.

### 4. Cold Desert: HP

NP - Pin valley

WLS - Kibber, Sarchu, Chandatal

Fauna - Snow leopard

### 5. Dibru - Saikhowa

Fauna - Bengal tiger, Indian leopard, clouded leopard, jungle cat, sloth bear, dhole, small Indian civets, Malayan giant squirrel, Chinese Pangolin, Gangetic Dolphin, slow loris, Hoolock gibbon, Asian elephant, wild boar, Sambar deer, hog deer, barking deer, golden langur.  
white-winged wood duck, Bengal Florican, lesser adjutant stork, spotted-billed Pelican, white-bellied Heron, Jerdon's babbler, Pallas' fish eagle.

Other Info

River - Brahmaputra, Lohit, Dibru

• Semi-evergreen forests, moist  
canebrakes & grasslands.

Telegram Channel: [t.me/sunyanotes50](https://t.me/sunyanotes50)

## 6. Seshachalam Hills

NP - Srivenkateshwara

WLS - Srivenkateshwara

Fauna - Slender loris, Indian giant squirrel, Mouse Deer,  
Golden Gecko, Yellow throated Bulbul.

Other info

- Eastern ghats
- Tirupati
- Peaks: Anjanadri, Garudadri, Narayanadri, Neeladri,  
Seshadri, Venkatadri and Vishalbadri (highest).
- Red Sandalwood.

## Seville Strategy

- Seville is in Spain & the strategy is adopted for BR.
- It talks about the community based approach having a scientific basis.

Conservation Reserve - State govt can declare the conservation reserve in any area which they own after consultation with local community.

Community Reserve - State govt. can declare this in any private land or a community land. Such land shd not be within a NP, WLS or Conservation Reserve.

\* Community & Conservation Reserve - both designated w/ WPA, 1972. In both these, the rights of the people living here is not affected.

## Sacred Groves

- do not have a legal backing.
- These are portions of forest worshipped bcoz of religious & socio-cultural reasons.
- Eg - Bishnoi Community; Garo, Khasi, Jaintia hills in Meghalaya.

## Topics

- Ex situ Conservation
- Convention on Biological Diversity
  - 15<sup>th</sup> CBD
- IUCN Red list

Ex-Situ Conservation - In this approach, the threatened plants & animals are taken out from their natural habitat & then they are placed in a diff. location.

Eg - Captive breeding, botanical garden, zoos, seed/pollen banks, gene bank, tissue culture.

## Central Zoo Authority (CZA)

- Estd in 1992
- CZA in India oversees the functioning of zoos & ensures that they meet international standards. They play a pivotal role in the conservation of endangered species through breeding programs.

## Captive Breeding

- It refers to the process of <sup>breeding</sup> animals or plants in controlled environments, such as wildlife reserves, zoos, botanical gardens, & other conservation facilities. The primary goal is to produce offspring that can be reintroduced into the wild, thereby bolstering populations that are endangered or extinct in their natural habitats.
- Eg - Great Bustard, Tiger
- Zoos have transformed into centers of wildlife conservation & environmental education.
- California Condor - In 1980s, California Condor was on the brink of extinction, with only 27 individuals remaining. A controversial decision was made to capture all remaining wild condors & start a captive breeding program. Today, there are over 400 California Condors, with more than half living in the wild.
- Bengal Tiger in India - While still endangered, concerted

conservation efforts in India, incl. captive breeding programs, have led to a significant ↑ in the tiger population. Facilities like Sariska TR imp. role.

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## Cryopreservation

→ It's the process of preserving cells, tissues or any biological constructs by cooling them to a very low temp<sup>r</sup>, typically that of liquid nitrogen ( $-196^{\circ}\text{C}$ ). At these temp<sup>r</sup>, any biological activity, incl. the biochemical reactions that would lead to cell death, is effectively stopped.

→ Examples:

- 1) Plant seeds & tissues - The Svalbard Global Seed Vault, located on the Svalbard archipelago in Norway, It's a secure seed bank designed to store variety of plant seeds from all over the world, ensuring preservation of plant diversity for future generations.
- 2) Animal Genetic Material - The San Diego Zoo's Frozen Zoo project collects & preserves genetic material, incl. DNA, gametes (sperm & egg cells) and embryos, from endangered species. This "bank" can potentially help in the ~~several~~ revival or genetic study of extinct or endangered species in the future.

## Frozen Zoo

San Diego Zoo's frozen zoo - This project aims to collect & preserve genetic material, incl. DNA, gametes & embryos, from endangered species. This 'bank' can potentially help revive extinct species in the future.

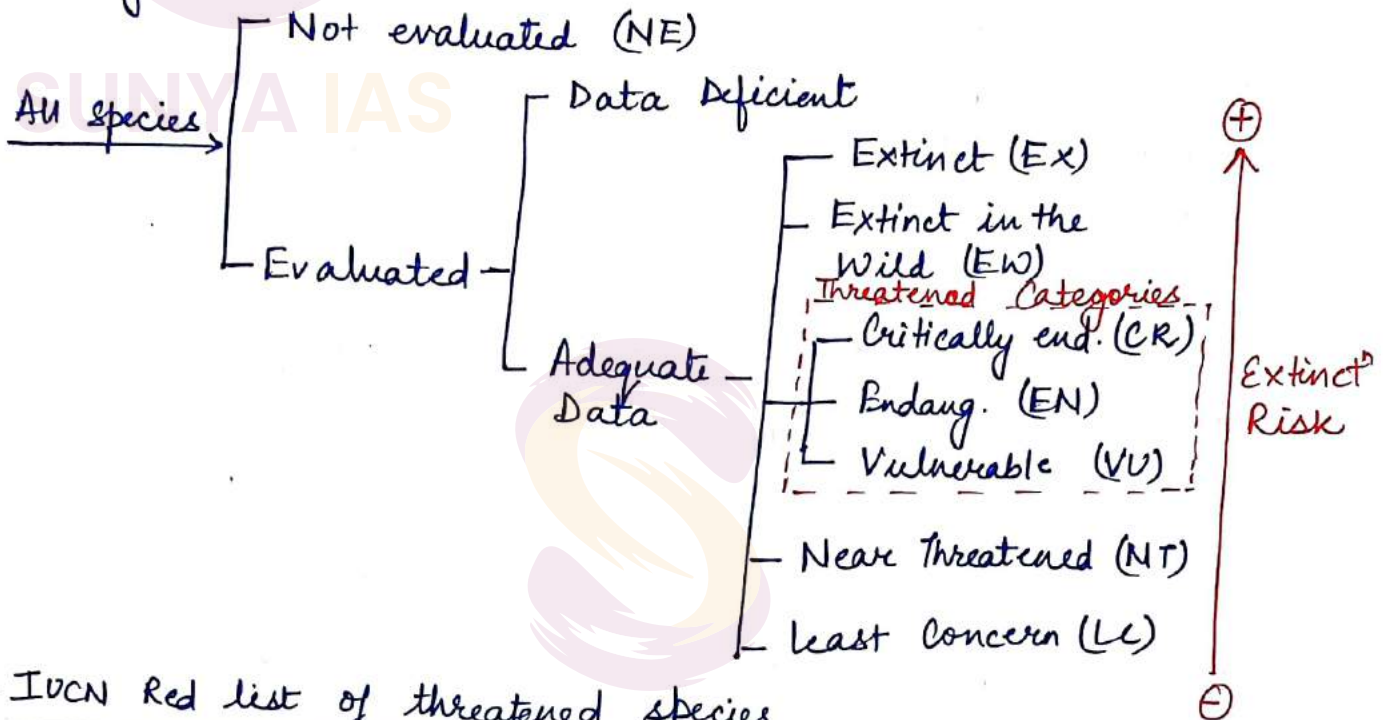
## Citizen Movt

1. Sundarlal Bahuguna - Tehri dam  
Tehri dam, on Bhagirathi r. (trib of r Ganga) to generate electricity; India's tallest dam.
2. Chipko movt. - 1st Chipko movt in independent

3. Appiko movt - in 1983 in Kar.

### IUCN

- International NGO formed in 1948.
- HQ: Gland, Switzerland
- working in the field of nature conservation & sustainable use of natural resources.



### IUCN Red list of threatened species

- founded in 1964 inventory of
  - is the world's most comprehensive Global conservation states of biological species.
  - Pink pages include the critically endangered species
  - Green pages are used for ~~formally~~ <sup>previously</sup> endangered species.
- Critically Endangered - the reduction in population is >90% in the last 10 years.
  - Population size ~ 50 mature individuals
  - Probability of extinction in wild → at least 50% in the last 10 years.

### UNCBD - Convention on Biological Diversity

1992 → Rio De Janeiro → Earth Summit

- Forest principles
- Agenda 21
- 1) UNFCCC
- 2) UNCCD
- 3) UN CBD

- Multilateral environmental agreement
- Drafted - 22 May 1992
- Signed - 5 June 1992 - 4 June 1993
- Location - Rio de Janeiro, Brazil, New York, US.
- Cond<sup>n</sup> - Ratific<sup>n</sup> by 30 states Effective - 29 Dec 1993
- Parties - 196 states
- Depository - Secretary General of UN
- Languages - Arabic, Chinese, English, French, Russian, Spanish

- Conservation - Parties are reqd to develop national strategies, plans or programs for the conservation & sustainable use of biological diversity.
- Sustainable Use - to ensure long-term benefits for humanity.
- Benefit Sharing - it emphasizes the fair & equitable sharing of benefits arising from the utilisation of genetic resources.
- UNCBD is a legally binding multilateral treaty. This is an outcome of Rio Earth Summit of 1992. It entered into force in 1993. All UN mem. states except for US have ratified the treaty.

\* India enacted Biological Diversity Act, 2002

Biopiracy - Practice in which indigenous knowledge of nature, originating with indigenous people, is used by others for profit, w/o authorization or compensation to the indigenous people themselves.

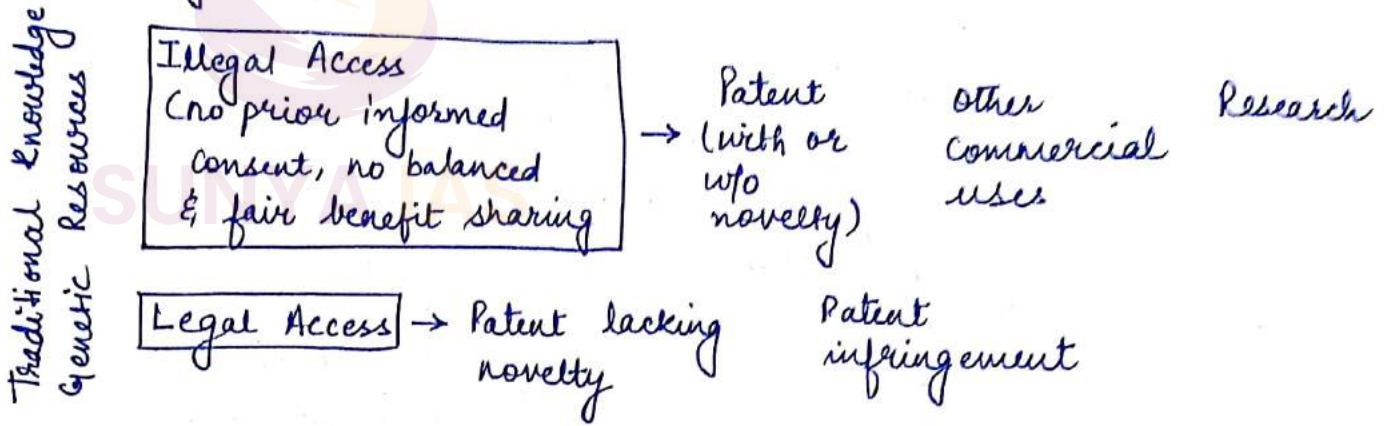
Bioprospecting - Systematic & organised search for useful products derived from bioresources incl. plants, microbes, animals etc. that can be developed further for commercialization & overall benefits of the society.

Biominer - Process of using microbes to extract metals of economic interest from rock ores or mine waste.

Biominer technique - also used to clean up sites that have been polluted with metals.

Bio remediation/ Mycoremediation - Waste management/ removal using microbes.

### Biopiracy



### Costa Rica's Bioprospecting Agreement

- Costa Rica is known for its rich bio-diversity. IMBio, a Costa Rican biodiversity Institute, entered into an agreement with the pharmaceutical Company Merck in the early 1990s.
- Outcome: Merck provided funding for conservation projects in exchange for access to samples of Costa Rica's biodiversity for potential drug development. This is how CBD's principles applied in practice.

### India's TKDL - Traditional Knowledge Digital Library

- Seeks to prevent the granting of patents for products developed utilizing TK where there has been little, if any, inventive step.
- intends to act as a bridge b/w info. recorded in ancient Sanskrit & patent examiners (with its database containing info. in a language & format understandable to patent examiners).
- facilitates access to info. not easily available to patent examiners, thereby minimising possibility that patents could be granted for 'inventions' involving only minor or insignificant modifications.
- TKDL is a prior art database of Indian traditional knowledge estd. in 2001, jointly by Council of Scientific &

TKDL is a first of its kind globally & has been serving as an exemplary model to other nations. TKDL currently contains info. from existing literature related to ISM such as ayurveda, unani, Siddha, Sowa rigpa and Yoga.

- Info. is documented in a digitized format in 5 ~~intert~~ international languages - English, German, French, Japanese, Spanish. TKDL provides info. in languages & format understandable by patent examiners at Patent offices worldwide, so as to prevent the erroneous grant of patents. Until now, access to complete TKDL database is restricted to 14 Patent offices worldwide for the purposes of search & examination. This defensive protection through TKDL effective in safeguarding Indian traditional knowledge from misappropriation, & is considered a global benchmark.

### Cartagena Protocol on Bio Safety

- is an international agreement ~~or~~ adopted in 2000. Cartagena is a place in Columbia, South America. This protocol is related to CBD. India has ratified this. It aims to - safe handling, transport & use of Living Modified Org. resulting from modern biotechnology. It addresses technology dev, transfer, benefit ~~to~~ sharing & bio safety issues.

### Nagoya Protocol

- adopted in 10<sup>th</sup> COP of CBD in 2010. Nagoya is in Japan. This protocol is related to CBD. It's about access to genetic resources and fair & equitable sharing of benefits. This deals with biopiracy.



Ecological Civilization - Building a Shared Future for All Life on Earth.

→ Kunming  
→ Montreal

7-19 Dec, 2022

### 15<sup>th</sup> COP to CBD

→ Intro

→ Objectives of CBD

1. Conservation of biodiversity
2. Sustainable use of biodiv.
3. Fair & equitable sharing of the benefits arising out of the utilization of genetic resources.

→ Theme: Ecological Civilization: Building a Shared Future for All Life on Earth.

→ Key Highlights

1. New Global Biodiversity Framework
2. Addressing Biodiversity Loss
3. Financial Resources for Biodiversity Conservation.
4. Indigenous People and Local Communities
5. Fair and equitable sharing of benefits.

→ Targets

→ Challenges

→ Way Forward

### Global Biodiversity Policy Framework for 2030

1. 'Whole of Society' Approach towards restoring nature.
2. The role of cities in the new deal of nature.
3. Global scenarios to halt & restore nature.
4. Transformative change
5. Rethinking the singular use of landscapes.
6. Role of Financial & Business Sector.

✳️ 12<sup>th</sup> COP in 2014 - talked abt Aichi biodiversity targets (20) to be achieved before the year 2020.

CBD has a report - Global Biodiversity Outlook. So, acc. to Global Biodiv. Outlook 5 - none of the 20 Aichi biodiv. targets have been met.

- \* COP15 adopted a new global biodiv. framework that sets out the global biodiv. goals for the next decade. The framework includes 21 targets & 10 headline goals, including protecting at least 30% of land & sea areas, reducing the rate of habitat loss & degradation, and halving the use of chemical for pesticides & fertilizers by 2030.
- \* COP15 of CBD focussed on addressing the drivers of biodiv. loss, incl. habitat destruction, overexploitation & climate change. The conference emphasized on the imp. of protecting & restoring biodiv. to prevent further loss & promote sustainable production & consumption patterns.

Decoding the 23 targets set at COP15

196 countries signed a deal to protect 30% of the world for nature by 2030 in Montreal.

### Reducing Threats to Biodiversity

1. Halting Biodiversity loss - Bring loss of areas of high biodiversity to 0, + respecting rights of indigenous people.
2. Effective Restoration - at least 30% of areas of degraded terrestrial, inland water, & coastal & marine ecosystem.
3. Mapping linkages - Sustainable use of above areas is consistent with conservation outcomes.
4. Saving endangered species - maintain their diversity through in situ & ex situ conservation

5. Protecting wild species - Sustainable, safe & legal use of wild species, preventing overexploitation.
6. Invasive alien species - Mitigating their impacts by reducing rates of introduction of 50%, controlling them in priority sites such as islands.
7. Tackling Pollution - Reduce pollution risks to levels that are not harmful to biodiversity & ecosystem functions.
8. Climate crisis - Minimise impact of climate change & ocean acidification through nature-based sol<sup>n</sup>.

### Meeting Human Req. through sustainable use

9. Serving humans - Ensure use of wild species yields benefits for humans, esp. yields benefits for humans those most dependent on biodiversity.
10. Ecosystem productivity - Sustainable management of areas under agriculture, aquaculture, fisheries, & forestry for resilience & long-term productivity.
11. Handling nature's contribution - restore, maintain & enhance nature's contribution to people through regulation of air, water & climate.
12. Biodiversity in urban fabric: Inc. the area <sup>and</sup> ~~under~~ quality & connectivity of, access to, & benefits from green & blue spaces in urban & densely populated areas.
13. Sharing genetic resources: Take effective legal, policy, administrative & capacity building measures to ensure equal sharing of benefits of genetic resources.

### Tools & Solution for implementation & mainstreaming

14. Policy making - Integration of biodiv & its values into policies across all levels of govt, other sectors.
15. Legal perils for businesses - Regular assessment fo by transnational firms of their risk, dependencies, impact on biodiversity, report on compliance with regulation.

17) Biosecurity Measures - Adopting measures steps for handling of biotechnology & distribution of its benefits.

18) Removal of harmful incentives: Identify by 2025, & eliminate / reform incentives harmful for biodiversity; cut them by \$500 bn per year by 2030.

19) Biodiversity finance - Inc. financial resources, mobilising \$200 bn per year by 2030.

20) Technical Cooperation: Strengthen capacity - building & dev.; access to & transfer of technology.

21) Sharing knowledge: Access to info by decision makers; practitioners & public; access to technologies of indigenous people only with their consent.

22) Equal representation: ensuring equitable representation in decision making.

23) Gender based review: A gender-responsive approach by recognising women's rights & access to natural resources.

### 30x30 Deal:

- ↳ Restore 30% degraded ecosystems globally (on land & sea) by 2030.
- ↳ Conserve & manage 30% areas (terrestrial, inland water & coastal & marine) by 2030.
- Stop the extinction of known species, & by 2050 reduce tenfold the extinction risk & rate of all species (including unknown).
- Reduce risk from pesticides by at least 50% by 2030.
- Reduce nutrients lost to the env. by at least 50% by 2030.
- Reduce pollution risks & -ve impact of pollution from all sources by 2030 to levels that are not

- harmful to biodiversity & ecosystem func<sup>n</sup>.
- Reduce global footprint of consumption by 2030, incl. through significantly inc. reducing overconsumption & waste generat<sup>n</sup> & having food waste.
- Sustainably manage areas under agriculture, aquaculture, fisheries & forestry & substantially inc. agroecology & other biodiv. - friendly practices.
- Tackle climate change through nature-based sol<sup>n</sup>.
- Reduce the rate of intro & establishment of invasive alien species by at least 50% by 2030.
- Secure the safe, legal & sustainable use & trade of wild species by 2030.
- Green up urban spaces.

### Sustaining Biodiversity

- Spatial & land / sea use planning to ensure that land, freshwater & marine resource use is appropriately situated to optimize product<sup>n</sup> w/o undermining or degrading biodiversity.
- Developing policy & regulatory framework that remove subsidies harmful to biodiversity & provide incentives for biodiversity - positive land and resource use that remains productive but that does not degrade biodiversity.
- Improving & changing production practices to be more biodiversity - positive & to promote sustainable use of biodiversity as appropriate with a focus on sectors that have significant biodiversity impact - agriculture, forestry, fisheries, tourism, extractive industries (gas, oil & mining) & infrastructure dev.
- Natural Capital Assessment & Accounting exercises designed to respond to specific decisions or policy questions.

### Tackling the Triple Planetary Crisis: A New Funding Paradigm

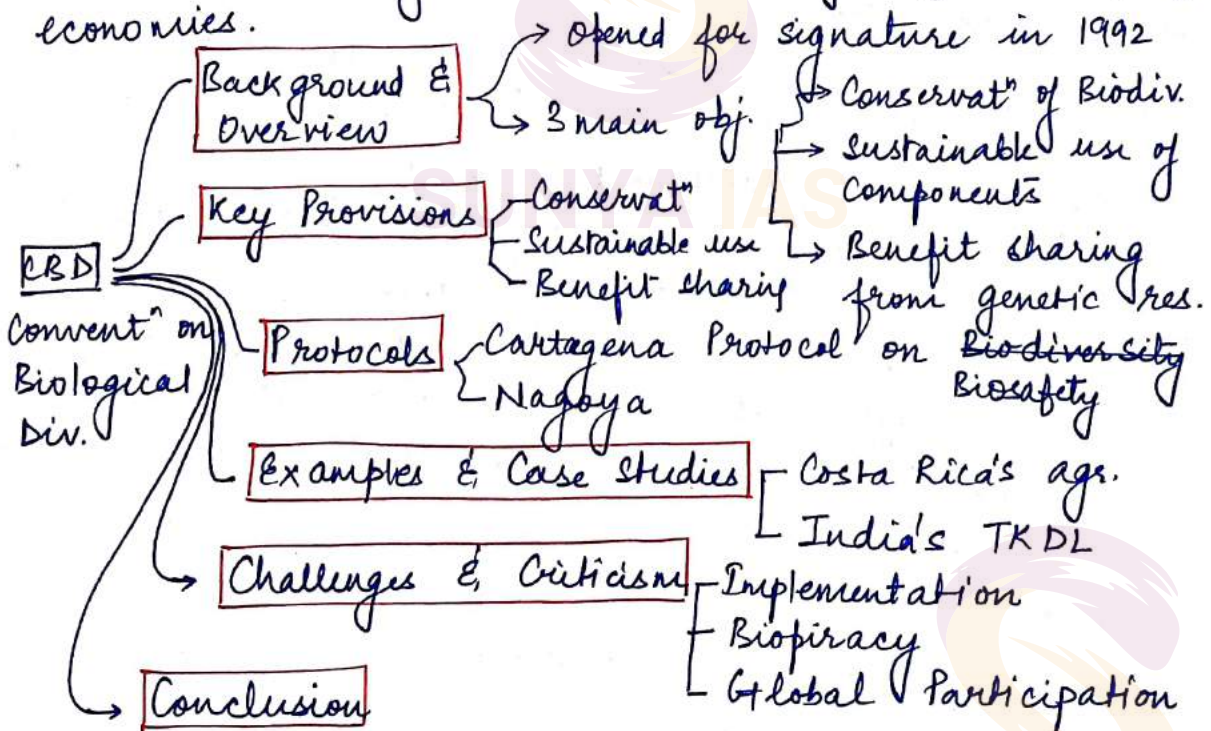
- Climate Stability ↔ Climate disrupt<sup>n</sup>
- Living in harmony with nature ↔ Nature & biodiv loss
- Towards a pollution free planet ↔ Poll<sup>n</sup> & waste

While the CBD has made significant strides in promoting biodiversity conservation, it faces challenges:

- Implementation - Many countries face difficulties in implementing provisions due to lack of resources or political will.
- Biopiracy - with corporations exploiting resources w/o fair compensation.
- Global Participation - Not all countries are signatories, which can lead to gaps in global conservation efforts.

High Ambition Coalition (HAC)

- India joins HAC for Nature & People.
- HAC members currently include a mix of countries in the global north & south; European, Latin American, Africa & Asia countries are among the mem. India is the 1<sup>st</sup> of the BRICS blocs of major emerging economies.



BIOFIN - Biodiversity Finance Initiative

- Launched by UNDP in 2012.
- This helps in implementing the national biodiversity action plan.

## UN Decade on Ecosystem Restoration

Telegram Channel: t.me/sunyanotes50

- UNGA has proclaimed the year 2021 to 2030 as the UN decade of ecosystem restoration.
- other partner org - UNEP, FAO.
- Obj - to achieve 30x30 target, COP15 of CBD, SDGs, Paris agreements, Ramsar Convention, UN Convention to combat desertification, global Partnership on Forest & Landscape restoration, and UNFCCC.

## UNESCO WHS (World Heritage Sites)

- UNESCO adopted the World Heritage Convention in 1972.
- Some sites are cultural & some are natural.
- Criteria: It must be of outstanding universal value. There are 10 criterias, it must ~~be~~ sld meet 1 of the 10 criterias.
- Natural heritage site comprise of:
  1. it sld give a furnish outstanding examples of Earth's record of life.
  2. Provide excellent examples of ongoing ecological & biological evolutionary process.
  3. Contain natural phenomenon that are rare, unique, superlative and/or are of outstanding beauty.
  4. Rare endangered animals or plants or exceptional biodiversity.

### # Natural Sites -

- Great Himalayan NP Conservation Area
- Kaziranga NP
- Keoladeo NP
- Manas WLS
- Nanda Devi & Valley of Flowers NP.
- Sunderbans
- Western Ghats
- Khangchendzonga NP - Mixed Site

### Great Himalayan NP

- Kullu, Himachal P.
- 1171 sq. km
- Flora: alpine, subalpine, oak, coniferous, pine + medicinal plants



SUNYA IAS

- Telegram Channel: t.me/sunyanotes50
- Fauna: > 375 species, incl. 31 species of mammals & 181 species of birds. Snow leopard, western tragopan, Himalayan brown bear, blue sheep, Himalayan Tahs.
  - UNESCO Status: Inscribed in 2014.

### Kaxiranga NP

- Golaghat & Nagaon district, Assam.
- 1030 sq. Km
- Flora: tall elephant grass, marshland, dense tropical moist broadleaf forests.
- Fauna: Indian One-horned rhinoceros, wild water buffalo, swamp deer. Birdwatcher's Paradise.
- UNESCO Status: Inscribed in 1985.

### Keoladeo NP

- Bharatpur, Raj
- 29 sq. Km
- Flora: dry deciduous forest + grasslands
- Fauna: > 230 species of birds + fish, invertebrates, amphibians, reptiles, mammals.
- UNESCO Status: Inscribed in 1985.

### Manas WLS

- Assam
- 2837 Km
- Flora: Semi-evergreen forests, mixed moist & dry deciduous forests, and alluvial grasslands.
- Fauna: Home to 22 of India's most endangered mammals incl. Assam roofed turtle, hispid hare, golden langur, pygmy hog.
- UNESCO Status - Inscribed in 1985, later listed as 'In Danger' from 1992 - 2011.

### Sunderbans

- Delta of Padma, Meghna, Brahmaputra river basin, West Bengal.
- 10,000 sq. Km, of which 4,262 sq. Km is in India.



- Flora - Mangrove incl. 84 species.
- Fauna - Bengal tiger, Indian python, *estuarine crocodile*, Indian Sundarbans mudskipper.
- UNESCO status - Inscribed in 1987.

### Nanda Devi & Valley of Flowers

- Chamoli, Uttarakhand
- Nanda Devi = 624.6 sq. km & Valley of Flowers = 87.5 sq. km
- Flora: Temperate forest with fir, birch, rhododendron, juniper trees. Valley of Flowers has over 300 species of wild flowers.
- Fauna: Endangered snow leopard, Himalayan musk deer, red fox.
- UNESCO status: Nanda Devi in 1988, Valley of flowers in 2005.

### Western Ghats - Gadgil Kasturirangam

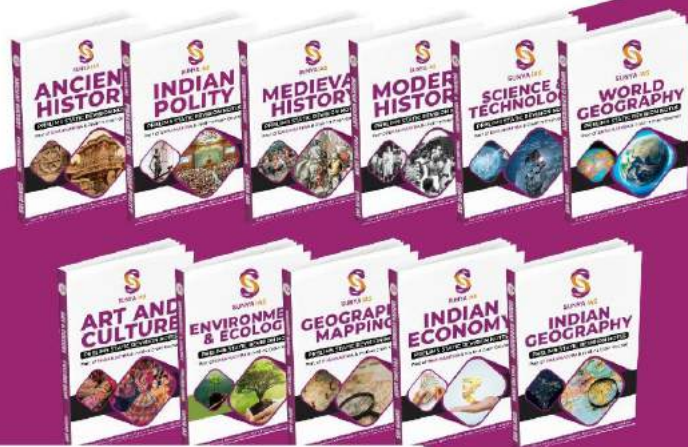
- Guj, Maha, Goa, Kar, Tamil N., Kerala
- 160,000 sq. km
- Flora: tropical wet evergreen & semi-evergreen forests to montane grasslands & shrublands. Home to around 7,402 species of flowering plants.
- Fauna: At least 325 globally threatened species, incl. the Nilgiri tahr, lion-tailed macaque, Indian elephant.
- UNESCO status: Inscribed in 2012.



SUNYA IAS

**FOR OTHER SUBJECT NOTES, DROP US  
A WHATSAPP ON 9311077443**

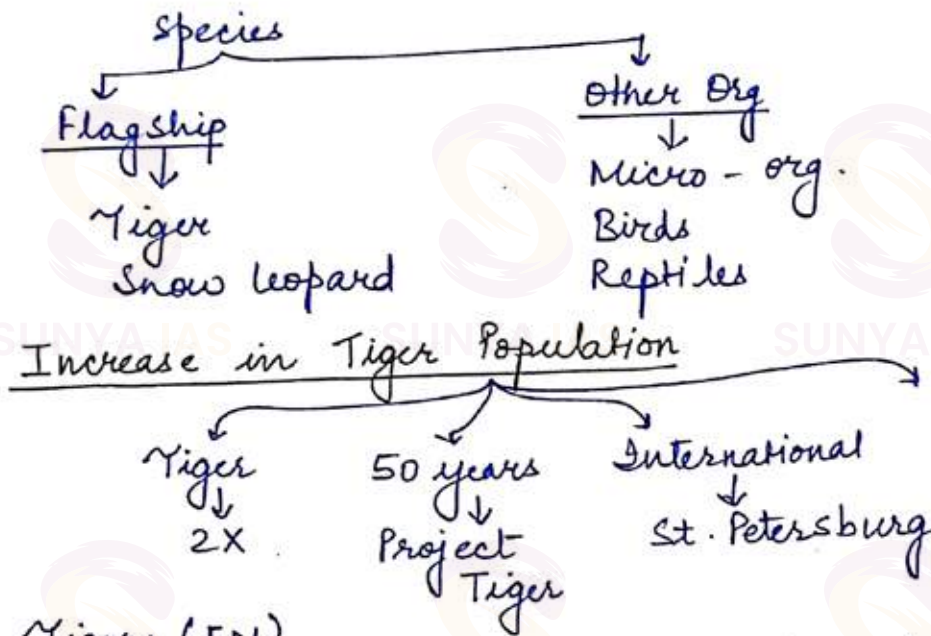
## **Lecture - 11 to 12 (Species Conservation)**



**PRELIMS 2024**

**STATIC REVISION NOTES**

Multiple Sources Covered in around 100 pages per subject



Tigers (EN)

NTCA approved Chattisgarh govt's proposal to declare combined areas of Guru Ghasidas NP & Tamor Pingla WLS as TR.

- TRs in India - 54.

Tiger Range Countries - WWF, TX2

↳ 13 tiger range countries - India, Nepal, Bhutan, China, Bangladesh, Myanmar, Vietnam, Laos, Thailand, Cambodia, Malaysia, Russia

- 1<sup>st</sup> country to double the population of Tiger - Nepal followed by India!

TX2 and CATS [Conservation Assured] Tiger Standards]

- Doubling wild tigers
- 1400 → 2006
- ↓
- 3200

• Not every tiger reserve in India has got CATS status.

Why Tiger Population conserving is a Challenge?

- 1) Fragmentation
- 2) Man and Animal Conflict (MAC)
- 3) Illegal - hunting, poaching
- 4) Encroachment
- 5) Reducing of Prey
- 6) Invasive species
- 7) Climate change

Q7) Among the following TR, which one has the largest area under 'Critical Tiger Habitat'?

- (a) Corbett
- (b) Ranthambore
- (c) Nagarjuna Sagar - Srisailem
- (d) Sunderbans.

Q8) Which of the following Protected Areas are located in Cauvery basin?

1. Nagarhole NP
2. Papikonda NP.
3. Sathyamangalam TR
4. Wayanad WLS

Select the correct answer:

- (a) 1 and 2 only
- (b) 3 and 4 only
- (c) 1, 3 and 4 only
- (d) 1, 2, 3 and 4

Q9) The term M-STRIPE is seen in context of

- (a) Captive breeding of wild fauna
- (b) Maintenance of TR
- (c) Indigenous satellite navigation system
- (d) Security of National highways.

Q10) From the ecological point of view, which of the foll. assumes importance in being a good link between the Eastern and Western Ghats?

- (a) Sathyamangalam TR
- (b) Nallamala Forest
- (c) Nagarhole NP
- (d) Seshachalam Biosphere Reserve.

Q11) Which of the foll. states Pakhui WLS located?

- (a) Arunachal P.
- (b) Manipur
- (c) Meghalaya
- (d) Nagaland

KAZI 106F → golden tiger found only in Kairanga NP. Telegram Channel: t.me/sunyanotes50

Tiger Census 2018 → MP (526) > Karnataka (524) > Uttarakhand (442)

- ↳ counting the tiger stripes
- ↳ 14,000 camera traps to be used.
- ↳ 3200m - altitude of highest spot under survey (in Arunachal)
- ↳ MSTRIPES mobile app to track, upload & geotag images.
- ↳ 55% of deaths - natural.

Project Tiger - 50 yr of Project Tiger (1973 → 2023)

- Centrally sponsored scheme of Min of Env, Forests and Climate Change.
- It provides central assistance to tiger range states for in-situ conservation of tigers in designated tiger reserves.
- Centre provides financial assistance of to States of 60% & 50% for expenditure on all non-recurring items & expenditure on recurring items respectively (90% in NE & Himalayan States)
- National Tiger Conservation Authority (NTCA) is the implementing agency.
- Resulted in ↑ in tiger popul<sup>n</sup> from 1411 in 2006 to 2967 in 2018. (Achieved targets in advance 4yrs).
- 14 TRs in India - CATS accreditation.
- NE suffered loss in population.
- Chattisgarh, Jharkhand, Odisha - ~~loss~~ declined.
- Largest contiguous tiger population in the world in Western Ghats (Nagarhole - Bandipur - Wayanad - Mudumalai - Satyamangalam - BRT Block) + Nagarjuna Srisaikalam Tiger Reserve (NSTR) - largest TR in the country.
- Big Cat Count - <sup>on</sup> steady rise.  $\left\{ \begin{array}{l} 2018 - 2967 \\ 2022 - 3167 \end{array} \right.$
- PM released the census while International Big Cat Alliance (IBC) in Karnataka's Mysuru, organised to mark 50 years of Project Tiger.

• IBCA is launched for conservation of 7 big cats - Tiger, Lion, leopard, Snow Leopard, Cheetah, Jaguar, Puma. Telegram Channel: t.me/sunyanotes50

• M-Stripes = Monitoring System for Tigers - intensive protection and ecological status. + It uses GPS to get tag photo-evidences & survey info.

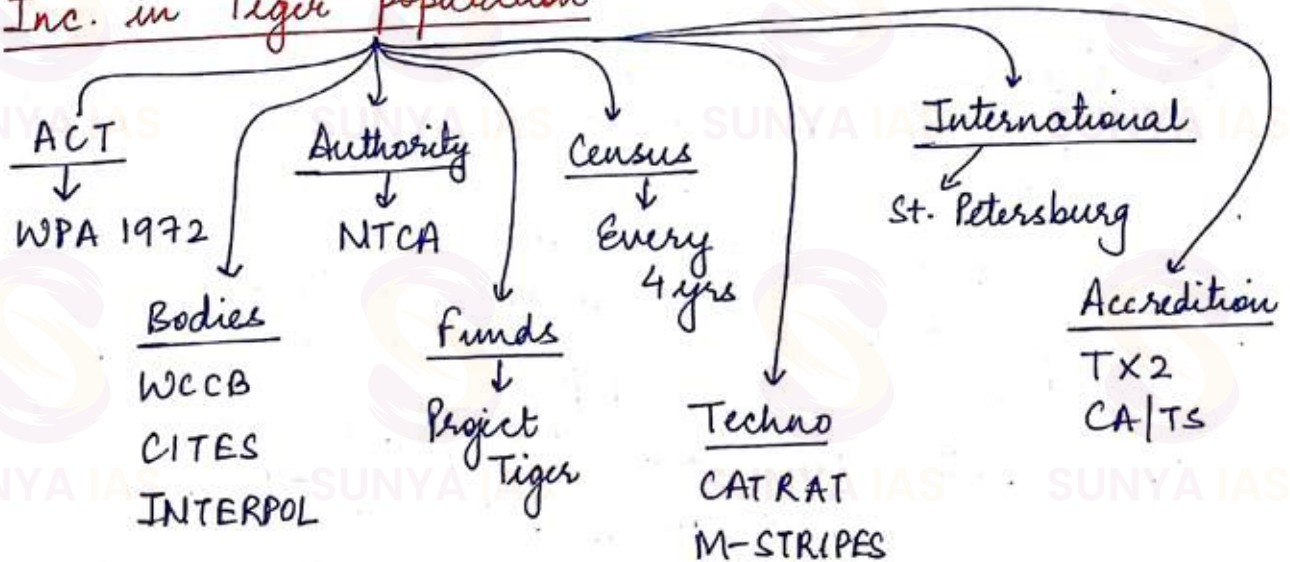
• CaTRAT = Camera Trap data Repository and Analysis Tool + for automated segregation of camera trap photographs to species.

• Failure of India's 1st Inter-State Tiger Relocation Project

→ Sundari - a tigress shifted as part of this project in 2018 from MP to Odisha - recently returned home

→ Project initiated in 2018 - 2 big cats, a male (Mahavir) from Kanha TR & female (Sundari) from Bandhavgarh from MP relocated to Satkosia TR in Odisha, to shore up the tiger population in the state.

• Inc. in Tiger population



NTCA - National Tiger Conservation Authority

→ Amendment to WPA created the body - NTCA.

→ It's a statutory body w/ Min of Env, Forest and Climate Change.

→ It administers Project Tiger.

- No alteration in the boundaries of the tiger reserve shall be made except on the recommendations of NTCA + Approval of National Board of Wildlife.
- No <sup>State</sup> govt. shall denotify a TR except in public interest with the approval of NTCA and National Board of Wildlife.
- It lays down standards, guidelines for tiger conservation.
- It prepares an annual report laid out to be in parliament.
- It collaborates with Wildlife Institute of India in carrying out the census.

### Snow Leopard

- only 500 remain in India.
- Native to High Himalayas
- Lipka Asrang wildlife sanctuary
- IUCN: Vulnerable
- CITES: Appendix I
- Wildlife (Protection) Act, 1972 : Schedule I.
- J & K, Ladakh, Himachal P., Uttarakhand, Arunachal P., Sikkim.
- Habitat: Cold High Mt +  
Uttarakhand - Nanda Devi Biosphere Res., Gangotri NP., Askot Wildlife S. etc. +
- 12 countries - China, Bhutan, Nepal, India, Pak, Afghanistan, Russia, Mongolia.
- Snow leopard Capital of the World - Hemis, Ladakh.  
↳ biggest NP in India
- Project Snow leopard launched in 2009.
- Bishkek declaration.

### Project Elephant

- 1992 / sponsored
- Centrally sponsored scheme
- It assists the states which have elephant population but its major role is to prevent the human animal conflict.
- Scientific & planned management for elephant conservation.

→ Haathi Mere Saathi - in 2011; initiative u/MOEFCC + Wildlife Trust of India.

→ E8 countries created - India, Botswana, Republic of Congo, Indonesia, Kenya, Sri Lanka, Tanzania, Thailand → to spread conservation related info.

→ Census (2017) - States: Kar > Assam > Kerala

Q) With reference to Indian elephants, Consider the foll. Statements:

1. The leader of an elephant group is a female.
2. The max. gestation period can be 22 months.
3. An elephant can normally go on calving till the age of 40 years only.
4. Among the states in India, the highest elephant population is in Kerala.

Which of the statements given above is/are correct?

- (a) 1 and 2 only  
(b) 2 and 4 only  
(c) 3 only  
(d) 1, 3 and 4 only

### MIKE - Monitoring the Illegal Killing of Elephants

→ MIKE Sites in India:-

Shivalik ER  
(Rajaji NP & Jim Corbett NP)

Chirang Ripu ER  
Eastern Dooars ER (Buxa NP)

Diking Patkai ER  
Deomali ER

Garo hills ER  
(Balpakram NP)

Mayurbhanj ER (close to Simlipal NP)

Mysore ER (Bandipur NP)

Wayanad ER  
Nilgiri ER.



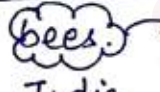
\* Lemru Elephant Reserve - in Chattisgarh.

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### Comparison - African vs Asian Elephant

- Asian - small ear, gestation period - 18 to 22 months, less hb.
- African - bigger ear, gest<sup>n</sup> period - 22 months, tall - more height.

### Elephants

- umbrella species, keystone species
- Ecological role played by elephants:
  1. Conservation of elephant leads to conservation of species in vicinity.
  2. If they are removed, it has disproportionate impact on ecosystem
  3. They have a nomadic behaviour
  4. They are national heritage animal of India.
  5. Imp. role in seed dispersal, trample down soil, nutrition.
  6. Role in forest regeneration.
- Project RE-HAB - Reducing elephant human attacks using  → Waggle dance  
Khadi India

→ Elephant Corridors

### Cheetah Reintroduction

→ <sup>African</sup> Cheetahs coming 8 from Namibia & 12 from SA to Kuno NP, MP.

[ Asiatic Cheetah - only in Iran ]

- Vulnerable, Bigger - African Cheetah
- CR, smaller - Asiatic Cheetah

### Kuno Pappur National Park

- close to Sal forests of Chattisgarh.
- Unique combination of forest & vegetation in the entire MP.
- Natural habitat for leopards in India.

Banni grasslands

- in Kachch, Guj.
- Concern? - Vegetation
  - No human settlement
  - Scope for co-existence here - tiger, lion, leopard.

Cheetah reintroduction - Why?

- Predators
- Better ecosystem
- Gene pool

Cheetah reintroduction - Challenges

- Long term coexistence of many predators
- Acclimatization of African cheetahs
- Resources reqd.

Asiatic Lion

- is in International Big Cat (IBC) Alliance
- Only abode GIR NP, Guj.
- lion count on the rise.
- Gujarat: SIMBA to give distinct identity to each Asiatic lion
  - SIMBA is a computer-assisted photo identification tool.
  - Help in identifying individual lions + understand populat<sup>n</sup> demographics.
  - Help in studying population dynamics, dispersal & social sys. of lions
  - create unique database of each individual
  - Easy to identify and locate all lions
- Census after every 5 years.

B) Recently there was a proposal to translocate some of the lions from their natural habitat in Gujarat to which one of the following sites?

a) Corbett NP.

- Telegram Channel: t.me/sunyanotes50
- (b) Kuno Palpur wildlife Sanctuary
  - (c) Mudumalai wildlife Sanctuary
  - (d) Sariska NP.

→ Asiatic lion deaths:

- a) Canine distemper virus
- b) due to Covid-19
- c) Babesiosis → Ticks

### Project lion

- Implemented in Gir region, Guj which is the last abode of Asiatic lions.
- It includes restoring the habitat of Asiatic lions.
- Veterinary services.

### Rhinos

→ 'State of the Rhino 2020'

- a) White Rhino
- b) Greater one horned Rhino
- c) Black Rhino
- d) Javan Rhino
- e) Sumatran Rhino

- Out of these rhinos, only the great one horned rhino found in India. Also, this is the largest among the available rhino species. African & Sumatran rhinos have 2 horns whereas Indian & Javan have only 1 horn. In Indian Rhino, horn is present in both males and females.
- Largest population of 1 horned Rhino is <sup>in</sup> Kaziranga NP, Assam.

### The Indian Rhino Vision 2020

- Bodo territorial Council, govt. of Assam have come together to build 3000 wild population of rhinos by the year 2020. Related to one horned rhino.

→ Imp. NPs and WLS

- a) Manas NP
- b) Pobitora WLS
- c) Kaziranga NP
- d) Orang NP
- e) Laokhowa WLS
- f) Burachapori WLS
- g) Dibru-Saikhowa NP.

→ Imp. minerals like Keratin present in one horned rhino - used in traditional medicines.

→ The GoI has launched a project 'National Conservation Strategy' to create DNA profiles of all the Rhinos.

→ In 2019, there was declaration of rhinos - New Delhi Declaration on Asian Rhinos. This was endorsed by 5 Rhino range countries - India, Nepal, Bhutan, Indonesia, Malaysia.

### Pangolins

→ Out of 8 species of Pangolin, 2 are found in India - Indian and Chinese.

→ World's largest trafficked mammals because of scales that they have.

\* Zoonotic diseases - Nipah virus - Kerala

### Deers

→ Sangai - sub species of brow antlered deer in Manipur  
↳ state animal

- Keibul Lamjao NP
- Loktak lake

→ Hangul / Kashmir Stag

→ Indian hog deer

→ Nilgiri ibex / Tahr

→ Barasingha / Swamp deer

Q) Which one of the following protected areas is well-known for the conservation of a sub-species of the Indian Swamp deer (Barasingha) that thrives well on hard ground & is exclusively gaminivorous?

- a) Kanha NP
- b) Manas NP
- c) Mudumalai RPP WLS
- d) Tal Chhapar WLS

\* Bhorsingh the Barasingha - Kanha TR becomes 1st in India get official mascot.  
→ State animal of UP and MP.

### Vultures

→ Population drop.

→ Census conducted by scientists at the Bombay Natural History Society (a Conservation NGO), along with teams from the 13 states & the MoEFCC.

→ 9 species of vultures found in India. Out of them,

4 are CE:

1. White rumped vulture
2. Red headed vulture
3. Long billed Vulture
4. Slender billed vulture

→ Vultures are dying due to Diclofenac. (non-steroidal anti-inflammatory drug administered to livestock).

This causes renal failure in vultures. Other 3 are Aceclofenac, Nimesulide, Ketoprofen. Safe alternative is Mexoxicam.

→ Steps taken by govt. to conserve vultures:

1. National Action Plan for Vulture Conservation, (APVC) 2020-2025.
2. Vultures added to species recovery program.
3. Creation of vulture restaurants.
4. Creation of ~~vulture~~ vulture safe zones. [1 in each state]

- 1<sup>st</sup> VCBC - Pinyore
- 1<sup>st</sup> Vulture restaurant - Phansad [2015]
- Conservation breeding centres - Ex: UP/ Yrupura / MH/ Kar/ T.N
- Pinyore / Bhopal / Guwahati / Hyd.

## Dolphins

- Gangetic Dolphin - National aquatic animal of India; an indicator species; state aquatic animal of Assam; aka Susu becoz of the sound it emits when it moves in freshwater. Only Gangetic dolphin present in CMS - Convention for Migratory Species.
- Females longer in size.
- All dolphins - EN
- India's and Asia's 1<sup>st</sup> National Dolphin Research Centre (NDRC) coming up in Patna Univ, Bihar.
- Distribution of Gangetic Dolphin - Ganga, Brahmaputra, Meghna.  
Found only in freshwater.
- Gangetic and Indus dolphin found in India, Pak, Bangladesh, Nepal.
- Indus Dolphin - found in Indus r., Pak, Beas & Sutlej. Beas is the only habitat of Indus dolphin in India.
- Irrawady Dolphin - found in brackish water (Irrawady, Mekong & Ganga r. + Chilika lake in Odisha).

## Crocodiles

- Odisha - only state in India to have 3 species of crocodiles. → 1) Mugger 2) Gharial 3) Saltwater Crocodile

→ Gharial - CE; only viable population is in Chambal or National Chambal Sanctuary spread in 3 states - UP, Raj, MP; are fish eating eating freshwater crocodiles; these are among the longest of all the living crocodiles.

→ Threats - river pollution, oil spills, ghost fishing, nets

→ Mugger - It's a fresh water species.

→ Salt water Crocodile - found in brackish regions.

↳ Salt water crocodiles is the largest living ~~re~~ reptile whereas Gharial was the longest.

↳ found in - Bhitarkanika in Odisha, Andaman & Nicobar

### Turtle

→ Difference b/w Turtle and Tortoise :

- TORTOISE
- Domed, heavy shell
  - Short, sturdy feet + bent legs
  - lives on land
  - All tortoise are turtles
  - Eats only plants [Herbivores]
  - Bad swimmers bcoz mostly live on land
  - Lifespan - live far longer (80 to 120 years)
  - Bigger

- Flat TURTLE
- Streamlined light shell
  - Flipper like legs, webbed feet
  - lives in water [comes to land to lay eggs]
  - All turtles are tortoises.
  - Eats both plants and animals. [Omnivores]
  - Good swimmers
  - lifespan - short (20 to 40 yrs)
  - Smaller
- \* Olive Ridley Turtle does a lot of mass egg hatching or nesting known as Arribada.

→ 5 basic species -

- a) Green sea turtle - only herbivorous species
- b) Olive Ridley (Gahinmatha Beach) - operation Olivia -

- a) Kemp Ridley Turtle - world's rarest and smallest sea turtles - found in North Atlantic region. Also carry out Arribada.
- c) Leather back - largest of the living sea turtles.
- d) Hawksbill - (CE) - migratory species - A & N, of TRR. Tamil coast.
- e) Loggerhead - multiple seas & oceans.

→ Threats :

a) Onshore :

Loss of Nesting beach

- Natural Causes - erosion, shifting sands, ipomoea invasion, cyclones, global warming, climate change.
- Anthropogenic Causes - Casuarina plantations, sand mining.

Coastal Dev. →

Disturbance & loss of nesting beaches due to construction of ports, jetties, resorts, industries etc

Pollution

- light pollution
- Marine plastic debris & pollution caused due to construction of ports, fish landings, resorts or tourism activities on or near the beach

Nest Predation

- by wild predators like jackals, wild pigs etc. as well as by the feral & domesticated dogs.

b) Offshore :

Fishing Related Mortality

- Bycatch due to near shore fishing, trawling, gill netting.

offshore Oil Explorations

- Destruction of habitat, oil spills, disturbance due to excessive movement of vessels



↓  
Pollution  
↓  
Disease

Plastics, Oil Spills, discharge from coastal industries & sewage.  
Fibropapillomatosis caused by water pollution.

→ National Marine Turtle Action Plan (2021-26) and Marine Mega Fauna Stranding Management Guidelines.

→ India is home to 3 crocodile species. They are:

a) Gharial - CE

b) Mugger aka Broad Snouted Crocodile or Marsh Crocodile - Vulnerable

c) Saltwater Crocodile - CE.

### Species Recovery Program

22. Caracat

1. Asian Wild Buffalo

2. Asiatic lion

3. Brow-antlered Deer or Sangai

4. Dugong

5. Edible Nest Swiftlet

6. Gangetic River Dolphin

7. Great Indian Bustard

8. Hangul

9. Indian Rhino or Great One-horned Rhinoceros

10. Jerdon's Courser

11. Malabar Civet

12. Marine Turtle

13. Nicobar Megapode

14. Nilgiri Tahr

15. Snow leopard

16. Swamp deer

17. Vultures

18. Northern River Terrapin

19. Clouded leopard

20. Arabian Sea Humpback whale

21. Red Panda

Elephants

- Engineers of the ecosystem.
- 3 varieties -
  - 1) Asian - endangered
  - 2) African Savanna (largest) - endangered
  - 3) African forest (smallest) - Critically Endangered.
- Herbivores
- Habitat - destruction
- Project elephant launched in 1992. It is a centrally sponsored scheme with the objective of:-
  - 1) long term survival of viable population of elephant.
  - 2) Reduce the man animal conflict
  - 3) To ensure the welfare of captive elephants.
  - 4) This project aims to establish elephant corridors & elephant reserves.
- Census: Karnataka > Assam > Kerala  
(27,000 elephants)
- Elephants follow Matriarchy in which the oldest female leader the group. They have longest gestation period among all mammals i.e. 26 weeks & adult male elephant live alone.
- Recent Elephant Reserves
  - ↳ Tamil N. & Assam have the highest no. of elephant reserve.
  - ↳ The elephant is India's Heritage animal.
  - ↳ 33rd elephant reserve - Terai Elephant reserve in Dudhwa - Pilibhit region of UP.
  - ↳ Lemru in Chattisgarh & Agasthyamalai in TN.
  - ↳ Mysore ER in Kar is the largest ER.

Olive Ridley Turtle

- They are also called Pacific Ridley sea turtles.
- It is the most abundant sea turtle.
- They are carnivores in nature.

→ Threats: a) Fishing nets  
b) Poaching  
c) light pollution disturbs their migration & movt.

→ Mass Nesting ⇒ Arribada (Gahirmatha Beach) → largest nesting site in India.

↳ b/w Nov to March

↳ Sites in India ⇒ Odisha, Andhra P. & TN

↳ They keep travelling through the year in the oceans but come to a specific place for mass nesting.

↳ Sri Lanka, Atlantic Ocean, Mexico, Costa Rica

↳ Gahirmatha Beach → lies along Brahmani

forms boundary of Sanctuary in East + largest colony of Olive Ridley Sea Turtles

↳ Baitarni delta, north of Mahanadi

→ Programs for their Conservation

only [a) Operation Olivia by Indian Coast Guard.

olive [b) Operation Save Kurma by Wildlife Crime Control Bureau, to support mass nesting & also control poaching.

Ridley [c) The Sea Turtle Project - by the Wildlife Institute of India, is for all turtle species in India.

→ Leatherback Sea Turtle - found in A & N Islands & is the largest sea turtle species.

→ Kemp's Ridley Turtle - the smallest sea turtle species.

### Project Snow Leopard

→ Started in 2009.

→ There are 12 snow leopard range countries.

→ Bishkek Declaration: signed by all 12 snow leopard countries.

→ Total 7500 snow leopards in world.

→ Highest :- China > Mongolia > India

Tiger: India > Russia

→ They are also called - Ghost of Mountains

→ IUCN Status - Vulnerable

→ Threat: a) Loss of prey

b) Poaching

c) Habitat destruction

d) Man-Animal Conflict

### Clouded leopard

→ State animal of Meghalaya

→ Vulnerable - IUCN

→ lives in dense forest & high precipitation

→ Available in the rainforest of NE, good climber & elusive.

→ As good as monkeys at climbing trees.

### Fishing Cat

→ Vulnerable

→ Found in wetlands, mangroves, swamps & lakes.

→ Nocturnal, is found in eastern India & many countries of SE Asia.

→ State animal of W. Bengal

→ Found in Sunderbans & Bhitarkanika NP.

→ Observed in some parts of Western ghats

→ WII will beg in collaring fishing cats in Coringa WS in Andhra P. ↳ to estimate its no.

### Rhino - Great One horned Rhino

→ It is a herbivore, found mainly in the Northern plains.

→ Now it is mainly in Assam region [Kaziranga NP]

→ Vulnerable

→ Horn is composed of Keratin & it is in very high demand & it is poached for its horn.

→ Indian Rhino is very fond of water & found in Aquatic & marshy regions + they are good swimmers.

→ Present location ⇒ Assam, UP, Bihar, Nepal & Bhutan borders.

→ Indo Rhino Vision - started in 2005

- the deadline was to achieve the target of 3000 by 2020.

Telegram Channel: t.me/sunyanotes50

- Aim: to relocate the Rhino outside Kaziranga to Manas NP, Dibru - Saikhowa BR.

### Black Buck

- Least Concerned
- Found in dryland and grassland habitat

### Brow-Antlered Deer (Sangai)

- Endangered
- Found in Loktak lake of Manipur.
- Aka dancing deer.

### Indian Gaxelle (Chinkara)

- Least Concern

### Musk Deer

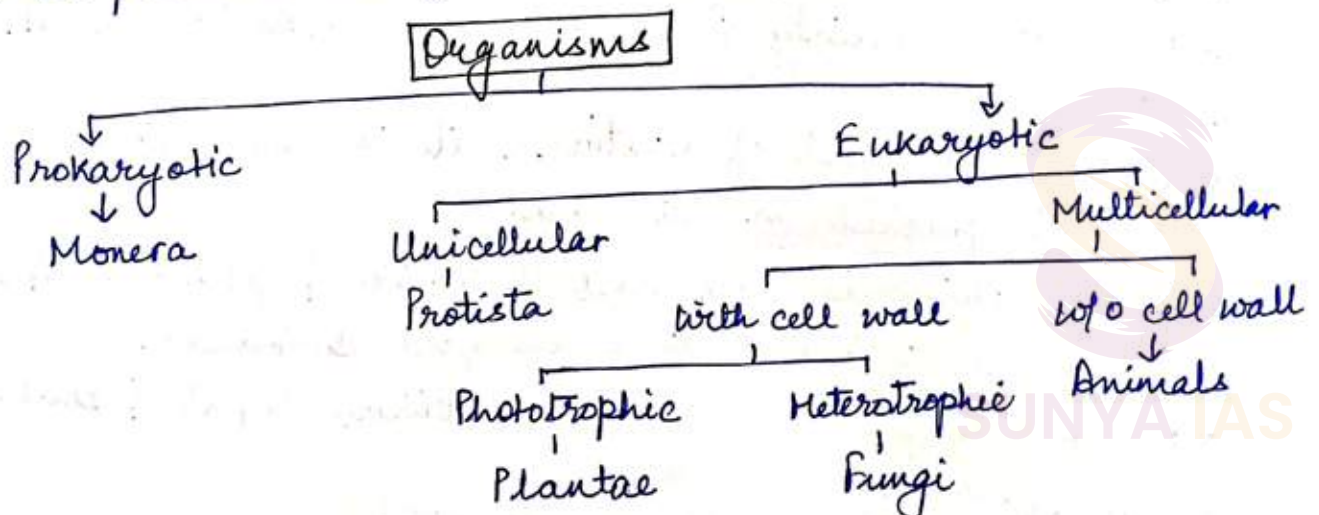
- EN
- Found in Askot WS
- It has long teeth but it does not have horns or antlers.

### Swamp Deer (Barasingha)

- State animal of UP & MP.
- Vulnerable

### Tibetan Antelope (Chiru)

- Near threatened
- It produces the finest wool → Shahtoosh Wool



## Eukaryotic Cells

↳ contain a nucleus & organelles bound by plasma membrane

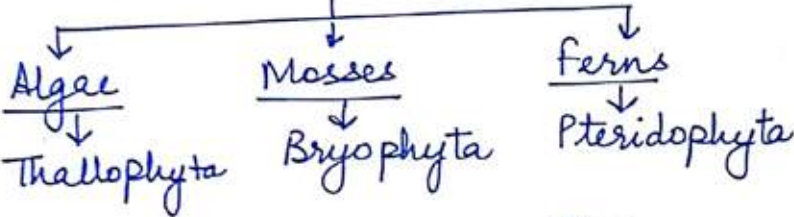
## Prokaryotic Cells

↳ do not have a membrane bound nucleus or organelles

## Plant Kingdom

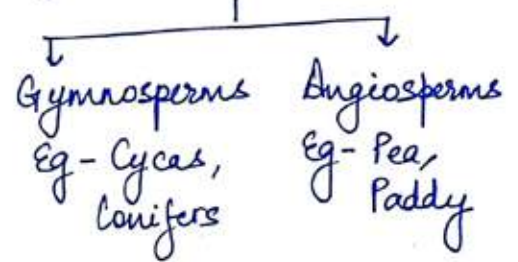
### Cryptogams

- 1) Reproductive organs are hidden
- 2) Reproduction happens w/o seeds (but with spores)



### Phanerogams

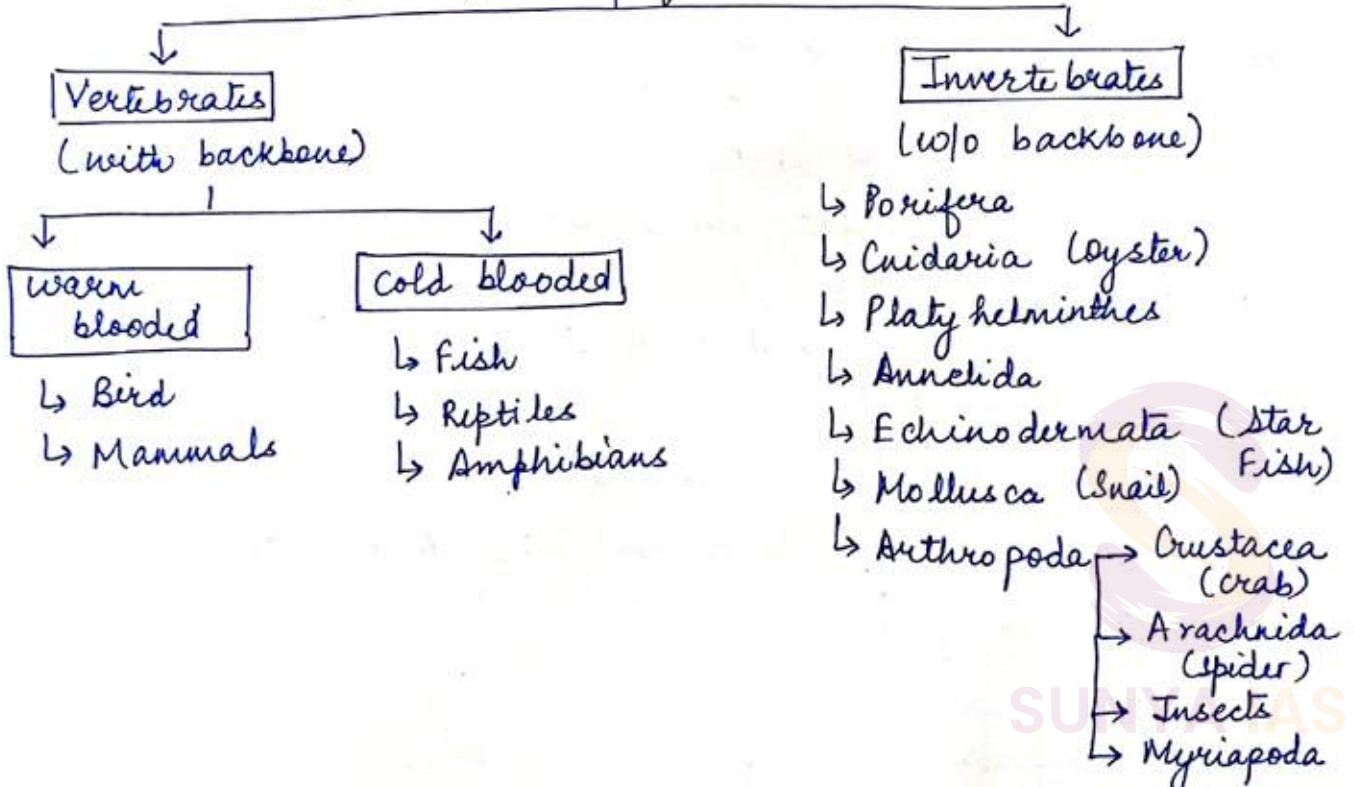
- 1) Visible
- 2) With seeds



Note - Recently, India's 1<sup>st</sup> Cryptogamic garden was set up in Dehradun, Uttarakhand.

- ↳ Bryophytes ⇒ Non vascular land plants [Mosses]
- ↳ Pteridophytes ⇒ Seedless vascular plants [Ferns]
- ↳ Gymnosperm ⇒ Pollen & 'naked' seeds [Conifers]
- ↳ Angiosperm ⇒ flowers & fruit

## Classification of Animals



Critically Endangered Birds

- 1) Baer's Pochard (*Aythya baeri*)
- 2) Forest owl (*Heteroglaux blewitti*)
- 3) Great Indian Bustard (*Ardeotis nigripes*)
- 4) Bengal Florican (*Houbaropsis bengalensis*)
- 5) Siberian Crane (*Grus leucogeranus*) → Keoladeo NP (Raj)
- 6) Spoon-billed sandpiper (*Euryrhynchus pygmaeus*)
- 7) Socially lapwing (*Vanellus gregarius*)
- 8) Jerdon's Courser (*Rhinoptilus bitorquatus*)
- 9) White backed vulture (*Gyps bengalensis*)
- 10) Red headed vulture (*Sarcogyps secalus*)
- 11) White bellied heron (*Ardeainsignis*)
- 12) Slender billed vulture (*Gyps tenuirostris*)
- 13) Indian vulture (*Gyps indicus*)
- 14) Himalayan Quail (*Ophryxia superciliosa*)
- 15) Pink headed duck (*Rhodonessacaryophyllacea*)

[Note] - 4/9 vultures are critically endangered.

- 16) Bugun liocichla → <sup>only found in</sup> Eagle's nest W & S (Arunachal P.)
- 17) Yellow breasted bunting

Great Indian Bustard (GIB)

- These are the heaviest flying birds.
- Almost 90% population decline in 50 years time.
- Largest population → Thar desert (Raj)
- State bird of Raj
- Found in the dry grassland of Raj, Gujarat (Kachch), MP, MH and Kar. & Kurnool in Andhra P.
- |                         |         |
|-------------------------|---------|
| MP, MH                  | Kar.    |
| ↓                       | ↓       |
| Solapur &<br>Chandrapur | Bellary |
- Only 150-200 GIB left.

- 90% of their population is in Raj and Guj.
- It is an indicator species of grasslands.
- Bustard species found in India:
  - 1) Great Indian Bustard.
  - 2) Lesser Florican
  - 3) Bengal Florican
- Reasons for declining population:

- 1) Poaching
- 2) Degradation of habitat
- 3) Collision with the power lines as they are too heavy to divert their pathway when they see the power lines closely. ∴ SC directed WII to underground the power lines & installation of bird diverters. [But the solution is time taking & too costly].

→ GIB is covered under centrally sponsored scheme of Integrated Dev. of wildlife habitat.

Terdou Courser

→ Location - Eastern Ghats of Andhra P.  
 ↓  
 Sri Lanka Malleshwar WLS which has scrub forest vegetation.

Asian Waterbird Census

→ It is coordinated by

- 1) Bombay Natural History Society
- 2) Wetlands International

Flame throated Bulbul → State Bird of Goa
---

→ Pulicat lake - Andhra P. & TN. border

Nelapattu BS - Andhra P.

Integrated Development of Wildlife Habitat / Species Recovery Program

- Centrally sponsored scheme (MoEFCC)
- National Board for Wildlife - authority to add to remove the species from list.
  - ↳ headed by PM
  - ↳ apex body related to wildlife conservation.



- list :
- 1) Asian Wild Buffalo
  - 2) Asiatic lion
  - 3) Brown - antlered deer / Sangai
  - 4) Dugong
  - 5) Edible nest swiftlet.
  - 6) Gangetic River Dolphin
  - 7) Great Indian Bustard
  - 8) Hangul
  - 9) Indian Rhino / Great one horned Rhino.
  - 10) Jordan's Courser
  - 11) Malabar civet
  - 12) Marine Turtles
  - 13) Nicobar Megapode
  - 14) Nilgiri Tahr
  - 15) Snow leopard
  - 16) Swamp deer
  - 17) Vultures
  - 18) Northern River Terrapin (CE)
  - 19) Clouded leopard
  - 20) Arabian Sea humpback whale
  - 21) Red Panda (EN)
  - 22) Caracal

- # Golden Langur (EN) → Assam, Tripura  
 Nilgiri langur (VU) → TN, Kerala, Kar.  
 Lion Tailed Macaque (EN) → Western Ghats, Save  
 Silent Valley Project

### Critically Endangered Mammals

- 1) Pygmy Hog → Manas NP
- 2) Andaman white toothed shrew
- 3) Jenkin's Andaman Spiny shrew
- 4) Nicobar white-tailed shrew

- 5) \*Kondana Rat
  - 6) Elvira Rat or large rock rat  $\Rightarrow$  TN
  - 7) Namdapha Flying squirrel  $\rightarrow$  Arunachal
  - 8) Malabar Civet
  - 9) Sumatran Rhinoceros
  - 10) Javan Rhinoceros
- ] Not found in India

### Critically Endangered Reptiles

- 1) Gharial  $\rightarrow$  Chambal region
- 2) Hawksbill Turtle
- 3) Leather back turtle
- 4) Four toed River Terrapin
- 5) Red crowned roofed turtle or Bengal Roof Turtle
- 6) Sispara day gecko (Lizard)

### Critically Endangered Fish

- 1) Pondicherry Shark
- 2) Ganges Shark
- 3) Knife tooth sawfish
- 4) Large tooth sawfish
- 5) long-comb sawfish / Narrow snout sawfish

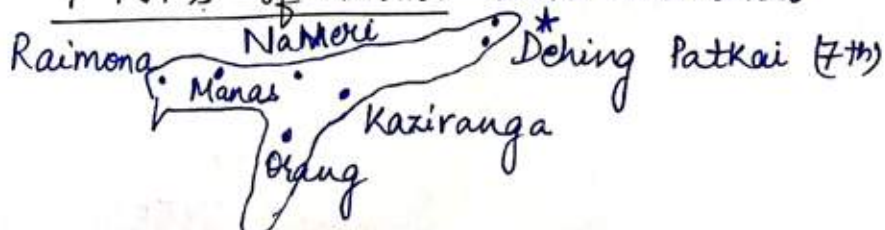
### Critically Endangered ~~Cats~~ Corals

Fire Corals

### Critically Endangered Spiders

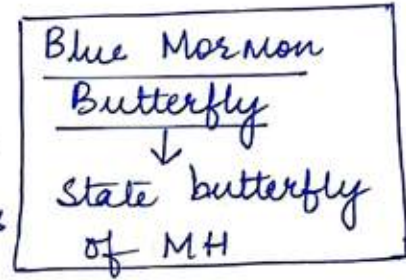
- 1) Rameshwaram Ornamental / Rameshwaram Parachute
- 2) Gooty Tarantula, Metallic Tarantula or Peacock tarantula

### 7 NP's of Assam Dibru Saikhowa



Kaiser-i-Hind Butterfly

- State butterfly of Arunachal
- Mid & high altitude



Locusts → to kill → pesticides { Malathion  
Chlorpyrifos

→ Grasshopper + omnivorous

- 4 species :
- 1) Desert
  - 2) Migratory
  - 3) Bombay
  - 4) Tree

Locust watch org <sup>n</sup> under FAO
--

- 3 breeding seasons :
- 1) Summer
  - 2) Spring
  - 3) winter

- Locust Warning Organism<sup>n</sup> under M/o Agriculture.
- Change in Cyclonic patterns over the Arabian sea is behind the locust invasion in East Africa, West & South Asia.
- unusual rainfall in Iran helped in their breeding.
- The recent infestation of Desert Locust is closely linked to climate change.
- Locust infestation can harm livelihoods & ultimately impact food security.

Dragonflies

- 1st global assessment - 16% are at risk of extinction
- Sensitive indicators ⇒ indicator species of freshwater ecosystem.

Dugong

- India's 1st Dugong Conservation → TN
- Marine mammal + Herbivore
- Sea cow
- Dugong & Seagrass Conservation Project <sup>GEF</sup> <sup>UNEP</sup>

- Population ↓ at an alarming rate
- Not endemic to India.

Wolbachia Mosquito

- Controlling dengue population by using bacteria.
- Wolbachia are natural bacteria present in around 60% of insect species including some mosquitoes. However, Wolbachia is not usually found in *Aedes Aegypti*. Then wolbachia is safe for humans, animals & environment.
- *Aedes Aegypti* mosquito female transmits - Dengue, Chikungunya, Zika & Yellow fever.
- *Aedes Aegypti* mosquito cannot spread these diseases, if it is artificially infected with this Wolbachia bacteria.

Tardigrade

- These are the most resilient species known to us.
- These are extremophiles (live in most extreme conditions), surviving for upto 30 yrs w/o food or water.
- These are microscopic multi-cellular organisms known to tolerate extreme physiochemical cond<sup>n</sup> through a latent stage of life k/a Cryptobiosis.
- Aka water bears.
- New Species ⇒ Batillipes kalamii  
↓  
2nd marine tardigrade species ever discovered in Indian waters & 1st to be identified in the East Coast.



## Mudumalai NP (TN)

Telegram Channel: t.me/sunyanotes50

- It has tall grasses k/a Elephant grass.
- Mudumalai means → the ancient hill range.
- located in Nilgiri district, TN @ tri-junction of 3 states -  
Kar, Kerala, TN.
- Moyar river
- Invasive species → Senna Spectabilis.

## Arukkampatti BHS (TN)

- Anaikondan lake (built by Pandiyar kings in 16th c.)
- Megalithic structures, rock cut temples, Tamil Brahmi inscriptions.

Nallur Tamarind Grove  
in Kar → 1<sup>st</sup> Biodiversity  
Heritage Site (BHS) of  
India, declared in 2007.

## Squirrel

- Omnivorous
- Black Squirrel, Malayan Giant Squirrel
- \* Colour diff. due to Melanocortin 1 Receptor (MC1R) gene.

## Hybodont Shark - of Jurassic age.

- Its teeth discovered - 1st time - from Jaisalmer by Geological Survey of India (GSI)

Q) W.r.t India's Desert NP, which of the following statements are correct?

1. It is spread over 2 districts.
2. There is no human habitation inside the park. X
3. It is one of the natural habitats of the Great Indian Bustard.

Select the correct answer:

- (a) 1 and 2 only  
(b) 2 and 3 only

- (c) 1 and 3 only  
(d) 1, 2 and 3

Q) W.r.t India's biodiversity, Ceylon Teardrop, Capped Woodpecker, Barbet, Gray-chinned minivet & White-throated Redstart are

- (a) Birds
- (b) Primates
- (c) Reptiles
- (d) Amphibians

Q) Consider the following pairs:

<u>Wildlife</u>		<u>Naturally found in</u>
1. Blue finned Mahseer	:	Cauvery river
2. Irrawaddy dolphin	:	Chambal river
3. Rusty-spotted cat	:	Eastern ghats

Which of the pairs given above are correctly matched?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

**FOR OTHER SUBJECT NOTES, DROP US  
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## **Lecture - 13 (Legislations)**

**MAINS 2024 | GS 1 | GS 2 | GS 3 | GS 4**



**MAINS GS PAPER-WISE NOTES**

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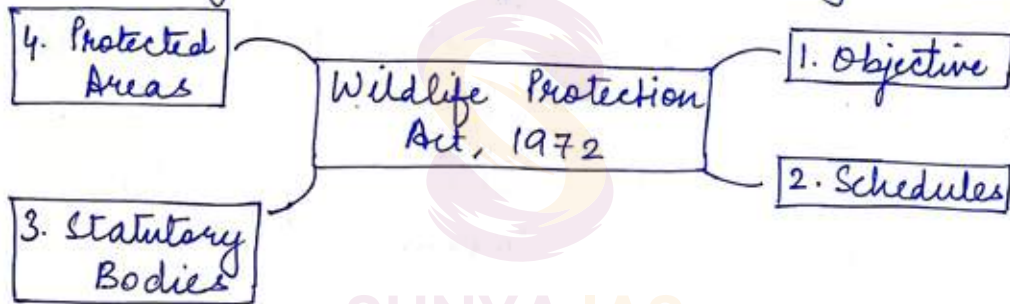


WPA, 1972

- Added by 42nd CAA - Art 51 A(g)
- It states that it shall be the duty of every citizen to protect and improve the natural environment incl. forest, lakes, rivers, wildlife and have a compassion for living creatures.

↳ This is a Fundamental Duty.

- Art 48 (a) - is a DPSP. - says that the state shall endeavour to protect & improve the env. & to safeguard the forest and wildlife of the country.
- Art 21 - Right to a safe and healthy environment



→ Objective: To protect wild animals, birds, plants & matter connected with them.

- Appointment of Wildlife Advisory Board, Wildlife Warden.
- Central Zoo Authority & National Board for Wildlife.
- Establishment of national parks, wildlife sanctuaries, conservation reserve, community reserves & tiger reserves.
- License for trade & commerce and some wildlife species & ban trade or commerce in scheduled animals. (CITES)
- In-situ & ex-situ conservation of wildlife.
- Regulations for hunting wild animals & birds.
- Management of zoo.
- Impose penalties on the violation of the act.



SUNYA IAS

1. MC Mehta vs UOI  
(related to Taj Mahal & was instrumental in the setting up of Taj Trapezium Zone - TTZ)
2. Union Carbide Case
3. Godavarman Case - 1996
4. Great Indian Bustard - 2022 (principle of biocentrism)

→ There are 6 schedules which gives varying degree of protection:

1. Schedule I & II provides absolute protection with highest penalties for violation.
2. Schedule III & IV species are also protected, but the penalties are lower.
3. Schedule V includes 'vermin' animals, which can be hunted.
4. Schedule VI includes endemic plants that are prohibited from cultivation and planting.

→ WPA (Amendment) 2006: Created National Tiger Conservation authority & Wildlife Crime Control Bureau (WCCB).

→ Schedule VI - No person is allowed to cultivate a specified plant mentioned in schedule VI except with a license granted by the chief wildlife warden.

Ex- Blue vanda, Cycad, Kuth, Red Vanda, Pitcher plant, ladies slipper orchids.

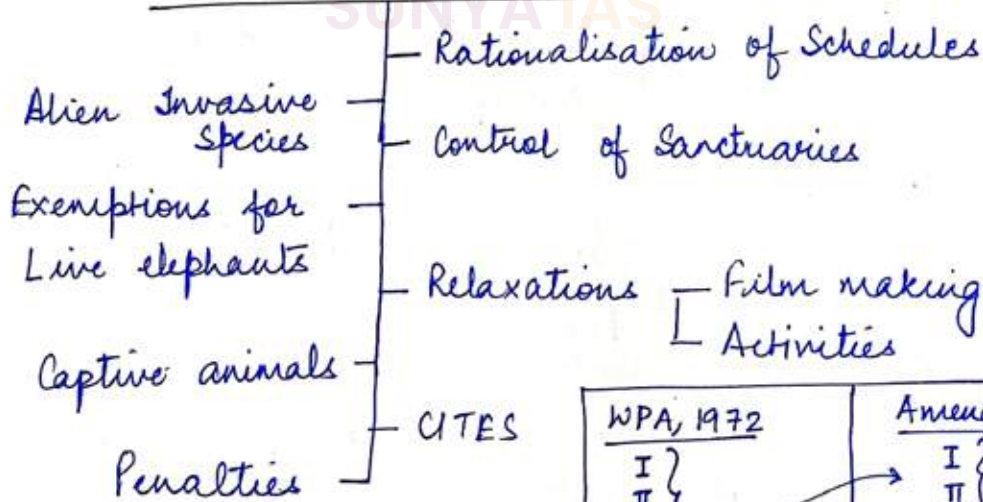
Statutory Bodies

- NTCA - 2006 Tiger Conservation
- Wildlife Crime Control Bureau - CITES, Interpol
- Central Zoo Authority
- National Board for Wildlife - Apex body headed by PM.

Protected Areas

- National parks
- Wildlife Sanctuary
- Tiger Reserve
- Community Reserve - land owned by community
- Conservation Reserve - land owned by govt.
- WPA is against Taxidermy (preservation of dead animals as trophy)
  - skins, antlers, horns, eggs, nails - all of these things are prohibited.

Amendments to WPA



WPA, 1972	Amendment
I } II }	I } II }
III } IV } V } VI }	III - Plants IV - CITES

Removed

Central Zoo Authority

- It will have a chairperson which is the environment minister.
- It will have mem. not exceeding 10 & they are appointed by central govt.
- It can recognize or derecognise any zoo in the country.

- It gives the guidelines in which animals can be transferred or can be exchanged nationally or internationally.
- It can also identify the endangered species of wild animals for captive breeding.
- It provides technical & financial assistance for zoos which have the potential to attain a desired standard.
- It is an affiliate member of world association for zoos and aquariums.

### National Board of Wildlife

- Headed by PM.
- Vice chairman is the minister in charge of the Ministry of Environment, Forest and Climate Change.
- No alteration in the boundaries of National Park or wildlife sanctuaries can be done w/o the approval of national board for wildlife.
- It is advisory in nature.
- It has a power to review all the Wildlife related matters & approve the projects in & around a national park.
- It helps in the creation of National Wildlife Action Plan (currently 3rd edition of National Wildlife Action Plan 2014-2031)
- This amendment gives effect to India's obligation under CITES.
- Rationalisation of schedules.
- Reduction of Alien Invasive Species.
- Conserve & protect wildlife through better management of protected areas.

- Benefit the local tribal communities.
- Central govt. has been empowered to regulate or prohibit trade, import, possession or proliferation of the alien invasive species.
- It empowers the central govt to declare areas adjacent to these protected areas as conservation reserve.
- Central govt. has to appoint a management authority to grant export or import permits & scientific authority to advise on the impact of the <sup>survival of</sup> specimens.

### Issues

1. Vermin - earlier there was a dedicated Schedule for Vermin so now this has been removed.
2. Vague w.r.t live elephants becoz this can be misused to carry out its captive breeding for any other purpose.
3. Enough consideration has not been given to reducing the man animal conflict.
4. Earlier the powers were fairly distributed b/w the centre and the state but <sup>after</sup> the 42nd Const<sup>n</sup> Amendment moved subject - 'wildlife' from state list to the concurrent list, which gave high powers to the central govt.

### Environment Protection Act, 1986

- Under Art 253, of the Const<sup>n</sup> & in wake of Bhopal gas tragedy, this act was formulated.
- Objective - to protect, improve environment & reduce pollution. Enacted aftermath of Bhopal Gas Tragedy (1984).
- Authorises the central govt to control & reduce

pollution from all sources.

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- Provides procedures for setting standards of emission or discharge of env. pollutants.

- To implement decisions of United Conference on Human Environment 1972. It is an umbrella for legislations to provide framework to central govt.

→ The act defines environment, pollution, pollutants and hazardous substances in a comprehensive way.

'Environment' includes water, air and land & the inter-relationships which exist among & b/w water, air and land, and human beings, other living creatures, plants, micro-organisms & property.

'Environmental Pollutant' means any solid, liquid or gaseous substance present in such concentration as may be, or tend to be, injurious to environment.

'Environmental Pollution' means the presence in the env. of any env. pollutant.

'Hazardous Substance' means any substance or preparation which, by reason of its chemical or physico-chemical properties or handling, is liable to cause harm to human beings, other living creatures, plant, micro-organisms, property or the environment.

→ The act is based on the Polluter Pays Principle.

→ The act gives wide ranging powers to central govt

### Statutory Bodies under this Act:

1. Genetic Engineering Appraisal Committee\*
2. Central Groundwater Authority
3. National Coastal Zone Management Authority
4. National Ganga River Basin Authority (not existing <sup>now</sup>)

# EIA get backing from this act.

# Coastal regulatory zones - a legal backing from the EPA - Shriresh Nayak Committee.

### Provisions

- It can include the coordination of actions by state.
  - It can help in planning & execution of nationwide programs.
  - Placing a restriction on the location of industries.
  - Laying on environmental quality standards.
  - It provides codes, guides, manuals.
  - The act explicitly prohibits discharge of env. pollutants which are in excess of the prescribed standards.
  - The act provides for penal provisions.
  - Sec 19 provides that any person in addition to the authorized individuals may file a complaint with a court highlighting the nature of the offense, so this is referred to as the citizen suit. Person must give a notice of not less than 60 days.
- Q) Acc. to Wildlife (Protection) Act, 1972, which of the foll. animals cannot be hunted by any person except under some provisions provided by law?
1. Gharial

2. Indian Wild Ass
3. Wild buffalo

Select the correct answer:

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

8) In India, if a species of tortoise is declared protected under Schedule I of WPA, 1972, what does it imply?

- (a) It enjoys the same level of protection as the tiger.
- (b) It no longer exists in the wild, a few individuals are under captive protection; and now it is impossible to prevent its extinction.
- (c) It is endemic to a particular region of India.
- (d) Both (b) and (c) stated above are correct in this context.

9) The EPA, 1986 empowers the Govt. of India to

1. State the requirement of public participation in the process of environmental protection, and the procedure & the manner in which it is sought.
2. Lay down the standards for emission or discharge of env. pollutants from various sources.

10) Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2.



Q) The Genetic Engineering Appraisal Committee is constituted under

- a) Food Safety & Standards Act, 2006.
- b) Geographical Indications Act, 1999
- c) Env. (Protection) Act, 1986
- d) Wildlife (Protect<sup>n</sup>) Act, 1972

Q) If a particular plant species is placed under Schedule VI of the WPA, 1972, what is the implication?

(a) A license is reqd. to cultivate that plant.

(b) Such a plant cannot be cultivated under any circumstances.

(c) It is Genetically Modified Crop plant.

(d) Such a plant is invasive & harmful to the ecosystem.

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## Indian Forest Act, 1927

- Objective - To protect & conserve forests.
- It categorised forest into Reserve forest, Protected forest & Village forest.
- Act defines forest offence. Specifies the acts prohibited inside a Reserved forest & penalties for the violation.
- Criteria & modalities for reserving and designating forests for conservation & legal protection, management of forest produce and issues regarding transit of the forest produce & the fees and duties leviable on this produce.
- Implementing agencies - Directorate General of Forests in the MoEFCC at the central level, state forest enactments & their subordinate agencies at lower admin<sup>ve</sup> levels.
- Indian Forest Amendment Act of 2017 amended the definition of a tree to remove the word 'Bamboo'. Bamboo growing in the non-forest area will be waved off the requirement of permission for its transit.

## Reserved Forest

1. All activities are prohibited in this unless they are permitted.
2. State govt. can constitute any forest land or a wasteland as a reserved forest which is the property of govt. & may sell the produce.
3. The state govt. may give out a notification & a

forest settlement officer has to be appointed by the State govt. Telegram Channel: t.me/sunyanotes50

### Protected forest

- It can be any forestland or wasteland which is not designated as a reserved forest.
- 2 types:
  - a) Demarcated
  - b) Undemarcated
- In protected forest, all activities are permitted unless prohibited.

### Village Forests

- The state govt. can assign to any village community the rights of govt. over any land which has been constituted as a reserved forest.

### Forest Conservation Act, 1980

- Objective: to protect the forest & control its deterioration.
- Mandatory central govt's prior approval for diversion of forest land for non-forestry purposes.
- Checks deforestation & encourage afforestation.
- Governs matters relating to diversion of forest land for any non-forest purpose. The diversion of forest is made subject to:
  - a) Stringent scrutiny
  - b) Recovery of net present value (NPV) and compensatory afforestation equal to the area diverted.

→ It covers 4 types of forests <sup>Reserved, Protected, Village and private forests.</sup> Telegram Channel: [t.me/sunyanotes50](https://t.me/sunyanotes50)

→ The provisions made for the conservation of forest must apply to all forests irrespective of the nature of ownership or classification thereof.

→ Forest Conservation Rules brought in the year 2002 & again in 2003 so Forest Conservation Amendment rules are related to the implementation of Forest Conservation Act of 1980.

\* Natural forest ≠ plantation  
\* Plantation cannot have level of biodiversity, gene pool support as of natural forest.

### Forest Rights Act, 2006

→ To restore the deprived forest rights of the STs & other traditional forest dwellers across India.

→ Grants legal recognition to the rights of traditional forest dwelling communities.

→ National Parks, Sanctuaries, Reserve Forest & Protected Forests are included for the recognition of rights.

→ Act defines 'Critical Wildlife Habitats' as areas of National Parks & wildlife Sanctuaries that are kept aloof for wildlife conservation.

### Rights Recognized

1. Title Rights - To legally hold forest lands (upto <sup>hectares</sup> 4 acres). Applies for land that is being cultivated by the concerned family, no new lands are granted.
2. Use Rights - Forest produce including non-timber forest produce of plants by the community.

3. Community forest resource rights: To protect, regenerate, conserve and or manage forest resources for sustainable use, providing for community governance of forests.

→ Implementat<sup>n</sup> Ministry - M/ of Tribal Affairs.

→ Provides for diff. rights :

1. Title rights

2. Use rights

3. Community rights

4. Relief and Dev Rights - the issues of illegal (like eviction) will be taken in this case.

→ Eligibility Criteria -

1. Must be a ST in the area where the right is claimed.

2. Primarily resided in forest or forest land for 3 generations (75 yrs) before 13-12-2005.

3. Depend on the forest or forest land for livelihood needs.

→ Process of recognition of rights :

1. Gram Sabha - pass a resolution recommending whose rights to which resources. S/d be recognised

2. Screening Committees - Resolution is screened & approved at the level of sub-division (or taluka) and the district level.

\* Screening Committees consist of 3 govt ~~off~~ officials (Forest, Revenue & Tribal Welfare departments) & 3 elected members of the local body at that level.

These committees also hear appeals.

→ The decision of gram Sabhas to reject or allow a claim

- Critical Wildlife Habitats - they are areas of national parks & sanctuaries which are reqd. to be kept as inviolate (or conversely speaking they have to be kept w/o any human intervention) for the purposes of <sup>conservat.</sup> wildlife.
- The Forest Rights Act identifies M/Environment as the agency to notify the guidelines related to the critical wildlife habitat.

### Biodiversity Act of 2002

- Objective: To conserve, promote sustainable use of biological diversity & ensure fair & equitable sharing of its benefits.
- The Act was enacted to meet the obligations under the the Convention on Biological Diversity (CBD).
- Prohibits the transfer of Indian genetic material outside the country, w/o specific approval.
- Prior permission is mandatory to claim IPR over Biodiversity & its derivatives.
- Regulation of the use of GM organisms.
- Establishes National, State & Local Biodiversity Funds.
- Set up Biodiversity Management Committees at the local village level, State Biodiversity ~~Fund~~ Boards at the State level & National Biodiversity Authority <sup>(NBA)</sup> at the National level.
- <sup>NBA -</sup> Enjoys power of a Civil Court.
- All foreign nationals or organisations require a prior approval of national biodiversity Authority.
- Indian individuals or entities require the approval of National Biodiversity Authority if they are transferring

- their knowledge etc. to a foreign firm.
- Indian citizens - local people including the Vaidyas, or the hakims get free access to use the biological resources within the country for their own use.
- Collaborative research project & exchange of knowledge & the resources is exempted provided they are drawn as per the policy of the central govt.
- If applying for any form of IPR can be in or outside India something which is related to a resource a biological resource originating or obtained from India, approval is reqd.
- Eco sensitive Zone are also under the Ambit of Environment Protection Act, 1986.

National Wildlife Action Plan, 2017-31

Key Focus Areas

1. Integrating actions for Climate Change mitigation & adaptation into wildlife management planning processes.
2. Adopts landscape approach in Conservation of all wildlife - uncultivated flora and fauna that have an ecological value to ecosystem & to mankind irrespective of where they occur.
3. Addresses rising human-animal conflict owing to shrinkage, fragmentation and deterioration of habitats.
4. Underscores increasing need for people's support for conservation of wildlife.
5. Underlines increased role of private sector

in wildlife conservation through ensure that adequate & sustained funding including Corporate Social Responsibility (CSR) funds.

### Compensatory Afforestation Fund Act (CAMPA Act), 2016

- Objective - To provide an appropriate institutional mechanism to utilise afforestation funds.
- Set up CAMPA at central & state level.
- Establishes a National Compensatory Afforestation Fund under the Public Account of India & a State Compensatory Afforestation Fund under the Public Account of each state.
- The National Fund receives 10% & state fund gets 90% of funds collected.
- The funds are utilised for afforestation, regeneration of forest ecosystem, wildlife protection & infrastructure dev.
- The Forest Conservation Act of 1980 provides that non-forest land = size of forest being 'diverted', is afforested or money deposited for the same.

### National Green Tribunal Act, 2010

- Objective - For effective and expeditious disposal (within 6 months of appeal) of the environmental cases + to help reduce the burden of litigation in the higher courts.
- Establishes NGT & it has jurisdiction over all Civil cases involving substantial ques. relating to the environment.
- Provides for enforcement of legal environmental



rights, relief and compensation for damage caused

- Tribunal is guided by principles of natural justice & its order is executable as a decree of a civil court.
- NGT orders are binding but can be challenged in the SC within 90 days.
- NGT - Principal bench at New Delhi & 4 regional benches in Pune, Bhopal, Chennai & Kolkata. There is also a mechanism for circuit benches.
- The chairperson of the NGT is a retired judge of the SC
- Each bench of the NGT comprises at least 1 judicial member & 1 expert member.

→ NGT deals with:

1. The Water Act, 1974
2. The water cess Act, 1977
3. The Forest (Conservation) Act, 1980
4. The Air Act, 1981
5. The EPA, 1986
6. The Public liability Insurance Act, 1991
7. The Biological Diversity Act, 2002.

→ It does not deal with -

1. WPA, 1972
2. Indian Forest Act, 1927
3. Forest Rights Act, 2006

→ Note: NGT Act, draws inspiration from India's constitutional provision of Art 48A (DPSP).

→ NGT will apply the principle of sustainable dev, precautionary principle & polluter pay principle.

- Q) Consider the following statements:
1. As per the law, the Compensatory Afforestation Fund Management & Planning Authority exists at both National & state levels. ✓
  2. People's participation is mandatory in the Compensatory afforestation programmes carried out under the Compensatory Afforestation Fund Act, 2016. ✗
- Which of the statements given above is/are correct?

- (a) 1 only  
 (b) 2 only  
 (c) Both 1 and 2  
 (d) Neither 1 nor 2.

- Q) Consider the following statements:
1. As per the recent amendment to the Indian Forest Act, 1927, forest dwellers have the right to fell the bamboos grown on forest areas.
  2. As per the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, bamboo is a minor forest produce.
  3. The Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 allows ownership of minor forest produce to forest dwellers.

Which of the statements given above is/are correct?

- (a) 1 and 2 only  
 (b) 2 and 3 only  
 (c) 3 only  
 (d) 1, 2 and 3.

- Q) Consider the following statements:
1. The definition of 'Critical Wildlife Habitat' is

2. For the first time in India, Baigas have been given Habitat Rights.
3. Union Ministry of Environment, Forest and Climate Change officially decides and declares Habitat Rights for Primitive and Vulnerable Tribal Groups in any part of India. ↳ M/Tribal Affairs

Which of the statements given above is/are correct?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 3 only
- (d) 1, 2 and 3

Q) At the national level, which ministry is the nodal agency to ensure effective implementation of the Scheduled Tribes & other traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006?

- (a) Min. of Env, Forest & Climatic Change
- (b) Min. of Panchayati Raj
- (c) Min. of Rural Dev.
- (d) Min. of Tribal Affairs.



**FOR OTHER SUBJECT NOTES, DROP US  
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# Lecture - 14

## Environment Impact Assessment (EIA)

**Prelims PYQ  
Content**



**9 Years (2015-2023)**

**(Topic Wise & Well researched)**



**Most Important  
Content**



**Content on Questions  
and Options (Both)**



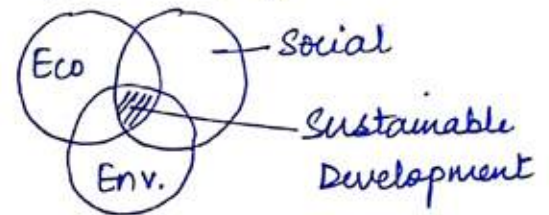
**Tackle Repeated  
themes**

**Contact- 8279688595 | [www.sunyaias.com](http://www.sunyaias.com)**

## Environmental Impact Assessment (EIA)

- UNEP defines EIA as a tool used to identify the environmental, social and economic impacts of a project prior to decision making.
- EIA help both environmental & economic benefits to be achieved, such as reduced cost & time of project implementation & design, avoided treatment/clean-up costs and impacts of laws & regulations.
- The important aspects of EIA are:
  - Risk assessment
  - Environmental Management
  - Post Product Monitoring
  - EIA provides a cost effective mtd to eliminate or minimize the adverse impact of dev. projects.

### Draft EIA 2020



→ Context

→ Features:

- Public Consultation
- Post Facto Approval
- Exemptions
- Compliance Report
- Strategic projects

→ Challenges:

- Exemptions
- Public Consultations
- Project clearance
- Reducing report submissions

→ Way Forward

- Stakeholder participation
- Regulatory body

- Political will
- Expert committees

- EIA is study to predict the effects of the proposed projects on the environment.
- It is a decision making tool to compare the various alternatives of a project and to identify which one represents the best combination of social, env. and economic costs.
- There is a project proposal given out by project developer to study the impact -
1. Screening - to det. whether proposed project requires EIA or not.
  2. Scoping - to identify the key issues and impacts & detail the TOR (Terms of reference) for EIA.
  3. Public Consultation - Examination of assessment reports & taking into consideration the opinion of the people.
  4. Assessment - predict and identify the likely impact.
  5. Decision Making - to decide whether the project is rejected or approved.
  6. Monitoring / Follow up - It is a post decision monitoring. Once the project is commissioned to check whether the mitigation plan is implemented or not.

### Benefits of EIA

- A EIA facilitates informed decision making by providing clear, systematic and unbiased analysis of the effect & consequences of proposed

projects.

- EIA provides for screening out & early withdrawal of environmentally unsound proposal; hence it saves the time & cost of the proposal project.
- It assists in the selection of alternative designs with modification to reduce negative environmental impacts & selects the best practicable & most environmentally friendly options.
- EIA predicts major adverse impacts & identifies mitigation measures to reduce or eliminate major impacts of the proposed project.
- EIA creates awareness and promotes the understanding about the project to the affected communities and individuals.
- It influences the decision-making process & dev. of terms & cond<sup>n</sup> w/o affecting the interests of all stakeholders & also the environment and related rules.
- It also lowers the conflict b/w the project and the local community by sharing & involving the people in decision making.

### History of EIA

- Origin - EIA introduced by NEPA in 1970 in US.
- India: Till 1994, it was an administrative decision & lacked legislative support.
- 1994, EIA notification promulgated under the Env. (Protection) Act 1986.
- It became mandatory to get environmental clearance for any project listed in the notification.

Public Hearing: The State Pollution Control Boards will conduct the public hearing before the proposals are sent to MOEF for obtaining environmental clearance. Anyone likely to be affected by the proposed project is entitled to have access to the Executive Summary of the EIA.

### Decision Making

Monitoring the Clearance Cond<sup>n</sup> - The project proponent, IAA and Pollution Control Boards shd monitor the implementation of conditions. The proponent is reqd. to file once in 6 months a report demonstrating the compliance to IAA.

### Classification of Projects

#### Category A Projects

- National level appraisal.
- Appraised by <sup>Central Govt through</sup> Impact Assessment Agency & Expert Appraisal Committee.
- Requires Mandatory environmental clearance. Hence, these projects do not undergo screening.

#### Category B Projects

- State level appraisal.
- Appraised by State Level Environment Impact Assessment Authority & State Level Expert Appraisal Committee.
- These projects undergo screening & are classified into 2 types:
  1. Category B1 (EIA is mandatory).
  2. Category B2 (Do not require EIA).



## Exempted Projects

1. Offshore & Onshore oil, Gas & shale exploration.
2. Hydroelectric projects up to 25 MW.
3. Irrigation projects b/w 2000 to 10,000 hac of command area.
4. Small & medium cement plants.
5. Acids other than Phosphoric, Ammonia or Sulphuric acid.
6. MSMEs in dye and dye intermediates, bulk drugs, synthetic rubbers, medium-sized paint units.
7. All inland waterway projects & expansion and widening of highways b/w 25 km & 100 km with defined parameters.
8. Aerial ropeways in ecologically sensitive areas.
9. Specified building construction & areas development projects; build-up area up to 1,50,000 sq.m.

## 2017 Amendment to EIA Rules 2006

1. Inc. the ambit of state govt. authorities to grant env. clearances esp. Mining projects.
2. State govt. are empowered for river valley or irrigation projects.
3. Change in irrigation technology but w/o inc. in dam height.

## Key Provisions of 2020 Draft

1. Reduced time for public hearings: 30 → 20 days
2. Exemption of projects.
3. Annual submission of reports
4. Report prepared solely by project proponents.
5. Post facto clearance
6. Penalty for firms

- SEA is a proactive & comprehensive process which identifies & evaluates the significant environmental & sustainability implications of particular plans, programmes & policies to ensure that they are fully considered & addressed at the earliest stages of decision making.
- SEAs can recommend changes within the proposed plans, or programmes, improvements in coordination b/w relevant agencies, new cross-sectoral interventions & suggestions for EIAs of future projects & improve their quality.
- Rapid EIA

→ SEA vs EIA

1. Better public consultation
  2. Wide expertise
  3. long term
- } in SEA

Eco-Sensitive Zones (ESZ)

- It is a buffer or transition zone around highly protected areas such as National Parks & Wildlife Sanctuaries.
- The purpose of declaring ESZs is to create some kind of 'shock absorbers' to the protected areas by regulating & managing the activities around such areas.
- The govt. regulates & manages the activities in such areas, so that there is no external harm to the higher protected areas.
- Acc. to SC, ESZ will be 1km from the protected area.

Telegram Channel: t.me/sunyanotes50  
→ ESZs are notified by the Central govt. through MOEFCC under the provisions of the EPA, 1986.

\* Radgill Committee - Entire western ghats to be ESZ

\* Kasturirangan Committee - Reduced area to 37% for ESZ.

\* Recent SC Verdict - 1km around each of protected areas will be declared as ESZ.

## Biocentrism

→ In recent ruling, the SC of India has sought to move away from an anthropocentric basis of law & stressed the importance of biocentrism.

→ The anthropocentric perception is widespread & is considered to be responsible for severe environmental crises ranging from global warming, ozone depletion & water scarcity to the loss of biological diversity. But now is the time for resorting back to biocentrism or ecocentrism.



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## Ecosystem Services Provided by Soil

Services Type →	Regulating & Supporting Services	Provisioning Services	Cultural & Community Services
Ecosystem Services →	Erosion control, water quality, Pollution attenuat <sup>n</sup> , Pest & disease control, Air quality & Climate regul <sup>n</sup> , biodiv. conservat <sup>n</sup>	Food, feed, fiber, water & energy supply	Physical or experiential use, preservat <sup>n</sup> of artifacts & support of infra.

→ As per ICC, land is the terrestrial portion of the biosphere that comprises of the natural resources, ecological process, topography, human settlements, & infrastructure that operate within the system.

### Land Degradation

→ It can be caused by direct or indirect human induced processes which leads to :-

- loss of biological productivity
- loss of ecological integrity and
- value to humans

→ In land degradation there is general decrease in land productivity.

**What happens when land is degraded?**

1. There is degradation of soil structure.
2. Reduction of nutrients availability.

3. Reduction of Soil Organic Carbon (SOC)
4. Reduction of soil biodiversity.
5. Reduction of crop productivity.
6. Increased run off / erosion.

⇒ Reduction of ecosystem services.

### Soil Pollution

1. Reduced crop yields
2. Limited buffering & filtering capacity.

Note\* - Buffering capacity - soil has the potential to reduce or inc. the pH to maintain at certain level, that capacity / potential is buffering capacity.

3. Higher GHG emissions contributing to climate change.
4. Nutrient imbalance
5. Reduced vegetation cover & flood control capacity.
6. Promotion of antimicrobial resistance & loss of genetic resources.
7. Polluted soils are not suitable for residential, agricultural and recreational uses.

\* SDG Target - 15.3 - End degradation & restore degraded land.

### Desertification

- Soil or land degradation is decline in soil quality caused by improper use (direct / indirect)
- This includes physical (soil erosion), chemical

(salinity) and biological deterioration (vegetation cover getting eroded).

→ Desertification is when land is degraded in arid/semi-arid or dry sub humid areas leading to decline of soil/land productivity & biodiversity.

### Causes of land degradation

1. Deforestation
2. Erosion - water/wind
3. Shifting cultivation / jhumming cultiv<sup>n</sup> / slash & burn
4. Climate change
5. Pollution
6. Excessive Agriculture
7. Overgrazing
8. Mining
9. Construction in hilly areas/ areas prone to landslides.
10. Soil salinization
11. Excessive accumulation of water
12. Saltwater intrusion
13. Inc. in demand for palm oil, coconut, coffee → increased plantation.
14. Industrial demand

\* 25% of the land is lost to land degradation in last 50 yrs (FAO).

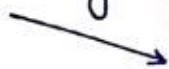
\* In India, 30% of land is affected by land degradat<sup>n</sup>.

### Indicators of land <sup>degradation</sup> sustainability

Productivity

Land Cover

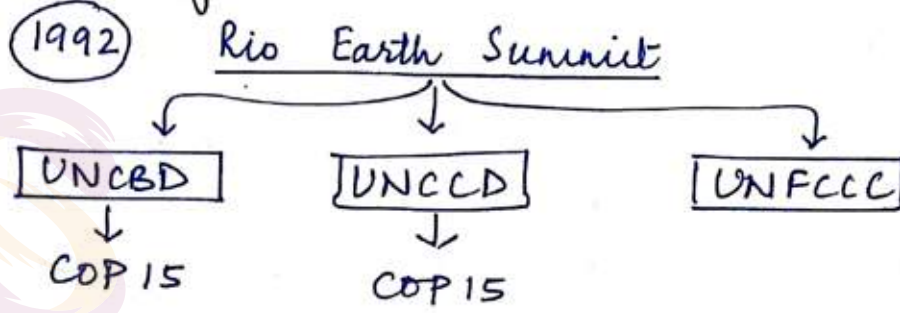
Soil Carbon



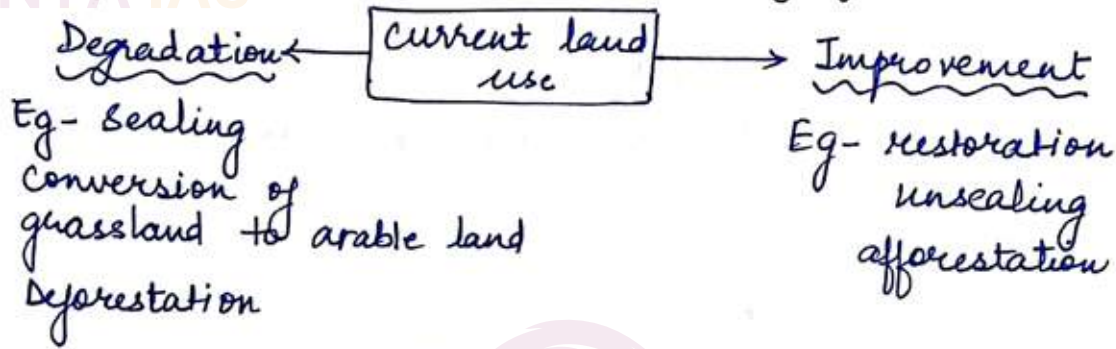
SDG Indicator 15.3.1:

Proportion of land degraded over total land area.

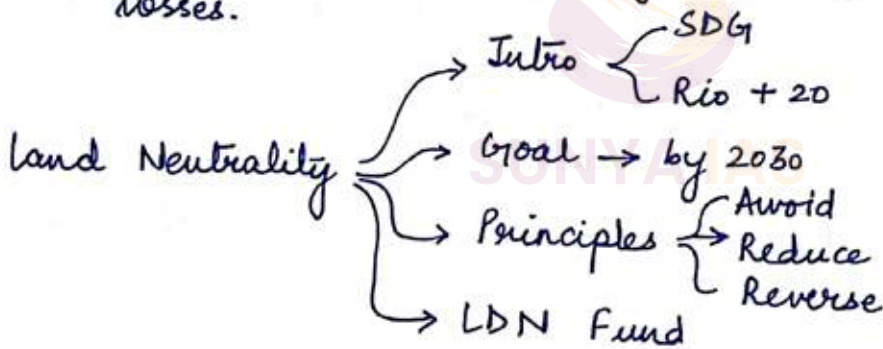
Land Neutrality



Land degradation neutrality: balancing gains & losses.



Obj → minimise & compensate degradation, balance gains/improvements & losses.



Desertification and Climate Change

- water scarcity
- soil erosion
- Disappearing Springs
- Invasive species
- decrease in resilience of dryland population

Desertification ↔ Climate Change

UNCCD - COP 15 (Abidjan 2022)

LDN (Land Degradation Neutrality) is defined as a state where the amount of healthy &

productive land resources necessary to support ecosystem services to remain stable or increase within the specified scale.

SDG 15.3 - aims to achieve LDN by 2030.

- Theme: The COP15 theme, 'Land. Life. Legacy: From Scarcity to Prosperity', is a call to action to ensure land, the lifeline on this planet, continues to benefit present & future generations.
- Mandate: COP15 of UNCCD to drive progress in the future sustainable management of land & will explore links b/w land and other key sustainability issues.
- UNCCD COP15 Agenda: Drought, land restoration & related enablers such as land rights, gender equality & youth empowerment are among the top items on the conference agenda.

### Arresting Desertification

1. National Afforestation Programme - Reforestation & Afforestation
2. Integrated watershed programme - PM Krishi Sinchayi Prog Yojana.
3. Sustainable agriculture - indigenous crops.
4. National Mission for Green India
5. MGNREGS
6. Soil conservation in the catchment of River Valley Project.
7. National watershed Development Project for Rainfed Areas (NWDPA)
8. Fodder & feed Development Scheme - Component of Grassland Dev. incl. Grass Reserves.
9. Command Area Dev. & water Management (CADWM) Prog.



10. Soil Health Card Scheme

11. Agro Forestry - Trees are combined with forest in same land. Recycling nutrients, reduce pressure on forests for timber, increases percolation of water.

12. Social Forestry - Growing the forests outside the conventional forest using common land & community land.

\* JFM - Joint Forest Management - National Forest Policy 1988. It is the involvement of the local community & forest department to conserve forests.

13. Crop rotation

14. Mulching - providing a layer of organic matter in the top layer;

(a) helps in retaining moisture

(b) adds more nutrients

(c) reduces surface runoff.

(d) increases soil organic matter

15. Use of early maturing varieties

16. Strip Cropping - involves planting of erosion resistant crops in alternative strips with erosion permissible crops.

17. Check on shifting cultivation

18. For hilly areas

a. Terrace farming

b. Contour ploughing - ploughing land at  $90^\circ$  angle  
→ reduces wind velocity & protects topsoil from erosion.

c. Contour bunding - constructing banks

19. Others: a) Shelterbelts

b) Windbreaks

20. Sand dunes fixation - it aims to reduce movement of sand and reduce impact of wind & water in soil.

21. Geotextiles - Natural or synthetic fibres - soil protection

22. Great Green Wall Initiative : Sahel - reforestation to stop the expansion of desert.

23. The Bonn Challenge : Germany + IUCN → restoration of degraded land : 2030

a) Global target - 350 mha

b) Indian target - 26 mha

24. UNCCD - Report - Global land outlook

\* UNCCD - agreement for ensuring global action against desertification or land degradation. It is the only legally binding international agreement that links environment & development to sustainable land management.

Convention requires countries to draw a National Action Programme (NAP) using a bottom up approach involving local communities to restore degraded lands. India signed it.

It assists countries in mobilization of finance to implement the convention.

COP - Conference of Parties

→ Supreme decision making body

→ Meets every 2 years

→ COP 13 - China

→ COP 14 - India

→ COP 15 - Abidjan - India reaffirmed its commitment to restore 25mha of degraded land by 2030.

→ COP 16 - 2024 in Saudi Arabia.

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## **Lecture - 15 - 16 (Pollution)**



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Pollution - The pollution can be defined as addition or release of undesirable physical, chemical and biological agents. These can be released by natural or anthropogenic means.

Types:

1. Soil pollution
2. Air pollution - Ozone pollution, Nitrogen pollution, methane pollution
3. Water pollution - oil pollution, marine plastic pollution
4. Noise pollution
5. Thermal pollution
6. Radiation pollution

Air Pollution

→ It is the release of pollutants in the air which is detrimental to human health and ecosystems.

→ Air Pollutants

- a) PM - Coarse PM 2.5 - 10  $\mu$ m  
- Fine PM < 2.5  $\mu$ m  
- Ultrafine PM < 0.1  $\mu$ m
- b) Gas - Ground level Ozone (O<sub>3</sub>)  
- NO<sub>2</sub>  
- SO<sub>2</sub>  
- CO  
- Volatile Organic Compounds (VOCs)

Primary Pollutant

- A primary pollutant is an air pollutant emitted directly from a source.

Secondary Pollutant

- A secondary pollutant is not directly emitted as such, but forms when other pollutants (primary pollutants) react in the atmosphere.

## Primary Pollutant

- Eg - particulates, CO, Nitrogen oxide, Sulphur oxide.
- Their levels can be tried to control or reduced to permissible limits.

## Secondary Pollutant

- Eg - O<sub>3</sub>, Secondary organic aerosol (haze).
- Secondary pollutants are harder to control becoz they have diff. ways of synthesizing & the form are not well understood. They form naturally in the environment & cause problems like photochemical smog.

### Source:

#### 1. Natural -

- a. Volcanic eruptions - sulphate particles
- b. Forest fires - produce black & organic carbon, nitrate particles
- c. Dust storms

\* MAIA - is a NASA project that will study the health impacts of air pollution that comes from particles (PM).

#### 2. Anthropogenic -

- a. Constructions
- b. Use of AC, Refrigerators etc.
- c. Burning biomass
- d. Traffic - adds Carbon particles
- e. Power - Sulphates
- f. Agriculture - nitrate particles + dust

#### 3. Indoor air pollution

- a. Curtains, mats, brinks etc. are source of

- indoor air pollution.  
b. Smoke from chulha in rural areas.

## Common Air Pollutants

### Gaseous Pollutants

#### 1. Oxides of Carbon (CO & CO<sub>2</sub>)

↳ black carbon

CO → incomplete burning of fossil fuels, wood, coal  
↳ high affinity to bind with oxygen in blood forming carboxyhaemoglobin.

Source - burning of wood, coal, fossil fuels.  
- Refer carbon cycle

Impact - (i) CO<sub>2</sub> - Global warming, respiratory prob., dizziness, decrease oxygen levels  
(ii) CO - impact oxygen levels in blood, highly poisonous.

#### 2. Oxides of Sulphur (SO<sub>2</sub>, H<sub>2</sub>S)

SO<sub>2</sub> - India is the largest emitter of SO<sub>2</sub>, lichens are indicator.

Source - power plants, volcanic eruptions, decomposition, refineries, when Sulphur containing fuel is burnt.

Impact - (i) acid rain  
(ii) respiratory issues  
(iii) Loss of chlorophyll - Chlorosis  
(iv) Smog

#### 3. Oxides of Nitrogen (NO and N<sub>2</sub>O)

Source - Natural process like lightning, burning of fossil fuels, automobile exhaust at high temp.



- Impact: (i) irritation in eyes  
 (ii) Respiratory issues  
 (iii) Smog  
 (iv) Acid rains  
 (v) Low productivity of plants

#### 4. Hydrocarbons (Benzene & Ethylene)

Source: Automobiles, petroleum industries (incomplete combustion of fuels)

Impact: (i) Carcinogenic  
 (ii) Respiratory issues

\* Black Carbon - formed due to incomplete burning, soot particles associated with it.

\* Brown Carbon - formed due to burning of organic matter/biomass. cause melting of ice, global warming, respiratory issues.

### Particulate Pollutants

#### 1. Suspended PM

- fly ash - next topic
- Lead & other metals

Source: Automobile exhaust, thermal power plants, ~~stubble burning~~, construction activities, ~~sand manufacturing~~, metallurgical processes.

Impact: respiratory issue, block lungs, smog formation, carcinogenic, breathing problems,  
 ↳ poor visibility  
 lead interferes with dev. of RBCs.

#### 2. PM

source - automobile exhaust, thermal power plants,

Stubble burning, construction activities, and manufacturing

Impact: respiratory issue, blocks lungs, smog formation, carcinogenic.

3. Fibres (Cotton, wool) (\* Indoor air pollution)

Source - Textile industries

- Carpets weaving industries

Impact - lung disorders

Diseases - Potential sources / causes & their effects

1. Pneumoconiosis - Coal dust, asbestos
2. Minamata - neurological disease caused by severe mercury poisoning
3. Blue baby Syndrome - bluish discoloration of infants' skin becoz of poorly oxygenated blood due to nitrate contamination in water.
4. Itai - Itai - Cadmium pollution causing softening of bones, lung & liver cancer.
5. Skeletal Fluorosis - Fluoride contamination causing teeth deformity, hardening of bones & joint pains.
6. Trachoma - An infectious eye disease caused by unclean water.
7. Black foot disease - Arsenic.

Fly Ash

- It is a very fine PM released through the burning of coal.
- Its size varies from 10-100 microns.
- It contains a lot of metallic content like Silicon dioxide, Aluminium dioxide, ferric oxides, calcium oxides & other minor metals.

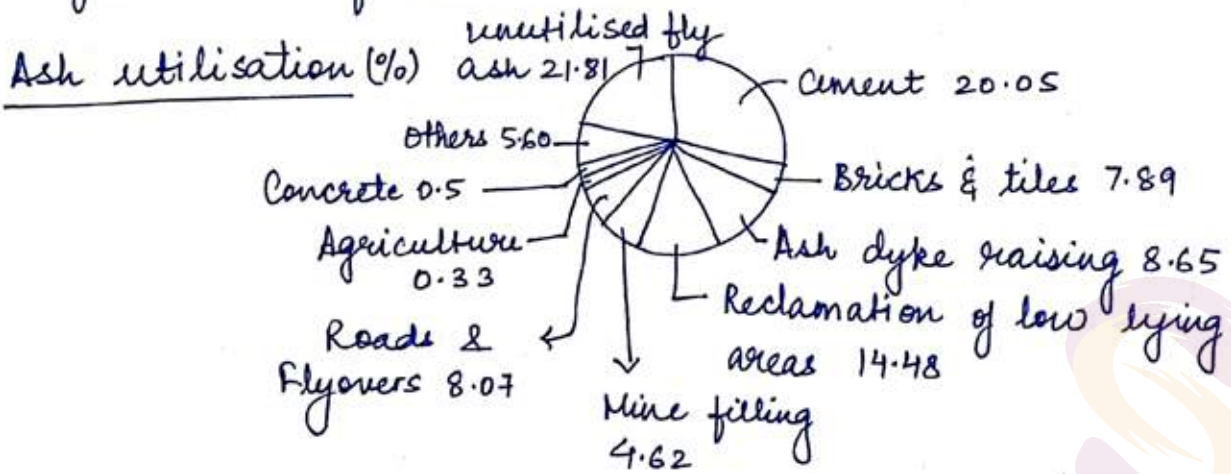


→ They are collected from electrostatic precipitators from the flue gas of thermal power plants.

- Impacts -
- 1) Reduction of photosynthesis
  - 2) Respiratory diseases
  - 3) Heart problems
  - 4) Carcinogenic
  - 5) Leaching of fly ash into ground water causes contamination.

Usage -

1. Reclamation of soil
  2. Construction of roads
  3. Brick making
    - a. Cheaper
    - b. light weight
    - c. Reduces load
    - d. Absorbs less heat
    - e) Requires less ~~heat~~ cement and mortar
- \* But cannot be used for strong building or structure as they cannot hold much weight.
4. Used in cement & concrete production
  5. Agriculture - for soil stabilization



\* Maharashtra was the 1st state in India to have fly ash utilization policy.

- It is mandatory for Thermal Power Plants (TPPs) to ensure 100% utilisation of fly ash within 3 to 5 yrs.
  - Existing provisions allow TPPs to fully utilise fly ash in a 4-year cycle in a staggered manner.
- It also introduced fines of ₹1,000 on non-compliant plants under the 'polluter pays principle', taking into account utilization targets from April 1 next year.
  - The 'polluter pays' principle is the commonly accepted practice that those who produce pollution should bear the costs of managing it to prevent damage to human health or the environment.
  - Under this, the collected fines will be deposited in the designated account of the Central Pollution Control Board (CPCB).
    - The fine collected by CPCB from the TPPs & other defaulters shall be used towards the safe disposal of the unutilised ash.
- It also deals with unutilised accumulated ash (legacy ash) where TPPs will have to utilise it within 10 years from the date of publication of final notification in a staggered manner.
  - If the utilization of legacy ash is not completed at the end of 10 years, a fine of Rs 1000 per tonne will be imposed on the remaining unutilised quantity which has not been fined earlier.

## Coal Ash pollutants

- Arsenic (As) — Ingestion
  - nervous system damage
  - cardiovascular issues
  - urinary tract cancers
- Inhalation — lung cancer
- Absorption — skin cancer

→ Mercury (Hg) - Exposure - poses particular risk to children, infants, and foetus.

- ↳ nervous system damage
- ↳ developmental defects like reduced IQ & mental retardation.

→ Lead (Pb) - There's no safe level of lead exposure, particularly for children.

- brain swelling, kidney disease, cardiovascular problems, nervous system damage, death.

Acid Rain - Normal rain has pH of about 5.6. When pH falls below this, it is called acid rain.

(pH 4.2 to 4.4)

$\text{NO}_x + \text{SO}_2 + \text{Moisture} + \text{other chemicals} = \text{Acid rain}$   
( $\text{HNO}_3 + \text{H}_2\text{SO}_4$ )

→ Acid rain formed due to formation of secondary pollutants.

→ Rainfall with pH < 5 or 6 in which sulphur & nitrogen compounds from atmosphere react with water to form sulphuric acid & nitric acid which dec. the pH value.

→ When the gaseous pollutants directly fall to the ground that is dry deposition.

→ In the areas where there is no precipitation, the acidic compounds get attached to dust & smoke and falls on surface through dry deposition & they stick on natural vegetation & buildings.

→ Dry deposition mixed with precipitation falls on the surface known as wet precipitation.

1. Plants - discoloration of plants, reduces the fertility of soil, discoloration of leaves, nutrient cycle is affected, decreased yield.
2. Humans - skin cancer, bad smell, reduces visibility
3. Buildings - discoloured monuments & other cultural heritage, get disfigured & get damaged
4. Terrestrial / Aquatic life - coral reefs will be destroyed, phytoplankton will be destroyed, disruption of food chain.

## SMOG

- Smoke + fog = Smog; intense air pollution
- Harmful mixture of fog, dust, and air pollutants like  $\text{NO}_x$ , VOCs etc.
- Types of Smog:
  - 1) Classical (London) - Have sulphur compounds  
- cold & humid
  - 2) Photochemical (LA) - Warmer + dry  
- have Nitrogen Compounds.
- Impact of Photochemical Smog
  1. Reduced visibility
  2. Headache
  3. Dry cough
  4. Chest pain
  5. Breathing issue
  6. Decreased productivity of plants
  7. Cracking of rubber & corrosion of metals & building materials.

→ NO<sub>x</sub>: can contribute to heart & lung prob.  
↳ ↓ resistance to infection

→ VOCs: - eye irritation  
- respiratory problems  
- carcinogenic

→ Ozone - coughing, wheezing  
- eye irritation  
- respiratory prob. (asthma)

→ PAN: - eye irritation  
- respiratory prob.

### Ozone Pollution

→ Ozone in troposphere

### Delhi's Air Pollution

- Movt. of monsoon with less wind speed.
- Temp of land is dec. in winters.
- Geographical location of Delhi causes stagnation of smog.

- Major Sources
- Power plants (4.8%)
  - Dust (11.5%)
  - Diffused sources (22.7%)
  - Diesel generator sets (12.2%)
  - Transport (22.5%)
  - Industries (17.2%)
  - Brick kiln (9.2%)

### Causes of Delhi Pollution

- |                       |                        |
|-----------------------|------------------------|
| 1. stubble burning    | 5. Vehicular pollution |
| 2. Construction brick | 6. Burning of waste    |
| 3. Dust               | 7. Governance          |

Stubble burning occurs in Haryana & Punjab due to the extra cost of cutting.

### Solutions for Stubble burning -

1) <sup>Turbo</sup> Happy seeder (THS) Machine

2) PVSA biodecomposer - developed by ICAR, it is a low cost microbial bio-enzyme solution which accelerates the decomposition of crop residue, including stubble from paddy crops into manure within 15-20 days.

3) Torrefaction - thermal process to convert biomass into coal like material, which has better fuel characteristics than the original biomass. Torrefied biomass is more brittle, making grinding easier & less energy-intensive.

### Anti-Pollution Measures

① Graded Response Action Plan (GRAP) - set of curbs triggered in phases as the air quality deteriorates. It includes strict measures such as a ban on the entry of heavy vehicles, the odd-even road rationing restrictions & a halt of const work. etc

② National Clean Air Program (NCAP) - launched in 2019, 5 year action plan to curb air pollution, build a pan India air quality monitoring network & improve citizens' awareness. Focuses on city specific action plans.

It aims to reduce PM<sub>2.5</sub> levels by 20-30% by 2024 (compared to 2017). Aligns with existing plans - National Action Plan on Climate Change, initiatives on electric vehicles and Smart Cities Mission.

→ Acceptable annual standard for PM 2.5 is 40 micrograms per  $M^3$ .

- ③ Introduction of Bharat Stage Emission Standards (BSVI) - cleaner fuel.
- ④ Push for electric vehicles, under Faster Adoption & Manufacturing of Hybrid & Electric Vehicles (FAME II) Scheme.
- ⑤ Odd-even as emergency measure. (for Delhi)
- ⑥ Construct<sup>n</sup> of Eastern & Western Peripheral Expressways.
- ⑦ SAFAR application
- ⑧ Carbon Emissions by Thermal Power Plants.
- ⑨ WHO Guidelines - recommend air quality levels for 6 pollutants - Particulate Matter (PM 2.5 and 10),  $O_3$ ,  $NO_2$ ,  $SO_2$ , CO.
- ⑩ New Commission for Air Quality Management
- ⑪ National Air Quality Monitoring Programme (NAQP) -  
Under NAQP, 4 air pollutants viz  $SO_2$ ,  $NO_2$ ,  $PM_{10}$  &  $PM_{2.5}$  identified for regular monitoring at all locations.
- ⑫ Artificial rains
- ⑬ Having filters
- ⑭ Smog towers - carbon nano fibre air filters
- ⑮ Flue gas desulphurization (FGD)
- ⑯ Electrostatic precipitators
- ⑰ Catalytic converters to vehicles
- ⑱ Scrubbers added to vehicles.
- ⑲ National Action Plan on Climate Change
- ⑳ Green Crackers - Gen. crackers have Antimony, Barium Nitrate, hence NEERI part of CSIR has replaced Barium nitrate with Potassium nitrate & zeolites to reduce  $PM_{10}$ , 2.5 by 30%.

Nitrogen Pollution

- ① Agricultural Runoff (41%) - Animal waste & fertilizers wash off agr land or contaminate groundwater, polluting rivers.
- ② Air Pollution (25%) - from power plants & motor vehicles falls back to the ground & is washed into our waterways by rain.
- ③ Wastewater treatment & factories (16%) - discharge from wastewater treatment plants & factories are released directly into our rivers & the bay.
- ④ Urban & suburban stormwater runoff (15%) - Stormwater running off parking lots, roofs & other hard surfaces carries pollution like fertilizer & pet waste into our waterways.
- ⑤ Septic (3%) - Drain fields of septic systems deliver pollution to our rivers & bay through contaminated ground<sub>H<sub>2</sub>O</sub>.

Gothenburg Protocol

- Protocol to abate acidification, eutrophication & ground level O<sub>3</sub>.
- Implemented in EU.
- Not adopted by India.

Black Carbon<sup>(BC)</sup> and Methane

- Black Carbon or soot, is part of fine particulate air pollution (PM<sub>2.5</sub>) & contributes to climate change.
- Sources - household energy, transport, agriculture, industrial production, waste, fossil fuel operation, large scale combustion.
- Impact - Deaths from heart, stroke, lung disease, lung cancer (Health)
  - Climate: Absorb IR & converts to heat.
  - Weather: prevents cloud from being formed



- Snow & Ice : accelerate the melting of snow & ice.  
- Agriculture & Ecosystem - affects plant growth & productivity.

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- BC is short lived climate pollutants & is 2nd largest pollutant to global warming after CO<sub>2</sub>.  
→ Unlike other GHGs which stay in atmosphere for long time, BC stays for only few weeks & can be eliminated if emissions are stopped.  
→ BC is an aerosol.

### Indoor Air Pollution

- Sources :  
Chulhas  
Tobacco  
Dust  
Outside air  
Wood & paper burning  
Agarbatti  
Wall & furniture paint  
Moss Mosquito repellent

### → Indoor air pollution Mitigation

- PM Ujjwala Yojana (PMUY) - provides LPG connection to BPL households (by Petroleum Ministry & part of Swachh Bharat Abhiyan).
- Graphene-based sensor - created by scientists to find indoor air pollution.
- Neerdhur - The National Environmental & Engineering Research Institute (NEERI) created revolutionary multi-fuel stove 'Neerdhur' for residential use.
- HEPA Filters (High Energy Particulate Arrestor) - Indoor air filters made of HEPA filters.
- WAYU (Wind Augmentation Purifying Unit) - CSIR NEERI produces WAYU. Along with UV lights and Activated ~~Charcoal~~ ~~the~~ Carbon (charcoal)

for eliminating harmful gases, it features filters for removing PM.

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- f) SDG 7 - aspires to guarantee that everyone has access to affordable, dependable, sustainable & modern energy.
- g) BS IV to BS VI
- h) Sustainable Alternative Towards Affordable Transportation (SATAT) - to set up 5000 compressed biogas production plants & make compressed biogas available in market for use.

## Water Pollution

Causes of water pollution - Oil spill, septic tank, animal dung, intensive farming, pesticide, water table, industrial waste, household waste, waste water, nuclear waste, oil pollution

Definition - Water pollution is the presence of undesirable substances in water which can be organic, inorganic, biological, chemical which degrades water quality & makes it unfit for use.

### Sources:

- Natural Sources: Erosion of soil  
leaching of minerals from rocks.  
Decay of OM.
- When pollutants are discharged from a specific location, it is known as point source.
- Whereas non-point sources include the discharge of the pollutants from larger areas, or they are diffused sources. Eg: runoff from agr. fields, crop land, grazing land, construction sites etc.

Measuring water pollution: There are factors like surface turbulence, photosynthetic activity, O<sub>2</sub> consumption by microbes & decomposition of OM - all this determines the

amount of DO in water.

→ BOD - It is the amount of DO needed by bacteria to decompose the organic waste present in  $H_2O$ . BOD is limited to biodegradable materials, therefore, it is not a reliable mtd of measuring water pollution. High value of BOD means DO is less and hence high level pollution.

→ COD - Measures amt of  $O_2$  in ppm (parts per million) reqd. to oxidise biodegradable, non-biodegradable & oxidisable inorganic matter. It's more reliable than BOD due to above reason.

### Impacts of water pollution:

- Human health - metals like Pb, Ar, Hg, Cd can adversely affect humans.
- It can lead to large scale growth of aquatic plants like duckweed, water hyacinth & blue green algae, reducing the penetration of sunlight to the lower layers.
- Presence of large amount of nutrients leads to algal bloom.
- Death of large scale fish, aquatic animals, causes discoloration & releases foul smell.
- Some substances can undergo biomagnification in the aquatic food chain like DDT & mercury.
- High levels of DDT can disturb the Ca metabolism in birds, cause premature breaking of eggshells & ultimately a decline in population of birds.
- Urban & domestic use - ↑ water treatment & inspection cost, maintenance costs from scouring & premature ageing of infra. Emergency & clean up cost from spills / accidents.
- Ecosystem Health - Damage to freshwater & marine

ecosystems (eg- fish kill, invertebrates, benthic fauna, flora, habitat degradation) + loss of ecosystem services, which may require investment in additional or diff. grey infra. alternatives to replicate these services.

- Industrial productivity - Exclusion of contaminated water for industrial use results in inc. H<sub>2</sub>O scarcity. Scouring of infra. & clean up costs from spills/accidents.
- Social values & tourism - Prohibition from recreational use (eg. swimming, fishing), beach closure, impacts on aesthetics, cultural & spiritual values. Losses in fishing, boating, rafting, swimming activities to other tourism activities or to other ventures with superior water quality.
- Agr. productivity - Exclusion of contaminated water for irrigation ⇒ ↑ water scarcity. Contaminated water causes damage to & reduced productivity of pasture & crops, soil contamination, livestock health & production. & scouring of infrastructure.
- Property values - waterfront property values can decline because of pollution & odour.
- Commercial fisheries - fish kill.
- Eutrophication - Enrichment of water bodies with nutrients.  
2 types of eutrophication -
  - a) Natural - through erosion & sedimentary deposition.
  - b) Cultural - by man-made factors like excessive fertilizers. etc.
- River pollution - Eg- Ganga is polluted by waste water & industrial effluents from industrial centres like Kanpur, Haridwar, Kannauj, Varanasi, Allahabad, Patna, Kolkata etc. → Tannery pulp, sugar distillery, paper & pulp mills.

## Tackling water Pollution

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1. Water Prevention & Control of Pollution Act, 1974
2. Central Pollution Control Board (CPCB)
  - PH, DO, BOD, Total coliform (MPN/100 ml), Free Ammonia (mg/l), electrical conductivity.
3. Sewage & Effluent treatment plants
4. Bio-remediation — Bregoli, water hyacinth
5. Oil Zapper → Involves the use of microbes (bacteria & fungus) to degrade
6. Coagulation / Flocculation
7. pH correction environmental contaminants into less toxic form.
5. Oil Zapper - TERI has developed a mixture of bacteria called oil zapper & OILIVOROUS - S which degrades pollutants of oil contaminated sites leaving behind no harmful residue.
6. Phytoremediation - Use of plants to remove contaminants from soil & water. Eg-
  - a) Water hyacinth can purify water by taking toxic materials & heavy metals from water.
  - b) Planting Eucalyptus trees help absorb surplus waste water & releases pure water vapour in the atmosphere.
7. Coagulation / Flocculation - Coagulants like alum are added to untreated water. Group of dirt particles stick together & forms flocs.
8. pH correction - lime is added to filtered water to adjust the pH and stabilize the naturally soft water to minimize the corrosion.

1. Ganga Action Plan, 1985 - Centrally sponsored scheme

2. NRCP, 1995 - across 20 states, Min of Jal Shakti

Obj: (i) Capture & treatment of raw sewage before flowing into river water (responsibility of state govt. & urban local body).

(ii) Prevention & control of industrial pollution by respective pollution control boards.

(iii) Low cost sanitation works to prevent open defaecation on river banks.

(iv) Electric Crematoria to ensure proper cremation of bodies brought to burning ghat.

(v) River front development ~~banks~~ works like improvement of bathing ghats.

3. NGC - estd by river Ganga rejuvenation protection & management authorities order, 2016. It replaced National River Ganga Basin Authority. National Mission for Clean Ganga (registered as a society under society Registration Act, 1860) is the implementation wing of NGC.

a) Mem. of NGC - PM (Chairman), Union Min. of Jal Shakti as vice-chairman, CM of states where Ganga or its tributaries flow.

b) National Ganga River Basin Authority was created under EPA, 1986.

4. Namami Gange Programme - Central Sector scheme

a) 20,000 cr budget

b) Obj - abatement of pollution, conservation & rejuvenation of Ganga.

c) Main Pillars - sewage treatment infra, river front dev, river surface cleaning, public awareness, biodiversity, afforestation etc.

- 2nd Oct 2014

- Ministry of Drinking Water and Sanitation

- Since 2019, it is being taken up by Jal Shakti

## Plastic Pollution

Microplastics - Plastics  $< 5$  mm in length but larger than  $1 \mu\text{m}$ .

Microbeads - tiny pieces of plastic added to health and beauty products.

- Size - less than  $0.5 \mu\text{m}$  but larger than  $0.1 \mu\text{m}$ .
- Very harmful for marine ecosystem.

Nanoplastics - Smaller than  $1000 \text{ nm}$

- They can pass through physiological barriers and enter organisms.

## Light Pollution

→ In 2022, district adm of Ladakh in India created the Hanle Dark Sky Reserve (HDSR) - 1st International Dark Sky Reserve in India.

→ Consequences - Harms wildlife

- Disrupts ecosystem
- Human health
- Energy

→ Solutions - only using light when & where it is reqd.

- only use the necessary amount.
- using energy efficient bulbs
- using bulbs with the right spectral power distributions.

→ International Best Practice - The Outdoor Lighting Code  
in the UK, aims to reduce light pollution by encouraging the use of lighting, that is only as bright & as long as necessary for the task.



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## Lecture - 17 (Climate Change)

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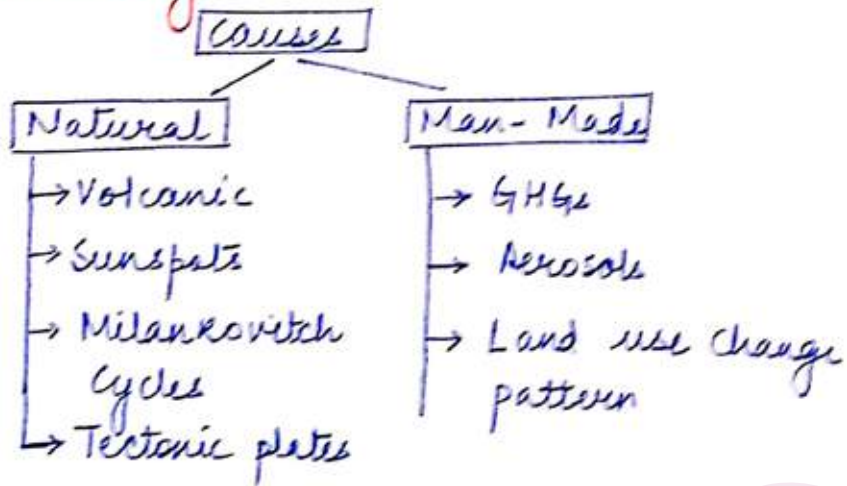
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- Climate Change - Intro
- Causes { Natural
  - Anthropogenic
  - Consequences
  - Initiatives { Indian
  - Global
  - Way forward

Introduction - Climate change is the long-term shift in temperatures and precipitation levels (weather patterns) caused directly or indirectly by human activity which alters the composition of global atmosphere.

UNFCCC defines climate change as the change of climate which is attributable directly or indirectly to human activity which alters the global composition of the atmosphere & which is in addition to the natural climate variability observed over comparable time periods.

Causes of Climate Change



Natural Causes -

1. Milankovitch cycle - changes in eccentricity of earth's orbit can lead to changes in insolation.
2. Sunspots - sunspot cycle is of 11 yrs which can lead to some changes in the variations of heat coming out.

of the Sun which in turn can lead to variation in heat rec'd by the Earth.

3. Tectonic plates - changes in tectonic plates lead to creation of various landforms.
4. Volcanic Eruptions - lead to changes in Earth's heat budget.

### Man-Made Budget Causes:

1. Greenhouse gases
2. Aerosols
3. Land use change patterns
4. Deforestation
5. Methane emissions from agriculture like paddy cultivation
6. large scale use of fertilizers.

Global Warming - Refers to long term warming i.e rise in the global temp.

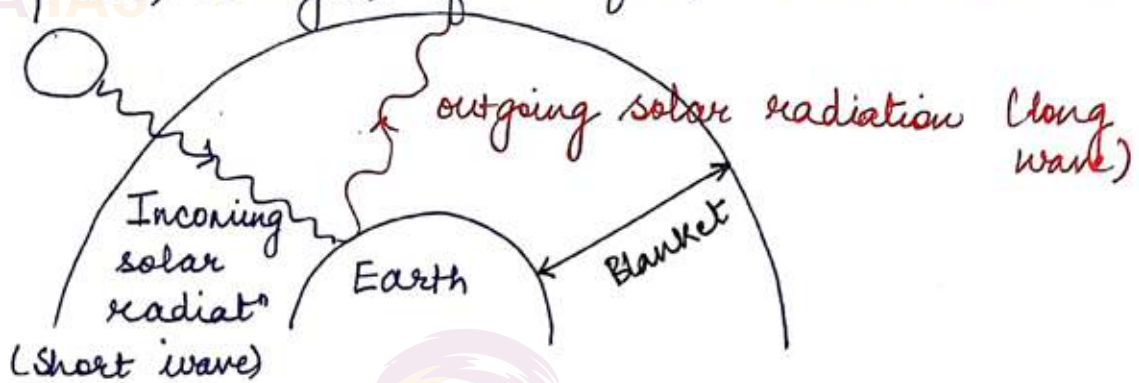
### Impact of Climate Change

- ① Air Pollution - Air poll<sup>n</sup> & climate change closely linked.
- ② Extreme heat - make lung dis. worse. + ↑ risk of drought + worsens air quality as dirt and dust from the ground rise up into air + wildfires & smoke.
- ③ Flooding - lead to damp ⇒ ↑ risk of mould growth. Mould triggers allergies, causes lung infection + asthma & ~~asthma~~ rhinitis.
- ④ Plant Pollen - Cause allergies  
- ↑ product<sup>n</sup> in high Temp + ↑ CO<sub>2</sub>
- ⑤ Infectious diseases - ↑ virus spreading ⇒ ↑ epidemics & pandemics.

Global Warming  
↓  
Gradual inc. of Earth's surface temp<sup>r</sup>

Climate Change  
↓  
Long term change in global weather patterns.

\* Climate change includes global warming but refers to more comprehensive understanding of changes in sea level, shrinking mountain glaciers, accelerated loss of cryosphere, drought, forest fires, salinization etc.



### Greenhouse Effect

- A greenhouse is a structure whose roof & walls are made of transparent material in which plants are grown. In a greenhouse, incident solar radiations pass through the glass which is absorbed by floor.
- The visible and adjacent portions of infrared and UV make incident short waves.
- Outgoing part is long wave infrared.
- It is a natural phenomenon.
- Life would ~~not~~ have not been possible on Earth if natural greenhouse effect (NGHE) would not have happened.
- NGHE helps to maintain an ambient temp<sup>r</sup> of 16-18°C. Without it, our temp<sup>r</sup> would have been around -18 to -20°C in which life would have not been possible.

Green House Gases - There are atm. gases like CO<sub>2</sub>, water vapour, CH<sub>4</sub>, N<sub>2</sub>O etc. trap the outgoing infrared radiations

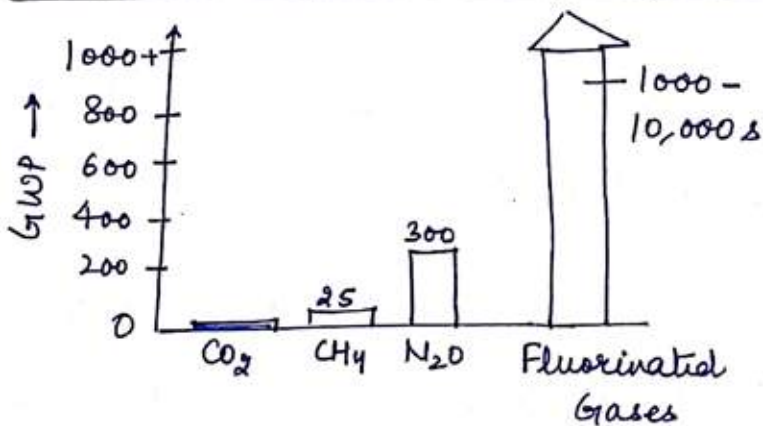
from Earth's surface. This causes ~~the~~ <sup>trapping of the</sup> Earth's ~~sw~~ atmosphere known as greenhouse effect & gases causing them are GHGs.

GHGs →  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ , HFCs, PerFluro Carbons (PFCs),  $\text{SF}_6$ .

## 2 aspects of GHGs

1. Global Warming Potential (GWP) - It is the measure of how much energy the emissions of a ton of gas can absorb over a period of time relative to 1 ton of  $\text{CO}_2$ .
2. Atmospheric lifetime - Measure for of duration for which a gas remains in the atmosphere before disintegration.

GHGs	GWP	lifetime (years)
$\text{CO}_2$	1	50-200
$\text{CH}_4$ (SLCP)	25	12
$\text{N}_2\text{O}$	310	120
HFCs	140-11700	1-270
PFCs	6500-9000	800-50,000
$\text{SF}_6$	2399	3200



## GHGs and Sources -

1.  $\text{CO}_2$  - fossilfuel emissions, transport, industrial, natural gas, diff. coal & thermal power plant, coal &

thermal power plant, coal & crude oil extraction, deforestation, stubble burning.

\* Keeling Curve shows the level of  $\text{CO}_2$  in the last 50 yrs.

2.  $\text{CH}_4$  - burning of biomass, agriculture, landfills, natural gas & systems.

3.  $\text{N}_2\text{O}$  - agricultural soil management, treatment of water, chemical & product management, manure management, transportation.

4. PFCs - used in Aluminium production, these are substitutes of ODS (Ozone Depleting Substances).

5.  $\text{SF}_6$  - electrical transmission, Magnesium production.

6. HFCs - semiconductor manufacturing, electronic industry, it's a substitute for ODS.

7. CFCs - Montreal protocol

General Fluorinated Gases:

1. Substitute to ODS.
2. Electronic industry
3. Semi conductor manufacturing
4. Electrical & transmission distribution
5. Used in processing of Mg and Al.

SLCP - Short lived Climate Pollutants

Powerful climate forcers that remain in the atm. for a much shorter period of time than  $\text{CO}_2$ , yet their potential to warm the atmosphere can be many times greater.

Eg- HFCs,  $\text{CH}_4$ , BC,  $\text{O}_3$ .

Impact

1. Warm the atmosphere

2. Cause disease and premature death.
3. Reduce the staple crop yields.
4. Damages the ecosystem.
5. Accelerates the melting of snow & ice.
6. It disrupts the weather patterns.

→ Climate & Clean Air Coalition is responsible for tracking & mitigating the SLCPs.

### Facts/ Evidence of Climate Change

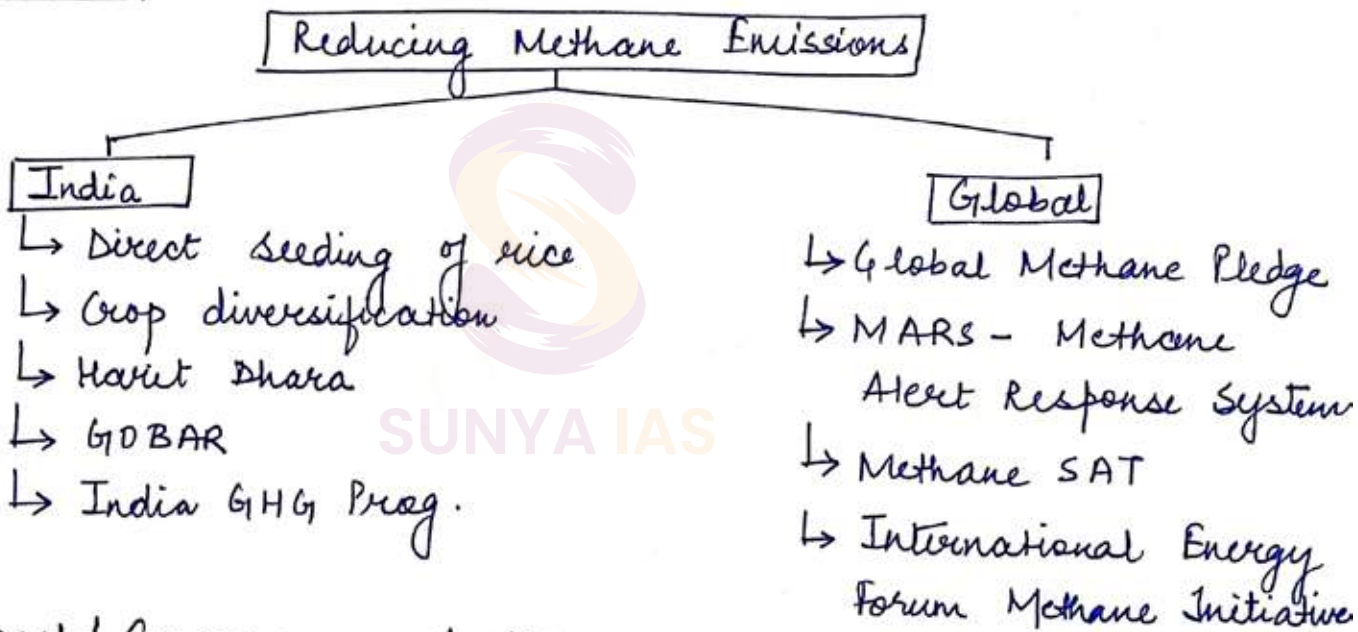
1. Global surface temp<sup>r</sup> has inc.  $\frac{2}{3}$  by  $1.09^\circ$  from 1850-2022.
  - a) The last 4 decades were successively warmer than any other previous decade.
  - b) Warmest year on record was 2016
2. Rise in sea level - Global MSL ~~was~~ has inc. by 0.2m in the last century.
3. Glacial retreats observed everywhere.
4. Polar regions - Arctic sea ice has dec. by 40% in summers and by 10% in winters.
5. Ocean acidification - inc. by 30%
6. Frequency & intensity of extreme weather events have increased. - Hurricanes, drought, heat waves, floods, tropical cyclones.
7. The atmospheric CO<sub>2</sub> emissions are highest in last 8 years.
8. IPCC AR6 concluded that human produce GHGs has caused an inc. in earth's temp<sup>r</sup> with a probability of 95%.

- Telegram Channel: t.me/sunyanotes50
- IPCC estd in 1988 by WMO & UNEP
  - IPCC was awarded noble peace prize 2007.
  - IPCC release its assessment reports & recently released 6th report.
  - Does not carry out any scientific analysis on its own, it only publishes the report.

### Global Carbon Budget

- 57% above pre-industrial levels
- Inc. in US, India.

### Methane



### Impact/Consequences of Climate Change

- Reduces the duration of precipitation
- Direct ↑ in GHGs emission
- Inc. CO<sub>2</sub> levels will cause ocean acidification.  
Bcoz of global warming & climate change, oceans have become more acidic.
  - Oceans absorb more CO<sub>2</sub> which dissolve in sea water forming carbonic acid dec. pH value & acidification impacts the aquatic ecosystem & nutrient cycle.
  - It impacts shell building species such as corals.



3. Impacts species growth & reproduction
4. Increased air temp<sup>o</sup>
5. Changes in rainfall
6. Changes <sup>in</sup> wind, storms etc.
7. Land thaw & ice melt
8. Inc. in melt water
9. Salinity changes.

### Ocean deoxygenation

Warmer ocean water holds less oxygen. Due to stratification & mixing oxygen levels in the deeper water decreases.

\* Ocean warming, ocean acidification & ocean deoxygenation is deadly trio.

Causes { Climate Change  
Eutrophication  
↑ in phosphorus supply

### Implications

→ Environmental { Ocean acidification  
Imbalance in marine life  
Disrupt ecosystem

### → Impact on Agriculture

1. Aquifers will get depleted.
2. Disruption in flowering and pollination
3. loss of natural resources
4. Fragmentation of natural habitats
5. loss of soil fertility
6. Excessive precipitation causes difficulty in plantation.
7. New pests and disease pressures.
8. Greater damage to crops
9. Flooding causing removal of top soil.

→ Impact on Food Security

1. Will inc. the cost of agriculture
2. Reduce the productivity.
3. Effect on fisheries production as warm water contains less nutrients & due to inc. temp<sup>r</sup>, pest & disease will inc.

→ Socially there is gender displacement bcoz of global warming.



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**FOR OTHER SUBJECT NOTES, DROP US  
A WHATSAPP ON 9311077443**

# Lecture - 18 - 25 (Environment)



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**Sociology**

**Enrichment Program**

**(Socio through 200+ Q)**

*(Revise, Enrich and Practice)*

## Sea level rise:

CO<sub>2</sub>  
concentration  
↓  
Highest  
in atleast  
2 million yrs

Sea level  
rise  
↓  
Fastest  
rates in  
atleast  
3000 yrs

Arctic Sea  
Ice Area  
↓  
lowest level  
in atleast  
1000 years

Glaciers  
Retreat  
↓  
Unprecedented  
in atleast  
2000 years



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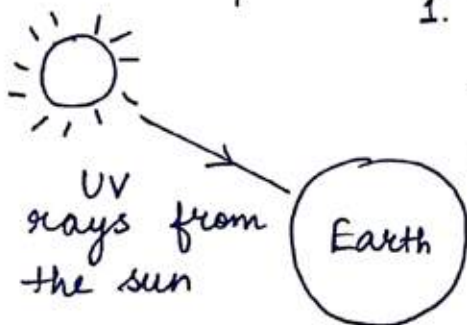
## 1. India -

- a) Vulnerable
- b) Coastal flooding
- c) Agriculture output will fluctuate
- d) Water stress
- e) Coastal infrastructure
- f) Migration

## 2. Global

- a) Displacement
- b) Cities close to coast prone to flooding.
- c) Ocean circulations will change
- d) Frequency and intensity of extreme weather events will increase
- e) Loss of livelihoods.

## Ozone depletion



1. Troposphere & Chlorofluorocarbons (CFCs) & halons rise from the earth's surface.

2. Ozone rich Stratosphere CFC & halon break down to Chlorine & Bromine which in turn break down the ozone layer.

3. Bcoz of the ozone depletion, more harmful UV rays reach the Earth from the Sun.

what is Ozone?

- UV radiations are of 3 types viz, UVA, UVB, UVC.
- UVC is the highest frequency and more harmful than others.
- UVC is completely ~~blocked~~ blocked in the atmosphere and 90% of it is absorbed in stratosphere.
- Longer exposure damages the skin cells, skin tanning, skin burning, and in extreme cases skin cancer.
- UVA is the ~~fastest~~ safest and UVB is the source of Vit D.
- Ozone is an allotrope of oxygen and is less stable than oxygen.
- 90% of OZONE is found in STRATOSPHERE (GOOD OZONE) and 10% in TROPOSPHERE (BAD OZONE).
- \*Ozone conc. is measured in dobsons unit.
- 300 - 500 DU is found in atmosphere.

ODS

- Cl, Br, NO groups are harmful for ozone.

## Ozone - Depleting chemicals

CFCs (Aerosols, Refrigerators, Solvents)

HCFs (Aerosols, Refrigerators, Solvents)

Halons (Fire Extinguishers)

Methyl Bromide (Pesticides)

The steady thinning of ozone layer in the upper atmosphere is known as ozone depletion.

- Ozone depletion leads to ozone hole which harms environment and natural world.
- Concerns over increasing cancer risks and other harmful impacts due to ozone depletion has become a worldwide phenomenon.
- Ozone layer blocks the harmful UV rays from entering the earth's atmosphere.
- These UV radiation harms animals, plants, cause skin, cancer, sun burn, permanent blindness, cataracts.
- Unregulated rocket launches.
- Caused by both human and natural factors like sunspots, stratospheric winds.

1. Increased UV radiations.
2. Impact on crops, plants, animals, and human health.
3. Marine ecosystem is affected.

### Polar stratospheric clouds

- They are dry clouds formed in the stratosphere near polar regions.
- The ice particles of polar stratosphere provide a substrate for chemical reactions and release active chlorine.
- It helps in the release of reactive Cl.

### Ozone depletion in Antarctica

- Very low temperature during winters.
- Has extensive land area.
- Polar stratospheric clouds are formed at low levels and in large quantities.
- Formation of a polar vortex which is a ring of rapidly circulating air.



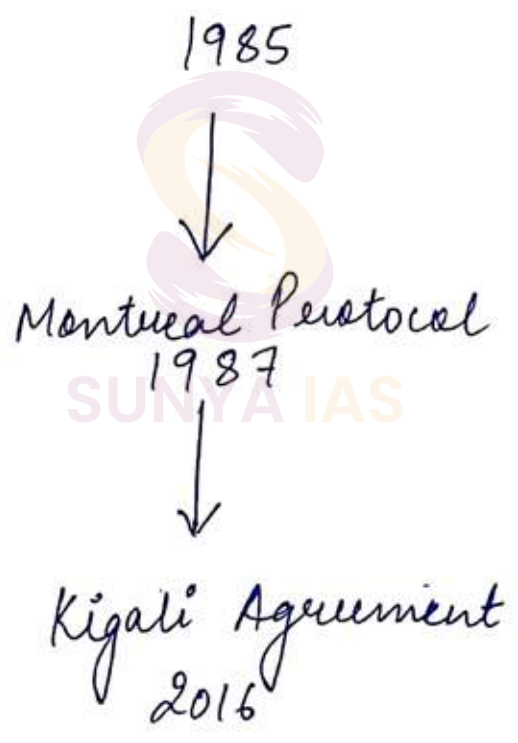
Why there is lesser ozone depletion in arctic?

- 1. Temperature is little warmer.
- 2. Polar stratospheric clouds are not found.
- 3. Absence of extensive land area.

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Convention

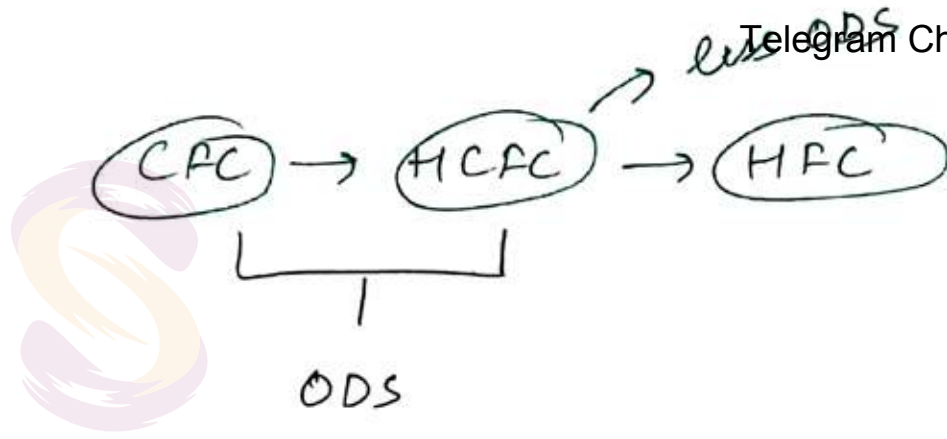
Vienna Convention



Vienna convention - 1985

Montreal protocol - 1987 - replacing CFCs with HCFCs and eventually with HFCs

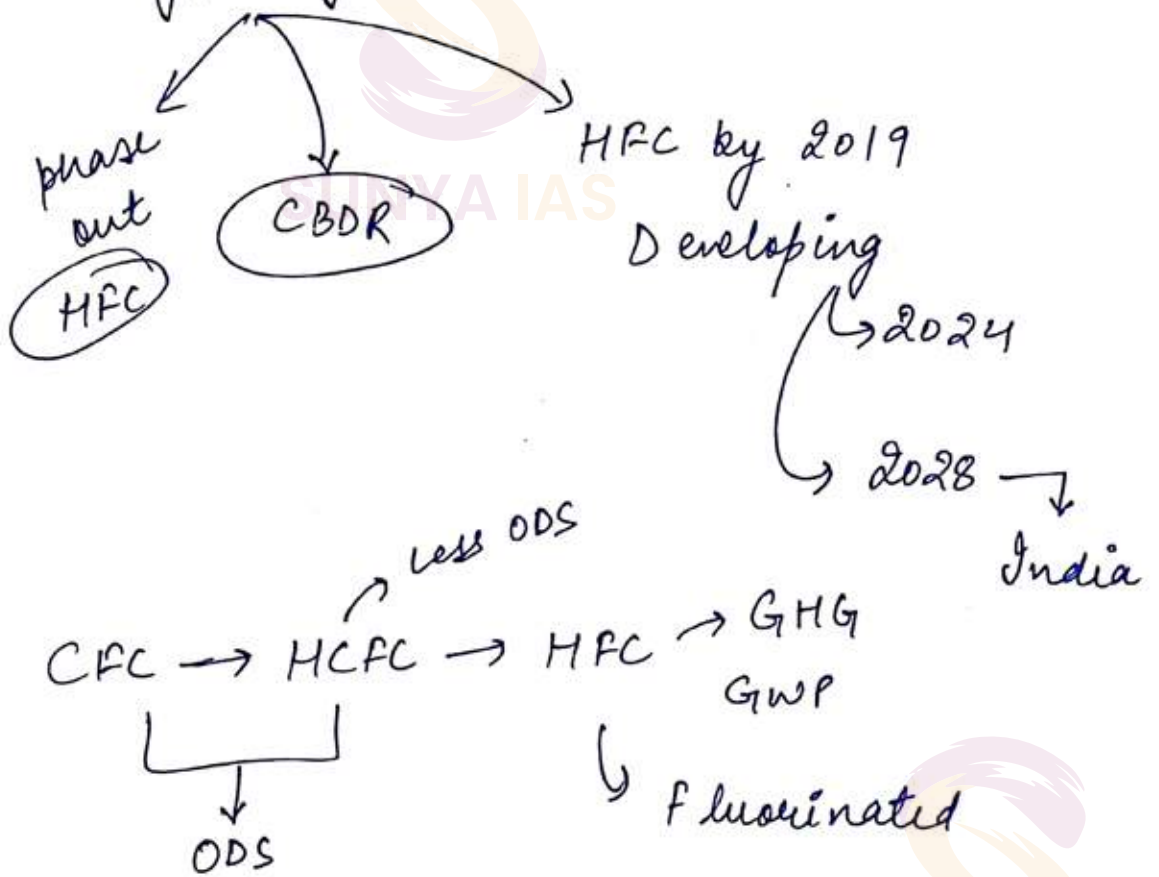
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Kigali agreement - 2016 - phase out HFCs

- 1) 1985 - Vienna convention
- 2) 1987 - Montreal Protocol
- 3) 2016 - Kigali Agreement



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HFCs are powerful man-made greenhouse gases that are rapidly building up in the atmosphere.

**CONSUMPTION** HFCs are a group of industrial chemicals primarily used for air conditioning and refrigeration.

**LIFETIME IN ATMOSPHERE**

15 YEARS (AVERAGE WEIGHTED BY USE)

Many HFCs are short-lived climate pollutants. The most abundant of these, HFC-134a, is 3,790 times more damaging to the climate than carbon dioxide ( $\text{CO}_2$ ) over a 20-year period.



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## USAGE

→ Residential, Commercial & industrial air conditioning & refrigeration. (47%)

→ Mobile air conditioning

→ Foam Agents

→ Unitary air conditioning

→ Aerosols

→ Fire extinguishers & solvents

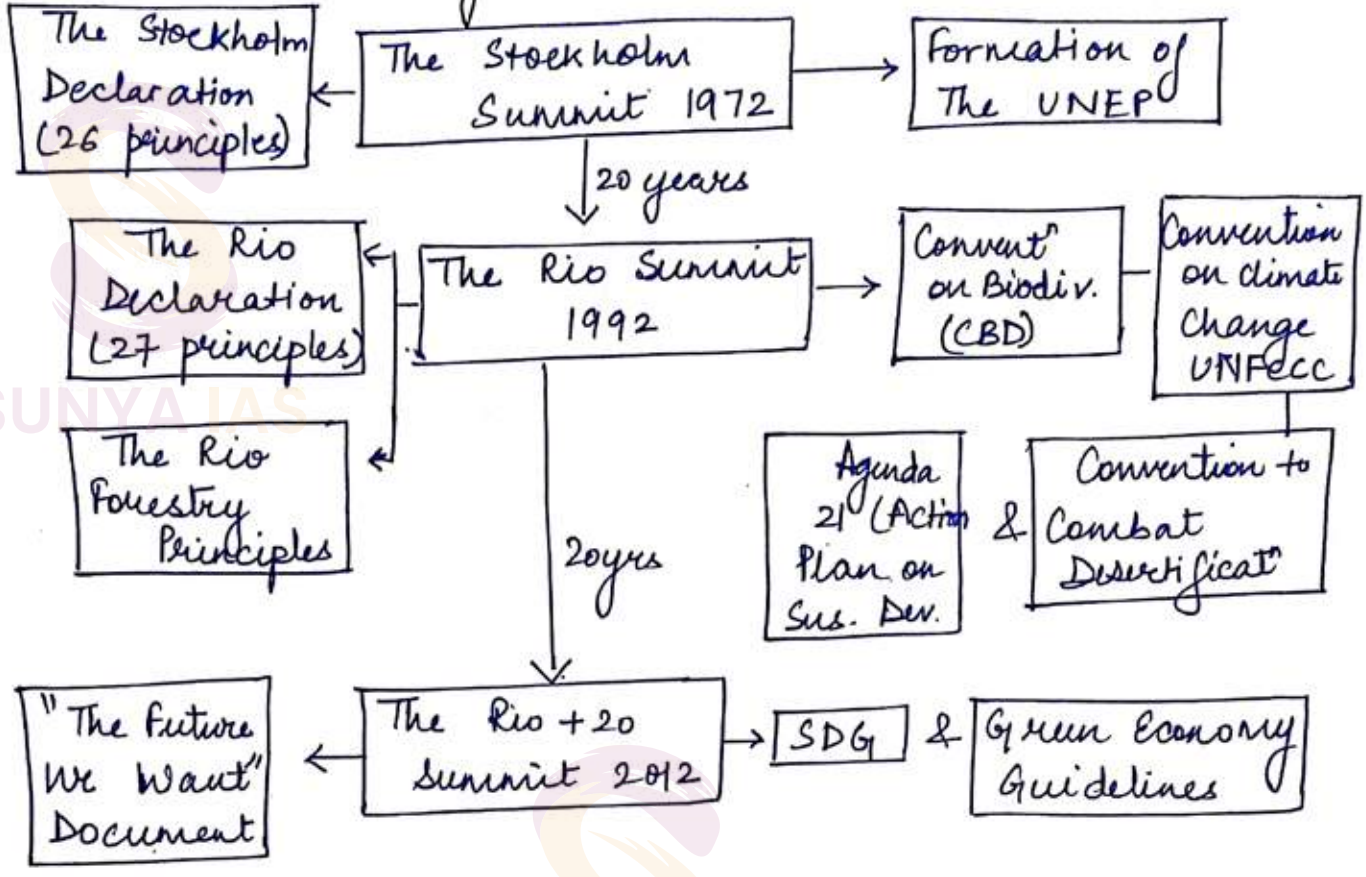


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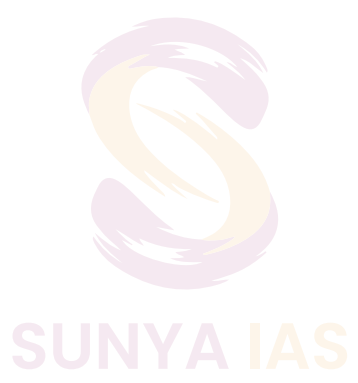


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# Climate change conventions



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- Also known as UN conference on environment and development.
- It led to 6 outcomes:
  - Rio declaration
  - Forest and principles: talk about sustainable forest development, non-legally binding.
  - Agenda 21: It is an action agenda for 21st century for united nations, other international organizations, countries etc.
  - UNFCCC
  - UNCCD
  - UNCBD
- It gave 27 principles to guide countries in sustainable development.
  - Polluter pay principle
  - Precautionary principle: before using any substance, we must first prove that the substance will not cause any pollution.

Rio 1992 - Rio de Janeiro (UNCED)

Rio +10 2002 - Johannesburg, SA  
(WSSD)

Rio +20 2012 - Rio de Janeiro (UNCSD)

Rio +10

- It reaffirmed the commitment to agenda 21.
- Johannesburg declaration committed the nations towards sustainable development.
- MDGs were established during the millennium summit in 2002.

Rio +20

- It is a 20 year follow up of Rio summit.
- SDGs were created.
- PAGE (partnership for action on green economy) is a direct outcome of this summit which is titled as "the future we want".

- To conserve biodiversity.
- Use biological resources in a sustainable manner.
- Fair and equitable sharing of benefits arising from the use of biodiversity.

### Cartagena Protocol

- 2000
- Handling transportation and use of living modified organisms (LMO) through the use of biotechnology.
- It brings advance agreement as a mechanism to inform countries involved in transportation and use of LMOs.
- A biosafety clearing house is also established to oversee the movement of LMOs.

### Nagoya Protocol

- It aims to ensure benefits arising from the utilization of genetic resources are shared in a fair and equitable manner.
- It brings access and benefit sharing in action.



- It is the sole legally binding treaty which is related to arrest or prevent desertification.
- It is an outcome of Rio Summit 1992.
- Entered into force in 1994.
- Legally binding convention which links development with environment to sustainable land development.
- It aims to protect and restore land and ensure a safe just and a fair future.
- It provided the idea of land degradation neutrality (LDN) to be achieved by 2030.
- 14<sup>th</sup> COP led to New Delhi declaration.
- 15<sup>th</sup> COP in Cote D'Ivoire.
- India has set a target to restore 26 mha of land by 2030.

## UNFCCC

- United Nations framework convention on climate change.
- It is an international environment treaty that came into existence under aegis of UN.

## • Objectives:

- The GHGs emissions at a level that will prevent dangerous consequences.
- It provides a framework within which binding limits on greenhouse gas emissions can be set.
- UNFCCC itself does not set any binding limits.

- NOT legally binding.
- COP is a decision-making body of UNFCCC.
- All states that are party to UNFCCC are represented at the COP.

1995: COP 1, Berlin, Germany - The Berlin Mandate calls to establish specific, legally-binding targets and timetables for reducing GHG emissions by developed countries to reduce their GHG emissions.

2002: COP 8, New Delhi, India

2005: COP 11 / CMP 1, Montreal Canada - Kyoto Protocol was ratified

2009 : COP 15 / CMP 5, Copenhagen, Denmark

2011 : COP 17 / CMP 7, Durban, South Africa

2012 : COP 18 / CMP 8, Doha, Qatar

2013 : COP 19 / CMP 9, Warsaw, Poland \*\*

2014 : COP 20 / CMP 10, Lima, Peru

2015 : COP 21 / CMP 11, Paris, France - concluded  
the Paris Agreement

2016 : COP 22 / CMP 12, Marrakech, Morocco

2017 : COP 23 / CMP 13, Bonn, Germany

2018 : COP 24 / CMP 14, Katowice, Poland

2019 : COP 25 / CMP 15, Madrid (Spain)

2021 : COP 26 / CMP 16 (Oct - Nov 2021), Glasgow

(Hosted by UK in partnership with Italy.)

2022 : COP 27 / CMP 17 (Nov 22), Sharm El  
Sheikh, Egypt

2023 : COP 28 / (Nov - Dec 2023) / CMP 18, Expo  
City, Dubai.

Most important ones marked Black

- It establishes a legally binding obligation for developed countries to reduce their greenhouse gas emissions.
- It came into force in 2005.
- It set compulsory targets for reducing GHGs from 2008-2012 (1<sup>st</sup> commitment period)
- 2013 - 2020 = 2<sup>nd</sup> commitment period.
- It targets 6 GHGs viz CO<sub>2</sub>, CH<sub>4</sub>, NO, HFCs, SF<sub>6</sub>, PFCs.

### COP 3

- 1997
- Kyoto, Japan
- The Kyoto Protocol was signed: More than 150 nations signed the treaty. The United States was a notable exception, even though Clinton signed it Congress did not ratify.

- Telegram Channel: t.me/sunyanotes50
- Annex 1 countries agreed to reduce their greenhouse gas emissions. They were also required to prepare policies for the implementation of their agreed upon reduction. Another aspect of the treaty was to establish an adaptation fund for climate change in developing countries.
  - The treaty required participation from all ratified countries during the commitment period of 2008 - 2012.

Adaptation fund is the part of Kyoto protocol.



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# Kyoto Mechanisms

# Classification of Parties to the Kyoto Protocol

- **International Emission Trading**: allows parties to buy 'Kyoto units' from other countries to help meet their domestic emission reduction targets.

- **Clean Development Mechanism (CDM)**: Countries can meet their domestic emission reduction targets by buying 'Kyoto units' from (projects in) non-Annex I countries.

- **Joint Implementation (JI)**: Any Annex Country can invest in emission reduction projects (referred to as "Joint Implementation

- **Annex I**: These are the industrialized (developed) countries and 'economic in transition' (EITs). EITs are the former centrally-planned (Soviet economies of Russia and Eastern Europe. The European Union - 15 (EU-15) is also an Annex I party.

- **Annex II**: Parties are made up of the organization for Economic Cooperation and Development (OECD). Annex II parties are required to provide financial resources to enable developing countries in reducing their greenhouse gas emissions (climate change mitigation) and manage the impacts of climate change (climate change adaptation)

- **Annex B**: Parties listed in Annex B of the Kyoto Protocol are Annex I parties with first or second round Kyoto greenhouse gas emissions targets.

Projects") in any other Annex I country as an alternative to reducing emissions domestically.

- The Adaptation Fund: to finance adaptation projects and programmes in developing countries. Fund was financed mainly with a share of proceeds from CDM project activities.

- Non - Annex I: Parties to the UNFCCC not listed in Annex I of the Convention so are mostly low-income developing countries. Developing countries may volunteer to become Annex I countries when they are sufficiently developed.

- Least - Developed Countries (LDCs): 49 parties are LDCs, and are given special status under the treaty in view of their limited capacity to adapt to the effects of climate change.

Emissions trading:

- It is a market mechanism to trade Kyoto units from one country to the other.
- A Kyoto unit is the excessive emission achieved by member country.



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- Annex B parties with binding targets in the second period.
- Annex B parties with binding targets in the first period but not the second.
- Non-Annex B parties without binding targets.
- Annex B parties with binding targets in the first period but which withdrew from the Protocol.
- Signatories to the Protocol that have not ratified.
- Other UN member states and observers that are not party to the protocol.

Signed 11 December 1997

Joint Implementation

- Any annex 1 country can invest in emissions reduction in another annex 1 country and take the credit.





### Clean development mechanism

- Annex 1 countries assisting non-annex 1 countries in GHGs emission reduction.

### Adaptation Fund

- Financing adaptation projects and programmes in developing countries.
- The fund is financed with a share of proceeds from CDM project activities.

### CBDR

- Common but differentiated responsibilities: based on common responsibility of all countries to reduce GHGs emissions but the developed countries should contribute more as they have emitted more.
- The different emissions target for different annex countries are based on the principles of CBDR.

### COP7

- Happened in Marrakesh in 2001.
- It brought the concept of adaptation fund in UNFCCC.

## COP 8

- The Delhi ministerial declaration called the developed countries to transfer technology and finance.

## COP 11

- Kyoto protocol ratified.

## COP 15

- In Copenhagen.
- Developed countries were reluctant.

## COP 16 - Cancun, Mexico

- The idea of green climate fund<sup>(GCF)</sup> was finalised.

GCF:

- to aid developing countries.
- Aimed to raise 100 billion dollars per year from developed countries and transfer to developing countries.



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### COP 15 Copenhagen accord 2009

- It includes the goal of limiting the average maximum global temperature increased to not more than 2 degrees Celsius above the preindustrial level.
- Developed countries promised to provide 30 b\$.

### COP 16 Cancun (Mexico)

- Parties agreed to commit to a max temp. rise of 2 degrees Celsius above pre industrial level and to consider to lower it to 1.5 degrees in near future.
- Parties agreed to establish a green climate fund (GCF) to finance projects, policies in developing countries.

### COP 17 Durban 2011

- GCF got a legal approval.
- 2<sup>nd</sup> phase of Kyoto protocol was secured.

- Spoke about extending the life of protocol.
- 2<sup>nd</sup> commitment period - 2013 to 2020
- Canada, Japan, Russia, Belarus, Ukraine, NZ did not participate in 2<sup>nd</sup> commitment period, Kyoto Protocol was limited in its scope.
- It covered only 15% of global carbon dioxide emissions.
- Countries like India, China, Brazil are not under the purview of Kyoto protocol

## COP 19, 2013 Warsaw

- Intended nationally determined contributions (INDC).
- Loss of and damage concept came in the Warsaw summit.
- But LLD fund came in COP27.
- The developed countries will aid the developing countries to cope with loss and damage.

\* link with COP 27

- The agreement urge the parties to take national pledges by finalising their INDCs.

## COP 21, Paris (2015)

- A legally binding treaty.
- A legally binding international treaty on climate change.
- Reaffirmed the goal of limiting global temperature increase to well below 2 degrees Celsius, while pursuing efforts to the limit the increase to 1.5 degrees.
- The countries to implement nationally determined contributions (NDCs) on a 5-year cycle.
- INDC: during COP 19 wausau summit, 2013, the countries agreed to publically outline what action they intended to take under a global agreement will before a paris summit 2015.

- 3 Objectives of India's NDCs:
  1. Reduce emissions intensity of its GDP by 33-35% by 2030 taking below 2005 levels.
  2. To achieve 40% of its total electricity capacity from renewables.
  3. Creation of additional carbon sink of 2.5 to 3 billion tons of CO<sub>2</sub>.
- This agreement is guided by the principles of CBDR.

### Global Stocktake

- The agreement has some binding elements such as global stocktake requiring the countries to participate in a system for measuring their progress.
- It is a universal agreement on climate change to be signed in 2015 and implemented by 2020.
- It entered into force in November 2016 after ratification by 55 countries.

that account for at least 55% of global countries.

- India signed and ratified in 2016.
- The developed countries reaffirmed their commitment to mobilize 100 b\$ a year in climate finance by 2020 and agreed to continue it till 2025.
- Climate neutral now - helps climate action to achieve a climate neutral world as envisioned in the Paris agreement.
- Net Zero - the amount of GHGs emitted into the atmosphere is less than the amount taken out of the atmosphere. Net zero CO<sub>2</sub> emissions.
  - EU target - 2050
  - China target - 2060
  - India target - 2070



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## Agreements

### Kyoto Protocol & Paris Agreement

#### Kyoto Protocol

#### Paris Agreement

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• was created in 1997 and ratified in 2005. Had two periods from 1997-2020.</li> <li>• Legally binding agreement to decrease GHG</li> <li>• Original commitment to decrease overall emissions by 5% from 1990 levels.</li> <li>• Only required developed nations to reduce emissions.</li> <li>• Targets are set but no determined time frame.</li> </ul> | <ul style="list-style-type: none"> <li>signed in november of 2016. New commitments are due every 5 years.</li> <li>Not legally binding commitment to reduce emissions, increase accountability.</li> <li>Overall goal to limit global temperatures to 1.5 degrees celcius above pre industrial levels.</li> <li>Asked all nations to reduce emissions.</li> <li>New set of targets declared after 5 years (these are now due in 2020).</li> </ul> |
|--|---|



## Solar alliance)

- ISA is action - oriented member driven and a collaborative platform.
- To increase the deployment of solar energy.
- Conceptualised in COP 21.
- In 2020 the framework agreement was amended and now all UN nations are eligible to Join ISA.
- I HQ ISA - Gurgaon, India.

## COP 22, Marrakech, 2016

- Aims to support the 2030 agenda for sustainable development by reducing GHGs emissions.

## COP 23, Bonn, 2017

Bonn Climate Meet  
(COP-23), 2017

- Talanoa Dialogue - It is a process designed to help countries implement and enhance their nationally determined contributions by 2020.



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- The ~~joint~~ <sup>joint</sup> ~~even~~ <sup>even</sup> Gender Action Plan to the UNFCCC was adopted here.
- Local communities and indigenous people's platforms: a new platform to include indigenous people's voices in the implementation of the Paris Agreement.
- No financial commitments were agreed upon between the negotiating parties on the issue of loss and damage.

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- Inclusive, participatory, and transparent dialogue (IPT)
- A transport decarbonisation alliance.
- To facilitate the shift to sustainable fuel.

COP 24, Katowice



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Madrid

COP 25,

2019

- On Emission Reductions: avoided strong language and setting a clear timeline for nations.
- On Loss and Damage: noted that the Green Climate Fund (GCF) already supports activities relating to 'loss and damage'.
- Santiago Network: was established for technical assistance to the most vulnerable countries.
- On Carbon Market: Could not set rules for carbon markets under Article 6 of the Paris Agreement.
- Decision was made on a new five-year gender action plan (GAP), intended to support the implementation of gender-related decisions and mandates in the UNFCCC process.

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- The present pledges of the member countries if fulfilled will limit global warming to 2.4 degrees Celsius.
- Therefore, the member countries were asked to cut down emissions to achieve the global temperature below 1.5 degrees Celsius.
- First ever decision to phase down coal was agreed to and it was decided to phase down out inefficient fossil fuels.
- Completing the Paris rulebook.
  - ↳ The 2018 Paris rulebook governs how the world community in 191 countries must pledge emissions reduction targets under the Paris agreement and report on their progress.
- Glasgow breakthrough agenda
  - ↳ To accelerate the development and deployment of clean energy.
  - ↳ It was agreed to increase the money supply under the green

Climate fund as the previous target of \$100 billion per year by 2020 was missed.

- India in COP 26 announced its climate commitments known as Panchamrita.

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500 GW  
Non-Fossil  
energy capacity by  
2030

Net Zero  
by  
2070

India's  
Panchamrita

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50%  
Energy  
through  
renewable  
sources

45%  
reduction in  
Carbon intensity

1 bn tonnes  
Carbon emission  
reduction by  
2030



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1. Achieving net-zero by 2070.
2. Reducing total projected carbon emissions by one billion tonnes starting now till 2030.
3. Increasing renewable energy component to 50% of our total energy requirements by 2030.
4. Reducing carbon intensity by 45% by 2030.
5. Increasing non-fossil energy capacity to reach 500 GW by 2030.

#### • Mission Life:

↳ It is piloted by NITI aayog and implemented by MoEFCC.

↳ PPP approach - Pro planet people-environmentally conscious lifestyle choice.

## Initiatives - India is a part of

Systems	Launched by
Breakthrough Agenda	
Declaration on "accelerating the transition to 100% zero-emission cars and vans".	governments, auto-motive manufacturers, financial institutions, and civil society organisations.
Global Resilience Index Initiative	10 global organizations
Infrastructure for Resilient Island States	India, along with Australia, UK, Fiji, Jamaica and Jamaica
The Green Grids Initiative	India, along with Australia, UK India in partnership with COP 26 Presidency - International Solar Alliance (ISA), World Bank, UK

government and  
Wilton Park.

E - Amit Patel

India at COP26

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Launched by	Description
	make clean technologies and sustainable solutions to the most affordable, accessible and attractive option in each emitting sector.
government, automotive manufacturers, financial institutions, and civil society organisations	To work towards all sales of new cars and vans being zero emission globally by 2040, and by no later than 2035 in leading markets.
10 global organisations	offer global open reference risk data using metrics built on insurance risk modelling principles.



<p>India, along with Australia, UK, Fiji, Jamaica and Jamaica.</p>	<p>promote disaster and climate resilience of infrastructure assets in SIDS, CDRI and SIDS.</p>
<p>India in partnership with COP26 Presidency, International Solar Alliance, World Bank, UK, govt and Wilton park</p>	
<p>India at COP26</p>	<p>Web portal; EV; Niti Aayog + UK Govt.</p>

INITIATIVES INDIA IS NOT A PART OF:

Systems	Country	Description
<p>Global Methane Pledge</p>	<p>United States</p>	<p>A voluntary non-binding agreement under which signatory countries have promised to cut their methane emissions by at least 30 percent by 2030.</p>

<p>Glasgow Methane Pledge Leader's Declaration on Forest and Land Use</p>	<p>China</p>	<p>Voluntary non-binding agreement under which signatory countries have promised to cut their methane emissions by at least 30 per cent by 2030.</p>
<p>FACT statement</p>	<p>UK and Indonesia</p>	<p>to support sustainable trade between commodity-producing and consuming countries.</p>
<p>Sustainable Agriculture Policy Action Agenda for the transition to sustainable Agriculture and Global Action Agenda for Innovation in Agriculture</p>	<p>European Union</p>	<p>Support to food and agriculture, to deliver these outcomes and enable a just rural transition.</p>
<p>Beyond oil and Gas Alliance</p>	<p>Denmark and Costa Rica</p>	<p>It is an international alliance of governments and stakeholders working together to facilitate the managed phase-out of oil and gas production.</p>

Systems	Country	Description
Clydebank Declaration	United States	Create zero emissions shipping trade routes between ports to speed up the decarbonisation of the global maritime industry

The COP 26 Clydebank Declaration: "The future of green shipping?"

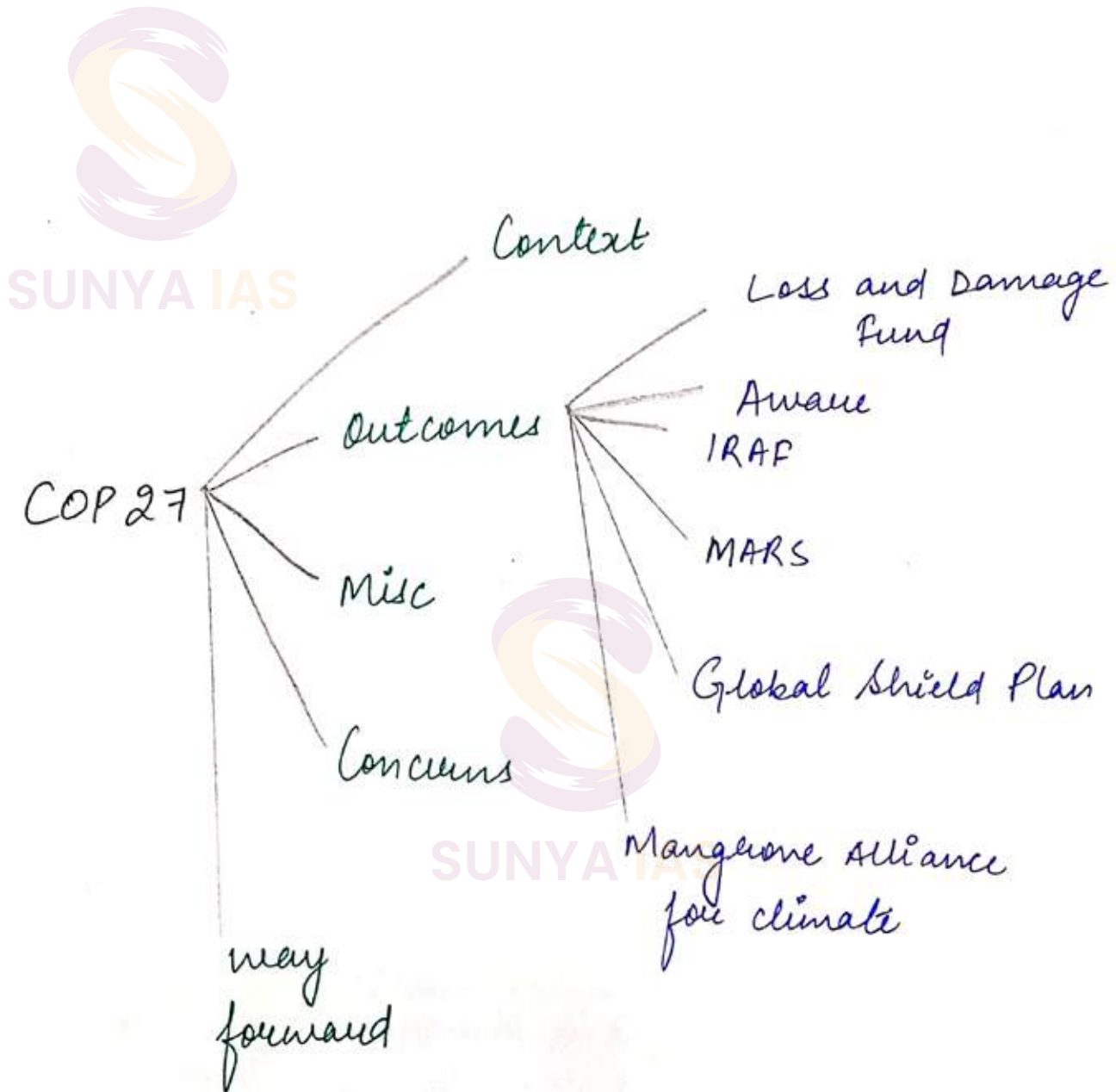
Clydebank declaration

The To support the establishment of at least 6 green corridors by 2025.

A green corridor is defined as a shipping route between two major port hubs on which the technological economic and regulatory feasibility of zero-emissions ships is accelerated by public and private action.

- It welcomed the operationalization of Santiago network.
- Santiago network - for having averting, minimizing, and addressing loss and damage associated with adverse effect of climate change.
- G20 Glasgow finance alliance for net zero (GFANZ).
- It brings together firms for leading net zero emissions by 2050.
- All members of GFANZ members must be accredited by the UN race to zero campaign.
- India gave slogan - one life one world.
- PM spoke about that developed economies must allocate 1 trillion \$ for climate finance.





- The term loss and damage refers to costs already being incurred from climate fueled weather extremes like rise in sea level.
- Loss and damage funding is expected to cover the cost of damage that countries cannot avoid or adapt to

- Rich caused bulk of climate change with majority of GHGs emissions.
- It will assist poor and developing countries that are vulnerable to adverse effects of climate change.
- To set up a L&D fund has been a long-standing demand by least developed countries and alliance of small islands states and by least developed countries.
- There has to be compensation for loss and damage for these vulnerable countries.
- AWARe - action for water adaptation and resilience.
  - Sustainable water management.
  - Has 3 principles
    - To decrease water losses and improve water supply.
    - Mutually agreed cooperative water adaptation action.
    - Promote cooperation and interlinkages between water climate action to achieve SDG 6.

• IRAP - Infrastructure Resilience Accelerator Fund.

- It is a multi-donor trust fund build with a support of UNDP and UNDRR (United Nations office on Disaster Risk Reduction)

- Aim to support global action on disaster resilience on infrastructure for specially SIDS.

• Methane alert and responses system (MARS)

- It is a satellite-based monitoring system for tracking methane emissions.

- It aims to accelerate the implementation of global methane pledge COP 26.

- it is set up as a part of UNEP's IMEO.

- It is implemented by international energy agencies (IEA) UNEP and CCAC (Climate and Clean Air Coalition)

- India is not a signatory of global methane pledge.

- IMEO

- It creates a global public data set of methane emissions.

- Telegram Channel: t.me/sunyaotes50
- It collects data from both public and private sources.
  - UNEP launched IEMO with a support of at G-20 summit of 2021.

### • Global shield plan

- It is a funding mechanism that provides funding to countries which are suffering climate disasters.
- G7 and V-20 are the coordinators of the group.
- Pakistan will be among the first recipients of funding from the G7 global shield plan.
- V-20 - vulnerable 20 group was established in 2015, Lima, Peru.
- India is not a member of V-20 group.
- India submitted its long-term low emission development strategy to UNFCCC in COP 27.
- LT leads - are qualitative requirements under Paris agreements.
- At COP 27 the basic groups opposed carbon border tax as it goes



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against the principle of CBOR that is  
why countries actually went against the  
Carbon tax.

- CBAM - Carbon border adjustment management - proposed by EU.
- It is a policy tool to reduce carbon emissions by ensuring that the imported goods are subjected to same carbon cost as the product produced within the EU.
- CBAM is the part of fit for 55 in 2030 package.
- Fit for 55 is the EU's strategy to reduce GHGs emissions by 55% by the year 2030 as compared to 1990 levels.



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## CONVENTIONS

- It is a grouping of countries that come together on a common agenda
- Eg: Ramsar convention, UNFCCC, recent COP 28.

## PROTOCOL

- The members of the convention have agreed to a common target and deadline.
- Eg: Kyoto protocol; COP 3-1997.

## AGREEMENT/TREATY

- It is very similar to a protocol in terms of its targets and ~~date~~ deadlines.
- It is more binding in nature and usually an agreement is done voluntarily.
- Eg: Paris agreement in COP 21, etc.

## INITIATIVE

- Like minded countries collaborate on a common project.
- Eg: biofuel alliance initiative, ISA of India and France.

## Timeline of Conventions

1. 1971 - RAMSAR Convention
2. 1972 - STOCKHOLM CONFERENCE
3. 1973 - CITIES
4. 1982 - Nairobi Conference
5. 1985 - Vienna Convention
6. 1987 - Montreal Protocol
7. 1988 - IPCC
8. 1989 - Basel Convention
9. 1992 - Rio Earth Summit
10. 1997 - Kyoto Protocol
11. 1998 - Rotterdam Convention
12. 2000 - Cartagena Protocol CBD
13. 2001 - Stockholm Convention
14. 2002 - Johannesburg
15. 2010 - Nagoya Protocol
16. 2012 - Rio de Janeiro
17. 2013 - Minamata
18. 2015 - CO<sub>2</sub> COP 21 Paris Agreement
19. 2016 - Kigali Agreement

- Intergovernmental body aims to conserve wetlands - natural and artificial.
- 6 partner convention on wetlands.

- Wetland international,
- IUCN,
- Birdlife international,
- WWF
- IWMI
- WWT

- 75 Ramsar sites
- 2<sup>nd</sup> Feb - world wetland Land
- Parties must agree on to work towards the wise use of wetlands.
- Designate a suitable number of wetlands as Ramsar sites to include them in the Ramsar list and ensure their effective management.
- Cooperate with transboundary wetlands.
  - Wetlands can be shared between two countries e.g., India and China shared Pangong Tso.
- Chilika lake - 1<sup>st</sup> Ramsar site in India.

4  
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- member countries are required to arrange funds on their own and no funding is provided through convention.

- One of the 9 criteria must be fulfilled:

1. If it contains one rare or unique example of natural or near natural wetland (dam, reservoir) found within the appropriate biogeographic areas.
2. It supports vulnerable or critically endangered, endangered or threatened species.
3. If it supports plant and/or animal species required to maintain the biodiversity of a particular biogeographic region.
4. If it supports plant and/or animal species at a critical stage in their lifecycle or provide refuge in adverse conditions.
5. If it regularly supports 20000 or more water birds.

6. If it regularly supports 1% of the population in the population of species or subspecies of water birds.

7. It supports significant proportion interaction in which ultimately supports greater biological diversity.

8. If it is an important source of food for fishes.

9. If it supports 1% of the individuals in a population of one species or subspecies of wetland dependent non-anian species

- Montreux record; list of Ramsar sites that are experiencing ecological change or are expected to achieve the ecological change in future.
- Out of 75 Ramsar sites, 2 are in Montreux record - Keoladeo in Rajasthan and Loktak lake in Manipur.
- Eaulim chilika was added to Montreux record but later removed as it improved.

• It contained 26 principles for environmental conservation.

- Natural resources must be safeguarded.

- Poverty alleviation for protecting the environment.

- Weapons of mass destruction must be destroyed.

- Non renewable resources must not be exhausted

- It resulted in the creation of UNEP.

- UNEP acts as nodal body for various programmes and provide secretarial services.

- It is agency of UN which coordinates environmental efforts.

- It has overall responsibility of environment protection amongst UN bodies.

\*(It has overall responsibility of environment)\*

- It covers various issues related to terrestrial marine and atmospheric ecosystems.

- Helped countries including India

to create environmental departments and ministries.

- Dept for environment was created in 1950.
- Ministry of environment and forest (MoEF) was created in 1985.

### CITES 1973

- It is the convention on international trade in Endangered Species of Wild Fauna and Flora.
- The convention does not aim to entirely stop wildlife but only aims to stop trade in endangered species.
- The objective is to limit and gradually decrease the trade in endangered species.
  - Appendix 1 - trade of those species which are threatened with extinction is prohibited under appendix 1.
  - Appendix 2 - has those species which are not threatened with extinction but may become extinct if trade not regulated.



- Appendix 3 - has those species which is subject to regulation within the jurisdiction of the party and for which the cooperation of the other members or countries is required.



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- UNEP provides secretarial services to CITES.

Nairobi Conference 1982

- It was a follow up to the 1972 Stockholm conference.
- This resulted in a Nairobi declaration.
- The conference gave the idea of sustainable development as per the limits to growth theory.

- This theory discusses the probability of exponential economic and population growth with a finite supply of resources.

\* Vienna Convention 1985 - after Kigali (done)  
Montreal Protocol 1987

- It is the only international convention with near universal ratification.



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• 197 countries have signed and ratified this

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- Aims to reduce the production and reduction of ODS.
- The emission of new ODS decreased by 80% between 1987 and 2014.
- Ozone hole started to shrink.
- The amount of ODS already emitted will take a long time to reduce.
- Legally binding targets.
- It recognises CBDR.
- Developed countries were supposed to phase out most ODS by 1996 while developing countries by 2010.
- Multilateral fund - to assist the developing countries.
- CFCs replaced with HCFC which was replaced by HFC.
  - HCFC were cheaper and 90% less ozone depleting.
  - \*HFC was even less ozone depleting, but it has GWP and is GHG.
- \* Kigali agreement - phase out (not eliminate) the HFC.

<p>BASEL 1989</p>	<p>ROTTERDAM 1998</p>	<p>STOCKHOLM 2001</p>
<p>1. Related to control of transboundary movement of hazardous waste and its disposal.</p>	<p>1. Aims to promote shared responsibility to protect human health from hazardous chemicals</p>	<p>1. It is a convention on persistent organic pollutants (POP). POPs are resistant to environmental degradation.</p>
<p>2. Objective - to stop the movement of hazardous waste from developed countries to developing countries</p>	<p>2. Prior information consent is needed before export or import of waste between countries.</p>	<p>2. Example: POPs - DDT, PCBs, Aldrin, dieldrin, furans, etc.</p>
<p>3. It provides rules and regulations for the movement of hazardous waste (It does not include nuclear waste).</p>		<p>POPs are non-degradable by a normal or natural process, and they have a capability for biomagnification. These pollutants stay in environment for long time. Dirty dozen</p>

Initially Stockholm Convention recommended 12 POPs as dirty dozen. Currently it regulates 29 POPs.

DDT effective in mosquito prevention.

### Minamata Convention 2013

- To protect human health and environment from anthropogenic emissions of Hg pollution.

### Kigali agreement

- 2016
- Phasing down HFC.
- Developed countries must start phasing down by 2019 while developing countries by 2024 and 2028 (India is part of second group).

- Funding will be provided through a multilateral fund under Montreal protocol.
- HFCs will be replaced by HFO (Hydro fluoro olefin) having low GWP.

\* Vienna Convention, 1985

- Objective is to promote cooperation in observation research & info. exchange.
- It talks about having or adopting measures against the activities which are affecting the ozone layer.
- It does not prescribe actions to be taken up by members.
- Steps to be taken to preserve the ozone layer are actually prescribed in 1987 - Montreal Protocol.



Mitigation and Adaptation



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	Mitigation	Adaptation
what it means	Reduce our emissions and enhance sinks and that sequester and store greenhouse gases - net zero	Adjust to expected and actual effects of climate change to reduce vulnerability.
what it does	Addresses the root cause	Address the effect
Goals	Avoid the negative impact of climate change	Reduce risk and increase the ability to prepare, absorb and recover from adverse climate events
Examples	Clean energy, energy efficiency, sustainable transportation etc.	Disaster Management, flood protection, infrastructure upgrades etc.

### Climate Finance:

- It refers to local, national, or global financing drawn from public, private, and alternative sources of financing.
- It seeks to support mitigation and adaptation actions that will address the problems of climate change.

- Telegram Channel: t.me/sunyanotes50
- The UNFCCC, Kyoto protocol (COP 3) and Paris agreement (COP 21) called for financial assistance from developed countries to support the developing countries.
  - It is in accordance with CBDR-RC (common but differentiated responsibilities and respective capabilities).
  - Climate finance is needed to transition the world's economy to a low carbon path.

### Principles of Climate Finance

- Polluter Pays - The 'polluter pays' principle is the economy commonly accepted practice according to which those who produce pollution should bear the costs of managing it to prevent damage to human health or the environment.
- Common but differentiated Responsibility and Respective Capability (CBDR-RC) - It acknowledges the different capabilities and differing responsibilities of individual countries in addressing climate change.



- **Additionality** - Climate finance should be additional to existing commitments to avoid the diversion of funding for development needs to climate change actions.
  - This includes use of public climate finance and investments by private sector.
- **Adequacy & precaution** - In order to take precautionary measures to prevent or minimise the causes of climate change as a stated goal under UNFCCC, the level of funding needs to be sufficient to keep a global temperature within limits as possible.
  - A better level of adequacy might be increased in the national estimates of the needed climate funds, this will help build planned investments with respect to INDC.
- **Predictability** - Climate finance must be predictable to ensure sustained flow of climate finance.
  - It can be done through multi-year, medium-term funding cycles (3-5 years).

## Need for climate finance:

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The world economy forum projects that 5.7 trillion \$ will be needed annually in green infrastructure and current commitment of green climate fund sums inadequate (\$ 100 billion per year is very less than \$ 5.7 tr.)

### 1. Mitigation and adaptation:

- a) funds are needed to reduce emissions and adjusting to climate impacts.
- b) This includes investing in renewable energy, energy efficiency and development of resilient infrastructure.

### 2. Support for developing countries:

- a) Developing countries often lack the resources who deal with the impacts of the climate change or to invest in low carbon technologies.
- b) Climate finance helps these countries to adapt to climate change and leap frog to sustainable clean technologies.

a) Cost of addressing the climate change is immense and the current levels of investment are not sufficient.

b) Climate finance is needed to close funding gap between what is currently being invested and what is needed to effectively combat climate change.

4. Promoting innovation:

a) CF can drive innovation in clean technology.

b) Funding R&D can lead to new more efficient technologies that reduce GHGs and help adapt to climate change.

5. Economic benefits:

a) CF can create jobs in new industries, stimulate economic growth (through development of new technologies).

- Bonds

- Green bonds
- Blue bonds

- Funds

- GEF
- Adaptation Fund
- GCF
- L&D

## GEF

- Global environment facility / fund was established on the eve of Rio earth summit.
- GEF is a private equity fund also known as family of funds dedicated to confronting loss of biodiversity, pollution and climate change (triple planetary crisis).
- 184 member countries including India.
- Secretariat: Washington, DC.
- The World Bank serves as GEF trustee and administers the GEF trust fund.
- It provides financial assistance to 5 international conventions: UNFCCC, UNCBD, UNCCD, Minamata convention

- GEF has very unique structure - has assembly, council secretariat and donors, it has a technical and scientific panel and it also has an evaluation office.

- GEF council is main governing body comprising 32 members; 14 from developed countries, 16 from developing countries and 2 from E.I.T.

- It meets twice a year.

- Members rotate at different intervals determined by each constituency.

- CA\* - recently at 64th GEF council meeting in Brazil the governing body approved the disbursement of \$1.4 billion.

- Governing board has approved the establishment of a global bio-diversity framework fund to finance the implementation of Cumming Montreal protocol

- It was established under Kyoto protocol in 2001.
- It is financed from the share of proceeds of clean development mechanisms.
- The share of proceeds amounts to 2% of certified emissions reduction (CER).
- Supervised and managed by adaptation fund board and AFB is composed of 16 members and 16 alternatives alternate which meet twice a year.

## GCF

- To the Cancun agreement of 2010, developed countries committed to a goal of mobilizing jointly \$100 billion per year by 2020 to address the needs of the developing countries.
- Under the Paris agreement of COP 21, 2015 confirmed this goal (\$100 billion per year) and they said that before 2025 they will start with \$100 billion per year.

- It is a financial mechanism designed to address the irreversible consequences of climate change that cannot be avoided or mitigated through adaptation efforts.
- This fund recognizes and aims to compensate for the real loss incurred by communities, countries and ecosystems due to impacts of climate change.
- COP 19 - discussion on L&D happened.
- COP 27 - agreed to set up L&D fund.

### Challenge to Climate Finance :

1. There is a gap between national needs and climate finance.
2. The uncertainties such as the refusal of US to pay \$2 billion have created shortage of funds.
3. Lack of alternative investment mechanisms.
4. LDC (least developed countries) received much less approved funding from multilateral climate fund.

5. Projects in climate finance have a longer gestation period which deters financial institutions from investing in them.

6. There is a shortage of fund because of insufficient budget allocation.

- Special Climate Change Fund and Least developed countries fund both are managed by GEF.

### Climate Financing in India

1. INDCs -

2. National clean energy fund -

a) created to promote clean energy by putting carbon tax.

b) \* Governed by interministerial group with finance secretary as chairman.

c) Mandate is to fund R&D of innovative clean energy technologies.

3. National adaptation fund

a) Established in 2014.

b) Rs. 100 cr corpus

c) Operated by MoEFCC



## REDD+ and UN-REDD

- United Nations Collaborative Programme on Reducing Emissions from Deforestation and degradation (UN-REDD).
- Created in 2008 in response to UNFCCC decision on Bali action plan.
- It is a set of steps to reduce emissions of CHGs from deforestation and degradation.
- It was used as an offset scheme by the carbon market to produce carbon credit by government, NGOs and private sector.
- It is an UN programme supported by the world bank.
- HQ - Geneva
- It is a multilateral collaborative programme of FAO, UNDP, UNEP.

- It partners with developing countries to support them in establishing the technical capacities needed to implement REDD+ and to meet UNFCCC requirements.
- REDD+ goes beyond deforestation and degradation and includes the role of conservation, sustainable management of forests, and enhancements of forest carbon stock.
- It aims to offer incentives to developing countries and allow for significant north-south financial flow.
- In addition to UN-REDD programme other initiatives assisting countries that are engaged in REDD+ include world bank forest carbon partnership facility, the global environment facility, etc.

World Bank Forest Carbon partnership facility - it is a global partnership of government's businesses, civil society and indigenous people. It is focused on reducing emissions for REDD+.

Climate change mitigation involves avoiding and reducing GHGs into the atmosphere or removing them from the atmosphere to prevent the planet from warming.

### Carbon Sink

It is a natural or artificial carbon reservoir that accumulates and stores carbon containing chemical compounds. The process through which the carbon sinks remove  $\text{CO}_2$  from the atmosphere is known as carbon sequestration. It is a process of capture and long-term storage of atmospheric carbon-dioxide.

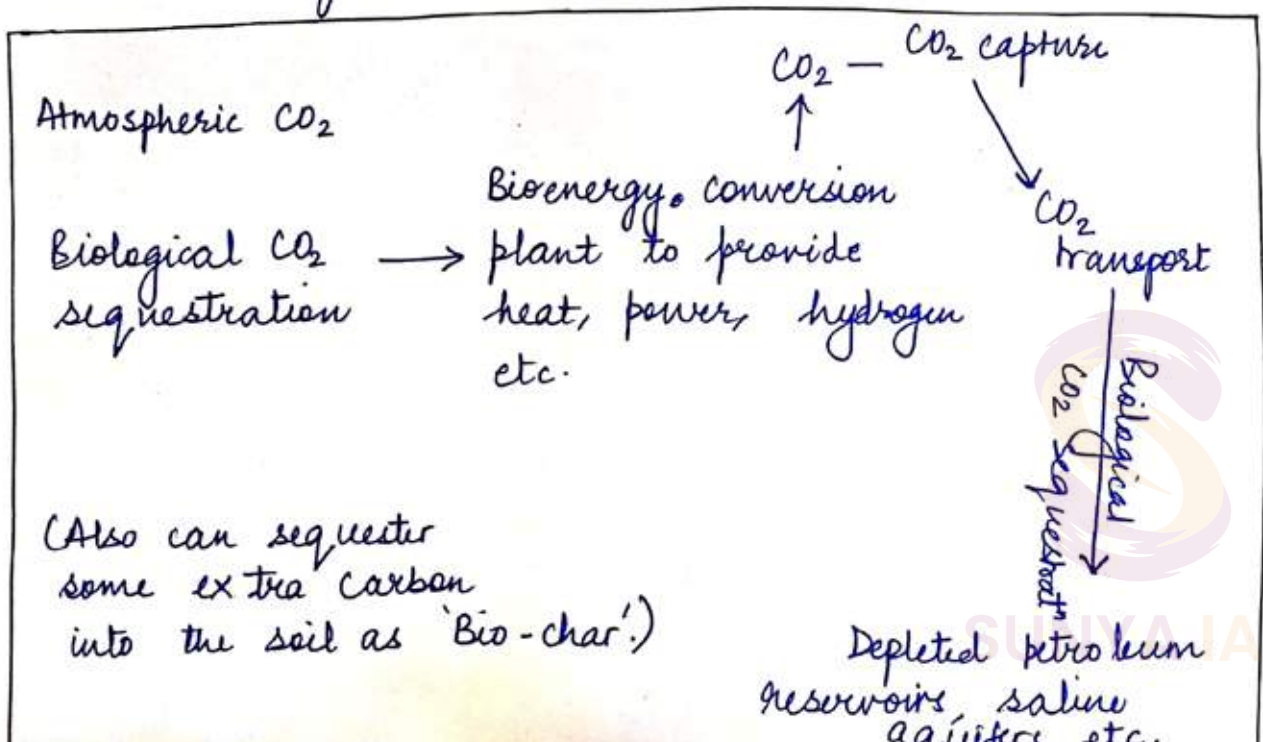
Natural reservoir - forests, oceans, and soil.

Blue carbon is the term used to describe the carbon captured by world's oceans and coastal ecosystems. Ex: mangroves, tidal marshes and sea grasses.

- 83% of the global carbon is dissolved through oceans.
- 2% of the total ocean area - coastal blue habitat.
- 50% of total carbon sequestered in ocean sediments is accounted for by coastal habitats.

Though the coastal systems take up small area however they sequester carbon at a much faster rate, and they can continue to do it for millions of years.

Hence, when these systems get damaged a lot of CO<sub>2</sub> is released.



Forest are carbon dioxide sinks. They increase in density or area, and they become carbon source when they are degraded.

GEO-ENGINEERING

Geo-engineering Proposals

Increased productivity from low clouds  
(Eg. by spraying sea salt into them)

Thinning High clouds  
(clouds act as a blanket, retaining heat)

Increased reflectivity from aerosols pumped into atm.

Ocean fertilisation  
(inc. population of carbon-absorbing plankton)

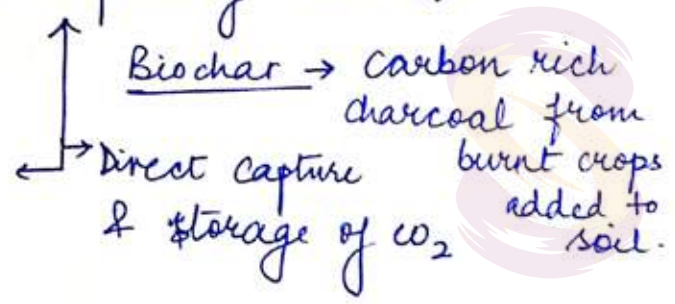
Afforestation

Increased reflectivity from deserts

Increased reflectivity from oceans  
(microbubbles inc. reflectivity)

Increased reflectivity of crops

Biomass energy with capture & storage  
(using biomass for energy & capturing the CO<sub>2</sub>)



Geo engineering is the deliberate large-scale interventions in earth's natural systems to counteract climate change.

Geo-engineering technologies include:

1. Solar radiation management
2. Carbon dioxide removal
3. Removal of other GHGs from atmosphere by Afforestation, cloud seeding etc.

Solar radiation management

- Solar radiation management techniques came to reflect a small proportion of sun's energy back to the space.
- Space mirrors, giant reflectors - block small proportions of sunlight before reaching the earth.
- Increased reflectivity from low clouds; also as albedo enhancement.
- Increased reflectivity from aerosols pumped into atmosphere - stratospheric aerosols.

- 19  
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- Cirrus cloud thinning and injection of sulphate aerosols in stratosphere is a solar radiation management techniques.

## Removal of CO<sub>2</sub>

1. Iron fertilization of sea/ ocean fertilization.
  - a. Adding nutrients in ocean in selected locations to increase the primary production.
2. Afforestation
3. Ambient air capture
  - a. To build large machines that remove CO<sub>2</sub> directly from ambient air.
4. Biomass energy with capture and storage.
5. Biochar - creates carbon-rich charcoal from burnt crops added to soil.
6. CO<sub>2</sub> can be stored in abandoned and uneconomic coal seams, depleted petroleum reservoirs, saline aquifers, subterranean deep saline formations.

## Geo engineering

1. Promotion of clean coal technologies.
2. Coal washing and efficient utilization of coal.
3. Clean and less carbon intensive transportation fuel.
4. Encourage the use of MMRT (mass rapid transit systems).
5. Improving energy efficiency and conservation.

## CCS

- Carbon capture and storage
- Capture - process of separating  $\text{CO}_2$  from other gases.
- Transportation - once captured  $\text{CO}_2$  is compressed and transported to a storage site. This is done by pipelines or by ships or trucks.
- Storage: the final step involves storing the captured  $\text{CO}_2$  underground.



• Ex :

- SLEIPNER project in Norway -  $\text{CO}_2$  is being injected into deep saline aquifers in North Sea.
- ONGC and IIT-B were planning to set up CCS project in Krishnapattam, AP.

## CCUS

- Utilized for enhanced oil recovery.
  - Injecting  $\text{CO}_2$  in oil fields to increase the extraction of crude oil.
- Algae production
  - Using  $\text{CO}_2$  to cultivate algae which can then be used as biofuels.



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## NAPCC - National Action Plan on Climate Change

- Launched on June 30<sup>th</sup> 2008 to combat climate change and establish sustainable development.
- It seeks to achieve this through 8 national missions.
- List of missions:
  1. National Solar Mission
  2. National Mission on Sustainable Habitat
  3. National Mission for Sustaining the Himalayan Ecosystem.
  4. National Mission for Enhanced Energy Efficiency
  5. National Water Mission
  6. National Mission on Strategic Knowledge for Climate Change
  7. National Mission for a Green India.
  8. National Mission for Sustainable Agriculture.



- NAPCC is governed by MoEFCC
- This comprehensive action plan outlines a strategic approach for the nation to effectively respond to climate change and improves India's ecological sustainability as it pursues national development.

### Principles of NAPCC

1. Protecting the weak and vulnerable sections of the society through an inclusive and sustainable development.
2. Achieving national growth objectives through a qualitative change which promote sustainable development.
3. Creating efficient and cost-effective strategies for the population.
4. Deploying appropriate technologies for adaptation and mitigation of GHGs emissions extensively.
5. Effective implementation in collaboration with civil society, private bodies, etc.
6. Enabling new and innovative market regulatory and voluntary mechanisms.

- Introduced in 2010.
- Claims target of 100 GW of solar PV by 2022.

### NATIONAL MISSION ON SUSTAINABLE HABITAT

- It intends to make the city more sustainable by enhancing building energy efficiency.
- Improving the management of solid and liquid waste.
- Encouraging the use of public transport.
- Promoting conservation through a proper legal and regulatory framework.
  - AMRUT mission
  - ATAL mission on rejuvenation and urban transformation
  - SMART cities.

### NATIONAL MISSION FOR SUSTAINING HIMALAYAN ECOSYSTEM

- 2010
- Governed by Mo S&T
- Only area specific mission
- Objective is to expand sustainable national capacity to regularly monitor the health of Himalayan ecosystem.

- Support policy making bodies.
- Helps the states in Himalayan region to carry out sustainable development.

• The states covered:

- J & K
- Ladakh
- HP
- Uttarakhand
- Sikkim
- Darjeeling
- A P
- Assam
- Meghalaya
- Tripura
- Manipur
- Mizoram
- WB

NATIONAL MISSION FOR ENHANCED ENERGY EFFICIENCY

- Main objective is to boost market for energy efficiency by providing supporting laws and policies.

- Energy conservation act of 2001 would be the foundation of this mission.

### • Initiatives:

- PAT (perform achieve and trade)

- Energy efficiency financing platform (EEFP).

- Market transformation for enhanced energy efficiency (MTEE).

- Framework for energy efficient economic development (FEEED)

### NATIONAL WATER MISSION

- Conservation of water
- Avoiding wastage
- Guaranteeing fair distribution among centre and states.
- This mission will take into account requirements of national water policy.
- Optimize water use by boosting water use efficiency.

## FOR CLIMATE CHANGE

- Mission's goal is to achieve to create dynamic and knowledge systems that supports and informs national policy and action for addressing climate change concerns without sacrificing the country's growth objectives.

## NATIONAL MISSION FOR A GREEN INDIA

- It talks about maintaining, restoring and improving India's forest cover.
- Achieving India's INDC
- Achieving India's goal in the national forest policy (cover of 33%)
- As per recent 2021 ISFR - India's forest and tree cover is 24%.
- Help achieving Bonn challenge - restoring 26 mha land by 2030.



- The goal of the mission is increased agricultural productivity particularly in rainfed area by emphasizing integrated farming, efficient water use, managing soil health and coordinating resource conservation.

### Actions for CC

1. NAPCC
2. SAPCC
3. National clean energy fund.
4. National adaptation fund
5. Indian network of climate change assessment (INCCA)
6. GRIHA (green rating for integrated habitat assessment)
7. ECBC

### Sustainable development

Development is an evolutionary process in which human capacity increase in terms of initiating new structures to cope up with problems which means adapting to continuous change (Industrial revolution).



Sustainable development is a development which meets the needs of present without compromising the needs of future generations.

↳ It helps in efficient utilization of resources.

↳ Reduce the ecological footprint and to live within carrying capacity of earth.

Ecological footprint - biological productive land and sea area needed to provide the resources that a population consumes.

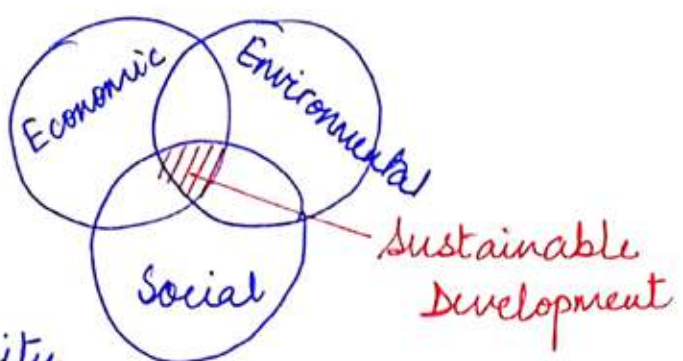
Carrying capacity - it is the size of the population that can be supported by an ecosystem indefinitely by its supporting system.

Pillars of Sustainable development

- 1. Economic sustainability - decisions made in an equitable manner with fiscal soundness.
- 2. Social sustainability - enabling conditions for everybody (women, children, elderly and overall vulnerable section)

3. Environmental sustainability - maintaining the ecosystem and the carrying capacity for the natural environment.

5Ps



1. People - End poverty & hunger in all forms & ensure dignity & equality
2. Prosperity - Ensure prosperous & fulfilling lives in harmony with nature.
3. Peace - Foster peaceful, just & inclusive societies.
4. Partnership - Implement agenda through a solid global partnership.
5. Planet - Protect our planet's natural resources & climate for future generation.



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- In 1789 - Malthus proposed that the human population grows in geometric progression while the resources grow in arithmetic progression only.
- Limits to growth:
  - ↳ Initiated by club of roman, 1972.
  - ↳ By 2072 a sudden and an uncontrollable decline in both population and industrial capacity will happen.
  - ↳ In stockholm conference countries agreed that both environment and development can be managed in a mutually beneficial way.
- In 1987, Brundtland report - the world commission on environment and development chaired by then PM of Norway released the report - "our common future".
- This report defined what is sustainable development.

- It was established in 1992.
  - It was responsible for monitoring the implementation of decisions by UN related to the sustainable development.
- 2000 - millennium summit, New York.
- ↳ Resulted in UN Millennium declaration which aimed for new global partnership to reduce extreme poverty and set out series of quantifiable and time bound goals to be achieved by 2015.
  - ↳ These targets were called as MDGs (Millennium development goals).
  - ↳ 8 MDGs
- Rio + 10 - 2002 - second earth summit and world conference on sustainable development resulted in Johannesburg declaration.
- ↳ Reaffirming its contribution to sustainable development.

• Rio + 20 - 2012

↳ Theme - to develop an institutional framework for sustainable development.

↳ Green economy to eradicate poverty and promote sustainability.

↳ Outcome was - "The future we want" which is a declaration on sustainable development.

↳ In this Rio + 20 the countries decided to launch sustainable development goals.

• SDGs are 17 objectives approved by the UN as a part 2030 agenda.

• Aims to ensure that all people enjoy peace and prosperity by 2030.

• Adopted by 193 countries and came into force in 2016.



MDG

8 goals

Narrow consultation  
between few experts.

The focus was on  
developing and less  
on developing countries.

More economic in  
nature

No concrete role for  
civil service organi-  
sation

SDG

17 goals and 169  
targets within  
that.

Wide ranging  
consultations by  
many experts

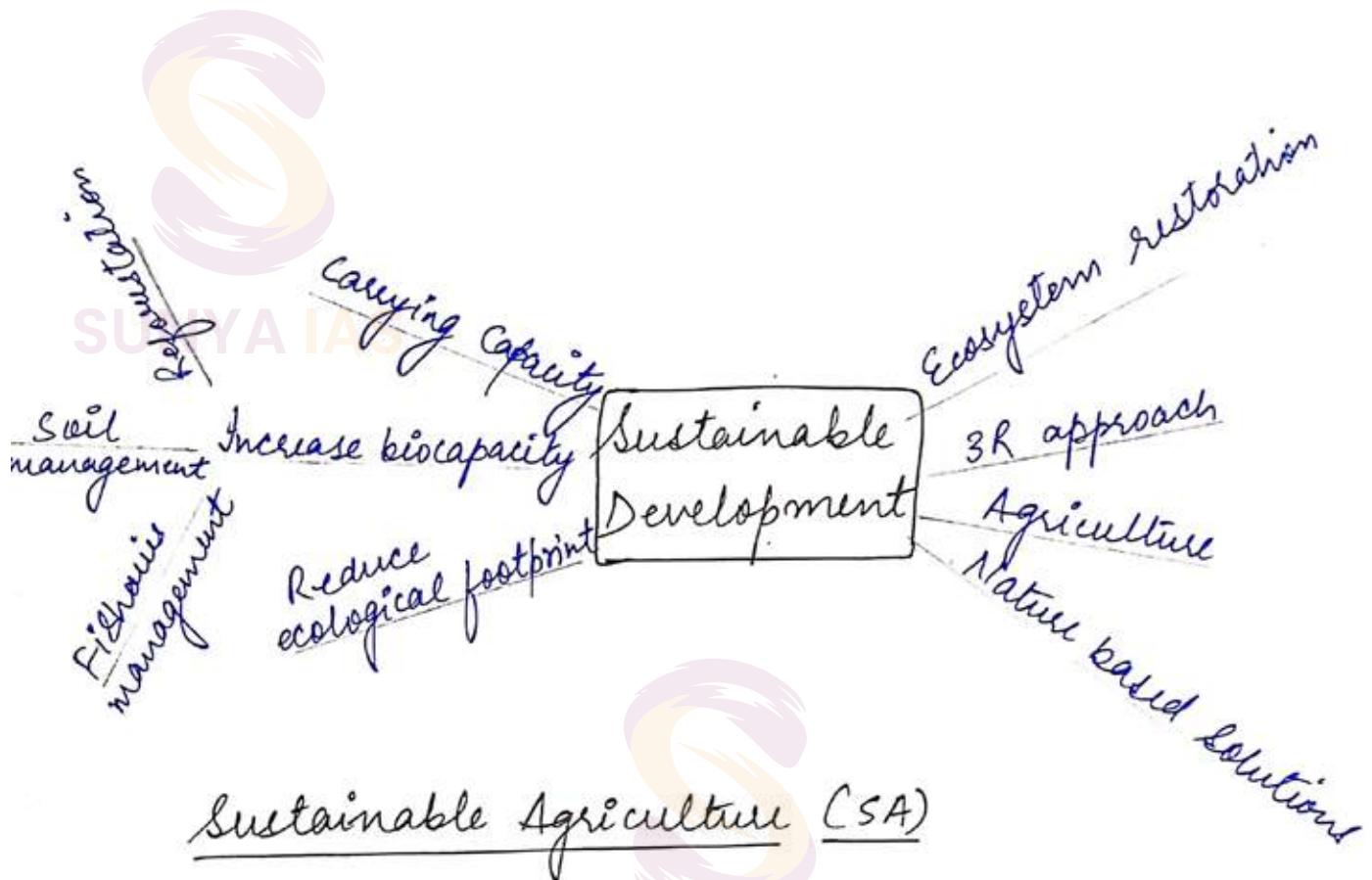
All the nations  
are in focus.

These have three  
pillars - economic,  
social and environ-  
ment.

Civil society play a  
crucial role here.



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## Sustainable Agriculture (SA)

The thrust areas of NMSA

- Biotechnology
- Access to information
- Risk management
- Dry land agriculture

The intricate link between food security, climate variability and sustainable agriculture has far reaching consequences.

Climate change threatens food security through erratic weathers and extreme event while agricultural policies worsen climate change. This leads to crop failures,

Erratic weather patterns disrupt traditional farming practices and make it challenging to predict and plan for successful harvest.

The vulnerable population are disproportionately impacted by extreme weather events like drought and floods.

Unsustainable land use practices like jhumming or slash and burn cultivation, deforestation, expansion of agriculture, paddy cultivation (CH<sub>4</sub>), livestock rearing, excessive and indiscriminate use of fertilizers and pesticides.

These activities release carbon into the atmosphere which contributes to global warming.

Benefits:





Improved food production

Improved environmental health

High production benefits and low cost production Agriculture

Minimisation of off site environmental impacts

Optimized resource usage and conservation

Reduced environmental risk

1. Mitigating environmental impact.

a) SA focuses on minimising environmental degradation associated with conventional farming. This includes reduction in use of synthetic pesticides and fertilizers which can harm the ecosystem and water quality.

2. Ensuring food productivity is essential.

a) Stable food productivity is supply especially in the phase of

### 3. Improved climate resilience.

- a) SA practices like crop rotation, organic farming, reduced pesticide use, ~~etc~~ enhance the resilience of farming ecosystem.

### 4. Carbon sequestration:

- a) Sustainable land use practices like reforestation, agroforestry, and land conservation can sequester carbon which helps to improve soil health and mitigating climate change.

### Promoting sustainable agriculture

- Increasing crop diversity
  - Crop diversity enhances nutrient cycle and reduces the risk of crop failure due to unpredictable weather patterns and pests.
- Diversifying farming systems
  - Promoting mixed farming which includes livestock and aquaculture.
  - Aquaculture - farming of fish,

• Efficient irrigation systems :

- Drip irrigation
- sprinkler irrigation
- Modern techniques to deal with changing rainfall patterns and water scarcity.

• Organic farming

- Minimising the use of fertilizers and pesticides can reduce harm.
- It can improve the resilience of these ecosystems.

• Cultivating climate resilient crops

- Drought resistant and climate resistant varieties like millets can help the farmers in changing climate scenario.

• Policy support

- Policies which incentivize sustainable practices can create enabling environment for farmers.
- Providing access to microfinance.

- Direct seeding of rice
  - Better water utilization and less emissions.
- Aquaponics (N<sub>2</sub> Cycle)
- Vertical gardens
- Zero tillage
- Conservation of agriculture
  - Conservation agriculture avoids soil tillage.
  - It maintains a permanent soil cover and cultivates a diverse range of species.
- Principles
  - Minimum mechanical soil disturbance
  - permanent soil organic cover
  - diversified crop rotations.
- Advantages
  - Checks soil erosion
  - It enhances soil organic matter and nutrient availability by growing green manure or cover crops.
  - It improves soil fertility.

- It protects the soil from predatory<sup>20</sup> wasps, insects, pests causing diseases.
- Water conservation - due to increased infiltration and higher water holding capacity
- Mulches protect the soil surface from extreme temperatures and greatly reduce surface evaporation. The risk of total crop failure is significantly reduced due to enhanced water efficiency.



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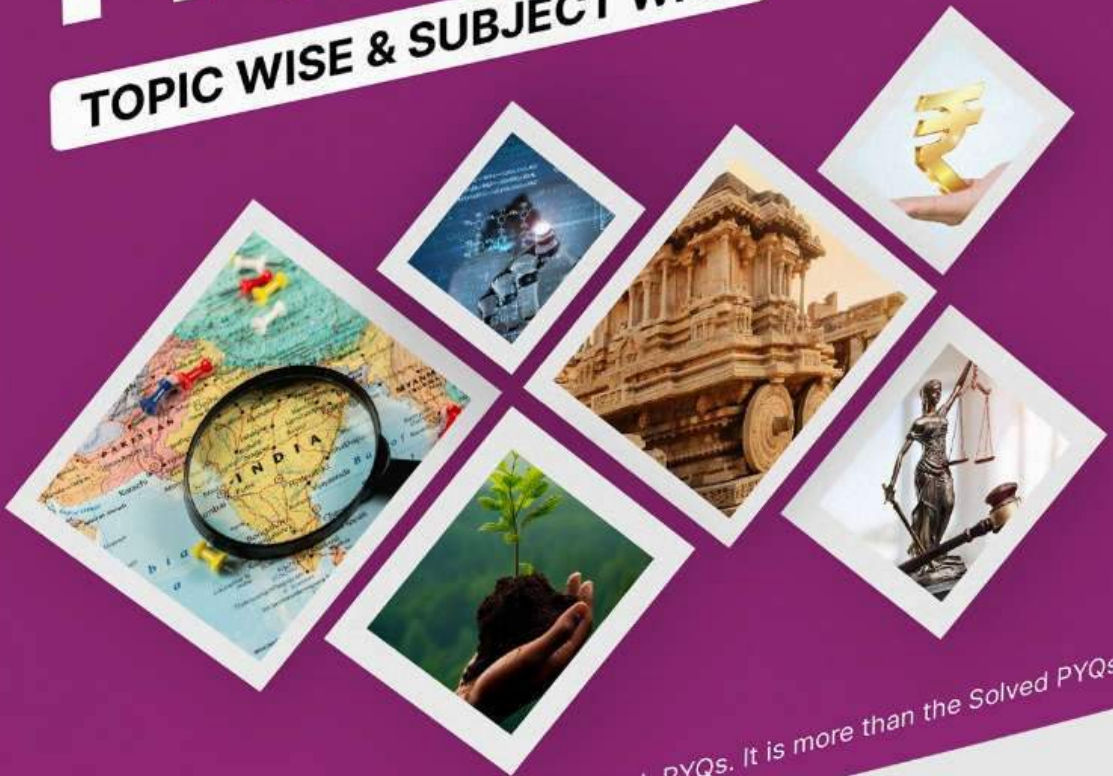
UPSC CSE PRELIMS

# 10 YEARS PYQ CONTENT

TOPIC WISE & SUBJECT WISE

10 Year PYQ Content

UPSC CSE PRELIMS



Content from both Questions and Options of ALL PYQs. It is more than the Solved PYQs

## Climate Smart Agriculture (CSA)

It is an approach that helps guide actions to systems to transform agriculture food systems towards green and climate resilient practices. It helps to achieve India's INDCs, Bonn challenge targets, double the farmers income and additionally helps to achieve SDGs.

### 3. Pillars of CSA

1. Sustainability increasing the agricultural productivity and income of farmers.
2. Helps the farmers to build resilience to adapt to climate change.
3. Reducing the CHGs wherever possible.

### Examples of CSA

1. Cultivating climate resilient crop variety -
  - a) Cultivating crops resistant to pest attack, temperature changes, diseases, salinity and precipitation changes.

b) Drought tolerant maize varieties in  
Sub-Saharan Africa.

2. Conservation agriculture -

- a) No tillage, or reduced tillage cultivation, employing crop residues and cover crops to keep the soil covered.
- b) It helps to reduce soil erosion, improve water retention.
- c) It helps to lower the CHGs emissions.

3. Agroforestry

- a) Integrating trees and shrubs with crops and livestock to create diverse and productive agricultural systems.

4. Variable rate fertilization

- a) Applying the right amount of fertilizer at right time.



1. Increased productivity: Produce more and better food to improve nutrition security and boost incomes, especially of 75 percent of the world's poor who live in rural areas and mainly rely on agriculture for their livelihoods.
2. Enhanced resilience: Reduce vulnerability to drought, pests, diseases and other climate-related risks and shocks; and improve capacity to adapt and grow in the face of longer-term stresses like shortened seasons and erratic weather patterns.

4  
3. Reduced emissions: Pursue lower emissions for each calorie or kilo of food produced, avoid deforestation from agriculture and identify ways to absorb carbon out of the atmosphere.

\* the share of agricultural sector in 2018 was 17%.

4. Supports small and marginal farmers by giving them more income.
5. The intersection of climate vulnerability and agricultural important places India at a unique juncture where CSA is not just desirable but essential.
6. It helps native plant species keep the pollinator population stable and mitigate the effects of habitat degradation.
7. CSA has an ecosystem based approach and different Crop variety help cropland and also wild regions to co-exist.

# Challenges of CSA

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- Knowledge gap
- Funding
- Resource availability

- The success of CSA relies in supportive infrastructure and institutions. This included irrigation system, storage facilities, and organisations that can provide assistance.

- Technology
- Policy and institutional barriers
- Uncertain climate projections
- Skilled technicians

## ZERO BUDGET NATURAL FARMING

ZBNF originated from Karnataka and spread to other states in South India with the efforts of Subhash Palekar and farmer associations.

It promises to end reliance on loans and drastically cut down production cost.

ZBNF is natural farming i.e. without using any chemical and credits and without spending any money on purchase inputs.

It is a chemical free agriculture which relies in agro-ecology.

It claims that there is no need for expensive inputs like fertilizers, pesticides etc.

4 pillars/components of ZBNF

- Teena Mutha -

↳ It is a mixture of fresh cow dung and aged cow urine jaggery, pulse flour, water, and soil.

- Beej Mitra -

↳ Combination of neem leaves and pulp, tobacco, green chillies prepared for insect and pests management.

- Mulching -

↳ It protects topsoil during cultivation and does not destroy it by tilling.

↳ It is the condition where both water and air molecules are present in soil.

↳ It helps in reducing irrigation requirement.

Zero Budget Natural Farming	Conventional Farming
1. Almost zero cost	1. High input and operational cost
2. Jeevamutha and other methods applied here	2. Fertilizers are used
3. No ploughing tilling needed	Ploughing and tilling needed
4. GMO not used here	4. GMO used here
5. Less irrigation requirement	5. Irrigation intensive
6. Based on ecological	6. Based on economic

Andhra Pradesh to become the first Indian state to practice 100% natural farming by 2024.

Sikkim is first 100% organic state in India.

## Challenges

- The effectiveness of ZBNF in relieving agrarian distress in India has been questioned by experts due to the fact that it has not been tried on a larger scale and on all soil kinds.
- Along with growing input costs, better MSP for farmers, and declining or stagnant prices, the agrarian crisis is the main source of worry.
- Even after implementations, problems with the knowledge gap, the accessibility of local seed banks, the cold chain facilities, MSP, and marketing continue.
- Concerns about the marketing of natural products are also quite important.
- Crops are produced slowly compared to traditional ways.

- Lack of R&D because most important sectors are hesitant to invest in it due to time and output restrictions.
- Lack of development and immigration.

ZBNF advocates need of Indian breed cow but numbers of these cows are declining at fast pace. According to livestock census the country's total population of indigenous cattle have dropped by 8.1%.

Many farmers reverted to conventional farming as their returns dropped.

### MISSION LIFE

Reduce, Reuse and Recycle and circular economy have been part of the lifestyle of Indians for thousands of years



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Mindful and Deliberate Utilization,  
not Mindless and Destructive  
Consumption, is needed today.

Concept was introduced in COP 26 (Glasgow, 2021), mobilise at least 1 billion Indians and other global citizens to take individual and collective action for conserving the environment from 2022 to 2028.

Piloted by Niti Aayog and implemented by MoEFCC.

According to UNEP, if 1 out of 8 billion people worldwide adopt environment-friendly behaviours in their daily lives, global carbon emissions could drop upto 20%.

Mission LIFE aims at following a three-pronged strategy for changing our collective approach toward sustainability.

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1. First is by nudging individuals to practise simple yet effective environment-friendly actions in their lives (demand);
2. Second is by enabling industries and markets to respond swiftly to the changing demand (supply).
3. The third is to influence government and government and industrial policy to support both sustainable consumption production (policy).

Mission LIFE is designed to mobilize at least one billion Indians and other global citizens to take individual and collective action for protecting and preserving the environment in the period 2022 - 2027.

### 3 Pillars

- 1.) Focus on individual behaviours
- 2.) Co-create globally
- 3.) Leveraging LOCAL culture



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## Equity

cycled at continuous high value

Materials

Value generated in measures beyond just financial.

Health & Well being

of humans & other species is structurally supported.

Transparency

7 pillars of Circular Economy

Energy - based on renewable source

Water - extracted at sustainable rate & resource recovery is maximised.

Biodiversity

structurally supported & enhanced

Society & Culture

preserved through social governance

Resilience



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1. A circular economy has products designed for durability, reuse and recyclability thus everything gets reused remanufactured, and recycled.

2. 6Rs -

6Rs

- 1.) Reduce
- 2.) Reuse
- 3.) Recycle
- 4.) Refurbish
- 5.) Repair
- 6.) Recover

- CE focuses on minimizing waste while maximising production.
- India always had a culture of recycle and reuse, its rapid economy growth, growing population, rising environmental pollution and impact of climate change make circular economy a necessity.

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Telegram Channel: @sunyanotes50  
India's initiative to protect environment  
economy

- Battery waste management rules 2022.
- Plastic waste amendment rules 2022.
- E-waste management rules.

These rules set out targets for waste disposal standards for manufacturers, producers, transporters, bulk consumers along with extended producer responsibility.

Plan was formulated across 10 sectors like E-waste, lithium ion batteries end of life vehicles scrap metals, MSW emphasizing... of reusing secondary materials.

### Waste management

India produces 62 million tonnes of waste annually out of which 70% is collected and only 12 million tonnes treated, 31 million tonnes end up in landfills.

### WASTE COLLECTION



Household waste

Commercial waste

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### WASTE SEGREGATION METHOD

Recyclable  
(Cans, Milk Bags, Disposable cups & plates etc)

Inert Debris  
(Waste that decomposes like diapers, sanitary, napkins etc.)

Organic  
of kitchen waste

Hazardous waste  
(Paints, batteries, cleaning agents etc)

The generation of MSW is expected to rise 165 million tonnes by 2030.

#### Challenges:

- Lack of waste segregation at source.
- Rapid urbanisation
  - Urban areas with 377 million people generate about 62 million tons of SW each year.
  - E-waste has become a growing concern.

- ~~E-waste has become~~
- Lack of adequate garbage collection with only 21 million garbage collectors as compared to china's 700 million.
- Sorting the recyclable materials is also a problem as only 30% of waste is only properly sorted leading valuable materials like aluminium, plastics to end up being in landfills

### SOLID WASTE MANAGEMENT

Solid waste includes solid or semisolid domestic waste, sanitary waste, commercial waste, market waste, agricultural and dairy waste, horticulture waste, but excluding industrial waste, biomedical waste, e-waste, battery waste and radioactive waste.



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## Solid waste management rules 2016

- It mandates segregation of waste at source to channelise the waste.
- Manufacturers of sanitary napkins are responsible for awareness on proper disposal
- Powers to local bodies across the country to decide the use fee.
  - Department of fertilizers, ministry of chemicals and fertilizers should provide market development assistance on city compost.
- Biodegradable waste should be processed, treated and disposed of through composting or bio-methanation within premises

## Issues in solid waste management

1. Poor implementation of rules
  - a.) Garbage bins in metro cities are either damaged, old or insufficient.
2. Urban local bodies struggle to implement SWM rules.
3. India lacks data collection mechanisms

which makes it difficult to have policies.

- Landfills or dumping sites are near to slum and settlement areas.
- Maximum people are under informal sector.

### Plastic waste Management

- India is generating around 3.5 million tonnes of plastic waste every year.
- MSW, plastic waste and automobile waste is going to triple by 2025.
- Less than 1/10<sup>th</sup> of plastic is recycled annually.
- Lack of cheap versatile alternatives.
- Syringe and surgical instruments are all SUP (single use plastics).
- In automobile industry they help in reduction of weight of fuel tanks, airbags, etc.

Single use plastics: they are produced from crude oil, gas or coal and 40% of total plastic is discarded after a single use.



Sea, sunlight, wind action breaks down the plastic into smaller particles often less than  $1/5^{\text{th}}$  of an inch called microplastics.

Issues in plastic waste:

1. Disrupts the food chain.
2. More plastic per person (per capita consumption of plastic is very high)
3. Unsustainable packaging.
4. Difficult to recycle.
5. Cause pollution and harm.
6. Impact health (animals, humans)

WHO in 2018 exposed in 2018 the presence of microplastics in 90% of bottled water.

Steps taken by India

• Project REPLAN:

- Reducing plastics in nature
- By KVIC (Khadi and village industry commission)
- It aims to reduce the consumption of plastic bags by providing a suitable or sustainable alternative.

- PWMR 2022 :

- Plastic waste management rules 2022.
- Tries to classify the plastics:
  - Category 1 - rigid packaging
  - Category 2 - flexible packaging
  - Category 3
  - Category 4
- Reuse of rigid packaging (mandatory)
- Guidelines allow the sale and purchase of surplus Extended producer responsibility (EPR) certificates which helps to set up a market mechanism for plastic waste management.
- Environmental compensation will be levied based upon PPP - polluter pay principle in case of non-fulfilment of EPR targets by producer, importer and brand owner.



- A committee constituted under chairmanship of CPCB chairman to recommend guidelines for effective implementation of EPR.

- Reports to be submitted by SPCP annually.

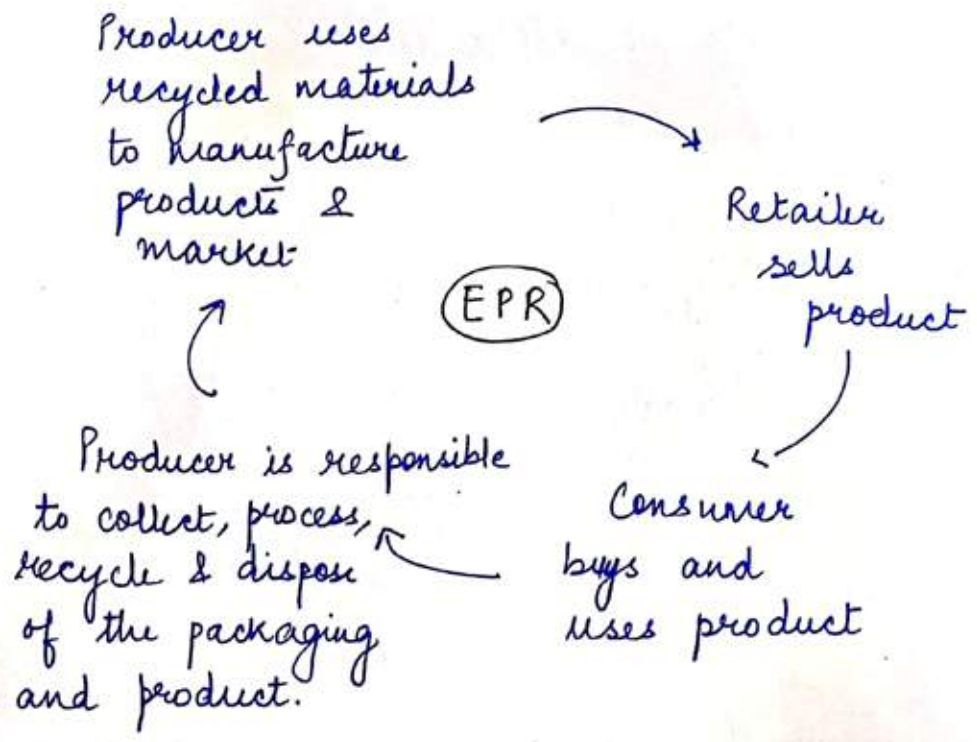
• India plastic pact

- First of its kind in Asia.

- It brings stakeholders for 3Rs - reduce, reuse, recycle.

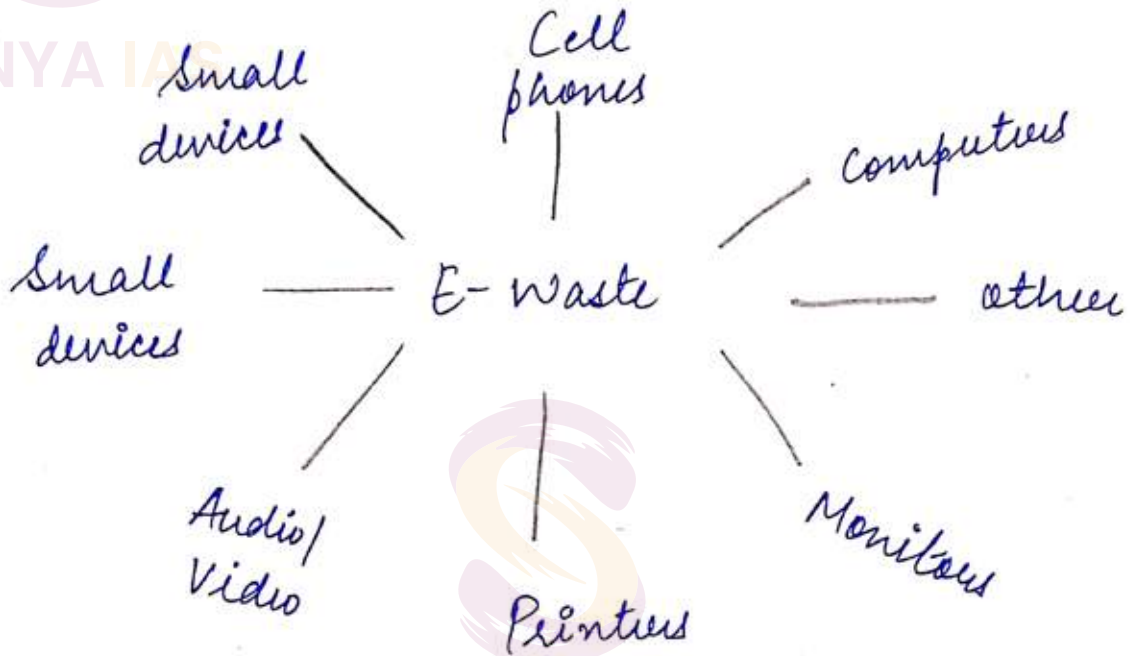
• National dashboard for elimination of single use plastics and plastic waste management.

What is Extended Producer Responsibility (EPR)?



# E - waste

- India's e-waste generation is rising at the rate of 4 to 5%.
- Huge gap b/w e-waste generation & e-waste dismantling / recycling.



- It is the term used to describe all types of old end of life or discarded electrical or electronic equipment.
- It contains numerous toxic chemicals including metals like Cd, Ni, Pb, Hg.
- India ranks 3<sup>rd</sup> in the generation of e-waste after China and US.
- 1.16 million tons e-waste by India.
- E-waste management in India is predominantly informal with 90% of e-waste collection and 70% of recycling being done in informal sector.

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• E-waste management rules in 2010: Telegram Channel: t.me/sunyanotes50

- Governed by EPR act 1986.

- E-waste management rule 2016 included CFL and Hg containing lamps.

- Amendment of this act in 2018 -

concept of product stewardship emphasizing responsibility of producer, manufacturer, and other stakeholders for the entire lifecycle of the product.

- E-waste rules 2022 with a ~~major~~ major aim to digitize e-waste management process.

- It restricts use of hazardous substances like Pb, Cd, Hg in manufacturing of electrical and electronic equipment.

## STEPS

1. Scientific studies and planning - type of waste, cost involved and the best location to disposal of the waste.

2. Improve waste collection.

3. Waste of to energy methods.

4. Integrating technologies.

5. Formalize the sector
6. Decentralised local management
7. Converting existing dumps into sanitary landfills.
8. Public private partnership for creating common waste treatment facilities.
9. Strictly implementing waste treatment facilities management rules (esp. PPP)
10. Awareness

### What can be done?

1. Handle e-waste in scientific manner.
2. Proper disposal of all components that cannot be recycled.
3. Inc no. of dismantling/recycling units from the current no. - 148.
4. Inc. awareness amongst consumers.



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## Types of waste

- Wet waste - biodegradable
- Dry waste - plastic, metal, wood
- Hazardous waste - paints, batteries, cleaning agents etc
- Solid waste - burning of solid waste is prohibited.

- Mandatory for all industrial units located within 100 km of a solid waste RDF (refused derived fuel plants) to use at least 5% of their fuel requirements

- Landfills sites - shall be located 100m away from the river, 200m from pond, 500m from highway, and 20 km from airports.
- Biomedical waste:
  - 4 categories so that waste can be segregated at source.
  - It is also colour coded
    - Red - Plastic waste such as bottles, syringes, etc.



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- Yellow - infectious waste like cotton and bandage, etc.
- Blue - glass bottles
- Black - needles and metal articles.

- At the sources waste should be given pretreatment.
- It should be treated completely at common bio medical waste treatment facility.

EPR

- Applies to e-waste produced in the country.
- A producer responsibility organisation can be given responsibility of collection and disposal of waste.

DRF - deposit refund scheme

- It is introduced as an economic tool for collection of e-waste.

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# Plastic Waste Management

- July 1st 2022, SVPs got banned in India.
- The plastic waste management rules of 2022 increased the minimum thickness of plastic carry bags to 75 microns from 50 (further increased from 75 to 120 microns).
- EPR is applicable to all other plastic products which is not banned.

## Waste to Energy

### Thermal

- 1.) Pyrolysis -  $\text{O}_2 + \Delta$
- 2.) Incineration -  $\text{O}_2 + \Delta$
- 3.) Gasification
- 4.) Torrefaction

### Biological

## 1. Incineration

- a) It is the burning of waste at high temperatures in the presence of  $O_2$ .
- b) It is a rapid oxidation process to convert VOC and other gaseous hydrocarbon pollutants to  $CO_2$  and water.

## 2. Pyrolysis

- a) It is the heating of the organic matter in the absence of  $O_2$ .
- b) Biomass pyrolysis is carried out at above 500 degree Celsius providing enough heat to deconstruct the strong biopolymers.

## 3. Gasification

- a) It is a process that converts organic or fossil based materials at high temperatures (greater than 700 degree Celsius) without combustion

with a controlled amount of  $O_2$  into  $H_2$  and CO and  $CO_2$ .

#### 4. Torrefaction

a) It converts biomass in the absence of  $O_2$  at temperatures of 200-300 degree Celsius to produce a torrefied matter.

#### BIOLOGICAL

It is designed for natural biological processes which can be aerobic or anaerobic.

#### Biofuel

- Any hydrocarbon fuel that is produced from an organic matter in a short period of time.
- They can be solid, liquid or gas.
  - Solid - dried plant materials, wood, manure.
  - Liquid - bioethanol and biodiesel.
  - Gas - biogas
- Uses of biofuel
  - Can be used to replace or they

can be used in addition to coal, petrol, and other fossil fuel.

- They can be used to generate, heat and electricity.
- They can be produced from variety of materials like crop waste and other byproduct.
- Has lesser emissions than fossil fuels.
- Biofuels can help in management of municipal solid waste by allowing garbage to be turned into a fuel.
- Local production of biofuels reduces the countries alliance on imported energy.
- They are renewable unlike oil

### 1<sup>st</sup> generation biofuels

- Made from food sources like sugar, starch, vegetable oil or animals fats, using conventional technology.

- Telegram Channel: t.me/sunyanotes50
- Common 1<sup>st</sup> generation biofuels include bio alcohols, bio diesel, vegetable oil, bio ethans, etc.

- Use of food sources in production of biofuels can create imbalance in food economy ultimately leading to increase in food prices and hunger.

## 2<sup>nd</sup> generation

- These are produced from non-food source or portion of food crops that are not edible and considered as wastes.
- Ex: rice husk, fruit skin, stem, wood chips, etc.
- Though these fuels do not affect the food economy their production is actually quite complicated.
- Emit less GHGs as compared to 1<sup>st</sup> generation.

## 3<sup>rd</sup> generation

- Produced from microorganisms like algae can be grown using land

and water therefore <sup>Telegram Channel: t.me/sunyanotes50</sup>  
on depleted water resources.

- Ex: butanol
- A disadvantage of this process is use of fertilizer which can be lead to environmental pollution.

4<sup>th</sup> generation

- In the production of these fuels, crops that are genetically engineered to be carbon negative are grown.

National Biofuel policy 2018

- An indicative target of 20% blending of ethanol in petrol and 5% biodiesel in diesel by 2030.
- Increase the scope of raw material for ethanol procurement by encouraging B molasses, sugarcane juice, sugar containing materials, sugar beet, sweet sorghum, starch containing materials, corn, etc, damaged food grains.

- With a focus on advanced biofuel, the policy indicates VGF (viability gap funding) for 2<sup>nd</sup> G ethanol biorefineries.
- Bio-diesel production to be encouraged from non-edible oil seeds and used cooking oil.
- Develop national biomass repository by conducting the appraisal biomass across the country.
- Research and development in the field of biofuel and advanced technology
- Setting up a national biofuel coordination committee under the MoPNG.

\* Ethanol blending programme - 20% ethanol in petrol by 2030 and 5% biodiesel by 2030. Ethanol blending in petrol is being done OMCs (oil marketing companies).

Government has advanced the targets for 20% ethanol blending in petrol to 2025 from 2030.

## • Geothermal energy

- It is the natural heat from the interior of the earth that can be used to generate electricity as well as to heat the buildings.
- In India northwest Himalayas and western coast are considered geothermal areas.
- The Puga valley in Ladakh has the most promising geothermal field.
- Steam also contains  $H_2S$  which can cause air pollution.
- India has set a target of 175 GW renewable energy capacity by 2022 which has 100 GW of solar energy; 40 - rooftop and 60 - large and medium grid connected solar projects.
- \* In COP 26 - MoNRE is working towards achieving 500 GW of installed capacity from non-fossil sources.



- Installed electric generating capacity at present is 411 GW incl. 175 GW from non-fossil source.
- India wants to have target of net zero by 2070.
- IEA publishes world energy output report.

### Solar Energy

- It can be converted directly into electrical energy by photovoltaic cells (solar cells).
- These PV cells are made of Si and other semiconductor materials.
- When the sunlight strikes the silicon atom it causes the e- to flow, which is known as photoelectric effect.
- ISA is a treaty based intergovernmental organization.
  - The objective of ISA is to mobilize investment \$1000 billion by 2030.



- 1000 GW by 2030

- In its 5<sup>th</sup> GA, ISA approved a solar facility - a payment guarantee mechanisms to stimulate investment in solar projects. It's objective is to attract private capital flows into underused market in Africa.

- OSOWOG - India's initiative to build a global ecosystem of interconnected renewable energy resources.

- It is supported by WB technical assistance programme.
- It is seen as India's counter to OBOR initiative.
- Interconnectivity within Asian continent.
- Globalise the whole project.



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- India has ~~targetted~~ targeted the solarization of 2.8M irrigating pumps.
- Set up a project preparation facility to develop solar energy projects in ISA countries
- MNRE
- Reduces the farmer's dependence on diesel and kerosene.
- \* Enables the farmers to set up solar energy generation capacity.

### Issues with solar power

- High import dependence - high cost
- High levels of atmospheric pollution reduces the solar power generation capacity.

### Hydrogen

- It is renewable and non-polluting.
- Most abundant chemical.
- lightest gas



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## Types of $H_2$

- Brown  $H_2$

- Produced using coal without carbon sequestration.

- Grey  $H_2$

- Produced from fossil fuel or natural gas without carbon sequestration

- Blue  $H_2$

- Produced using natural gas, fossil fuel with carbon sequestration.

- Turquoise  $H_2$

- Through pyrolysis

- Green  $H_2$

- Green  $H_2$  produced using renewable energy.
- Electrolysis.

Most  $H_2$  in India is produced through reforming methane resulting in  $CO_2$  emissions.

H<sub>2</sub> is used as an industrial feedstock so as to create ammonia based fertilizers.

HCNG - mix of compressed natural gas and 2-9% of H<sub>2</sub>.

Delhi became 1<sup>st</sup> city in India to have buses with HCNG.

It helps in 5% fuel savings because of high octane number of H<sub>2</sub>.

HCNG reduces hydrocarbon emissions of CO by 70%.

National Green Hydrogen Mission

- With the vision to make India energy independent nation, a green H<sub>2</sub> hub and decarbonise certain sectors govt approved NIGHM.
- Green H<sub>2</sub> is an important element of India's long term low emissions development strategy (LTLEDS).
- Green H<sub>2</sub> production capacity of at least 5 million metric tonnes every year.

- ₹ 1 lakh crore import Telegram channel: t.me/sunyanotes50
- 50 MMT CO<sub>2</sub> annual emissions averted.
- 125 GW RE Capacity added.
- Financial incentive targeting the domestic production or manufacturing of electrolyzers.
- Making regions green H<sub>2</sub> hub.

→ Union Cabinet approves National Green Hydrogen Mission

↳ Expected deliverables by 2030

- At least 5 MMT GH<sub>2</sub> annual production
- 60-100 GW electrolyser capacity
- 125 GW RE capacity for GH<sub>2</sub> generation & associated transmission network.

↳ Total outlay approved: ₹ 19,744 crore

↳ ₹ 1 lakh crore - import savings

↳ 6 lakh jobs

↳ ₹ 8 lakh crore investment

↳ 50 MMT CO<sub>2</sub> annual emissions averted.



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- will support pilot projects in emerging end-use sectors, supporting large scale production or utilization of Hydrogen will be identified and developed as Green Hydrogen Hubs.
- Strategic Hydrogen Innovation Partnership (SHIP):
  - Public - Private Partnership framework for R&D will be facilitated under the Mission, which will be goal-oriented and suitably scaled up for global norms.
  - Skill development:
  - Programme, for the workforce in the sector will also be undertaken under the Mission.

### Challenges

There is a need of innovation in electrolysis technology to drive its cost down.

According to NITI aayog cumulative value of Green H<sub>2</sub> value in india will be \$ 8 billion by 2030 and \$ 340 billion by 2050.

Adoption of green H<sub>2</sub> resulting in 3-6 gT reduction in CO<sub>2</sub>.

1. Ques - emphasis on solar - Telegram Channel: t.me/sunyanotes50

2. Issue in matching solar peak demand -
3. Solar output is max. in 11 am to 12 am but peak demand is in evening.

SUNYA IAS a.) Leading to low utilization of transmission lines and high cost.

3. Because discoms in India are loss making they are not able to contribute to renewable energy.

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## Energy Conservation

### Energy Conservation Act 2001

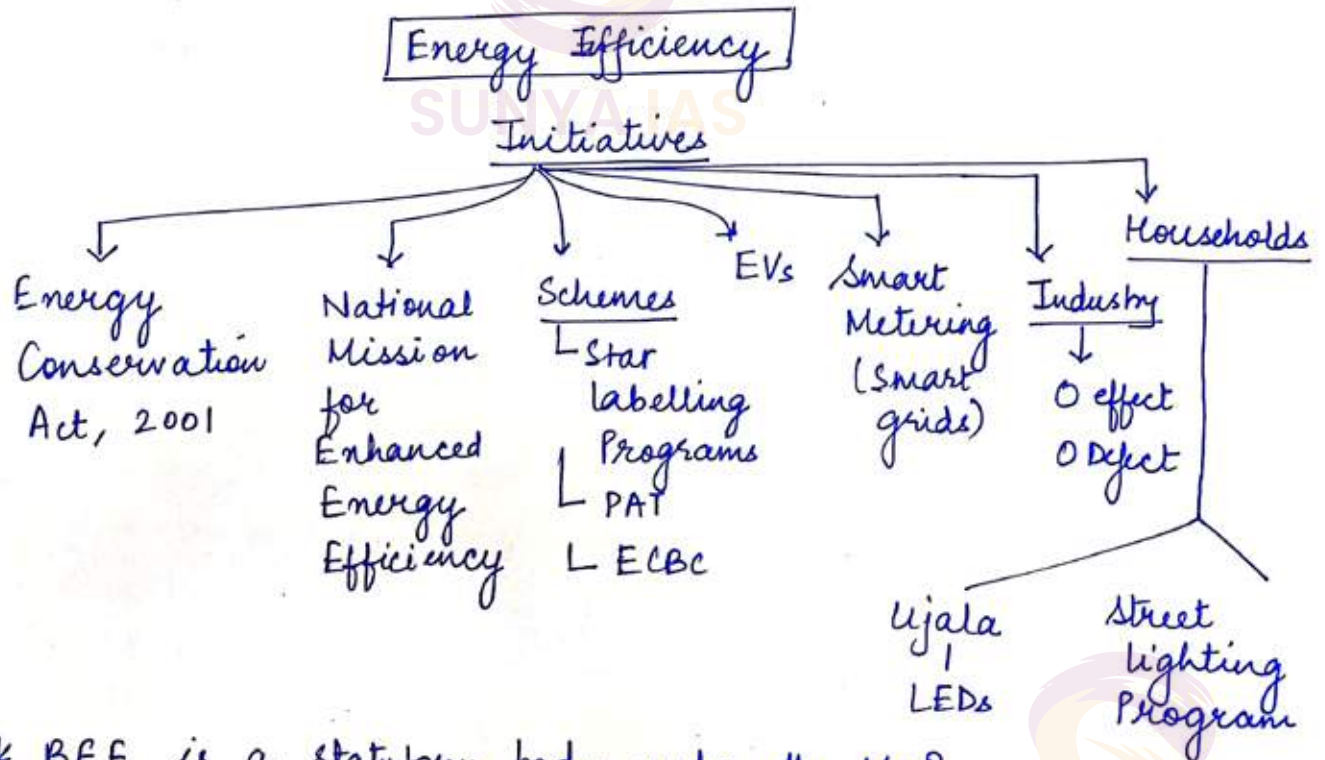
- It is a legal framework that regulates energy consumption and promotes energy efficiency.
- It is applied to appliances, buildings, vehicles industrial and commercial establishments.
- 5 major provisions of this act relate to -
  - designated consumers
  - Standard and labelling of appliances
  - Energy conservation building codes.
  - Creation of BEE.
  - Creation of energy conservation fund.
- Energy conservation amendment of 2010 empowered central government to issue ESC to designated consumers whose energy consumption is less compared to prescribed norms.

India - active participant in global energy conservation efforts

Min. of Sci & Technology collaborates to accelerate efforts towards energy efficiency, energy conservation & generation of alternative energy.

1. Participation in Mission Innovation
2. High efficiency Silicon Solar Cell
3. Hybrid solar biomass power plant
4. Energy saving water filter: Talkalp
5. Surya Jyoti: Captures day light & concentrate it inside a dark room.
6. Passive Ambient Air Purifier System (PAARS)
7. Air Purifier Purification using solar power: WAYU

\* National Energy Conservation Day - 14 Dec.



\* BEE is a statutory body under the MoP.

## Energy Conservation Amendment Bill 2022.

### • Proposed changes in the act:

- Defines the minimum share of renewable energy to be consumed by industrial units or any other establishment.
- Incentivise efforts to use clean energy by issuing carbon saving certificates.
- Facilitate the promotion of green hydrogen as an alternative to fossil fuels.
- To strengthen the institutions like BEE.
- Currently only large industries and their buildings come under the act. The amendment proposes to include large residential buildings.

### • Objective

- To reduce India's net power consumption and minimise national footprint.
- To develop India's carbon market and promote the use of clean technologies.

- Telegram Channel: t.me/sunyanotes50
- Help India meet its Paris agreement and SDGs (SDG 7).

## Star and labelling Programme

1. It was started by BEE in 2006.
2. It aims to provide the consumer informed choice about energy savings.
3. Manufacturer is required to place a label indicating how much electricity the appliance is likely to consume.
4. It talks about 23 appliances out of which 10 are mandatory.
  - a) Room AC
  - b) Frost free refrigerator
  - c) Tubular fluorescent lamp
  - d) Distribution transformer
  - e) Direct cool refrigerator
  - f) Colour TV
  - g) Electric geyser
  - h) LED lamp

j.) Floor standing tower ceiling  
corner AC

## 5. Voluntary appliances

a.) Washing machine

b.) Ceiling fans

c.) Diesel generators

d.) Microwaves

e.) Induction

## UJALA

- Unnat Jyoti by Affordable LEDs
- It is the world's largest domestic lighting programme.

## SLP

- Street Lighting Program
- World's largest street light replacement programme.

Both have been implemented by energy efficiency services limited - a joint venture of PSUs under the MoP.

- Launched by BEE, MoP in 2007.
- Currently 23 states have notified rules to enforce ECBC compliance.
- ECBC sets minimum energy standards for commercial buildings with an objective of enabling energy savings of 25-50% of compliance building.
- Code is applicable to commercial buildings like hospitals, hotels, schools, shopping complex and multiplex with a connected load of 100 kW or more than 120 kVA.
- Buildings in India account for 30% of total electricity consumption which can reach by 50% by 2042.
- Acc to BEE 40% of the buildings designs - are yet to be built.

- ECBC focuses on 6 components of building designs -
  - Envelope - windows, walls and roof.
  - Lighting system
  - HVAC - heating, ventilation and AC
  - The electrical power systems
  - These codes apply both to new and retrofitting buildings.
- It has both mandatory and prescriptive requirements.
- State energy efficiency Index (SEEI)
  - Released by BEE in association with alliance for energy efficient economy (AEEE)
  - It is an annual report.
  - SEEI 2022 - ranked Karnataka as top state for energy efficiency in buildings followed by Telangana, Haryana, AP and Punjab.

- Bihar scored lowest followed by Odisha, WB, TN and Jharkhand.
- These are the 5 worst states for energy efficiency in buildings.

## India Cooling Action Plan

- It is a long-term vision to address the cooling requirements across sectors.
- Reducing the cooling demand by 20-25% and refrigeration demand by 25-30%.
- Refrigeration and cooling causes 10% of global CO<sub>2</sub> emissions.
- Surge in the people using HVAC.
- Present day cooling systems are not highly efficient.
- Unskilled and untrained technicians lead to leakage from Acs and refrigerators.
- Reduce the cooling energy requirement by 25-40%.



- Training and certification of air conditioning sector technicians in link with skill India mission.
- It is in line with Montreal protocol and emphasis on cutting down elements that deplete ozone layer.
- Seeks to improve provide sustainable cooling and thermal comfort for all while ensuring environmental and socio-economic benefits.

## Energy Conservation

### National

- PAT - perform achieve and trade is a market-based mechanism to improve the cost effectiveness by improving energy efficiency. It is done through these energy saving certificates which can be traded.
- Standard and labelling.

- Telegram Channel: t.me/sunyanotes50
- Energy conservation building code.
  - Demand side management - Indian cooling action plan.

## Global

- International energy agency (IEA)
  - India is not a member of IEA but an association country.
  - IEA has invited India to be full time member.
- SE4A11
  - Sustainable energy for all - to achieve SDG 7 by 2030.
  - International organisation that works with partnership with UN, leaders in the govt, private sector, civil society and financial institutions.
- Paris agreement
- Mission Innovation
  - It is a global initiative of 24 countries and EC (on the behalf of EU) to

- accelerate clean energy innovation.
- India is one of member country.

## Environmental Bodies

### • AWBI

- Est. 1962
- HQ - Ballabgarh, Haryana.  
(earlier in Chennai)
- Animal welfare board in India.
- Statutory body
- Prevention of cruelty to animals act 1960.
- Under MoFAHD
- Rukmani devi Arundale was first chairperson of animal welfare board of India.
- It advice the govt on matters related to animal welfare.
- Provides the grants related to animal welfare organisation.



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- HQ - new delhi
- Est - 1992
- Statutory body - WPA 1972
- Objective - conservation of wildlife
- Compliment the national effort in conservation of wildlife.
- Maintain Indian zoos on the par with international standards.
- Exchange of animals between Indian and foreign zoo
- Chairman - minister of env.

SUNYA IAS

## • WCCB

- WPA 1972 amendment Act of 2006
- MoEFCC
- Objective - combat organised wildlife crime
- Additional director general wildlife is ex-officio director of WCCB.
- WCCB is nodal point for SAWEN (south asia wildlife enforcement network)

SUNYA IAS

- Conducted operation - Save Kuema, thunderbird wild net, operation less know, Birkil, Man ant.

- UNEP awarded WCCB with Asia environment enforcement award in 2018.

## Wildlife Crime

### • Cites

- Convention on International Trade in Endangered Species of Wild Fauna and Flora.
- Legally binding on parties but it does not take place of national laws.
- International agreement / multilateral treaty between govt. to ensure the international trade in specimens of wild animals and plants does not threaten their survival.

- The countries need to adopt their domestic legislation to ensure implementation of CITES at national level.

## SUNYA IAS Traffic

- Wildlife trade monitoring network
- NGO
- 1976
- Joint programme of WWF and IUCN
- HQ - Cambridge UK
- It is complimentary to CITES.
- Mission is to ensure that trade in wild plants and animals is not a threat to their conservation.

## • Mike

- Monitoring the illegal killings of elephants.
- Est. by CITES resolution adopted in 1997.

- There are 28 sites in MIKE in Asia

- India has 10 MIKE sites.

- Entirely dependent on donor support.

• ~~CAWT~~

• Cawet

- Coalition against wildlife trafficking

- It is a coalition to promise to fight against illegal wildlife trade.

- 2005

- Led by US

- India is a member.

Acts enable CITES

- WPA 1972

- The foreign trade development regulation act of 1992

- Foreign trade policy of India

- Customs act

## F S I

- Forest survey of India

- 1981

- HQ - Dehradun

- Mo EFCC

- Pre investment survey of forest & resources before 1981.

- ISFR - since 1987 in every 2 years (biennial)

- Latest report in 2021

## Z S I

- Zoological survey of India

- 1916

- HQ - Kolkata

- Mo EFCC

- Promote survey exploration and research of fauna.

- History of ZSI goes back to Asiatic society of Bengal founded by William Jones in 1784.



- Botanical Survey of India

- 1890

- HQ - Kolkata

- MoEFCC

- Publishes red data book of Indian Plants.

- It is the apex taxonomic research organisation of country.

## NTCA

- 2006

- HQ - New Delhi

- MoEFCC

- Statutory body under WPA 1972 amendment act 2006.

- Chairperson is the minister of environment.

- It provides statutory authority to project tiger.

- Addresses the livelihood interest of local people in areas surrounding the tiger reserve.

- State level steering committee will be set up in the tiger states under chairmanship of respective CMs.

## NBWL

- Statutory under WPA 1972
- Mo EPCC
- HQ - New Delhi
- Chaired by PM
  - ↳ Vice chairperson - Minister of env.
- Objective - conservation and development of wildlife and forest.
- Has the power to review all wildlife related matters and approve project in and around national park and sanctuaries.
- No alteration in boundaries on NP and sanctuary can happen without approval of NBWL.



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- National Ganga River Basin Authority.
- 2009
- HQ - ND
- Min. of Jal Shakti
- Chaired by PM
- Members - Union ministers, CM of states in which Ganga flows.
- Mandate is abatement of pollution and conservation of river Ganga.

CPCB

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- Statutory body
- Created under Water Prevention and Control of Pollution Act of 1974.

CGWA

- Central Ground Water Authority
- EPA 1986

NGT

- NGT Act 2010



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## IUCN

- 1948
- International NGO
- HQ - Switzerland
- Publishes red list of threatened species (founded in 1964).
- Commissions
  - ↳ Species survival commission
  - ↳ Invasive species specialist group, etc
- Global union composed of govt as well as civil society organisations.

## UNEP

- 1972
- HQ - Nairobi, Kenya
- India is member.
- Reports -
  - ↳ Adaptation gap report
  - ↳ Emissions gap report
  - ↳ Production gap report
  - ↳ Global environment outlook

- World meteorological Org.
- Publishes - state of world climate, greenhouse gas bulletin
- Predicts the tourists swamps and transport of various pollutants.

### UNFF

- UN forum of forests
- There is ecosoc - economic and social Council of UN.
- ECOSOC est UNFF
- This forum has universal membership.

### Birdlife International

- World's largest nature conservation partnership.
- strives to conserve birds their habitats and global biodiversity.
- BI is the official red list authority for birds - IUCN
- It identifies sites known as important bird and biodiversity area
- Bombay Natural history society is the partner to BI for India.

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- PSIR FOUNDATION (Online & Offline)
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- PSIR TEST SERIES

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- ANTHRO TEST SERIES

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