New Vision IAS Academy
....wings to aspirations

ENVIRONMENT FULL FINAL COPY

CHAPTER 1 TO 16

ENVIRONMENT

CHAPTER 1 : INTRODUCTION TO THE SUBJECT

- Word Origin and Define Environment
- Gaia Hypothesis -Principle
- Basic Function of Environment
- Components of Environment : Biotope and Biocenosis
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ABOUT THE ENVIRONMENT:

- **Word Origin :** French meaning "neighbourhood"
- **Refers to :** Surrounding of the Organism or Group of Ecosystems

Other Defination :

- **Sum total of all the forces, materials and influences around us at a given point of time and place (NCERT Defination)**
- **the sum total of all conditions, agencies and influences which affect the development, growth, life and death of an organism, species or race. (Universal Encyclopedia)**
- **Environment as comprising air, land and water, especially representative samples of natural ecosystems (Declaration of the UN Stockholm Conference on Human Environment, Stockholm 1972)**
- **Environment "as the sum total of water, air and land, inter relationship among themselves and also with human being, other living organisms and property." (Environment Protection Act of 1986)**

"Environment means the sum total of all conditions agencies and influences which affect the development, growth, life and death of an organism, species or race".

Who created this definition of environment ?

(1) Universal Encyclopedia (2) Britanica Encyclopedia

(3) A. C. Tansley (4) Jackie Smith

CONCEPT OF THE GAIA HYPOTHESIS/ GAIA THEORY / GAIA PRINCIPLE:

- proposes that all organisms and their inorganic surroundings on the Earth are closely integrated to form a single and selfregulating complex system, maintaining the conditions for life on the planet.

- The Gaia Hypothesis was formulated by the chemist, James Lovelock, and co- developed by the microbiologist, Lynn Margulis, in the 1970s.
- This ecological hypothesis has also inspired analogies and various interpretations in social sciences, politics and religion under a vague philosophy and movement.
- Natural environment consist of Four Domains ?

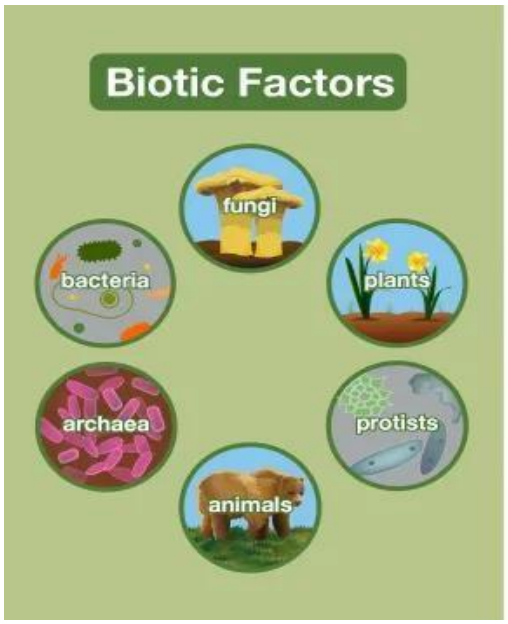
BASIC FUNCTIONS OF ENVIRONMENT

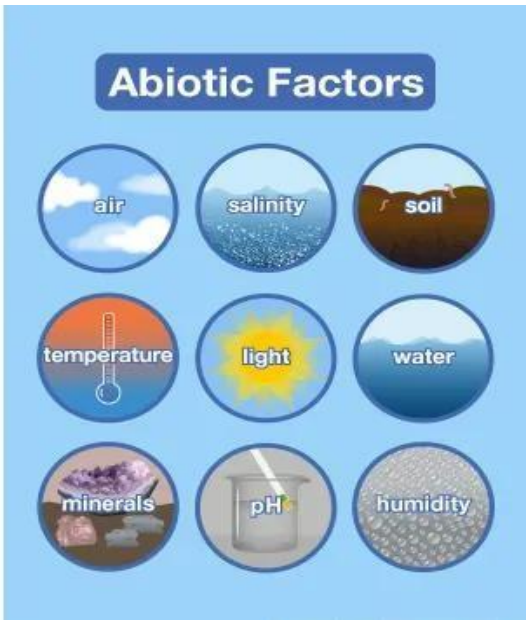
- It Supplies resources: resources here include both renewable and non-renewable resources
- It assimilates (absorb and digest) waste
- it sustains life by providing genetic and bio diversity and
- it also provides aesthetic services like scenery etc.

TWO COMPONENTS OF ENVIRONMENT

1 Physical Component/ Biotope Or Abiotic Factor

2 Biological Component / Biocenosis Or Biotic Factor





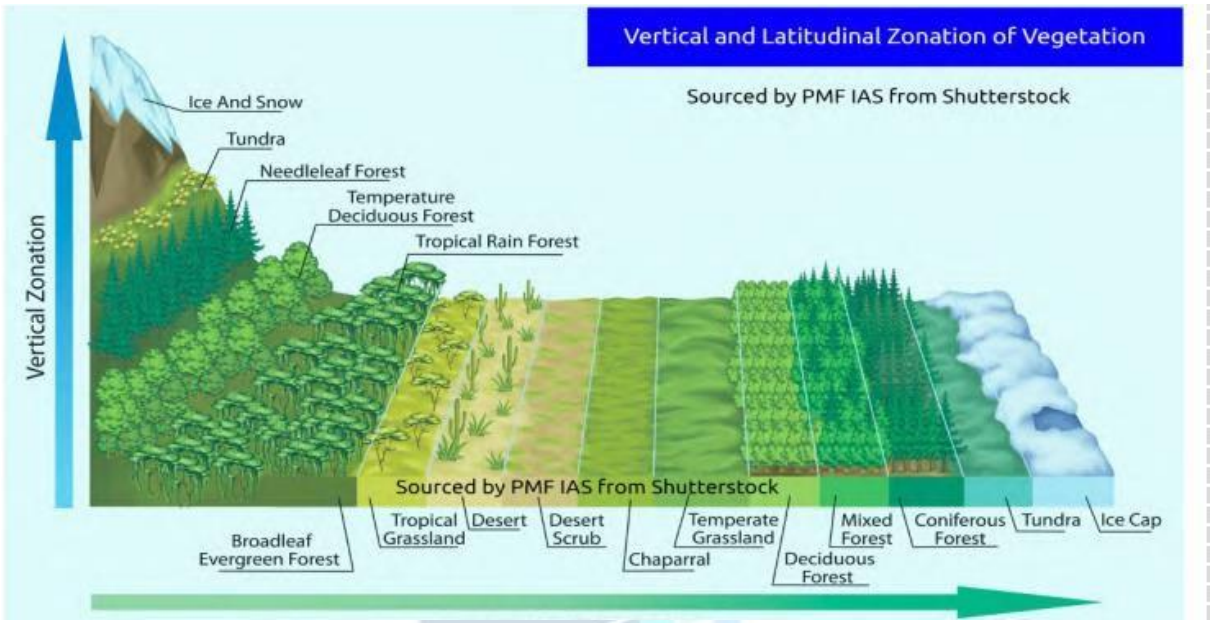
1. BIOTOPE OR ABIOTIC FACTOR:

- **a particular physical environment with specific physical characteristics such as the climate, temperature, humidity, concentration of nutrients or pH.**
- **It includes Physical Factors : Temperature, Humidity , Light etc**
- **It Includes Inorganic substances : water , oxygen, carbon dioxide**
- **It includes organic substances : Humus , Proteins, Carbohydrates, Lipids**

- **Humus is organic component of soil formed by the decomposition of plant material**
- **A lot of abiotic factors determine the survival of an organism.**

Concept of Limiting Factor

- Limiting Factor : But one single factor can limit the range of an organism. This single factor is called a limiting factor.



See Image : Here Temperature is limiting factor for latitudinal zonation and Altitude for ?

Various Example of Limiting Factor

- Change in temperature with altitude is a limiting factor.
- Snow shortens the period of vegetative grow
- In aquatic ecosystem , productivity is limited by light which decrease with increasing water depth.
- For example, seeds do not germinate quickly in evergreen rainforests despite good rains and luxuriant vegetation. This is because the surface soil is heavily leached (nutrients washed away) by running water. Here, the inferior surface soil is the limiting factor that limits the germination of seeds .

- Likewise, germinated saplings may not survive due to a lack of light because of the dense canopy. Here, the absence of light (shade) is the limiting factor.
- Extremely high intensity favours root growth than shoot growth which results in increased transpiration, short stem, smaller thicker leaves.
- On the other hand, low intensity of light retards growth, flowering and fruiting.
- High temperature disturbs the balance between respiration and photosynthesis.

- When the Intensity of light is less than the minimum, the plants cease to grow due to the accumulation of CO_2 and finally die
- Of the visible part of the spectrum, only red and blue are effective in photosynthesis.
- Plants grown in blue light are small, red light results in elongation of cells (etiolated plants).
- Plants grown in ultraviolet and violet light are dwarf.

❖ **Eurythermal**: few organisms can tolerate and thrive in a wide range of temperatures

❖ **Stenothermal:** Organisms restricted to a narrow range of temperatures

❖ **Euryhaline :** Some organisms are tolerant of a wide range of salinities.

❖ **Stenohaline :** Others are restricted to a narrow range of salinities .

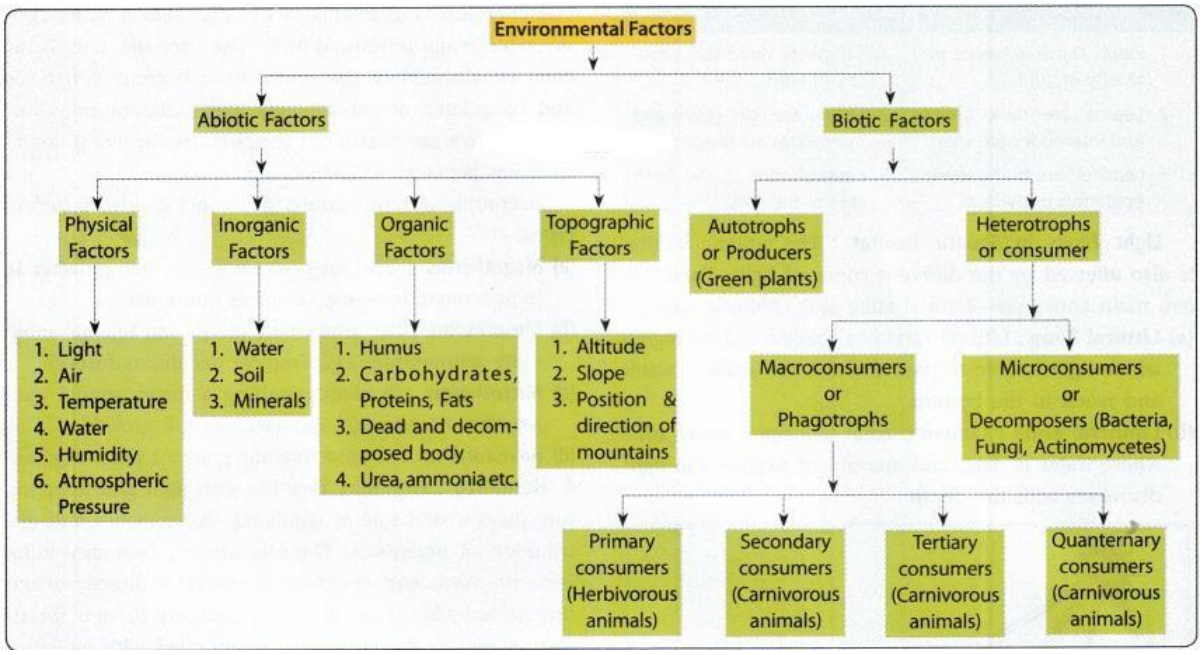
Dieback Mechanism :

- Refers to the progressive dying usually backwards from the tip of any portion of the plant.
- This is one of the adaptive mechanisms to avoid adverse conditions like drought.
- In this mechanism, the root remains alive for years together, but the shoots die.
- E.g.sal,red sanders, silk cotton tree etc

Range of Tolerance: The organisms can tolerate changes in environment within a certain range called 'range of tolerance'

2. Biocenosis or Biotic Factor :

- **Refers to** all surrounding living species, including plants, animals and microorganisms, Decomposers like Bacteria and Fungi.
- It Includes : Producers and Consumers and Decomposers
- Primary Producers called : Autotrophs
- Consumers called : Heterotrophs or Phagotrophs
- Decomposer called : Saprotrophs or Osmotrophs



PRODUCERS:

- organisms that use photosynthesis to capture energy by using sunlight, water and carbon dioxide to create carbohydrates
- Producers, which are mostly green plants, are also called autotrophs.
- they do not depend on other organisms for their food.
- Green plants and blue-green algae are major producers in an ecosystem that perform photosynthesis to form their food.
- Producers are the suppliers of energy in an ecosystem. They act as food for primary consumers.

PRIMARY PRODUCERS EXAMPLES

- **Green Plant, Algae, Kelp, Sea weeds , Sea Grass**
- **Mosses and Lichens**
- **Horsetails**
- **Microscopic Algae (planktons) and**
- **Certain Bacteria**
- **Cyanobacteria : Primary Producers of Aquatic, Terrestrial and in Desert**
- **Prochlorococcus : One of the Marine Bacteria responsible for carbon fixation in Oceans .**
- **Chloroflexi : Bacteria species found in freshwater ecosystems**
- **Chromatium : Purple sulphur bacterium found in low oxygen levels and sediments of aquatic ecosystems**
- **Acidobacteria : Some species perform photosytnesis in acidic and nutrient poor soils**

Do You Know ? Kingdom Monera : Unicellular Prokaryotic Microorganisms on Earth

- Archaebacteria (ancient bacteria)
- eubacteria (true bacteria)
- Cyanobacteria (blue green algae)

Aquatic Ecosystem Producers :

Neuston

- **refers Aquatic Organism that live at water- air interface.**
- **They are mobile**
- Plankton (organisms that drift with water currents) can be contrasted with nekton (organisms that swim against water currents), neuston (organisms that live at the ocean surface) and benthos (organisms that live at the ocean floor).

Planktons

- They are Aquatic organisms
- Marine plankton include bacteria, archaea, algae, protozoa and drifting or floating species
- They called as " Sea wanders" or Producers of Ocean
- Play a key role in Aquatic Food Chain (Food Source)
- About 50 % global Oxygen Production through photosynthesis
- Regulating Climate Change, and GHGs
- Play a Key role in Carbon Nutrient Cycling
- Supports Biodiversity
- They drift or float in the water column called " Non Swimmers ".
- Lack ability to swim against water currents (immobile)

Examples of Planktons

1. Diatoms
2. Dinoflagellates
3. Coccolithophores
4. Radiolarians
5. Silicoflagellates
6. Foraminifera
7. Ciliates
8. Tintinnids
9. Artemia
10. Cyanobacteria
13. Ostracods
14. Rotifers
15. Coccoloba

16 nostoc,

17 spirogyra(green algae,)and

18 Spirulina,

19 Volvox

20 Nostoc are **producers**

ZOOPLANKTONS

- **are small organisms that drift and float in aquatic ecosystems**
- **Play a crucial role in marine and freshwater environments**
- Zooplankton are heterotrophic (other-feeding), whereas phytoplankton are autotrophic (self-feeding)
- Examples : Amoeba, Ciliates, protozoans, amphipods

Examples of Zooplanktons

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2. Rotifers

3. Copepods

4. Krill

5. **Radiolaria**

6. **Foraminifera**

7. **Jellyfish**

8. **Chaetognaths**

9. **Amphipods**

10. **Tunicates**

CONSUMERS:

- Organism which doesn't make its own food, but gets it from eating plants or other animals
- These are the heterotrophic organisms that cannot synthesize their food.
- They depend on other organisms to fulfilling their food needs.
- These are categorized into herbivores, carnivores, and omnivores based on their position in the food chain.
- Consumers help in the **circulation of energy** in an ecosystem.

Types of Consumer :

- Herbivores consume producers such as plants or algae. They are a necessary link between producers and other consumers. Examples include deer, rabbits, and mice.
- Carnivores consume animals. Examples include lions, polar bears, hawks, frogs, salmon, and spiders. Carnivores that are unable to digest plants and must eat only animals are called obligate carnivores. Other carnivores can digest plants but do not commonly eat them.
- Omnivores consume both plants and animals. They include humans, pigs, brown bears, gulls, crows, and some species of fish.

Examples of Omnivorous

- Squirrel
- Ostrich, Emu
- Cockroach
- Rat
- Hedgehogs
- Turkeys
- Turtles
- Crow
- Bat ,
- Bees
- Gibbon
- Red Panda

Decomposer: Organism which digests or breaks down formerly living material

DECOMPOSERS :

- When organisms die, they leave behind energy and matter in their remains. Decomposers break down the remains and other wastes and release simple inorganic molecules back to the environment

- They help in keeping the environment clean and mineral recycling
- Decomposers eventually convert all organic matter into carbon dioxide (which they respire) and nutrients. This releases raw nutrients (such as nitrogen, phosphorus, and magnesium) in a a form usable to plants and algae, which incorporate the chemicals into their own cells. This process resupplies nutrients to the ecosystem, in turn allowing for greater primary production.
- Decomposers are classified by the type of organic matter they break down:
- Scavengers consume the soft tissues of dead animals. Examples of scavengers include vultures, raccoons, and blowflies.
- Detritivores consume detritus—the dead leaves, animal feces, and other organic debris that collects on the soil or at the bottom of a body of water. On land, detritivores include earthworms, millipedes, and dung beetles (see Figure below). In water, detritivores include "bottom feeders" such as sea cucumbers and catfish.
- Saprotrophs are the final step in decomposition. They feed on any remaining organic matter that is left after other decomposers do their work. Saprotrophs include fungi, bacteria, and single-celled protozoa. Fungi are the only organisms that can decompose wood.

- Although decomposers are generally located on the bottom of ecosystem diagrams such as food chains, food webs, and energy pyramids, decomposers in the biosphere are crucial to the environment

Examples of Decomposers :

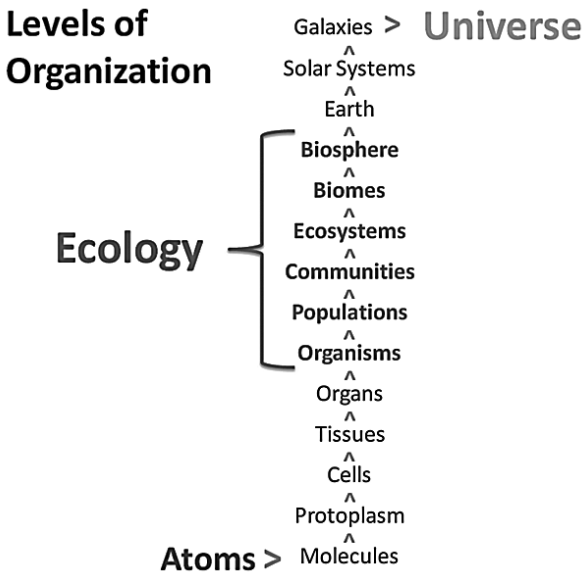
- Fungi
- Bacteria
- Insects
- Earthworms
- Woodlic e
- Sea cucumber
- Protozoas
- Millipedes
- Mites , termites
- Spring tails
- Snails and Slugs
- Beetles
- Isopods
- Centipeds
- Nematodes
- Ants ,
- Worms,
- Crabs

ECOLOGY

- **Word derived from Greek**
- **Oikos' meaning home and 'logos' meaning study**
- **Refers to study of Ecosystems**
- **Refers to : Scientific study of the interactions of organisms with their physical environment and with each other. (biotic and abiotic relationship)**
- **is the branch of biology concerned with the relations of organisms to one another (energy flow and mineral cycling) and their physical surroundings (environment).**

- **Levels of Ecology :** Ecology encompasses the study of individuals, organisms, populations, communities, ecosystems, biomes and biosphere, which form the various levels of ecological organisation.

Levels of Organisation of Ecology



- Ecology Deals with Biotic Potential, Biotic Interactions and Tropic level Interactions and Four core functions of ecosystem

KEY PEOPLE ASSOCIATED WITH THIS CONCEPT

- German zoologist **Ernst Haeckel**, who used the term as 'oekologie' in 1869, became the first person to use the term 'ecology'.
- **Alexander Humbolt** : Father of Classical Ecology, "***the father of environmentalism***"
- **Eugene Odum** is known as the Father of modern ecology. He says that "Ecology is the study of structure and function of ecosystems".(fundamental of ecology book)
- **Ramdeo Mishra** : father of Ecology in India (Banaras Hindu University Professor)

ECOLOGY TYPES, RULES AND PRINCIPLES

Autoecology : study of single species and their environment
Synecology : study of group of population

RULES OF ECOLOGY

- Gloger Rule
- Bergman Rule
- Allen Rule
- Rensch Rule
- Jordon Rule
- Shelford's law
- Ten percent **Law**

PrincipleofEcology

- Adaptation
- Variation

- Speciation
- Mutation
- Natural Selection
- Evolution
- Extinction

RULES OF ECOLOGY (Not Absolute and may have exceptions)

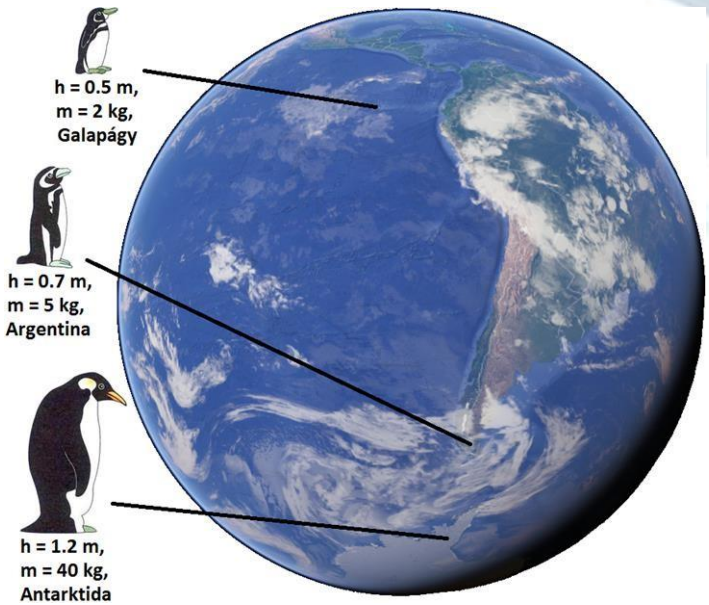
❖ **Gloger Rule**: ecological principle, focus on adaptation to local environment.

- Some Insect, birds, mammals in Warm humid climate bear darker pigment than races of Same species in cool and dry climate.
- Colour variation due to difference in Melanin Pigmentation.
- Humid areas animals have more pigmentation as compared to dry areas
- Animals living in humid environment tends to have more pigmentation(dark fur or feathers)may help absorb heat and protect against excessive moisture.
- Drier environments animals, have lighter pigmentation can reflect sunlight and help body temperature
- Among Mammals , Equatorial and tropical regions populations have a darker skin colour than pole population.

❖ **Bergman Rule:**

- Temperature also affect absolute size of animal and relative proportions of various body parts .Like Birds, Mammals attain greater body size in Cold region than the warm area

➢ Influence of Temp is size dependent .
➢ Species of larger size = Cold Environment (Heat lost slow)



➢ Species of Smaller size = Warm Environment (Heat lost fast)

Que : A general increase in the average body mass of animal population within a species with latitude is known as

a) Allen Rule
b) Bergmann Rule
c) Rensch Rule
d) Gloger Rule

Ans : B

❖ **Allen Rule:**

- This rule was given by Joel Allen in 1877
- Tail, Snout, ears and legs of Mammals are relatively shorter in Colder part than Warm areas.
- cold climate Bird and mammals : short limbs or appendages
- warm climate : long limbs or appendages
- Artic tern and great hornbill bird.

❖ **Rensch Rule**: races of birds with relatively narrow and more acuminate wings tends to occur in colder region while those in warmer areas tends to be broader.

➢ **Jordon Rule** : Law of vertebrae for fish : According to this law, in the case of certain groups of fishes, the fishes which are found in the cold-water or regions have a larger number of vertebrae than those members which are found in tropical

- ➢ vertebral number increase with latitude
- ➢ Decreasing temperature increase the number of vertebrae
- ➢ In humans, the vertebral column usually consists of 33 vertebrae

- 5 Groups of vertebrates : Fish, Amphibians , Repltiles, Birds , mammals

According to Shelford's Law of Tolerance, the organisms wide environmental factor tolerance limit show

1. Narrow distribution with low population size
2. Wide distribution with high population size
3. Narrow distribution with high population size
4. Wide distribution with low population size

Ans- Wide distribution with high population

Explanation- According to the law species that are able to withstand high stress usually have a greater area of distribution and large population.

American zoologist Victor Ernest Shelford in 1911.**Shelford's law of tolerance** A law stating that the abundance or distribution of an organism can be controlled by certain factors (e.g. the climatic, topographic, and biological requirements of plants and animals) where levels of these exceed the maximum or minimum limits of tolerance of that organism.

Que: Match the Following :

(1) Bergmann's rule	(i) Pigmentation of the skin
(2) Gloger's rule	(ii) Metabolic rate
(3) Allen's rule	(iii) Number of vertebrae of codfish
(4) Jordan's rule	(iv) Body size(mammals)
	(v) Size of extremities of body parts

The correct match is

(a) 1-iii, 2-v, 3-i, 4-iv
(b) 1-iv, 2-i, 3-iii, 4-v
(c) 1-iv, 2-i, 3-v, 4-ii
(d) 1-iv, 2-i, 3-v, 4-iii

Q. Choose the incorrect pairs

Characteristic feature	Vegetation
1) Sloping branches and needle-like leaves	Desert vegetation
2) Deep roots	Taiga vegetation
3) Waxy stem, thick leaves or no leaves	Tundra vegetation
4) Canopy	Tropical vegetation

Select Codes:

a) All

b) 4 only

c) 1, 2, 3 only

d) 2, 3 only

Ans C

Ans All

Which of the following is/are the adaptive mechanism(s) of plants to avoid adverse conditions?

1. Dieback
2. Viviparity mode of reproduction
3. Pneumatophores
4. Dormant

Select the correct answer using the code given below:

Dieback Mechanism :

- Refers to the progressive dying usually backwards from the tip of any portion of the plant.
- This is one of the adaptive mechanisms to avoid adverse conditions like drought.
- In this mechanism, the root remains alive for years together, but the shoots die.
- E.g.sal,red sanders, silk cotton tree etc

PRINCIPLES OF ECOLOGY

1. Adaptation:

- Allows Organism to survive in a particular environment .

- "Adaptation is defined as the process where a species or an organism gradually becomes better acclimated to its environment."

Types of Adaptation: three categories play a critical role in the survival of an Organism

- Morphological (body parts)
- Physiological (Body coverings)
- Behavioural (Behaviours)/ animals migrating temporarily to a less stressful habitat.

Morphological Adaptation:

- Desert Plants Have no leaves , thick cuticle on their leaf surface (to reduce transpiration)
- Mammals from Cold Climates generally have: Short Ears and limbs to minimize Heat loss. (Allen 's Rule) Polar Bear and Penguins , Seal, Sealions and Walrus.
    - whales and seals, a thick layer of fat covers the entire body,called blubber This layer provides insulation from the bitter cold and also aids in buoyancy.
- Elephants don't sweat, reason flapping ears to lose heat and keep body cool.
- Hyperthermophile Organism thrives in extreme hot Environments from 60 degree Ex Archaebacteria flourish in hot springs and deep sea hydrothermal vents.

Physiological Adaptation:

- Kangaroo rats can survive without ever drinking any water, getting needed moisture from their seed diet.Kangaroo rats (noctural)are found in the drier regions of the western and southwestern U.S. North Amercia.However, if a kangaroo rat drinks water, **the necessary bodily liquids and vitamins are flushed out, and it dies as a result of dehydration**.
- Plants employ spines, thorns or toxins to deter herbivores
- Sheep grow very thick wool in cold, damp climates
- Small changes taking place in the body of organism over short periods to overcome minor problems due to changes in the surrounding is called acclimatization.
- Other Ex: The Body compensates for low oxygen availability in high altitude region by increasing red blood cells production, decreasing the binding capacity of haemoglobin and increasing breathing rate,
- *cheeks are red primarily due to increased blood flow near the skin surface. More red blood cells help her get oxygen to the tissues of her body*
- High Altitude region (Cold Weather and less Oxygen (hypoxia))Higher altitudes mean increased UV exposure, which can damage skin low humidity level leave skin dry (WV decrease as we go up)

The mechanism present in an organism that allow it to perform certain biochemical reactions to survive in its natural habitat is called Physiological Adaptations.
Which of the Following is the examples of it

a) A snake's ability to produce venom
b) mammal's ability to maintain constant body temperature
c) our body to produce hydrochloric acid to digest food
d) All of the Above

Que : Which of the statements given below correctly relates to Allelopathy?

(a) This is a mechanism of competition found in the animals, when one species dominates the food, wiping out the other species.

(b) This is a mechanism of competition found in the plants, when the plants produce chemicals which are toxic for other plants.

(c) This is a mechanism of co-operation between two plants, when both the plants compete for sunlight.

(d) This is a mechanism of synergistic existence between two species, where one species eats the waste of other species.

- EXp Answer B
- Amongst the plants, it has often been claimed that interference occurs through the production and release into the environment of chemicals that are toxic to other species, but not to the producer (known as allelopathy).
- These biochemicals are known as allelochemicals and can have beneficial (positive allelopathy) or detrimental (negative allelopathy) effects on the target organisms and the community.

Behavioural adaptation :

Adaptations in the behaviour of Organism are called Behavioural Adaptation

- Ectotherms : cold blood animals : Fish, amphibians, reptiles
- Endotherms : Warm Blood Animals : Birds and Mammal escape cold conditions by hibernating during winters and Aestivating during summer , some organism like Birds Migrate (Migration)
- Euryhaline : organism tolerant a wide range of salinity
- Stenohaline : organism tolerant a narrow range of salinity
- Eurythermal: Organism tolerate wide range of temperature
- Stenothermal: Organism tolerate narrow range of temperature
- Burrowing strategies by animals : like Pangolin, Rats, Ants , Prairie Dog, Rabbit
- **Hibernation:** Winter dormancy(to minimize energy needs during tough time): Brown Bear, Black Bear, Common Box Turtle, Alaskan Wood Frog
- **Aestivation:** summer dormancy: Snails,turtles, snakes, lungfish, Crocodile (suspended animation during severe drought) it is common among some desert animals

2. Variation : induced by changes in genetic makeup due to addition or deletion of specific genes. like colour of skin type of hair, eye colour, blood type.

3. Speciation : Process by which new species are formed .geographic Isolation leads to speciation. The species evolve by genetic modification. The new species are reproductively isolated from the previous species.

4. Evolution :

- Mechanism by which speciation is brought about .
- Gradual changes in an organism to survive in an environment .
- the evolution of the Giraffes neck over a period of time.

5. Mutation: a change in genetic material that results from an error in replication of DNA causes new genes to arise in a population.

6. Natural Selection :

- Mechanism Proposed by Darwin and Wallace
- Process by which species adapt to their Environment .

- it is evolutionary force that select among variations .
- Valid theory of Evolution given by Charles Darwin and Alfred Wallace 1859.

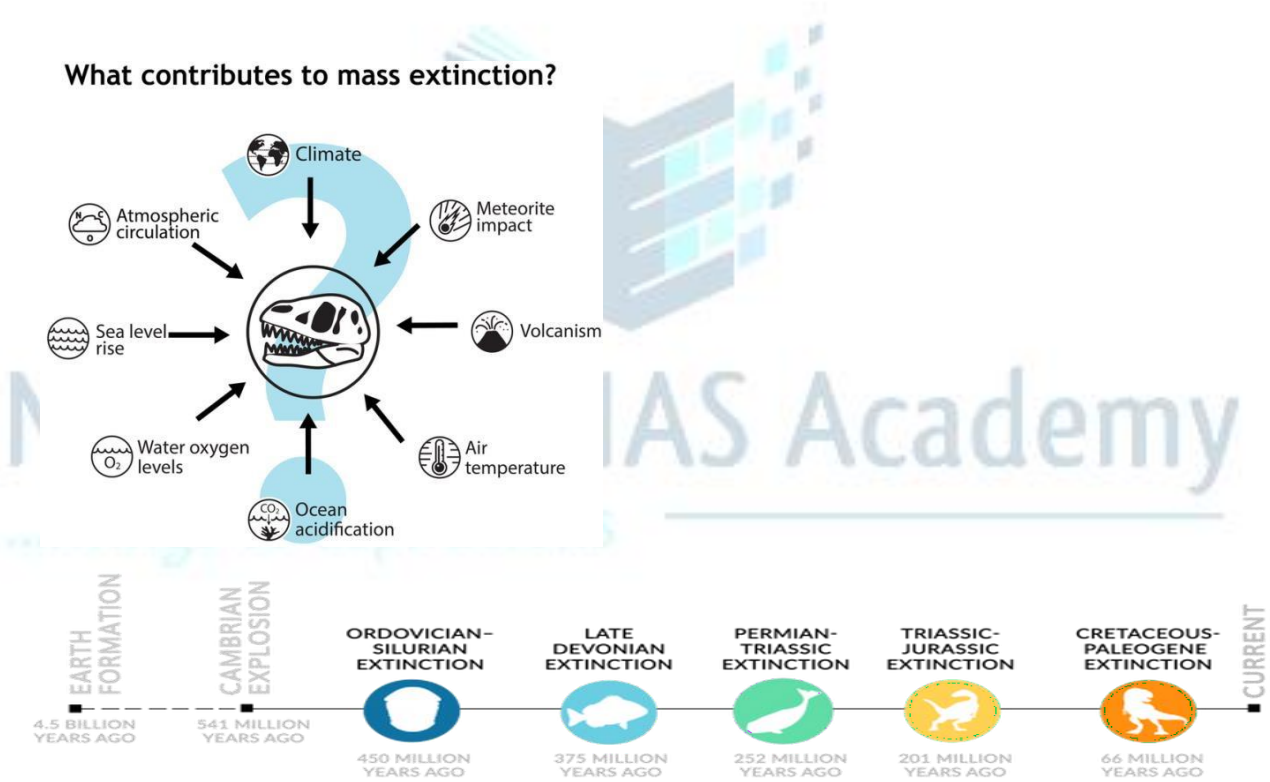
7. Extinction :

- occurs when species cannot evolve fast enough to cope with the changing environment .
- Primary reason behind extinctions is an environmental change or biological competition.
- At Present, the Sixth Mass Extinction (Anthropogenic Extinction -Human -Induced) is in progress.

DEFINE MASS EXTINCTION

- refers to a substantial increase in the degree of extinction or when the Earth loses more than three-quarters of its species in a geologically short period of time.

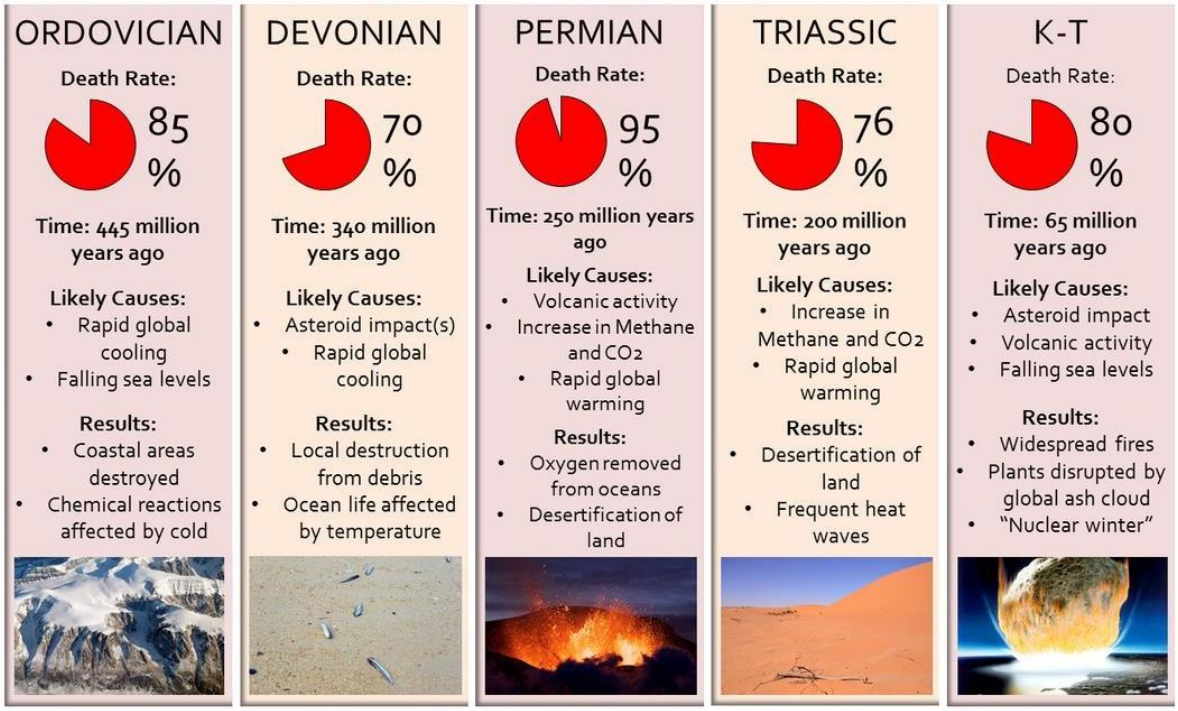
- Researchers have observed that the ongoing sixth mass extinction is one of the most serious environmental threats to the existence of civilisation.



the Earth has experienced **five mass extinctions.**

MASS EXTINCTIONS:

The biggest disasters in history



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The term "sixth mass extinction/sixth extinction" is often mentioned in the news in the context of the discussion of (UPSC 2018)

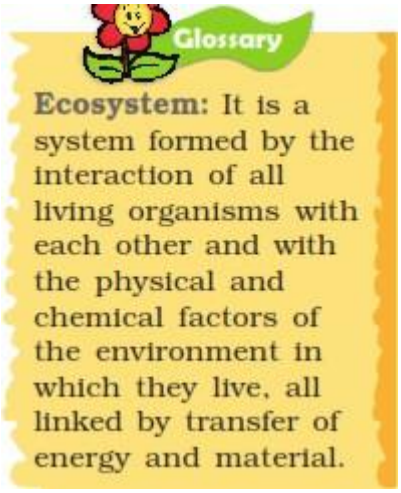
a. Widespread monoculture practices in agriculture and large-scale commercial farming with indiscriminate use of chemicals in many parts of the world that may result in the loss of good native ecosystems.

b. Fears of a 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 genetically modified crops in many parts of the world and promoting their cultivation in other parts of the world which may cause the disappearance of good native crop plants and the loss of food biodiversity.

d. Mankind's over-exploitation/misuse of natural resources, fragmentation/loss of natural habitats, destruction of ecosystems, pollution and global climate change.

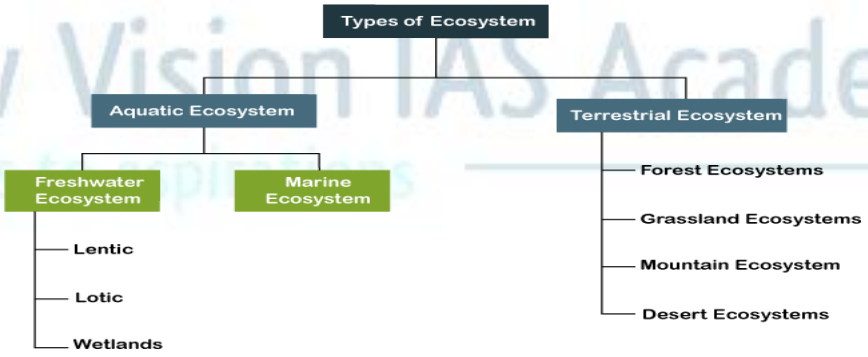
Ans D



ECOSYSTEM

- A community of organisms together with the environment in which they live
- a structural and functional unit of nature,
- Interaction of biotic and abiotic through : Nutrient Cycles and Energy flows
- The term "ecosystem" was first used in 1935 in a publication by British ecologist Arthur Tansley.
- Size of ecosystem in decreasing order: Biosphere, biome, landscape, ecosystem, community, population, individual/ species

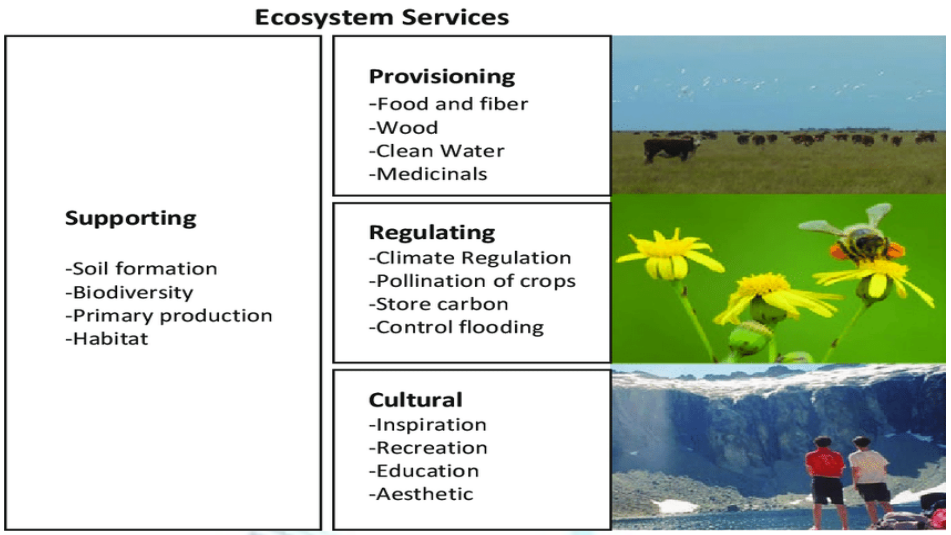
Types of Ecosystem :



Lotic Water : Means moving / flowing water

Lentic Water : Stagnant or non flowing water

Ecosystem Services :



ECOSYSTEM SERVICES: Ecosystem services are classified into **four** services:

A. Provisioning Services: food, water, medicines and other resources from ecosystems. Ecosystems are a source of food, water, medicines, wood, biofuels, forest etc

B. Regulating Services:

- for maintaining ecological balance
- Carbon sequestration, forest purify and regulates air quality,
- prevent soil erosion, and control greenhouse gases.
- Pest and Disease Control :Biotic components such as birds, rats, frogs, act as natural controllers and thus help in pest and disease control. Hence, ecosystems act as regulators.
- Pollination services critical for reproduction and survival of many plants including agricultural crops .
- coastal protection: Mangroves, Salt Marshes, Coral Reefs acts as natural barriers against erosion , storm surges and sea level rise.
- water filtration : Wetlands and Marshes acts as natural water filters , trapping sediment and absorbing pollutants , thereby purifying water and prevent contamination of water bodies.
- Nutrient Cycling : Ecosystems facilitate the recycling and redistribution of nutrient .

C. Supporting services:

- provisioning of habitat. like Wildlife Habitat
- Genetic Resources and They provide habitat for different life forms, retain biodiversity, nutrient cycling,
- soil formation and retention,
- production of oxygen,
- nutrient cycling,
- water cycling,
- Seeds dispersal,
- Waste Decomposition

D. Cultural services:

- tourism;
- recreational, aesthetic, cultural and spiritual services, etc.
- spiritual enrichment, cognitive development
- provide enormous economic and social benefits

The Millennium Ecosystem Assessment describes the following major categories of ecosystem services-provisioning, supporting, regulating, preserving and cultural. Which one of the following is supporting service?

A) Production of food and water

B) Control of climate and disease

C) Nutrient cycling and crop pollination

D) Maintenance of diversity

Que: carbon sequestration and climate regulation? is Which type of Ecosystem Service

FOUR CORE FUNCTIONS OF ECOSYSTEM

- Energy Flow and Trophic Level Interactions
- Productivity and Decomposition
- Ecological succession and its stages
- Biogeochemical cycle/ nutrient cycles

Four Main Function of Ecosystem

1. Energy flow and Trophic Level of Interaction :

a) Food Chain (2 types):

- Grazing Food chain
- Detritus Food chain
- Parasite Food chain

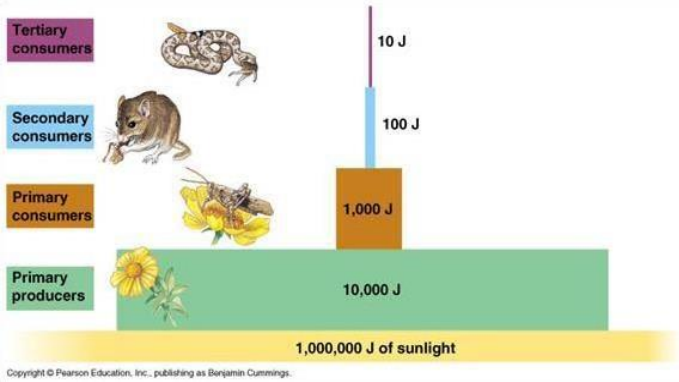
b) Food Web

c) Ecological Pyramids (3 types):
    - Pyramid of numbers (upright and inverted)
    - Pyramid of biomass (upward and inverted)
    - Pyramid of Energy

2. Productivity and Decomposition and

3. Ecological succession and its stages

4. Biogeochemical cycle/ nutrient cycles



ENERGY FLOW:

- Energy is the basic force responsible for all metabolic activities. The flow of energy from producer to top consumers is called energy flow which is **unidirectional** or linear or one way.
- E Shape Pattern
- **90% of the energy involved is degraded at each tropic transfer and only 10 % of the energy is conserved in the organism tissue**

At every step in a food chain the energy received by the organism is also used for its own metabolism and maintenance. The left over is passed to next higher trophic level.

Thus energy flow decreases with successive trophic levels. The number of steps is limited to four or five in a food chain for the transfer of energy.

DEFINE TROPIC LEVEL:

- Transfer of Energy from one tropic level to next tropic level .
- Each step in the food chain is called trophic level.
- 1942 Liendman studied trophic levels
- At Each Trophic Level Energy is lost in Respiration and metabolism.

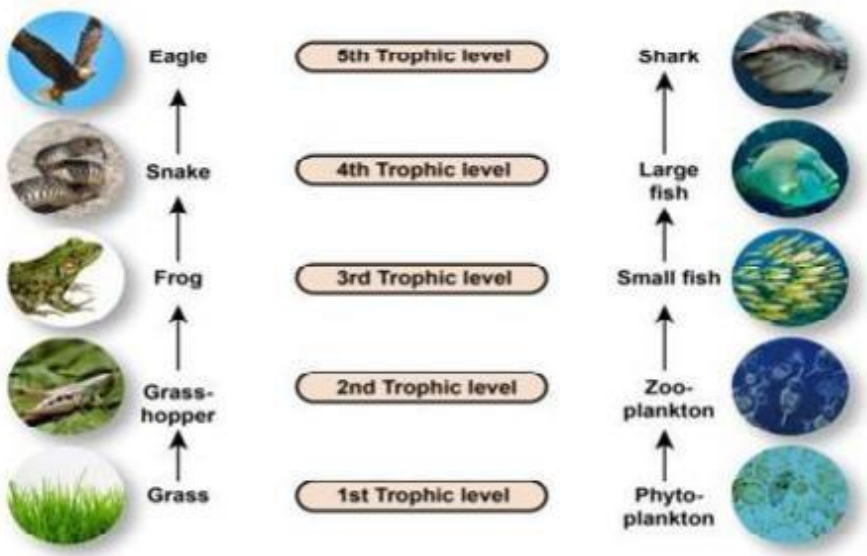
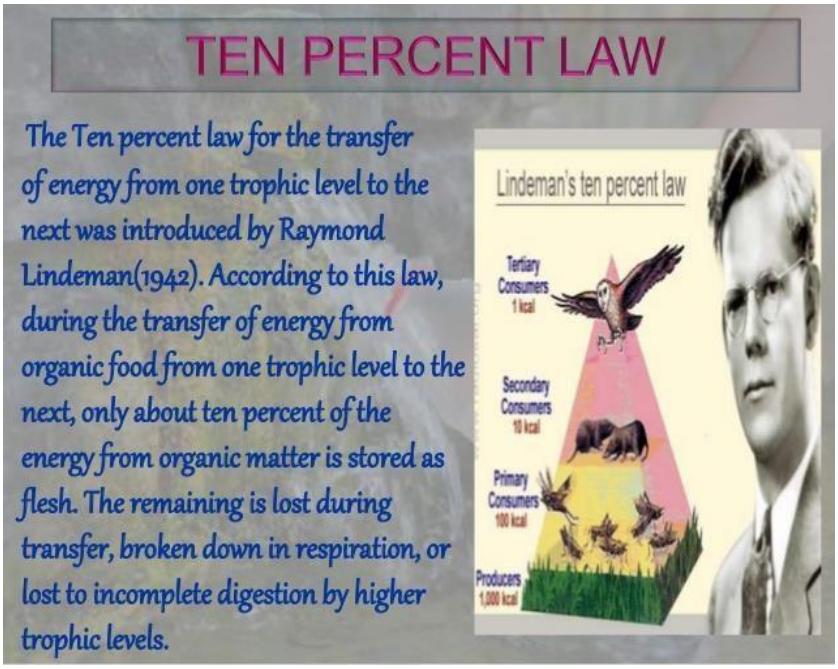
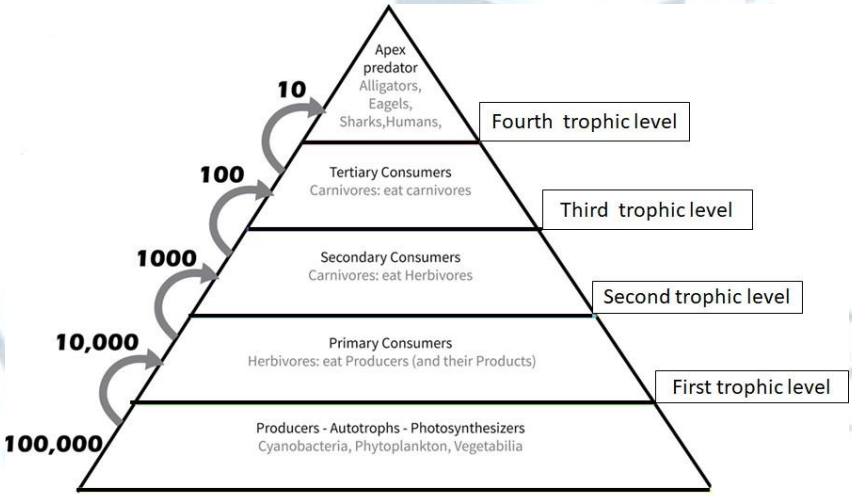


Fig. 2.5: Trophic levels in a food chain in: i) a terrestrial and an ii) aquatic environment.





Pyramid of energy

The trophic level interaction involves three concepts namely :-

1. Food Chain

2. Food Web

3.Ecological Pyramids

FOOD CHAIN:

- The sequence of eaten and being eaten, produces transfer of food energy and it is known as the food chain.
- A food chain starts with producers and ends with top carnivores
- is a linear sequence of organisms through which nutrients and energy pass as one organism eats another."
- follows a single path
- an organism eats a single item
- there is a singular path for energy flow
- Each step in the food chain is called Trophic Level
- One organism becomes food for the other .
- repeated eating and being eaten link
- A sequence of organism that feed on one another , form a food chain

THREE TYPES OF FOOD CHAIN:

1. **Grazing food chain (depend on living / organic matter)**
   - Grass- caterpillar-lizard- Snake- Hawk(Terr. Ecosystem)
   - Grass- Grasshopper-frog -snake - Eagle/ hawk
   - Grass- Rabbit- Wolf/jackel- Tiger
   - Phytoplanktons-Zooplanktons-fishes- pelicans(Aquatic Ecosystem)
   - Diatoms-- Crustaceans-- Herrings Aquatic Ecosystem)

Note :

Crustaceans : Arthropods : crabs, Crayfish, Lobsters, Shrimp, Krill, Barnacles Cetaceans: Dolphin, Porposies, Whale

Herring : Fish

- Grazing food chain begins with autotrophs like green plants, cyanobacteria, etc that are able to synthesise their own food and pass on the energy to herbivores and further to carnivores.

- In an aquatic ecosystem, decomposition is very less. That is the reason why GFC is the major conduit of energy in an aquatic ecosystem

- in aquatic ecosystems there are a smaller number of producers, and a high number of herbivores the grazing food chain to be dominant.

- In an aquatic ecosystem, GFC is the major channel for energy flow and in a terrestrial ecosystem, a much larger fraction of energy flows through the DFC.

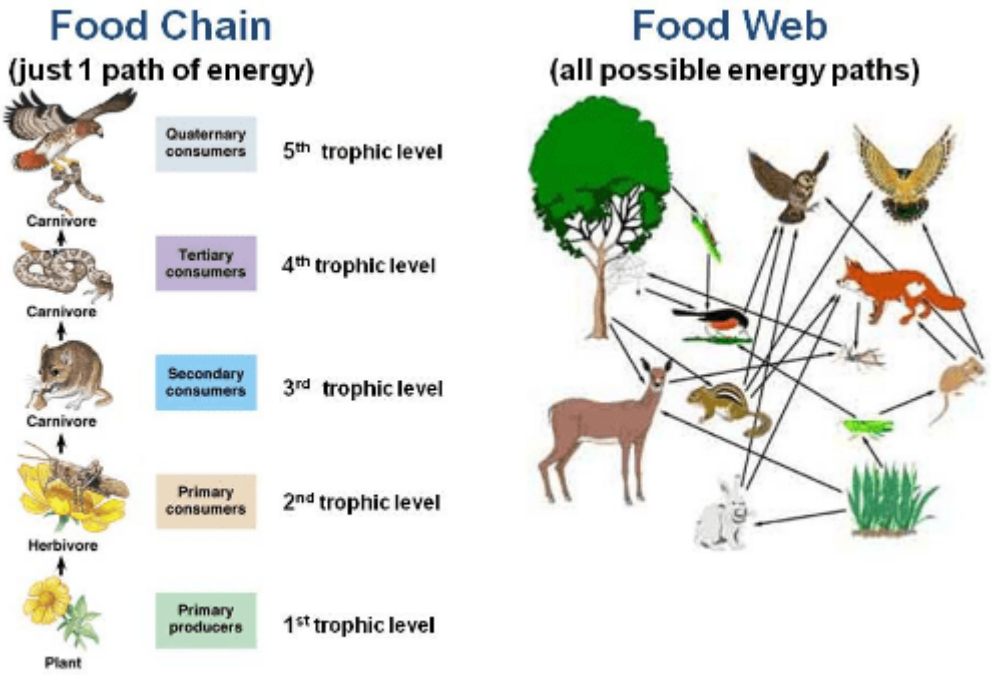
- Most terrestrial ecosystems have a high number of producers and relatively lower number of herbivores than detritivores. Hence, the detrital food chain is dominant.

2. Detritus food chain:

- Source of Energy : Dead Organic matter or Detritus
- Detritus feeding organism called Detrivores or decomposers
- The detrivores are eaten by predators
- ex: Litter-Earthworm- Chicken- Hawk/Eagle.
- ex; Dead leaves --woodlouse-- blackbird
- Such ecosystems are thus less dependent on direct solar energy.

3. Parasitic Food Chain :

- This type of food chain starts with green plants, then goes to the plant or the herbivores on which the parasitic organisms feed.
- Grass> cow> lice.: Also starts with green plants but here smaller organisms depending on larger organism. other are
- Trees→ Fruit eating birds→ Lice and bugs→ Bacteria and fungi
- Zebra--Nematode--- Bacteria



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

Food Web:

- Shows different paths where plants and animals are connected .
- comprises several **food chains**
- an organism consumes multiple items
- there are different paths for energy flow
- All food webs begin with autotrophs and end will decomposers
- In nature the food chains are interconnected at various points and together take the form of a food web
- A net work of food chains which are interconnected at various trophic levels of the food chain to form a number of feeding connections is called a food web.
- **In a food web one trophic level may be connected to more than one food chain**

- In nature the food chains are not isolated sequences but they are interconnected with one another.
- "A food web illustrates all possible transfers of energy and nutrients among the organisms in an ecosystem, whereas a food chain traces only one pathway of the food".

Significance of Food Chains and Food webs

- They help in maintaining the ecological balance.
- They help in understanding the feeding relations among organisms.

- Energy flow and nutrient cycling take place through them.
- It explains the concept of biomagnification.

3. ECOLOGICAL PYRAMIDS (1927, Charles Elton)

- The steps of trophic levels expressed in a diagrammatic way are referred to as ecological pyramids.
- Food chain and food web do not give any information about the numbers of organism involved .
- This information can be shown through ecological pyramids

The ecological pyramids are of three categories-

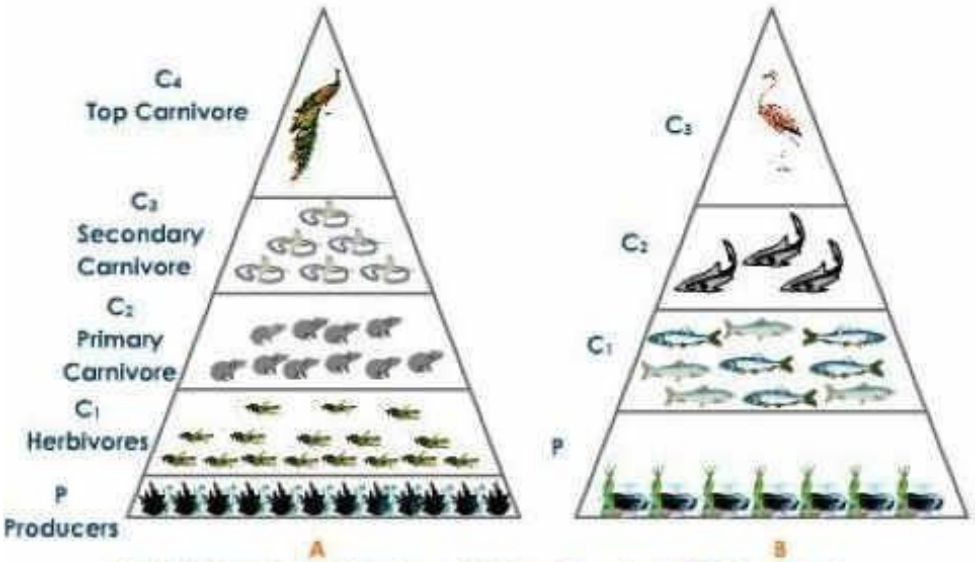
1. Pyramid of numbers,
2. Pyramid of biomass, and
3. Pyramid of energy or productivity

Do You Know ?

- In a tree ecosystem, the Pyramid of Numbers in inverted, while the Pyramid of Biomass is upright.
- In an aquatic ecosystem, the Pyramid of Numbers is upright, while the Pyramid of Biomass is inverted.

Pyramid of Numbers:

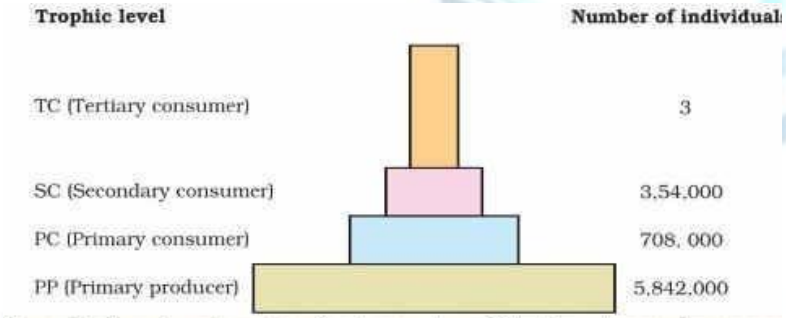
- **is used to show the total number of individuals of different species at each tropic level.**



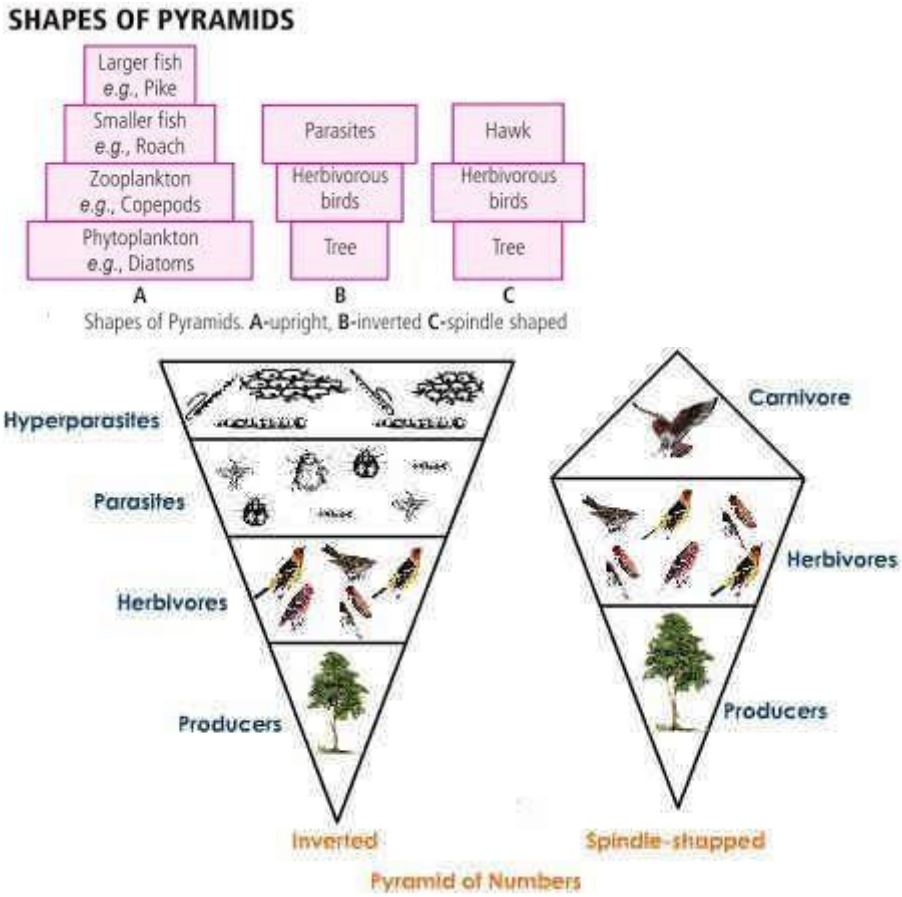
Upright Pyramids of Numbers. (A) In a Grass Land (B) In a Pond

PYRAMID OF NUMBER:

- UPRIGHT :it is upright in case of grassland and pond system, here number of individuals is decreased from the lower level to higher tropic level.



Pyramid of numbers in a grassland ecosystem. Only three top-carnivores are supported in an ecosystem based on production of nearly 6 millions plants



INVERTED in Tree ecosystem : number of individuals is increased from lower level to higher trophic level.

Spindle Shaped : found in Forest Ecosystem or Tree Ecosystem

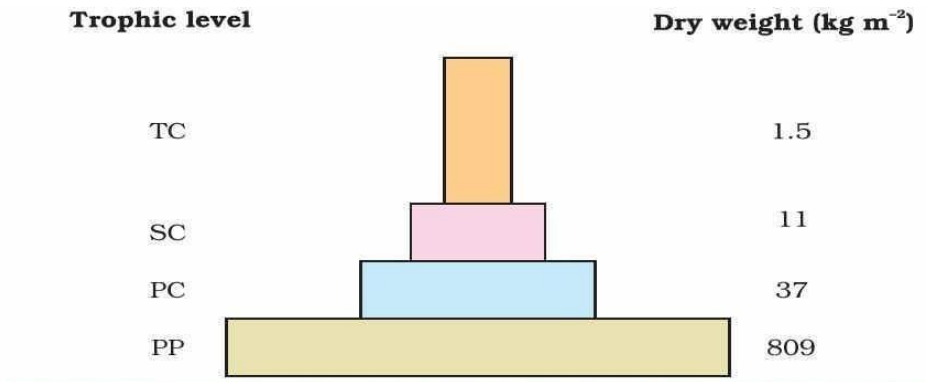
In a **forest ecosystem**, the producers are large size trees which make the base of pyramid. The herbivores such as fruit eating birds, deer, elephants etc. make the primary consumers and are more than producers but these herbivores support fewer number of carnivores. Hence, the pyramid of numbers becomes spindle shaped.

Trees- Birds - hawk : Spindle shaped

Criticism about pyramid of number:

- A **pyramid of Number** *does not* take into account the fact that size of organism being of counted in each trophic level can vary .
- It is **difficult to count number of organism.**
- So Pyramid of numbers **does not** completely define trophic structure of the ecosystem.

PYRAMID OF BIOMASS: Pyramid of Biomass

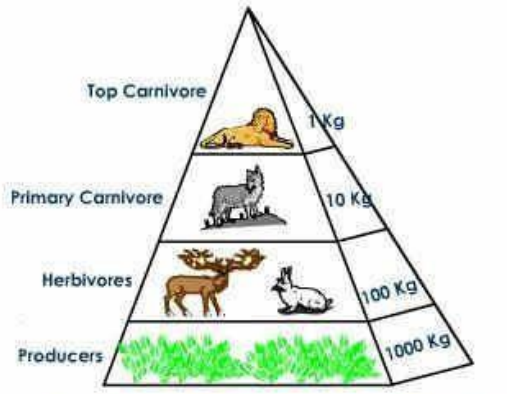


Pyramid of biomass shows a sharp decrease in biomass at higher trophic levels

- Pyramid of biomass is usually determined by collecting all organisms occupying each trophic level separately and measuring their **dry weight**.
- This overcomes the size difference problem because all kinds of organisms at a trophic level are weighed. Biomass is measured in g/m^2.
- The biomass of a species is expressed in terms of fresh or dry weight. Measurement of biomass in terms of dry weight is more accurate.
- Each trophic level has a certain mass of living material at a particular time called as the **standing crop**.
- **The standing crop is measured as the mass of living organisms (biomass) or the number in a unit area**.

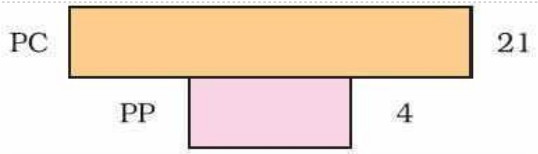
- **Pyramid of Biomass is better than pyramid of numbers for showing the realtionships between the organisms.**
- Pyramid of Biomass – Upright

- For most ecosystems on land, the pyramid of biomass has a large base of primary producers with a smaller trophic level perched on top.
- The biomass of producers (autotrophs) is at the maximum. The biomass of next trophic level i.e. primary consumers is less than the producers. The biomass of next higher trophic level i.e. secondary consumers is less than the primary consumers. The top, high trophic level has very less amount of biomass.



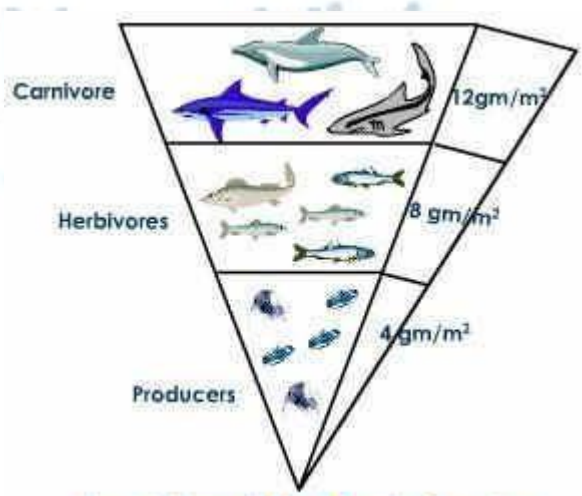
Upright Pyramid of biomass in a Terrestrial Ecosystem

Pyramid of Biomass – Inverted



Inverted pyramid of biomass-small standing crop of phytoplankton supports large standing crop of zooplankton

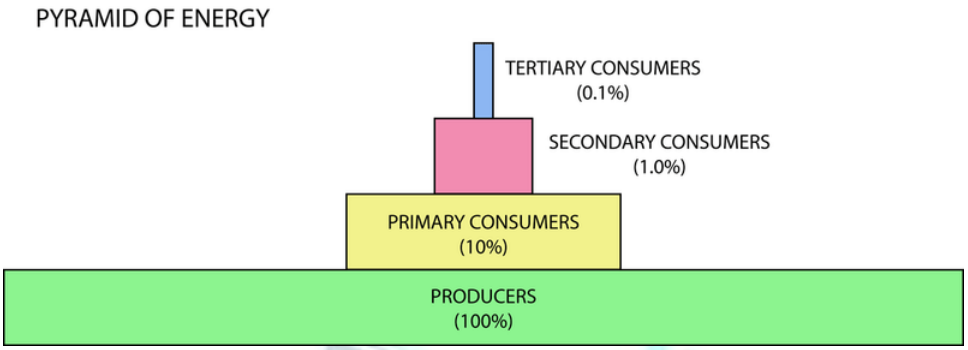
- In contrast, in many **aquatic ecosystems**, the pyramid of biomass may assume an inverted form. [Pyramid of numbers for aquatic ecosystem is upright]
- The pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton
- This is because the producers are tiny phytoplankton that grow and reproduce rapidly.
- Here, the pyramid of biomass has a small base, with the consumer biomass at any instant actually exceeding the producer biomass and the pyramid assumes inverted shape.



Inverted Pyramid in an Aquatic Ecosystem

Pyramid of Energy

- To compare the functional roles of the trophic levels in an ecosystem, an energy pyramid is **most suitable**.
- **An energy pyramid represents the amount of energy at each trophic level and loss of energy at each transfer to another trophic level.**
- **Hence the pyramid is always upward, with a large energy base at the bottom.**

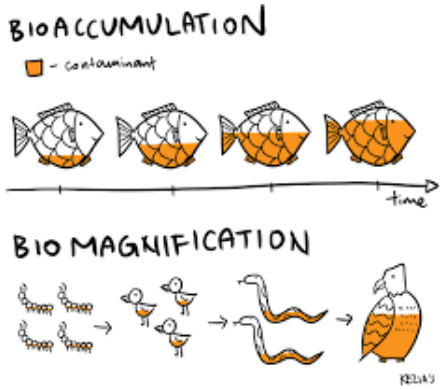


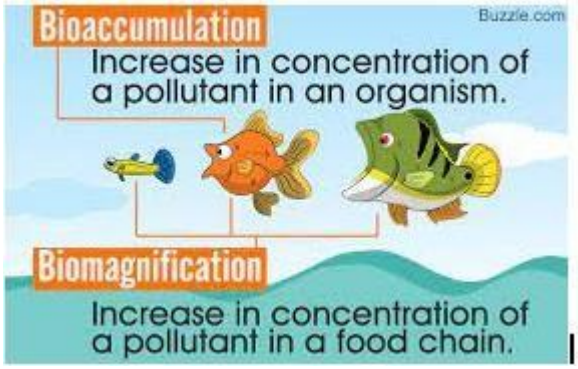
Limitations of Ecological Pyramids

- It does not take into account the same species belonging to two or more trophic levels.
- It assumes a simple food chain, something that almost never exists in nature;
- it does not accommodate a food web.
- saprophytes (plant, fungus, or microorganism that lives on decaying matter) are not given any place in ecological pyramids even though they play a vital role in the ecosystem.
- Ecological pyramid concept help to explain phenomenon of Biological Magnification- Tendency for toxic substances to increase in concentration progressively at higher level of food chain.

Pollutants :

- Non degradable pollutants move through the various trophic level in an ecosystem.
- Movement of Pollutants involves two main processes





1. **Bioaccumulation :**
   - refers to how pollutants enter a food chain .
   - General accumulation of pollutants, chemcials or other substances in an organism.
   - **Bioaccumulation**: refers to **how pollutant enter a food chain**. Increase in concentration of pollutant from environment to first organism in the food chain
   -

2. **Biomagnification**:
   - refers to tendency of pollutants to concentrate as they move from one trophic level to the next.
   - Progressive bioaccumulation (ie increase in concentration) at each trophic level with the passage of time.
   - In order for biomagnification to occur , the pollutant must be long lived ,mobile , soulble in fats and biologically active.

BIOACCUMULAION VERSUS BIOLOGICAL MAGNIFICATION

BIOACCUMULAION	BIOLOGICAL MAGNIFICATION
The gradual accumulation of substances such as pesticides or other chemicals in living organisms	The concentration of a toxic chemical in the tissues of tolerant organisms at the successively higher levels in a food chain
The process of building-up of toxic chemicals in the body of a living organism	The increase of the toxic chemicals in the amount each time they move up a food chain
Caused by the uptake of toxic chemicals into the body either through the skin or through ingestion	Toxic chemicals start in small amounts at the lower levels of the food chain and gradually increase in amount when it moves to the higher levels
Results in chronic poisoning even when the concentration of the toxic compound in the surrounding environment is not too high	Results in higher concentrations of toxic substances at the higher tropic levels of a food chain

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TERM COINED BY

- "ecology" was coined by the German biologist Ernst Haeckel.
- "habitat" was coined by the German zoologist Ernst Haeckel.
- "ecosystem" was introduced by the British ecologist Sir Arthur Tansley.
- "home range" was coined by the American zoologist Edward O. Wilson.
- "ecozone" was introduced by the Canadian ecologist David Schindler.
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- "ecotope" was coined by the German ecologist Carl Troll.
- "ecological niche" was coined by the ecologist G. Evelyn Hutchinson.
- The word "habitat" was coined by the German zoologist Ernst Haeckel.
- "ecotype" was coined by the American botanist Frederic Clements.
- "biome" was coined by the American ecologist Frederic Clements
- ecotype" was coined by the American botanist Frederic Clements.
- "ecological succession: Frederic Clements and Henry Gleason.
- "biosphere" was introduced by the Austrian geologist Eduard Suess.
- "biodiversity" was coined by the American biologist Edward O. Wilson.
- "biodiversity hotspots" was developed by the British ecologist Norman Myers.
- "megadiverse countries":Russell Mittermeier
- "hopespots" was introduced by the marine biologist Sylvia Earle to refer to areas of the ocean

that are particularly important for conservation.

BIOSPHERE / ECOSPHERE

- it is largest ecosystem on the Earth
- refers to Narrow Zone of Life on the Earth
- it is largely self regulating
- coined by geologist **Edward Suess in 1875**

Ecozones or Biogeographic realms :

- are large areas (spatial region) with particular flora and fauna, due to their isolation during continental drift. they are usually a continent or subcontinent sized area with unifying features.
- World is divided into 8 Ecozones

They are : Australasia, Antarctica, Afro-tropics, Indo-Malay, Nearctic, Neotropical, Oceania and Palaearctic.

In India, Realm are Two

- Himalayan region-- Palaearctic realm/Eurasian
- Rest of Subcontinent represented by –Malayan realm/Indo-Malayan origin (3 Some books :Afro-tropical)

Each ecozone may include a number of different biomes.

BIOME: (BIOLOGICAL HOME)

- term coined by: Frederic Clements in 1916
- It is not an ecosystem.
- refers to Plant and animal community that covers a large geographical area.
- main group of plants and animals living in a areas of certain climatic patterns
- the total assemblage of plant and animal species interacting within specific conditions.
- total accumulation of flora and fauna interacting within particular conditions
- Major biomes of World: Forest , Grassland, desert , Tundra biomes , aquatic and altitudinal biomes.

In India, Five Biome:

1. Tropical Humid forest,
2. Tropical Dry deciduous forest.

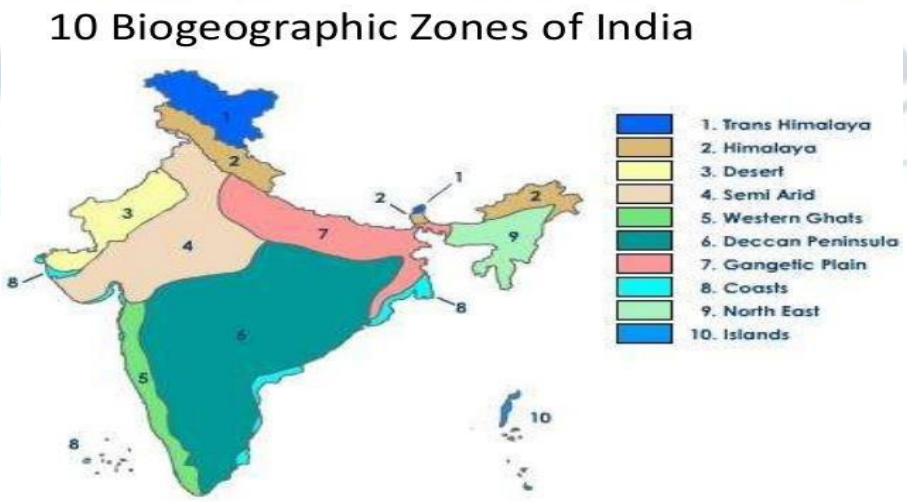
3. Warm desert/ semi arid areas
4. Coniferous forest
5. Alpine Meadows

BIOGEOGRAPHIC REGIONS —OR BIOREGIONS—

- are geographical areas described in terms of their unique combination of plants, animals, geology, climate and water features. They are defined by natural boundaries and distinct living communities

The most accepted and followed classification is the one developed at Wildlife Institute of India by Rodgers and Panwar (1988). It divides India into **10 bio-geographic** regions/zones. These zones reflect major species groupings. In addition, they have a distinct set of physical, climatic and historical conditions. The ten zones are:

1. Trans Himalayan
2. Himalayan
3. Indian desert
4. Semi arid
5. Western Ghats
6. Deccan Peninsula
7. Gangetic Plain
8. North-East India
9. Islands
10. Coasts. (BZ were used as a basis for planning wildlife protected areas in India)



S.NO.	BIOGEOGRAPHIC ZONES	BIOTIC PROVINCES TOTAL 26 IN INDIA
1.	Trans-Himalaya	Ladakh mountains, Tibetan plateau
2.	Himalaya	Northwest, West, Central and East Himalayas

3.	Desert	Thar, Kutch
4.	Semi-arid	Punjab plains, Gujarat Rajputana
5.	Western Ghats	Malabar plains, Western Ghats
6.	Deccan Peninsula	Central highlands, Chotta-Nagpur, Eastern highlands, Central Plateau, Deccan South
7.	Gangetic plains	Upper and Lower Gangetic plains
8.	Coast	West and East coast, Lakshadweep
9.	North-East	Brahmaputra valley, Northeast hills
10.	Islands	Andaman and Nicobar

Table 15.1 : World Biomes

Biomes	*Subtypes*	*Regions*	*Climatic Characteristics*	*Soil*	*Flora and Fauna*
Forest	A. Tropical 1. Equatorial 2. Deciduous B. Temperate C. Boreal	A1. 10° N-S A2. 10° - 25° N-S B. Eastern North America, N.E. Asia, Western and Central Europe C. Broad belt of Eurasia and North America (parts of Siberia, Alaska, Canada and Scandinavia)	A1. Temp. 20-25°C, evenly distributed A2. Temp. 25-30°C, Rainfall, ave. ann. 1,000mm, seasonal B. Temp. 20-30° C, Rainfall evenly distributed 750-1,500mm, Well-defined seasons and distinct winter. C. Short moist moderately warm summers and long cold dry winter; very low temperatures. Precipitation mostly snowfall 400 - 1,000mm	A1. Acidic, poor in nutrients A2. Rich in nutrients B. Fertile, en-riched with decaying litter C. Acidic and poor in nutrients, thin soil cover	A1. Multi-layered canopy tall and large trees A2. Less dense, trees of medium height; many varieties co-exist. Insects, bats, birds and mammals are common species in both B. Moderately dense broad leaved trees. With less diversity of plant species. Oak, Beach, Maple etc. are some common species. Squirrels, rabbits, skunks, birds, black bears, mountain lions etc. C. Evergreen conifers like pine, fur and spruce etc. Wood peckers, hawks, bears, wolves, deer, hares and bats are common animals

					animals
Desert	A. Hot and Dry desert B. Semi arid desert C. Coastal desert D. Cold desert	A. Sahara, Kalahari, Marusthali, Rub-el-Khali B. Marginal areas of hot deserts C. Atacama D. Tundra climatic regions	A. Temp. 20 - 45°C. B. 21 - 38°C. C. 15 - 35°C. D. 2 - 25°C A-D Rainfall is less than 50 mm	Rich in nutrients with little or no organic matter	A-C. Scanty vegetation; few large mammals, insects, reptiles and birds D. Rabbits, rats, antelopes and ground squirrels
Grassland	A. Tropical Savannah B. Temperate Steppe	A. Large areas of Africa, Australia, South America and India B. Parts of Eurasia and North America	A. Warm hot climates, Rainfall 500-1,250 mm B. Hot summers and cold winter. Rainfall 500 - 900 mm	A. Porous with thin layer of humus. B. Thin flocculated soil, rich in bases	A. Grasses; trees and large shrubs absent; giraffes zebras, buffalos, leopards, hyenas, elephants, mice, moles, snakes and worms etc., are common animals B. Grasses; occasional trees such as cottonwoods, oaks and willows; gazelles, zebras, rhinoceros, wild horses, lions, varieties of birds, worms, snakes etc., are common animals

Aquatic	A. Freshwater B. Marine	A. Lakes, streams, rivers and wetlands B. Oceans, coral reefs, lagoons and estuaries	A-B Temperatures vary widely with cooler air temperatures and high humidity	A. Water, swamps and marshes B. Water, tidal swamps and marshes	Algal and other aquatic and marine plant communities with varieties of water dwelling animals
Altitudinal	——	Slopes of high mountain ranges like the Himalayas, the Andes and the Rockies	Temperature and precipitation vary depending upon latitudinal zone	Regolith over slopes	Deciduous to tundra vegetation varying according to altitude

HOME RANGE :

- was coined by the American zoologist Edward O. Wilson
- an area where an animal lives and moves on a daily or periodic basis".
- it is the spatial area that an organism inhabits and utilizes for finding food, shelter, mates, and other resources necessary for survival and reproduction.
- This concept helps to understand the behaviour and ecology of animals in their natural habitats.

Examples of Home Range

- Indian Leopard : around 20 to 30 sq. km.
- Indian elephant : around 200 to 2000 sq. km
- Indian Male Tiger : around 300 sq. km (female 100 sq.km)
- Arctic Tern (Sterna Paradiseaea) :round trip around 70000 sq.km

The Arctic tern is a bird which travels from the Arctic to the Antarctic region and then back again. Hence it sees two summers in a year. On an averge, Arctic terns travel a distance of 70,000 km annually. This is an example of: Migration (See Image Arctic tern bird)

HABITAT

- **physical environment in which an organism lives**
- **refers to : 'addresses' of organisms.**
- **it is structural component of the ecoystem**
- **Earth has four major habitats-(1) Terrestrial (2) Freshwater (3) Estuarine (where rivers meet the ocean) and (4) Oceanic**

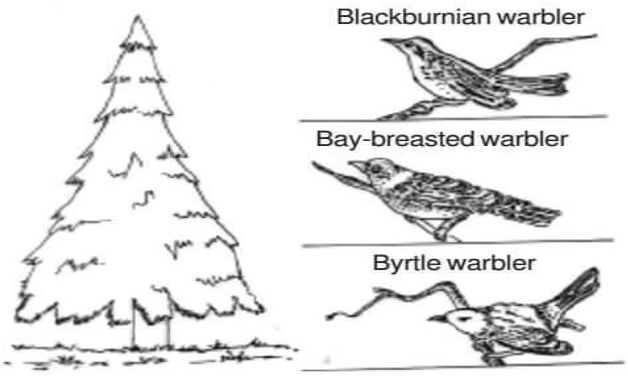
ECOTOPE:

- refers to specific subset within a habitat that has unique ecological characteristics.
- refers to smaller scale , localized area, with specific environmental characteristics

- ecological habitat of specific population within a species that has adapted to particular habitat or niche.
- example of ecotopes within a forest habitat could be stream bank, or a rocky outcrop.

ECOLOGICAL NICHE

- coined by Joseph Grinnell in 1917
- functional characteristics of a species in its habitat
- refers to : Profession of the organisms
- No two species in a habitat can have the same niche.
- entails the following: (a) Habitat or the specific area where an organism inhabits; (b) The role or function of an organism or species in an ecosystem; (c) Inter-relationship of a species with all the biotic and abiotic factors affecting it
- If we have to conserve species in its native habitat, we should have knowledge about the niche requirements of the species.
- Niche plays an important role in the conservation of organisms



The three species of warbler birds search for insects as food in the forest at different levels in the tree and so occupy different niches

Fig Shown About Resource Partitioning

CONCEPT OF RESOURCE PARTITIONING

- Coexisting species' niches differ from each other in one or more ways. Although these birds niches seem identical, they spend their time eating in different parts of spruces and other conifer trees
- Fundamanetal Niche : Whole Tree and Realised Niche : Specific Elevations

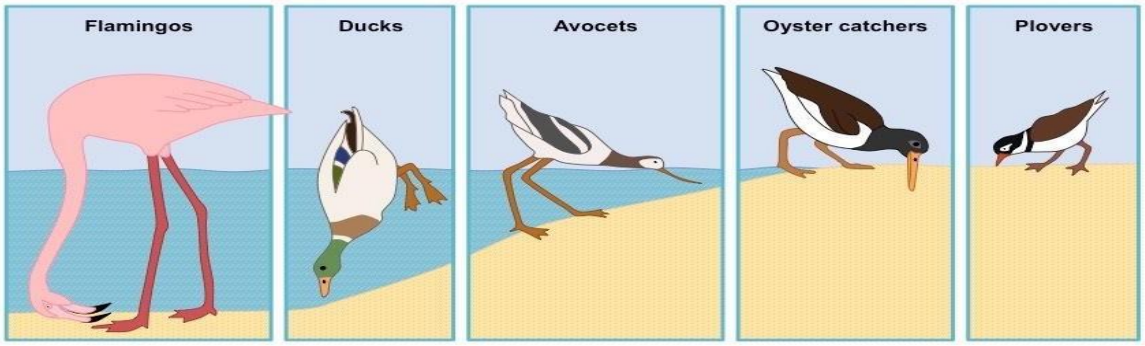
CONCEPT OF NICHE DIFFERENTIATION

- Niche differentiation describes the way by which competing species use the environment differently in order to exist.
- If two species with identical niches compete, two distinct outcomes are possible:

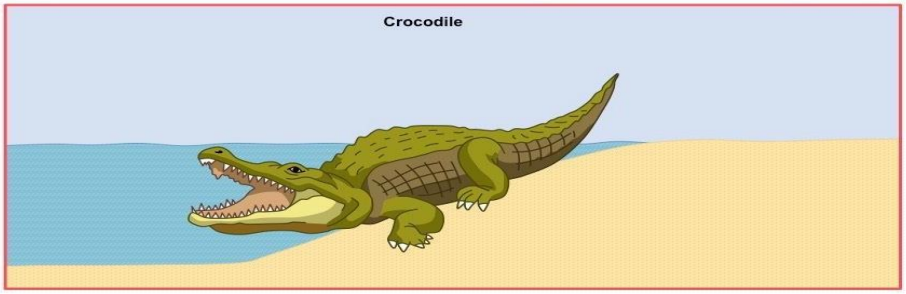
❖ **Competitive exclusion**: One species will use the resources more efficiently and drive the other species to local extinctio **(Concept given by The Russian ecologist G. F. Gause)**

❖ **Resource partitioning:** Two species will alter their use of the niche to avoid direct competition, allowing for co-existence/Both species alter their use of the environment to divide the resources between them **(Resource Partioning coined by Schoener, 1974)**

Resource Partitioning: Species alter their use of the niche to avoid competition, by dividing resources among them



Competitive Exclusion: One species uses the niche more efficiently, precluding survival of other competing species



- competitive exclusion is a Imp principle in ecology that says two species competing for identical resources can't coexist. Eventually, the weak species may face extinction or behavioural shift toward a different ecological niche

- while resource partitioning is the division of limited resources by species to avoid interspecies competition in an ecological niche. Ex One Species is active in Night and another in day time; Bats and Swallows both eat flying insects, but Bat eat night flying insect and swallow day flying insects

- Competitive exclusion can be avoided by resource partitioning.

Que : UPSC: **Gause's principle of competitive exclusion states that -**

(a) Larger organisms exclude smaller ones through competition
(b) More abundant species will exclude the less abundant species through competition
(c) Competition for the same resources excluding species having different food preferences
(d) No two species can occupy the same niche indefinitely for the same limiting resource.

EXP :

Gause's competitive exclusion principle states that two closely related species completing for the same resources can not coexist indefinitely and the competitively inferior species will be eliminated eventually.

CONCEPT OF ECOTYPE :

- A group of organisms, normally a subdivision of a species, that is adapted to a specific environment.
- genetically distinct populations of a plants, animals or other organisms.

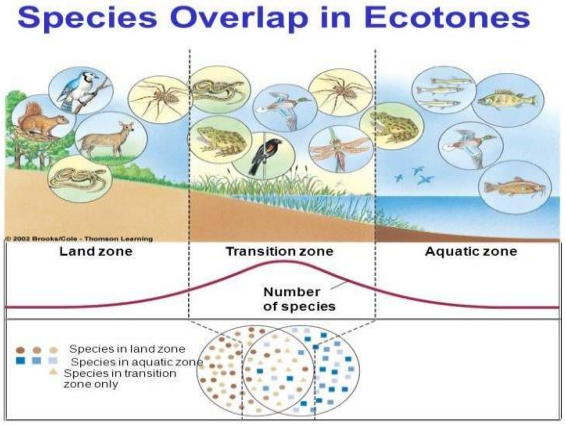
- refers to the genetic and adaptive differences between populations of a species

What are the Similarities Between Ecocline and Ecotone?

- These concepts are related to ecology.
- Both are considered concepts of ecosystems differentiation.
- Both analyze the behaviour of species in varied ecological conditions.

ECOLINE :

- **ecocline is based on the variation of physicochemical factors across ecosystems**
- " Zone of gradual but continuous change from one ecosystem to another when there is no sharp boundary between the two in terms of species composition."
- it occurs across the environmental gradient ie gradual change in abiotic factors
- Like Thermocline (temperature), Halocline (salinity)



Ecozone :

- **ecotone is based on the variation between species existing in different ecosystems.**
- Zone of transition or junction between two ecosystems.
- It has characteristics of both ecosystems
- have far greater productivity than natural ecosystems
- may be narrow (between grassland and forest) or wide (between forest and desert)
- It has conditions intermediate to the adjacent ecosystems.
- Hence it is a zone of tension.
- **Edge Effect :** As a rule ecotones contains more species and denser population that either of the neighboring communities. This is called Edge Effect.
- **Edge Species :** species which occur primarily or most abundantly in this Ecozone/ edge effect.

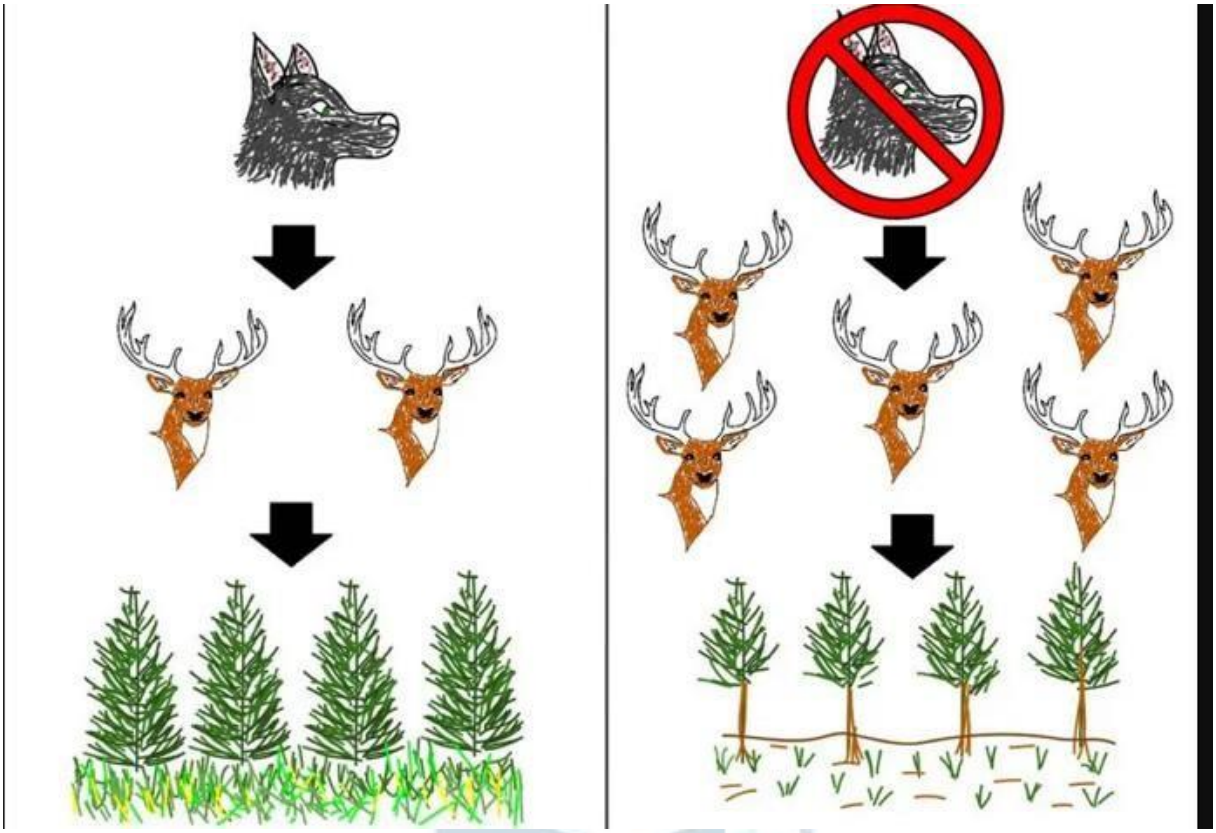
Importance of Ecotone :

- They have a greater variety of organisms.

- good nesting place for animals
- serve as a bridge of gene flow from one population to another because of the larger genetic diversity present.
- They can act as buffer zones offering protection to the bordering ecosystems from possible damage
- Ecotones are also a sensitive indicator of global climate change
- In the terrestrial ecosystems edge effect is especially applicable to **birds**.
- Some species in a well-developed ecotone are completely distinct from those in neighbouring groups

Examples of Ecotone :

- Mangrove forest : represent ecotone between Marine and Terrestrial ecosystems.
- Grasslands (between forest and desert),
- Estuarine (between fresh water and saltwater) and
- Riverbank or marshland (between dry and wet)
- Wetlands



CONCEPT OF TROPHIC CASCADE

- it is Side Effect when a Trophic level (species) of the Ecosystem is reduced or removed .
- It triggers a cascade effect on other species that changes the balance of the entire ecosystem.
- it is ecological concept which focus on ecological imbalance
- Trophic cascades are powerful indirect interactions that can control entire ecosystems. Trophic cascades occur when predators limit the density and/or behavior of their prey and thereby enhance survival of the next lower trophic level.
- The trophic cascades are immensely powerful interactions that can strongly regulate biodiversity and proper ecosystem functioning.
- Trophic cascades not only control species composition, but also production of biomass and interaction of plants and herbivores.
- Trophic cascades by definition must occur across a minimum of three feeding levels.
- Trophic cascade theory has been widely applied to terrestrial, freshwater, and nearshore marine ecosystems,
    -

See Trophic Cascade level 1 , Level 2 and 3 . When top predator is removed the population of deer is able to grow unchecked and this causes over consumption of the primary producers.

Top-Down Cascade:

- occurs in ecosystems where the top consumer or apex predator controls population of the primary consumer (herbivore).
- This, in turn, allows the population of the primary producer (plant species) to thrive
- However, removal of the top predator can result in alteration throughout the food web which can have long lasting effects.
- Eventually, there won't be enough plants (producers) to feed the increased amount of consumer population. When there's limited primary producers, consumers will fight amongst themselves for competition and the ones starving will die off.
- Invasive species can trigger this cascade by removing existing apex predator and take its place

Bottom-up Cascade

- In a bottom-up cascade, the population of primary producers will always control the increase/decrease of the energy in the higher trophic levels.
- The number of primary producers is altered by the amount of nutrients in the habitat. The food web relies on limitation and availability of resources in ecosystem habitat.
- Populations of all trophic levels will suffer with starvation if there isn't a large amount of nutrients available on an initial basis.

Examples

- In Pacific kelp forests, sea otters feed on sea urchins. In areas where sea otters have been hunted to extinction, sea urchins increase in abundance and kelp populations are reduced.
- In the Eel River, in Northern California, fish (steelhead and roach) consume fish larvae and predatory insects. These smaller predators prey on midge larvae, which feed on algae. Removal of the larger fish increases the abundance of algae
- In North American lakes, piscivorous fish can dramatically reduce populations of zooplanktivorous fish; zooplanktivorous fish can dramatically alter freshwater zooplankton communities, and zooplankton grazing can in turn have

large impacts on phytoplankton communities. Removal of piscivorous fish can change lake water from clear to green by allowing phytoplankton to flourish.

- A classic example of a terrestrial trophic cascade is the reintroduction of gray wolves (*Canis lupus*) to Yellowstone National Park, which reduced the number, and changed the behavior, of elk (*Cervus canadensis*). This in turn released several plant species from grazing pressure and subsequently led to the transformation of riparian ecosystems.

What would be the most likely effect of adding wolves to the Yellowstone National Park

a) Increased aquatic plant population

b) Decreased maple population

c) Decreased cottonwood population

d) Increased elk population

Exp : The most likely effect of adding wolves to the park would be increased aquatic plant population in the Yellowstone National Park **food web.**

PRODUCTIVITY :

- Biomass: the net dry weight of organic material
- It is the biomass that feeds the food chain
- The rate of biomass production is called Productivity .
- It is expressed in terms of gm-2 yr -1 or (kcal m-2) yr-1 to compare productivity of different ecosystems.

productivity of an ecosystem on the basis of the following:

- Primary productivity
- Secondary productivity

1 PRIMARY PRODUCTION:

- Amount of biomass or organic matter produced per unit area over a time period by the plants during photosynthesis.
- It refers to the biomass generation by autotrophy: chemoautotrophs or photoautotrophs
- Primary Production expressed in terms of weight (gm -2) or energy (kcal m-2)

Primary productivity can be divided into-

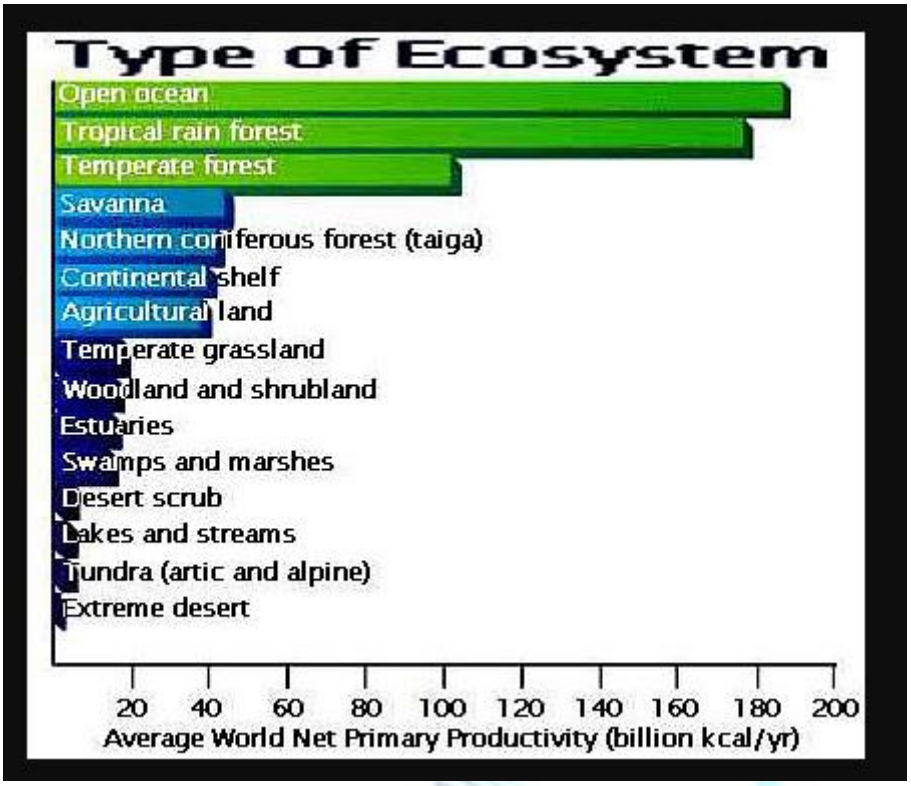
-Gross primary productivity (GPP) –

Net primary productivity (NPP)

Two Types :

- It can be divided into GPP and NPP.
- GNP: Gross Primary Productivity of an ecosystem is the rate of production of organic during photosynthesis.
- Gross NP minus respiration losses (R) is the net primary productivity (NPP)
- GNP-R= NPP
- NNP: refers to available biomass for the consumption to the heterotrophs (herbivorous and decomposers).
- The net primary production tends to be the highest in the tropical rain-forests and tends to decrease in higher latitudes
- equatorial regions have more net biomass productivity, while the deserts and the arid regions have low and very low biomass productivity

2 Secondary productivity is defined as the rate of formation of new organic matter by the consumers .



Biomass and their Net Primary Production:

Biome / Ecosystem	***Area (106 sq km)***	***World Net Primary Production***
Tropical Rainforest	17.0	37.4
Savanna	15.0	13.5
Boreal Forest (Taiga)	12.0	09.6
Temperate Deciduous Forest	07.0	08.4
Cultivated Land	14.0	09.1
Woodland and Shrubland	8.5	06.0
Temperate Grassland	9.0	05.4

DECOMPOSITION: decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition, Dead plant remains such as leaves, bark, flowers and dead remains of animals, including fecal matter, constitute detritus, which is the raw material for decomposition.

What are decomposers? Name any two of them. What do they do in the forest? Answer:
Decomposers are micro-organisms that digest things that are dead or decaying and turn the dead plants and animals into humus.

Examples of decomposers. **The biological term for decomposers is saprotrophs.**

The decomposers are

1. Bacteria
2. Fungi
3. Earthworms

Non Decomposers : Paramecium (consumer) and Euglena(producer)

The important steps in the process of decomposition are

- fragmentation,
- leaching,
- catabolism,
- humification and
- mineralisation

- Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called **fragmentation.**
- By the process of leaching, watersoluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
- Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as **catabolism**
- Humification and mineralisation occur during decomposition in the soil.
- **Humification** leads to accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. Being colloidal in nature it serves as a reservoir of nutrients.

- The humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as **mineralisation**

In a particular climatic condition,

- decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.
- Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes.
- Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build up of organic materials.

- Scavenger and decomposer are two types of organisms that are responsible for the recycling of organic matter.
- scavenger consumes dead plants, animals or carrion to break down the organic materials into small particles.
- **Scavengers can be animals such as birds, crabs, insects, and worms. They can be also called as detritivores. whereas decomposer consumes the small particles produced by the scavengers**

Examples Scavengers :

- Hyenas , Vultures, komodo dragon lizard
- Cockroaches,
- jackal, crocodile,
- wild dogs and crow, termite,,
- dung bettle,
- Polar Beer, red weaver ants, crabs and lobsters

Concept of **Nutrient Cycling or biogeochemical cycle** (abiotic- biotic - abiotic)

- it is vital function of ecology of any region**.**
- It is a movement of nutrients and other elements between living and non-living beings.
- It is the movement of nutrient elements like C, N, H, O, P, and S through the Earth's atmosphere, ocean and sediments
- describe how nutrients move from physical environment to the living organisms and subsequently recycled back to the physical environment .
- These cycles are largely energized by solar insolation.
- The cycle starts by absorbing the chemical elements by the organism and is returned to the air, water, and soil through decomposition.

Types of NC:
1 Based on Replacement Period : Perfect and Imperfect cycle

2. Based on Nature of reservoir : Gaseous and Sedimentary Cycle

- **Perfect Nutrient Cycle**: in which nutrients are replaced as fast as they are utilised. Ex Gaseous Cycles: water cycle, carbon cycle, nitrogen cycle

- **Imperfect Nutrient Cycle**: in which nutrients are lost from the cycle and get locked into sediments so unavailable for immediate cycling .Ex Sedimentary Cycle: Phosphorus, Calcium, magnesium

- **Gaseous Cycle:** Where the reservoir is the atmosphere or the hydrosphere
- **Sedimentary Cycle:** where the reservoir is the Earth Crust .

Important Biogeochemical Cycles

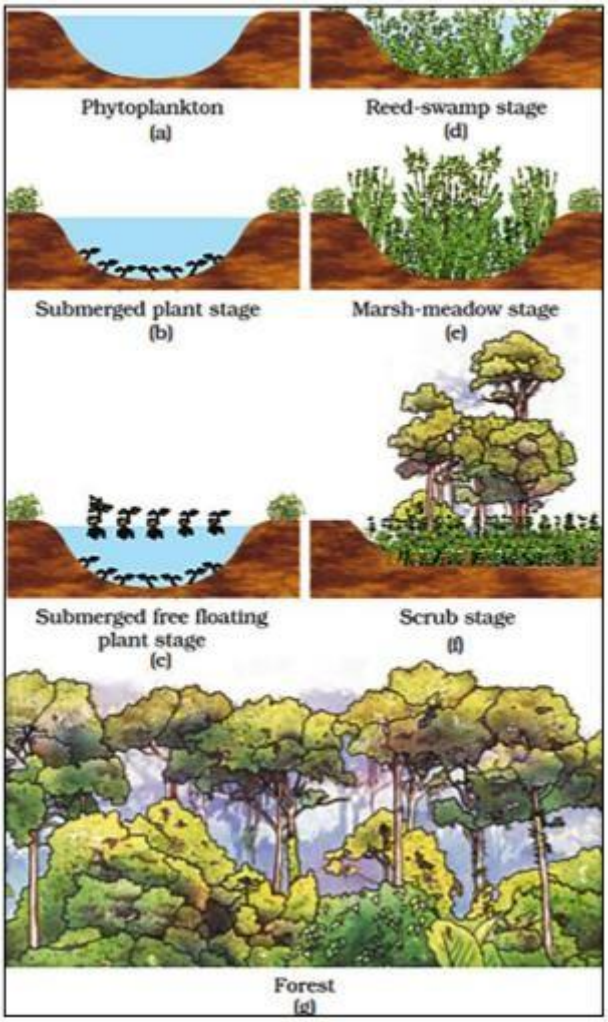
- The Carbon Cycle
- The Nitrogen Cycle
- The Oxygen Cycle
- The Phosphorus Cycle
- The Sulphur Cycle
- The Water Cycle/ Hydrological Cycle
- The Rock Cycle

****

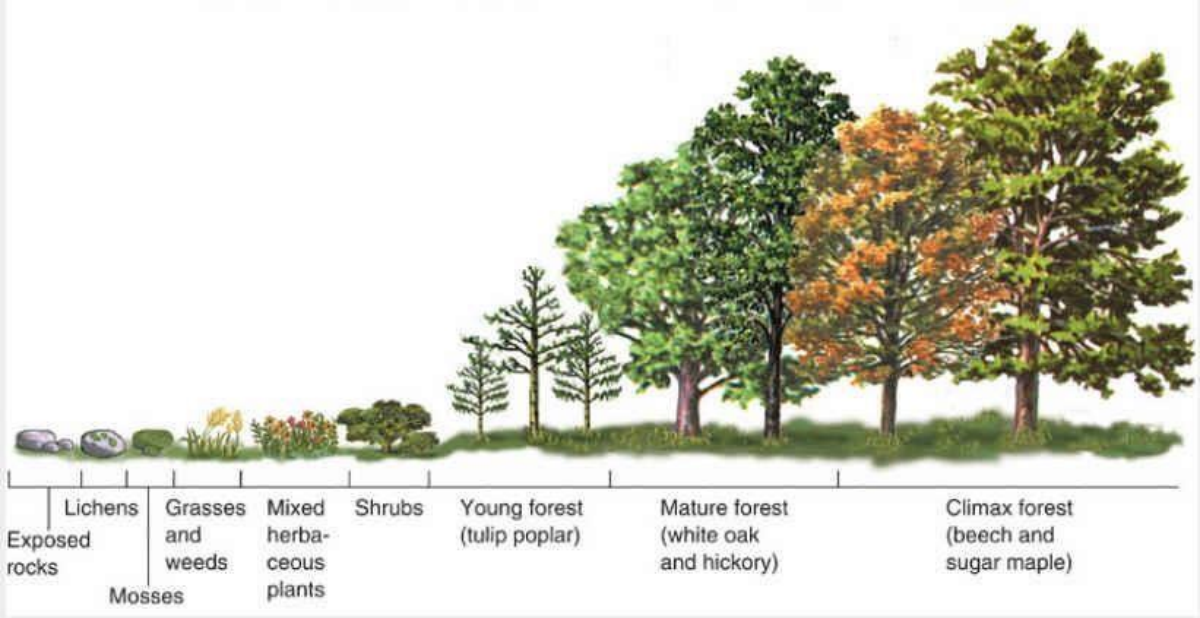
- **ECOLOGICAL SUCCESSION :**

Define :

- refers to process of change in the structure and composition of an ecological community over time.
- it involves gradual replacement of one set of plant species by another , which ultimately leads to development of a stable and mature community (climax community)
- Succession is a universal process , and it occurs due to large scale changes or destruction
- Here one community replacing another until a stable, mature, climax community develops.
- while ecological succession is primarily associated with changes in plant communities it can also have significant impact on animal communities within an ecosystem .



In primary succession in water, the pioneers are the small phytoplankton, which are replaced with time by rooted-submerged plants, rooted-floating angiosperms followed by free-floating plants, then reed-swamp, marsh-meadow, scrub and finally, the trees. The climax again would be a forest. With time, the water body is converted into land.



Note: Crab grass--Horseweed-- Aster(flowering plant)-- Broomsedge(grass)-- Shrubs-- Pine-- Hardwood like Oak--Hickory

TWO TYPES OF ECOLOGICAL SUCCESSION

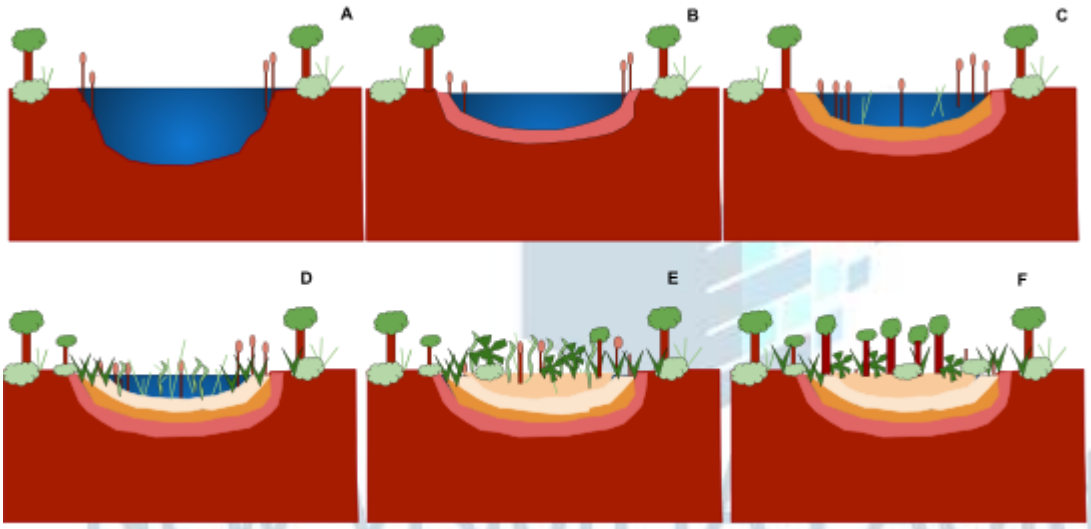
Primary Succession :

- occurs in lifeless areas regions in which the soil is incapable of sustaining life due to factors like lava flows, newly formed sand dunes, or rocks left from a retreating glacier.
- Primary succession takes place over a bare or unoccupied area, such as rocks, outcrop, newly formed deltas and sand dunes, emerging volcano islands and lava flows, as well as glacial moraines (muddy areas exposed by a retreating glacier), where no community has existed previously
- **It is the beginning of a new habitat in a uninfluenced area without any pre- existing communities**.
- first colonised by Pioneer species : microbes, lichens, mosses.
- These Pioneer species help to further break down the mineral-rich rocks into soil where other, less hardy species can grow and eventually replace the pioneer species. In addition, as these early species grow and die, they add to an ever-growing layer of decomposing organic material and contribute to soil formation.
- Autotrophic succession: in which green plants are much greater in quantity.
- Heterotrophic succession: in which heterotrophs are greater quantity.

- Eventually a **climax community stage** is reached where the succession **process is stabilized** until the land is forced to turn into a barren land once again. Some of the **features or the characteristics of the climax community** are:

  - The vegetation of this region is **tolerant** to the environmental conditions.

- : The plants that invade first bare land, where soil is initially absent, are called the pioneer species. The assemblage of pioneer plants is collectively called the pioneer community.
- A pioneer species generally shows high growth rate, but short life span
- This second community gets replaced by a third community. This process continues sequence-wise, in which a community replaced previously by another community.
- Each transitional (temporary) community, that is formed and replaced during succession, is called a stage in succession or a seral community.
- The terminal (final) stage of succession forms the community, which is called as climax community. A climax community is stable, mature, more complex and long lasting.
- The entire sequence of communities in a given area, succeeding each other, during the course of succession is termed sere.
- The stage leading to climax community is called successional stages or seres .
- seral community : stage in succession.



Pond succession or sere A: emergent plant life B: sediment C: Emergent plants grow inwards, sediment accretes D: emergent and terrestrial plants E: sediment fills pond, terrestrial plants take over F: trees grow

Sere(seeuh)
Sere or Seral Community :

- Part of ecological succesion
- related with sequence of development stages of an ecological community
- it starts from pioneer to the climax stage
- A seral community is an intermediate stage found in an ecosystem advancing towards its climax community. In many cases more than one seral stage evolves until climax conditions are attained.
- can be classified into primary or secondary succession

Sere Types

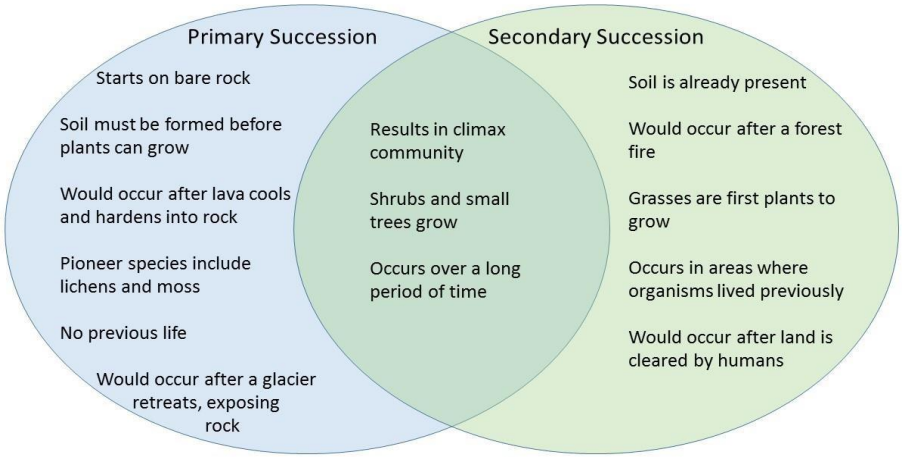
- hydrosere - a community that forms in water;
- lithosere - a community that forms on rocks;

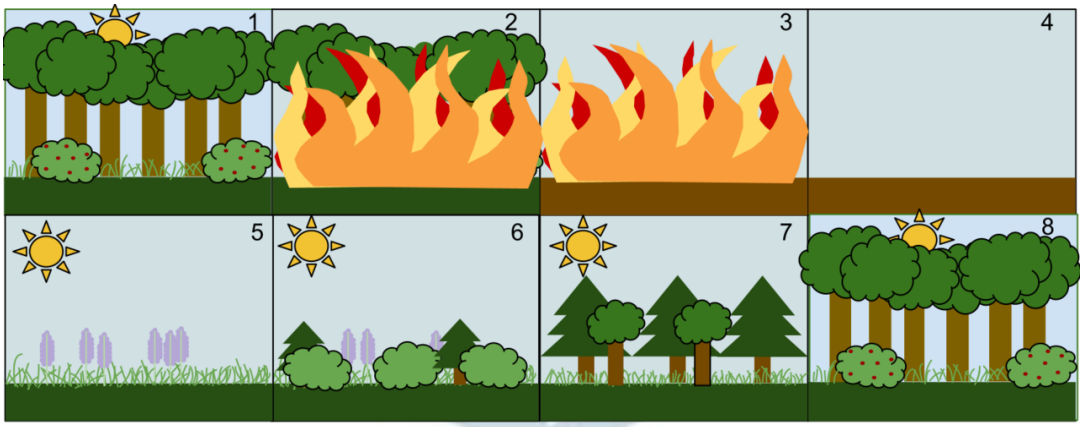
- psammosere - a community that forms on sand;
- xerosere - a community that forms on a dry and arid area;
- halosere - a community that forms on a marshy and saline area.

Secondary Succession :

- occurs in areas where a previous existed community has been removed . It begins in areas where natural biotic communities have been destroyed . Since some soil or sediment is present . secondary succession is faster than Primary one .
- primary succession takes a very long time, as compared to secondary succession, as the soil is to be formed during primary succession, while secondary succession starts in an area where soil is already present.
- Since soil is already present in place**, Secondary succession can take place 5 to 10 times faster than primary succession .**
- Secondary succession is relatively fast, as the soil has the necessary nutrients, as well as a large pool of seeds and other dormant stages of organisms

Venn Diagram Answer Key





An example of secondary succession by stages:

1. A stable deciduous forest community
2. A disturbance, such as a wild fire, destroys the forest
3. The fire burns the forest to the ground
4. The fire leaves behind empty, but not destroyed, soil
5. Grasses and other herbaceous plants grow back first
6. Small bushes and trees begin to colonize the area
7. Fast-growing evergreen trees develop to their fullest, while shade-tolerant trees develop in the understory
8. The short-lived and shade-intolerant evergreen trees die as the larger deciduous trees overtop them. The ecosystem is now back to a similar state to where it began.

EARLY SUCCESSIONAL PLANTS

- typically colonize open habitats which often have abundant sunlight,
- fewer established competitors, and a readily available pool of nutrients and resources.
- In such conditions, it's advantageous for plants to have high rates of photosynthesis and respiration
- have high rates of photosynthesis and respiration
- high rates of resource uptake, and high light compensation points
- Early successional systems tend to have smaller plant biomass, shorter plant longevity,
- faster rates of soil nutrient consumption, a reduced role for decomposer organisms,
- more open and rapid biogeochemical cycling, higher rates of net primary productivity (NPP), lower stability, and lower diversity than late successional system

Ex Pioneer Species

- are adapted for rapid growth,
- they reproduce and die relatively quickly,
- lower litter production and faster decomposition rates that result in less organic matter accumulation on the forest floor,
- high NPP for investing more energy in growth and reproduction.
- Their priority is rapid growth.

ABOUT LATE SUCCESSIONAL PLANTS

- often have opposite characteristics.
- are often found in habitats that have already been colonized by other plant species
- resulting in more shade, limited sunlight, and competition for resources.
- adapt by having lower rates of photosynthesis and respiration to maintain a slower, more efficient use of resources
- This strategy allows them to persist in lower light conditions and compete effectively in a crowded environment.
- are characterized by larger and more stable plant biomass, greater longevity, slower nutrient cycling, and a more prominent role for decomposers.
- They support a wider range of species and exhibit greater ecological stability

Successional Stages of Ecosystem Affect Species Diversity ?

- Yes,
- Species diversity increases with the successional age of an ecosystem
- because older ecosystems offer more niches and resources for a wider variety of species to thrive.
- As ecosystems mature, they become more structurally complex, allowing for resource partitioning and specialization among species
- Stable conditions, evolving species, and ecological interactions further contribute to diversity. Succession provides opportunities for different species at various stages

Consider the following statements :

1. Ecological succession is of paramount importance in order to practice an effective silviculture.
2. Fire can help to reset the ecological succession in wetlands by maintaining an equilibrium state.
3. Pioneer species in ecological succession help in formation of soil by breaking down hard rocks, as well asadding layers of organic material.

How many of the statements given above are correct?

(a) Only one (b) Only two **(c) All three** (d) None

- Statement 2 is correct: Fire can play a role in maintaining an equilibrium state in a wetland ecosystem by burning off vegetation, which can help interrupt the accumulation of peat.
- Fires can help to reset the ecological succession in wetlands by removing excess vegetation and peat accumulation.
- By burning off some of the organic matter, fires can reduce the dominance of certain plant species, maintain open water areas, and promote the growth of other wetland vegetation. This can help maintain a wetland's characteristic hydrology and habitat for specific plant and animal species.

- In wetlands, particularly in peat-forming wetlands like bogs, organic matter accumulates over time, leading to the formation of peat
- This accumulation can result in the gradual transformation of the wetland, making it drier and more terrestrial over time. While this process is natural and part of wetland succession, it may not be desirable in all cases, especially in situations where conservation of the wetland's unique characteristics is a priority

About Silviculture

- is the practice of managing and cultivating forest

- the practice of controlling the growth, composition/structure, as well as quality of forests to meet values and needs, specifically timber production.
- The name comes from the Latin silvi- ('forest') and culture ('growing').

In the context of silviculture , Ecological Succession is of paramount importance for several reasons

- helps in selecting suitable species by understanding which species are likely to succeed each other during succession.
- promoting forest regeneration
- Help in understanding the natural progression of a forest stand .
- play a key role in maintain and conserving biodiversity
- Contributes various ecosystem services like soil fertility , water retention and carbon sequestration.

Que Which of the following statements is incorrect?

(a) Early successional plants tend to have high rates of photosynthesis and resource uptake, whereas late successional plants often have opposite characteristics.

(b) Species diversity tends to increase with the successional age of an ecosystem.

(c) Early successional systems tend to have smaller plant biomass and higher rates of net primary productivity than late successional systems.

(d) Restoration ecology is a proven method to speed successional processes to reach a desired climax community.

AnsD

Concept of Restoration ecology

- is *the scientific study of repairing disturbed ecosystems through human intervention*
- though not a proven method, can be viewed as an attempt to speed successional processes to reach a desired climax community.

Que 1 : Lichens, which are capable of initiating ecological succession even on a bare rock, are actually a symbiotic association of

a) algae and bacteria
b) **algae and fungi**
c) bacteria and fungi
d) fungi and mosses

Que 2 In the grasslands, trees do not replace the grasses as a part of an ecological succession because of

a) insects and fungi
b) limited sunlight and paucity of nutrients
c) water limits and fire
d) None of the above

Answer: c)Explanation:

- Grasses have this one good trick to monopolize a place. In dry season the grasses dry up and cause fires which destroy other plant species and their seeds.
- Also grasslands develop in regions with scanty rainfall where plant growth cannot be achieved.
- Though forests form the climax community in most of the ecosystems**, but in grassland ecosystem** [In the grasslands, trees do not replace the grasses as a part of an ecological succession] **grasses form the climax community**. Thanks to fire and lack of water.

Autogenic succession :

- When succession is brought about by living inhabitants of that community itself, the process is called .
- so it is driven by biotic components of ecosystem

Allogenic succession:

- change brought by outside forces
- driven by abiotic components of ecosystem. like forest fire or flood

STAGES OF ECOLOGICAL SUCCESION

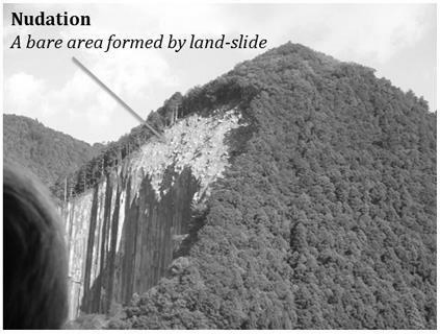
Frederic Clements in 1916 for the first time proposed the sequential phases of succession.

Henry Gleason Stages of Ecological Succesion

1. **Nudation**: Bare area without any life. it is first stage of Successsion.

Causes of Nudation:

- Topographic : Soil or topgraphy related causes; soil erosion, sand deposit, landslide, volcanic activity result in formation of bare area
- Climatic : Destruction of community due to glaciers, dry period and storm
- Biotic: it include forest destruction , agriculture and diseases epidemic



2. **Invasion Stage:**

- is the successful establishment of the species in the bare area., it is second step of ES.

- Process of invasion 3 steps: 1. Migration 2. Ecesis 3. Aggregation
- Migration or Dispersal : like seeds ,spores reach the bare area due to migration. this process can be achieved by Air and Water medium.
- Ecesis: is the process of successful establishment of a species in the bare area..
- Aggregation: After Ecesis, the individuals of a species increase their number and they stay close to each other.

3. **Competition and co action**:
   - result in increase of the number of species within a limited space., result in competition, which may be Interspecific(individuals between species; Tiger -Bison) and Intraspecific (individuals within a species; deer-deer)

4. **Reaction**:
   - Most important stage in ES.
   - it is modification of environment through influence of living organism present on it. Reaction cause change in soil, water, tempt, rainfall, .
   - Due to these modification the present community is unsuitable for existing env conditions..Such communities quickly replaced by other communities.

5. **Stabilization/ Climax:** last stage, The final community called climax community, ex: Forest, Grassland, Coral reef. **This community can maintain its equilibrium**

Concept of Biotic Interaction :

The biotic interaction is an influence that two species living in the same community have on each other

Two Types:

Positive Interaction(where population help each other, the interaction being either one way or reciprocal) **: Mutualism, Commensalism, Colonisation, Proto-cooperation**

Positive Interactions:

Interaction	**Effect on species A**	**Effect on species B**	**Nature of Interaction**
A. Positive			
Scavenging	(+)	(Nil)	Beneficial to scavenger, who feeds on flesh or dead organisms
Commensalism	(+)	(Nil)	One is beneficial, other is unaffected
Proto- cooperation	(+)	(+)	Beneficial to both, but not obligatory
Mutalism or symbiosis	(+)	(+)	Beneficial to both, obligatory

Colonisation: Colonial life exihibited by animals. demostrate shade of mutualism and commensalism. it result in collective effort in gathering food and greater chance of fertilisation during reproductive phase. Ex: Bees

Proto- cooperation: Non obligatory/ not essential mutualism, in this mutualism contact between 2 species for short period . However, the interaction is not obligatory for their survival as both can live without this interaction. Ex: Sea anemone -**Hermit Crab**

Fig. 11.9. Crab and sea anemone mutualism.

Example 2: **Crocodile bird (Pluvianus aegyptius**) enters the mouth of the crocodile and feed on parasitic leeches. By this the bird gets food and the crocodile gets rid of blood sucking parasites.

Bird inside the crocodile mouth

Ex 3:Red billed ox-pecker (Buphagus erythrorhynchus) and yellow billed ox-pecker (Buphagus africanus) **feeds on the ectoparasites, lice, ticks and mites** etc which will be **on the skin of** rhinoceros (Diceros dicornes). So the bird gets food and the richnoceros is relieved of its sanguivorous ectoparasites.

Ox-pecker on the back of hippopotamus

Beautifully coloured **antennae of the shrimp** on the coral reefs attract the fishes. When the fishes approach the shrimp it feeds on the parasites on the fishes body. Fishes get a cleaning service done and shrimp obtains its food.

Commensalism: It is a **positive interspecific** interaction in which a **smaller member called 'commensal'**, is benefitted, while the **larger member called 'host'**, is **neither benefitted nor harmed**.

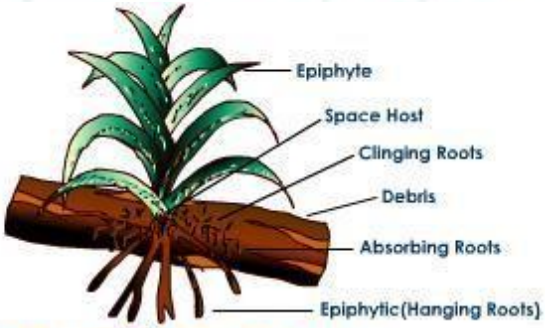
Commensalism represents a beneficial relation

Que: An orchid living on a tree exhibits

1. Predator
2. Mutualism
3. Commensalism
4. Parasitism

The correct answer is – 3. Commensalism.

For e.g.,a) **Epiphytes are small green plants** found growing on other plants for space only. They absorb **water and minerals from the atmosphere by their hygroscopic roots and** prepare their own food. The plants **are not harmed in any way**.

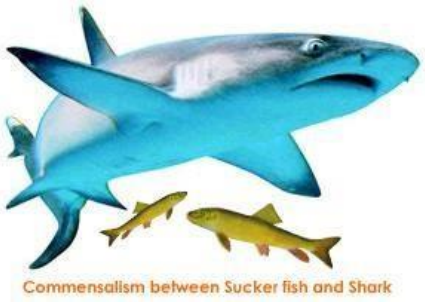


Vanda showing thicker Epiphytic roots, and narrow clinging and absorbing roots.

An Epiphyte Growing on another Plant as Space Parasite

Examples: Orchids, lianas and Vanda hanging mosses are common epiphytes found on the tree of tropical rain forests1) Several species of Barnacles (molluscs) grow on the hard shell of Limulus polyphemus (horse shoe crab).

2) Sucker fish (echeneis) gets attached to the under surface of sharks by its sucker. This provides easy transport for new feeding grounds and also food pieces falling from the sharks prey, to Echeneis.



Commensalism between Sucker fish and Shark

3) Entamoeba coli (protozoan) and *Escherichia coli*)lives as a commensal in the intestine of man..

Mutualism: both species are beneficial

- bees and Flowers
- Coral and Zooxanthellae

Negative Interaction: where members of one population may eat members of other population, compete for food and space, excrete harmful wastes or otherwise interfere with other populations . These Include: **Amensalism**(Species 1 : Harmed , Species 2 : Unaffected), **Competition, Predation, Parasitism, Antibiosis(** one species produce a poisonous substance or change in env conditions inimical to another species, none derives benefit. .

Negative			
Interaction	**Effect on species A**	**Effect on species B**	**Nature of Interaction**
Predation	(+)	(-)	Beneficial to predator (generally layer), which kills and eats up the prey; prey is harmed
Parasitism	(+)	(-)	Parasite (usually smaller) is benefited, host is harmed
Amensalism	(-)	(Nil)	One is inhabited; other is unaffected, large tree retard small plant growth
Competition			
(a) Direct	(-)	(-)	Mutual inhibition
(b) Indirect	(-)	(-)	Inhibition due to short supply of resources
Mimicry	(+)	(-) or (Nil)	Mimic is benefited; predator unaffected but prey is caught easily

Predation:

It is a negative, direct food related interspecific interaction between two species of animals in which larger species called predator attacks, kills and feeds on the smaller species called prey.

Ex: There are certain carnivorous plants also referred, as insectivorous plants that act as predators in nature. Plant like Nepenthes (pitcher plant), Drosera (sundew), Dionoeae (Venus fly trap) etc. feed on insects to fulfil their nitrogen requirement.

Amensalism :

- **type of negative biotic interaction**
- **Here, One of the Species is harmed while other benefits or remains unaffected.**
- **One Harmed - Other Unaffected**

Three Types :

- **Antibiosis : association between two organisms in which one is affected .** interaction between Penicillium and bacteria. The mould Penicillium creates the secretion known as penicillin, which is extremely toxic to bacteria.
- **Competition : A large Tree shades a small plant and retarding the growth of small plant . The small plant has no effect on the large tree.**
- **Allelopathy : organism release biochemical compounds into the environment that inhibits the growth of other organism**

Mimicry:

- is a phenomenon in which a living organism modifies its form, appearance, structure or behaviour and looks like another living organism or some inanimate (non- living) object so as to defend from its predators, or to increase the chances of capturing the prey.
- Mimicry increases the survival value of the organism. Examples: a) Carausius morasus (stick insect) the body of the insect resembles thin, dry braches.

Stick insect

Phyllium frondosum (leaf insect) body is flat and green resembling a leaf.

1. Legs 2. Leaf like wing 3. Extended body

eligiosa) is not noticed in the green foliage by the prey (small insects).

Praying mantis

a yellow spider (predator) on a marigold flower is invisible to insects (prey).

Yellow spider

Topic: Neutralism :

Neutral			
Interaction	**Effect on species A**	**Effect on species B**	**Nature of Interaction**
Neutralism	(Nil)	(Nil)	None of the species are benefitted or harmed

Lack of interaction between individuals of different species is called 'neutralism'. Examples: Rabbits, deer, frogs, live together in a grassland with no interaction between them. In

nature, other than those mentioned, there are several other interactions happening such as plants and animals, in general, are interdependent. Plants provide food, shelter and oxygen to animals and in turn animals provide carbon dioxide to plants, disperse their seeds and pollen etc.

Eagle -Grass interaction: Neutral; bcz Rabbits eats grass and eagle eats rabbit, an eagle indirectly benefits the grass by helping to control rabbit population .....and the grass indirectly benefits the eagle by fattening up its prey.

Plants on the basis of Soil

1. Plants of acidic soil (Oxylophytes)
2. Plants of saline soil (Halophytes)
3. Plants growing on the sand (Psamophytes)
4. Plants growing on the surface of rocks (Lithophytes)
5. Plants growing within the crevices of rocks (Chasmophytes).

Plants on the basis of water requirement

1) Plants growing in arid/semi arid environments (Xerophytes)
2) Plants growing in waterlogged or marshy areas, or in water either partly or wholly submerged (Hydrophytes)
3) Plants growing in constantly wet or flooded environments (Hygrophytes)
4) Plants growing in extreme cold or high altitude environments (Cryophytes)
5) Plants growing in disturbed or urban environments (Urbanophytes)
6) Plants growing in shade or low light conditions (Sciophytes)
7) Mesophytes: Plants growing in an environment which is neither very dry nor very wet.

Plants growing under direct sunlight are known as

a) Heliophytes
b) Sciophytes
c) Psamophytes
d) Dicots

The correct answer is – 1. Heliophytes.

Plants growing under shade are known as

a) Psamophytes
b) Sciophytes
c) Heliophytes
d) Monocots

The correct answer is – 2. Sciophytes

CHAPTER 2

BLUE FOREST : MANGROVES : IMPORTANCE AND ISSUES

MANGROVES CALLED AS

- **Swampy Forest**
- **Soldiers of Our Coast,**
- **Guardians of the Coasts,**
- **Littoral Plants**
- **Silent Green Sentinels of the Coasts**
- **Salt tolerant Trees (Halophytes)**
- **Found in Inter tidal Zones**
- **Found in Tropical and Subtropical and Warm Temperate Oceans**

BLUE CARBON / BLUE FOREST

- Blue carbon is the **carbon stored in coastal and marine ecosystems**
- The sequestration of carbon into ocean sediments by marine ecosystems for long-**term storage** is termed 'blue carbon'

- Under water ecosystems / Coastal and Marine ecosystems called Blue Forest
- Examples of Blue Forest : Mangroves, Salt Marshes, Sea Grass Meadows, Kelp Forest, Coral Reefs .
- Mangroves helps us fight the climate crisis.
- are coastal guardians and cost-effective nature-based solutions for climate mitigation and adaptation.
- They take 5 times more carbon out of atmosphere than forest on land.

Key Role :

- Provide Critical Ecosystem Services for Biodiversity and For Humanity
- Protect Biodiversity Carbon Sequestration
- Prevent Coastal Erosion
- Protect coastal lands from tsunami, cyclones
- Climate change adaptation
- Shoreline / Coastal Protection
- Habitat for fisheries and Marine Line
- Supplies wood, firewood, medicinal plant and edible plant to local people
- Food Security for Coastal Communities
- Functions: Like Salt Filtration Systems, absorbing nutrients and pollutants
- Complex Root Systems
- Mangrove vegetation facilitates **more water loss**. Leaves are thick and contain salt secreting glands
- enhance natural recycling of nutrients and provide breeding ground for fishes and supports biodiversity

Mangroves Key words :

- are part of Forest Biome
- Provide important habitat for Animals and fish areas
- Play a important role in Trophic level Interaction at Both Ecosystem ie Food chain, Food Web and Ecological Pyramid.
- Provide a good role in Niche differentiation.
- Provide important mechanism for Biotic Interaction in mangrove ecosystem.
- Part of Ecotone and provide edge effect and Edge species like Bengal tiger.
- Play important role in Biogeochemical cycle . basically Carbon Cycle, Oxygen cycle, Methane Cycle and Water Cycle.

KEY CHARACTERISTICS :

- The latitudinal distribution of mangroves is limited by key climate variables such as aridity and frequency of extreme cold weather events

- In the tropics Mangroves are not found everywhere. They are found only in the tropical and subtropical regions, mainly between latitudes 25 °N and 25 °S.
- Trees can grow to a height of 25 metres.
- They require high solar radiation and have ability to absorb fresh water from saline brackish water
- They clean out air, Store carbon in their roots, leaving branches, release oxygen and little methane Gas
- **Root Mechanism ::** Mangrove plants have (additional) special roots such as prop roots, pneumatophores
- Leaves are thick, exhibit viviparity mode of reproduction ie. Seeds germinate in tree itself. it is adaptive mechanism to overcome problem of germination in Saline water.
- Mangrove trees are hermaphrodites. This means that they have both male and female flowers on the same tree, and pollinate and reproduce on their own.
- Mangroves belong predominantly to the family of plants known as Rhizophoraceae

WORLD DISTRIBUTION REGION:

- *Mangroves are found in 123 nations and territories*
- *Mangrove soils are highly effective carbon sinks*
- About 75% Mangroves found in just 15 countries:
- Asia 40%,Africa 19% South America 16% North Amercia and central America 15%
- Countries in decreasing order of Mangroves :
- Indonesia> Australia> Brazil, Nigeria, Mexico, Malayasia**.**
-

There are **two main regions of mangrove vegetation in the World**

A. —the Eastern hemisphere (eastern Africa, Asia, including India, and Australasia) and
B.-------Western hemisphere (Americas and western Africa). The Eastern hemisphere is considered to be the original home of mangroves, and, thus, the mangroves here are

called the old world mangroves. The Western hemisphere mangroves are called new world mangroves.

Mangroves Colour :

- the most common mangrove species in the world. Red mangroves (genus Rhizophora) are well adapted to salty water and salty swamps. Black mangrove, white mangrove, and buttonwood grow around red mangrove clusters.
- Mangroves and Coral reef have a symbiotic relationship
- Mangroves grows, and Mangroves in turn trap sediment washed from land , Provide relief to corals reef.
- Australian aborigines eat the fruit of mangrove trees. But first, they remove harmful tannins from the fruits by soaking them in mangrove mud for three to seven days.

MANGROVES ROOTS :

- it produces pneumatophores{(blind roots) from the mud} or air roots u to overcome respiration problem in the anaerobic soil conditions.
- Apple of the eye Mangrove apple (Sonneratia alba) is also a common type of mangrove plant.
- Mangrove apples are cream-coloured with a grey or dark brown bark. They have cone-shaped projections called pneumatophores, which help in breathing.
- Leaves are rounded with a leathery texture.

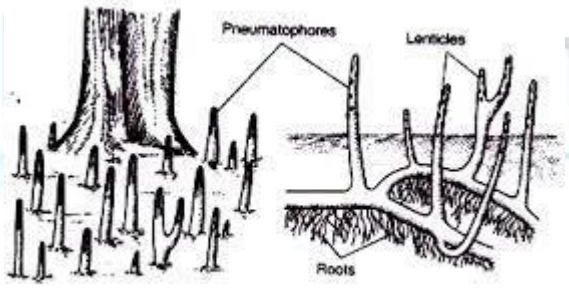


Fig. 10.1. Pneumatophores of mangrove plant.

It has specialised roots called pneumatophores which emerge above ground and help in gaseous exchange i.e. respiration. During the rainy season when the entire forest is waterlogged, the spikes rising from the grou"nd has their peak in the air and helps in the respiration process. So They are called " Breathing Roots"

Avicennia, Laguncularia, and Sonneratia, growing from these cable roots are pneumatophores, vertical roots that spring up from the ground. Some are thin and pencil-like while others are in the shape of a cone. Pneumatophores are specialized roots that act like snorkels when partially flooded and have pores called lenticels that cover their surface where oxygen exchange occurs.

Note: Mangrove plants survive in very little fresh water. They have thick, waxy leaves to prevent loss of water by evaporation. Mangroves grow in waterlogged soil with little oxygen. So, their roots absorb gases like oxygen and nitrogen directly from the atmosphere.

Adventitious roots which emerged from main trunk of a tree above ground level are called Stilt roots.

Ex: Rhizophora - Prop root/ stilt root down into water

Ex Avicennia: send vertical pneumatophores/ blind roots .--Flat root system

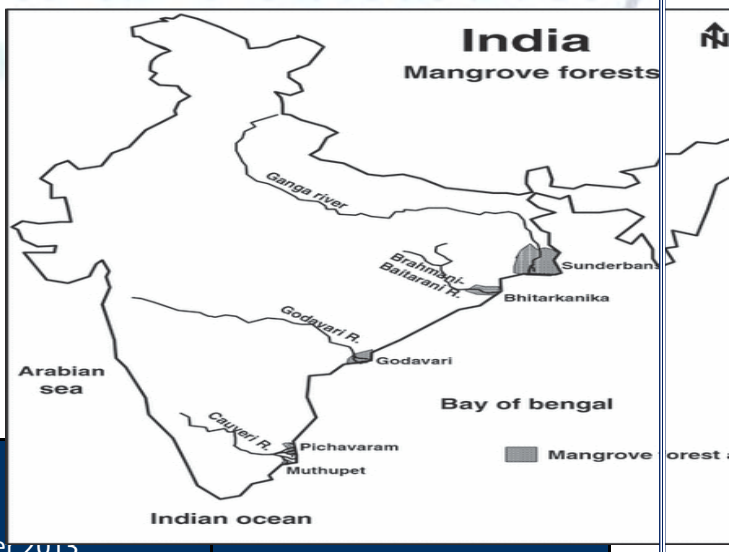
Myristica swamps

- are a type of freshwater swamp forest
- Myristica swamps are called live fossils, a biodiversity hotspot dominated by evergreen trees belonging to *Myristicaceae family,* one of the oldest flowering plants on earth.

- *Myristica* swamps have adapted to inundation by way of stilt roots and knee roots.
- Geographical distribution: In India, these unique habitats occur in the Western Ghats and a smaller distribution exists in the Andaman and Nicobar Islands.
-
- These are found in three localities in India. Uttara Kannada district of Karnataka State and in the southern parts of Kerala. Recently it is found in village Bambarde, in Maharashtra's Sindhudurga district.

MANGROVES IN INDIA:

- India is home to more than 7 per cent of the world's mangrove forests.
- Mangroves make up for 8 per cent of the Indian coastline.
- Eighty per cent of these forests are found on the eastern coast of India.
- In India, mangroves occur on the West Coast, on the East Coast and on Andaman and Nicobar Islands.
- According to the Indian State Forest Report 2021, Mangrove cover in India is 4992 sq. Km which is 0.15% of the country's total geographical area.
- Largest Mangrove Forest: Sundarbans in West Bengal are the largest mangrove forest regions in the world. It is listed as a UNESCO World Heritage Site.
- It is followed by Gujarat and Andaman, and Nicobar Island
- In India, there are 34 species of true mangroves. Bhitarkanika (Orissa) has 31 species, the Sundarbans have 27, and the Andaman & Nicobar islands have 24 species.



Rank	Mangrove Cover 2015	
1	West Bengal	2,097
2	Gujarat	1,103

3	Andaman And Nicobar Islands	604
4	Andhra Pradesh	352
5	Odisha	213
6	Maharashtra	186
7	Tamil Nadu	39
8	Goa	22
9	Kerala	6
10	Karnataka	3

-
- **West Bengal** has 42.45% of India's mangrove cover, followed by **Gujarat** 23.66% and **A&N Islands** 12.39%.
-
-
-
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THREATS TO MANGROVES:

- If they destroyed, degraded or damage, their carbon sink capacity is lost or adversely affected, and the carbon stored is released, resulting in emissions of carbon dioxide (CO_2) that contribute to climate change.
- They are destroyed for conversion of area for agricultural purpose, fuel, fodder and, salinization, mining, oil spills, aqua cultural (shrimp farming), use of chemical pesticides & fertilizers, industrial purposes.
- Urbanization :Development of coastal cities , increasing encroachment
- increasing in aquaculture activities
- Dumping of waste and increasing Pollution and contamination
- Changes in local water conditions caused by upstream dams, irrigation and pollution have led to the loss of many mangroves.
- Climate change and Rising sea levels are a longer-term challenge.

CONSERVATION MEASURES

Awareness Day ?

- The **International Day for the Conservation of the Mangrove Ecosystem** is celebrated every year on **26 July** by UN Educational, Scientific and Cultural Organization (UNESCO) since, 2015.
- The day commemorates the Greenpeace activist Hayhow Daniel Nonoto.
- On July 26, 1998, the activist died of a heart attack while protesting for re- establishment of mangrove wetlands in Muisne, Ecuador.

INTERNATIONAL MEASURES

1. Sri Lanka has become the first nation in the world to comprehensively protect all its mangrove forests
2. One Blue Forests initative, *Mikoko Pamoja* (Mangroves Together) in Gazi Bay, Kenya, has become the world's first conservation project to link mangrove forests to the global carbon market

- Blue Forest project sites globally – from Abu Dhabi to Ecuador, Indonesia, Madagascar and Mozambique.

1. The International Blue Carbon Initiative:

- focused on mitigating climate change through the **conservation and restoration of coastal and marine ecosystems.**

- focuses on mangroves, salt marshes and seagrasses, which are found on every continent except Antarctica
- It is coordinated by Conservation International (CI), IUCN, and the Intergovernmental Oceanographic Commission-UNESCO (IOC-UNESCO).

2 Global Mangrove Alliance :

- Co founded by Conservation International
- Coordinated in partnership with the International Union for Conservation of Nature, The Nature Conservancy, World Wildlife Fund and Wetlands International,
- the GMA has set the ambitious goal of expanding the global mangrove habitat

3. Mangroves for the Future Initiative:

- initiative, led by IUCN and UNDP, encourages the rehabilitation of mangroves by engaging with local stakeholders and creating a platform for change

- will first focus in South Asia, South East Asia, and the Western Indian Ocean, including India. It initially concentrated on India, Indonesia, Maldives, Seychelles, Sri Lanka, and Thailand, which were the nations most severely impacted by the tsunami.
- Bangladesh, Cambodia, Myanmar, Pakistan, and Vietnam have all lately been added to the list.

What is the Mangrove Alliance for Climate (MAC)?

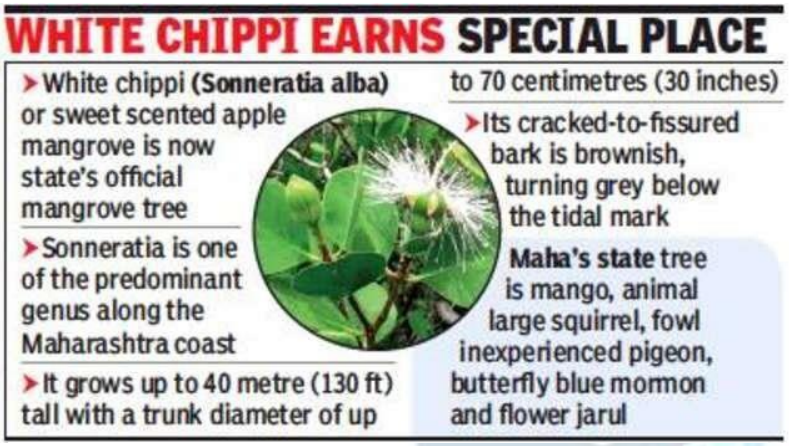
- During the **COP27 climate summit** in Sharm El Sheikh, Egypt, **the UAE and Indonesia announced the "Mangrove Alliance for Climate."**
- It was later joined by India, Sri Lanka, Australia, Japan, and Spain.
- It seeks to **educate and spread awareness worldwide on the role of mangroves in curbing** global warming and its potential as a solution for climate change
- This is an intergovernmental alliance with no binding targets.
- It means they will work on a voluntary basis. Here, the parties are given flexibility to decide their own targets and commitments to plant trees.

- India has signed the Mangrove Alliance for Climate in COP 27 in egypt held in November 2022

News : Maharashtra notifies 1,500 hectare of mangroves as protected forests.

Sonneratia alba or mangrove apple/ White chippi

News: Maharashtra is set to become the first state in the country to declare Sonneratia alba as a state mangrove tree species. Maharashtra first state to get its official mangrove tree



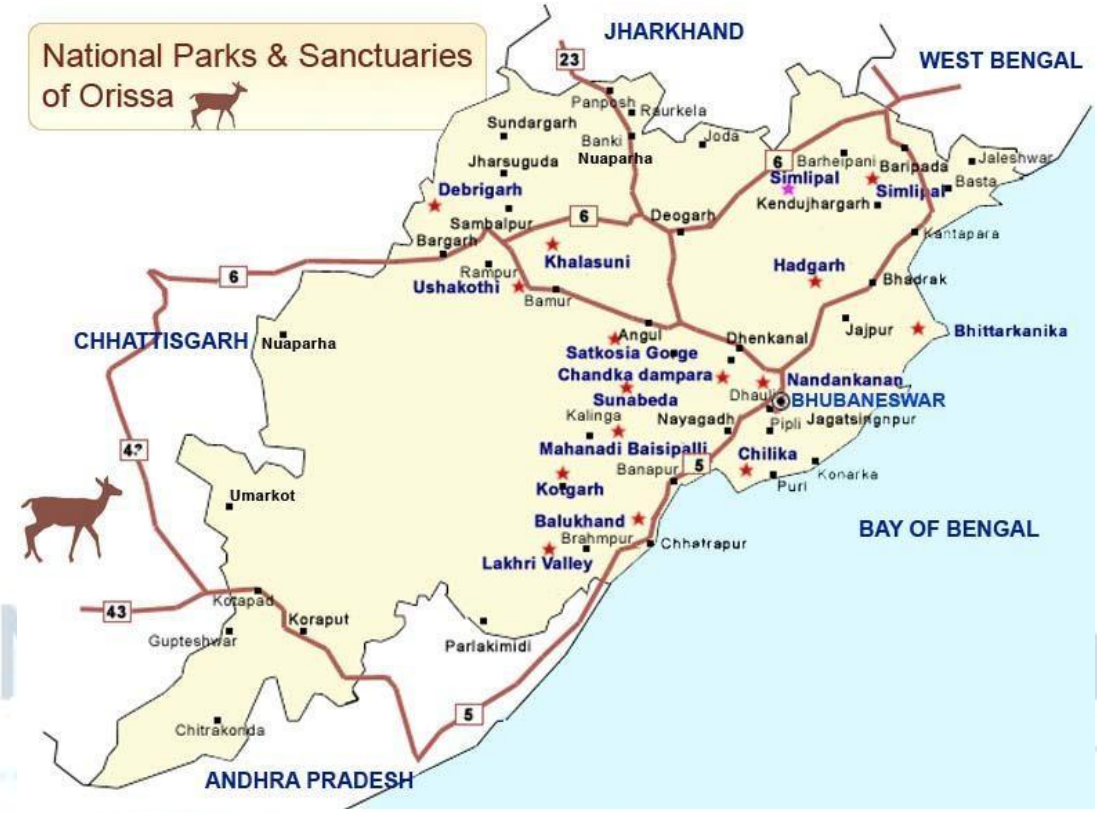
Que: Some times in news, the Forest of ' Heritiera Fomes' related with which of the following areas of India.

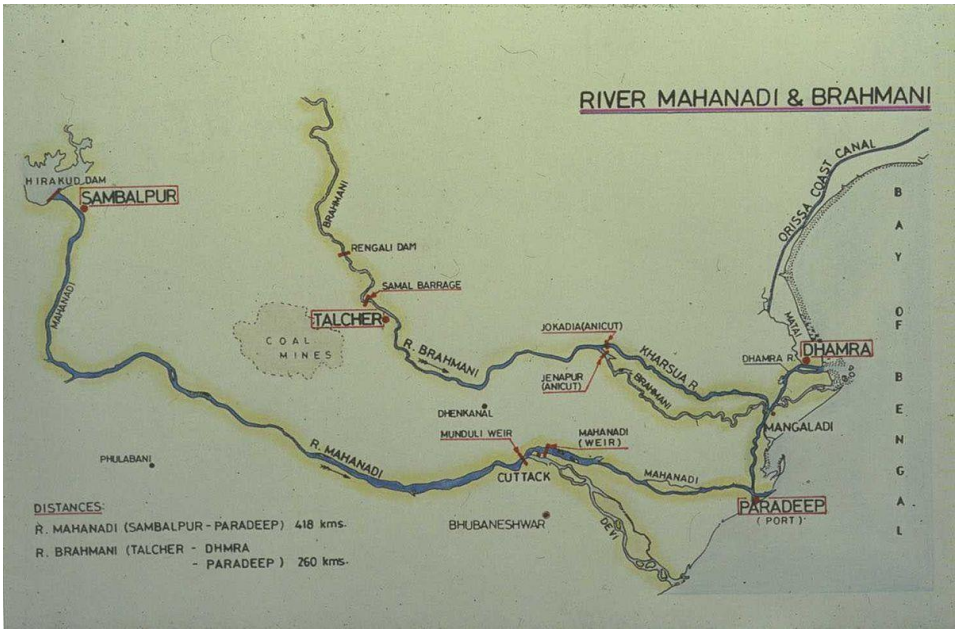
a. Rann of Kutch
b. Sunderbans
c. Western Ghats landscape area
d. Khasi and Jaintia Hills area Complex

What are Green Recovery Measures ?

- German agency to conserve mangroves in Odisha's Bhitarkanika:Bhitarkanika National Park, India's second-largest mangrove forest.
- Green recovery measures offer employment opportunities, increase fish production, freshwater supply and food security to communities around the project sites in short term,)
- In the long-term, it will enhance storm protection, reduce soil erosion, improve biodiversity and increase productivity, thereby, leading to improved food security and income,"


BHITARKANIKA NATIONAL PARK


National Parks & Sanctuaries of Orissa
JHARKHAND
WEST BENGAL
CHHATTISGARH
ANDHRA PRADESH
BAY OF BENGAL
BHUBANESWAR
Panposh
Raurkela
Sundargarh
Banki
Joda
Jharsuguda
Nuaparha
Barhelpani
Baripada
Jaleshwar
Basta
Simlipal
Kendujhargarh
Debrigarh
Sambalpur
Deogarh
Bargarh
Kantapara
Khalasuni
Hadgarh
Rampur
Ushakothi
Bamur
Bhadrak
Angul
Dhenkanal
Jajpur
Bhittarkanika
Satkosia Gorge
Chandka dampara
Nandankanan
Sunabeda
Dhauli
Kalinga
Nayagadh
Pipli
Jagatsinghpur
Mahanadi Baisipalli
Chilika
Banapur
Puri
Konarka
Kotgarh
Umarkot
Balukhand
Brahmpur
Chhatrapur
Lakhri Valley
Koraput
Gupteshwar
Parlakimidi
Chitrakonda

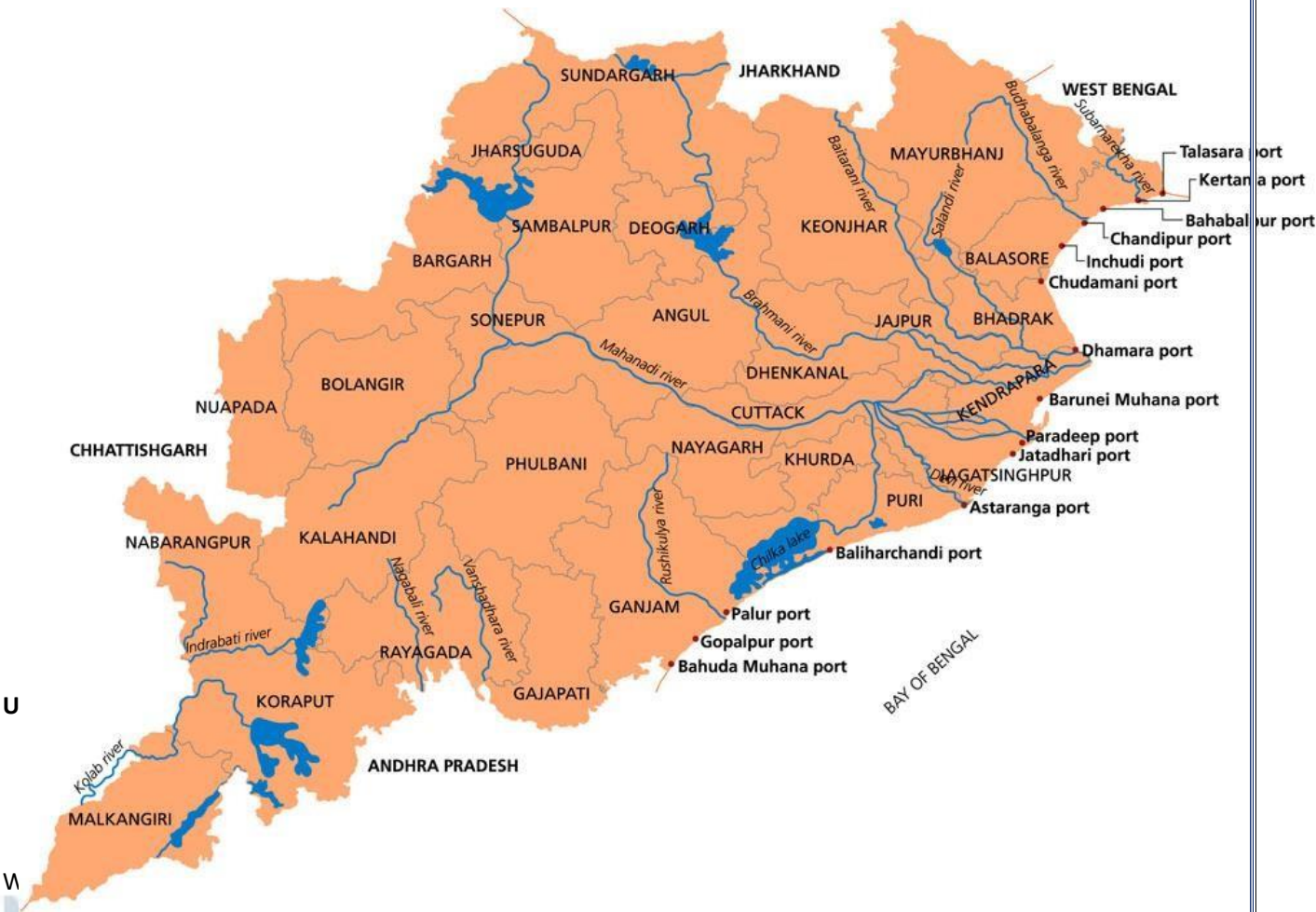


QUES 1 . Two important rivers — one with its source in Jharkhand (and known by a different name in Odisha), and another, with its source in Odisha — merge at a place only a short distance from the coast of Bay of Bengal before flowing into the sea. This is an important site of wildlife and biodiversity and a protected area.

Which one of the following could be this?

(a) Bhitarkanika
(b) Chandipur-on-sea
(c) Gopalpur-on-sea
(d) Simlipal

EXPECTED : Coastal plain of Odhisa called Hexadeltaic region" or the "Gift of Six Rivers. Hexadeltaic region" or the "Gift of Six Rivers
West Bengal border, i.e. from the River Subarnarekha in the north the Budhabalanga, the Baitarani, the Brahmani, the Mahanadi, and River Rushikulya in the south



U

W

a. 1 and 2
b. 2 and 4
c. 3 and 4
d. 1 and 3

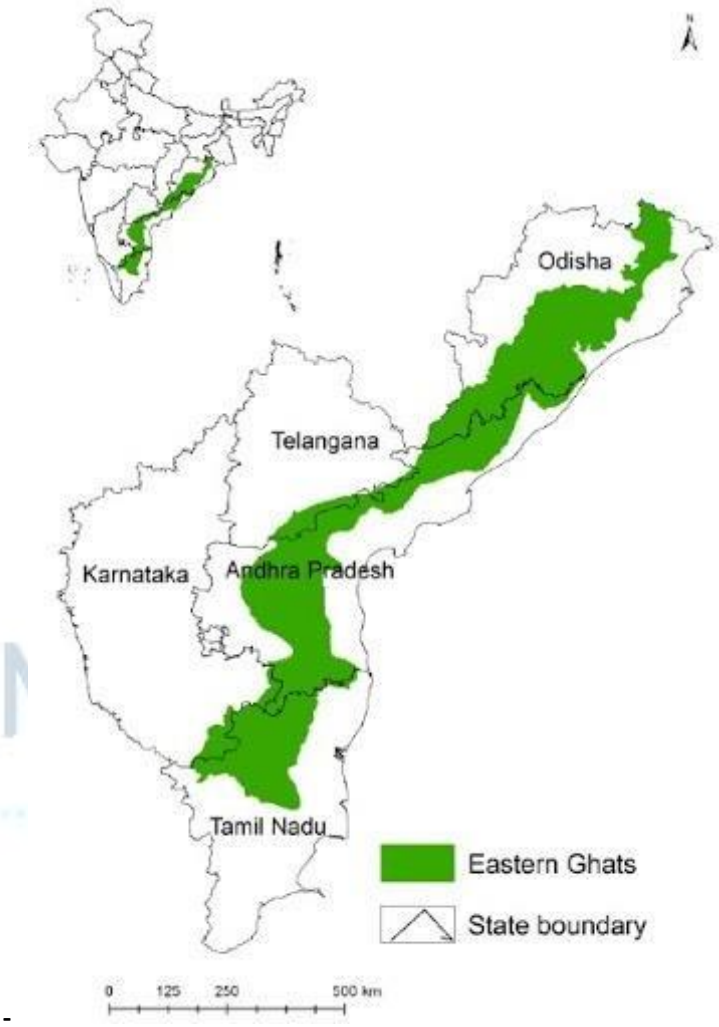
Correct Option: (b)

- **Mahanadi** : originates : Amarkantak hills/ Bastar Plateau / Raipur district of Madhya Pradesh
- **Brahmani** It originates as two major rivers like the Sankh and the Koel from the Chhotanagpur Plateau and both join near Rourkela of Sundargarh district of Odisha
- **Baitarani**:It originates from the Gonasika hills of the Keonjhar districts.
- **Rushikulya**:Rushyamala hills of the eastern ghats. Or Slope of Daringbadi hill, **Kashmir of Odhisa**, coffee

- **Vamsadhara /Bansadhara** orisaa to Ap flow :It originates from the Flanks of the Durgakangar hills (Lingaraj hills) of the eastern ghats in Kalahandi districts
- **Nagabali river:Bijipur** Hills of the eastern ghats

About The Eastern Ghats

are a discontinuous range of mountains along India's eastern coast. The Eastern Ghats pass through Odisha, Andhra Pradesh to Tamil Nadu in the south passing some parts of Karnataka as well as Telangana. They are eroded and cut through by four major rivers of peninsular India, viz. Mahanadi, Godavari, Krishna, and Kaveri.



-

They neither have structural unity nor physiographic continuity. Therefore these hill groups are generally treated as independent units

Jindhagada Peak (1690 m) in Araku Valley **Arma Konda (1,680 m) of** The **Madugula Konda** range has higher elevations ranging from 1,100 m and 1,400 m with several peaks exceeding 1,600 m
Less forested - Mostly dry deciduous to moist deciduous. and having red sandy soil . Limestone, bauxite and iron ore are found in the Eastern Ghats hill ranges.

Rivers originating on the Eastern Ghats include:

- Baitarani River
- Budhabalanga River
- Rushikulya River
- Vamsadhara River
- Nagavali River
- Champavathi River
- Gosthani River
- Sabari River
- Sileru River

Rivers flowing through the Eastern Ghats include:

- Brahmani
- Godavari
- Kaveri
- Krishna
- Mahanadi
- Subarnarekha
- Tungabhadra

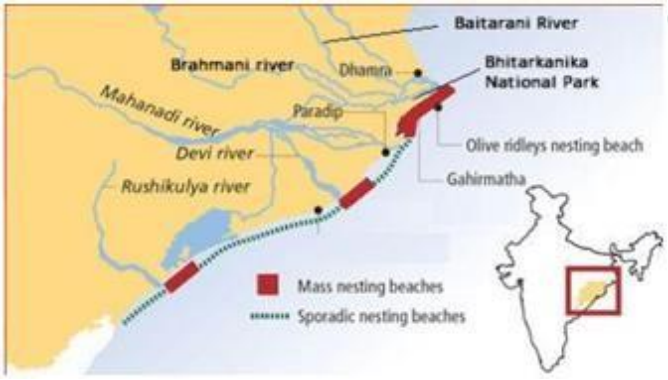
About Bhitarkanika Wildlife Sanctuary/ National Park

- The Bhitarkanika National Park is located in **Kendrapada** district of **Odisha** in the delta of rivers **Brahmani, Baitarani and Dhamara.**
- It is the **second largest mangrove ecosystem** in India and is a **Ramsar site**.
- Gahirmatha Beach and Marine Sanctuary which is known as the **world'slargest rookery of Olive Ridley sea turtle**s, lies to its east. The national park is home to saltwater crocodile, **White Crocodile**, Indian python,King cobra,

Gahirmatha Marine Sanctuary

It is located in **Odisha** and extends between the mouths of **Dhamra River** (in the North) and **Mahanadi River** (in the South).

It is the world's largest nesting beach for **Olive Ridley Turtles.**



Dr. Abdul Kalam Island,

- Old Name : **Wheeler Island**
- **Located : Odhisa Coast** approximately 10 kilometres off the eastern coast of India
- 70 kilometres south of Chandipur in Balasore district, Odisha
- The nearest port is Dhamra Port.
- This island belongs to Bhadrak district.

About ITR:

- The Integrated Test Range,
- is a missile testing facility composed of two complexes - Launch Complex-IV (LC-IV) located on Abdul Kalam Island and Launch Complex-III (LC-III) located at Chandipur

- Abdul Kalam Island is located close to the Gahirmatha Marine Sanctuary, the world's largest rookery of the endangered olive ridley sea turtle

Major Concern?

- change of the island's topography, owing to sand erosion.
- Since the island is technically a shoal, seawater frequently causes sand-shifting.
- The situation is being monitored by geological experts from National Institute of Ocean Technology and the DRDO

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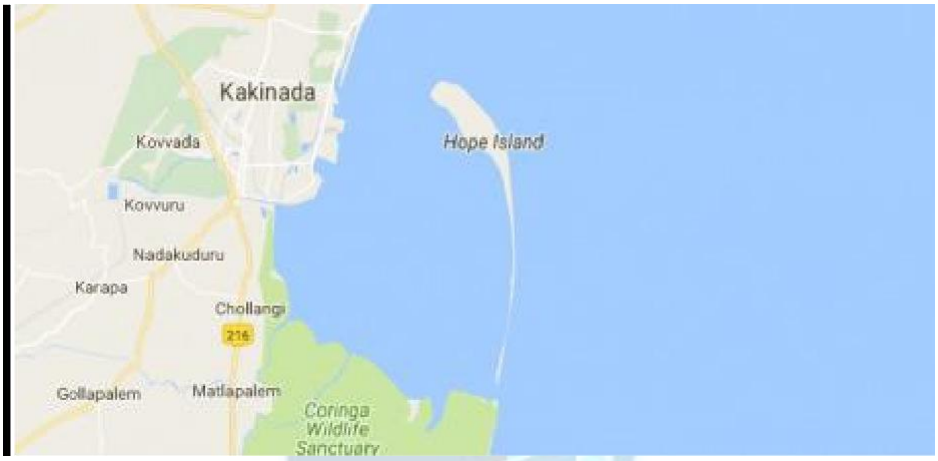
Que : Consider the following Statements related with Which one of the following State if India.

1. **Hope Island** is a relatively young island,formed in the late 18th century, from the sediment outflow carried by the waters of the Koringa River, a distributary of the Godavari.

2. The sandy beaches of Hope island, along with the adjacent ***Coringa Wildlife Sanctuary*** are a nesting ground of the ***Vulnerable Olive Ridley turtle***

Select the Correct one

a) Odhisa
b) Andhrapradesh
c) Telegana
d) Tamilnadu



Hope Island

- is a small tadpole shaped Island situated off the coast of Kakinada, India, in Bay of Bengal.
- Hope Island is located at 16.977°N 82.343°E
- Located near Coringa Wildlife Sanctuary are a nesting ground of the vulnerable olive ridley turtle,

Que : Given below are the statements relating with a National Park-

1. The Gahirmatha Beach and Marine Sanctuary lies to the east of the National Park.
2. It lies in the estuarine region of Brahmani- Baitarani rivers.
3. It was designated a Ramsar site in 2002.

The National Park described above is –

a. Simlipal National Park
b. Bhitarkanika National Park
c. Jaldapara National Park
d. Gorumara National Park

Which National Park is home to Saltwater crocodile –

a. Neora Valley National Park
b. Buxa National Park
c. Bhitarkanika National Park
d. Papikonda National Park

MANGROVE PLANTATION INITIATIVE IN INDIA

- **MISHTI (Mangrove Initiative for Shoreline Habitats & Tangible Incomes)**
- **Sustainable Aquaculture In Mangrove Ecosystem (SAIME) initiative**

MISHTI : Focus, Obective, Implemented by , Funding ?

- Promoting mangrove afforestation along India's coastlines and saltpan lands.
- Program focus: intensive plantation of mangroves to protect shoreline habitats and generate tangible income.
- The implementation of MISHTI will be achieved through collaboration between MGNREGS (Mahatma Gandhi National Rural Employment Guarantee Scheme), CAMPA Fund (Compensatory Afforestation Fund Management and Planning Authority Fund), and other sources
- MISHTI is in line with India's Nationally Determined Contributions of creating an additional carbon sink of 2.5-3 billion tonnes of carbon dioxide (CO_2) equivalent by 2030.
- The central government will bear 80% of the project cost, while state governments will contribute the remaining 20%.
- So, The mangroves are an essential part of the "build back better" strategy in response to sea storms, tsunamis, and cyclones.

Sustainable Aquaculture In Mangrove Ecosystem (SAIME) initiative

- in Sundarbans, a new shrimp farming initiative offers hope for **mangrove restoration**
- the community-based initiative of sustainable shrimp cultivation is being conceived by **NGOs-Nature Environment and Wildlife Society (NEWS) and Global Nature Fund (GNF),** Naturland, Bangladesh Environment and Development Society (BEDS).

DEDICATED CONSERVATION EFFORTS

- Establishing protected Zones /Marine Conservation areas
- Promoting sustainable fishing practices

- Sustainable aquaculture practices
- Reducing nutrient pollution
- Reducing carbon emissions
- Mangroves and Coral Reefs restoration Intiativties
- Education and awareness campaigns
- Monitoring and Research, Early Detection

Way Forward

- Participatory approach deserves much more attention with peoples participation especially youth
- Community participation for conservation and management. The communities dependent on these forests can be supported to take up alternative economic activities to increase sustainable use of these mangroves.
- Restoration of mangrove ecosystem services in vulnerable areas
- Systematic and periodic environmental monitoring of existing mangroves. The species depending on mangrove forests must also be documented.
- Encouraging basic & applied research on mangroves
- Amajor need is the enforcement of legislative mandate.
- Private sector establishments near the mangroves can be incentivised to take up conservation activities.

Que **: Consider the following statements :**

1. Mangrove roots obtain nutrition from the soil and absorb gases like oxygen and nitrogen directly from the atmosphere.
2. The medicinal value is one of the major reasons for the destruction of mangroves.
3. West Bengal and Gujarat have nearly two-thirds of the mangrove cover in India Which of

the statements given above are correct ?

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

Exp : B

Shrimp farming is a major reason for the destruction of mangroves. Rising temperatures, rising seas Rising sea levels due to climate change and the consequent risingtemperatures pose a grave threat to mangroves.

2. Which of the following are considered as Benthos ?

1. sea anemones
2. sponges
3. corals
4. sea stars
5. sea urchins
6. worms
7. bivalves
8. crabs

Select the correct answer using the code given below :

(a) 1, 2, 4, 6 and 7
(b) 1, 2, 4, 5, and 6
(c) 1, 2, 3, 4, 5, 6 and 7
(d) 1, 2, 3, 4, 5, 6, 7 and 8

3. Which of the following are the characteristics of Ecotone ?

1. It can be natural or man-made.

2. Organisms that occur primarily in this zone are known as 'Edge species'.

3. It can have a distinct species that might not be found in other bordering ecosystems. Select the

correct answer using the code given below :

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Ans D Ecotones can be natural or man-made. For example, the ecotone between an agricultural field and aforest is a man-made one.

4. **The 2004 Tsunami made people realize that mangroves can serve as a reliable safety hedge against coastal calamities. How do mangroves function as a safety hedge? (2011)**

(a) The mangrove swamps separate the human settlements from the sea by a wide zone in which people neither live nor venture out

(b) The mangroves provide both food and medicines which people are in need of after any natural disaster

(c) The mangrove trees are tall with dense canopies and serve as an excellent shelter during a cyclone or tsunami

(d) The mangrove trees do not get uprooted by storms and tides because of their extensive roots

5. **Which one of the following regions of India has a combination of mangrove forest, evergreen forest and deciduous forest? (2015)**

(a) North Coastal Andhra Pradesh
(b) South-West Bengal
(c) Southern Saurashtra
(d) Andaman and Nicobar Islands

5 . Consider the following statements :

1. Mangrove species diversity is not uniform across geographical regions along the equator.

2. Sundarbans mangrove forest is the only mangrove habitat in the world for any tiger species.

3. Rising temperatures and sea level due to climate change are expected to expand the range of mangrove distribution.

How many of the statements given above are incorrect?

(a) Only one (b) Only two (c) All three **(d) None**

Ans : Mangrove species diversity is not uniform across geographical regions along the equator. It is highest along the equator in the Southeast Asia region.

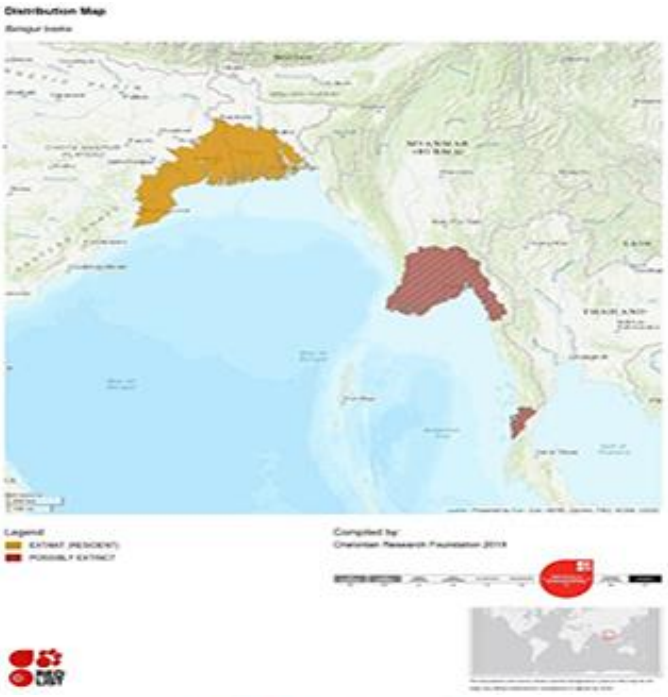
The Sundarbans mangrove forest is the only mangrove habitat in the world for any tiger species. It is the largest contiguous mangrove forest in the world. With a total area of 10,000 km2 , 60% of the forests lie in Bangladesh and the rest in India. It is internationally recognized for its high biodiversity of mangrove flora and fauna both on land and water. The Sundarbans is of universal importance for globally endangered species including the Royal Bengal Tiger, Ganges and Irrawaddy dolphins, estuarine crocodiles and the critically endangered endemic river terrapin (Batagur baska).

Common Names:
Batagur, Common Batagur, Four-toed Terrapin, River Terrapin

- is a species of riverine turtle native to Southeast Asia.
- The northern river terrapin is one of Asia's largest freshwater and brackwater turtles,

- The River terrapin is found in India and Bangladesh (Sundarbans), Myanmar, Malaysia (peninsular), Indonesia (Sumatra), Thailand, and Cambodia (Stuart et al., 2001). It is regionally extinct in Myanmar, Singapore, Thailand and Vietnam
- It is strongly aquatic but uses terrestrial nesting sites, frequenting the tidal areas of estuaries, large rivers, and mangrove forests
- The northern river terrapin is omnivorous, taking waterside plants and small animals such as clams.

- A hatchery and captive breeding project was established in Bhawal National Park in Bangladesh and another in Sajnakhali Wildlife Sanctuary in the Sunderban Tiger Reserve in India with support from Turtle Survival Alliance See location map



Conservation Status:
IUCN : Critically Endangered
IWPA : Schedule I
CITES : Appendix I

Que : Which of the following statements is correct?

(a) The lenticels in mangroves are designed to block salt and only allow water to enter.
(b) All mangroves are adapted to block the salt from entering their tissue.
(c) Mangrove seeds remain dormant until after they are dispersed to a favorable environment.
(d) Microbes and fungi establish important symbiotic relationships with mangroves

Ans d
The bacteria provide services such as N-fixation while the mangroves trees provide root exudates, stimulating microbial growth activity. Fungi show similar relationships with the mangrove trees. Plants also supply oxygen to these organisms. There is also competition among the microorganisms because of the limited amount of nutrients available in mangroves

B is incorrect : There are mangroves that are either secretors – those that actively rid their tissue of salt – and non-secretors – those that block the salt from entering their tissue.

c is incorrect : Mangrove offspring begin to grow while still attached to their parent plants. This type of plant reproduction is called vivipary. After mangrove flowers are pollinated the plants produce seeds that immediately begin to germinate into seedlings. The little seedlings, called propagules, then fall off the tree, and can be swept away by the ocean current. Depending upon the species, propagules will float for a number of days before becoming waterlogged and sinking to the muddy bottom, where they lodge in the soil.

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CHAPTER 3 CORAL REEFS ECOSYSTEM

CORAL REEF ECOSYSTEM

- Underwater Aquatic ecosystems
- called as " Rainforest of the Sea "
- most ancient and dynamic ecosystems
- Coral reefs have existed about 400/200 million years ago (Devonian Period/ Triassic)
- However, since that time there have been many phases of disappearance/reappearance. The development of the Great Barrier Reef seems to have begun 20 million years ago
- They are Primary or Secondary consumers (carnivorous)
- They are engineering organisms, capable of building a rich ecosystem that provides habitat for many other creatures
- Coral reefs host far more number of animal phyla than those hosted by tropical rainforests
- They support over 25% of marine biodiversity even though they take up only 1% of the seafloor.
- The ability to live in symbiosis with dinoflagellates has allowed coral reefs to build large constructions in usually oligotrophic conditions, that is, nutrient-poor waters.
- Unique combination of Animals and Plants (Mutualism : + Biotic Interaction)

CORAL REEFS :

- two-layered marine invertebrates (sessile/fixed in place) that live in groups of animals, Cnidaria
- All corals are in the phylum Cnidaria , **class Anthozoa.**
- The cnidarians are the soft-bodied animals that include corals, jellyfish and sea anemones.
- each individual coral made up of a Polyps : **genetically identical organisms** , tube-shaped structure, attached to a reef at one end and open at the other. The open end has a mouth that is surrounded by a ring of tentacles
- corals extract calcium from seawater to make limestone outer skeletons
- Are Colonies of Coral Polyps (connected by calcium carbonate)
- Animal Polpys : Provides algae : Protected environment
- **zooxanthellae single-celled algae photosynthesize** :
- Microscopic Algae zooxanthellae : Provides , colour , oxygen , nutrition to Corals and also help to remove wastes
- “Organismic engineers”, they are the source of the largest biological constructions on the planet.

Reproduction:

- Corals have multiple reproductive strategies – **they can be male or female or both, and can reproduce either asexually or sexually.**
- Asexual reproduction is important for increasing the size of the colony, and sexual reproduction increases genetic diversity and starts new colonies that can be far from the parents.

KEY CHARACTERISTICS

- **Location** Mainly Located within 30 N/ S of the Equator (Tropical/ Subtropic Region)
- 33° North and 30° South: intertropical zone
- **Temperature** : The temperature of the water should not be below 20°C
- 25 to 30 °C but should not exceed 35 **°C.**
- **Salinity** : Survive under Saline Conditions between 27 to 40 PPT.
- **Low Turbidity : Require** Clean Water to permit high light penetration and little or no sedimentation
- Some in Deep and Cold Water
- **Depth** : Prefer warm Shallow sea , The depth of the water should not exceed 200m
- Both **stony corals and soft corals can be found in the deep sea**

Deep Water Corals :

- live in the cold, dark waters of the oceans
- are large buildup of stony corals forming a complex three dimensional skeletal framework which occur in waters between 200m and 1,500m deep often on continental slopes, submarine plateaus, ridges and seamounts
- same order of cnidarians as reef-building corals and Class Anthozoa
- include sea anemones, stony corals, soft corals and sea pens
- Deep-sea corals may provide historical clues to climate change and may also be the source of important drugs from the sea.

- Cold-water corals can be found in the Atlantic, Indian, and Pacific Oceans.

- The **Rost Reef off the coast of Norway** is the **world's largest coldwater coral reef**.
- According to the United Nations Environment Programme, cold-water coral reefs outnumber tropical reefs worldwide.

Thorny or BLACK CORALS: Recently in the News : five new species of black corals were discovered in the **Great Barrier Reef and Coral Sea off the coast of Australia.**

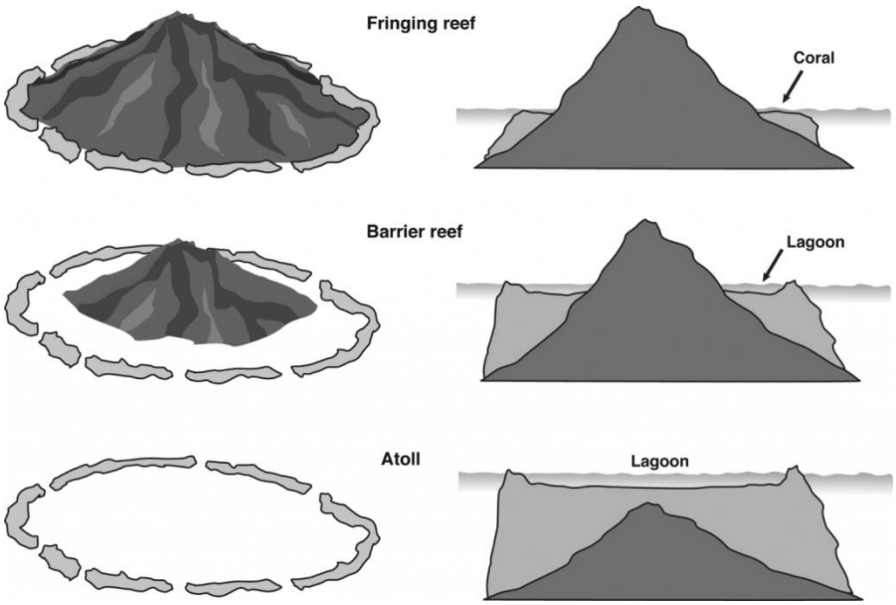
- Found in **shallow waters and down to depths of over 26,000 feet (8,000 meters**).
- **Black corals or antipatharians** are colonial animals named for the **colour of their stiff, black or brownish skeleton**
- Distribution: Black corals are found in all oceans, but are most common in deep water habitats of tropical and subtropical seas.
- Black corals are carnivores.

- Black corals are filter feeders and eat tiny zooplankton that are abundant in deep waters.
- While colourful shallow-water corals rely on the sun and photosynthesis for energy.

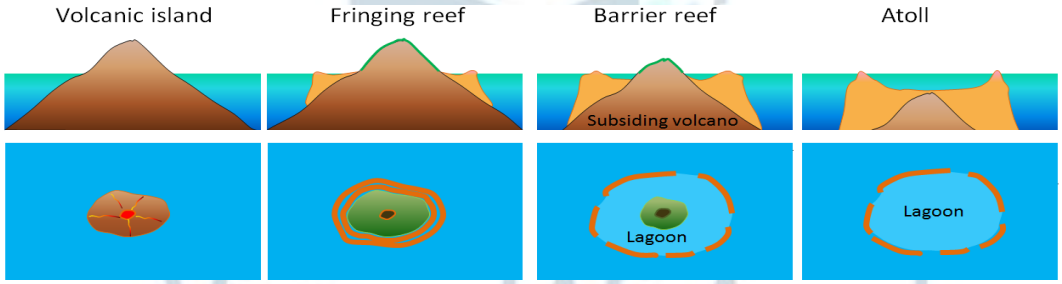
Note: Is corals harmful to human? Yes , Some Corals contain a highly toxic, naturally occurring and potentially lethal substance known as Palytoxin that can cause a severe respiratory reaction, hemorrhaging and death to humans if ingested

TYPES

- **Hard or Stony /** hermatic coral :, shallow-water corals—the kind that builds reefs.
- **Soft** corals and deepwater corals that live in dark cold waters.



According to Charles Darwin : Coral Reef Theory : Three Types of Coral Reefs



- **Patch reefs**: They are small, isolated reefs that grow up from the open bottom of the island platform or continental shelf. They usually occur between fringing reefs and barrier reefs. They vary greatly in size, and they rarely reach the surface of the water.

All the four major reef types occur in India (atoll, fringing and barrier)

Fringing reefs/ Shore Reefs

- They follow the coastline
- Grows close to the Shore and extended to the sea

- Found in Gulf of Mannar and Palk Bay.
- Fringing and barrier reefs are found in Andaman and Nicobar Islands.

Barrier reefs

- **Grows parallel to coast , but separated from land by a lagoon.**
- **Great Barrier Reef ,** runs along the north-eastern coast of Northern Australia over a distance of 2300 km located in the Coral Sea, **off the coast of Queensland, Australia..** It is known as the only animal construction visible from space.
- The second largest reef is French New Caledonia Barrier, which is 1600 km long. These two barrier reefs have been included in the UNESCO World Heritage list (respectively in 1981 and 2008).

Atolls

- Grows surrounding an Island , having central Lagoon, like rough circular Ring
- where the island has completely disappeared below the sea surface.
- Atolls preserve the initial circular shape of the island.
- There are approximately 400 atolls in the world.

- A chain of various Atoll collectively are called as **Faros.**
- Atoll reefs are found in Lakshadweep

What is an Atoll?

(a) A detached elevation with shallow depths. Since they project out of water with moderate heights.
(b) A predominantly organic deposit made by living or dead organisms that forms a mound or rocky elevation like a ridge.
(c) Low islands found in the tropical oceans consisting of coral reefs surrounding a central depression.
(d) A deep gorge, especially one with a river flowing through it

GLOBAL PRESENCE

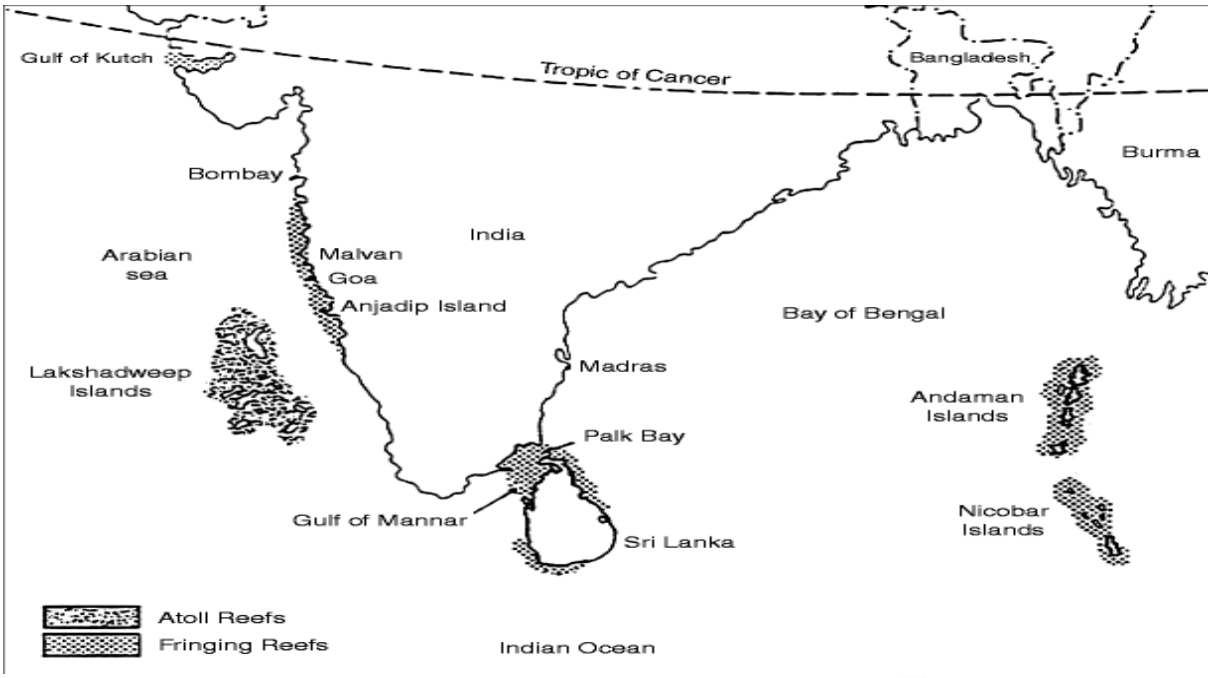
- Covering only 0.09 % of the total areas of Oceans
- located on shallow submarine platforms within the Tropics and in deep water
- coral triangle : centre for coral diversity
- Highest Coral Diversity Region : South East Asia
- More than one-third of the world's coral reefs are located in the territories of, The Philippines, Indonesia, Malaysia and Papua New Guinea and Australia
- Indonesia has the largest coral reef area in the world
- The Great Barrier Reef of the Queensland coast of Australia is the largest aggregation of coral reefs**.**

Which of the following have coral reefs? (2014)

1. Andaman and Nicobar Islands
2. Gulf of Kachchh
3. Gulf of Mannar
4. Sunderbans

Select the correct answer using the code given below:

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



DISTRIBUTION IN INDIA

- Indian Coastline harbours around 1 % or less than 1 % of the global coral reef area.
- Four Regions : i) Gulf of Mannar, ii) Gulf of Kutch, iii) Lakshadweep and iv) Andaman & Nicobar Islands
- Diversity More: Andaman and Nicobar, Laksadwee, Manner and Kutch
- Andaman and Nicobar Islands are found to be very rich and Gulf of Kachchh is poor in species diversity
- Lakshadweep Islands have more number of species than the Gulf of Mannar
- Chandrabhaga coast and Ramachandi in the Konark area of Odisha
- The absence of reef in Bay of Bengal (North East Coast) is attributed to the immense quantity of freshwater and silt brought by the rivers such as Ganga, Krishna and Godavari.
- patches of reef growth on the West Coast : The Angria Bank is a coral reef off Vijaydurg in Maharashtra. Tarkarli in Malwan (Maharashtra) is a smaller reef.
- There is a coral reef in the Netrani Island and Gaveshani Bank about 100km offshore from Mangalorein Karnataka

See largest Area distribution of Coral in India ?

Particulars	Geographical location	Area of the reef (in Sq.Km)
Gulf of Mannar	21islands,South East Coast of India 140 km, between Tuticorin and Rameswaram	94.3
Gulf of Kutch	40 islands, Northern side of Saurashtra peninsula	325.5
Andaman and Nicobar Islands	**530 islands**	**1021.46**
Lakshadweep Islands	Uninterrupted chain of coral atolls- stretch of 2000 km	933.7

KEY RELEVANCE

- coral reefs provide housing construction materials (Maldives, Indonesia), sand for the construction of roads or fertilizers for agricultural land

- Source For Economic livelihood and Food and Nutrition Security
- Source of Food For Marine Species
- Source of New Medicines (Health Security)
- Provides Habitat , feeding , Nursery Grounds for many Aquatic Species
- Protects Coastline from Storms and Erosion (Ecological Security)
- Provide revenue and employment through tourism and recreation
- Helps in Nutrient Cycling , Provide Key Ecosystem Services
- provisioning ecosystem services like Lime/ Calcium Carbonate (cement Industry, Jewellery)
- According to a recent study by the Indian Institute of Meteorology, Pune corals along the northwestern coast / North Indian Ocean (Lakshaweep and maldives) could provide some information on the patterns of the arrival and departure of the Indian monsoon (bands growing on the coral surface reveal about the paleoclimatic conditions, rainfall, ambient water temperatures and similar aspects from the past.) Some earlier studies on the coral band width had traced links to the rainfall recorded over the Western Ghats.

KEY THREATS

- locally (pollution, sedimentation, unsustainable coastal development, nutrient enrichment, overfishing, use of destructive fishing methods…) and, since the 1980s, globally (global warming, ocean acidification).
- Corals are vulnerable to thermal stress
- Ocean Warming :Increase in Sea Surface Temp of about 1 to 3 degree C are projected to coral bleaching events and widespread mortality.
- Ocean Acidification : Rising carbon dioxide in the Sea water
- Part of the excess carbon dioxide produced by human activities dissolves into the oceans, reducing on one hand the greenhouse effect (and thus reducing the increase in global temperature), but on the other hand causing a increasing acidity of the oceans,
- pH of seawater has decreased
- Acidification primarily affects the calcification rates of corals, and therefore reef growth.
- Environmental Stressors: elevated seawater temp, variation in salinity , water quality depletion, increasing pollution loads, sedimentation
- Sea Level Rise
- Destructive and Indiscriminate Fishing activities
- Boat anchoring cause physical damage to the reefs and associated fauna and flora.
- Bottom trawling by large mechanized boats , deplete fishery resources and cause damage to critical habitat like sea grass beds and coral reefs
- Sand mining
- Seaweed and Mollusc collection
- Industrial Pollution due to oil refineries, Fertiliser , Chemical Plants , ports , thermal plants (Gulf of Kutch and Gulf of Manner Region)
- Discharge of domestic sewage stressing coral habitats
- Eutrophication : Harmful algal bloom
- Invasive alien species : Kappaphycus alvarezzi, pose a threat to reef ecosystems in Gulf of Manner
- Ozone Depletion : associated rises in UV concentrations / increase in Cyclones storms

EFFECTS OF STRESSORS ON THE CORAL REEFS

- Coral Bleaching
- Changing the timing of Reproduction
- Reduced Reproduction rate
- Slower growth
- More Prone to Coral Disease : Black Band, white Band, Pink band yellow band, white plague

SUPPORT TO MULTILATERAL ENVIRONMENTAL AGREEMENTS

The **International Coral Reef Initiative** (ICRI)

- It is the "only global entity solely devoted to coral reefs

- It was announced at the First Conference of the Parties of the Convention on Biological Diversity,1994.
- at the initiative of eight founding nations: Australia, France, Japan, Jamaica, the Philippines, Sweden, the United Kingdom, and the United States.
- ICRI is a joint initiative , global partnership, of several countries in partnership with other coral reef nations around the world, non-governmental organizations (NGOs), international organizations, multilateral development banks, and private sector businesses.
- UNEP has been an active player in ICRI since its inception
- 1994
- not a UN body
- More than 100 Members, including India
- The ICRI Secretariat is hosted for a determined term (usually two years) by State members, on a voluntary basis
- The Global Coral Reef Monitoring Network (GCRMN) was established by ICRI
- is an operational network of the International Coral Reef Initiative (ICRI) that aims to provide the best available scientific information on the status and trends of coral reef ecosystems to provide an evidence base for their conservation and management

CORAL REEF BREAKTHROUGH

- **Science based Initiative**
- **Launched by International Coral Reef Initiative** in partnership with the **Global Fund for Coral Reefs (GFCR)(37th ICRI General Meeting, 2023.)**
- Aims: to secure the future of at least **125,000 km^2** of **shallow-water tropical coral reefs** with investments of **at least USD 12 billion** to support the resilience of more than half a billion people globally **by 2030.**
- **Double the area of coral reefs under effective protection .**

Global Fund for Coral Reefs (GFCR):

- is 10 Year , $ 625 Million is a blended finance instrument to mobilise action and resources to protect and restore coral reef ecosystems.
- It provides grant funding and private capital to support sustainable interventions to save coral reefs and the communities that rely on them.
- UN Agencies, nations, philanthropies, private investors and organisations have joined the Global Fund for Coral Reefs Coalition to deliver on ecological, social and economic resilience.

CORAL TRIANGLE

- Geographical Term , Triangular shape of marine waters between Pacific and Indian Ocean
- 56% of the coral reef fishes in the Indo-Pacific region live here
- "Amazon of the seas
- Coral Triangle Day June 9
- World Ocean Day June 8

CORAL TRIANGLE INITIATIVE
ON CORAL REEFS, FISHERIES AND FOOD SECURITY

The **Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF)**, also shortly known as the **Coral Triangle Initiative (CTI)**, is a multilateral partnership of six countries (Indonesia, Malaysia, Philippines, Papua New Guinea, Solomon Islands, Timor-Leste) working together to sustain extraordinary marine and coastal resources by addressing crucial issues such as food security, climate change, and marine biodiversity.
Headquater: Indonesia,
Member 6 Countries
Established May 2009
The Coral Triangle Atlas is an online GIS database, providing governments, NGOs and researchers with a view of spatial data at the regional scale. This CT Atlas project will improve the efficiency of management and conservation planning in the region by giving researchers and managers access to spatial information while encouraging them to share their data to complete the gaps

Other Coral Reef Mechanism WorldWide :

1. CBD adopted Jakarta Mandate on Marine and Coastal Biological Diversity 1995
2. Ramsar convention on wetlands identifies CR as wetland type
3. Convention on International Trade in Endangered Species of Wild Fauna and Flora, CITES, identifies some coral reefs trade be restricted
4. Bonn Convention: Convention on Conservation of Migratory species of Wild Animals also focus on exploitation of species dependent on coral reefs

CONSERVATION MEASURES (INDIA)

- The Ministry of Environment, Forest and Climate Change manages and guidelines for the protection of the Coral reefs in India. If the Coral reef region is under a protected area then it comes under the jurisdiction of the State Wild life department.
- Wildlife Protection Act 1972 : All the Scleractinian corals and gorgonids are included in Schedule I of the Act.
- EPA 1986- prohibits use of corals and sands from the beaches and coastal water for constuction and other purposes.

- CRZ Notification 1991 regulates onshore developmental activities which affects coastal environments
- Coral reef in Gulf of Mannar and A&NI are declared as Biosphere Reserves
- Coral Triangle Day : 9 June
- Central Marine Fisheries Research Institute (CMFRI), kochi , Ministry of Agriculture and Farmers Welfare , has taken part in a pioneering project of the Union Department of Fisheries to deploy artificial reefs in a total of 3,477 fishing villages in the country, starting from Kerala
- For the last few years, the CMFRI has been successfully undertaking the installation of artificial reefs in the coastal waters of Tamil Nadu, Andhra Pradesh, Gujarat, and Kerala on experimental basis

- country's first 'Coral garden' will be set up at Mithapur coastal region of Devbhoomi-Dwarka district in Gujarat. Wildlife Trust of India (WTI) and Tata Chemicals Limited (TCL) have signed a Memorandum of Understanding to set up the first of its kind coral garden, The project will be funded by the Gujarat forest department

CORECTIVE MEASURES /NEEDS TO:

- Focus on Improving Mangroves cover
- Focus on comprehensive assessments of coral reefs along Indian Coastline
- Ground and Aerial Surveillance (Remote sensing satellites of ISRO)
- Increasing Research and Development
- Increasing International collaborations

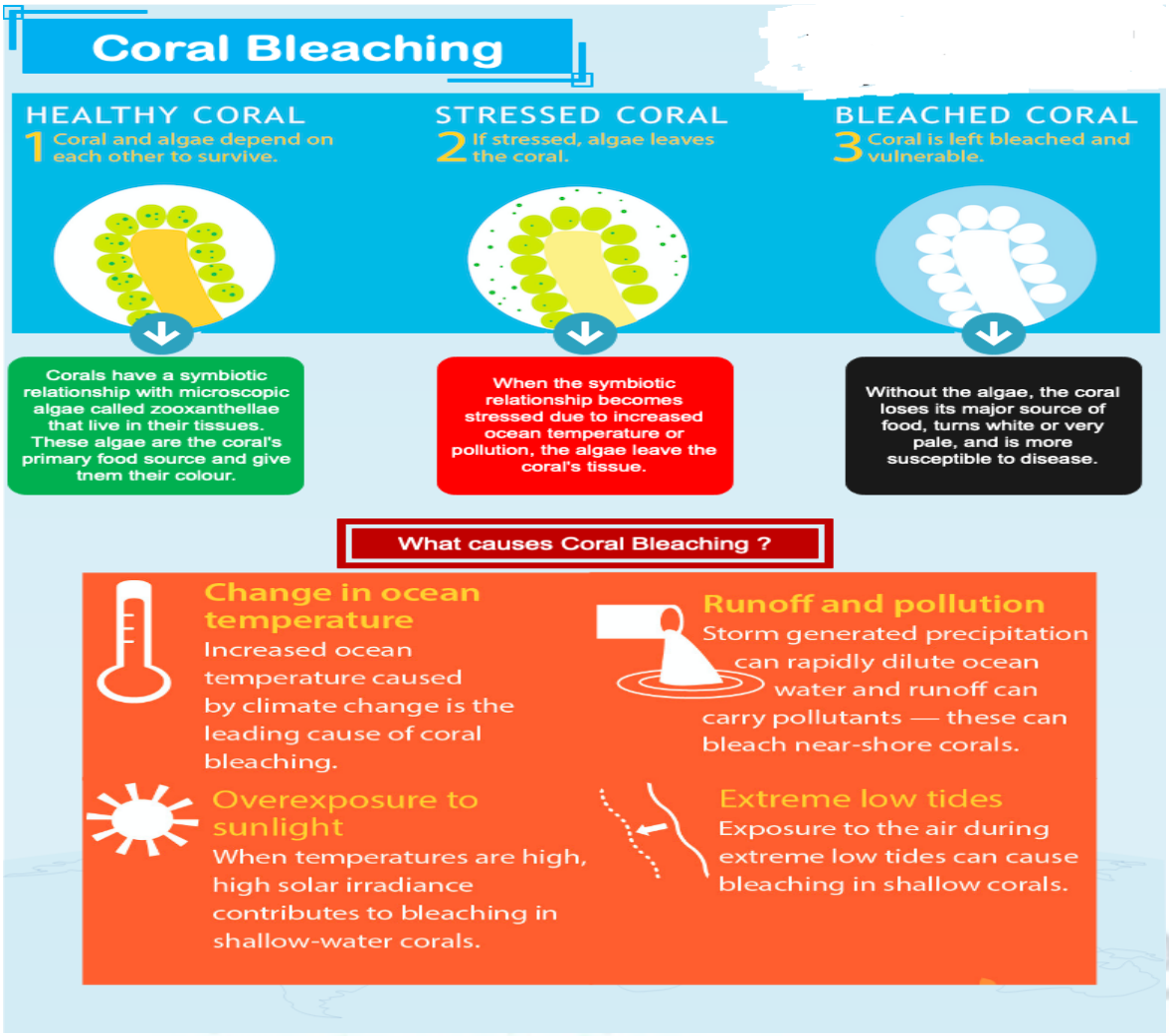
- Reducing Global Warming by Halting deforestation, focus on Renewable Energy Solutions
- Regulating : Coastal Zones , Tourism , Nutrient Pollution , Over fishing
- Community based approach and incentive based activities for effective coral management

CORAL BLEACHING: A GLOBAL PHENOMENON

- When corals face stress by changes in conditions such as temperature, light, or nutrients, rise in sea surface temperature :they expel the symbiotic algae zooxanthellae living in their tissues, causing them to turn completely white. This phenonmen is called coral bleaching.

- symbiosis biotic interaction breaks down

- Term Bleaching means " Loss of Algae and rapid whitening of the coral bleaching."
- The pale white colour are visible due to the loss of pigment producing zooxanthellae.



Causes of Coral Bleaching

- Increase UV radiations, decrease cloud covers .
- Elevated sea temperature , Ocean Warming due to Global Warming , El nino
- Ocean Acidification: rising carbondioxide levels in ocean water inhibits corals ability to create calcareous skeletons, which is essential for their survival.
- Increase in industrial ,chemical , agriculture pollutions in oceanic regions thereby increase nutrient concentrations
- Increase sedimentation due to poor land use , deforestation, dredging , make algae prone to bleaching
- Human induced threats : overfishing , cyanide fishing etc

UPSC Prelims 2022 Question:

"Biorock technology" is talked about in which one of the following situations?

a) Restoration of damaged coral reefs

b) Development of building materials using plant residues

c) Identification of areas for exploration/extraction of shale gas

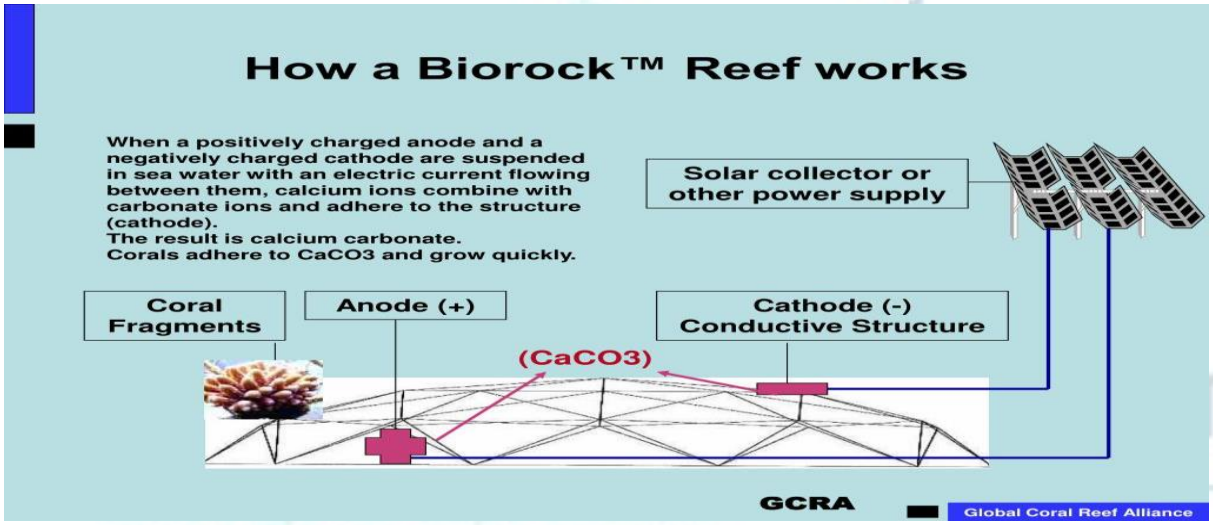
d) Providing salt licks for wild animals in forests/protected areas

EXP:

Biorock technology is an innovative process originally invented in 1976 to produce natural building materials in the sea. It is a unique method that **allows coral reefs, and other marine ecosystems including seagrass, salt marsh, mangrove, and oyster reefs to survive and recover from damage** caused by excessive nutrients, climate change, and physical destruction. It greatly increases the settlement, growth, survival, and resistance to stresses, including high temperature and pollution, of all marine organisms.

Concept of Bio Rock Technology

- Also called " Mineral accretion Technology "
- Zoological Survey of India with help of Gujarat Forest Department is attempting to process to restore coral reefs .
- Biorock™ technology : architect Professor Wolf Hilbertz
- works by passing a low-voltage electrical current through seawater
- This current causes the seawater to become slightly alkaline, which promotes the precipitation of calcium carbonate onto the steel structures
- The calcium carbonate is deposited in a thin layer, which gradually builds up over time to form a thick, hard coating.



- This technology used to make artificial reefs
- Biorock structures are stronger , durable , than concrete structures
- they are also more resistant to erosion and corrosion
- Biorock structures are also self-repairing, as the calcium carbonate coating is constantly being replenished.
- Corals growing on Biorock™ reefs have 1600% to 5000% times higher survival after severe bleaching than corals on nearby reefs
- Biorock structures provide habitat for a wide variety of marine life, including fish, corals, and invertebrates.

- Coastal protection: Biorock structures are being used to protect shorelines from erosion and storm damage.
- Reef restoration: Biorock structures are being used to restore damaged coral reefs.
- Aquaculture: Biorock structures are being used to create artificial reefs for aquaculture purposes.
- Marine habitat restoration: Biorock structures are being used to create artificial habitats for marine life
- Biorock™ technology is the only sustainable method of protecting coral reefs from mass extinction from global warming.

Example :

Tamil Nadu deploying artificial reefs to save sinking islands: Vaan island in the Munnar region.

Consider the following:

1. Assertion: Color is not necessarily an indicator of health in deep-sea corals.
2. Reason: Deep-sea corals thrive in cold waters that are 4-12˚C, and have been found as cold as -1˚C.

Which one of the following is correct in respect of the above?

(a) Both Assertion and Reasoning are true and Reasoning is the correct explanation of Assertion.

(b) Both Assertion and Reasoning are true but Reasoning is not the correct explanation of Assertion. (c) Assertion is true but Reasoning is false.

(d) Assertion is false but Reasoning is true.

Ans B

- Both Assertion and Reasoning are true but Reasoning is not the correct explanation of Assertion.
- Color is not necessarily an indicator of health in deep-sea corals since they do not rely on photosynthetic zooxanthellae which impart color to shallow water corals
- Some species, like Iridigorgia soft coral, can be white in color due to their lack of photosynthetic zooxanthellae

Que Consider the Statements

1 . Deep water corals may lack Zooanthellee and instead get all nutrients by using tentacles .

2 Deep-sea corals are able to live in many different places around the world.

3. Deep Sea Corals do not have stony skeletons and are non-reef-building corals and Like hard corals, they tend to live in colonies

4 Tentacles house thousands of cnidocytes, each with a special stinging organelle called a nematocyst.

How Many statements are correct ?

a) one only
b) two only
c) three only
d) All

Que: Consider the following statements in the context of protection of Coral reefs in India

1. The Government has taken steps to protect and sustain coral reefs in the country through promotional as well as regulatory measures.

2 The promotional measures have been implemented through a Central Sector Scheme under National Coastal Mission Programme of the Ministry at four sites namely Lakshadweep, Gulf of Kutch, Gulf of Mannar and Andaman & Nicobar Islands for restoration, monitoring, conservation and management of coral reefs.

3 Regulatory measures are implemented through Coastal Regulation Zone (CRZ) Notification (2019) under the Environment (Protection) Act, 1986; the Wild Life (Protection) Act, 1972; the Biological Diversity Act, 2002; and rules under these acts as amended from time to time.

How many statements are correct ?

Note:

All the hard corals i.e. Scleractinian coral species are protected under the Wildlife (Protection) Act, 1972 and listed in Schedule-I category which prevents collection of live and dead corals. In addition, major coral reefs areas in the country have been declared as Protected Areas

All marine resources are protected under the Coastal Regulation Zone (CRZ) of 1991. All types of coral reefs are protected under the CRZ1 category.

No corals are collected from the country for jewellery making

no such incidence of harvesting and trade of black and white corals for jewellery making or any other purpose are reported from the territory of Andaman & Nicobar Islands and Gulf of Kutch.

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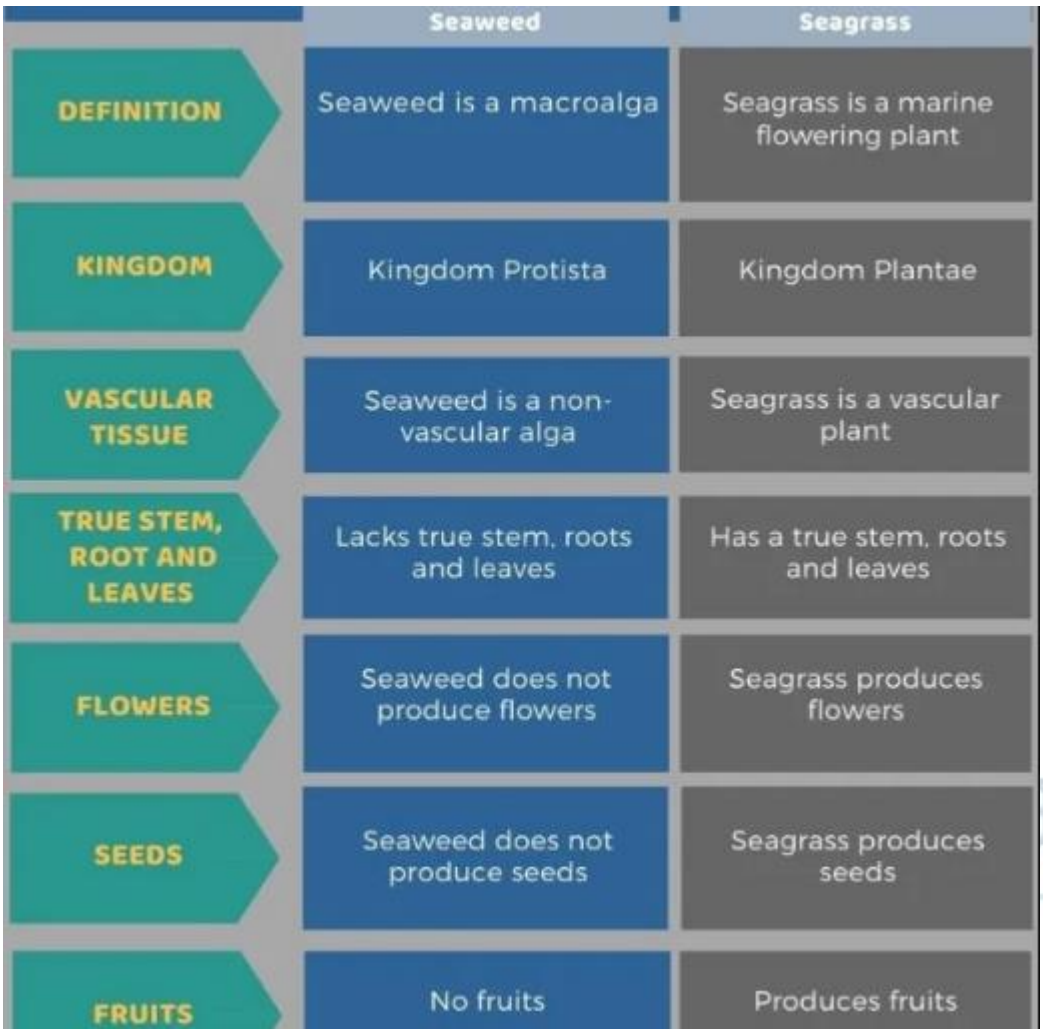

What are Seagrasses?

- Seagrasses are flowering plants that grow submerged in shallow marine waters like bays and lagoons.
- They are so-named because most species have long green, grass-like leaves.
- Seagrasses have roots, stems, and leaves and produce flowers and seeds.
- Like terrestrial plants, seagrass also photosynthesizes and manufactures their own food and releases oxygen.
- Seagrasses can reproduce both sexually and asexually.
- They evolved around 100 million years ago, and there are approximately 72 different seagrass species that belong to four major groups.
- Some of the important seagrasses are Sea Cow Grass (Cymodocea serrulata), Thready Seagrass (Cymodocea rotundata), Needle Seagrass (Syringodium isoetifolium), Flat-tipped Seagrass (Halodule uninervis), Spoon Seagrass (Halophila ovalis) and Ribbon Grass (Enhalus acoroides).

Distribution:

- They are found on all continents except Antarctica.

- The tropical waters of the Indo-Pacific hold the highest diversity of seagrasses in the world.
- Seagrass distribution in India:
- They occur all along the coastal areas of India.
- They are abundant in the Palk Strait and Gulf of Mannarin Tamil Nadu.

Sea - Grass - Importance

- Ecosystem Engineers: Seagrasses are referred to as "Ecosystem Engineers" since they are known for offering a variety of ecosystem services.
- Lungs of the Sea: They are also known as "the lungs of the sea" because they use photosynthesis to release oxygen into the water.
- Carbon Sequestration: Despite taking up only 0.1 % of the ocean floor and annually absorbing 83 million tonnes of carbon from the atmosphere, they sequester up to 11 % of the organic carbon buried in the water.
- Absorption: Compared to tropical rainforests, seagrass may absorb carbon from the atmosphere up to 35 times faster.
- Water Quality: Clarity is improved and fine sediments and suspended particles are trapped, helping to maintain water quality.
- Filtration: Before fertilizers from land-based industries reach delicate environments like coral reefs, they filter them.
- Prevent Soil Erosion: As seagrasses' broad vertical and horizontal root systems stabilize the ocean floor, they help to prevent soil erosion.
- Habitat: They serve as a habitat for fish, octopuses, shrimp, blue crabs, oysters, etc., and as a source of food.
- Prevent Endangered Species: Grazing on seagrass fronds are endangered marine animals including dugongs (also known as sea cows), green turtles, and others.
- Bottlenose dolphins consume the creatures that inhabit seagrass habitats.
- Source of Nutrition: Detritus (natural waste) from dead seagrass that has decomposed provides food for creatures like worms and sea cucumbers.
- Release of Nutrients: Seagrasses and phytoplankton take nitrogen and phosphorus once it decomposes, releasing these nutrients.
- As a Defense: Protect young and small fish from huge predators, and keep powerful currents away from creatures like worms, crabs, starfish, sea cucumbers, and sea urchins.
- Ideal Nursery Sites: Ensure that vital marine life used for commerce, such as squids and cuttlefish, has ideal nursery sites.

Ecosystem services:

- They are considered to be ‘Ecosystem Engineers’.
- Seagrasses help maintain water quality. They trap fine sediments and suspended particles in the water column and increase water clarity.
- They filter nutrients released from land-based industries before they reach sensitive habitats like coral reefs.
- The extensive vertical and horizontal root systems of seagrasses stabilise the sea bottom.
- They are one of the most productive ecosystems in the world.

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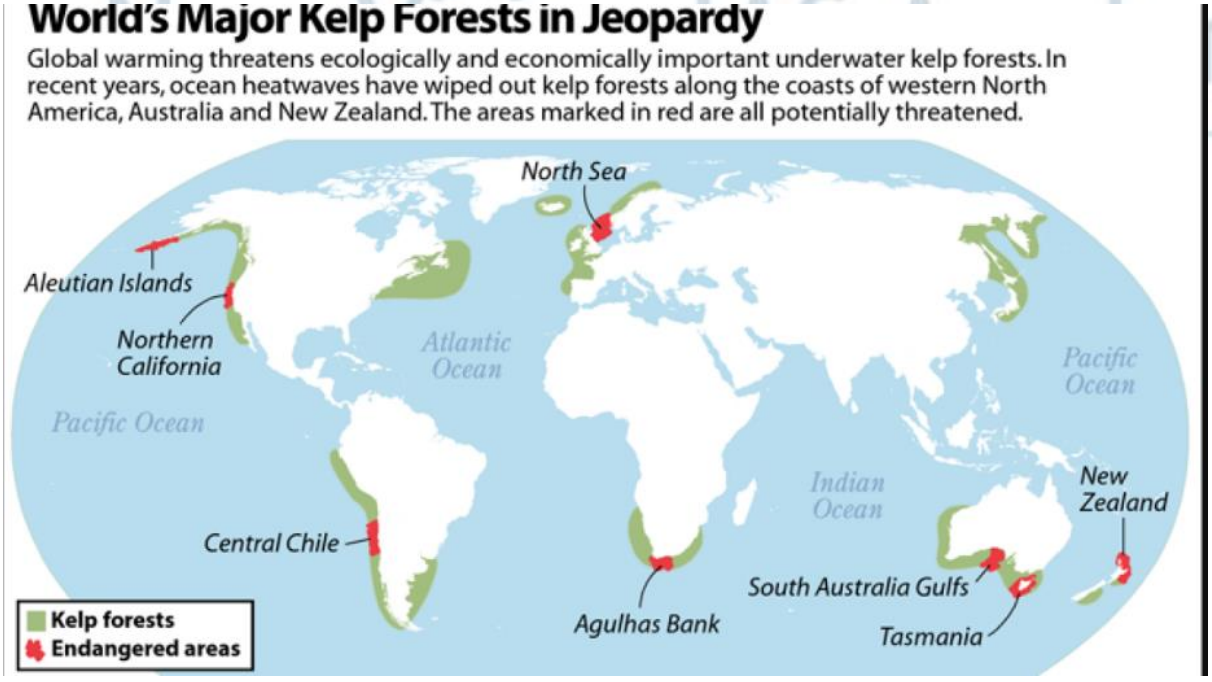
A recent study has revealed that **Kelp forests are declining because of climate change**.

About Kelp Forests:

- Kelp forests are underwater ecosystems **formed in shallow water by the dense growth of several different species.**
- Kelp are **large brown algae that live in cool,** relatively shallow waters close to the shore.

- Kelp thrives in **cold, nutrient-rich waters**.
- They attach to the seafloor and eventually grow to the water's surface and rely on sunlight to generate food and energy, kelp forests are always coastal and require shallow, relatively clear water.
- They provide underwater habitats to hundreds of species of invertebrates, fishes, and other algae and have great ecological and economic value.



What is the distribution of Kelp forest?

- Kelp forests have been observed throughout **the Arctic by the Inuit.** The Canadian Arctic alone represents 10 per cent of the world's coastlines.

- They have adapted to severe conditions. These cool water species have special strategies to survive freezing temperatures and long periods of darkness and even grow under sea ice.
- In regions with cold, nutrient-rich water, they can attain some of the **highest rates of primary production** of any natural ecosystem on Earth.

Between Ellesmere Island and Labrador, as well as along the coasts of Lancaster Sound, Ungava Bay, Hudson Bay, Baffin Bay, and Resolute Bay in Hudson Bay and eastern Canada, kelp forests have been scientifically documented.

MARINE PROTECTED AREA (MPA)

Define : Geographical regions that are set aside for conservation and sustainable use of marine and coastal biodiversity.

- Marine Protected Area is an umbrella term to describe a wide range of protected areas for marine conservation
- critical management tool to protect, maintain, and restore natural and cultural resources in coastal and marine waters
- Here human activities are more strictly regulated and given special protections
- Within the region, certain activities are limited, or entirely prohibited, to meet specific conservation, habitat protection, ecosystem monitoring, or fisheries management objectives.
- MPAs it include fishing, research, or other human activities; in fact, many MPAs are multi-purpose areas
- MPA network in India has been used as a tool to manage natural marine resources for biodiversity conservation and for the well-being of the people dependent on
- MPAs can serve as carbon sinks, helping to absorb and store carbon dioxide from the atmosphere and mitigate the impacts of climate change on marine ecosystems
- MPAs can provide valuable opportunities for scientific research and educational activities, helping to increase our understanding of the marine environment and promoting ocean literacy.
- Under the provisions of the Wild Life (Protection), Amendment Act of 2002, the Maine protected area seeks to preserve and protect the natural marine ecosystems in their pristine state

Key facts :

- India's coastline supports almost 30% of its human population
- There are a total of more than 133 marine Protected Areas in India.
- In India, there are **33 national parks and wildlife sanctuaries** designated under the Wildlife (Protection) Act of 1972 that make up the country's MPAs.
-
- The shoreline of India is home to 31 marine protected areas,and more than 100 MPAs in the country's 2 islands

MARINE NATIONAL PARKS IN INDIA ARE:

1. Marine National Park, Gulf of Kutch
2. Mahatma Gandhi Marine National Park, Andaman & Nicobar Islands
3. Malvan Marine Sanctuary, Sindhudurg district in Konkan region of Maharashtra
4. Gahirmatha Marine Sanctuary, Odisha
5. Bhitarkanika NP Odisha
6. Gulf of Mannar Marine National Park, Tamil Nadu
7. Rani Jhansi Marine National Park, Andaman and Nicobar Islands

Name Three Marine BP ?

- The Gulf of Mannar Marine National Park, Sundarbans National Park, Gulf of Kachchh National Park, Gahirmatha Marine Sanctuary, Coringa Wildlife Sanctuary and Chilika Wildlife Sanctuary, on the mainland

INDIA HAS PASSED LAWS FOR COASTAL AND MARINE CONSERVATION

- Wildlife (Protection) Act of 1972,
- the Environment (Protection) Act of 1986,
- the Coastal Regulation Zone Notification of 1991,
- the National Biodiversity Act of 2002

IMPORTANCE OF MPAS

- They provide essential habitat for Biodiversity Conservation and protect various threatened and endangered and critically endangered species
- They boost Ecosystem Protection and Many Ecological functions
- help in Climate Change Mitigation Measures
- Provide various Economic Benefits , Tourism, recreational possibilities, sustain ecossytem services and its core functions.

Classification of MPAs

Category I: covers National Parks and Sanctuaries having entire areas in intertidal/sub-tidal or mangroves, coral reefs, creeks, seagrass beds, algal beds, estuaries, and lagoons.

Category II: includes Islands, which have major parts in the marine ecosystem and some parts in the terrestrial ecosystem.
Category IIIA: includes sandy beaches beyond the intertidal line but occasionally interacting with the seawater.
Category IIIB: includes evergreen or semi-evergreen forests of islands.

List of Marine Protected Areas in Peninsular India

S.No.	State/UT	Name of MPA	Legal Status	Area	Year of Notificaion
1	Andhra Pradesh	Coringa	Sanctuary	235.70	1978
2	Andhra Pradesh	Krishna	Sanctuary	194.81	1989
3	Andhra Pradesh	Pulicat Lake	Sanctuary	600.00	1980
4	Daman & Diu	Fudam	Sanctuary	2.18	1991
5	Goa	Chorao Island	Sanctuary	1.78	1988
6	Gujarat	Marine (Gulf of Kachchh)	National Park	162.89	1995
7	Gujarat	Marine (Gulf of Kachchh)	Sanctuary	295.03	1980
8	Gujarat	Khijadia	Sanctuary	6.05	1981
9	Kerala	Kadalundi Vallikkunnu	Community Reserve	1.50	2007
10	Maharashtra	Malvan Marine	Sanctuary	29.12	1987
11	Maharashtra	Thane Creek Flamingo	Sanctuary	16.905	2015
12	Odisha	Bhitarkanika	National Park	145.00	1998
13	Odisha	Bhitarkanika	Sanctuary	525.00	1975
14	Odisha	Chilka (Nalaban)	Sanctuary	15.53	1987
15	Odisha	Gahirmatha	Sanctuary	1435.00	1997
16	Odisha	Balukhand Konark	Sanctuary	71.72	1984
17	Tamil Nadu	Gulf of Mannar Marine	National Park	526.02	1980
18	Tamil Nadu	Point Calimere	Sanctuary	17.26	1967
19	Tamil Nadu	Pulicat Lake	Sanctuary	153.67	1980
20	Tamil Nadu	Pulicat Lake Block-A & Block-B	Sanctuary	124.0727	2013
21	West Bengal	Sundarbans	National Park	1330.10	1984
22	West Bengal	West Sundarbans	Sanctuary	556.45	2013
23	West Bengal	Haliday Island	Sanctuary	5.95	1976
24	West Bengal	Sajnakhali	Sanctuary	362.40	1976
25	West Bengal	Lothian Island	Sanctuary	38.00	1976
Total Area				**6852.14**	

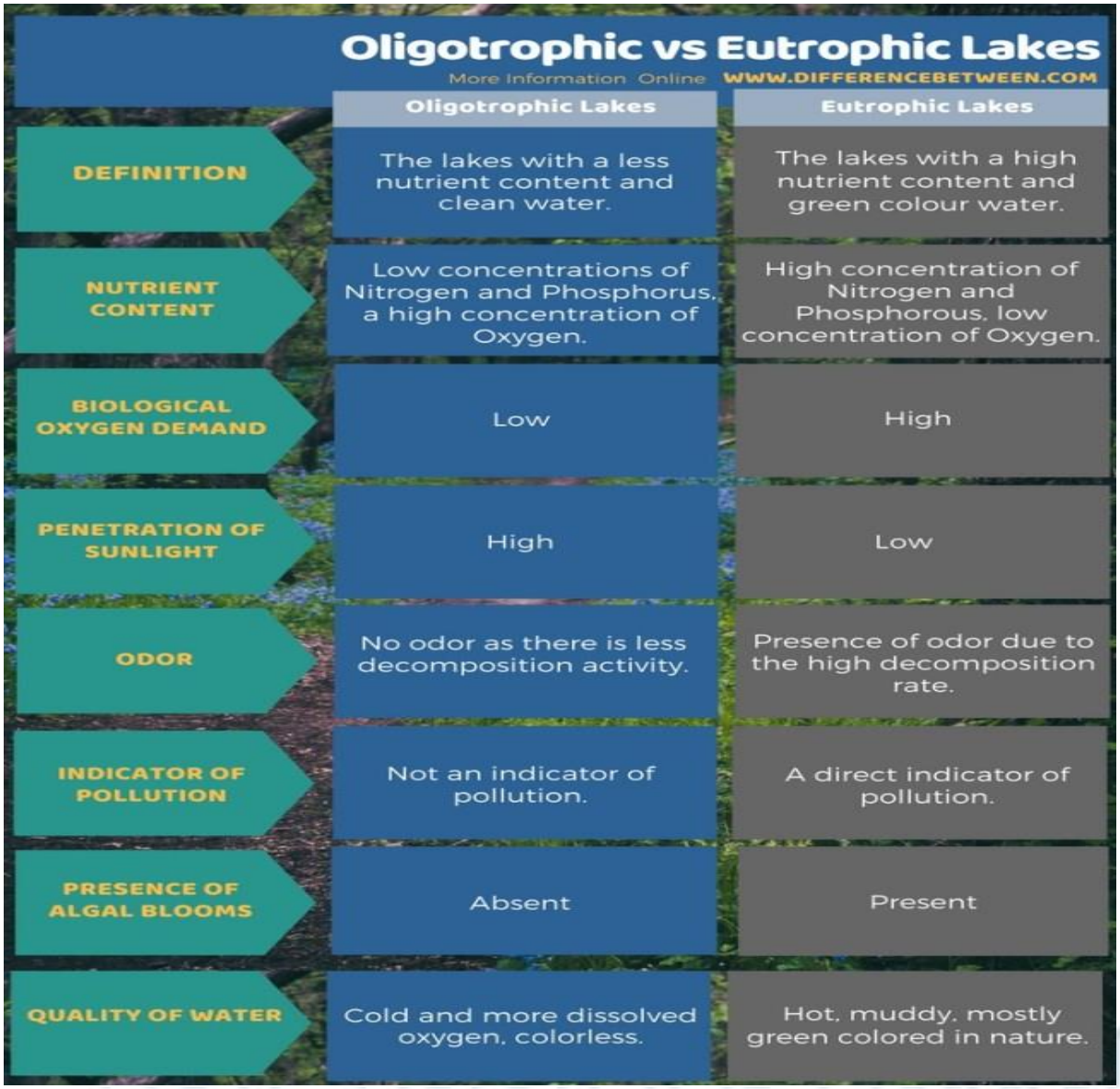
List of Marine Protected Areas in Islands of India

S.No.	Name of MPA	Legal Status	Area of MPA	Year of Notification
Andaman & Nicobars Islands				
1	Campbell Bay	National Park	426.23	1992
2	Galathea Bay	National Park	110.00	1992
3	Mahatama Gandhi Marine (Wandoor)	National Park	281.50	1983
4	Mount Harriett	National Park	46.62	1987
5	Rani Jhansi Marine	National Park	320.06	1996
6	Saddle Peak	National Park	32.54	1987
7	Arial Island	Sanctuary	0.05	1987
8	Bamboo Island	Sanctuary	0.05	1987
9	Barren Island	Sanctuary	8.10	1987
10	Battimalv Island	Sanctuary	2.23	1987
11	Belle Island	Sanctuary	0.08	1987
12	Benett Island	Sanctuary	3.46	1987
13	Bingham Island	Sanctuary	0.08	1987
14	Blister Island	Sanctuary	0.26	1987
15	Bluff Island	Sanctuary	1.14	1987
16	Bondoville Island	Sanctuary	2.55	1987
17	Brush Island	Sanctuary	0.23	1987
18	Buchanan Island	Sanctuary	9.33	1987
19	Chanel Island	Sanctuary	0.13	1987
20	Cinque Islands	Sanctuary	9.51	1987
21	Clyde Island	Sanctuary	0.54	1987
22	Cone Island	Sanctuary	0.65	1987
23	Curlew (B.P.) Island	Sanctuary	0.16	1987
24	Curlew Island	Sanctuary	0.03	1987
25	Cuthbert Bay	Sanctuary	5.82	1997
26	Defence Island	Sanctuary	10.49	1987
27	Dot Island	Sanctuary	0.13	1987
28	Dottrell Island	Sanctuary	0.13	1987
29	Duncan Island	Sanctuary	0.73	1987
30	East Island	Sanctuary	6.11	1987
31	East of Inglis Island	Sanctuary	3.55	1987
32	Egg Island	Sanctuary	0.05	1987
33	Elat Island	Sanctuary	9.36	1987
34	Entrance Island	Sanctuary	0.96	1987
35	Gander Island	Sanctuary	0.05	1987
36	Girjan Island	Sanctuary	0.16	1987
37	Goose Island	Sanctuary	0.01	1987
38	Hump Island	Sanctuary	0.47	1987
39	Interview Island	Sanctuary	133.87	1987
40	James Island	Sanctuary	2.10	1987
41	Jungle Island	Sanctuary	0.52	1987
42	Kwangtung Island	Sanctuary	0.57	1987
43	Kyd Island	Sanctuary	8.00	1987

44	Landfall Island	Sanctuary	29.48	1987
45	Latouche Island	Sanctuary	0.96	1987
46	Lohabarrack (Saltwater Crocodile)	Sanctuary	22.21	1987
47	Mangrove Island	Sanctuary	0.39	1987
48	Mask Island	Sanctuary	0.78	1987
49	Mayo Island	Sanctuary	0.10	1987
50	Montogemery Island	Sanctuary	0.21	1987
51	Narcondam Island	Sanctuary	6.81	1987
52	North Brother Island	Sanctuary	0.75	1987
53	North Island	Sanctuary	0.49	1987
54	North Reef Island	Sanctuary	3.48	1987
55	Oliver Island	Sanctuary	0.16	1987
56	Orchid Island	Sanctuary	0.10	1987
57	Ox Island	Sanctuary	0.13	1987
58	Oyster Island-I	Sanctuary	0.08	1987
59	Oyster Island-II	Sanctuary	0.21	1987
60	Paget Island	Sanctuary	7.36	1987
61	Parkinson Island	Sanctuary	0.34	1987
62	Passage Island	Sanctuary	0.62	1987
63	Patric Island	Sanctuary	0.13	1987
64	Peacock Island	Sanctuary	0.62	1987
65	Pitman Island	Sanctuary	1.37	1987
66	Point Island	Sanctuary	3.07	1987
67	Potanma Islands	Sanctuary	0.16	1987
68	Ranger Island	Sanctuary	4.26	1987
69	Reef Island	Sanctuary	1.74	1987
70	Roper Island	Sanctuary	1.46	1987
71	Ross Island	Sanctuary	1.01	1987
72	Rowe Island	Sanctuary	0.01	1987
73	Sandy Island	Sanctuary	1.58	1987
74	Sea Serpent Island	Sanctuary	0.78	1987
75	Shark Island	Sanctuary	0.60	1987
76	Shearme Island	Sanctuary	7.85	1987
77	Sir Hugh Rose Island	Sanctuary	1.06	1987
78	Sisters Island	Sanctuary	0.36	1987
79	Snake Island-I	Sanctuary	0.73	1987
80	Snake Island-II	Sanctuary	0.03	1987
81	South Brother Island	Sanctuary	1.24	1987
82	South Reef Island	Sanctuary	1.17	1987
83	South Sentinel Island	Sanctuary	1.61	1987
84	Spike Island-I	Sanctuary	0.42	1987
85	Spike Island-II	Sanctuary	11.70	1987
86	Stoat Island	Sanctuary	0.44	1987
87	Surat Island	Sanctuary	0.31	1987
88	Swamp Island	Sanctuary	4.09	1987
89	Table (Delgarno) Island	Sanctuary	2.29	1987

90	Table (Excelsior) Island	Sanctuary	1.69	1987
91	Talabaicha Island	Sanctuary	3.21	1987
92	Temple Island	Sanctuary	1.04	1987
93	Tillongchang Island	Sanctuary	16.83	1985
94	Tree Island	Sanctuary	0.03	1987
95	Trilby Island	Sanctuary	0.96	1987
96	Tuft Island	Sanctuary	0.29	1987
97	Turtle Islands	Sanctuary	0.39	1987
98	West Island	Sanctuary	6.40	1987
99	Wharf Island	Sanctuary	0.11	1987
100	White Cliff Island	Sanctuary	0.47	1987
		Total Area	**1594.78**	
Lakshadweep				
1	Pitti	Sanctuary	0.01	2002
2	A. Attakoya Thangal Marine	Conservation Reserve	40.00	2019
3	Dr. K.K. Mohammed Koya Sea Cucumber	Conservation Reserve	172.59	2019
4	P.M. Sayeed Marine Birds	Conservation Reserve	57.46	2019
		Total Area	**270.06**	
		Grand Total Area	**1864.84**	

https://wii.gov.in/images/images/documents/GIZ/Reference.pdf

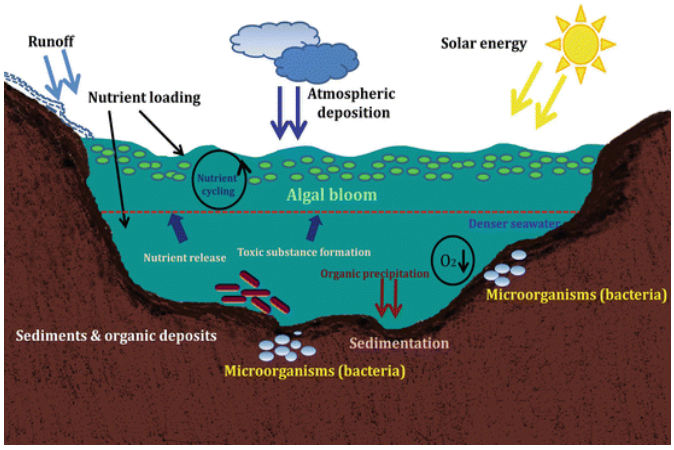


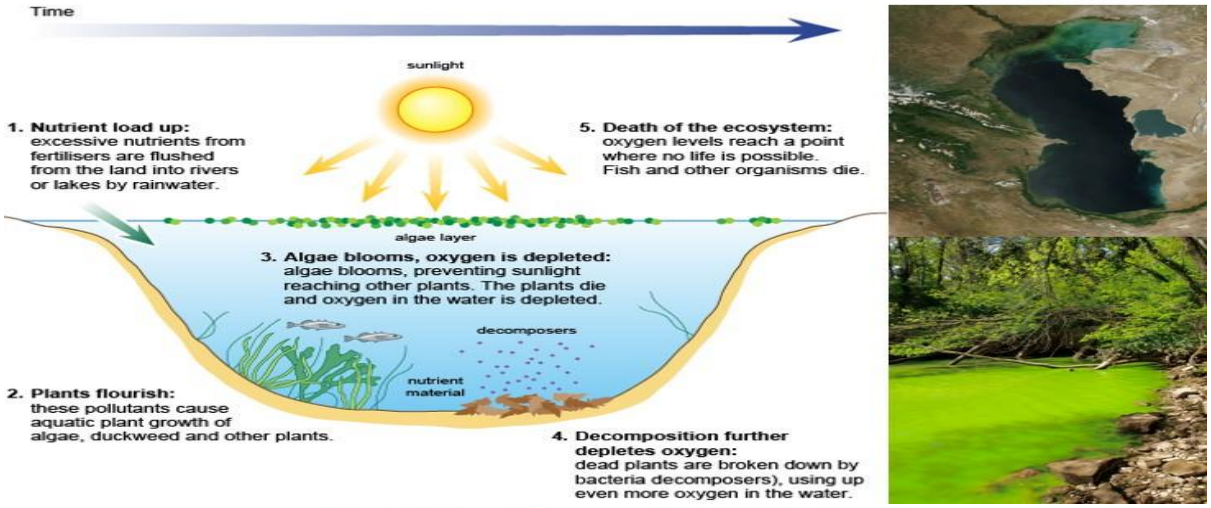
Define Eutrophication means excessive nutrients in water

- Ans : is the process of enrichment of an ecosystem's water body by the addition of nutrients by artificial or natural means, leading to plentiful plant growth.
- The excess supply of nutrients may be through detergents, fertilizers, or sewage, to an aquatic system. And also deforestation increases soil erosion, leading to eutrophication.
- 80 per cent of all pollution in seas and oceans comes from land-based activities.
- Nitrogen loads to oceans roughly tripled from pre-industrial times due to fertilizer, manure and wastewater. The global economic damage of nitrogen pollution is estimated at $200–800 billion per year
- In many parts of the world, (urban) sewage flows untreated, or under-treated, into the ocean
- Pollution and eutrophication (excessive nutrients in water) are also caused by run off from the land, which cause dense plant growth and the death of animal life
- The five large marine ecosystems most at risk from coastal eutrophication are: Bay of Bengal, East China Sea, Gulf of Mexico, North Brazil Shelf and South China Sea
- Increased nutrient loading from human activities, combined with the impacts of climate change and other environmental change has resulted in an increase in the frequency, magnitude, and duration of harmful algal blooms worldwide.
- These algal blooms can contaminate seafood with toxins, and impact ecosystem structure and function, recreational activities, fisheries, tourism and coastal property values

Algal bloom are the consequences of eutropication (Phytoplankton (algae and blue-green bacteria) thrive on the excess nutrients and their population explosion covers almost entire surface layer. This condition is known as **algal bloom**
Most algal blooms are not harmful but some produce toxins and do affect fish, birds, marine mammals and humans. The toxins may also make the surrounding air difficult to breathe. These are known as Harmful Algal Blooms (HABs). Blooms can

appear greenish, brown, and even reddish orange depending upon the type of organism, the type of water, and the concentration of the organisms.



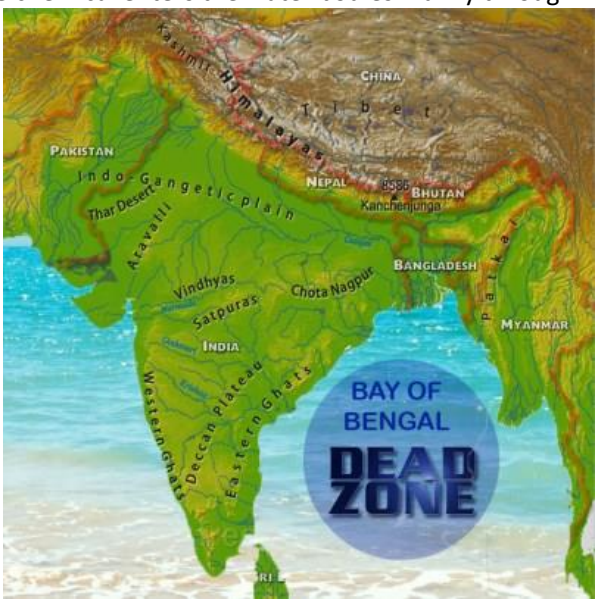


What are Dead Zones?

- Nutrient over-enrichment from agricultural, municipal and industrial sources contributes to the socalled “dead zones”—hypoxic regions that exhibit oxygen levels that are too low to support many aquatic organisms including commercially desirable species. The extent and duration of “dead zones” is also increasing worldwide.
- Dead zones are large areas in water bodies which have little or no oxygen concentration. They have no marine life as the immovable ones die due to suffocation while the movable ones, like fish, crab etc swim away.

What causes Dead Zones:

The main cause of dead zones are nutrient pollution. The Nitrogen and Phosphorous are the main chemicals responsible for dead zones. These chemical enters the water bodies mainly through human activities**. In Bay of Bengal. It is a matter of big concern for envir**



famous seas and oceans which have dead zones are:

1. *Entire bottom floor of Baltic Sea*
2. *Some areas in Gulf of Mexico*
3. *Western coasts of North and South America*
4. *Coast of Namibia*
5. *Western coast of India.*

The Bay of Bengal hosts a 'dead zone' of an estimated 60,000 square kilometres — an area that contains little or no oxygen and supports microbial processes that remove vast amount of nitrogen from the ocean, scientists, including those from India, have found

- **Process of formation of Dead Zone & Eutrophication**:

- Eutrophication is a condition in water body where large amount of nutrients are accumulated in the water.
- The nutrients involved in Eutrophication are Nitrogen and Phosphorus.
- These nutrients enter the water body through:
- Runoff from agriculture and development
- pollution from septic systems and sewers,and other human-related activities

Explanation:

1. Presence of large amount of nutrients causes algae to grow.
2. Excessive grow of algae cause Algal bloom.
3. It absorbs oxygen from water body. The Algal Boom stops the light to enter the water body. Causing Marine life to dead.
4. The dead marine life is decomposed by bacteria's, which consumes all oxygen in the water body and ends the marine life.

ECOLOGICAL EFFECTS OF EUTROPHICATION:

- Phytoplankton grows much faster in such situations.
- These phytoplankton species are toxic and are inedible.
- Gelatinous zooplankton blooms fast in these waters.
- Increased biomass of benthic and epiphytic algae.
- Changes in macrophyte species composition and biomass.
- Decreases in water transparency.
- Colour, smell, and water treatment problems.
- Dissolved oxygen depletion.
- Increased incidences of a fish kill.
- Loss of desirable fish species.
- Reductions in harvestable fish and shellfish.
- Decreases in the perceived aesthetic value of the water body.

EFFECTS OF EUTROPHICATION

- ***Loss of fresh water lakes:*** Eutrophication eventually creates detritus layer in lakes and produces successively **shallower** depth of surface water. Eventually the water body is reduced into marsh whose plant community is **transformed** from an aquatic environment to recognizable **terrestrial** [Lakes are one of the major sources of fresh water]
- ***New species invasion:*** Eutrophication may cause the ecosystem competitive by transforming the normal limiting nutrient to abundant level. This cause shifting in species composition of ecosystem.
- ***Toxicity:*** Some algal blooms when died or eaten, release **neuro & hepatotoxins** which can kill aquatic organism & pose threat to humans. E.g. **Shellfish poisoning**.
- ***Loss of coral reefs:*** Occurs due to decrease in water transparency (increased turbidity).
- Affects navigation due to increased turbidity; creates colour (yellow, green, red), smell and water treatment problems; increases biomass of inedible toxic phytoplankton, benthic and epiphytic algae and bloom of gelatinous zooplankton.

MITIGATION OF EUTROPHICATION

- Checking water pollution is the ultimate solution to eutrophication.
- Treating Industrial effluents domestic sewage to remove nutrient rich sludge through waste water processing.
- Riparian buffer: Interfaces between a flowing body of water and land created near the waterways, farms, roads, etc. in an attempt to filter pollution. Sediments and nutrients are deposited in the buffer zones instead of deposition in water [Wetlands, estuaries are natural riparian buffers].
- Increase in efficiency of nitrogen & phosphorous fertilizers and using them in adequate levels.
- Nitrogen testing & modeling: N-Testing is a technique to find the optimum amount of fertilizer required for crop plants. It will reduce the amount of nitrogen lost to the surrounding area.
- Encouraging organic farming.
- Reduction in nitrogen emission from vehicles and power plants.

What Policy makers also focus on: In order to reverse eutrophication trends and mitigate nutrient losses to aquatic ecosystems, policymakers should:

- **Implement research and monitoring programs** to characterize the effects of eutrophication, collect water quality data, **and inform adaptive management strategies**. Information is a key element in the development of robust strategies to reduce eutrophication.
- **Raise awareness of eutrophication**. Eutrophication and its effects are not well understood by the public or policymakers. Public **awareness campaigns, school environmental education programs, and targeted outreach and technical assistance** are all important components of raising the profile of eutrophication within communities and building a foundation and support for effective actions to reduce nutrient losses and eutrophication.
- **Implement regulations to mitigate nutrient losses**, such as standards, technology requirements, or pollution caps for various sectors.
- Create fiscal and economic incentives to encourage nutrient reducing actions using taxes and fees, subsidies, or environmental markets.
- Preserve and restore natural ecosystems that capture and cycle nutrients.
- Establish strong, engaged, and coordinated institutions to address eutrophication. Effective institutions to implement and enforce policies are important to the success of any eutrophication strategy, especially where multiple jurisdictions are involved.
- Capitalize on environmental synergies when designing comprehensive policies to address eutrophication. Many policies and activities associated with reducing nutrient pollution have synergies with other environmental problems such as climate change, smog, and acid rain.

OCEAN ACIDIFICATION:

- is the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide (CO_2) from the atmosphere.
- Seawater absorbs CO_2 to produce carbonic acid, bicarbonate and carbonate ions.

However, increase in atmospheric CO_2 levels lead to decrease in pH level, and

1. increase in the concentration of carbonic acid and bicarbonate ions,
2. causing a decrease in the concentration of **carbonate ions**.

Thus carbonate ions are less available and calcification is therefore harder to achieve, and may be prevented altogether

CAUSES OCEAN ACIDIFICATION:

- The Ocean acidification has increased only after the industrialisation, Burning of fossil fuels, Changes of land use, increase, add, Raising of carbon dioxide levels in the ocean,. Raising of carbon dioxide in the atmosphere, Lack of environmentally friendly laws and regulations.
- the release of carbon dioxide from these Human activities is also leading to ocean acidification. The oceans ultimately absorb most carbon dioxide from the atmosphere, and thus play a critical role in regulating climate. They also help to mitigate human caused climate change. But the unprecedented amount of carbon dioxide being created by human activity has surpassed what the oceans can healthfully absorb, changing ocean chemistry and making them more acidic
- The increased acidity in the oceans is expected to lead to a shortage of carbonate, a key building block that
- some animals (and plants) need to build their shells and skeletons. Besides corals, other animals that use
- carbonate to build and strengthen their shells (called calcifiers) may also suffer. These animals include shellfish like clams, oysters, crabs, and lobsters.
- Carbon dioxide dissolves more readily in cold water, acidifying polar waters faster than in lower latitudes. In fact, scientists have determined that the surface waters of the Southern Ocean will begin to become corrosive to some types of carbonate structures by the year 2050 if carbon dioxide emissions continue to increase at the current rate.

I**MPACT**:

- Direct effects on the physiology of animals and plants may result from a lack of available carbonate needed to build and strengthen shells and .skeletons
- BIOLOGICAL PROCESSES AFFECTED BY OCEAN ACIDIFICATION Increasing acidity, which also changes the carbonate chemistry of seawater, combined with other environmental stressors like increasing ocean temperature and pollution, has the potential to affect many biological processes.
- Increasing acidity depresses metabolic rates and immune responses in some organisms.
- increasing acidity may reduce the ability of certain fish to breathe, and increase the growth rates of some sea stars

- Indirect effects may occur due to loss of habitat, changes in food availability or the abundance of predator populations
- Plankton to Whale affected leads to population levels consequences and ripple effect on Marine ecosystem.
- Corals Show Decreased Growth, Some 500 million people worldwide depend on reefs for coastal protection, food and income. Also, apprx 4000 species ,of fish depend on coral reefs for habitat
- decrrease of coral reef, impact sea turtle which depand upon it.
- Pteropods, abundant, tiny swimming sea snails, called as " Potato chips of the sea", or "sea butterfly," is a tiny sea creature about the size of a small pea.,they build calcium carbomnate shells, diminsh due to ocean acidity. it is imp part of diets of Zooplanktons., salmon, herrings ,birds etc, its effect, creates ripple effect thru the food chains.
- Most devasttating impact of OC is Could be Collapse of Food Web,
- Sea urchin are found near coral reef and rock coast decline

IMPACT OF OCEAN ACIDIFICATION ON CLOUD FORMATION

- The majority of sulfur in the atmosphere is emitted from the ocean, often in the form of dimethylsulfide (DMS) produced by phytoplankton.
- Some of DMS produced by phytoplankton enters the atmosphere and reacts to make sulphuric acid, which clumps into aerosols, or microscopic airborne particles.
- **Aerosols seed the formation of clouds**, which help cool the Earth by reflecting sunlight.
- **But, in acidified ocean water, phytoplankton produce less DMS. This reduction of sulfur may lead to decreased cloud formation, raising global temperatures.**
- It has a huge impact on commercial fisheries, shellfisheries, aquaculture, recreational fisheries, Subsistence, traditional shellfisheries and fisheries, Tourism activities such as scuba diving.
- **Ecological Winners** :Algae and sea grasses, flourish, Jellies or jellyfish ,Sea Star,and invasive may dominate,
- Decline in Commercial fisheries which impact nutritional aspect and The rapid decrease or disappearance of marine life could also affect the diet of Indigenous peoples.

The acidification of oceans is increasing. Why is this phenomenon a cause of concern?

1. The growth and survival of calcareous phytoplankton will be adversely affected.
2. The growth and survival of coral reefs will be adversely affected.
3. The survival of some animals that have phytoplanktonic larvae will be adversely affected.
4. The cloud seeding and formation of clouds will be adversely affected.

Which of statements given above is / are correct?

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

Gothenburg Protocol is related to which among the following?

[A] Protocol to Abate Acidification, Eutrophication and Ground-level Ozone
[B] Protocol aimed to reduce green house gases.
[C] Protocol on the Transboundary Movement of Hazardous Wastes and their Disposal
[D] Protocol for the protection of migratory birds

EXP : 1999 Gothenburg Protocol (Gothenburg (Sweden) on 30 November 1999.)

- The **1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone** (known as the **Multi-effect Protocol** or the **Gothenburg Protocol**)
- The Protocol is part of the Convention on Long-Range Transboundary Air Pollution.

- is a multi-pollutant protocol designed to reduce acidification, eutrophication and ground-level ozone by setting emissions ceilings for sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia to be met by 2010. As of August 2014, the Protocol had been ratified by 26 parties, which includes 25 states and the European Union

- The Protocol sets emission ceilings for 2010 for four pollutants: Sulphur, NOx, VOCs and ammonia.
- The Convention is an **international agreement to protect human health and the natural environment from air pollution** by controlling and reducing air pollution, including long-range transboundary air pollution.

  - It was updated in 2012 to include particulate matter (PM) and black carbon (as a component of PM) and to include new commitments for 2020.
  - This multi-pollutant, multi-effect protocol is meant to eventually replace the older protocols that cover the same pollutants.
  - Thus, when all Parties ratify the amended Protocol, their obligations under the following existing protocols: SO2 (1985 Helsinki and 1994 Oslo Protocols); NOx (1988 Sofia Protocol); and VOC (1991 Geneva Protocol); will become null and void.
  - India has not signed the protocol.

Kyoto Protocol

- The Kyoto Protocol is a protocol (update) to the United Nations Framework Convention on Climate Change. It was initially adopted on 11 December 1997 in Kyoto, Japan and entered into force on 16 February 2005. As of July 2010, 191 states have signed and ratified the protocol.
- Kyoto Protocol aims to reduce the emissions of the Green House Gases such as:
  1. Methane Nitrous Oxide
  2. Carbon dioxide
  3. Hydrofluorocarbons
  4. Perfluorocarbons
  5. Sulphur hexafluoride

Q: Which of the following is/are among the international initiative taken to contain Nitrogen Pollution?

1. Gothenburg Protocol
2. Kyoto Protocol
3. Minamata Convention

Select the correct answer using the correct codes given below:
(a) Only 1
(b) Only 2
(c) Only 1 and 2
(d) Only 2 and 3
Ans.(c)

****

CHAPTER 4 : WETLAND : IMPORTANCE AND ISSUES

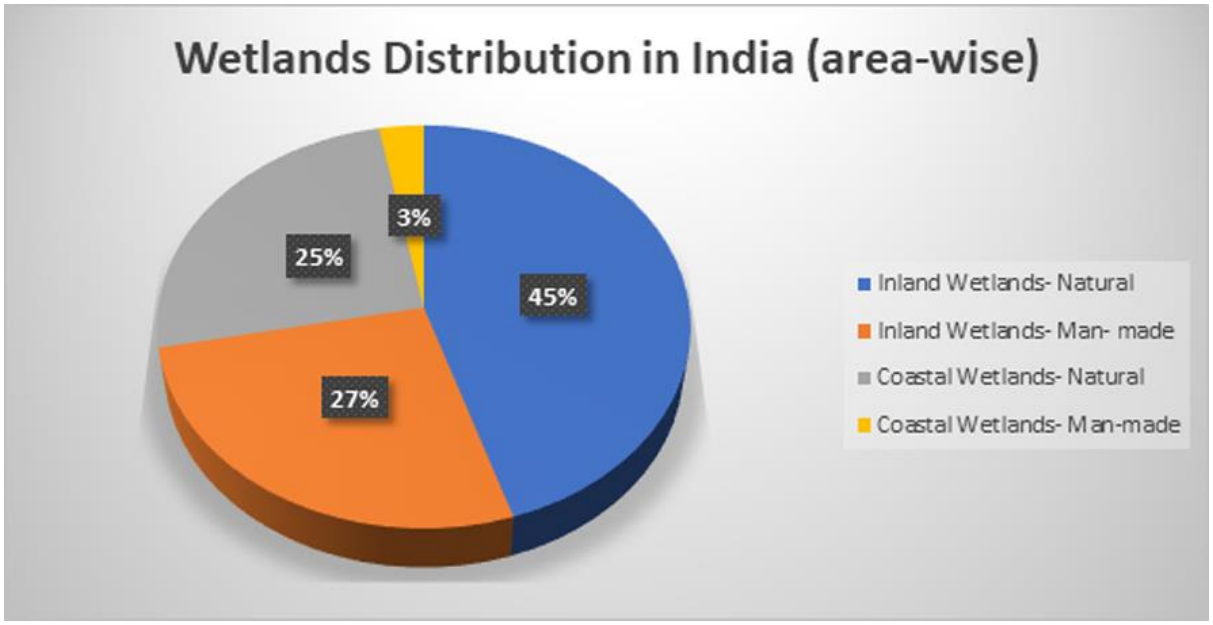
Why India bestowed with rich diversity of Wetland?

Reason : wide variations in rainfall, hydrology, physiography, geomorphology and climate

How Much India 's Land under Wetland ?

- It is estimated that India has 15.98 million ha area under wetlands, roughly equal to 4.86% of its land area, as per the National Wetlands Atlas, 2021 published by Space Applications Centre, Ahmedabad

- India has totally 27, 403 wetlands, of which 23,444 are inland wetlands and 3,959 are coastal wetlands. The coastal wetlands occupy an estimated 6,750 sq km and are largely dominated by mangrove vegetation. Most of the wetlands in India are directly or indirectly linked with major river systems such as the Ganges, Cauvery, Krishna, Godavari and Tapti.
-
- inland wetlands constitute 74.1% (11.85 million ha) and rest coastal wetlands (see ratio)



Inland Wetlands – Natural 45 % (decreasing percentage wise)

- River /Stream (35 %)
- Lake/ Pond (5 %)
- waterlogged
- High Altitude
- Ox bow lake / Cut off Meander
- Riverine wetland

Inland Wetlands -Man-made

- Reservoir/Barrage
- Tank/Pond
- Waterlogged
- Salt pan

Coastal Wetlands – Natural

- Intertidal mud flat
- Mangrove
- Lagoon
- Creek
- Salt Marsh
- Coral Reef
- Sand/Beach

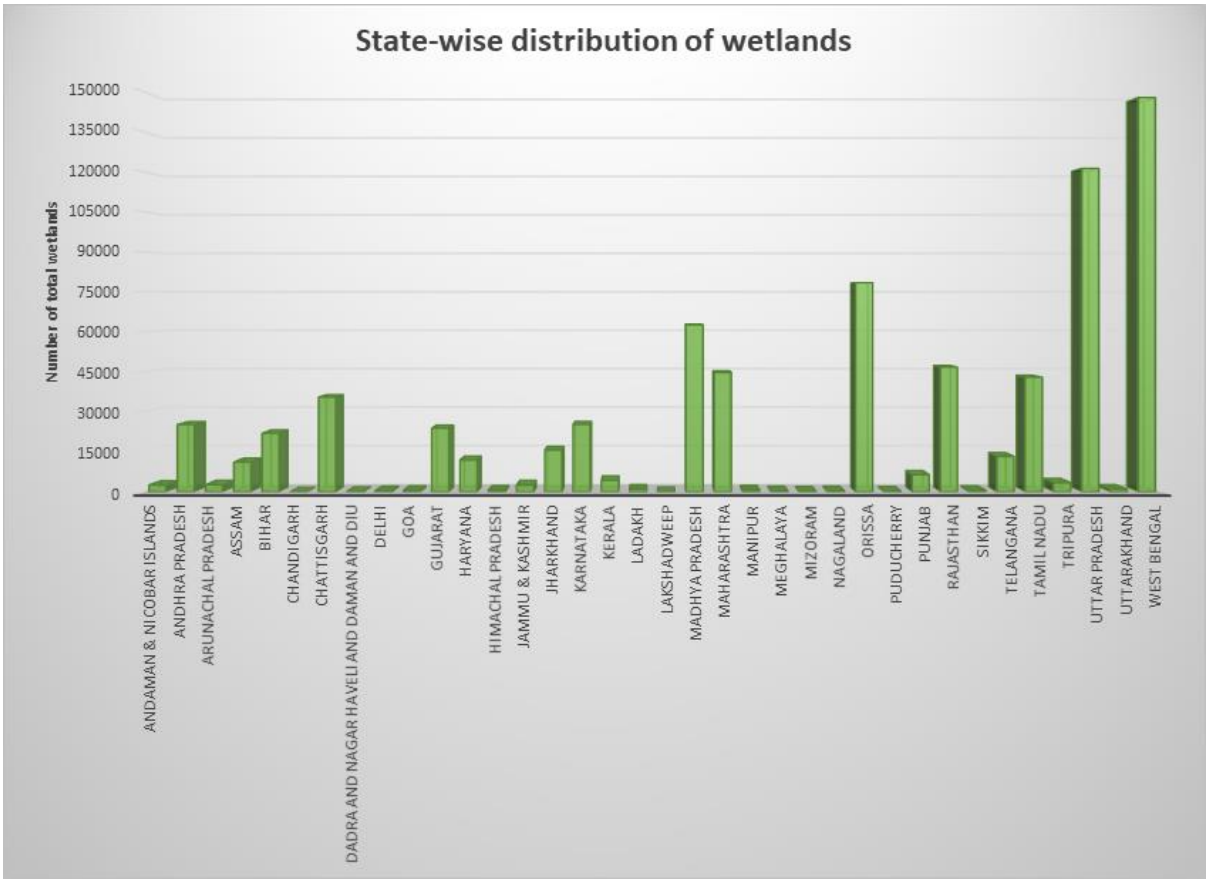
Coastal Wetlands – Man-made

- Aquaculture pond
- Salt pan

Key Note :

- Bogs : waterlogged peatlands in old lake basins or depressions in the landscape. Almost all water in bogs comes from rainfall or snow
- Fens are less acidic than Bogs because water flow through them. **receive water and nutrients from mineral-rich surface or groundwateR**

Features	Fens	Bogs
Geographic distribution	worldwide, moist locations	primarily boreal, moist locations
Abundance	numerous	less numerous
Surface topography	concave/flat	convex (raised)
Peat depth	shallow	deep
pH	4–9	3.5–4.5
Nutrient source	ground water and atmosphere	atmosphere
Productivity	low - high	low
Decomposition	relatively high	low
Floristic diversity	low - high	low



WHAT IS THE RAMSAR CONVENTION?

- Ramsar Convention is known as the Convention of Wetlands. It was established in 1971 by UNESCO and came into force in 1975.
- February 2 is celebrated as International Wetlands Day, as the Ramsar Convention was signed on February 2, 1971.
- Secretariat: It is based at the headquarters of the International Union for Conservation of Nature (IUCN) in Gland, Switzerland (Global Wetland Outlook)

Global wetland Outlook facts

- report reveals that World's wetlands disappearing three times faster than forests

- Approximately 35 per cent of the world's wetlands were lost between 1970-2015 with annual rates of loss accelerating from 2000

What are Ramsar Sites?

- Any wetland site which has been listed under the Ramsar Convention that aims to conserve it and promote sustainable use of its natural resources is called a Ramsar Site.

- As per the Ramsar Convention, a wetland is defined as 'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tides does not exceed six meters'
- Wetlands rich in nutrients than lake and having abundant growth of aquatic Macrophytes. They support high densities and diverse fauna, particularly birds, fish and macroinvertebrates, and therefore, have high value for biodiversity conservation

Is India a part of the Ramsar Convention?

Yes, India is a party to the Ramsar Convention. India signed under it on 1st February 1982.
Rivers and rice paddies can also be classified as wetlands according to the Ramsar Convention.

But in India , River channels and paddy fields cannot be notified as wetlands under the Wetlands (Conservation and Management) Rules, 2017

The Ministry of Environment, Forest and Climate Change notified Wetlands (Conservation and Management) Rules, 2017 under the provisions of the Environment (Protection) Act, 1986 as the regulatory framework for conservation and management of wetlands in India.

The Ministry of Environment has notified the Guidelines for implementing Wetlands (Conservation and Management) Rules, 2017. Permission for carrying out any prohibited activity within a notified wetland can only be given by the Ministry of Environment upon a specific request made by State Government. State govt alone cannot permit to use for any prohibited activity

Wetlands falling within areas covered under the Wildlife (Protection) Act, 1972; Indian Forest Act, 1927; Forest (Conservation) Act, 1980; State Forest Acts; Coastal Regulation Zone Notification, 2011; and amendments to each of them, cannot be notified under the Wetlands (Conservation and Management) Rules, 2017.

The Wetlands (Conservation and Management) Rules, 2017 do not apply to which of the following?
1. River channels
2. Paddy fields
3. Wetlands falling within areas covered under the Wildlife (Protection) Act, 1972
4. Wetlands categorized as 'wetlands of international importance' under the Ramsar Convention
Select the correct answer using the code given below.
a) 1 and 2 only
b) 3 and 4 only
c) 1, 2 and 3 only
d) 1, 2, 3 and 4
Correct answer is option 'C'. Can you explain this answer?

How many Ramsar Sites are in India?

"international importance" under the Ramsar Convention : There are 80 Ramsar sites in India as of January 2024 (Year 2014: 26 Ramsar Sites)

Which is the first Ramsar Site in India?

Chilika Lake (Odisha) and Keoladeo National Park (Rajasthan) were recognized as the first Ramsar Sites of India

Key Facts :

- Tamil Nadu has the highest number of Ramsar Sites in India with 16 Ramsar Sites.
- Which is the largest Ramsar Site in India : Sundarbans is the largest Ramsar Site in India
- Which is the smallest wetland in India?: Renuka Wetland (Area – 20 ha) in Himachal Pradesh is the smallest wetland of India
- The United Kingdom has the world's largest number of Ramsar Sites i.e. 175.
- There are currently over 2500 Ramsar sites in the world
- World's First Ramsar site was identified in 1974, which was the Cobourg Peninsula in Australia.

The main advantages of joining Ramsar Convention are that it.

- Encourages international cooperation
- Brings access to expert advice and latest information
- Presents an opportunity for a country to make its voice heard at the international and the Governmental level
- Provides an opportunity for wise use of wetlands
- Opportunity for getting international guidelines on various wetland• conservation themes

The Ramsar Convention works with the collaboration of the following organizations:

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

Wetland International

- is an NGO.
- Formed in 1954
- But Ramsar convention was signed in 1971
- It is **one of the International Partner Organizations of the Ramsar Convention**.
- work in reserach, advocacy , and engagement with government , corporate, and international policy forums
- **coordinates the International Waterbird census of which the Asian Waterbird census is an integral part**.
-

New Added in January 2024

five new sites were added to the list of Ramsar Sites in India.

1. **Ankasamudra Bird Conservation Reserve – Karnataka**
2. **Aghanashini Estuary – Karnataka**
3. **Magadi Kere Conservation Reserve – Karnataka**
4. **Karaivetti Bird Sanctuary – Tamil Nadu**
5. **Longwood Shola Reserve Forest – Tamil Nadu**

WETLAND ECOSYSTEM

Importance Of Wetlands : Ecosystem Services And Biodiversity Values

- They are essential for human wellbeing, economic security and climate change mitigation and adaptation
- 'cradles of human civilisation: important societal assets and liquid assets
- 'kidneys of landscape

- Biological Supermarkets
- They regulate water quantity, groundwater recharge, and can contribute to regulating floods (work as sponge)
- These are found in ecotone region and one of the most productive habitat in the world With greater species diversity nutrient recycling and niche specialization , great Biotic and tropic level interaction than most other ecosystems
- play crucial role in hydrological cycle. Wetlands cycle both sediments and nutrients,
- A natural function of wetland vegetation is the up-take, storage, and (for nitrate) the removal of nutrients found in runoff water from the surrounding landscapes
- In many wetlands, microbial processes convert soluble nutrients to a gaseous form, such as denitrification of nitrate, which then moves the nitrate to the atmosphere mostly as harmless nitrogen gas
- wetland dominated by trees called " Swamps" like freshwater swamps, brackish swamps and saltwater swamps
- Swamps and marshes are generally found in warm climates. Bogs are more common in cold or even Arctic areas. Bog found in water high region having acidic soils so limited species of Plants

ECOSYSTEM SERVICES :

- Water storage
- **Waterfowl Habitat (**birds depended on water bodies)
- Water-regime and stream flow regulators
- Water purification
- Habitat to diverse flora and fauna including resident and migratory species
- Nutrient recycling;
- Buffer shorelines from erosion;
- Buffer communities against floods, droughts, cyclones and wave surges;
- Local climate regulators
- Carbon sinks
- Coastal wetlands such as mangroves sequester carbon up to 55 times faster than tropical rainforests.
- Support livelihoods by providing food, water and fiber;

- Support a variety of life forms through extensive food webs
- Ground water recharge;
- Cultural and spiritual values: Enhance landscape aesthetics
- Provide recreational opportunities

What is wetland? Explain the Ramsar concept of 'wise use' in the context of wetland conservation. Cite two examples of Ramsar sites from India

Wetlands are ecotones between terrestrial and aquatic ecosystems. They get periodically get inundated with water. Swamps, marshes and mangroves are examples of wetlands

Ramsar "Wise use concept" based on :

- the sustainable utilization of wetlands for benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem".
- it requires that wetlands' **ecological character** should be maintained **within the framework of sustainable development**
- the conservation and restoration of the natural state of the wetlands.
- This involves the participation of the government, communities, individuals and NGOs for mitigating negative impacts on the wetland ecosystems.
- **due to high level of poverty & population,** it's not possible for developing countries & Least Developed Countries (LDCs) to keep wetlands in pristine conditions completely free from human activities.
- The "wise use" concept of Ramsar convention is a notable attempt made to strike balance **between these two opposing aspects.**
- It is, therefore, recommended that the 'precautionary approach is adopted to ensure wetland conservation.

See Two Example

- For instance, in an urban lake type of wetland, intervention like concretisation of shoreline for beautification will increase the aesthetic value and tourism benefits but will lead to decrease in the "ability to accommodate monsoon flows" and thus may not be a "wise-use".
- for example a Lagoon area Prawn aquaculture by creating enclosures within the lagoon area Intervention will provide food and livelihoods for coastal communities but disturb flood buffering and water regime moderation, so it is not be a wise use
It is, therefore, recommended that the 'precautionary approach is adopted to ensure wetland conservation.

A wetland use is not 'wise-use' if: The intervention leads to adverse changes in ecosystem components and processes, such as:

- i. Reduction in water flowing into the wetlands
- ii. Reduction in the area under inundation, or changes in inundation regime
- iii. Reduction and alteration of natural shoreline
- iv. Fragmentation of wetlands into small patches of water v. Reduction in water holding capacity
- vi. Degradation of water quality
- vii. Reduction in diversity of native species
- viii. Introduction or emergence of invasive species
- ix. Decline in wetlands resources, such as fish, aquatic plants, and water

Environmental Principles:

- **Polluter Pays Principle:** It states that the polluter should bear the cost of damage caused by it to the natural environment
- **Precautionary Principle:** It states that even in the absence of scientific evidence, measures must be taken to anticipate and prevent the causes of environmental degradation. It is the social responsibility of the State to protect the public from any plausible risk. (like government make compulsory mask wearing)

- **Public trust Doctrine:** It states that resources like water, air, sea and forest have a great importance to the general public that it would be unjustified to make it the subject of private ownership. It poses a duty on the State to protect such resources for the benefit of all and not to permit any commercial use of it.
- **Sustainable Development Principle:** It states that the State should try to strike a balance between development and environment.

THREATS

- Wetlands : stressed by a range of anthropogenic and non-anthropogenic pressures,
- Climate Change
- sea level rise adversely affect the coastal wetlands: experience changes to their morphology, water balance, salinity levels and biodiversity.
- The high altitude wetlands would suffer due to problems associated with the reduction in the thickness and area of glaciers
- Retreating glaciers: number of glacial lakes has increased (creating positive feedback loop) But increasing the risk of Glacial Lake Outburst Floods (GLOFs)
- land use change,
- Fragmentation of hydrological regime
- Encroachment and land reclamation
- Siltation; eutrophication
- Pollution;
- Species invasion including alien species; Water hyacinth, Tilapia, Salvinia, Ipomoea and Alternanthera
- over harvesting of natural resources,
- Unregulated Tourism
- Pastoralism : Changes in grazing regime(Indigenous communities like Gaddi of Himachal Pradesh and Dopka and bhutia of Sikkim graze their cattle; Changpa nomads of Changthang plateau,
- Conversion for Agriculture
- Infrastructures development
- Intensive agriculture, Aquaculture

Suitable Examples

- Reclamation of urban lakes in Bangalore and Chennai is one of the major factors leading to increased urban flooding

- Enhancement of permanent agriculture has adversely affected the livelihoods of over 15,000 fishermen living around Kanwar Jheel in North Bihar. Agriculture in turn has been impacted by lowering of ground water levels and flooding attributed to the shrinkage in wetland area

- Conversion of marshes associated with Wular Lake for agriculture and afforestation has reduced the capacity of the wetland system to regulate the flow regime leading to increased floods and droughts

- Changes in water regimes of Loktak Lake Manipur and decimation of migratory fisheries and rapid degradation of habitat of globally endangered ungulate species - Brow Antlered Deer (Rucervus eldii) or Sangai for which the wetland is the only known natural habitat
- Agriculture in the backwaters of VembanadKol created distress to the farmers and also caused irreversible changes to the wetland habitat

- **Regulations of Wetlands in India**: Wetlands are regulated under the **Wetlands (Conservation and Management) Rules, 2017.**

- The 2010 version of the Rules provided for a Central Wetland Regulatory Authority, but new Rules of 2017 replaced it with state-level bodies and created a National Wetland Committee, which functions in an advisory role.
- The newer regulations removed some items from the definition of "wetlands" including backwaters, lagoons, creeks, and estuaries.
- Under the 2017 regulations, the process to identify the wetlands has been delegated to the States.
- Legal Framework in India : MOEFCC Wetlands (Conservation and Management) Rules, 2017, the guidelines said the management of notified wetlands is recommended to "be based on wise-use approach".

The 2010 Rules included in the definition of wetlands all inland waters such as lakes, reservoir, tanks, backwaters, lagoon, creeks, estuaries, etc.
It also included man-made wetland and the zone of direct influence on wetlands.
However, the 2017 Rules are not as comprehensive as this.
It does not include river channels, paddy fields, human-made water bodies/tanks specifically for drinking water purposes, aquaculture, salt production, recreation and irrigation purposes.
It also do not include wetlands under forest and coastal regulation zones..

- The **Central Wetlands Regulatory Authority** will be replaced by the **National Wetland Committee (NWC)**, which will be led by the MoEFCC secretary.

According to this new definition (excluding the aforementioned wetlands), nearly 65 percent of the country's wetlands will lose their status.

Wetlands (Conservation and Management) Rules 2017 have enhanced the focus of management of wetlands from a central authority to state bodies. The rules provide for an advisory role for the National Wetland Committee, to guide the state bodies on the integrated management of wetlands based on wise-use principle

_ Several legislations have been enacted which have relevance to wetland conservation.
These include

- Forest Act, 1927,
- Forest (Conservation) Act, 1980,
- the Wildlife (Protection) Act, 1972,
- the Air (Prevention and Control of Pollution) Act, 1981
- water Act 1974 the Water Cess Act, 1977
- Environment (Protection) Act, 1986.

The Water (Prevention and Control of Pollution) Cess Act was enacted in 1977, **to provide for the levy and collection of a cess on water consumed by persons operating and carrying on certain types of industrial activities**

INDIA CONSERVATION MEASURES :

- India is committed to conservation of wetlands in Indian Constitution : Article 51-A(g)

- India's assent to the Ramsar Convention in September 1982 provided an important backdrop to this decision
- The MoEFCC, at its inception in 1985, identified wetland conservation and sustainable management as one of its important programming themes.

- The Ministry established the National Wetlands Conservation Programme (NWCP) in 1986 to provide the overarching policy framework and financial assistance to the State Governments for implementation of site management plans.

- 2001, the National Lake Conservation Plan (NLCP) was introduced to address pollution issues in urban and semi-urban environments through interception, diversion and treatment of pollution load entering lakes

- 2013 'National Plan for Conservation of Aquatic Ecosystems' (NPCA) : uniform policy measure to promote an integrated and multi-disciplinary approach with a common regulatory framework.

- The NPCA is designed to address the gaps through focus on integrated wetland management in relation to their drainage basins, strengthening institutional arrangements and governance mechanisms, enhancing capacity and improving knowledge base and developing decision support system.

- In May 2022, the Ministry launched Mission Sahbhagita as a whole of society approach for wetland conservation and management

- Acknowledging the importance of conservation of Ramsar Sites, Government of India introduced 'Amrit Dharohar' in budget of FY 2023-24, to promote conservation values of Ramsar Sites.

Amrit Dharohar strategy

- Launched : June 5, 2023
- Goal : promoting the unique conservation values of Ramsar Sites
- operates within the broader framework of NPCA
- Focus on Four Components

a) Species and habitat conservation, b) Nature tourism, c) Wetland livelihoods, and d) Wetland carbon

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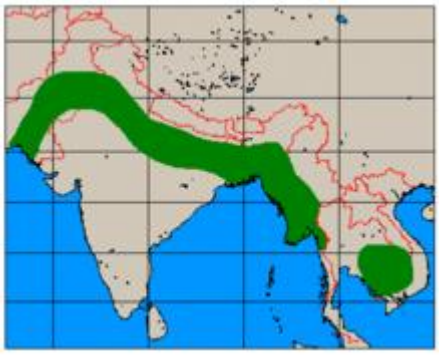
S. No.	State Location	Name of Site	Date of Declaration	Area
1	Andhra Pradesh	Kolleru Lake	19.8.2002	901.00
2	Assam	Deepor Beel	19.8.2002	40.00
3	Bihar	Kabartal Wetland	21.07.2020	26.20
4	Goa	Nanda Lake	06.08.2022	0.42
5	Gujarat	Khijadia Wildlife Sanctuary	13.04.2021	5.12
6	Gujarat	Nalsarovar Bird Sanctuary	24.09.2012	120.00
7	Gujarat	Thol Lake Wildlife Sanctuary	05.04.2021	6.99
8	Gujarat	Wadhvana Wetland	05.04.2021	6.30
9	Haryana	Bhindawas Wildlife Sanctuary	25.05.2021	4.12
10	Haryana	Sultanpur National Park	25.05.2021	1.43
11	Himachal Pradesh	Chandertal Wetland	8.11.2005	0.49
12	Himachal Pradesh	Pong Dam Lake	19.8.2002	156.62
13	Himachal Pradesh	Renuka Wetland	8.11.2005	0.20
14	Jammu and Kashmir	Hokera Wetland	8.11.2005	13.75
15	Jammu and Kashmir	Hygam Wetland Conservation Reserve	13.08.2022	8.02
16	Jammu and Kashmir	Shallbugh Wetland Conservation Reserve	13.08.2022	16.75
17	Jammu and Kashmir	Surinsar-Mansar Lakes	8.11.2005	3.50
18	Jammu and Kashmir	Wular Lake	23.3.1990	189.00
19	Karnataka	Ranganathittu Bird Sanctuary	15.02.2022	5.18
20	Kerala	Asthamudi Wetland	19.8.2002	61.40
21	Kerala	Sasthamkotta Lake	19.8.2002	3.73
22	Kerala	Vembanad Kol Wetland	19.8.2002	1512.50
23	Ladakh	Tso Kar Wetland Complex	17.11.2020	95.77
24	Ladakh	Tsomoriri Lake	19.8.2002	120.00
25	Madhya Pradesh	Bhoj Wetlands	19.8.2002	32.01
26	Madhya Pradesh	Sakhya Sagar	01.07.2022	2.48

27	Madhya Pradesh	Sirpur Wetland	01.07.2022	1.61
28	Madhya Pradesh	Yashwant Sagar	13.08.2022	8.23
29	Maharashtra	Lonar Lake	22.7.2020	4.27
30	Maharashtra	Nandur Madhameshwar	21.6.2019	14.37
31	Maharashtra	Thane Creek	13.08.2022	65.21
32	Manipur	Loktak Lake	23.3.1990	266.00
33	Mizoram	Pala Wetland	31.08.2021	18.50
34	Odisha	Ansupa Lake	13.08.2022	2.31
35	Odisha	Bhitarkanika Mangroves	19.8.2002	650.00
36	Odisha	Chilka Lake	1.10.1981	1165.00
37	Odisha	Hirakud Reservoir	13.08.2022	654.00
38	Odisha	Satkosia Gorge	10.12.2021	981.97
39	Odisha	Tampara Lake	13.08.2022	3.00
40	Punjab	Beas Conservation Reserve	26.9.2019	64.29
41	Punjab	Harike Lake	23.3.1990	41.00
42	Punjab	Kanjli Lake	22.1.2002	1.83
43	Punjab	Keshopur-Miani Community Reserve	26.9.2019	3.44
44	Punjab	Nangal Wildlife Sanctuary	26.9.2019	1.16
45	Punjab	Ropar Lake	22.1.2002	13.65
46	Rajasthan	Keoladeo Ghana NP	1.10.1981	28.73
47	Rajasthan	Sambhar Lake	23.3.1990	240.00
48	Tamil Nadu	Chitrangudi Bird Sanctuary	13.08.2022	2.60
49	Tamil Nadu	Gulf of Mannar Marine Biosphere Reserve	04.08.2022	526.72
50	Tamil Nadu	Kanjirankulam Bird Sanctuary	13.08.2022	0.97
51	Tamil Nadu	Karikili Bird Sanctuary	04.08.2022	0.58
52	Tamil Nadu	Koonthankulam Bird Sanctuary	11.08.2021	0.72
53	Tamil Nadu	Pallikaranai Marsh Reserve Forest	04.08.2022	12.48
54	Tamil Nadu	Pichavaram Mangrove	04.08.2022	14.79
55	Tamil Nadu	Point Calimere Wildlife and Bird Sanctuary	19.8.2002	385.00
56	Tamil Nadu	Suchindram Theroor Wetland Complex	13.08.2022	0.94
57	Tamil Nadu	Udhayamarthandapuram Bird Sanctuary	04.08.2022	0.44
58	Tamil Nadu	Vaduvur Bird Sanctuary	13.08.2022	1.13
59	Tamil Nadu	Vedanthangal Bird Sanctuary	04.08.2022	0.40
60	Tamil Nadu	Vellode Bird Sanctuary	04.08.2022	0.77
61	Tamil Nadu	Vembannur Wetland Complex	04.08.2022	0.20
62	Tripura	Rudrasagar Lake	8.11.2005	2.40
63	Uttar Pradesh	Bakhira Wildlife Sanctuary	29.06.2021	28.94
64	Uttar Pradesh	Haiderpur Wetland	8.12.2021	69.08
65	Uttar Pradesh	Nawabganj Bird Sanctuary	19.9.2019	2.25
66	Uttar Pradesh	Parvati Agra Bird Sanctuary	2.12.2019	7.22
67	Uttar Pradesh	Saman Bird Sanctuary	2.12.2019	5.26
68	Uttar Pradesh	Samaspur Bird Sanctuary	3.10.2019	7.99
69	Uttar Pradesh	Sandi Bird Sanctuary	26.9.2019	3.09
70	Uttar Pradesh	Sarsai Nawar Jheel	19.9.2019	1.61
71	Uttar Pradesh	Sur Sarovar	21.8.2020	4.31
72	Uttar Pradesh	Upper Ganga River	8.11.2005	265.90
73	Uttarakhand	Asan Conservation Reserve	21.7.2020	4.44
74	West Bengal	East Kolkata Wetlands	19.8.2002	125.00
75	West Bengal	Sunderbans Wetland	30.1.2019	4230.00

- Beas Conservation Reserve Punjab : endangered Indus river dolphin , endangered mahseer, hog deer, critically endangered gharial
-

-  Hog Deer Range in Green
- Bhitarkanika It is also famous for its saltwater crocodiles and olive ridley sea turtle..
- Nalbana Island was notified in 1987 and declared a bird sanctuary in 1973 under the Wildlife Protection Act. The Irrawaddy dolphin (*Orcaella brevirostris*) is the flagship species of Chilika lake
- Keoladeo NP: Additionally, the invasive growth of the grass *Paspalum distichum* has changed the ecological character of large areas of the site, reducing its suitability for certain waterbird species, notably the Siberian crane.
- Stork and crane : Stork (Carnivores , more adapted to dry environments.)and Crane (Omnivores cranes are found in wet areas)
- Lonar Lake Recently, the color of Lonar lake water had turned pink due to a large presence of the salt-loving "haloarchaea" microbes. Haloarchaea or halophilic archaea is a bacteria culture that produces pink pigment and is found in water saturated with salt.

What is wetland? Explain the Ramsar concept of 'wise use' in the context of wetland conservation. Cite two examples of Ramsar sites from India

Wetlands are ecotones between terrestrial and aquatic ecosystems. They get periodically get inundated with w ater. Swamps, marshes and mangroves are examples of wetlands

Ramsar "Wise use concept" based on :

- the sustainable utilization of wetlands for benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem".
- it requires that wetlands' **ecological character** should be maintained **within the framework of sustainable development**
- the conservation and restoration of the natural state of the wetlands.
- This involves the participation of the government, communities, individuals and NGOs for mitigating negative impacts on the wetland ecosystems.
- **due to high level of poverty & population,** it's not possible for developing countries & Least Developed Countries (LDCs) to keep wetlands in pristine conditions completely free from human activities.
- The "wise use" concept of Ramsar convention is a notable attempt made to strike balance **between these two opposing aspects.**
- It is, therefore, recommended that the 'precautionary approach is adopted to ensure wetland conservation.

See Two Example

- For instance, in an urban lake type of wetland, intervention like concretisation of shoreline for beautification will increase the aesthetic value and tourism benefits but will lead to decrease in the "ability to accommodate monsoon flows" and thus may not be a "wise-use".
- for example a Lagoon area Prawn aquaculture by creating enclosures within the lagoon area Intervention will provide food and livelihoods for coastal communities but disturb flood buffering and water regime moderation, so it is not be a wise use
It is, therefore, recommended that the 'precautionary approach is adopted to ensure wetland conservation.

A wetland use is not 'wise-use' if: The intervention leads to adverse changes in ecosystem components and processes, such as:

- i. Reduction in water flowing into the wetlands
- ii. Reduction in the area under inundation, or changes in inundation regime
- iii. Reduction and alteration of natural shoreline
- iv. Fragmentation of wetlands into small patches of water v. Reduction in water holding capacity
- vi. Degradation of water quality
- vii. Reduction in diversity of native species
- viii. Introduction or emergence of invasive species
- ix. Decline in wetlands resources, such as fish, aquatic plants, and water

Environmental Principles:

- **Polluter Pays Principle:** It states that the polluter should bear the cost of damage caused by it to the natural environment
- **Precautionary Principle:** It states that even in the absence of scientific evidence, measures must be taken to anticipate and prevent the causes of environmental degradation. It is the social responsibility of the State to protect the public from any plausible risk. (like government make compulsory mask wearing)
- **Public trust Doctrine:** It states that resources like water, air, sea and forest have a great importance to the general public that it would be unjustified to make it the subject of private ownership. It poses a duty on the State to protect such resources for the benefit of all and not to permit any commercial use of it.
- **Sustainable Development Principle:** It states that the State should try to strike a balance between development and environment.

Wetland Degradation in India

- Urbanisation and land use changes :mainly to illegal construction, unsustainable urbanisation, agricultural expansion and pollution . examples cities facing wetland loss: Mumbai, Ahmedabad, Bengaluru, Hyderabad ,Delhi and NCR, Pune
- the **Kanwar lake in Bihar**, Asia's largest freshwater oxbow lake, has shrunk to one-third of its size due to encroachment, much like Jammu and Kashmir's Dal lake.
- Agriculture residues : Due to more population in India, demand for food is increasing , As a result of intensification of agricultural activities and fertilizer consumption pattern in India is more .therby ; High nutrient contents s**timulate algal growth**, leading to **eutrophication** of surface water bodies
- Untreated Municipal and Industrial waste/ effluents pollute the soil and water bodies

Note:

- Renuka Wetland of Himachal Pradesh is smallest ramsar site in India
- Tamilnadu largest number of ramsar site total 14
- first Ramsar sites in India: Chilika Lake and Keoladeo National Park\Chilika Lake (Orissa) and Keoladeo National Park (Rajasthan) were recognized as the first Ramsar Sites of India in 1981

Shrinking Lakes in India

- **Vembanad lake, the second largest wetland system in India after the Sunderbans in West Bengal, is shrinking and its unique biodiversity is under threat of ecological decay despite it being declared as a Ramsar site 20 years ago (encroachment , illegal construction, effluents from the houses as well as the houseboats)**

Sambar lake in Rajasthan s **constantly shrinking with the degradation of soil** and **water quality** and **a decline in the population of** migratory birds**. (illegal salt pan encroachments.)**

- **Pulicat lake, India's second largest lagoon bordering Tamil Nadu and Andhra Pradesh, is threatened by the Dugarajapatnam port project. Tirupati district AP**

- Hyderabad Ramakrishnapuram (RK Puram) lake or Mukidigan cheruvu, which was spread over 100 acres during the Nizam-era has shrunk to 30 acres today.
- Wular lake is Kashmir is the largest freshwater lake in India is shrinking
- Dal Lake Srinagar
- Naini lake Uttarkhand
- Chilka lake
- Belandar lake Bangalore
- **Salinization :** Over withdrawal of groundwater has led to salinisation. see in Indian cities

Other Issue :

- Increased air temperature; shifts in precipitation; increased frequency of storms, droughts, and floods; increased atmospheric carbon dioxide concentration; and sea-level rise could also affect wetlands.

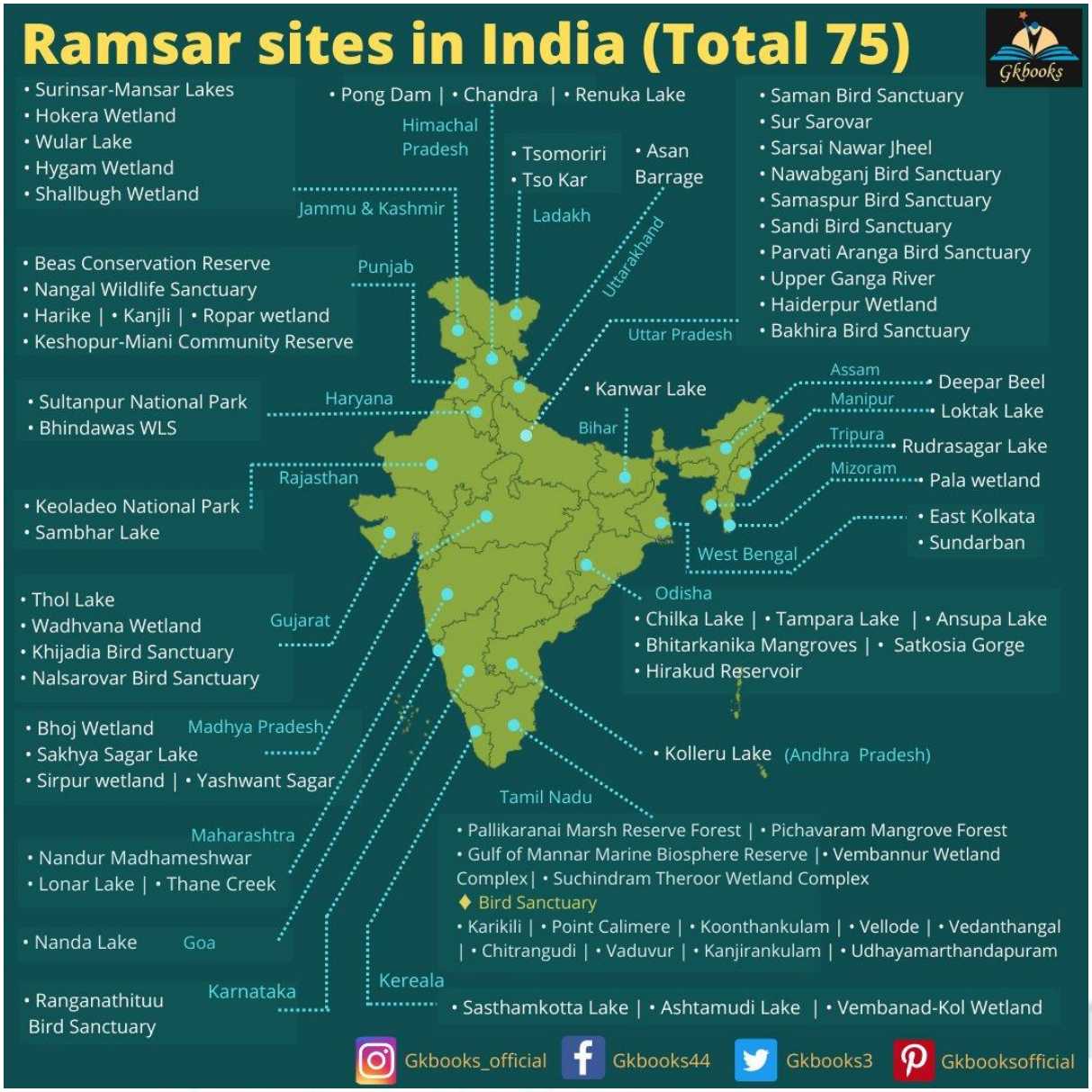
- Indian wetlands are threatened by exotic introduced plant species such as water hyacinth and Salvinia. They clog waterways and compete with native vegetation.
    - Vast stretches of wetlands have been converted to paddy fields. Construction of a large number of reservoirs, canals and dams to provide for irrigation significantly altered the hydrology of the associated wetlands.

Montreux Record: It is maintained as part of the Ramsar List.

- Montreux Record is a register of wetland sites on the List of Wetlands of International Importance where changes in ecological character have occurred, are occurring, or are likely to occur as a result of technological developments, pollution or other human interference.
- **Two wetlands of India are in Montreux Record**: Keoladeo National Park (Rajasthan) and Loktak Lake (Manipur). Chilka lake (Odisha) was placed in the record but was later removed from it.

Way forward

- To counter unplanned urbanization and a growing population, management of wetlands has to be an integrated approach in terms of planning, execution and monitoring.
- Effective collaborations among academicians and professionals, including ecologists, watershed management specialists, planners and decision-makers for the overall management of wetlands.
- The dynamic nature of wetlands necessitates the widespread and consistent use of satellite-based remote sensors and low-cost, affordable GIS tools for effective management and monitoring.



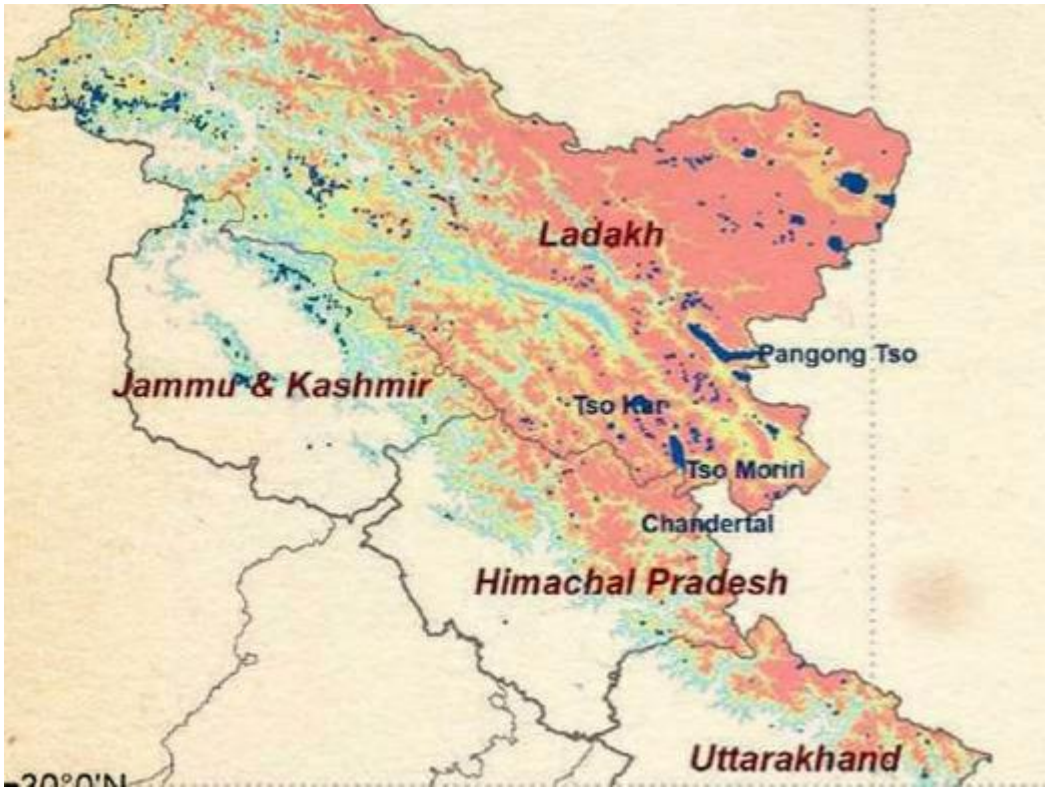
Que

Beas Conservation Reserve, Bhitarkanika Wildlife sanctuary, Bhoj wetland, Keoladeo National park

Siberian crane, Olive ridley turtle and salt water crocodile, Dolphin, Sarus crane (Largest Bird of India)

High-Altitude Wetlands

- wetlands located at an elevation of 3,000m amsl and beyond



CHAPTER 5 ANIMALS CONSERVATION

The International Big Cat Alliance is an extension of this spirit.

- Launched in April 2023 during the 50th anniversary of Project Tiger
- Focus : conservation of seven major big cats of the world.
- The countries which have Tiger, Lion, Leopard, Snow Leopard, Puma, Jaguar and Cheetah will be a part of this alliance.
- The Intergovernmental body will have 97 countries with many Asian and African countries becoming a part of the alliance

What Alliance Do ?

- the member countries will be able to share their experiences and mplement the conservation and protection agenda of various countries
- alliance will also lay emphasis on Research, Training and Capacity Building
- It will help mobilize financial and technical resources for the entire ecosystem associated with the big cat.

Census

- Counting number of specific species at specific time and place .
- Every 10 Years : Human Census
- Ganga Dolphins: Every Year

- Rhino : Every 3 Years
- Tiger :Every 4 Years
- Elephants Every 5 Years
- Lion: Every 5 Years

Asiatic Lion

- Saurashtra region of Gujarat,
- **Census happened every five years**
- **latest census 2020 , species population 674 Lions In India**
- **first Lion Census** was conducted by the **Nawab of Junagadh** in **1936.**
- **Since 1965, the Forest Department** has been regularly conducting the Lion Census every five years
- IUCN Endangered
-

What is Poonam Avlokan ?

- The count was estimated from a **population observation exercise** called **Poonam Avlokan** in place of the **15th Lion Census**
- Poonam Avlokan is a monthly in-house exercise carried out every full moon. It was a mechanism developed by the Forest Department in 2014 as part of preparations for the 2015 Lion Census.
- The Lion Census usually runs for more than two days, including a preliminary census and a final census.
- However, the Poonam Avlokan is carried out for 24 hours assessing the number of lions and their locations in their respective jurisdictions.
- Poonam Avlokan exercise is conducted **only by forest staff.**

- **Methodology Used:**

- The Lion Census is done using the **block counting method —** in which census enumerators remain stationed at water points in a given block and estimate abundance of lions in that block, based on direct sighting of lions who need to drink water at least once in 24 hours during the summer.
- Under Poonam Avlokan exercise, the teams keep moving in their respective territories and make their estimates based on **inputs provided by lion trackers and on chance sightings.**

Key Lines of Report :

- **674 Lions were recorded Lion census 2020**
- **(523 Lions census 2015)**
- **411 Lions census 2010**
- Over the last several years, the lion population in Gujarat has been **steadily rising.**
- The lion population has **grown** by **almost 29%** from the last count in 2015
- The lion population in the state of Gujarat has **doubled since 2001**

- the **geographical distribution area** for Gir forests's lions has been **increased by 36%expanded from 22,000 sq. km** in **2015 to 30,000 sq. km in 2020.**

REASON FOR INCREASE :

- This increase has been powered by community participation, emphasis on technology, wildlife healthcare, proper habitat management and steps to minimise human-lion conflict**.**

DEATH OF LION:

- peste des petits ruminants virus (PPRV)
- Outbreak of Canine Distemper Virus (CDV) **2015**
- **Outbreak of babesiosis in 2018, 2020**
- Babesia is a tiny parasite that infects red blood cells and is usually transmitted by a tick bite. Infection with Babesia is called babesiosis.

What is CDV?

- Canine distemper virus is known mainly to cause a severe infection in dogs.

Which Types of Animals affected by CDV ?

- may also affect wild carnivores such as wolves, foxes, raccoons, red pandas, ferrets, hyenas, tigers, and lions.

Why CDV is dangerous for Lion than Tiger ?

- A lion does not eat the entire prey at one go. In between, the dogs consume the kill and infect it with the CDV. Once the lion returns to finish it off, its gets the deadly disease.
- The CDV is more dangerous for lions than tigers. This is because lions move together in large numbers, making them more vulnerable to the virus as compared to tigers that are more isolated and territorial animals.

About Gir Forest

- Is WLS (1965) and NP (1975)
- Located : Junagadh District
- Only Natural Habitat of Asiatic Lions
- Maldharis : Religious Pastoral communities living in Gir
- They Have symbiotic relationship with the Lions . Their Settlements are called " Nesses"

.

Habitat : Dry deciduous forest and tropical thorn forest
Feeding Ecology and Behaviour : Chital (Axis axis) and Sambhar (most common prey)
and lion is social animal living in family unit (called pride)
Lion inactive for around 20 Hours per day

Geographical Distribution :

-

Table 1: Biological attributes of Asiatic lion

Attributes	Males	Females
Body weight	160 – 190 kg	110 – 120 kg
Age at first reproduction (free ranging)	5 – 8 years	4 years
Age at first reproduction (in captivity)	3 – 4 years	2 – 3 years
Longevity	Approximately 16 years	Approximately 17 – 18 years
Gestation period	116 days approximately	
Litter size	Ranging from 1 – 5 cubs	

(Source: Haas *et. al.* 2005)

PROTECTION :

- **IUCN Red List:** Endangered
- **CITES:** Appendix I
- **Wildlife (Protection) Act 1972:** Schedule I

CONSERVATION EFFORTS

- Asiatic Lion Conservation project : Launched by Ministry of Environment , Forest and Climate Change.
- World Lion Day : 10 August to raise awareness of the sharp decline in lion populations due to threats ranging from habitat loss to illegal hunting.

PROJECT LION

- Launched 2020
- Aim: Habitat development of Lions
- Engaging modern technologies in management of lions

Six Sites For Lion Relocation

1. Madhav National Park , MP
2. Gandhisagar Wildlife Sanctuary , MP
3. Sitamata Wildlife Sanctuary , Rajasthan
4. Mukundra Tiger Reserve , Rajasthan
5. Kumbalgarh Wildlife Sanctuary , Rajasthan
6. Balram Ambaji Wildlife Sanctuary, Gujarat

News World First melanistic Tiger Safari in Odisha

- Odisha is set to unveil the world's first melanistic tiger safari near the Similipal Tiger Reserve (STR).
- Melanism is a genetic condition, that results in increased melanin production, leading to black or nearly black skin, feathers, or hair in animals.

- The Royal Bengal Tigers of Similipal boast a distinctive lineage with elevated melanin levels, giving rise to black and yellow interspersed stripes, making them pseudo-melanistic.
- According to the All India Tiger Estimation, 2022, Similipal Tiger Reserve houses 16 tigers, with 10 of them displaying melanistic traits

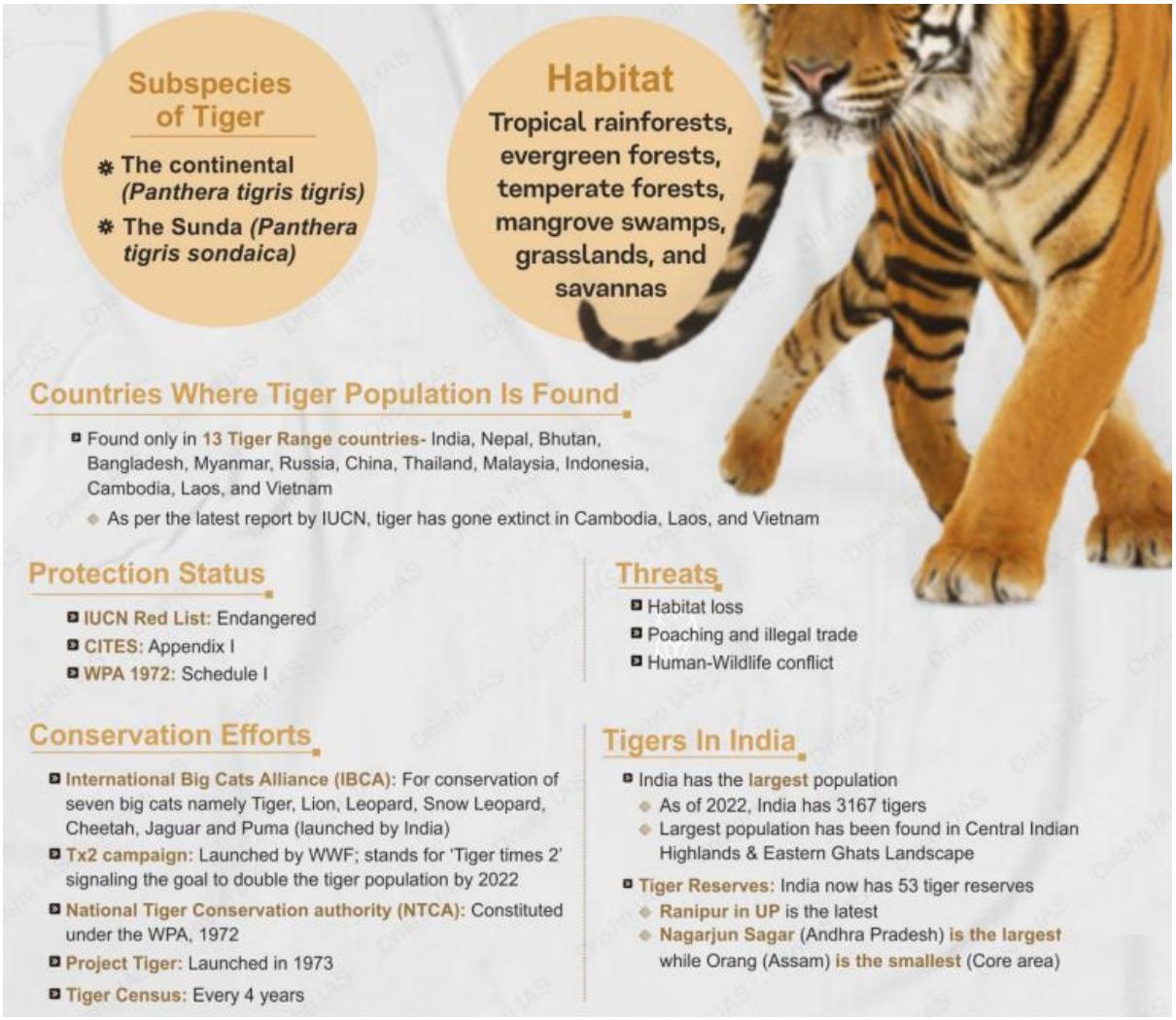
- According to the All India Tiger Estimation, 2022, Similipal Tiger Reserve houses 16 tigers, with 10 of them displaying melanistic traits

Location of Safari: • Spanning approximately 200 hectares near Dhanbad-Balasore National Highway18, the safari site lies in close proximity to STR, providing a landscape akin to Simlipal. • In the beginning, three melanistic tigers from Nandankanan Zoo, along with rescued or orphaned tigers, will occupy the open enclosures of the safari.

Objective: • It aims to raise awareness about the conservation needs of melanistic tigers, providing a platform for researchers and enthusiasts to engage with these rare big cats. Approval: The project necessitates approvals from the Central Zoo Authority and other regulatory bodies overseeing wildlife initiatives in the country.
• A National Tiger Conservation Authority committee will also conduct a feasibility study of the proposed site before granting final clearance.

OTHER COLOR VARIATIONS IN TIGER

- Orange with Black or Brown Stripes: • This is the most common and widely recognized tiger coloration, e.g, the Royal Bengal Tiger. • Each tiger's stripe pattern is unique, serving as a form of camouflage, in their natural habitat.
- White Tigers: • They are not considered a separate subspecies. The colour of the white tiger's fur is the result of a genetic mutation called leucism
- Leucism is a genetic condition that results in reduced pigmentation in animals, causing them to have white or pale-colored skin, feathers, fur, or scales.
- Golden Tigers: They are also not considered a subspecies of tigers because their golden colour variation is caused by the presence of a recessive gene called "wideband".
    - The wideband gene reduces melanin production during the cycle of hair growth. • Recently, it was spotted in Kaziranga National Park.
- Black tigers and Gloden Tiger basically exist as they both possess a recessive gene ich is e xpressed due to absence of domminant gene to suppress it. When two individulas with dominant trait breed, recessive gene are masked, but when two individuals with recessive gene breed, the recessive gene is expressed and such is the case for these two black anf golden tiger



Tiger Species :

- Traditionally eight sub-species of tigers have been recognized, out of which three are extinct.

Extinct Tiger Species

- Bali tiger. Bali, Indonesia. (extinct since the Forties).
- Caspian tiger. Turkey through central and west Asia. (extinct since the Seventies).
- Javan tiger. Java, Indonesia. (extinct since the Eighties).

Live Species

- Bengal tiger
- Amur tiger.
- Javan tiger
- South China tiger.
- Indo-Chinese tiger

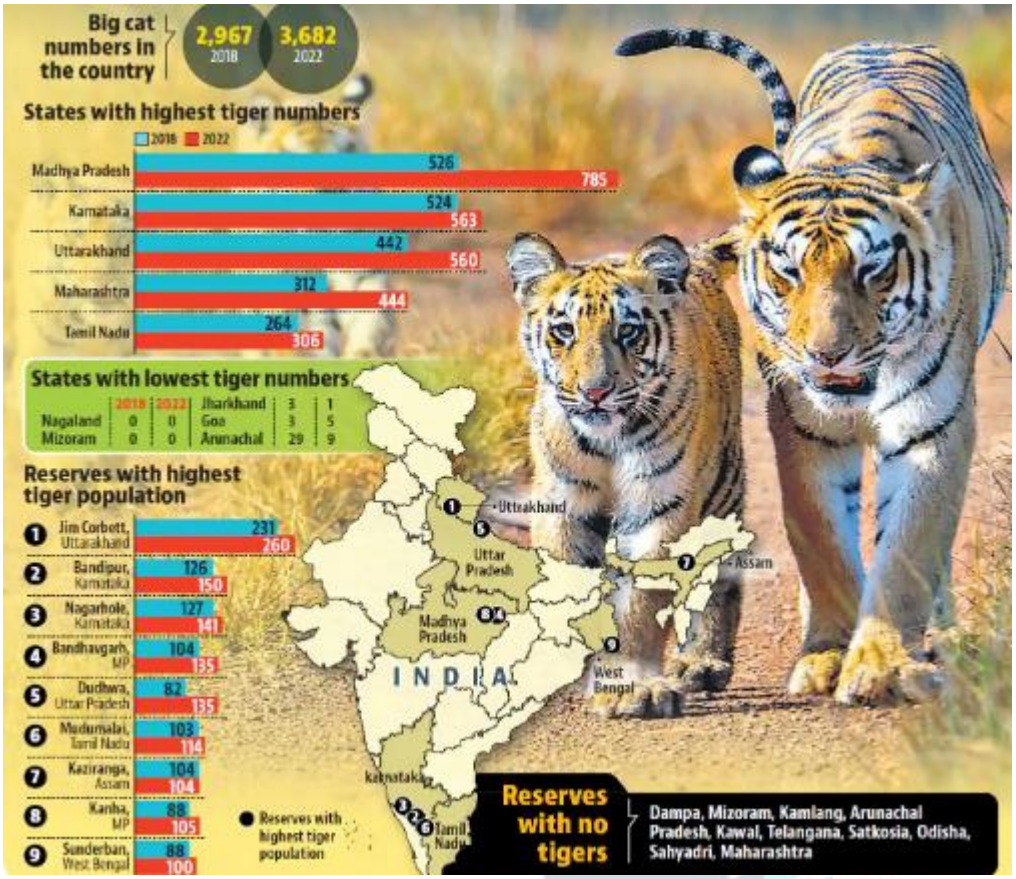
PROJECT TIGER

- Launched in 1972-73
- Has completed 50 years
- Expanded to 9 to 54 Tiger Reserves in India
- India Home to 75 percent of the world's tiger population in the 75th year of India's independence
- tiger reserve in India is spread over 75,000 square kilometers

- tiger population has also increased by 75 per cent in the last 10-12 years
- tiger is the vehicle of Maa Durga and Lord Aiyappa.(Hinduism /Sabarimala,Kerala) Which Tiger Reserve related with Sabarimala?
- See Who is Tiger Man of India ?
-
- the Bharias living in Central India and the Worlis living in Maharashtra, Baigas, Gonds in Madhya Pradesh, Gonds in Maharashtra, Chenchus in Andhra Pradesh, Sholigas in Karnataka, Gujjars in Uttarakhand and Irulas in Tamil Nadu worship the tiger.
- tiger reserves were created in the country based on 'core-buffer' strategy
- Tiger day : 29 July
- Wildlife Institute of India and and NTCA helps in tiger estimation Census Every Four Years

2006: 1411
2010: 1706
2014 : 2226
2018 : 2967 (51 tiger reserves across 18 states with 2967 tigers as per 2018 estimation)
2022: 3167 Tigers (India home to 75 % World Tiger Population)

2023



Reason For Increase :

- First Phase : Enactment of Wildlife Protection Act, 1972
- Establishment of Protected Areas
- Second Phase Since 2005 (due local extinction of tigers in Sariska TR, 2005)
- Then Government , adopted a landscape-level approach and implemented strict monitoring for tiger conservation

NTCA

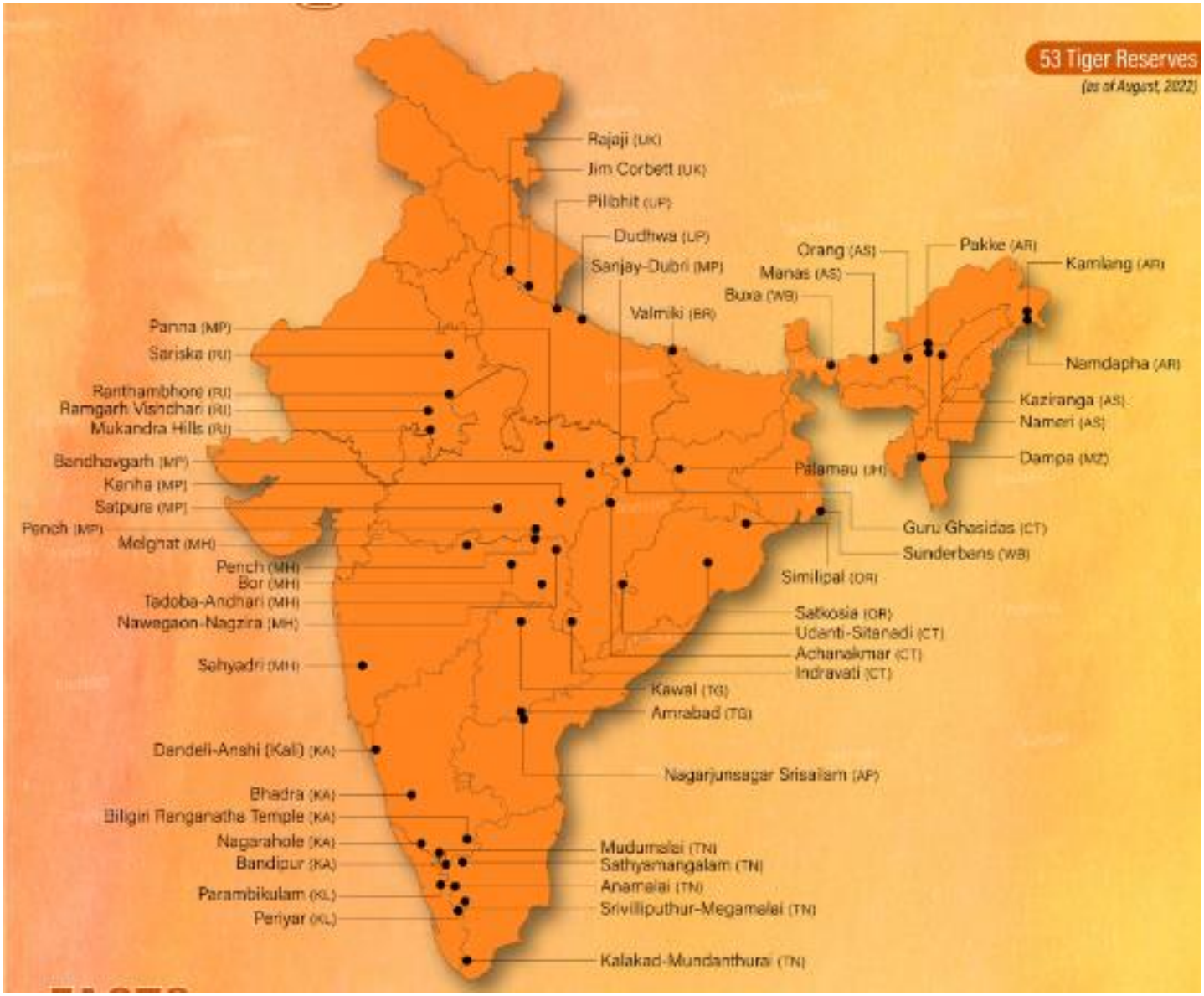
- **statutory body under MOEFCC**
- **under WPA 1972 (amended in 2006)**
- founded 2005
- Chairman : Minister for Environment and Forests

TIGER RESERVES

- Governed by Project Tiger
- Administrated by NTCA
- Total 55
- 55 : **Dholpur-Karauli Tiger Reserve** in the state of Rajasthan.
- **fifth** tiger reserve in the state of Rajasthan following **Mukundra Hills, Ramgarh Vishdhari, Ranthambore, and Sariska.**
- **Largest TR: NSTR (Andhra Pradesh)**
- **Smallest TR: Orang (Assam)**
- **Reserve with highest tiger density : corbett, then Nagarhole, Bandipur**
-
- **States with max. tiger : MP**

State	Tiger Population
Madhya Pradesh	785

State	Tiger Population
Karnataka	563
Uttarakhand	560
Maharashtra	444



New TR:

- **Veerangana Durgavati Tiger Reserve**: MP
- **Ranipur Tiger Reserve**:: UP
- **Ramgarh Vishdhari Tiger Reserve Rajsthan**

See Link wiienvis.nic.in/database/trd_8222.aspx

S. No.	Name of Tiger Reserve	State	Year of Inclusion under Project Tiger	Year of Notification/ Re-notification under Section 38V, WPA, 1972, India	Area of the core / critical tiger habitat (In Sq. Km.)	Area of the buffer / peripheral (In Sq. Km.)	Total area (In Sq.Km.)	Gazette Notification
1.	Nagarjunsagar Srisailam Tiger Reserve	Andhra Pradesh	1982-1983	2007	2,595.72	700.59	3,296.31	PDF
2.	Kamlang Tiger Reserve	Arunachal Pradesh	2016-2017	2015	671.00	112.00	783.00	PDF
3.	Namdapha Tiger Reserve	Arunachal Pradesh	1982-1983	1987	1,807.82	245.00	2,052.82	PDF
4.	Pakke Tiger Reserve	Arunachal Pradesh	1999-2000	2012	683.45	515.00	1,198.45	PDF
5.	Kaziranga Tiger Reserve	Assam	2008-2009	2007	625.58	548.00	1,173.58	PDF
6.	Manas Tiger Reserve	Assam	1973-1974	2008	526.22	2,310.88	2,837.10	PDF
7.	Nameri Tiger Reserve	Assam	1999-2000	2000	320.00	144.00	464.00	PDF
8.	Orang Tiger Reserve	Assam	2016	2016	79.28	413.18	492.46	PDF
9.	Valmiki Tiger Reserve	Bihar	1989-1990	2012	598.45	300.93	899.38	PDF
10.	Achanakmar Tiger Reserve	Chhattisgarh	2008-2009	2009	626.195	287.82	914.01	PDF
11.	Indravati Tiger Reserve	Chhattisgarh	1982-1983	2009	1,258.37	1,540.70	2,799.07	PDF
12.	Udanti-Sitanadi Tiger Reserve	Chhattisgarh	2008-2009	2009	851.09	991.45	1,842.54	PDF
13.	Palamau Tiger Reserve	Jharkhand	1973-1974	2012	414.08	715.85	1,129.93	PDF
14.	Bandipur Tiger Reserve	Karnataka	1973-1974	2007	872.24	584.06	1,456.30	PDF
15.	Bhadra Tiger Reserve	Karnataka	1994-1995	2007	492.46	571.83	1,064.29	PDF
16.	Biligiri Ranganatha Temple Tiger Reserve	Karnataka	2010-2011	2011	359.1	215.72	574.82	PDF
17.	Dandeli-Anshi (Kali) Tiger Reserve	Karnataka	2008-2009	2007	814.884	282.63	1,097.51	PDF
18.	Nagarahole Tiger Reserve	Karnataka	2008-2009	2007	643.35	562.41	1,205.76	PDF

S. No.	Name of Tiger Reserve	State	Year of Inclusion under Project Tiger	Year of Notification/ Re-notification under Section 38V, WPA, 1972, India	Area of the core / critical tiger habitat (In Sq. Km.)	Area of the buffer / peripheral (In Sq. Km.)	Total area (In Sq.Km.)	Gazette Notification
19.	Parambikulam Tiger Reserve	Kerala	2008-2009	2009	390.89	252.77	643.66	PDF
20.	Periyar Tiger Reserve	Kerala	1978-1979	2007	881.00	44.00	925.00	PDF
21.	Bandhavgarh Tiger Reserve	Madhya Pradesh	1993-1994	2007	716.90	820.03	1,536.93	PDF
22.	Kanha Tiger Reserve	Madhya Pradesh	1973-1974	2007	917.43	1,134.36	2,051.79	PDF
23.	Panna Tiger Reserve	Madhya Pradesh	1993-1994	2007	576.13	1,021.97	1,598.10	PDF
24.	Pench Tiger Reserve	Madhya Pradesh	1992-1993	2007	411.33	768.30	1,179.63	PDF
25.	Sanjay-Dubri Tiger Reserve	Madhya Pradesh	2008-2009	2011	812.57	861.93	1,674.50	PDF
26.	Satpura Tiger Reserve	Madhya Pradesh	1999-2000	2007	1,339.26	794.04	2,133.30	PDF
27.	Veerangana Durgavati Tiger Reserve	Madhya Pradesh	-	2023	1414.006	--	1414.006	PDF
28.	Bor Tiger Reserve	Maharashtra	2014	2012	138.12	678.15	816.27	PDF
29.	Melghat Tiger Reserve	Maharashtra	1973-1974	2007	1,500.49	1,268.03	2,768.52	PDF
30.	Nawegaon-Nagzira Tiger Reserve	Maharashtra	2013-2014	2013	653.67	1,241.27	1,894.94	PDF
31.	Pench Tiger Reserve	Maharashtra	1998-1999	2007	257.26	483.96	741.22	PDF
32.	Sahyadri Tiger Reserve	Maharashtra	2009-2010	2012	600.12	565.45	1,165.57	PDF
33.	Tadoba-Andhari Tiger Reserve	Maharashtra	1993-1994	2007	625.82	1,101.77	1,727.59	PDF
34.	Dampa Tiger Reserve	Mizoram	1994-1995	2007	500.00	488.00	988.00	PDF
35.	Satkosia Tiger Reserve	Odisha	2008-2009	2007	523.61	440.26	963.87	PDF
36.	Similipal Tiger Reserve	Odisha	1973-1974	2007	1,194.75	1,555.25	2750.00	PDF
37.	Mukandra Hills Tiger Reserve	Rajasthan	2013-2014	2013	417.17	342.82	759.99	PDF

S. No.	Name of Tiger Reserve	State	Year of Inclusion under Project Tiger	Year of Notification/ Re-notification under Section 38V, WPA, 1972, India	Area of the core / critical tiger habitat (In Sq. Km.)	Area of the buffer / peripheral (In Sq. Km.)	Total area (In Sq.Km.)	Gazette Notification
38.	Ramgarh Vishdhari Tiger Reserve	Rajasthan	2022	2022	481.91	1,019.98	1,501.89	PDF
39.	Ranthambore Tiger Reserve	Rajasthan	1973-1974	2007	1,113.36	297.92	1,411.29	PDF
40.	Sariska Tiger Reserve	Rajasthan	1978-1979	2007	881.11	332.23	1,213.34	PDF
41.	Anamalai Tiger Reserve	Tamil Nadu	2008-2009	2007	958.59	521.28	1,479.87	PDF
42.	Kalakad-Mundanthurai Tiger Reserve	Tamil Nadu	1988-1989	2007	895.00	706.54	1,601.54	PDF
43.	Mudumalai Tiger Reserve	Tamil Nadu	2008-2009	2007	321.00	367.59	688.59	PDF
44.	Sathyamangalam Tiger Reserve	Tamil Nadu	2013-2014	2013	793.49	614.91	1,408.40	PDF
45.	Srivilliputhur Megamalai Tiger Reserve	Tamil Nadu	2020-2021	2021	641.86	374.70	1,016.57	PDF
46.	Amrabad Tiger Reserve	Telangana	2014-2015	2015	2,166.37	445.02	2,611.39	PDF
47.	Kawal Tiger Reserve	Telangana	2012-2013	2012	893.23	1,123.21	2,015.44	PDF
48.	Dudhwa Tiger Reserve	Uttar Pradesh	1987-1988	2007	1,093.79	1,107.98	2,201.77	PDF
49.	Pilibhit Tiger Reserve	Uttar Pradesh	2014	2014	602.798	127.45	730.25	PDF
50.	Ranipur Tiger Reserve	Uttar Pradesh	2022-2023	2022	230.31	299.05	529.36	PDF
	Amanagarh buffer*	Uttar Pradesh	2012-2013	2012	-	80.60	80.60	PDF
51.	Corbett Tiger Reserve	Uttarakhand	1973-1974	2010	821.99	466.32	1288.31	PDF
52.	Rajaji Tiger Reserve	Uttarakhand	2015	2015	819.54	255.63	1075.17	PDF
53.	Buxa Tiger Reserve	West Bengal	1982-1983	2009	390.58	367.32	7,57.90	PDF
54.	Sunderbans Tiger Reserve	West Bengal	1973-1974	2007	1,699.62	885.27	2,584.89	PDF

S. No.	Name of Tiger Reserve	State	Year of Inclusion under Project Tiger	Year of Notification/ Re-notification under Section 38V, WPA, 1972, India	Area of the core / critical tiger habitat (In Sq. Km.)	Area of the buffer / peripheral (In Sq. Km.)	Total area (In Sq.Km.)	Gazette Notification
55.	Dholpur – Karauli Tiger Reserve	Rajasthan	-	2023	599.6406	-	599.6406	PDF

Consider the following protected areas: (2012)

1. Bandipur
2. Bhitarkanika
3. Manas
4. Sunderbans

Which of the above are declared Tiger Reserves?

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

Ans B

From the ecological point of view, which one of the following assumes importance in being a good link between the Eastern Ghats and the Western Ghats? (2017)

(a) Sathyamangalam Tiger Reserve
(b) Nallamala Forest
(c) Nagarhole National Park
(d) Seshachalam Biosphere Reserve

Ans A Exp : S. T R

- Erode district
- Wildlife corridor in Niligiri between EG and WG
- Gateway to Eastern ghats
- Provide genetic link between five other protected area like biligiriranga swamy temple wildlife sanctuary,sigur plateau , mudumali national park and Bandipur NP
- dry deciduous forest region
- Home to : indigenous tribal Urali and Soliga communties

CRITICAL TIGER HABITATS

- are wildlife habitat means created in areas of National Parks and Sanctuaries which are required to be kept as inviolate for the purposes of wildlife conservation.
- under WPA 1972
- without affecting the right of ST or other forest dwellers
- Notification done by state government

India - Landscape Approach	2018 Census 2967
1. Shivalik Hills & Gangetic Plains Landscape	646
2. Central Indian Highlands & Eastern Ghats Landscape	1033
3. Western Ghats Landscape	981
4. North Eastern Hills & Brahmaputra Plains Landscape	219
5. Sunderbans Landscape	88

Shivalik Hills & Gangetic Plains Landscape

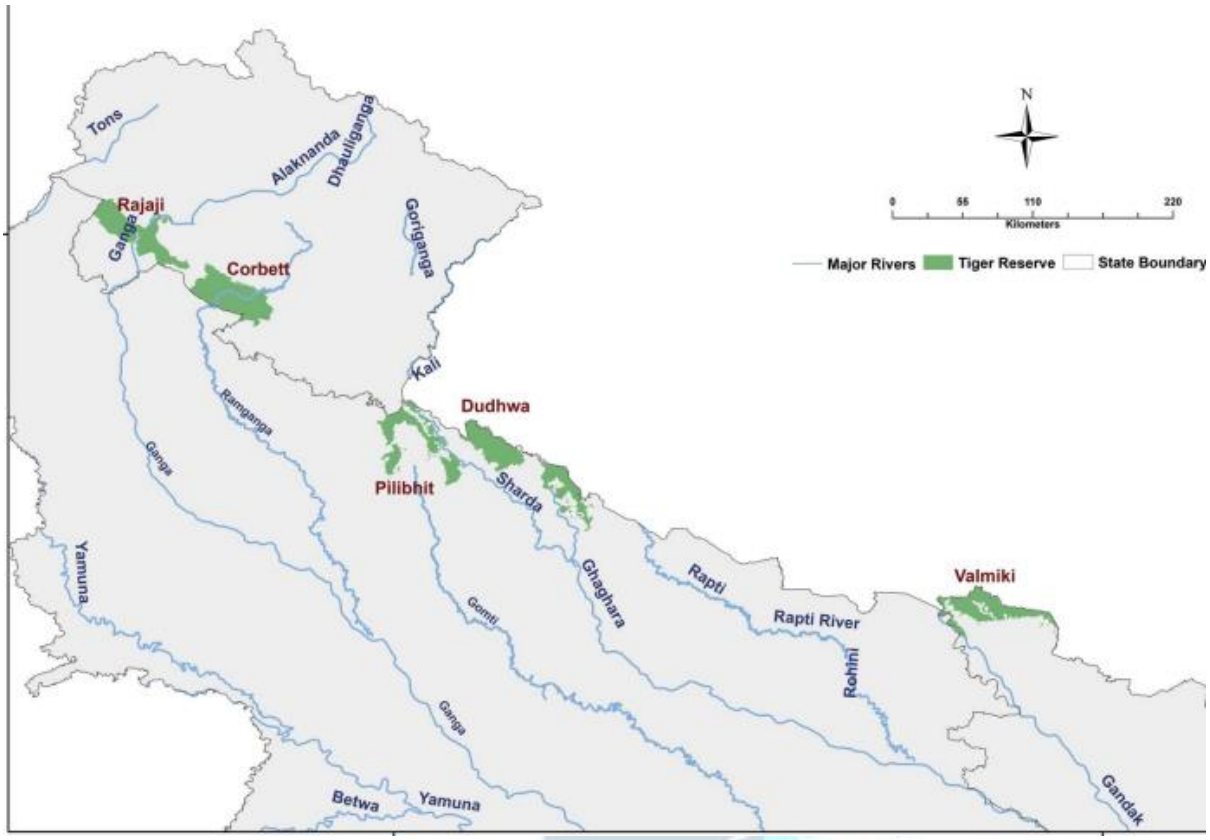
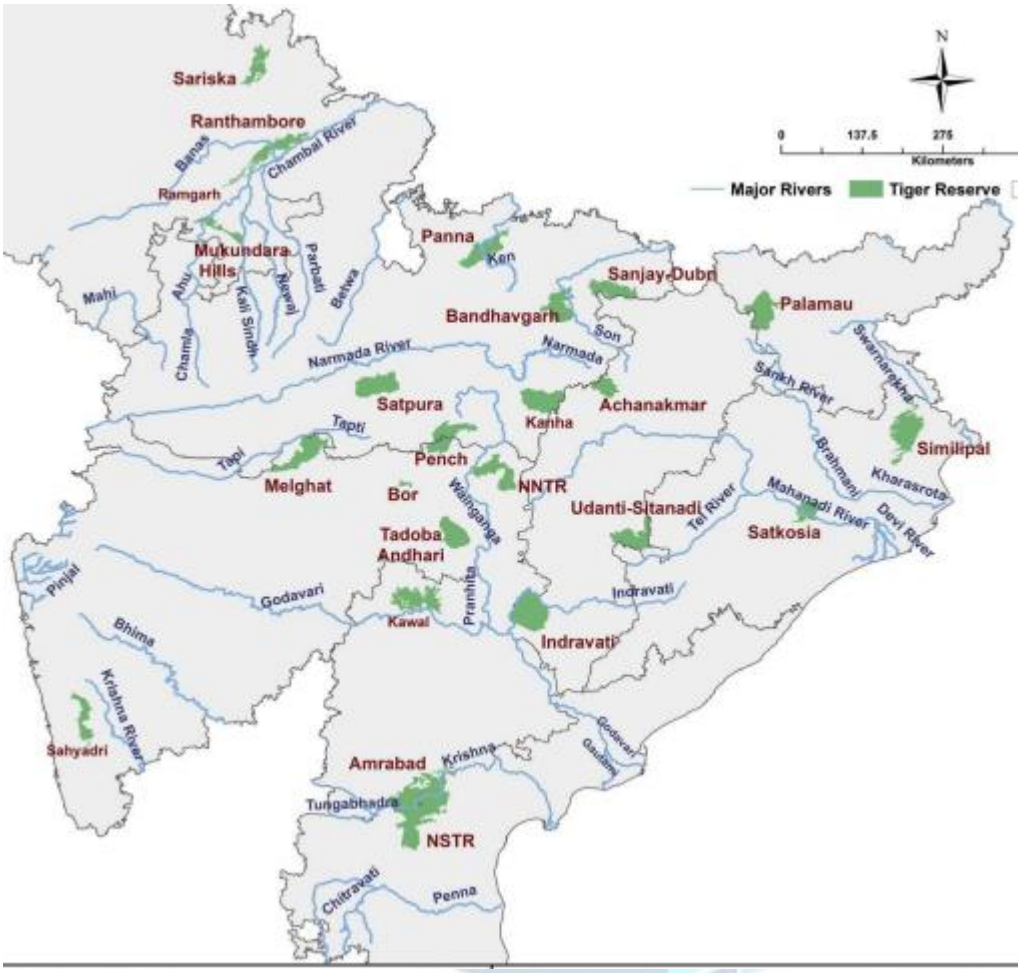


Fig : Water Source Atlas of Tiger Reserves , NTCA, Delhi

- See Five Places
- The area supports highly endangered wildlife like Barasingha, one-horned rhinoceros, Bengal florican, Hispid hare, and Hog deer, Hyneas, Wolf
-

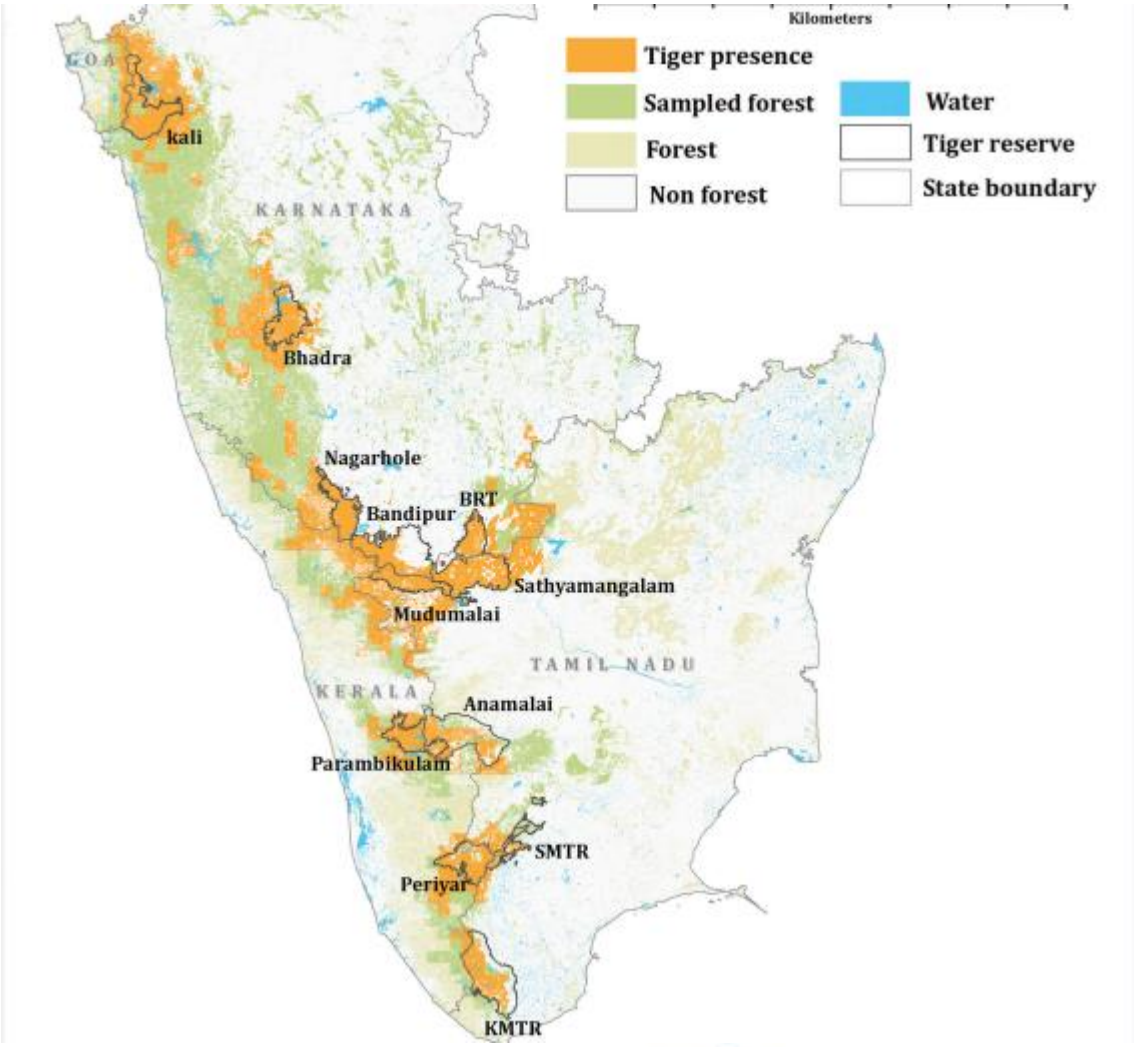
CENTRAL INDIA AND EASTERN GHATS LANDSCAPE

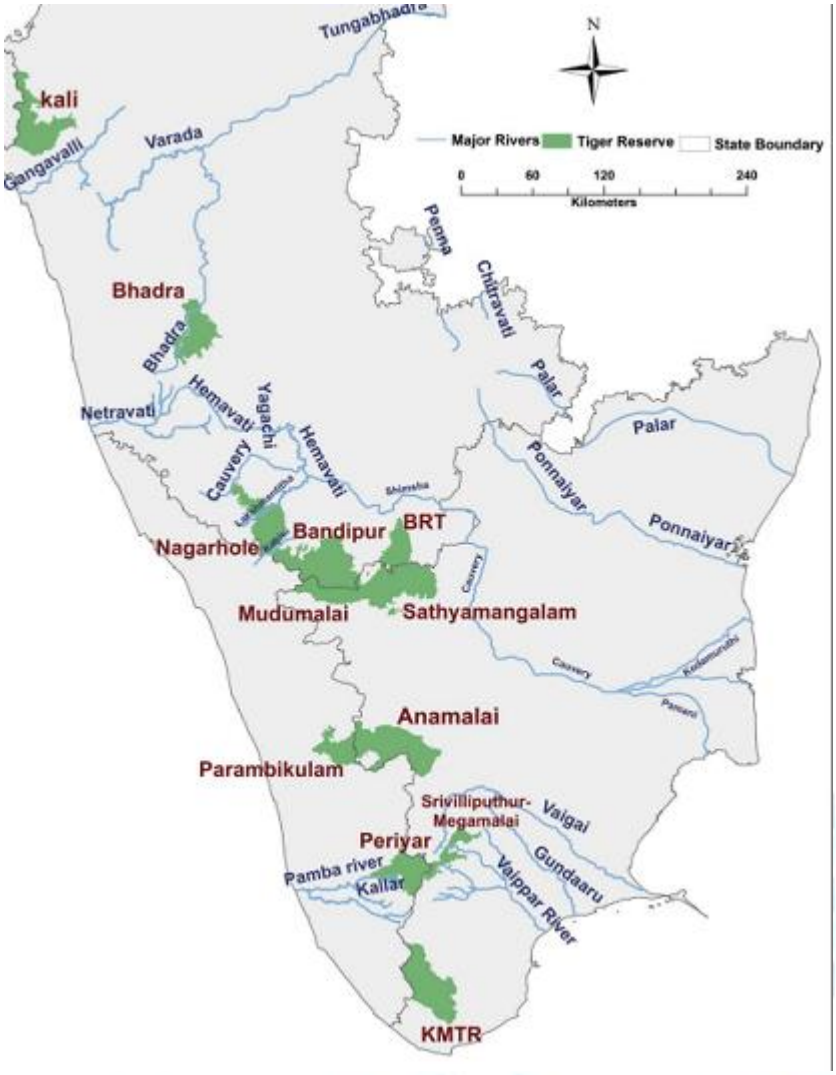
- The landscape comprises of the semi-arid zone of Rajasthan, central Indian plateau and includes parts of Eastern Ghats across seven states namely Andhra Pradesh, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha and Telangana
- 25 tiger reserves in the watershed region of Chambal, Godavari, Ken, koel, Krishna, Mahanadi, Narmada, Son River, Tapi, and Wainganga rivers in the landscape.
- Around 22 dams are located in the tiger reserves in this landscape.



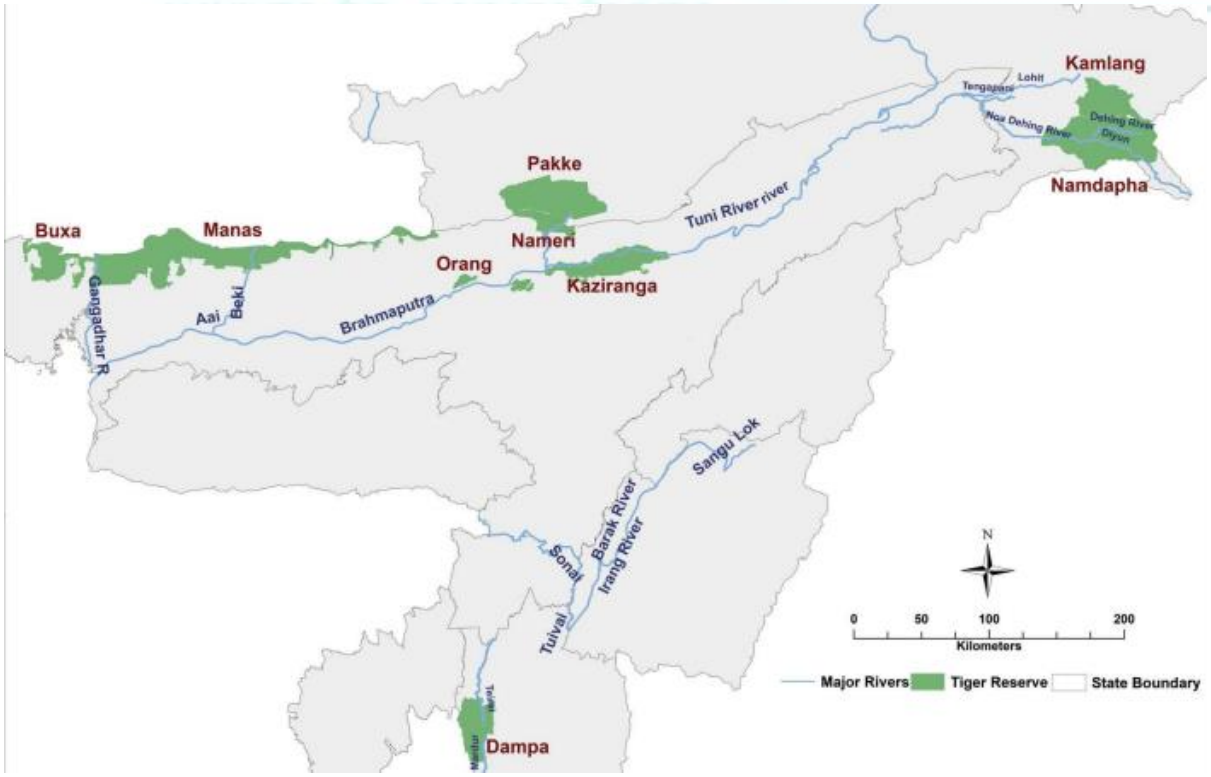
Nagarjunasagar- Srisailam Tiger Reserve(NSTR) is India's largest Tiger Reserve.

' Tiger distribution in Western Ghats landscape i





Tiger distribution in the North East Hills and Brahmaputra



The eastern part of India is a biodiversity hotspot, including the North Bengal dooars, flood plains of Brahmaputra, and North Eastern hill ranges, spread across nine states. The region has a high forest cover, with Mizoram, Arunachal Pradesh, Meghalaya, Manipur, and Nagaland having the highest percentage

The region is also an "Endemic Bird Area"
Buxa tiger reserve, Neora valley national park and Mahananda wildlife sanctuary of West Bengal
Nampdapha tiger reserve, Arunachal Pradesh (Burhi Dihang River)
Dampa tiger reserve, Mizoram
Nameri and Pakke Tiger Reseve: Kameng River
Orang and Kaziranga Tiger Reserve : Brahmaputra River

Technological Advancement for Tiger Conservation

- Mobile App :**M-STrIPES (Monitoring System for Tigers Intensive-Protection & Ecological Status)** Assist in effective patrolling and protection.

- titled 'E-Bird Technology for Tiger Conservation : Development and Integration of Unmanned Aerial Vehicles (UAV) as a Surveillance and Monitoring tool for Protection of Tiger

How are tiger reserves notified?

- notified by State Governments by Wildlife (Protection) Act, 1972
- on advise of the National Tiger Conservation Authority.
- National Tiger Conservation Authority recommends the proposal to the State
- The State Government notifies the area as a Tiger Reserve

Can tiger reserves be altered and de-notified?

"No alteration in the boundaries of a tiger reserve shall be made except on a recommendation of the Tiger Conservation Authority and the approval of the National Board for Wild Life".

"No State Government shall de-notify a tiger reserve, except in public interest with the approval of the Tiger Conservation Authority and the National Board for Wild Life".

1. **Which are the States where Project Tiger is implemented?**

Wild tigers are found in 18 of our States, viz. Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Ch hattisgarh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Mizoram, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttarakhand, Uttar Pradesh and West Bengal. Project Tiger is being implemented in these States in collaboration with the respective State Governments.

Which one of the following is the national aquatic animal of India? (2015)
(a) Saltwater crocodile
(b) Olive ridley turtle

(c) Gangetic dolphin
(d) Gharial

About Dolphins

- marine mammal , social animals use echolocation in order to locate food and other objects and communicate through squeaks, whistles, and clicks.
- Known for **intelligence, playfulness, and friendliness to humans.**
- It is a reliable indicator of the health of the entire river ecosystem.
- **apex predators in the freshwater food chain**
- presence indicates that the **water is clean** and there is a good **number of prey species such as fish, turtles, crustaceans**

GANGA DOLPHIN

- Census every year
- By UP Government and WWF
- IUCN Status Endangered
- Local Name" Susu"
- The Ganges river dolphins can only live in freshwater and are essentially blind.
- They hunt by emitting ultrasonic sounds waves that bounce off of fish and other prey
- Found in India, Nepal and Bhutan
- Female are long in length
- Being a Mammal , They are air breathers and surface for air with a mean dive time of 2 to 7.5 min once.
- Because of the sound it produces when breathing, the animal is popularly referred to as 'Susu'.
- Feed: fishes, crustaceans (shrimps and prawns)
-

PROJECT DOLPHIN

- (*Platanista gangetica gangetica*)
- one of the five river dolphins found in the world
- declared National Aquatic Animal 2009
- Launched 2021
- Parent Department : Wildlife institute of India
- Aim : Habitat Protection : To Protect Both River and Ocean Dolphin
- Involvement of Fishermen
- Use of Technology
- Oct 5: National Dolphin Day
- Vikramshila Dolphin Wildlife Sanctuary: only dolphin sanctuary in India located in Bihar for conservation of this animal
- official animal of the Indian city of Guwahati.

Protection Status:

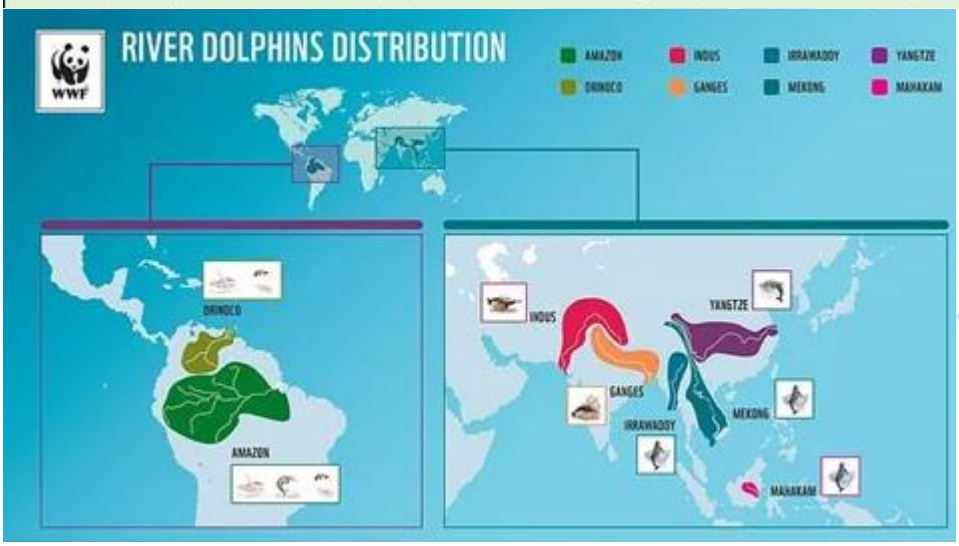
- Schedule I of Wildlife Protection Act (1972
- Appendix I of CITES
- IUCN: Endangered

PYQ
Other than poaching, what are the possible reasons for the decline in the population of Ganges River Dolphins? (2014)
1. Construction of dams and barrages on rivers
2. Increase in the population of crocodiles in rivers
3. Getting trapped in fishing nets accidentally
4. Use of synthetic fertilisers and other agricultural chemicals in crop-fields in the vicinity of rivers
Select the correct answer using the code given below:

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

Threats :

- Habitat destruction due to development projects water development projects,
- Pollution, (industrial waste and pesticides, municipal sewage discharge and noise from vessel traffic)
- hunting and Poaching for dolphin oil,
- death due to accidental catch in fishing gear.
- Fragmented populations created by dams and barrages have degraded downstream habitat



Indus River Dolphins native to the Indus River in Pakistan.

Bhulan dolphin, is found in the Sutlej River in Pakistan and the Beas River in India. It is closely related to the Indus dolphin.

- Indus River dolphin has been declared as the national mammal of Pakistan and **the state aquatic animal of Punjab, India**.

Irrawady Dolphin

- The front of its snout is blunt.

- Euryhaline Species adapt wide range of salinities
- IUCN : Endangered
- Nocturnal
- State Animal of West Bengal
- Found in Chilka Lake (Nalabana WLS), Ganga river, mekong and Irrawadday river
- Found near sea coasts, estuaries ,and in rivers mouths in bay of Bengal region mainly

- Dugong / Sea Cow Found in Chilka Lake
- Green Sea Turtle Endangered found in Chilka Lake

Orca : Killer Whale

- The **orca (killer whale) is the largest dolphin**
- black-and-white patterned body.
- A cosmopolitan species, orcas are found in diverse marine environments, from Arctic to Antarctic regions to tropical seas

Where We Find Dolphins in India

- Goa : oceanic dolphins
- Andaman Islands
- Maharastra Konkan Region Dapoli Ratnagiri , murud etc
- Kerala, Kochi Region
- Lakshadweep
- West Bengal : Irrawaddy and Ganga dolphins
- Odisha chilka lake
- UP and Bihar : River Dolphins : chambal river (ganga dolphin)
- Assam : Dibru Saikowa National Park : Rare Pink Dolphin found here

Consider the Statements with respect to National Chambal Sanctuary
1. it is tri - state protected area in three states tri-junction point : Rajasthan -Madhya pradesh and uttar pradesh
2. The Key stone species of this sanctuary are gharial , red crowned rood turtle, and Ganga river dolphin.
3 it is part of Khathiar-Gir dry deciduous forests ecoregion
Options :

Dugong :

- Sea Cow
- IUCN Vulnerable
- First Conservation Reserve For Dugong at Gulf of Manner- Palk Bay

ANIMAL IN FOCUS :

With reference to 'dugong', a mammal found in India, which of the following statements is/are correct?

1 . It is a herbivorous marine animal called Sea cow

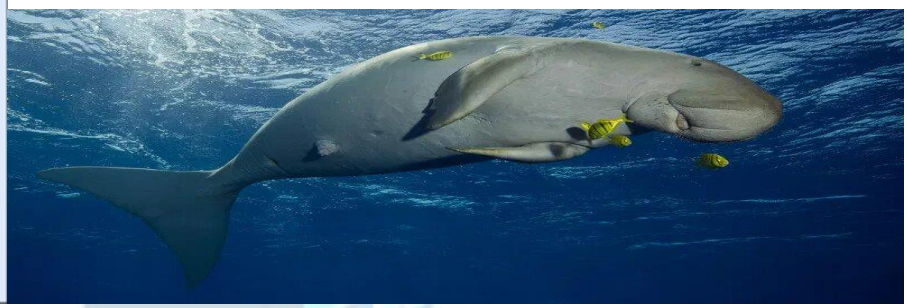
2 . It is found along the entire coast of India

3 . It is given legal protection under Schedule 1 of the Wildlife (Protection) Act, 1972.

Select the correct answer using the code given below.

(a) 1 and 2 (b) 2 only (c) 1 and 3 (d) 3 only Answer: (c)

News : India's first dugong conservation reserve to come up in Tamil Nadu



Where is India's first dugong conservation reserve?

The Tamil Nadu State government announced last week that a 500-sqkm dugong conservation reserve will soon be set up in the Palk Bay

Dugong are commonly known as sea cows. According to Wildlife Institute of India (WII) estimates, only 200-250 Dugongs are left in the wild, of which 150 are found in the Palk Bay and Gulf of Mannar in Tamil Nadu.

In Which Areas they are found in India?

Ans: Distributed in shallow tropical waters in the Indo-Pacific region, in India, they are found in the

- Gulf of Kutch,
- Gulf of Mannar,
- Palk Bay, and
- Andaman & Nicobar Islands.

Key facts :

- **State animal of Andaman & Nicobar Islands.**
- never enters freshwater
- survive on seagrass and other aquatic vegetation found in the area.
- the only herbivorous mammal that is strictly marine
- Dugongs are usually about three-meter long and weigh about 400 kg. Dugongs have an expanded head and trunk-like upper lip.
- Elephants are considered to be their closest relatives.
- Dugong's have **very small brain** in comparison to their body size and have a distinct dolphin-like tail.
- **long-living animals**, that **have a low reproductive** rate, long generation time, and high investment in each offspring.
- Dugongs are The female dugongs do not bear their first calf until they are at least 10 and up to 17 years old. A dugong population is unlikely to increase more than 5% per year. They take a long time to recover due to the **slow breeding rate**

Causes of extinction

- slow breeding rate, fishing, and the loss of habitat.

- Due to natural and human-induced activities, the natural habitat of the animal is on a risk.
- habitat loss is also attributed to the increase in conversion of coastal forests to banana, areca nut, and coconut plantations and high boat traffic.
- Gill-net fishing: Dugongs are also known to suffer due to accidental entanglement and drowning in gill-nets. Fishing activities around the Indian, Andaman, Nicobar, and Sri Lankan coasts include gill netting and **dynamite fishing.**
- Natural factors are also responsible for the decline in dugongs population like extreme weather events such as cyclones and high energy tidal storms may also contribute to the loss of seagrasses in the region.

Conservation of Dugong

1. Dugongs are protected in India under Schedule 1 of the Indian Wildlife Act 1972 which bans the killing and purchasing of dugong meat.

Dugongs are listed as Vulnerable on the IUCN Red List of Threatened Species

2. The proposed reserve area has the highest concentration of dugongs in the country.

3. studies suggest that simultaneous effort towards seagrass meadow restoration, reduction of dugong mortalities, and community participation in dugong conservation can help in helping the dugong population recover.

4. It also calls for creating awareness among the people, involving the local communities

Gulf of Mannar Marine National Park (1986) and Biosphere Reserve (1989)

- the first Marine Biosphere Reserve in the South and South East Asia
- Location : Rameswaram to Kanyakumari in Tamil Nadu,
- chain of 21 Islands and adjoining Coral reefs
- Known for Pearls Banks and Religious Significance
- Key Fishing and " Key Important Bird Area " (ecotone)
- Dugong , Sea Turtles , Sea Snakes , Coastal birds
- Key region for " Coral Reefs " and Mangroves

Managed Under :

- Wildlife (Protection) Act, 1972,
- the Indian Forest Act, 1927,
- Forest (Conservation) Act, 1980,
- Environmental (Protection) Act, 1986,
- National Forest Policy, 1988,

- Coastal Zone Regulation Act, 1992 and
- Coastal Zone Management Plans of the Tamil Nadu State Government

Region Issues :

- Area Impacted by cyclonic storms, tsunami and flood
- The Gulf of Mannar Biosphere Reserve comes in the "Semi-Arid" under the classification of the bioclimatic zones of India
- Therefore, it is prone to drought.(Being in a low rain fall zone)
- part of biogeographic province of Deccan Peninsula-Deccan South

Issue:

- River Tamirabarani Pollution in GOM Region
- Acid Wash from Shell craft industries
- Solid and waste water from Ice factories
- Sea food processing centres
- Oil Spills Issues : new Tuticorin port became operational impact GOM Region
- establishment of Sethusamuthram Canal
- intensive aquaculture farm
- Invasive alien Species : Prosopisjuliflora, Acacia spp., Parthenieum (which occurs on almost all islands) and Kappaphycusalvarezii (K. alvarezii / aquatic weed)

RHINO

- IUCN: vulnerable
- Project Rhino 2005
- 14 Census Happened in 2022
- 2613 Rhinos in Assam
- Kaziranga , Assam
- Jaldapara, West Bengal
- Orang , Assam
- Pobitara , Assam (Highest Density)

States in which it found ?

- West Bengal: Jaldapara NP, Gurumara NP
- UP: Dudwa NP , Katrnighat NP
- Assam is home to nearly 85% of the world's Indian rhinoceros population, with Kaziranga National Park housing 70% of the rhino population.
- Assam : Kaziranga National Park, Pobitora National Park, Orang National Park, Manas National Park, Laokhowa Wildlife Sanctuary, Burachapori Wildlife Sanctuary, and Dibru Saikhowa Wildlife Sanctuary are the seven protected areas

Species of Rhino

1. Black African: Critically Endangered
2 White Rhino: Near Threaten
3. One Horn Rhino: Vulnerable
4. Javan: Critically Endangered
5 Sumatran : Critically Endangered

About Kaziranga National Park

- Located in two district Gologhat and Nagaon (Assam)
- Part of Eastern Himalaya Biodiversity
- Part of Indomalyan realm
- UNESCO Natural Heritage site
- Famous for indian Rhino , wild buffalo, Elephant, key bird area
- Declared Tiger Reserve 2006
- Big five : Indian rhinoceros, royal Bengal tiger, Asian elephant, wild water buffalo and swamp deer
- Kaziranga's rivers are also home to the endangered Ganges dolphin, Sea otters , vultures
- Two of the largest snakes in the world, the reticulated python and Indian rock python, as well as the longest venomous snake in the world, the king cobra, inhabit the park
- Habitat : Terai -Duars Savanna Grasslands and tropical moist deciduous forest
- located on Brahmaputra river
- NP Impact by : Hyacinth and mimosa plant is Invasive alien species
- recently Uttarkhand state has cleared proposal by WII to introduce rhinoceros in Corbett Tiger Reserve.

Wildlife Institute of India

- It is an autonomous institution under the Ministry of Environment, Forest and Climate Change.
- It was established in 1982.
- It offers training programs, academic courses, and advisory in wildlife research and management.
- Hq Dehradun

SNOW LEOPARD STATUS :

- **called as " Ghosts of the Mountains** "
- Panthera uncia
- IUCN Status :Vulnerable
- Apex Predator in Himalayan Ecosystem
- Thereby influencing ecological equilibrium of its habitat
- Project SnowLepoard : Launched 2009
- Aim : promote conservation through the implementation of participatory policies and actions .

Snow Leopard Countries in World:

- 12 C : Uzbekistan, Tajikistan, Russia, Pakistan, Mongolia, Kyrgyzstan, Kazakhstan, India, China, Bhutan, and Afghanistan and Nepal
  In total, there are about 7,500 snow leopards left in the world, out of which 500 are in India.

- India Distribution : In India, Snow leopard's geographical range encompasses a large part of the western Himalayas including the UT of Jammu and Kashmir, UT of Ladakh, Himachal Pradesh, Uttarakhand and Sikkim and Arunachal Pradesh in the eastern Himalayas. (6)

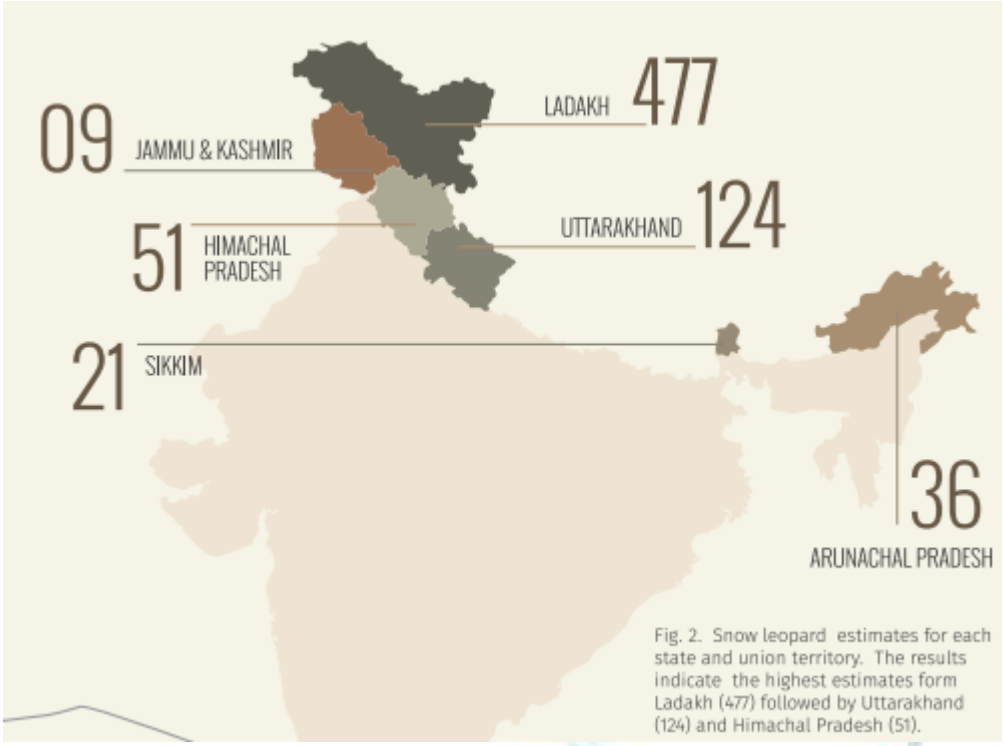


Fig. 2. Snow leopard estimates for each state and union territory. The results indicate the highest estimates form Ladakh (477) followed by Uttarakhand (124) and Himachal Pradesh (51).

- Ladakh Union Territory adopted two endangered species, snow leopard and black-necked crane, as State animal and State bird.
- Black-necked cranes are only found in Ladakh's Changthang region. The bird is classified as Near-Threatened, as per the IUCN classification; whereas Snow leopard has been classified as 'vulnerable' and in the Schedule I of the Indian Wildlife (Protection) Act 1972.
- Hangul (JK) + SnowL (L) + Sl (HP) +Alpine Musk Deer (UTK) +Redpanda (Sikkim)+ Mithum (Arunachal pradesh): all State animals
- Like St Petersburg Declaration : Tigers , then

What is Bishkek Declaration in News?

- International Snow Leopard Day: 23rd October
- **12 Countries** : Uzbekistan, Tajikistan, Russia, Pakistan, Mongolia, Kyrgyzstan, Kazakhstan, India, China, Nepal Bhutan, and Afghanistan.

- On the 23rd of October, in 2013, these countries signed the Bishkek Declaration regarding the conservation of the snow leopard. This happened in the capital of Kyrgyzstan, Bishkek, at the very first Global Snow Leopard Forum.

- They tend to be found in rugged, high mountain landscapes, at elevations between 3,000 and 4,500m

Protected areas for the Snow leopard

- ✓ Sacred Himalayan Landscape
- ✓ Kibber Wildlife Sanctuary at Lahaul Spiti, Himachal Pradesh
- ✓ Pin Valley National Park at Lahaul Spiti, Himachal Pradesh
- ✓ Great Himalayan National Park at Kullu, Himachal Pradesh
- ✓ Dibang Wildlife Sanctuary, near Anini, Arunachal Pradesh
- ✓ Hemis National Park, in Ladakh- Jammu and Kashmir
- ✓ Gangotri Np, Uttarkhand
- ✓ Khangchendzonga National Park, Sikkim (UNESCO first Mixed Heritage Site in India)
- ✓ Namdapha National Park, Arunachal Pradesh
- ✓ The snow leopard is no longer an endangered species

- ✓ International Union for the conservation of nature IUCN on September 14, 2017, **has changed** the IUCN red list status of **Snow leopards from endangered category to vulnerable category** ie very high risk too high risk of extinction in the wild.

Potential Threats :

- Habitat degradation due to tourism and Infrastructure Development
- Over grazing
- Climate induce shifts
- Human Animal Conflict
- Poaching
- Free ranging dogs

KEY DECLARATION

- Paris Declaration by International Solar Alliance joint effort of france and India
- St Petersburg Declaration: Tiger 2X by 2022
- St Bishkek Declaration: Protection and Conservation of Snow Leopards habitat by 2020
- Gandhinagar Declaration : Conservation of Migratory Species of Ecological connectivity .
- New York Declaration : Voluntary and non binding - Focus on Halting Deforstation
- Florianopolis Declaration: Conservation of Whales (Brazil)
- Colombo Declaration : Decreasing Nitrogen Waste by 50 %: by 2030

Animal in Focus : Elephants and Camels

Que : With reference to Indian elephants, consider the following statements :

1. The leader of an elephant group is a female
2. The maximum 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

Ans A

National Heritage Animal : Elephant

- Indian elephant Elephas maximus
- slow-growing, long-lived mammals, surviving up to 70 years in the wild
- An elephant pregnancy lasts about 660 days, or approximately 22 months
- elephants are listed as “Endangered” on the IUCN Red List of threatened species
- Schedule I of the Indian Wildlife (Protection) Act, 1972
- Appendix I of the Convention on International Trade in Endangered Species of Flora andFauna (CITES).
- More than 60% of the world’s elephant population is in India,
- It occurs in 16 of the 28 states in the country
- World Elephant Day: August 12

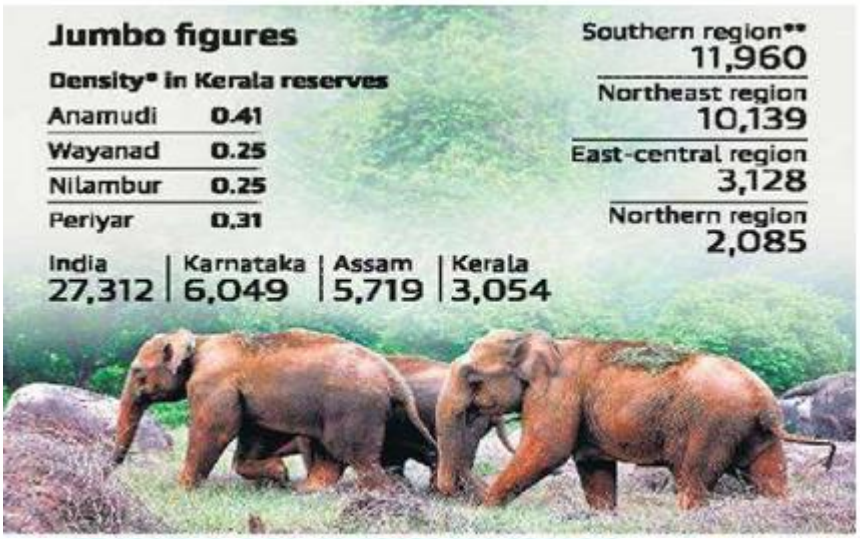
- proposed National elephant conservation authority (NECA) on the lines with NTCA hasbeen proposed to be constituted by amending the Wildlife Protection Act 1972

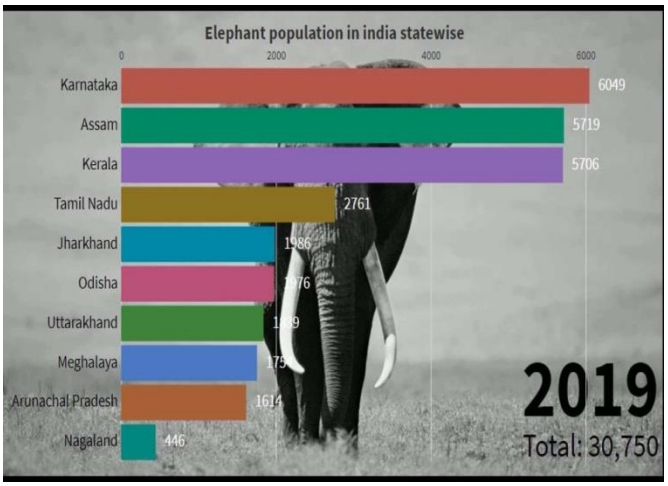
ISSUES:

- Illegal Wildlife Trade : Poaching mainly for ivory, meat, leather, and body parts
- Biodiversity loss due to deforestation
- Increasing Mining and Agriculture Activities near forest region
- Fragmentation of the Habitat
- Human elephant conflict
- Mistreatment in Captivity

Project Elephant :

- Launched 1992
- Central Sponsored Scheme
- Project Implemented in 16 states
- / UTs , viz. Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Jharkhand, Karnataka, Kerala, Maharashtra, Meghalaya, Nagaland, Orissa, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal.





32 elephant Reserves in India. The veryfirst elephant reserve or elephant sanctuary was the Singhbhum Elephant Reserve of Jharkhand

MIKE Programme

- Monitoring of Illegal Killing of Elephants program
- 2003 (starts from)

The Ministry of Environment and forests in partnership with Wildlife Trust of India has launched a campaign Hathi Mere Sathi

Mela shikaris a traditional method of capturing wild elephants for captive use. These methods get employed in Burma, Thailand, Vietnam, Laos and Cambodia and in Assam inIndia.

The Ministry of Environment, Forest and Climate Change launched 'Gaj Yatra', a nation- wide campaign to protect elephants on the occasion of World Elephant Day.

Que :Which of the following statements with reference to camels is/are correct?

1. All camels have one hump which consists of stored fat, which they can metabolize when food and water is scarce.
2. Camels like to stay together in groups called herds.
3. Camels are herbivores.

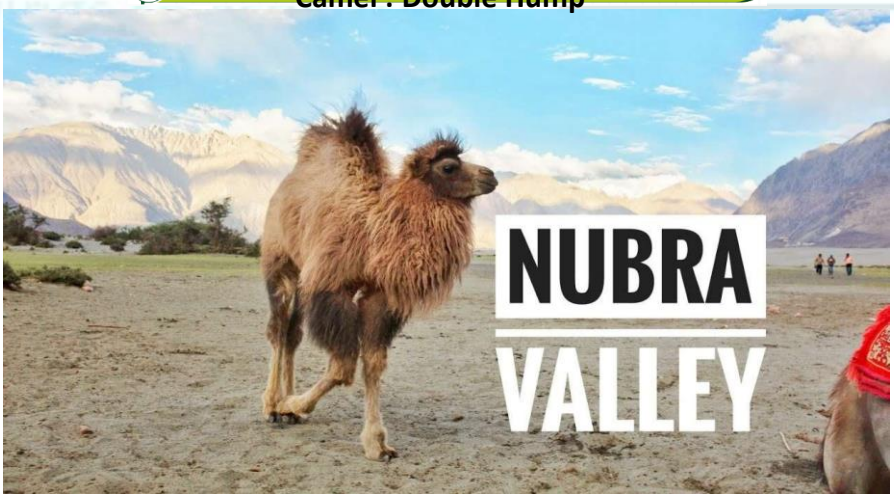
Select the Correct Code:

a) a and b
b) b and c
c) a and c
d) a, b and c

About Camels :

- Camels are herbivores.
- They can drink 113 liters of water in just 13 minutes. Their bodies rehydrate faster than any other mammal.
- Camels like to stay together in groups called herds.

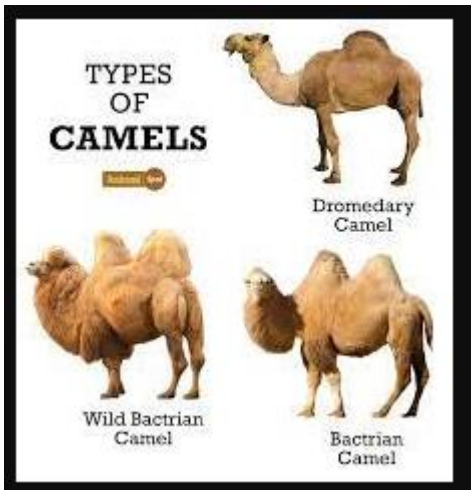
Camel : Double Hump



➢

- Only Found in Leh.
- These camels were brought along by travelers and traders from Yarkand in Xinjiang province of modern-day China. They are exclusively found in the Nubra Valley of Ladakh in India.
- It is **found in Gobi desert of central Asia.** It is **native to China and Mongolia**. It is also found in **China, Kazakhstan, Turkmenistan, Uzbekistan, and parts of Afghanistan.**
- **Both male and female Bactrian camels have two large humps on their backs.**

- called as as Bactrian Camel
- Bactrian camels have two humps rather than the single hump of their Arabian relatives.
- is the only living remnant of India's connection with famous silk route and Ladakh as the link of this ancient trade route
- National Institute of Camel Research, Bikaner has paved the way for growth in its popu- lation from mere 64 in 2004 to 298 in 2020.



- **double-humped camel has more water-retaining capacity** than the Dromedarian.
- **Dromedarian is longer-legged than the Bactrian**, has a shorter coat and is generally more lightly built.
- **Bactrians can also store more food** than the Dromedarians in their two humps.

Que: The Kharai Camel or "Swimming Camel" is found in which of the following states of India?

the kharai camel or "swimming camel" is found in which of the following states of india?

[a] tamil nadu
[b] maharashtra
[c] gujarat
[d] rajasthan

- Gujarat: Kharai Camel or Swimming Camels are found only in Gujarat's Bhuj area.
- **IUCN: Endangered**
- It has been recently recognized as a separate breed (one among nine such breeds found in India) of camel for better conservation.
- This camel is adapted to the extreme climate of Ran of Kachh where shallow seas and high salinity is prevalent.
- Kharai Camel can live in both coastal and dry ecosystems.
- It grazes on saline / mangrove trees and is tolerant to high saline water.
- It can swim up to three kilometers into the sea in search of mangroves,their primary food.
- The camel is distinct from other camels because of its rounded back,long and thin legs and small feet.
- the Kharai camel is probably the **only domesticated breed of camel that lives in dual ecosystems.**
- **It is the ninth recognised camel breed of India.** Kutchi, Kharai, Bikaneri, Jaisalmeri, Mewari, Jalori, Mewati and Marwari camel

S.N.	Breed	Home Tract
1.	Bikaneri	Rajasthan
2.	Jaisalmeri	Rajasthan
3.	Jalori	Rajasthan
4.	Kutchi	Gujrat
5.	Malvi	Madhya Pradesh
6.	Marwari	Rajasthan
7.	Mewari	Rajasthan
8.	Mewati	Rajasthan and Haryana
9.	Kharai	Gujarat

- **Industries in Kutch–salt, thermal power, cement and shipyards, among others–pose a huge threat to the dwindling mangroves**

What is/are unique about 'Kharai camel', a breed found in India?
1. It is capable of swimming up to three kilometres in seawater.
2. It survives by grazing on mangroves.
3. It lives in the wild and cannot be domesticated.
Select the correct answer using the code given below:

Only two statements correct .

****

CHAPTER 6 : ECOLOGY AND MANAGEMENTS OF GRASSLANDS HABITAT IN INDIA

INTRODUCTION

- Grassland : area where the vegetation is dominated by grasses and herbs, scattered trees or shrubs .
- graminoid : refers to a herbaceous plant with a grass-like morphology
- Location : The grassland ecosystem lies between the deserts and the forest ecosystems.
- Grasslands occur naturally on all continents except Antarctica
- Found in Ecotone Region and in all Ecozones
- Grasslands cover 31–43% of the Earth's land area
- These ecosystems are mainly found in regions, where there is a scarcity of water and not enough and average rainfall to support the growth of plants and forests.
- The height of grass is closely linked to the precipitation it receives.
- annual rainfall ranges from 25 to 75 cm
- The grass or plants of these regions have been adapted to drought, fires and other climatic conditions
- Reservoirs of Crop Genes and Back Bone of Livelihood of Pastoral Communities

ROLE OF GRASSLAND :

- regulating our weather and climate
- supporting the nutrient cycle and water storage
- enabling pollination
- maintaining biodiversity conservation
- preventing soil erosion
- In India grazing-based livestock husbandry plays an crucial role in the rural economy.

TYPES OF GRASSLAND : primarily two categories of grasslands: tropical and temperate

Areas of Temperate Grasslands

1) Pampas in South America./Argentina
2) Veld in Africa.
3) Canterbury Plains in New Zealand.
4) Downs / Murray-Darling Basin in Australia.
5) Prairies in North America.
6) Steppes in Central Asia. And
7) Pantagonian Steppe in S America

TEMPERATE GRASSLAND :

- Part of Terrestrial Ecosystems
- Short Grass than Tropical Grass but more nutritious than tropical grass
- having vast grasses with minimal tree cover .
- Found in Temperate regions, Hot summer and cold winters
- Found in interior of continents , away from maritime influence
- Soil Mollisols and chernozem soil

- Mollisols are distributed across various regions of the world, primarily in temperate grassland areas.
- Chernozem : a fertile black soil rich in humus and with a lighter lime-rich layer beneath, typically occurring in the temperate grasslands of the Russian steppes and North American prairies.
- some vegetation that grows here are, **cacti, sagebrush, perennial grasses, buffalo grass clovers, and wild indigos, etc.**

Tropical Grassland Regions

1. Horn of Africa Acacia Savannahs.
2. East African - Savannahs.
3. Central and Eastern Miombo Woodlands.
4. Sudanian Savannahs.
5. Terai-Duar Savannahs and Grasslands.
6. Llanos Savannahs.: Venezulea
7. Cerrado Woodlands and Savannahs of Brazil
8. Campos of Brazil

- Indian subcontinent grassland

Flooded Grasslands

- Pantanal Flooded Savannahs in Central South America
- Sudd-Sahelian Flooded Grasslands and Savannahs in Central Africa.
- Zambezian Flooded Savannahs in in Africa.
- Rann of Kutch Flooded Grasslands in India and Pakistan
- Everglades Flooded Grasslands in North America.

TROPICAL GRASSLAND REGION (SAVANNA)

- Type of terrestrial biome
- Combination of grasses and scattered trees / shrubs
- Found in Tropical regions with distinct wet and dry seasons
- warmer drier climate and seasonal droughts
- Distribution: Transitional between the equatorial forests and the trade wind hot deserts
- Soil type: Alfisols and Ultisols
- **tropical grassland is a home for elephants, giraffes, lions, cheetahs, zebras, and other spectacular species.**
- Tall, elephant grass and short trees that have long roots and water storing devices
- examples (e.g: baobabs and bottle trees)

See Figure of Bottle Tree : native to Africa , easily identified by their swollen trunks , spectacularly large and can age beyond 1000 years . Approx 60 feet tall


- Second figure **: Baobabs**
- They are long-lived deciduous, small to large trees from 20 to 100 ft tall with broad trunks and compact tops.
- The Baobab Tree is also known as the upside-down tree.
- The baobab is a prehistoric species which predates both mankind and the splitting of the continents over 200 million years ago.
- There are 9 species of baobab tree. Two are native to mainland Africa, six to Madagascar, and one to Australia.
- Mandu, in the Dhar district of Madhya Pradesh, is perhaps the only place in India where baobab trees are found in abundance, with an estimated 1,000 trees in the periphery of Mandu town.

- Mature trees have massive trunks that are bottle-shaped or cylindrical and tapered from bottom to top.
- The fruit of the tree is round or oval-shaped and is highly nutritious.

WHY ARE THEY CALLED THE 'TREE OF LIFE'?

- They can store large amounts of fresh water in their extraordinary trunks.
- It also allows the baobab tree to produce nutritious fruits even during the driest years.
- This makes them true life savers during times when water is scarce.

Key Concepts :

- Three factors that contribute to the preservation of grassland ecosystems are limited rainfall, natural wildfires, and grazing by animals. Larger animals, such as African elephants, can also help prevent tree growth by trampling the ground.
- Frequent wildfires are also instrumental in maintaining the integrity of grassland ecosystems
- When conditions are dry, fire is sometimes required to protect grasslands against the invasion of desert shrubs.
- Grasses have evolved to recover and regrow quickly after a fire.

Que : The vegetation of savannah consists of grassland with scattered small trees, but extensive areas have no trees. The forest development in such areas is generally kept in check by one or more or a combination of some conditions. Which of the following are such conditions?

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

Select the correct answer using the code given below.

a. 1 and 2 b. 4 and 5 c. 2, 3 and 4 d. 1, 3 and 5

Correct Option: (C)

Explanation Savannas are defined based on vegetation structure, the central concept being a discontinuous tree cover in a continuous grass understorey. Fire, grazing herbivore and seasonal rainfall are behind the scarce forest development in the region.

EMISSIONS FROM GRASSLANDS : CLIMATE CHANGE

- Grasslands absorb and release carbon dioxide (CO_2), emit methane (CH_4) from grazing livestock, and emit nitrous oxide (N_2O) from soils.
- Grasslands sequester their carbon underground Soil,
- Grasslands hold about 20 percent of global soil carbon stocks.
- A new study shows that emissions of methane (CH4) and nitrous oxide (N2O) from grasslands increased by a factor of 2.5 since 1750 mainly due to increased emissions from livestock.

Carbon sink

- refers to any reservoir, natural or artificial, that absorbs more carbon than it releases, helping to decrease the concentration of carbon dioxide in the atmosphere.
- forests, oceans, and wetlands, Grasslands

carbon sequestration :

- process of capturing and storing carbon dioxide to prevent it from being released into the atmosphere.
- carbon sequestration technologies, such as carbon capture and storage (CCS) or carbon farming, are man-made methods of capturing carbon emissions from industrial processes or agricultural practices.

INDIA GRASSLANDS :

India's Grasslands occupy 24 % of India geographical area . They support high density of domestic livestock which forms the backbone of rural livlihood. The 24% area under cover of grasslands in India has come down to almost 15% area now.

- Alpine Moist Meadows of the Great Himalaya
- Alpine Arid pastures or steppe formations in Trans Himalaya
- Hill Side Grasslands in Himalayas
- Chaurs of Himalaya foothills
- Wet Alluvial- Terai Grasslands of Ganga and Duars of Brhmaputra flood plains
- Phumdi or floating grasslands of Manipur
- Bannis of kutch and Vidis grassland Saurastra of Gujarat
- Savannah of western and Peninsular India
- Valley grasslands in Satura and Maikal Hills
- Dry grasslands of Andrapradesh and Tamilnadu plains
- Mangroves grasslands found between adjacent mangrove forest and sea beaches.
- Riverine Alluvial Grasslands along near river bank, ex Kazairanga NP south of brahmaputra

- Note Except Alpine Grasslands of Himalaya and Shola of Western ghat, most of the grasslands in th country are antropogenic in Origin and evolved under infuence of fire , livestock grazing , cleaninf of forest , flood and drought.

About Shola Grasslands Of Western Ghats

- stunted tropical montane evergreen forests found in the highest reaches of the Western Ghats
- location South India: largely in Kerala, Karnataka and Tamilnadu.
- called as " Sky Island ".
- Shola forests are found in the higher elevation hill regions of the Nilgiris, Anaimalai, around Anamudi, Palni hills, Meghamalai, Agasthyamalai to the south and the Malnad and associated ranges in parts of Wayanad, Coorg, Baba Budangiri, Kudremukh up the north, to Goa, Satara district and Sindhudurg district in the states of Karnataka, Kerala, Goa, Maharashtra and Tamil Nadu
- Shola forests have also faced disproportionately high deforestation rates over the past century. Shola forests and adjoining areas also happen to be one of the major tourist attractions of India (Ooty, Kodaikanal, Munnar), generating income for a large number of people.
- For invasive species such as *Acacia mearnsii* , *Eucalyptus globulus* that grow rapidly and disperse seeds widely
- *Strobilanthes kunthiana*, known as **Kurinji** or **Neelakurinji** in Tamil, is a well known shrub endemic to Western Ghats that blossoms only once in 12 years
-

THREATS TO GRASSLANDS COMMUNITIES :

- Habitat Degradation and fragmentation induced by anthropogenic Pressure , Land fillling, for developmental activities grazing pressure, fragmentation, invasive species and to an extent climate change.
- The Process of degradation and loss is more prevalent in Tropics and Sub Tropics.
- Rapid Urbanization and development of tourism amenities in and around like high altitutde grasslands have increased Human Interference and introduction of other grass species through construction material (sand)from other areas.
- Forest Fires in grasslands communities have played imp role in Prevention of Succession of grasslands into woodlands. However, frequent fires have played a negative role in changing composition of grasslands species.

- Reduced Snowfall in the tree line zone of alpine meadows have also resulted in invasion of lower altitude species into the tree line.
- Toxic pesticide use in agri croplands affect wild flora and fauna and impact gene pool and genetic diversity.

Reason :

- Greater Demand on Land for agriculture activities and mining
- Infrastructure Development and Fodder Production to meet the requirements of Human and Livestock Populations.

Pastoralist communities in India

Pastoralist communities	Area	Livestock species
Bakarwal, Changpa	Jammu and Kashmir	Goats, Yaks
Bhotia	Uttarakhand, Garhwal, Kumaon	Sheep, goats, cattle
Bhutia	North Sikkim	Sheep, goats, cattle
Gaddi	Himachal Pradesh, Jammu and Kashmir	Sheep and goats
Kinnaura	Kinnaur, Himachal Pradesh	Sheep and goats
Gujjar	Jammu and Kashmir, Rajasthan, Himachal	Buffaloes
Monpa	Tawang, West Kemeng of Arunachal Pradesh	Yaks and cattle
Van Gujar	Uttarakhand, Uttar Pradesh	Buffaloes
Bharwad and Charans	Gujarat	Sheep, goats, cattle
Dhangar	Maharashtra, Karnataka, Madhya Pradesh	Sheep
Gavli	Gujarat, Goa, Karnataka, Maharashtra	Cattle
Gayri	South Rajasthan	Sheep
Ghosi	Bihar, Rajasthan, Uttar Pradesh	Cattle
Golla	Andhra Pradesh, Maharashtra	Cattle
Jath	Kutch, Gujarat	Cattle, occasionally camels
Mer	Saurashtra, Gujarat	Camels, some cattle
Rath	Western Rajasthan	Cattle
Rebari/Raika	Rajasthan, Gujarat	Camel, cattle, goats

Sindhi Sipahi	Marwar and Jaisalmer	Camels mainly and cattle and sheep

NEEDS TO BE DONE : MANAGEMENT OF GRASSLANDS

1. Map various grasslands communities and compile their findings to bring about revised classification of grasslands communities of Indian Subcontinent.
2. Quantification of Biomass, assessment of Carbon sequestration potential, threat assesment and conservation requirement need to be worked out and other ecological studies need to be taken up as emerging research and ecologists.
3. Continued education effort particular among farmers and livestock herders on hoe to protect the soil and prevent soil erosion
4. Protect and restore wetlands , which is imp part of grasslands ecology.ie Management of water resources.
5. Include grasslands come under protected area system, like forest if want to save Great Indian Bustard.
6. Grassland as critical habitats was first recognised by the National Forest Commission in 2003 and recommended protection of grasslands to protect wildlife and livestock by developing a centrally coordinated and funded scheme.
7. Formulate a National Grazing Policy to ensure the sustainable use of grasslands and biodiversity conservation. Report of the Task Force on Grasslands and Deserts submitted in 2006 to the Planning Commission of India.

Species of Grasslands Habitat that need Immediate Attention

1. Kashmir Stag or Hangul
2. Manipur Deer or Thamin
3. Swamp Deer or Barasingha
4. Hog Deer
5. Black Buck
6. Great Indian Rhinoceros and pygmy Hog
7. Great Indian Bustard
8. Lesser and Bengal florican
9. Snow Leopard
10. The Blackbuck is the only true antelope found in India. It lives in large herds. The males are black on top and cream below and have beautiful spiral horns that form a 'V' shape.

DEER/ ANTELOPE: Antelope: Their Horns are permanent. They do not shed their horns and Both male and female antelope have horns.

There are only four species of antelope found in India,

1. Black Buck,
2. Chinkara Gazelle,
3. Nilgai/ Blue Bull and
4. Four Horned Antelope/ Chousinga (is the only animal in the world that has four horns.)

GAZELLE	ANTELOPE
Gazelle is a member of a sub-class of the Antelope genus	Antelope is a member of the Bovidae family, which includes cloven-hoofed ruminant mammals
Have a smaller body	Most members have larger bodies
Most male and female gazelles bear ringed horns	Most male antelopes possess horns
Quicker and have an action unique to them called stotting	Not as quick as gazelles
19 different breeds recognized so far	91 species recognized so far
Diet is plant-based	Some species feed on small insects, mammals, and birds

Deer : Their horns are not permanent. They shed their antlers annually. Only male deer have antlers. Deers have a great vision, as their eyes are placed at the side of the head which gives them a vision of 310 degrees.

Species of deer found in India are :

1. Sambhar a large deer,
2. chital or spotted dear, and
3. barasingha or swamp deer,
4. Hog Deer,
5. Barking deer or munjtac,
6. Hangul or Kashmir Stag

news : The Great Indian Bustard (GIB) has not been spotted at the Rollapadu Wildlife Sanctuary in Nandyal district of Andhra Pradesh and its surrounding areas for the last couple of years, which is an indication that the bird is at risk of local extinction.

- **Rollapadu Wildlife Sanctuary** is a wildlife sanctuary in the Nandyal district of Andhra Pradesh, India. Known primarily as a habitat of the great Indian bustard, the species has suffered a drastic fall in its numbers in the sanctuary in recent years

BIRD IN FOCUS:

- Great Indian Bustard (GIB),
- the State bird of Rajasthan,
- With less than 140 individuals globally, it is listed as "critically endangered"
- it stands about a meter tall, weighing approximately 15 kg.
- The majority of the population resides in the arid grasslands of the Thar desert, particularly in the Desert National Park and the Pokhran Field Firing Range in Rajasthan.
- Its population is confined mostly to Rajasthan and Gujarat. Small populations occur in Maharashtra, Karnataka and Andhra Pradesh.
- considered the flagship grassland species, representing the health of the grassland ecology.

The bird is under constant threats due to collision/electrocution with power transmission lines, hunting (still prevalent in Pakistan), habitat loss and alteration as a result of widespread agricultural expansion, etc.

- **Protection Status:** International Union for Conservation of Nature Red List: **Critically Endangered**
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): Appendix1
- Convention on Migratory Species (CMS): Appendix I
- Wildlife (Protection) Act, 1972: Schedule 1

See Six States ?

Male Plumage: Males have a distinctive black cap contrasting with their pale head and neck, earning them the nickname "Blackheaded Bustard.

Female Plumage: Females are generally smaller and lack the black chest band and vibrant head coloration of males. Their head and neck are a pale buff color, and their bodies are more uniformly brown with subtle markings

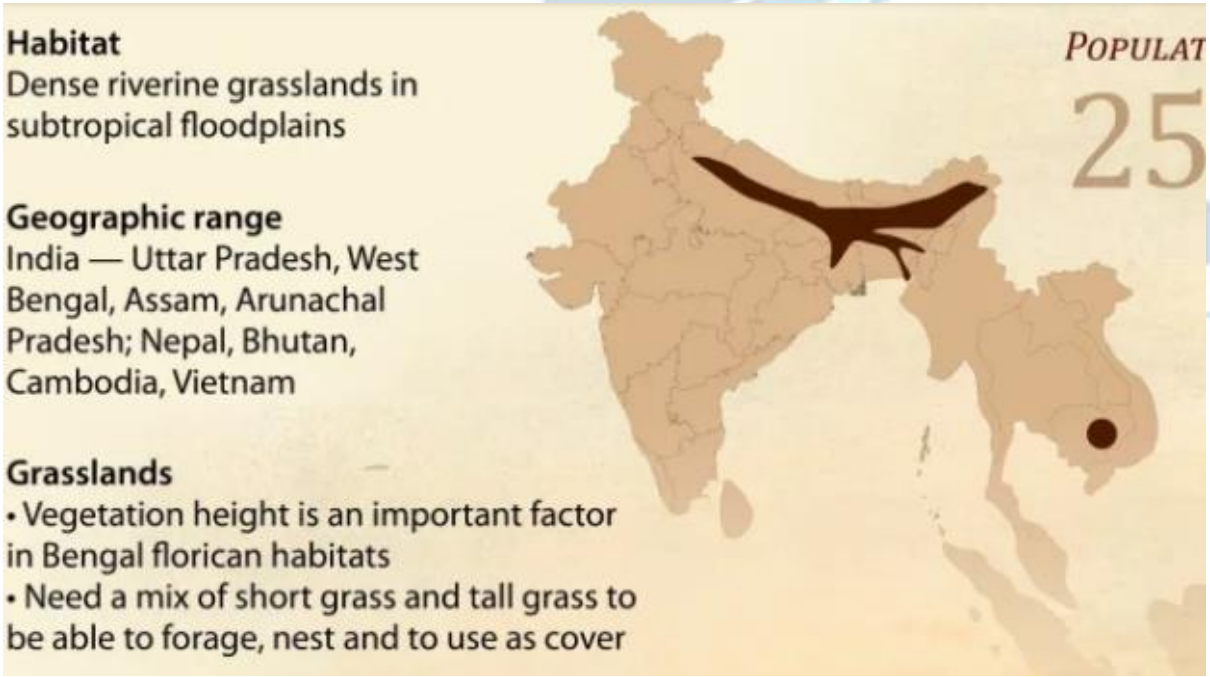
Gular Pouch: Males possess a unique gular pouch on their throat. This inflatable pouch expands during courtship displays, amplifying their booming calls to attract females.

threats to Great Indian Bustard:

- **Hunting**
- **Habitat Loss**
- **Infrastructure Development**
- **Renewable Energy Expansion**
- **Migration risks**
- **Lack of Protection**
- **Failed captive breeding attempts**
- **Power lines collision related mortality :** Due to their large size and preference for open habitats, GIBs are more susceptible to collisions with power lines.

The recent survey by an Indian Habitat trust team studied the fall in numbers or extinction of the grassland species Bengal Florican at the Dudhwa National park.

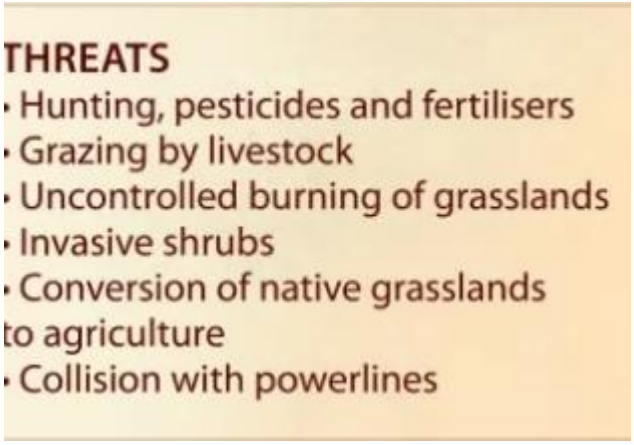
Ambassadors of flood plain grasslands



About Bengal florican

- **Bengal bustard**, is a bustard species native to the Indian subcontinent, Cambodia, and Vietnam. It is listed as Critically Endangered on the IUCN Red List
- Listed under ***Schedule I of the Wildlife Protection Act of India, 1972***
- The male Bengal florican has a black plumage from the head and neck to underparts
- Bengal floricans live in open tall grassland habitats with scattered bushes.
- Habitat : The Bengal florican has two disjunct populations. One occurs from Uttar Pradesh through the Terai of Nepal to Assam and Arunachal Pradesh in India, and historically to Bangladesh. The other occurs in Cambodia and perhaps adjacent southern Vietnam

- They are found in th**e Dibru-Saikhowa and Kaziranga National park of Assam and Dudhwa Tiger reserve of Uttar Pradesh**.



Threat:

- Its migration exposes it to threats such as land-use changes, collision with power transmission line at the boundary area of India-Nepal and probable power-line collisions
-

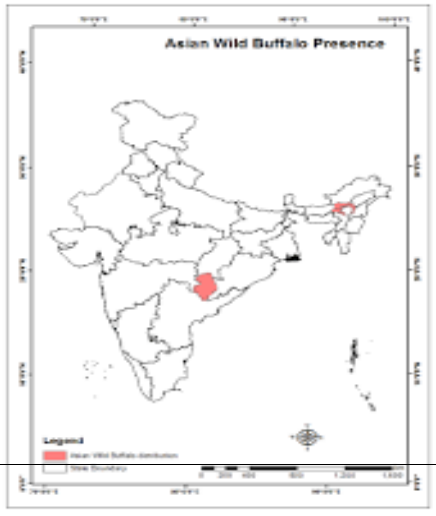
The Lesser Florican *(Sypheotides indicus)* is a characteristic bird of grasslands, endemic to the Indian subcontinent. Locally, the bird is known as *Kharmor* (grass peacock) in Gujarat and *Khar titar* (grass pheasant) in Rajasthan. It belongs to the Bustard family, and is the smallest of all cousin species found in India. It inhabits the states of Rajasthan, Gujarat, Madhya Pradesh, and parts of Andhra Pradesh, Maharashtra, and Karnataka. The bird is currently listed as Critically Endangered on the IUCN Red List.

Breeding Behaviour

The most characteristic feature of the bird is the mating strategy. A BNHS project report states that during the breeding season, males are seen folding their legs and leaping upwards, reaching a height of about 2 to 3 metres. They flutter rapidly, even up to 600 times a day, while emitting a croak-like sound. This sound is produced by the rotation of feathers around the carpal joint as they beat their wings, and is loud enough to be heard from a distance of 300 to 400 metres. This behaviour serves purposes like announcing territory, repelling rival males, and attracting the female.

ASIAN WILD BUFFALO:

- Listed as Endangered in the IUCN Red List since 1986,
- The global population has been estimated at 3,400 individuals, of which 3,100 (91%) live in India, mostly in Assam
- It is associated with wet grasslands, swamps, flood plains and densely vegetated river valleys
- Restricted Kaziranga, Manas and Dibru-Saikhowa National Parks and more in Assam and Ap area
- A small population survives in Balphakram National Park in Meghalaya, and
- in Chhattisgarh in Indravati National Park and Udanti Wildlife Sanctuary.



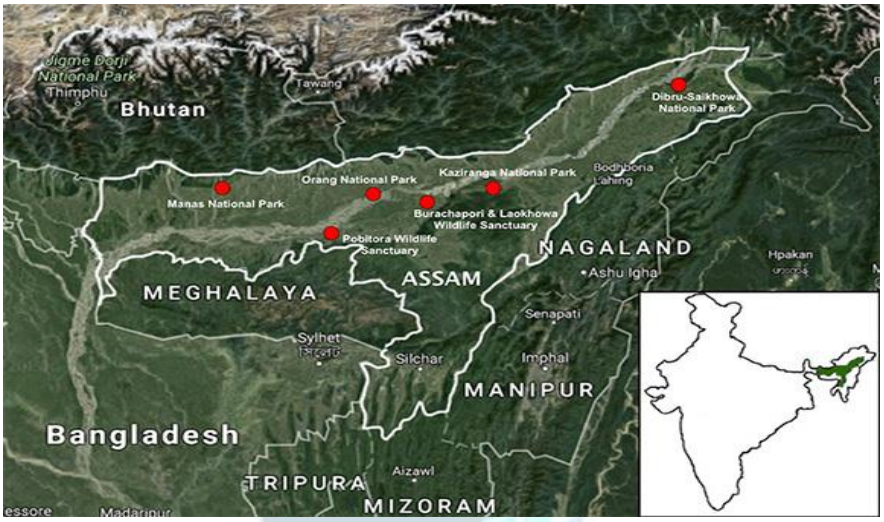
See Wild Buffalo Presence in India

Pygmy Hog (*Porcula salvania*) :

- the world's rarest and smallest wild pigs,
- native to alluvial grasslands , tall and wet grasslands, in the foothills of the Himalayas at elevations of up to 300 m

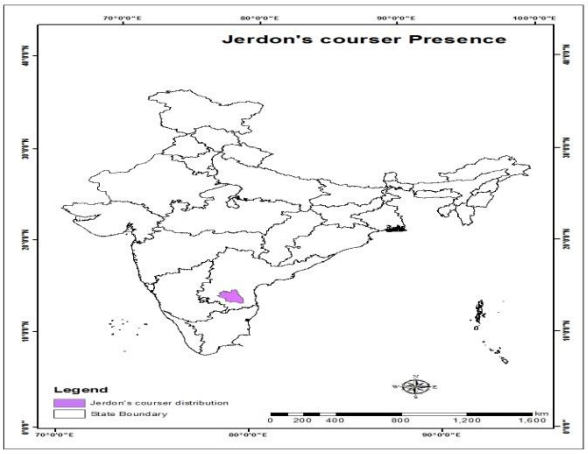
- Today, the only known population lives in Assam, (Manas National park)and possibly southern Bhutan.
- As the population is estimated at less than 250 mature individuals,
- it is listed as Endangered on the IUCN Red List.
- **Schedule I species 1972 Act**.
- It is also an indicator species. Its presence reflects the health of its primary habitat, the tall, wet grasslands of the region.

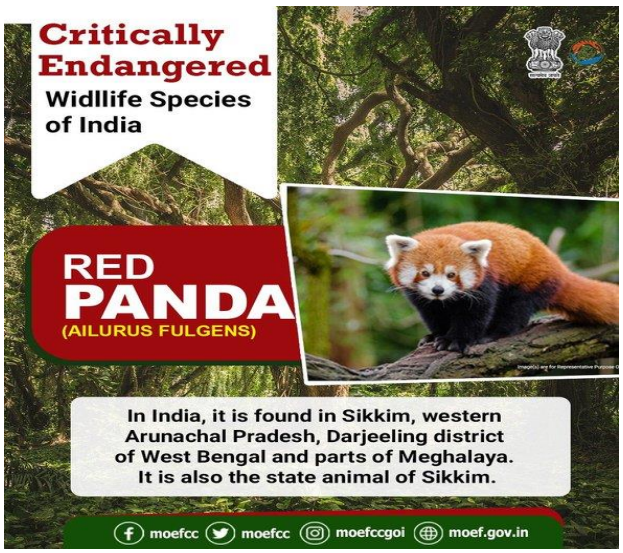
Assam currently has seven national parks: Kaziranga, Manas, Orang, Nameri, Dibru-Saikhowa and more recently, Raimona and Dehing Patkai



Jerdon's courser

- Critically endangered ,is a nocturnal bird endemic to India
- This courser is a restricted-range endemic found locally in India in the Eastern Ghats of Andhra Pradesh.
- It is currently known only from the Sri Lankamalleswara Wildlife Sanctuary, where it inhabits sparse scrub forest with patches of bare ground.
- It was considered to be extinct from the beginning of the 20th century until its rediscovery in 1986





About Red Panda / red cat bear:

- found mostly in the sub Himalayan states of North East.
- In India, Red Pandas are only found in the states of Sikkim, northern West Bengal (Darjeeling and Kalimpong), Meghalaya and Arunachal Pradesh.
- Padmaja Naidu Himalayan Zoological Park also known as Darjeeling zoo has successful captive breeding programs of Red Pandas in India

Small arboreal mammal means living in Trees. in mixed deciduous and conifer forests with dense understories of bamboo
1.Singalila National Park, Darjeeling
2. Nokrek National Park, Meghalaya
3. Neora Valley National Park, Darjeeling/Kalimpong hills
4. Namdapha National Park, Arunachal Pradesh
5. Khangchendzonga National Park, Sikkim

- Endemic to the temperate forests of the Eastern Himalayas
- omnivores.:They eat mostly bamboo, and may eat small mammals, birds, eggs, flowers

CHAPTER 7 : BIODIVERSITY CONSERVATION

Two Key Aspect / Ideologies of Environmental Management, but they have different goals and approaches **.**

CONSERVATION :

- the sustainable use of natural resources
- aims to manage natural resources and ensure availability for future generations
- is done to prevent the damage or destruction before it causes more serious problems .
- promotes the wise utilization of resources and allows their use in a manner that ensures their continued availability
- reducing the 'wear and tear' of the Earth.

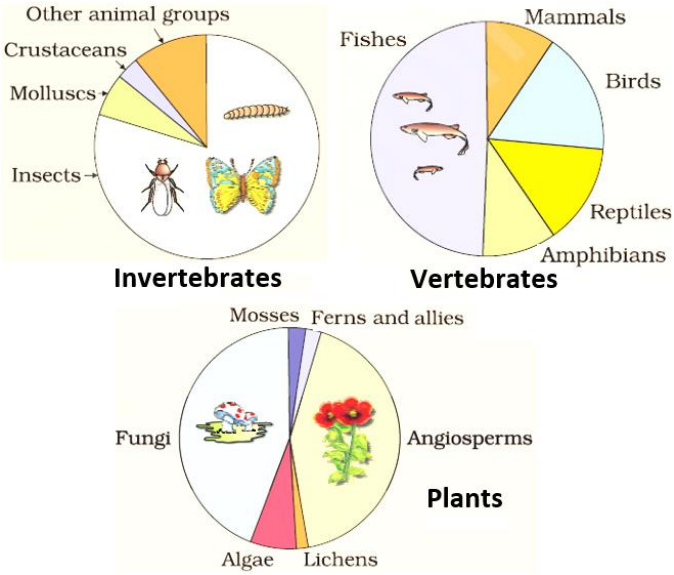
PRESERVATION:

- aims to keep the resources in a pristine state.(original state)
- seeks to protect natural resources without any human interference
- is done to environments that were already damaged.
- discourages the use of resources in order to maintain their present state;

- focus on protecting natural resources for their intrinsic value .

BIODIVERSITY

- **is** the variety of all forms of life.
- is a system in constant evolution.
- refers to the varieties of plants, animals and micro organism, the genes they contain and the ecosystem they form.
- it is the variability among living organisms and their habitats, including diversity within species, among species, and within ecosystems**.**
- The range of variation found among microorganisms, plants, fungi, and animals



- The number of fungi species in the world is more than the combined total of the species of fishes, amphibians, reptiles and mammals.
- Among animals, insects are the most species-rich taxonomic group, making up more than 70 per cent of the total.
- More than 70 per cent of all the species recorded are animals, while plants (including algae, fungi, bryophytes, gymnosperms and angiosperms) comprise no more than 22 per cent of the total

Coined by :

- **The term biological diversity was** used first **by wildlife scientist and conservationist** Raymond F. Dasmann in 1968**, where he advocated conservation**
- The term Biodivesity coined by Walter Rosen in 1985
- **Biodiversity is the term** popularised **in 1988 by the** sociobiologist Edward Wilson **to describe the combined diversity at all the levels of biological organisation. He is regarded as** the Father of Biodiversity.

Key Facts :

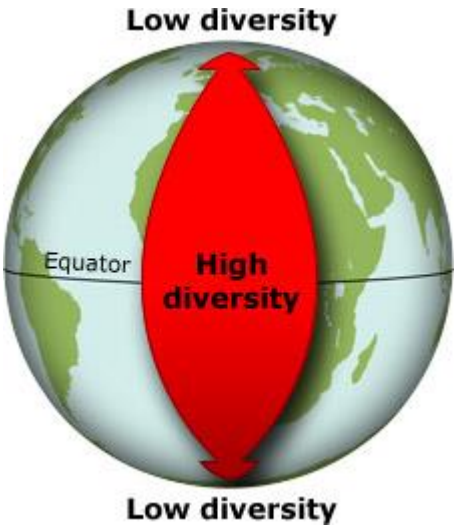
- Generally, there is an increase in biodiversity from the poles to the tropics.
- Even though terrestrial biodiversity declines from the equator to the poles

- This is often referred to as the latitudinal gradient in species diversity.

- Colombia located near the equator has nearly 1,400 species of birds while New York at 41° N has 105 species and Greenland at 71° N only 56 species.

- The largely tropical Amazonian rain forest in South America has the greatest biodiversity on earth

- In general, species diversity **decreases** as we move away from the equator towards the poles.



Biodiversity is unevenly distributed. It varies globally and within regions. The various factors that influence biodiversity include -temperature, altitude, precipitation, soils, and their relation with other species.
For instance, ocean biodiversity is 25 times lesser than terrestrial diversity.
In marine ecosystems, species richness tends to be much higher in continental shelves.

Biodiversity is the result of 3.5 billion years of evolution. It has been subject to periods of extinction.

Consider following statements regarding biological diversity:
1. Tropical latitudes have remained relatively undisturbed for millions of years in comparison to temperate regions.
2. Availability of more solar energy in tropical regions.
3. Frequent and major seasonal variations in tropical regions.
4. Tropical latitudes have niche specialisation and a greater species diversity.
How many of the above factors is/are responsible for greater biological diversity in tropical regions as compared to temperate regions?
(a) Only one
(b) Only two
(c) Only three
(d) All four
Ans C

- temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification.
- tropical regions are less seasonal, relatively more constant and predictable. This helps in species diversification.
- there is more solar energy available in the tropics, which contributes to higher productivity and indirectly contributes to diversity.

- Tropical latitudes have less seasonal variations which promote niche specialisation and lead to a greater species diversity.

Consider the following statements:

1. Biodiversity is normally greater in the lower latitudes as compared to the higher latitudes.
2. Along the mountain gradients, biodiversity is normally lesser in the lower altitudes as compared to the higher altitudes.
3 The variety of ecosystems and habitats also changes as you ascend or descend a mountain, contributing to the gradient of biodiversity .
4 The higher altitudes of a mountain often have more specialized species that are adapted to harsh conditions than generalist species in lower altitudes which can survive in wide range of conditions .

Which of the statements given above is/are correct?
(a) only one
(b) Only two
(c) only three
(d) All

Importance of Biodiversity : it Play three important Roles :

Ecological Role of Biodiversity :

- help to regulate the climate
- help to cycle water and nutrient
- help to maintain energy flow and niche pattern
- fix atmospheric gases
- more the variety of species in an ecosystem , the more stable the ecosystem is likely to be.

Economic Role of Biodiversity

- it provide basic natural resources to human beings for their day to day life.
- Provide Crop Diversity or Agro Diversity
- Provide Livestock diversity
- Provide Economic commodities: food, crops, livestock, fish.. forest, medicinal resources .

Note : This Concept of biological resources is responsible for deterioration of biodiversity .

Scientific Role of Biodiversity :

- Biodiversity is important because each species can give us some clue as to how life evolved and will continue to evolve.
- Biodiversity also helps in understanding how life functions and the role of each species in sustaining ecosystems of which we are also a species.
- . This fact must be drawn upon every one of us so that we live and let other species also live their lives.
- . The level of biodiversity is a good indicator of the state of our relationships with other living species. In fact, the concept of biodiversity is an integral part of many human cultures. biodiversity provides an abundance of systematic ecological data that aids in our comprehension of the natural world and its origins.

Why Important ?

- **Maintaining The Balance of The Ecosystem**: Recycling and storage of nutrients, combating pollution by breaking it down and its absorption, stabilizing climate, protecting water resources, forming and protecting soil, recovery from unpredictable events and maintaining overall eco-balance.
- **Provision of Biological Resources**: Provision of medicines and pharmaceuticals, food for the human population and animals, ornamental plants, wood products, breeding stock, future resources and diversity of species, ecosystems, and genes.
- **Social Benefits**: Recreation and tourism, cultural value and education, research and monitoring.

So Biodiversity – A Solution to Climate Change

India Reference :

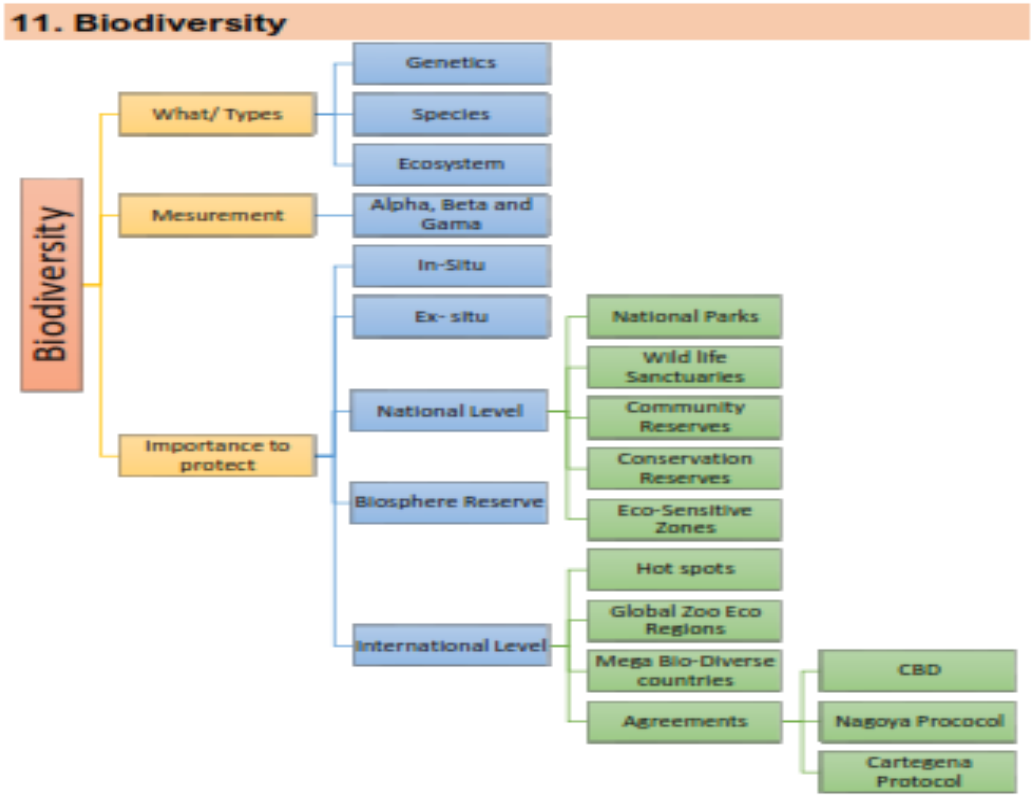
- 18% of the world's population of India crammed into just 2.4% of the global landmass, India's biodiversity is under pressure.
- It is Estimated that 70% of the Indian Population are directly dependent on the biodiversity for their livelihoods and socio economic growth and sustainable development .

- However due to growing Population pressure , rapid economic growth , and industralization, there is immense pressure on Biodiversity and Ecosystem services, with the consequences being Habitat destruction, Fragmentation, over –explotation of the Natural habitat, shrinking genetic diversity , Invasion of alien Species.

Four animals - the cheetah, Lesser Indian Rhinoceros, Pink-headed duck, and the Himalayan Mountain Quail - have become extinct in the last century.

Thus, there is urgent need

- for Mapping all species,
- focus on Wildlife crime control,
- mapping for biological corridors ,and
- for accelerating our efforts towards conservation and sustainable use of biodiversity fair and equitable sharing of benefits arising from use of genetic resources.



What are the LEVELS OF BIODIVERSITY ?

Biodiversity can be discussed at three levels: Genetic diversity, Species diversity and Ecosystem diversity.

- **Species diversity:** Variety of species and abundance of species
- **Genetic diversity:** Genetic variability present within the species
- **Ecosystem / Ecological diversity:** Ecosystem variety present within a geographical area

GENETIC DIVERSITY :

- **building block of biodiversity ,**
- **facilitating fitness,**
- **adaptation and evolution**

- **essential for healthy breeding of population of species**

1. Genetic biodiversity refers to the variation of genes **within species**.
2. Groups of individual organisms having certain similarities in their physical characteristics are called species.
3.Human beings genetically belong to the homo-sapiens group and also differ in their characteristics such as height, colour, physical appearance, etc., considerably. This is due to genetic diversity.

The genetic diversity is essential for a healthy breeding of population of species.

- ❖ Genetic diversity is all the different genes contained in all individual plants, animals, fungi, and microorganisms. It occurs within a species as well as between species
- ❖ Genetic diversity plays a great role in the adaptability and survival of a species.
- ❖ Different breeds of dogs, different varieties of rose flower, wheat, etc.
- ❖ India has more than 50,000 genetically different strains of rice, and 1,000 varieties of mango.

So, Genetic diversity, for instance, helps species to fight diseases. it help Species for Adjustment and Adaptation

Genetic diversity has the following importance:
(i) It helps in speciation or evolution of new species;
(ii) It is useful in adaptation to changes in environmental conditions;
(iii) It is important for agricultural productivity and development.

****

SPECIES DIVERSITY :

1. is the variety of genetically dissimilar organisms present in the region. This refers to the variety of species.
2. It relates to the number of species in a defined area. Areas rich in species diversity called Hotspots of diversity.
3 . The diversity of species can be measured through its richness, abundance and types. Some areas are richer in species than others. Areas rich in species diversity are called hotspots of diversity.

Species diversity is all the differences within and between populations of species, as well as between different species.

Ex:
1. Great Barrier Reef of Australia is the world's largest coral reef . Because it contain coral+ Fish+ Molluscs+ turtles + Breeding site for birds
2. Tropical rainforest
3 Coral reefs
4. For example, the Western Ghats have a greater amphibian species diversity than the Eastern Ghats
****

ECOSYSTEM DIVERSITY :

- is the variety of distinct landscape patterns in a given region.
- An ecosystem is a collection of living and non-living organisms and their interaction with each other. Ecological biodiversity refers to the variations in the plant and animal species living together and connected by food chains and food webs
- The broad differences between ecosystem types and the diversity of habitats and ecological processes occurring within each ecosystem type constitute the ecosystem diversity. The boundaries of communities (associations of species) and ecosystems are not very rigidly defined.
- Thus, the demarcation of ecosystem boundaries is difficult and complex.

➢ Ecosystem diversity is all the different habitats, biological communities, and ecological processes, as well as variation within individual ecosystems

It is the diversity observed among the different ecosystems in a region. Diversity in different ecosystems like deserts, rainforests, mangroves, etc., include ecological diversity.

At the ecosystem level, India, for instance, with its deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows has a greater ecosystem diversity than a Scandinavian country like Norway

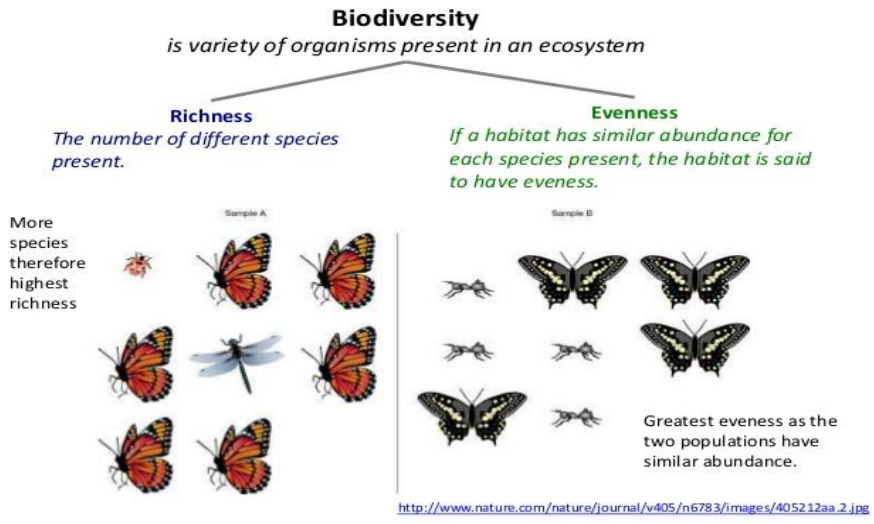
Although India has only 2.4 per cent of the world's land area, its share of the global species diversity is an impressive 8.1 per cent. That is what makes our country one of the 12 mega diversity countries of the world. Nearly 45,000 species of plants and twice as many of animals have been recorded from India

Consider the following pairs:
Type of Diversity Examples
1. Genetic diversity Mangroves Forests and Rain Forests
2. Species diversity Greater amphibian species in Western Ghats than the Eastern Ghats
3. Ecosystem Different varieties of diversity Mango found in India
How many of the above pairs is/are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans A

What is Simpson's Index?

C.4.U6 Richness and evenness are components of biodiversity.



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What is Simpson Index ?

- Measurement of Biodiversity.
- It includes Two Components : Species Richness and Species Evenness .

Species richness:

- Number of different species present in an ecosystem.
- The number of species fond at a particular site.
- Tropical rainforest in Land ecosystem an coral reefs in marine ecosystem best example of species richness

Species Richness can again be categorised into:

- **Alpha Diversity:** It is the diversity of species within a particular area or species (species richness)
- **Beta Diversity:** It is the expression of diversity between habitats.
- **Gamma Diversity: I**t is landscape diversity or diversity of habitats within a region.

Diversity may be measured at different scales. These are three indices used by ecologists:

Alpha diversity represents the diversity within a particular habitat or local area. It quantifies the number of species or taxa present within a specific location.

- It provides insights into the species richness and evenness within a single ecosystem or site.
- Alpha diversity is usually measured using indices like species richness, Shannon-Wiener index, or Simpson's index.

Beta diversity quantifies the change in species composition or turnover between different habitats or sites within a region.

- It measures the variation or differentiation in species composition among multiple locations.
- Beta diversity reflects the degree of dissimilarity between habitats and helps identify unique or distinct species assemblages.
- It is commonly assessed using metrics such as Jaccard's index or Sørensen's index.

Gamma diversity represents the overall diversity at the regional or landscape scale.

- It encompasses the total number of species found across multiple habitats or sites within a larger geographical area.
- Gamma diversity provides a comprehensive view of the total species pool and captures the cumulative diversity of all the habitats within the region. Gamma diversity is most stable and productive-

Diversity between two communities is called

A) Alpha diversity
B) Beta diversity
C) Gamma diversity
D) None of above

Species evenness:

- Species eveness is measure of the relative abundance of the different species making up the richness of the area .
- Low evenness indicates that few species dominate the site.
- High evenness indicates more species .
- High evenness leads to greater specific diversity

The species diversity varies in a different geographical location with tropics having highest and declines as we move towards poles.

enigma(i-nig-muh) : something hard to understand or explain
Humboldt's enigma:

- The reason behind the mountains' disproportional contribution to global species diversity is not understood and has been dubbed "Humboldt's enigma."
- In recent years, Humboldt's enigma has garnered increased attention in the field of ecology as researchers seek to understand the unexpected biodiversity found in mountain ecosystems, challenging traditional beliefs.
- Sparked by Alexander von Humboldt's observations, it questions the conventional notion that tropical regions, fueled by ample sunlight, are the primary centres of biodiversity on Earth

Conventional Notions **Alexander von Humboldt:** Explored South America and conducted significant studies on Chimborazo mountain diversity in Ecuador. Recognized the interplay between temperature, altitude, humidity, and species occurrence patterns.

- It contends that despite receiving less sunlight and enduring colder temperatures, mountain ecosystems defy this notion by showcasing exceptional biodiversity, thereby challenging traditional ecological theories and prompting investigation into this anomaly

Humboldt's Enigma:

- Proposed by contemporary biogeographers.
- Challenges the traditional beliefs, prevailing belief that biodiversity is concentrated in tropical regions.
- **Mountain Exception**: Mountains, despite being outside the tropics, have been an exception to the rule, posing Humboldt's enigma.
- Identifies mountains, such as the Eastern Himalaya, as unexpectedly diverse areas, sparking further exploration into the factors contributing to this diversity.
- Role of Geology play a key role in this concept : Different rock types influence soil composition, creating unique habitat patches. Geological diversity contributes to the promotion of species diversification.

Which Factors are important for Mountain biodiversity

- **Varied Topography:** Mountains offer a mosaic of **microclimates,** ranging from snow-capped peaks to sheltered valleys. This diversity creates distinct ecological niches, suitable for a wider range of species.
- **Isolation:** Mountains act as **isolated "islands" in the sky,** promoting unique evolutionary pathways and endemic species, found nowhere else.
- **Dynamic landscapes**: Geological processes like **landslides and glacial retreats** constantly reshape mountain landscapes, creating opportunities for new species to colonize and evolve.

Q: Humboldt's enigma, which explores the factors influencing biodiversity in mountainous regions, involves key concepts. Consider the following statements:

1.Humboldt's enigma challenges the assumption that biodiversity is highest in regions receiving maximum solar energy.

2.Geological processes play a significant role in Humboldt's enigma, contributing to the formation of diverse habitats on mountains.

3.Coastal tropical sky islands, like the Shola Sky Islands in the Western Ghats, are exceptions to Humboldt's enigma, showcasing biodiversity patterns contrary to expectations.

Which of the statements above is/are correct?

A. Statements 1 and 2 only

B. Statements 2 and 3 only

C. Statements 1 and 3 only

D. All of the above

Correct Answer:

A. Statements 1 and 2 only

Explanation:

- **Statement 1: Humboldt's enigma challenges the assumption that biodiversity is highest in regions receiving maximum solar energy.**
-

- This statement is correct. Humboldt's enigma challenges the conventional belief that regions receiving the most solar energy (tropics) exhibit the highest biodiversity. It highlights exceptions, particularly in mountainous regions, where biodiversity is not solely determined by solar energy.

- **Statement 2: Geological processes play a significant role in Humboldt's enigma, contributing to the formation of diverse habitats on mountains.**

- This statement is correct. Humboldt's enigma emphasizes the role of geological processes, such as uplifts, in biodiversity. Mountains serve as "cradles" for new species due to the creation of new habitats and as "museums" where species persist over time.

- **Statement 3: Coastal tropical sky islands, like the Shola Sky Islands in the Western Ghats, are exceptions to Humboldt's enigma, showcasing biodiversity patterns contrary to expectations.**

- This statement is incorrect. Coastal tropical sky islands, like the Shola Sky Islands, are not exceptions but align with Humboldt's enigma. They exemplify how old lineages persist on mountaintops despite fluctuating climates in the lower elevations.

Therefore, the correct answer is: **A. Statements 1 and 2 only**

Which of the Following Statement related with the concept of " Humboldt Enigma ".
1. The Concept proposes that biodiversity is not confined solely to Earth Tropical Regions .
2. It Suggest that various regions beyond the Tropics like Mountain Regions also exhibits significant Biodiversity.
3. The History of the Earth , its Geography and the Climate , Geological Processes of Mountains are the key drivers of biodiversity .

How Many of the Statements is /are correct ?

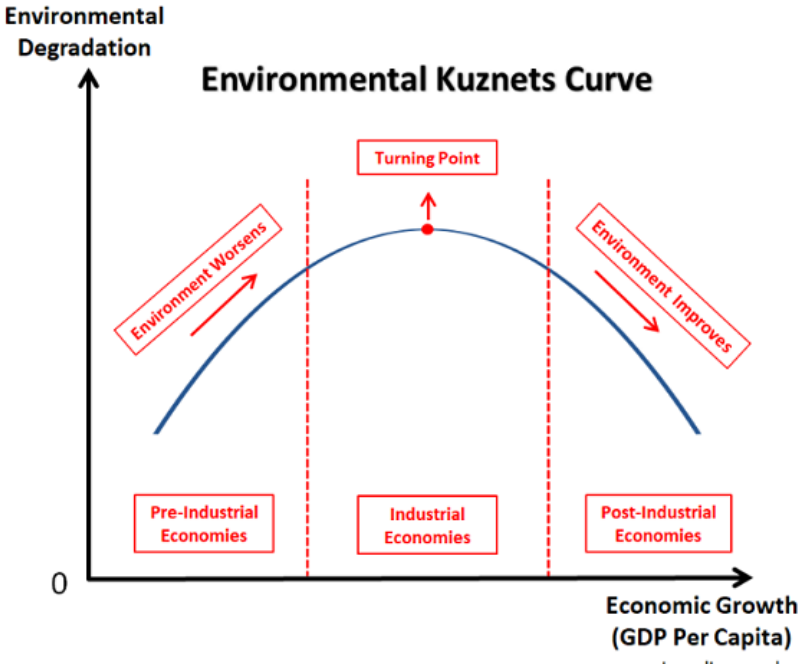
a) one only
b) two only
c) All Three
d) None

In which of the following places in India, the two new species of songbird named as Sholicola and Montecincla respectively have been found?
a)Western Ghat
b)Eastern Ghat
c)Andaman and Nicobar
d)Lakshadweep

The research team has designated two new genera, the Western Ghats short-wings as Sholicola (closely related to flycatchers) and the laughing thrushes as Montecincla (closely related to babblers).

Sky islands are isolated mountains surrounded by radically different lowland environments
The complex dynamics of species richness on sky islands draws attention
Indian Example : Shola Sky Island of Grasslands

Environmental Kuznets Curve interconnects the Economy and Environment. It can be express as_____
(a) An increase in the Environmental pollution rate decreases the National income of an economy. (b) At higher globalisation of the economy happens, environmental pollution lowers.
(c) Environmental degradation increases in the early stages of economic growth, but a higher level of economic growth provides reduced environmental degradation.
(d) Higher greenhouse gas emissions and Per Capita income have an inverse relationship.
Ans C



- The Environmental Kuznets Curve is a hypothesised relationship between various indicators of environmental degradation and per capita income.
- shows the relationship between economic progress and environmental degradation
- In the early stages of economic growth, pollution emissions increase and environmental quality declines, but beyond some level of per capita income (which will vary for different indicators) the trend reverses so that at high-income levels, economic growth leads to environmental improvement. This implies that environmental impacts or emissions per capita are an inverted U-shaped function of per capita income.
- When the stages of economic development is expressed on the X axis and Environmental degradation on the Y axis, the Environmental Kuznet curve gives an inverted 'U' shape **(∩)**
- The Environmental Kuznets Curve is used to graph the idea that as an economy develops, market forces begin to increase and economic inequality decreases.
- The Environmental Kuznets Curve suggests that there may be an optimal level of economic development beyond which environmental quality begins to improve
- The Environmental Kuznets curve shows an increasing pollution with initial development. But further economic progress brings down pollution
- So The relationship between environment and economic activities is very strong.

THREAT TO BIODIVERSITY

Threats to species diversity

The world is facing an accelerated rate of extinction of species largely due to human activities. The four major causes of loss of diversity are known as **"The Evil Quartet".**

The "evil quartet" identified by Jared Diamond is overkill, habitat destruction, secondary extinctions, and introduced species These are:

- **Habitat Loss and Fragmentation:** Due to pollution, urbanisation and various other human activities, habitat loss and fragmentation is a major cause of loss in species diversity and driving plants and animals extinct. E.g.
    - Amazon rainforest (lungs of the planet), which is a house to millions of species are being cut and cleared for various purposes
    - Tropical rainforest, which once covered 14 per cent of landmass, is no more than 6 percent now

  Over Exploitation: Over-exploitation of natural resources leads to the extinction of many species. E.g. Steller's sea cow, the passenger pigeon, many marine fishes are overharvested

  Alien species invasions: When alien species are introduced deliberately or unintentionally, some of them become invasive, leading to the extinction of indigenous species. E.g.
    - Extinction of cichlid fish in Lake Victoria due to the introduction of the Nile perch
    - Illegal introduction of the African catfish Clarias gariepinus for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers.
    - invasive weed species like carrot grass (Parthenium), Lantana and water hyacinth (Eicchornia)

Co-extinctions:

- When a species becomes extinct, the species that are associated with it also becomes extinct. E.g.
  - When a host fish goes extinct, the parasite also goes extinct
  - Mutualism like a plant-pollinator, where extinction of one species leads to the extinction of other species too

In the context of Biodiversity, consider the following:
1. Habitat loss and fragmentation
2. Alien species invasions
3. Over-exploitation
4. Co-extinctions

Which of the above are the Causes of biodiversity losses?
(a) 3 only
(b) 1 and 2 only
(c) 2, 3 and 4 only
(d) 1, 2, 3 and 4

****

Factors identified by Edward Wilson are described by the acronym

Threat to Biodiversity: HIPPO
H: Habitat Destruction
I: Invasive species
P: **Human Over** Population
P: Pollution
O: Overgrazing/ Over harvesting

What Are the Threats to Biodiversity?
There are a lot of threats to biodiversity. Here are some of the major threats:

→ Using up natural resources before they can be renewed (over-fishing in oceans, or over-harvesting trees on land)
→ Habitat destruction like clearing forests or draining wetlands for towns or agricultural purposes
→ Releasing invasive species into foreign ecosystems (like the cane toad in Australia or the zebra mussel in the Great Lakes)
→ Any kind of pollution (water, air, soil, etc).
→ Failure of food chains
→ Those are some of the big threats to biodiversity, and some of those are threats to other things, too. For example, using up natural resources can hurt the world's economy.

Some examples of recent extinctions include the dodo (Mauritius), quagga (Africa), thylacine (Australia), Steller's Sea Cow (Russia) and three subspecies (Bali, Javan, Caspian) of tiger

Careful analysis of records shows that extinctions across taxa are not random; some groups like amphibians appear to be more vulnerable to extinction.

****

UPSC Question : Which of the following can be threats to the biodiversity of a geographical area? (2012)

1. Global Warming
2. Fragmentation of habitat
3. Invasion of alien species
4. Promotion of vegetarianism

Select the correct answer using the codes given below:
a) 1, 2 and 3 only
b) 2 and 3 only
c) 1 and 4 only
d) 1, 2 and 4 only

Consequences of loss of Biodiversity:

- Affects livelihoods
- Impacting food and nutritional security / crisis
- Impact Habitat and home range of animals
- Human animal conflict increases
- Impact genetic diversity and affecting species diversity
- Impacting biotic interaction and Trophic level interaction mechanism
- Disturbing biotic potential, and niche types and impact niche differentiation.
- disturb ecological imbalance
- Impact energy flow and nutrient cycling and
- Impact Four important ecosystem services

With reference to the biodiversity, consider the following statements:
1. Decline in plant production
2. Lowered resistance to environmental perturbations such as drought
3. Decreased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles.
How many of the above may lead to loss of biodiversity in a region?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans B

- Statement 1 is correct: Decline in plant production

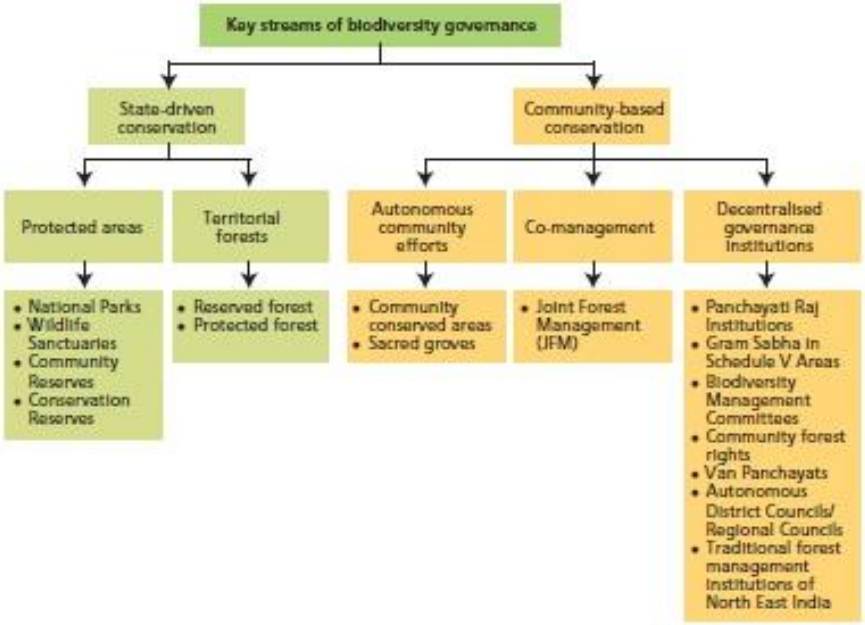
Statement 2 is correct: Lowered resistance to environmental perturbations such as drought Statement 3 is incorrect: Increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles

Approaches to Biodiversity Governance:

Biological diversity or biodiversity refers to the variability among living organisms and the ecological complexes of which they are part. It includes diversity within species, between species and of ecosystems.

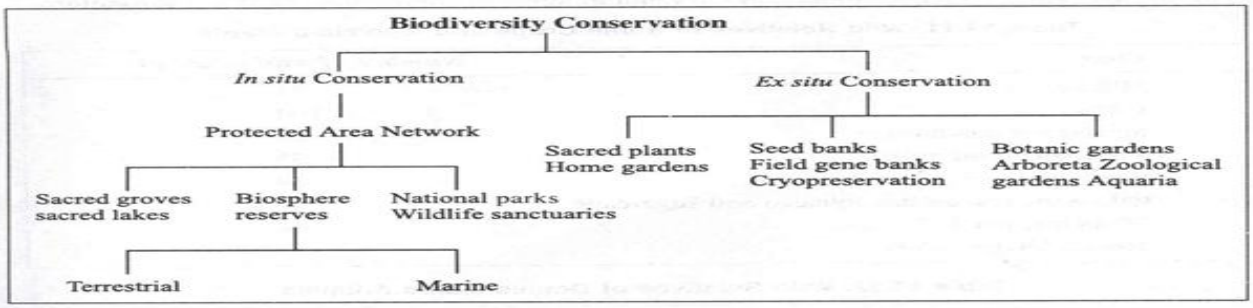
Governance refers to the process whereby elements in society wield power and authority, and influence and enact policies and decisions concerning public life, and economic and social development.

Governance involves interaction between formal institutions of government and those of civil society



Conservation of Species Diversity:Each species has an important role to play in an ecosystem. It is important to conserve diversity because once extinct, we can not get it back.

Table 14.10. In Situ and Ex-situ Biodiversity Conservation



Biodiversity rich regions are protected as biosphere reserves, national parks and sanctuaries i.e. called **in-situ conservation**. Protecting Sunderbans for many endangered species like the royal Bengal tiger, olive ridley sea turtles, mangrove species etc

India has a network of 990 Protected Areas including (covering of geographical area of the country which is approximately 5.27%.)

- 106 National Parks,
- 573 Wildlife Sanctuaries,
- 115 Conservation Reserves and
- 220 Community Reserves

Other Areas :

- 104 Marine Protected Areas
- **80 Ramsar sites**
- **18 biosphere reserve**
- **55 Tiger reserve**
- **32 Elephant reserve**

- **Ex-situ conversation,** where threatened and endangered species are identified, taken out and given full protection and kept in special reserves like botanical gardens, wildlife safari, etc.
- cryopreservation of gametes: .Gametes of threatened species are preserved by cryopreservation techniques
- Seeds of commercially important plants are kept in the seed bank

- in vitro fertilisation, tissue culture propagation

Which one of the following is not a site of in-situ method of conservation of flora? (2011)
a) Biosphere Reserves
b) Botanical garden
c) National Park
d) Wildlife Sanctuary

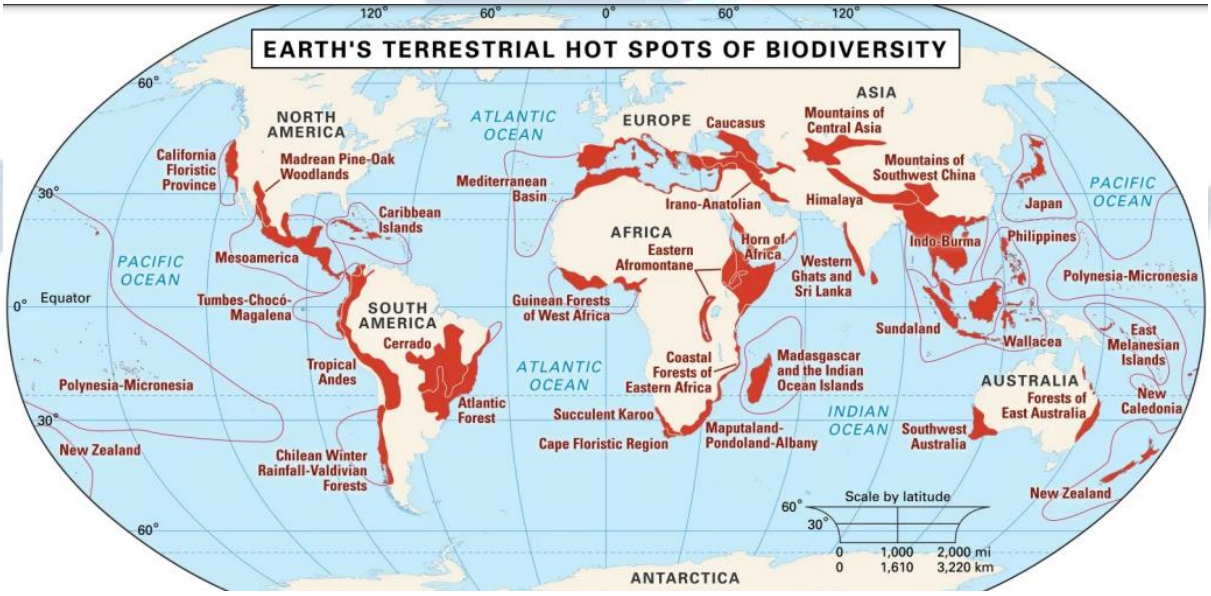
BIOLOGICAL DIVERSITY ACT, 2002: An Act to provide for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected therewith or incidental thereto.

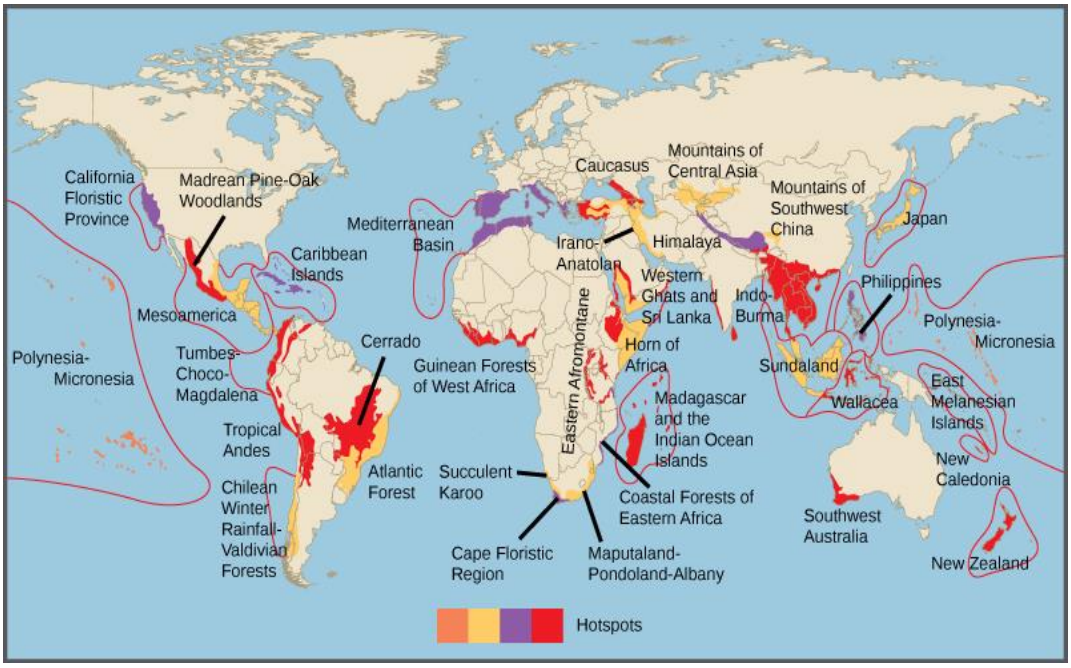
Practice Main Question:

Biodiversity knows no political boundaries and its conservation is therefore a collective responsibility of all nations

Explain

7 Biosphere Hotspots and Reserve





BIODIVERSITY HOTSPOTS given by 1988 British ecologist, Norman Myers:

Def: The biologically rich regions in the world are recognized as biodiversity hotspots.

According to **Conservation International**, a region must fulfill the following two criteria to qualify as a hotspot:

1. The region should have at least 1500 species of vascular plants as endemic i.e., it should have a high degree of endemism. (richness in endemic species)
2. It must contain 30% (or less) of its original natural vegetation/ habitat, i.e. it must be threatened or it has to have lost at least 70% of its primary vegetation. (impact by human activities)

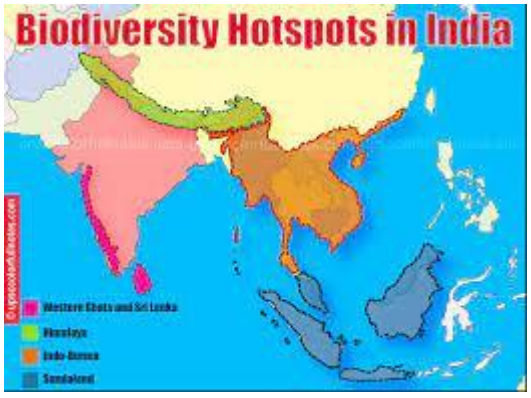
So, A biodiversity hotspot is a biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction. (Good Def)

Conservation International (CI) adopted Myers' hotspots as its institutional blueprint in 1989, and in 1996, the organization made the decision to undertake a reassessment of the hotspots concept.

Note: **Conservation International (CI)(1987)** is an American Non- profit environmental organization headquartered in Arlington, Virginia. Its goal is to protect nature as a source of food, fresh water, livelihoods and a stable climate

World's 36 Biodiversity Hotspots Their intact habitats represent just 2.5% of Earth's land surface, but they support more than half of the world's plant species as endemics — i.e., species found no place else — and nearly 43% of bird, mammal, reptile and amphibian species as endemics.

Following the criteria must for an area to be declared as Biodiversity Hotspot, there are major four biodiversity hotspots in India:



BIODIVERSITY HOTSPOTS IN INDIA (source: Conservational International, website Envis)

- Himalaya: Includes the entire Indian Himalayan region (and that falling in Pakistan, Tibet, Nepal, Bhutan, China and Myanmar)
- Indo-Burma: Includes entire North-eastern India, except Assam and Andaman group of Islands (and Myanmar, Thailand, Vietnam, Laos, Cambodia and southern China)
- Sundalands: Includes Nicobar group of Islands (and Indonesia, Malaysia, Singapore, Brunei, Philippines)
- Western Ghats and Sri Lanka: Includes entire Western Ghats (and Sri Lanka)

1. The most important strategy for the conservation of biodiversity together with traditional human life is the establishment of

a) biosphere reserves
b) botanical gardens
c) national parks
d) wildlife sanctuaries

2. The Himalayan Range is very rich in species diversity. Which one among the following is the most appropriate reason for this phenomenon?

a) It has a high rainfall that supports luxuriant vegetative growth.
b) It is a confluence of different bio geographical zones.
c) Exotic and invasive species have not been introduced in this region.
d) It has less human interference.

Biodiversity forms the basis for human existence in the following ways : (2011)

1) Soil formation
2) Prevention of soil erosion
3) Recycling of waste
4) Pollination of crops

Select the correct answer using the codes given below:
(a.) 1, 2 and 3 only
(b.) 2, 3 and 4 only
(c.) 1 and 4 only
(d.) 1, 2, 3 and 4

3. Three of the following criteria have contributed to the recognition of Western Ghats-Sri Lanka and Indo-Burma regions as hotspots of biodiversity: (2011)

1) Species richness
2) Vegetation density
3) Endemism
4) Ethno-botanical importance
5) Threat perception
6) Adaptation of flora and fauna to warm and humid conditions

Which three of the above are correct criteria in this context?
(a.) 1, 2 and 6
(b.) 2, 4 and 6
(c.) 1, 3 and 5
(d.) 3, 4 and 6

4. Consider the following statements: [2010]

1) Biodiversity hotspots are located only in tropical regions.
2) India has four biodiversity hotspots, i.e., Eastern Himalayas, Western Himalayas, Western Ghats and Andaman and Nicobar Islands.

Which of the state ments given above is/are correct?

a) 1 only B) 2 only C) Both 1 and 2 D) Neither I nor 2

Answer: d) neither

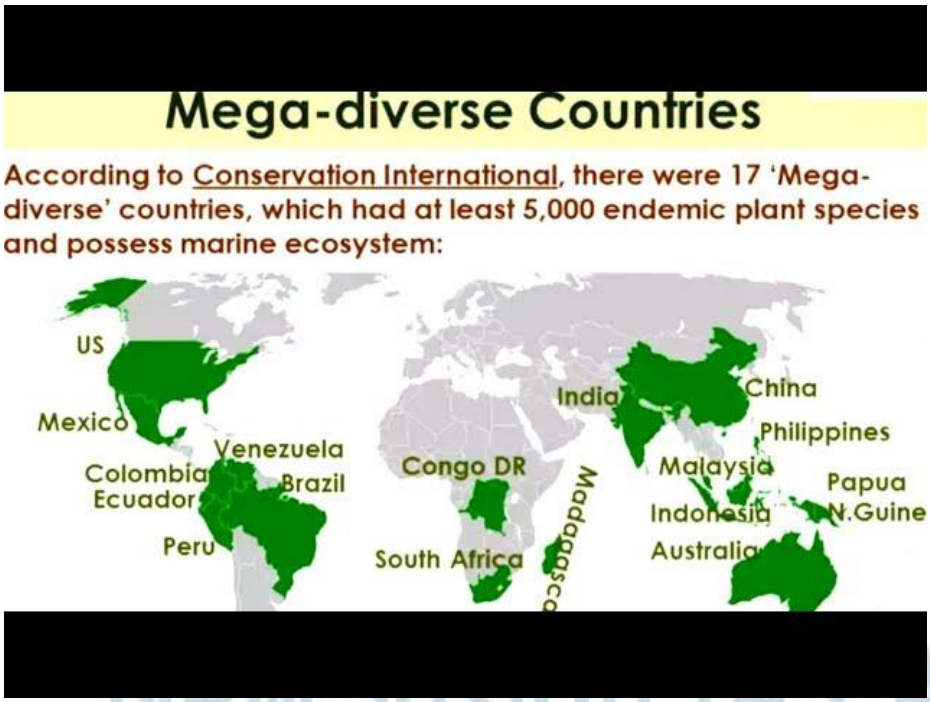
MEGADIVERSE COUNTRIES

- concept first proposed by Russel mittermeier, 1988

- concept refer to world top biodiversity rich countires
- classification brought by Conservational International
- This group was formed in 2002 under Cancun Declaration to act as mechanism of cooperation o nthe CBD and traditional knowledge
- Starting 12 countires now 17 .

Qualification :

- Have at least 5000 world plants as endemic
- HAve marine ecosystem within its borders
- focus on endemism is in line with IUCN : doctrine of ultimate responsibility



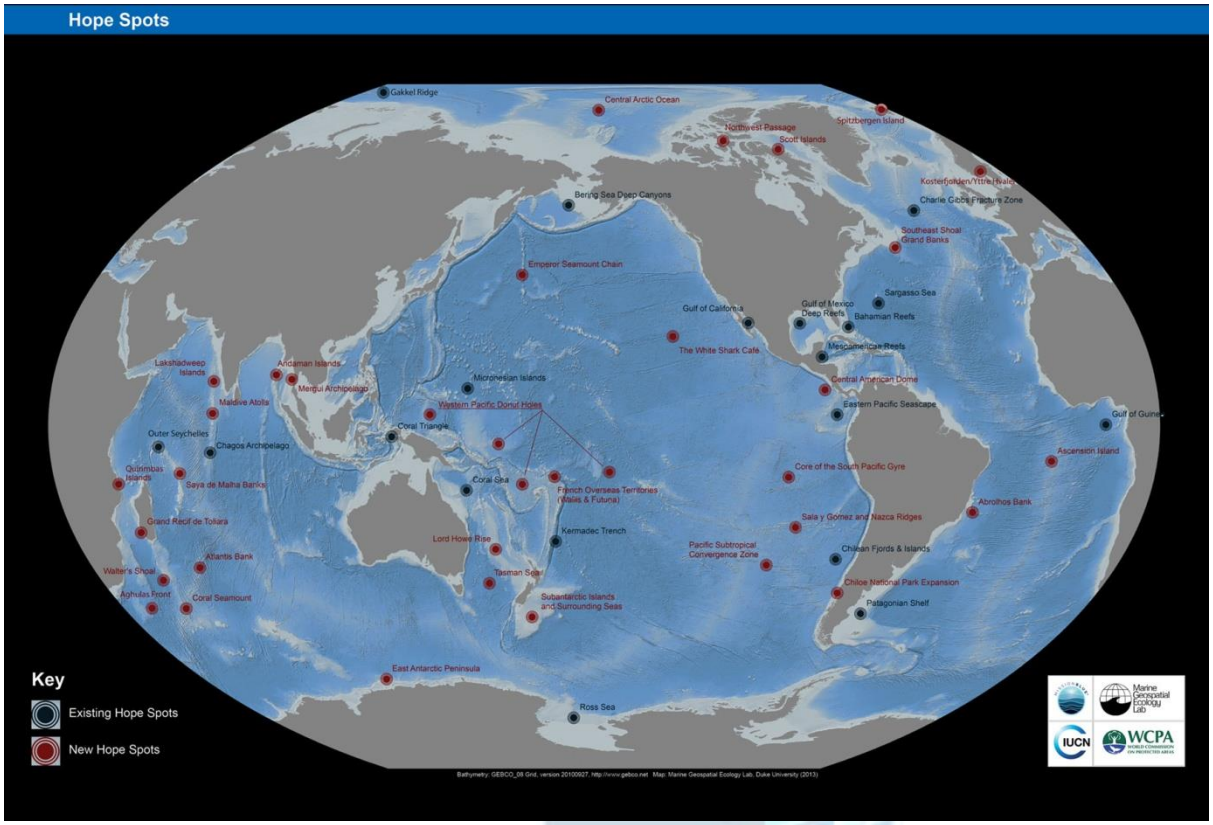
Hope Spots

- is an area of an ocean that needs special protection because of its wildlife and significant underwater habitats.
- are ecologically unique areas of the ocean designated for protection under a global conservation campaign
- Hope Spots can be Marine Protected Areas (MPA) that need attention
-

Who define it :

- by the International Union for Conservation of Nature (IUCN) and Mission Blue, an organization involved in the study of oceans.
- Mission Blue, a non-profit organization founded by Sylvia Earle

- There are 76 Hope Spots worldwide
- In India: Andaman and Nicobar Islands and Lakshadweep islands have recently been named as the new "hope spots



Cold Spots: Areas of Low Biodiversity but they are under threat.

Global 200:

- List of ecoregions identiifed by World Wide Fund for Nature
- Define : relatively large unit of land or water containing a characteristic set of natural communities that share a large majority of their species dynamics, and environmental conditions"
- Conservation Status : **critical or endangered**; **vulnerable**; and **relatively stable or intact**
- Over half of the ecoregions in the Global 200 are rated endangered.
- This process yielded 238 ecoregions--the Global 200--comprised of 142 terrestrial, 53 freshwater, and 43 marine priority ecoregions.
- Based on a comprehensive list of ecoregions, The Global 200 includes all major habitat types (biomes), all ecosystem types, and species from every major habitat type
- The **World Wide Fund for Nature** (**WWF**) WWF : international non-governmental organization founded in 1961 at Gland , Switzerland

India Ecoregions :

- South Western ghats moist deciduous forests and South Western ghats montane rain forests .
- Eastern Deccan Plateau moist forests
- Eastern Himalaya vroadleaf forest
- western himalayas broadleaf forest
- Terai–Duar savanna and grasslands
- Rann of Kutch seasonal salt marsh
- Sunderaban Mangroves

NATIONAL BIODIVERSITY AUTHORITY

- NBA is autonomous organisation under MOEFCC
- Formed 2003, HQ: Chennai
- Purpose: Implement the Provisions of Biological Diversity Act, 2000 after India signed Convention of Biological Diversity(CBD)
- Performs : facilitative, regulatory and advisory functions for the Government of India on issues of conservation, sustainable use of biological resources and fair and equitable sharing of benefits arising out of the use of biological resources.

- The Convention on Biological Diversity (CBD) was negotiated and signed by nations at the **Earth Summit at Rio de Janeiro in Brazil on June 5, 1992.**
  - The convention came into force on **December 29, 1993. India became a party to the convention on February 18, 1994.** At the present, there are **196 Parties to this Convention.**
  - CBD is a legally binding treaty and has 3 main objectives:
    - Conservation of biodiversity.
    - Sustainable use of the components of biodiversity.
    - Fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.
  - The **Secretariat of the CBD is based in Montreal, Canada.**

India's Biological Diversity Act 2002

- was enacted to meet the requirements of the United Nations Convention on Biological Diversity (CBD) 1992, to which India is a party.

- The Act was enacted to meet the requirements stipulated by the United Nations Convention on Biological Diversity (CBD), are conservation of Biodiversity ; sustainable use of its components and fair and equitable sharing of benefits arising from genetic resources. also, covers the protection of traditional knowledge.
- The Act formulates a three-tier structure consisting of a National Biodiversity Authority (NBA) at the national level, State Biodiversity Boards (SBBs) at the State level and Biodiversity Management Committees (BMCs) at local body levels.
  - it focus on Decentralized System
- At National Level , National Biodiversity Authority , at State Level , State Biodiversity Boards, SBB in in 28 States and 2,77,219 BMC at local Level
- There are No State Biodiversity Boards constituted for Union territories.
- The National Biodiversity Authority exercises the powers and performs the functions of a State Biodiversity Board for the UTs
- The Act provides for sharing of benefits with conservers of biodiversity and holders and creators of associated knowledge

What Benefits Share ?

Benefits may be shared in various forms such as:
(a) monetary compensation,
(b) sharing of intellectual property rights, or
(c) technology transfer

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

About People's Biodiversity Register?

- As per Biological Diversity Act, 2002, one of the main functions of the Biodiversity Management Committee (BMC) is to prepare People's Biodiversity Register
- The **People's Biodiversity Register** serves as a **comprehensive record of various aspects of biodiversity,** including **conservation of habitats, preservation of land races, folk varieties, and cultivars,** domesticated stocks and breeds of animals, and micro-organisms.
- People's Biodiversity Register (PBR) is a legal document that contains details of biological resources occurring within a BMC and contains associated knowledge as well.
- The PBR acts as a source of inventory of biological resources and knowledge and for benefit sharing purposes under the ABS component

- Till now, **2,67,608 PBRs** have been prepared in the country.
-
- Any grievances related to the determination of benefit sharing or order of the National Biodiversity Authority or a State Biodiversity Board under this Act, shall be taken to the National Green Tribunal (NGT).

How does National Biodiversity Authority (NBA) help in protecting the Indian agriculture?

1. NBA checks the biopiracy and protects the indigenous and traditional genetic resources.
2. NBA directly monitors and supervises the scientific research on genetic modification of crop plants.
3. Application for intellectual Property Rights related to genetic / biological resources cannot be made without the approval of NBA.

Which of the statements given above is/are correct?

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

EXP:

- The top biotech regulator in India for Genetically Modified Organisms is **Genetic Engineering Appraisal Committee (GEAC)**.
- it would be required to obtain the approval of the National Biodiversity Authority before seeking any IPR based on biological material and associated knowledge obtained from India.

Answer: c) 1 and 3 only

Biodiversity Heritage Sites

Under Section 37 of BDA,2002, the State Government in consultation with local bodies may notify the areas of biodiversity importance as Biodiversity Heritage Sites.

The Biodiversity Heritage Sites are the well defined areas that are unique, ecologically fragile ecosystems - terrestrial, coastal and inland waters and, marine having rich biodiversity comprising of any one or more of the following components:

- ✓ richness of wild as well as domesticated species or intra-specific categories
- ✓ high endemism

- ✓ presence of rare and threatened species
- ✓ keystone species
- ✓ species of evolutionary significance
- ✓ wild ancestors of domestic/cultivated species or their varieties
- ✓ past preeminence of biological components represented by fossil beds
- ✓ having significant cultural, ethical or aesthetic values; important for the maintenance of cultural diversity (with or without a long history of human association with them)

.

Note : An application for designating a BHS shall originate from BMCs

So far forty four (44) Biodiversity Heritage Sites have been notified by sixteen (16) states

ANNEXURE

Sl. No.	Name of Biodiversity Heritage Site (BHS)	Location	Area (Ha)	Date of Notification
1.	Nallur Tamarind Grove	Bengaluru, Karnataka	21.85	20.07.2007
2.	Hogrekan	Chikmagluru, Karnataka	1015	30.04.2010
3.	University of Agricultural Sciences, GKVK Campus	Bengaluru, Karnataka	167	02.09.2010
4.	Ambaraguda	Shimoga, Karnataka	3857.17	18.11.2011
5.	Glory of Allapalli	Gadchiroli, Maharashtra	6	15.07.2014
6.	Tonglu BHS	Darjeeling, West Bengal	230	20.03.2015
7.	Dhotrey BHS	Darjeeling, West Bengal	180	20.03.2015
8.	Ghariyal Rehabilitation Centre	Lucknow, Uttar Pradesh	10	11.08.2016
8.	Ameenpur lake	Sangareddy, Telangana	229.05	21.11.2016
10.	Majuli	Majuli, Assam	87500	29.03.2017
11.	Dialong Village	Tamenglong, Manipur	1135	23.05.2017
12.	Chilkigarh Kanak Durga	Jhargram, West Bengal	22.62	21.05.2018
13.	Khlaw Kur Syiem Kmielng	Ri Bhoi, Meghalaya	16.05	13.12.2018
14.	Mandasaru	Kandhamal, Odisha	528	12.03.2019
15.	Asramam	Kollam, Kerala	57.33	19.06.2019
16.	Naro Hills	Satna, Madhya Pradesh	200	31.10.2019
17.	Patalkot	Chhindwara, Madya Pradesh	8367.49	31.10.2019
18.	Purvatali Rai	North Goa, Goa	0.73	21.12.2019
19.	Baneswar Shiva Dighi	Cooch Behar-II, West Bengal	0.667	14.08.2020
20.	Ganeshkhind Garden	Pune, Maharashtra	33.01	31.08.2020

Sl. No.	Name of Biodiversity Heritage Site (BHS)	Location	Area (Ha)	Date of Notification
21.	Landorkhori	Jalgaon, Maharshtra	48.08	31.08.2020
22.	Bambarde Myristica Swamps	Dodamarg, Maharashtra	2.59	28.01.2021
23.	Schistura Hiranyakeshi	Sindhudurg, Maharshtra	2.11	31.03.2021
24.	Amarkantak	Anuppur, Madhya Pradesh	7681.50	22.07.2022
25.	Borjuli Wild Rice Site	Sonitpur, Assam	0.41	10.08.2022
26.	Hajong Tortoise Lake	Dima Hasao, Assam	526.78	10.08.2022
27.	Birch Pine Forest Patch at Nain Gahar	Lahaul & Spiti, Himachal Pradesh	12.22	18.08.2022
28.	High Altitude Meadow at Hudan Bhatori	Chamba, Himachal Pradesh	8.74	18.08.2022
29.	Sacred Grove at Sural Bhatori Monastery	Chamba, Himachal Pradesh	0.60	18.08.2022
30.	Baramura waterfall	Khowai, Tripura	150	12.09.2022
31.	Betlingshib and its surroundings	North District, Tripura	350	12.09.2022
32.	Debbari or Chabimura	Gomati, Tripura	215	12.09.2022
33.	Silachari Caves	Gomati, Tripura	100	12.09.2022
34.	Unakoti	Unakoti, Tripura	40	12.09.2022
35.	Arittapatti	Madurai, Tamil Nadu	193.215	22.11.2022
36.	Mahendragiri Hill	Gajapati, Odisha	4250	25.11.2022
37.	Amkhoi wood fossil park	Birbhum, West Bengal	10	17.03.2023
38.	Char Balidanga	Nadia, West Bengal	46.862	17.03.2023
39.	Namthing Pokhari	Darjeeling, West Bengal	4.819	17.03.2023
40.	State Horticulture Research and Development Station	Nadia, West Bengal	39.61	17.03.2023
41.	Gandhamardan Hill	Bolangir & Bargarh, Odisha	18963.898	20.03.2023
42.	Birampur- Baguran Jalpai	Purba Medinipur, West Bengal	95.91	16.05.2023
43.	Haldir Char Island	Purba Medinipur, West Bengal	4.73	16.05.2023
44.	Tungkyong Dho	North Sikkim, Sikkim	0.0650	02.06.2023

Courts :

- Part of traditional judicial system and give decision on civil and criminal cases.
- Deals with variety of cases
- its decision called " Judgement, conviction, acquittal etc
- all courts are tribunals

Tribunal

- being quasi-judicial bodies
- minor courts
- Deals with specific Cases
- its decision called " Awards"
- All tribunals are not courts
- It cannot decide the validity of legislation.
- Tribunals are bound by the principles of natural justice and not the civil procedure codes.
- Tribunals are created to avoid the regular courts' route for dispensation of disputes

What are the constitutional and legal provisions pertaining to Tribunals in India?

- The original Constitution did not contain provisions with respect to tribunals. The **42nd Amendment Act of 1976** added a new **Part XIV-A** to the Constitution. This part is titled 'Tribunals' and consists of only two Articles–
  - **Article 323A** dealing with administrative tribunals and
  - **Article 323B** dealing with tribunals for other matters.

  (The 42nd Amendment Act introduced these provisions in accordance with the recommendations of the **Swaran Singh Committee**.

  - 323B deals with other types of tribunals (like National Green Tribunal, Competition Appellate Tribunal (COMPAT), Securities Appellate Tribunal (SAT), etc.

salient features of tribunals in India are

- **Principles of natural justice:** Tribunals in India follow the principle of natural justice, which requires that all parties to a legal proceeding be given a fair and impartial hearing and that no person should be a judge in their own cause.
- **Not bound by Civil Procedure Code (CPC):** Unlike traditional courts, they are not bound by the strict rules of procedure and evidence set out in the CPC.
- **Subject expertise:** A significant part of tribunals is comprised of members who have specialized expertise in the subject matter over which they have jurisdiction.
- **Quasi-judicial powers:** Tribunals can hear evidence, examine witnesses, make findings of fact, apply the law to the facts, and make binding decisions.
- **Appellate authority:** The decisions of tribunals can be appealed to a higher court. The decision of tribunals in the first instance can be appealed to the appellate authority and, later, to the High Courts and/or Supreme Court.
- **Time-bound resolution:** The adjudicatory process in tribunals is usually faster than the traditional court system, which helps resolve disputes more quickly and efficiently.

SEVERAL TRIBUNALS IN INDIA

- There are tribunals for settling various administrative and tax-related disputes, including:
  - **Central Administrative Tribunal (CAT),**
  - **Income Tax Appellate Tribunal (ITAT),**
  - **Customs, Excise and Service Tax Appellate Tribunal (CESTAT),**

- **National Green Tribunal (NGT),**
- **Competition Appellate Tribunal (COMPAT)** and
- **Securities Appellate Tribunal (SAT),** among others.

NGT - Background

- The Chief Justice of India, **Justice P.N. Bhagwati**, had advised the central government in the M.C. Mehta Vs Union of India case in 1986 that it could be beneficial to set up Environmental Courts on a regional basis.
- In the landmark **case A.P. Pollution Control Board Vs Prof. M.V. Nayudu**, the Supreme Court cited his observations in 1999. The court stressed the importance of a court made up of judges and technical specialists once more. The SC could hear an appeal from such a court.
- India promised at the **1992 Earth Summit that** victims of pollution and other environmental disasters would have access to judicial and administrative remedies..
- The parliament itself had passed laws about the establishment of the **National Environmental Tribunal (1995)** and a National Environmental Appellate Tribunal (1997). The appellate tribunal in this act was envisaged to award compensations in case of environmental damages.
- Finally, the NGT act was passed in the parliament in 2010 and in October 2010 the NGT was instituted.

The National Green Tribunal (NGT) has recently imposed a fine of Rs 2,232 crore on the Delhi government for damage caused to the environment due to improper solid and liquid waste management.

When it comes to the development vs. environment issue, the NGT is an important institution since it gives credible cases for the environment.

National Green Tribunal,

- established in 2010, as per the National Green Tribunal Act, 2010, is a specialised judicial body (not constitutional body)equipped with expertise solely for the purpose of adjudicating environmental cases in the country
- As per the provisions of the NGT Act, 2010, the National Environment Appellate Authority (NEAA) established under the NEAA Act, 1997 stands dissolved and the cases pending before the NEAA stand transferred to the NGT. So NGT replaced NEAA
- With the establishment of the NGT, India became the **third country** in the world to set up a specialised environmental tribunal, only after **Australia and New Zealand**, and the first developing country to do so.
- NGT is mandated to make disposal of applications or appeals finally within 6 months of the filing of the same

What is the composition of NGT?

- The Tribunal comprises **the Chairperson, the Judicial Members, and Expert Members**.
- They shall hold office for a **term of 5 years** and are **not eligible for reappointment**.
- The Chairperson is appointed by the Central Government in consultation with the Chief Justice of India (CJI).
- A Selection Committee shall be formed by the central government to appoint the Judicial Members and Expert Members.
- There are to be at least 10 and a maximum of 20 full-time Judicial members and Expert Members in the tribunal.
    - It has **appellate jurisdiction** to hear appeals as a Court.
    - The Tribunal is **not bound by the procedure laid down under the Code of Civil Procedure, 1908,** but shall be guided by principles of natural justice.
-

- The Tribunal is tasked with providing effective and expeditious remedy in cases relating to environmental protection, conservation of forests and other natural resources and enforcement of any legal right relating to environment
- The Tribunal's orders are binding and it has power to grant relief in the form of compensation and damages to affected persons.
- **Are decisions of the Court binding?** Yes, decisions of the Tribunal are binding. The Tribunal's orders are enforceable as the powers vested are the same as in a civil court under the Code of Civil Procedure, 1908.
- The Tribunal has powers to review its own decisions. If this fails, the decision can be challenged before the Supreme Court within ninety days.
- Decision Challenge ? Yes, it can be challenged before the Supreme Court within 90 days

  The Apex court may entertain the appeal after even 90 days if satisfied that the Appellant was prevented by sufficient cause from preferring the appeal.

Section 26: Penalty

Whoever fails to comply with the order or award or decision of the Tribunal shall be punishable with imprisonment up to three years, or fine up to Rupees 10 crores or both.In case failure or contravention continues,with additional fine @Rs.25,000/-every day after conviction for first such failure.In case of company, it is up to Rupees 25 crores and for continuous contravention, additional fine may extend to Rupees1 lakh/day.

Who may submit cases to the Tribunal and what sort of cases are heard?

Any person seeking relief and compensation for environmental damage involving subjects in the legislations mentioned in Schedule I of the National Green Tribunal Act, 2010 may approach the Tribunal.

It draws inspiration from India's constitutional provision of (Constitution of India/Part III) Article 21 Protection of life and personal liberty,

The statutes in Schedule I are:

1. The Water (Prevention and Control of Pollution) Act, 1974;
2. The Water (Prevention and Control of Pollution) Cess Act, 1977;
3. The Forest (Conservation) Act, 1980;
4. The Air (Prevention and Control of Pollution) Act, 1981;
5. The Environment (Protection) Act, 1986;
6. The Public Liability Insurance Act, 1991;
7. The Biological Diversity Act, 2002.

Not Included in NGT

1. Code of Civil Procedure, 1908
2. Indian Evidence Act, 1872

3. Wildlife (Protection) Act, 1972, the
4. Indian Forest Act, 1927,
5. Scheduled Tribes (Recognition of Forest Rights Act) 2005

Note : Additionally, the Tribunal is not bound by procedure under the Code of Civil Procedure, 1908 or the Indian Evidence Act, 1872 and is guided by principles of natural justice. However, the Tribunal is vested with the powers of a civil court under the Code of Civil Procedure for discharging its functions.

Rules of evidence drafted as per Indian Evidence Act, 1872 does not bind the tribunal, making it easier for conservation groups to present facts and issues before tribunal than other courts, which may include raising issues relating to technical design,or suggesting alternative plans of nature protection which has not been considered in plan layout.

What is the difference between legal justice and natural justice?

Legal Justice is governed by the law of the State. Whereas, natural justice relies on conscience rather than legal principles

Concept of principles of natural justice

- aim to provide fair, impartial and reasonable justice.
- No person should be a judge in his own cause.
- Each party should be given the opportunity to be heard
- Natural Justice implies fairness, reasonableness, equity and equality
- violation of natural justice is violation of Equality
- focus - fair administrative procedure
- It also defends individual liberty against any arbitrary action.
- Its goal is to prevent mischievousness and unfairness towards the resident with managing authorities.
- The idea of natural justice is not present in the Indian constitution.
- the Indian Constitution does not use the expression 'Natural Justice' anywhere.
- two principles of Natural Justice: 'Rule against Bias' which signifies that the judge must be impartial and must decide the case objectively on the basis of the evidence on record.
- 'Rule of Fair Hearing' which means that a person must be given an opportunity to defend himself.However, the following parts of the Constitution with their respective expressions convey the idea of Natural Justice.

- **Preamble:** 'Social, Economic and Political' justice, liberty of belief, thought, worship, and equality of opportunity and status
- **Article 14:** Equal protection of the law for all citizens of India and equality before law
- **Article 21:** Right to liberty and life
- **Article 22:** Provision of fair hearing for an arrested person
- **Article 39-A:** Free legal services for disabled and indignant people
- **Article 311:** Constitutional protection for civil servants
- **Article 32, 136, and 226:** Constitutional solutions for violations of fundamental rights

In essence, what does 'Due Process of Law' mean?
a) The principle of natural justice
b) The procedure established by law
c) Fair application of law
d) Equality before law

Ans C **Due process refers to just, rational, fair, and fair treatment under the regular judicial proceedings,** thus it means the fair application of law.

“procedure established by law” : only the decisions of the executive will be tested by the courts with the touchstone of fairness

“due process of law”: the courts will examine the fairness of not only the decisions of the executive but also that of a law passed by the legislature.
In India, due process of law is not only a protection against arbitrary executive action, but also against arbitrary legislative action

- The Supreme Court of India has the power to declare laws unconstitutional if they violate due process of law. This means that the Court can strike down laws that are unfair, unjust, or unreasonable.
- The phrase "due process of law" is not mentioned explicitly anywhere in the Indian Constitution, but it has been interpreted by the Supreme Court to be a fundamental right.
- The concept of due process of law is borrowed from the US Constitution, but it has been adapted to the Indian context.
-

Do I need to engage an advocate to approach the Tribunal?
No, engaging an advocate is not necessary. Aggrieved parties may approach the Tribunal in person by submitting an application in the required format.

How can I attend hearings of the Court?
The Tribunal is an open court and its proceedings can be attended in person.

- **Chairperson:** Is a retired Supreme Court Judge based in Delhi.
- **Other Judicial members:** Retired High Court Judges.

Former and Current Chairperson
1. Justice L. S. Panta (10/ 2010 to 10/ 2011)
2. Justice Swatanter Kumar (12/ 2012 to 12/ 2017)
3. Justice Adarsh Kumar Goel
4 Justice Prakash Shrivastava since August 2023

Present: 6 Judicial Members and 5 expert members

The Tribunal is headed by the Chairperson who sits in the Principal Bench and has at least ten but not more than twenty judicial members and at least ten but not more than twenty expert members.

Qualifications for the appointment of Chairperson

- a Judge of the Supreme Court of India, or
- Chief Justice of a High Court

Qualifications for the appointment of Judicial Member

- a Judge of the Supreme Court of India, or
- Chief Justice of a High Court, or
- a person who is or has been a Judge of the High Court.

Who appoints NGT Chairman?
The Chairperson of the National Green Tribunal (NGT) is appointed by the Central Government of India in accordance with the Chief Justice of India.
Who appoints NGT members?
A Selection Committee is formed by the central government of India for the appointment of Judicial Members and Expert Members.

How many national green tribunals are there in India?

	Zone	Place of Sitting	Territorial Jurisdiction
1.	Northern	Delhi (Principal Bench)	Uttar Pradesh, Uttarakhand, Punjab, Haryana, Himachal Pradesh, Jammu and Kashmir, Goa, National Capital Territory of Delhi and Union Territory of Chandigarh, Daman and Diu and Dadra and Nagar Haveli
2.	Western	Pune	Maharashtra, Gujarat, Goa with Union Territories of Daman and Diu and Dadra and Nagar Haveli
3.	Central	Bhopal	Madhya Pradesh, Rajasthan and Chhattisgarh.
4.	Southern	Chennai	Kerala, Tamil Nadu, Andhra Pradesh, Telangana, Karnataka, Union Territories of Puducherry and Lakshadweep.
5.	Eastern	Kolkata	West Bengal, Odisha, Bihar, Jharkhand, Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Union territory of Andaman and Nicobar Islands.

Que : Consider the following statements regarding NGT, handles cases related to:

1. Environment Protection
2. Conservation of forests and other natural resources
3. Environmental clearances for projects by the government
4. Enforcement of any legal right relating to the environment.
5. Relief and compensation for damages to persons and properties.

Answer the correct code

Associated Challenges:

- The tribunal faces the challenges of understaffing.
- The NGT's authority is **restricted.** The Wildlife Protection Act of 1972 and the Forest Rights Act of 2006 are two major acts that are not covered by it.
  - **Experts are all from the Indian Forest Services.** As a result, the majority of technical work is outsourced. It causes a pause in the proceedings
  - NGT website even mentions that the tribunal has cleared 90% of the cases but close look will reveal the tribunal's mandate to protect the environment is not yet fulfilled.
  - Since the inception of the NGT Act, the tribunal **never functioned in its full capacity**
  - the **Supreme Court has allowed appeals** from NGT decisions under Article 136 to be heard.
  - many decisions of NGT have been challenged and overruled in the Supreme Court. For Instance The Supreme Court questioned the expertise of NGT in **the case of the Subansiri Hydropower Project in Arunachal Pradesh 2019.** Further, the court also overruled the ban imposed by NGT on that project.
  - The NGT has **no enforcement powers**, thus once a judgement is issued, it is up to the governments to follow through, which they usually do not.
  -
  - **Limited Regional Benches:** The NGT has located only in big cities. But, environmental exploitation is majorly taking place in the tribal areas of dense forest. There is a limited opportunity for these people to come forward and file a case in NGT.

Way Forward

- To harmonize the environmental adjudication procedure, the **Wildlife Act and the Forest Rights Act** must be brought within the jurisdiction of the NGT.
- **Judge and expert openings** must be filled quickly, and the experts must be impartial and have experience in environmental study and action
- For complete justice to be served, the NGT **must be given tribunal powers** to follow up on the verdict and enforce its rulings
- Instead of going to the HCs or the SC, NGT should be able to **make an intra-tribunal** appeal to a larger bench
- The Supreme Court must use its special leave jurisdiction **under article 136** very conservatively as SC itself has declared in the past that environmental cases need special expertise
- There is a need for more autonomy and to widen NGT's scope for effective protection of the environment in balance with human developmental activities.
- The government needs to provide adequate financial and human resources — if it does not want the NGT to wither away.
- the government also needs to ensure the filling of Vacancies in a time-bound manner. This will ensure the proper functioning of NGT.
- NGT should apply the principles of sustainable development, principle for precautionary and principles that polluter pays, while passing any award/decision/order.
- The tribunal should impose costs for lost benefits due to any interim injunction, if it discovers a false claim.

	National Parks	Wild Life Century	Biosphere Reserve
Acts	WPA, 1972	WPA, 1972	National Component, WPA, 1992
Govt.	State Govt. and Central Govt.	State Govt. and Central Govt.	Central Govt. under UNESCO's MAB programme.
	Everything is prohibited, Unless permitted	Everything Permitted unless prohibited.	Protecting the area. Where man is integral part of conservation
	No Human Interference allowed	Limited Human interference	-NA-
Boundary	Fixed by Legislation	Not Fixed by Legislation	Fixed by Legislation
	Cannot be degraded to WLS	Upgraded to NP	-NA-
Protection	Highest	Moderate	High
Size	Small	Medium	Large

- Largest National Park in India :

1 Hemis National Park, : ladakh
2. Desert National Park, : Rajasthan
3. Gangotri National Park,
4. Namdapha National Park ,
5. Khangchendzonga National Park,
6. Guru Ghasidas (Sanjay) National Park chhatisgarh ,
7. Gir Forest National Park,
8 Sundarbans National Park
9Jim Corbett National Park
10 Indravati National Park Chhatisgarh

Biosphere Reserve:

- Much larger in size
- focus on complete ecosystem.
- they may also overlap other protected areas.
- called " Learning Space for Sustainable Development"

Table 4.52 : Comparison of National Park, Wildlife Sanctuary and Biosphere Reserve

	National Park	Wildlife Sanctuary	Biosphere Reserve
1.	Attention is not given to biotic community as a whole. Rather conservation is connected to habitats for particular wild animal species such as lion, tiger, rhinoceros etc.	Attention is not given to biotic community as a whole. Conservation rather is species oriented such as citrus, pitcher plant, Great Indian bustard etc.	Attention is focussed on biotic community as a whole. Thus, conservation is ecosystem oriented.
2.	The approach is not based on scientific principles.	The approach is not based on scientific principles.	The approach is based on sound scientific principles.
3.	The size ranges from 0.04 to 3,162 sq. kms.	The size ranges from 0.61 to 7,818 sq. kms.	Size well over 5,670 sq. kms.
4.	Boundaries circumscribed by state legislation.	Limits are not sacrosant.	Boundaries incumscribed by state legislation.
5.	No biotic interference permissible except in buffer zone.	Limited biotic interference occur.	No biotic interference permissible except in buffer zone.
6.	Tourism is not only permissible, but is often encouraged.	Tourism is permissible.	Normally tourism is not permissible.
7.	Research and scientific management are lacking.	Research and scientific management are lacking.	Research and scientific management are carried out.
8.	Due attention is not given to gene pool conservation of economic species, particularly of plants.	Proper attention is not given to gene pool conservation of economic species, particularly of plants.	Due attention is given to conservation of plants as well as animal species.

BIOSPHERE RESERVE

- **Biosphere reserves are 'learning places for sustainable development'**
- Biosphere reserves are sites established by countries and recognized under UNESCO's Man and the Biosphere (MAB) Programme to promote sustainable development based on local community efforts and sound science.
- Biosphere reserves are nominated by national governments and remain under the sovereign jurisdiction of the states where they are located

World Distribution :

- The programme of Biosphere Reserve was initiated by UNESCO in 1971.
- There are currently 738 biosphere reserves in 134 countries, including 22 transboundary sites, that belong to the **World Network of Biosphere Reserves**.

Distribution in India :

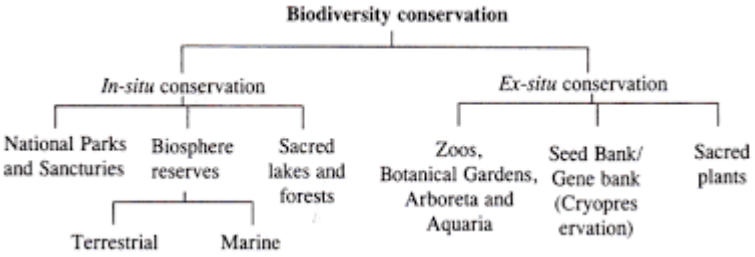
- The Indian government has established 18 biosphere reserves in India: which protect larger areas of natural habitat (than a National Park or Animal Sanctuary), and often include one or more National Parks or preserves, along with buffer zones that are open to some economic uses.

- Protection is granted not only to the flora and fauna of the protected region, but also to the human communities who inhabit these regions, and their ways of life. Animals are *protected and saved* here.

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

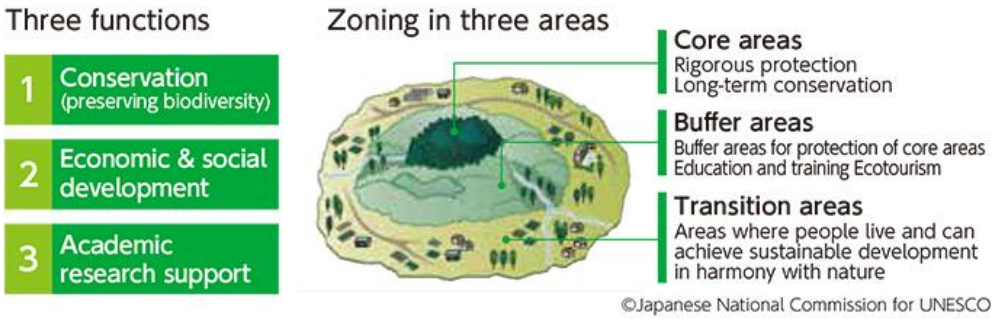
BRs are thus special environments for both people and the nature and are living examples of how human beings and nature can co-exist while respecting each others' needs.
These areas are internationally recognized within the framework of UNESCO's Man and Biosphere (MAB) programme, after receiving consent of the participating country
Biosphere reserves are 'learning places for sustainable development' so they are refer as
" Living Laboratories"
A core zone is a protected region, like a National Park or Sanctuary/protected/regulated mostly under the Wildlife (Protection) Act, 1972. It is kept free from human interference

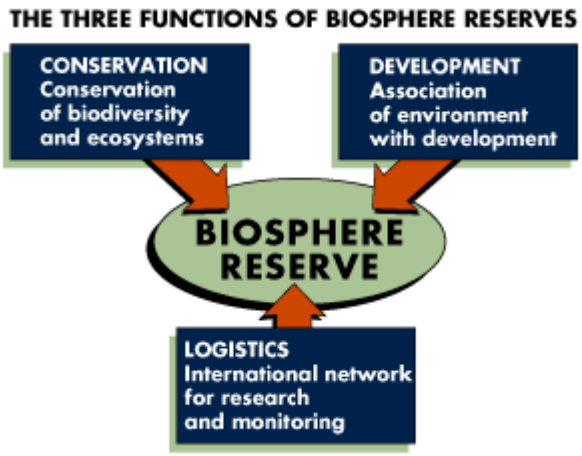
There is no comprehensive legislation in India dealing with all aspects of the Biosphere Reserves.

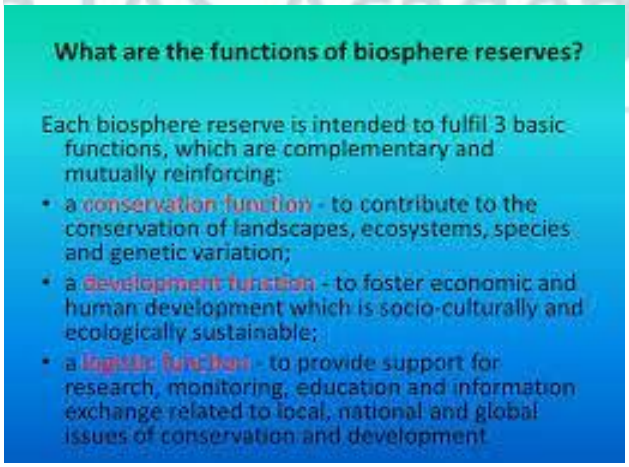


criteria for selection of Biosphere Reserve

1 . A site must contain an effectively protected and minimally disturbed core area.
2 . The Core area should be typical of a biogeographical unit
3. Areas have rare and endangered species
4 Areas having diversity in soil and micro climatic conditions and indigenous varities of biota
5 . Areas potential for preservation of traditional Tribal or rural modes of living for harmonious use of Environment



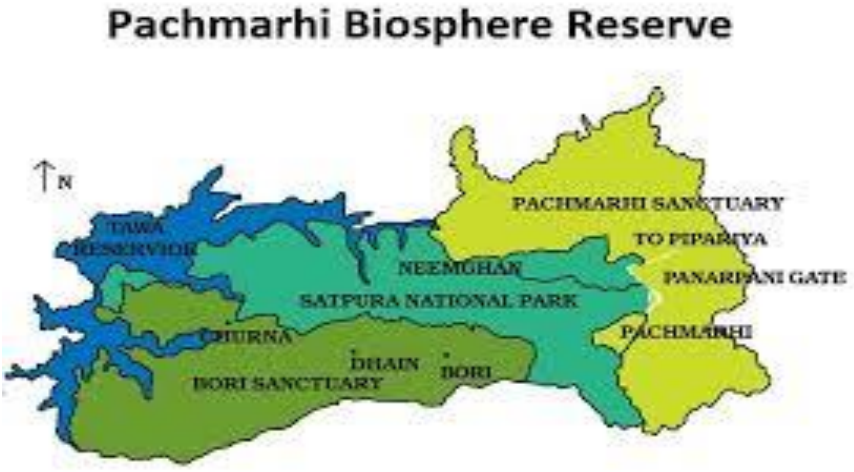




List-I (Biosphere Reserve)	List-II (Map of India indicating them)
A. Manas	
B. Pachmarhi	
C. Nokrek	
D. Achanakmar-Amarkantak	

Code

(a)	A	B	C	D
	4	3	1	2
(b)	A	B	C	D
	2	1	3	4
(c)	A	B	C	D
	4	1	3	2
(d)	A	B	C	D
	2	3	1	4



Which Type of Biosphere Reserve Located on Maikala Hills?

a) Simlipal Biosphere Reserve
b) Nokrek Biosphere Reserve
c) Achanakmar -Amarkantak Biosphere Reserve
d) Pachmari Biosphere Reserve

Ans : C and D is located on Mahadeo Hill of Satpura Range

The first Biosphere Reserve in India is the Nilgiri Biosphere Reserve that is a part of Tamil Nadu, Karnataka, and Kerala.

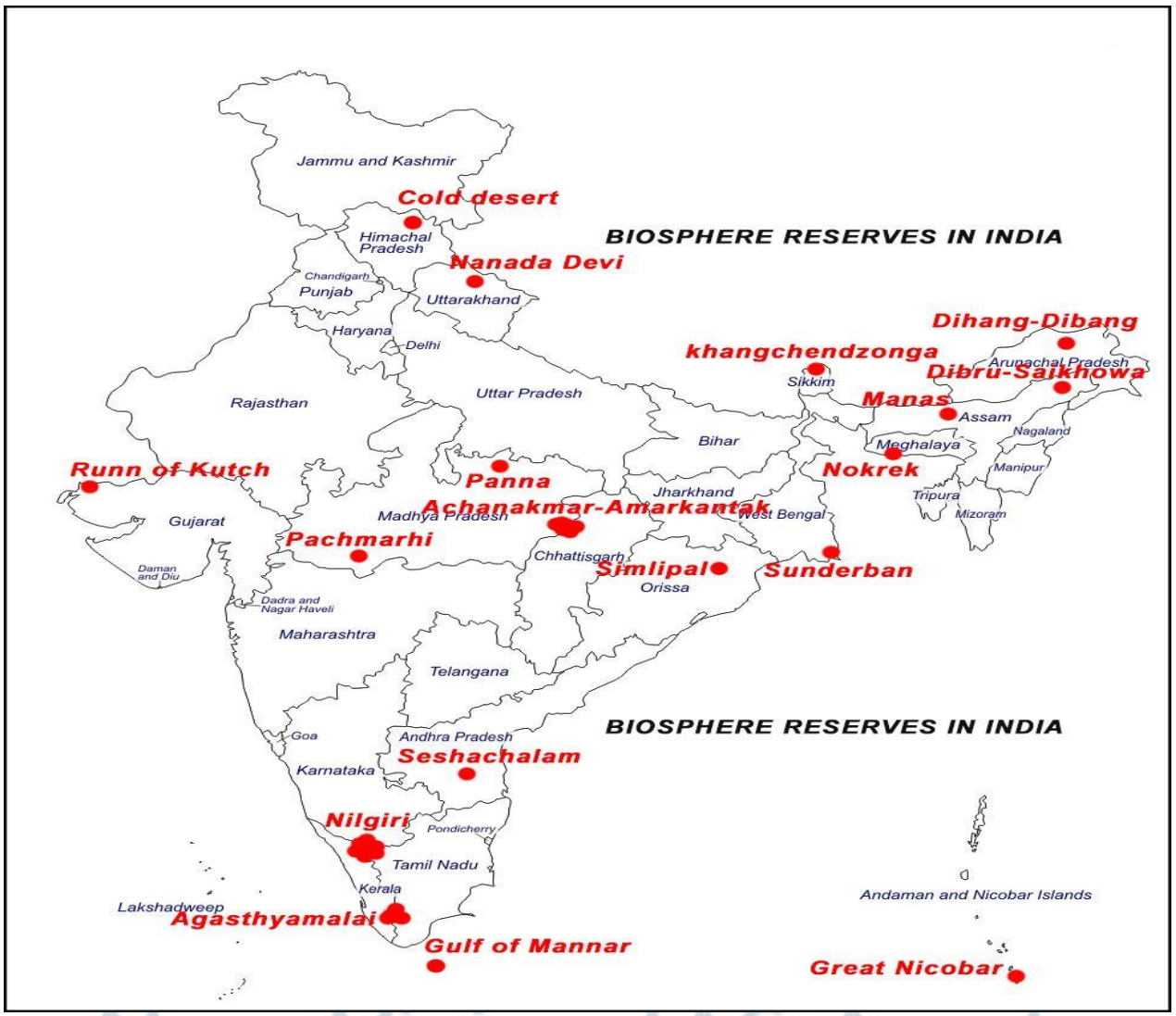
The largest Biosphere reserve in India is the Gulf of Kachchh, Gujarat and the smallest Biosphere Reserve in India is Dibru-Saikhowa in Assam

The Biosphere Reserves in India are declared by the State or Central Government through Nomination under the UNESCO'S Man & Biosphere (MAB) Programme

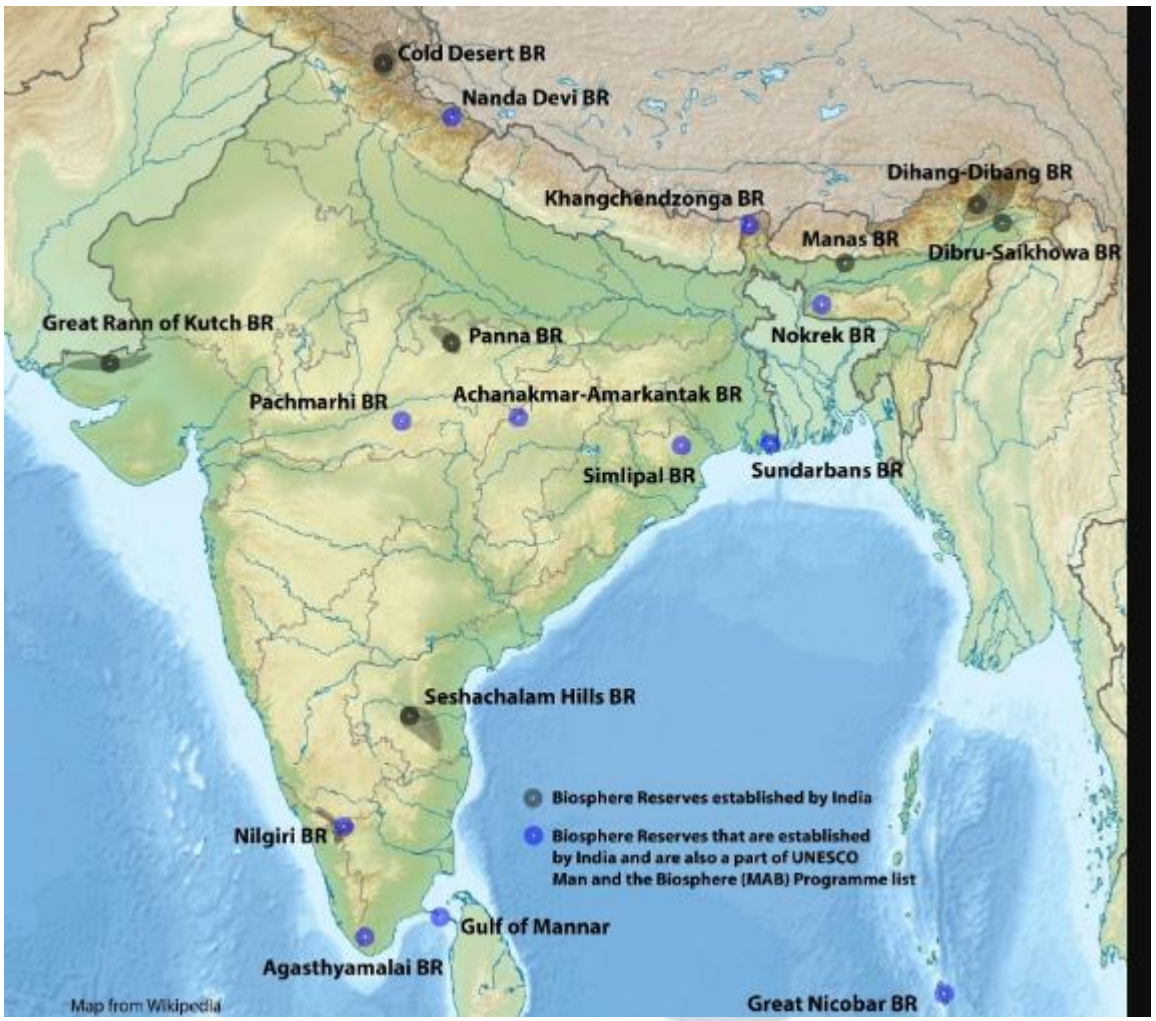
The Man and Biosphere Programme (MAB) was launched by UNESCO in 1971 to establish a scientific basis for the improvement of relationships between people and their environments

LIST OF BIOSPHERE RESERVES OF INDIA

Sr. No	Year	Name	State	Type	Key Fauna
1	2008	Great Rann of Kutch	Gujarat	Desert	Indian Wild Ass
2	1989	Gulf of Mannar*	Tamil Nadu	Coasts	Dugong or Sea Cow
3	1989	Sundarbans*	West Bengal	Gangetic Delta	Royal Bengal Tiger
4	2009	Cold Desert	Himachal Pradesh	Western Himalayas	Snow Leopard
5	1988	Nanda Devi*	Uttarakhand	Western Himalayas	NA
6	1986	Nilgiri Biosphere Reserve*	Tamil Nadu, Kerala and Karnataka	Western Ghats	Nilgiri Tahr, Lion-tailed macaque
7	1998	Dihang-Dibang	Arunachal Pradesh	Eastern Himalaya	NA
8	1999	Pachmarhi Biosphere Reserve*	Madhya Pradesh	Semi-Arid	Giant Squirrel, Flying Squirrel
9	2010	Seshachalam Hills	Andhra Pradesh	Eastern Ghats	NA
10	1994	Simlipal*	Odisha	Deccan Peninsula	Gaur, Royal Bengal Tiger, Wild elephant
11	2005	Achanakamar -Amarkantak*	Madhya Pradesh, Chhattisgarh	Maikala Hills	NA
12	1989	Manas	Assam	East Himalayas	Golden Langur, Red Panda
13	2000	Khangchendzonga	Sikkim	East Himalayas	Snow Leopard, Red Panda
14	2001	Agasthyamalai Biosphere Reserve	Kerala, Tamil Nadu	Western ghats	Nilgiri Tahr, Elephants
15	1989	Great Nicobar Biosphere Reserve*	Andaman and Nicobar Islands	Islands	Saltwater Crocodile
16	1988	Nokrek*	Meghalaya	East Himalayas	Red Panda
17	1997	Dibru-Saikhowa	Assam	East Himalayas	Golden Langur
18	2011	Panna	Madhya Pradesh	Ken River	Tiger, Chital, Chinkara, Sambharand Sloth bear



- There are 18 Biosphere Reserves in India.
- There are 12 UNESCO Biosphere Reserves in India.
- First Biosphere Reserve in India: Nilgiri was the first Bioreserve in India notified on 01 September 1986.
- Largest Biosphere Reserve in India: The Gulf of Kachchh
- Smallest: Dibru-Saikhowa is the smallest Biosphere in India with an area of 765 km2



Great Rann of Kutch Biosphere Reserve

- The Great Rann of Kutch is a **salt marsh in the Thar Desert**.
- Great Rann of Kutch BR = **Kachchh Desert Sanctuary (in Great Rann of Kutch) + Wild Ass Sanctuary (in Little Rann of Kutch), Narayan Sarovar Sanctuary + Kutch Bustard Sanctuary + Banni Grasslands Reserve**.
- Major Fauna: **Great Indian Bustard (CR), Indian Wild Ass (NT)**, etc.

Cold Desert Biosphere Reserve

- It includes **Pin Valley National Park, Chandratal, Sarchu and Kibber Wildlife Sanctuaries**.
- Major Fauna: **Snow Leopard (VU), Himalayan Ibex (also referred to as Siberian Ibex – LC)**.

Seshachalam Hills Biosphere Reserve

- The **Seshachalam Hills** are part of the **Eastern Ghats (south of Panna River) in southern Andhra Pradesh**.
- **Tirupati**, a major Hindu pilgrimage town and Srivenkateshwara National Park are located in these ranges.
- Major Flora: rare and endemic plant species like **Red Sanders (NT)** are of great economic importance.
- Major Reptilian Fauna: **Golden Gecko (LC – Endemic To Tirumala Hills)**.

Dibru-Saikhowa Biosphere Reserve

- Dibru-Saikhowa BR = **Dibru-Saikhowa National Park**.
- Major Fauna: **Bengal Tiger, Clouded Leopard (VU), Gangetic Dolphin (EN)**, etc.

Dihang-Dibang Biosphere Reserve

- The **Mouling NP** and the **Dibang WLS** are located fully or partly within this biosphere reserve. The terrain is rugged, with an altitudinal range of 750 to 3000 m at the highest point, the Mouling Peak.
- Major Fauna: **Takin (VU)**, **Red Panda (EN)**.

Khangchendzonga Biosphere Reserve

- The biosphere reserve is a transboundary bio-diversity hotspot conservation area. It includes the third **highest mountain peak** in the world, **Kanchenjunga (8,586 m)**. It is one of the highest ecosystems in the world, **reaching elevations of 1,220 m to 8,586 m above sea level**.
- The **Khangchendzonga NP**, which comprises the core area of the KBR, was inscribed as **India's first "Mixed World Heritage Site"**.
- Major Fauna: **Red Panda (EN), Snow Leopard (VU), Musk Deer (EN), Great Tibetan Sheep (Argali – NT),**

Similipal Biosphere Reserve

- It includes **Mayurbhanj Elephant Reserve (Similipal TR + Hadgarh Wildlife Sanctuary + Kuldiha WLS)**.
- Tribes: Erenga, Kharias, Mankirdias, Ho, Gonda & Munda.
- Major Fauna: **Royal Bengal Tigers, Wild Elephants (EN), Gaurs (VU – Indian Bison), Chausingha (VU)**.

Pachmarhi Biosphere Reserve

- **Pachmarhi BR (Satpura National Park + Bori Wildlife Sanctuary + Pachmarhi WLS)** lies in the centre of the **Satpura Range**. The highest peak is the Dhoopgarh (1,352 m). **Gonds** are the major tribes.
- Fauna: **Tiger, Gaur, Indian Giant Flying Squirrels (LC)**, etc.

Sundarbans Biosphere Reserve

- It is located in the vast Delta of the Ganges, south of Kolkata and bordering Bangladesh in the east. It provides habitat for the threatened **Royal Bengal Tiger (EN)**.
- **Sundarbans BR = Sundarbans National Park + Sajnekhali Wildlife Sanctuary + Lothian Wildlife Sanctuary + Haliday WLS**.

Nokrek Biosphere Reserve

- **Nokrek (1,412 m) is the highest peak of the Garo hills**.
- Vegetation: Evergreen, semi-evergreen & deciduous.
- Key Fauna: **Red Panda (EN), Hoolock Gibbons (EN), Red Giant Flying Squirrel (LC)**, etc.

Manas Biosphere Reserve

- **Manas BR = Manas National Park**. It is contiguous with the Royal Manas National Park in Bhutan. Manas is famous for its population of the **Wild Water Buffalo (EN)**.
- Rare and endemic wildlife: **Assam Roofed Turtle (EN), Hispid Hare (EN), Golden Langur (EN) & Pygmy Hog (EN)**.
- The grassland biomes: **Pygmy Hog, Rhinoceros (re-introduced in 2007)**, elephants, **Bengal florican (CR)** etc.

Gulf of Mannar Biosphere Reserve

- It lies between the west coast of Sri Lanka and the south-eastern tip of India, in the **Coromandel Coast** region.

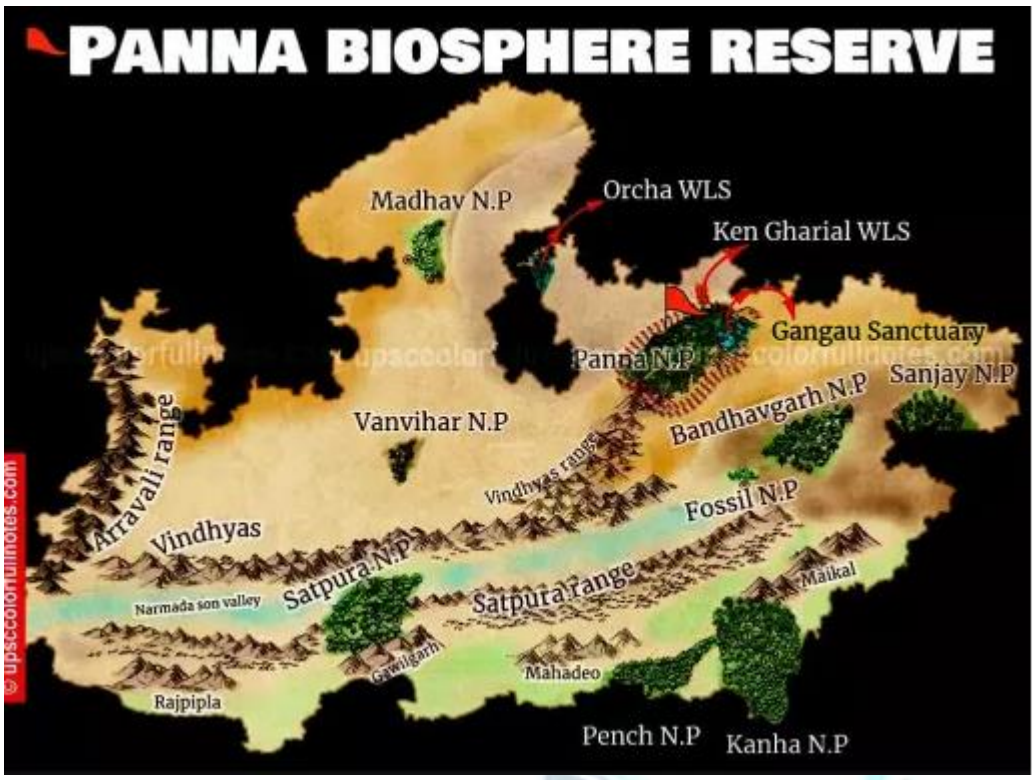
- The chain of low islands and reefs known as **Ramsethu (Adam's Bridge)**, which includes **Mannar Island**, separates the **Gulf of Mannar** from **Palk Bay**, which lies to the north between Sri Lanka and India.
- The biosphere reserve comprises islands with estuaries, seagrasses, coral reefs, salt marshes and mangroves.
- Major Fauna: **Dugong (VU), Olive Ridley turtles (VU)**, etc.

Great Nicobar Biosphere Reserve

- **Great Nicobar BR = Campbell Bay National Park + Galathea NP**.
- Vegetation: tropical wet evergreen forests.
- Major Fauna: **Dugong (VU), Saltwater Crocodile (LC)**, etc.

Nanda Devi Biosphere Reserve

- **Nanda Devi Biosphere Reserve = Nanda Devi National Park + Valley of Flowers NP**.
- Major Fauna: **Snow Leopard (VU), Musk Deer (EN), Bharal Or Blue Sheep (LC)**, etc.


PANNA BIOSPHERE RESERVE
Madhav N.P
Orcha WLS
Ken Gharial WLS
Gangau Sanctuary
Panna N.P
Sanjay N.P
Bandhavgarh N.P
Vanvihar N.P
Vindhyas range
Arravali range
Fossil N.P
Vindhyas
Satpura N.P
Satpura range
Maikal
Narmada son valley
Gawilgarh
Mahadeo
Rajpipla
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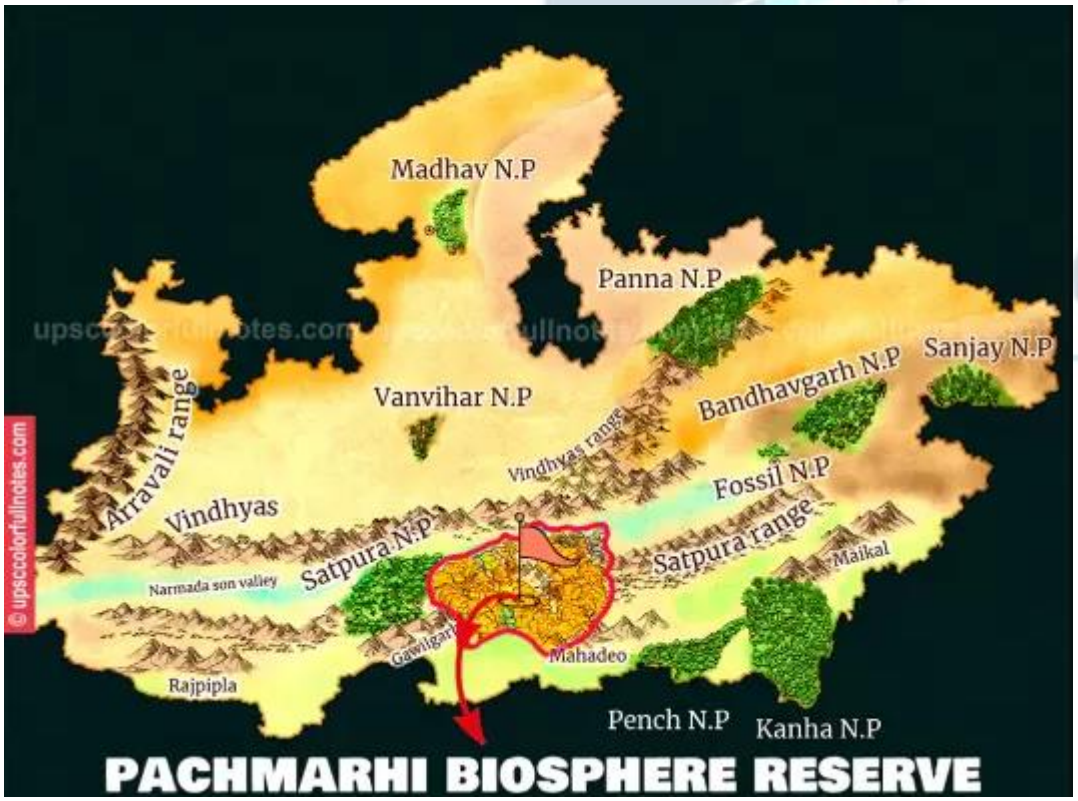
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Vindhyas range
Arravali range
Fossil N.P
Vindhyas
Satpura N.P
Satpura range
Maikal
Narmada son valley
Gawilgarh
Mahadeo
Rajpipla
Pench N.P
Kanha N.P
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Agasthyamala Biosphere Reserve

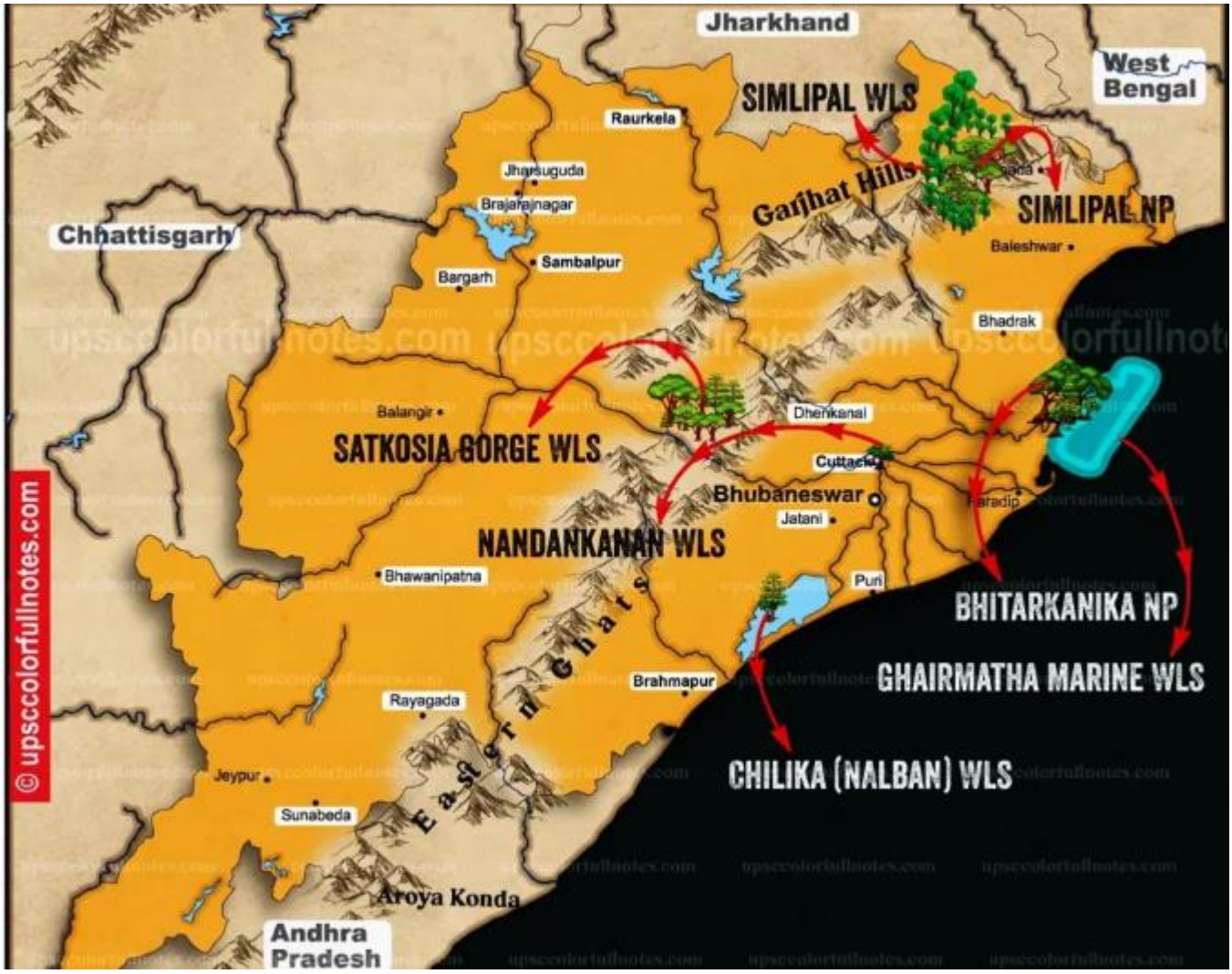
- **Agasthyamala BR = Shendurney Wildlife Sanctuary + Peppara Wildlife Sanctuary + Neyyar Wildlife Sanctuary + Kalakad Mundanthurai TR**. The reserve is home to Kani tribes from both Tamil Nadu and Kerala.

Which one of the following are Agasthyamala biosphere reserve?

a. Neyyar, Peppara and Shendurney wildlife sanctuaries and Kalakad Mundanthurai Tiger Reserve
b. Mudumalai Sathayamangalam and Wayanad wildlife sanctuaries and Silent Valley National Park
c. Kaundinya Gundla Bhrameshwaram and Papikonda wildlife sanctuaries and Mukurthi National Park
d. Kawal and Shree Venkateshwara wildlife sanctuaries; and Nagarjunasagar-Srisailam tiger reserve

Nilgiri Biosphere Reserve

- **Nilgiris** (**blue mountain)** got their name from the purplish blue flowers of **Neelakurinji** (blossoms once in 12 years).
- The **Nilgiri Sub-Cluster (UNESCO World Heritage Site)** includes the **Mudumalai, Mukurthi, Nagarhole, Bandipur and Silent Valley national parks**, as well as the **Aralam, Wayanad** and **Sathyamangalam wildlife sanctuaries**.
- Vegetation: tropical evergreen forests (western side of Western Ghats), montane sholas and grasslands (at high altitudes), semi-evergreen forests, moist deciduous forests, dry deciduous forests, and thorn forests.
- Major Fauna: **Lion Tailed Macaque (EN), Nilgiri Tahr (EN), Malabar Giant Squirrel (LC), Nilgiri Langur (VU)**, etc.



The World Network of Biosphere Reserves of the MAB Programme consists of a dynamic and interactive network of sites of excellence to contribute to the 2030 Agenda and the Sustainable Development Goals (SDGs). It promotes North-South and South-South collaboration and represents a unique tool for international co-operation through sharing knowledge, exchanging experiences, building capacity and promoting best practices.

With the addition of the two Biosphere Reserves, 12 of the 18 biosphere reserves in the country have become part of the World Network of Biosphere Reserves

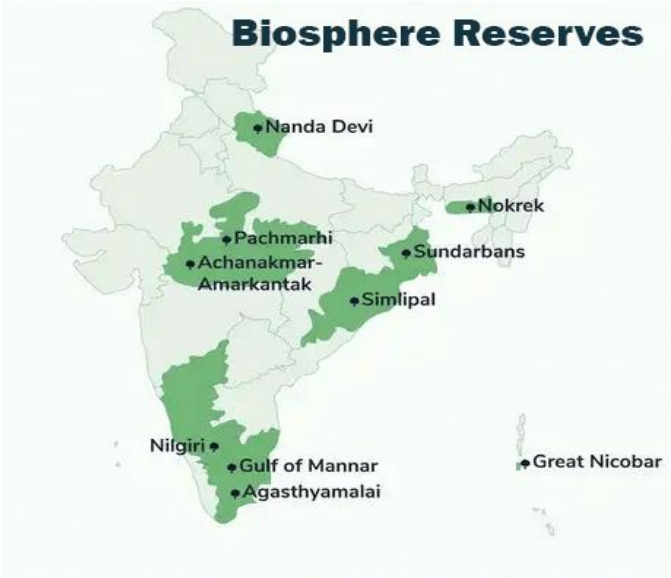
YEAR	NAME	STATES
2001	Sundarbans Biosphere Reserve	West Bengal
2009	Simlipal Biosphere Reserve	Odisha
2009	Pachmarhi Biosphere Reserve	Madhya Pradesh
2009	Nokrek Biosphere Reserve	Meghalaya
2000	Nilgiri Biosphere Reserve	Tamil Nadu

2004	Nanda Devi Biosphere Reserve	Uttarakhand
2001	Gulf of Mannar Biosphere Reserve	Tamil Nadu
2013	Great Nicobar Biosphere Reserve	Great Nicobar
2012	Achanakmar-Amarkantak Biosphere Reserve	Chhattisgarh
2016	Agasthyamala Biosphere Reserve	Kerala and Tamil Nadu
2018	Kanchenjunga Biosphere Reserve	Part of North and West Sikkim districts
2020	Panna National Park	Madhya Pradesh

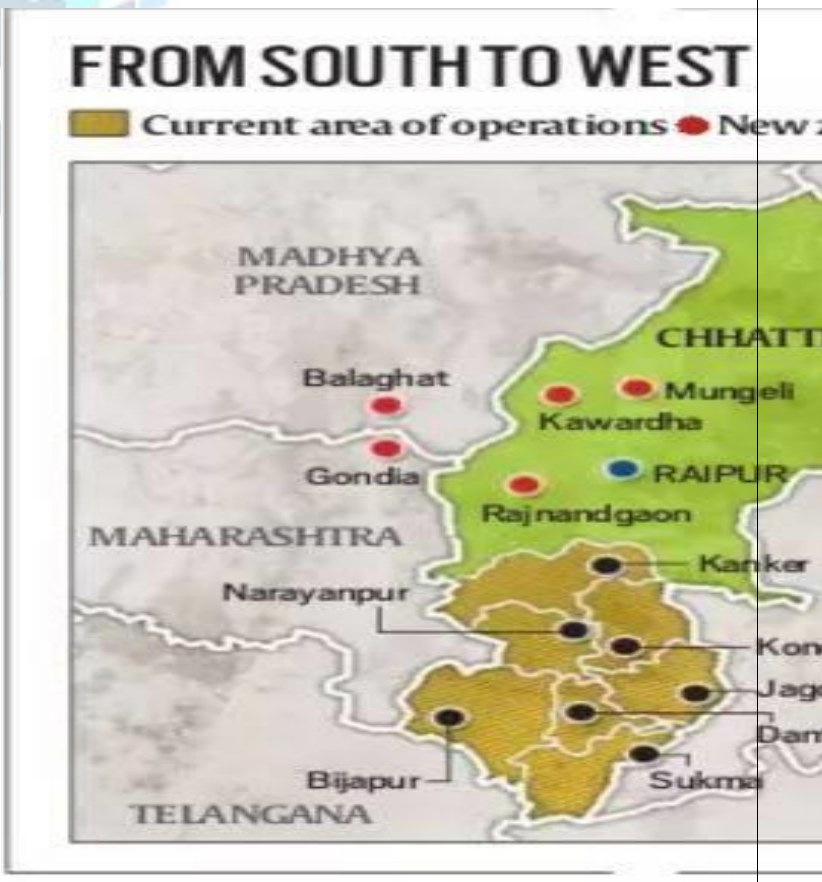
Key fauna

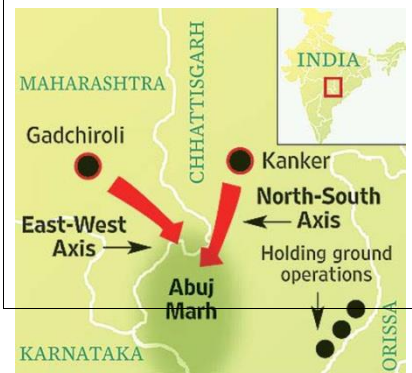
Name	Key fauna
Nilgiri Biosphere Reserve	Lion Tailed Macaque (EN), Nilgiri Tahr (EN), Malabar Giant Squirrel (LC), Nilgiri Langur (VU)
Nanda Devi	Snow Leopard (VU), Musk Deer (EN), Bharal Or Blue Sheep (LC)
Nokrek	Red Panda (EN), Hoolock Gibbons (EN), Red Giant Flying Squirrel (LC)
Great Nicobar	Dugong (VU), Saltwater Crocodile (LC)
Gulf of Mannar	Dugong (VU), Olive Ridley turtles (VU)
Manas	Assam Roofed Turtle (EN), Hispid Hare (EN), Golden Langur (EN), Pygmy Hog (EN), Wild Water Buffalo (EN), Bengal florican (CR)
Sunderbans	Royal Bengal Tiger (EN)
Simlipal	Royal Bengal Tigers, Wild Elephants (EN), Gaurs (VU – Indian Bison), Chausingha (VU)
Dibru-Saikhowa	Bengal Tiger, Clouded Leopard (VU), Gangetic Dolphin (EN)
Dehang-Dibang	Takin (VU), Red Panda (EN)
Pachmarhi	Tiger, Gaur, Indian Giant Flying Squirrels (LC)
Khangchendzonga	Red Panda (EN), Snow Leopard (VU), Musk Deer (EN), Great Tibetan Sheep (Argali – NT)

Agasthyamalai	Nilgiri Tahr (EN)
Achanakamar - Amarkantak	Four Horned Antelope (Chausingha (VU)), Indian Wild Dog (VU)
Great Rann of Kutch (Kachchh)	Great Indian Bustard (CR), Indian Wild Ass (NT)
Cold Desert	Snow Leopard (VU), Himalayan Ibex (also referred to as Siberian Ibex – LC)
Seshachalam Hills	Red Sanders (NT), Golden Gecko (LC – Endemic To Tirumala Hills)
Panna	Tiger (EN), Chital (LC), Chinkara (LC), Sambar (VU)



Which of the following are in Agasthyamala Biosphere Reserve?
(a) Neyyar, Peppara and Shendurney Wildlife Sanctuaries; and Kalakad Mundanthurai Tiger Reserve
(b) Mudumalai, Sathyamangalam and Wayanad Wildlife Sanctuaries; and Silent Valley National Park
(c) Kaundinya, Gundla Brahme-swaram and Papikonda Wildlife Sanctuaries; and Mukurthi National Park
(d) Kawal and Sri Venkateswara Wildlife Sanctuaries; and Nagarjunasagar-Srisailam Tiger Reserve





Future/ Potential sites for Biosphere Reserves as selected by Ministry of Forests and Environment:

- Abujmarh, Chhattisgarh
- Andaman and Nicobar, North Islands
- Chintapalli, Visakhapatnam Andhra Pradesh
- Kanha, Madhya Pradesh
- Kovalam, Kerala
- Lakshadweep Islands, Lakshadweep
- Little Rann of Kutch, Gujarat
- Phawngpui (Blue Mountain), Mizoram
- Namdapha, Arunachal Pradesh
- Singhbhum
- Tawang and West Kameng, Arunachal Pradesh
- Thar Desert, Rajasthan
- Tadoba National Park and Sanjay Gandhi National Park, Maharashtra

Que: Which of the following National parks are part of Nilgiri Biosphere Reserve?

1) Nagarhole National Park
2) Mudumalai National Park
3) Bandipur National Park
4) Eravikulam National Park

Select the correct answer code:

a) 1, 2, 3
b) 1, 3, 4
c) 1, 2, 4
d) 1, 2, 3, 4

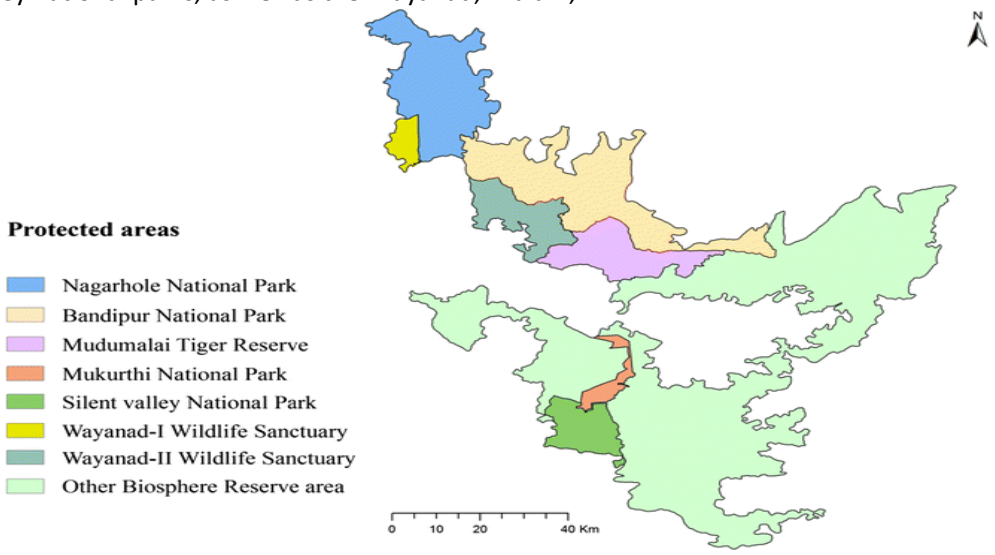
Solution: a

Location Niligiri Mountain of Western Ghats. It is the largest protected forest area in India, spreading across Tamil Nadu, Karnataka and Kerala.(areawise) India's first biosphere reserve under UNESCO's Man and the Biosphere Programme.

Protected forest :It includes TN: Mudumalai + Mukurthi(shola grassland) + Sathyamangalam wildlife sanctuaries.

Karnataka : Nagarhole + Bandipur, and

Kerala : Silent Valley national parks, as well as the Wayanad, Aralam,



The United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Sites are the important places of cultural or natural heritage

As of July 2021, 19 of the 36 States and union territories of India are home to the World Heritage Sites, with Maharashtra having highest number of sites

At present,

- there are 42 World Heritage Sites located in India.
- Out of these, 34 are cultural, 7 are natural, and 1 is mixed (meeting both cultural and natural criteria)

Natural World Heritage Sites

1. Kaziranga National Park – Assam
2. Manas Wildlife Sanctuary – Assam
3. Nanda Devi National Park and Valley of Flowers – Uttarakhand
4. Great Himalayan National Park – Himachal Pradesh
5. Sunderbans National Park – West Bengal
6. Western Ghats
7. Keoladeo Ghana National Park – Rajasthan

Mixed : Khangchendzonga National Park (2016) sikkim

1. Which among the following National Parks has been inscribed to the UNESCO World Heritage Sites list as the "Mixed Heritage" site of India?

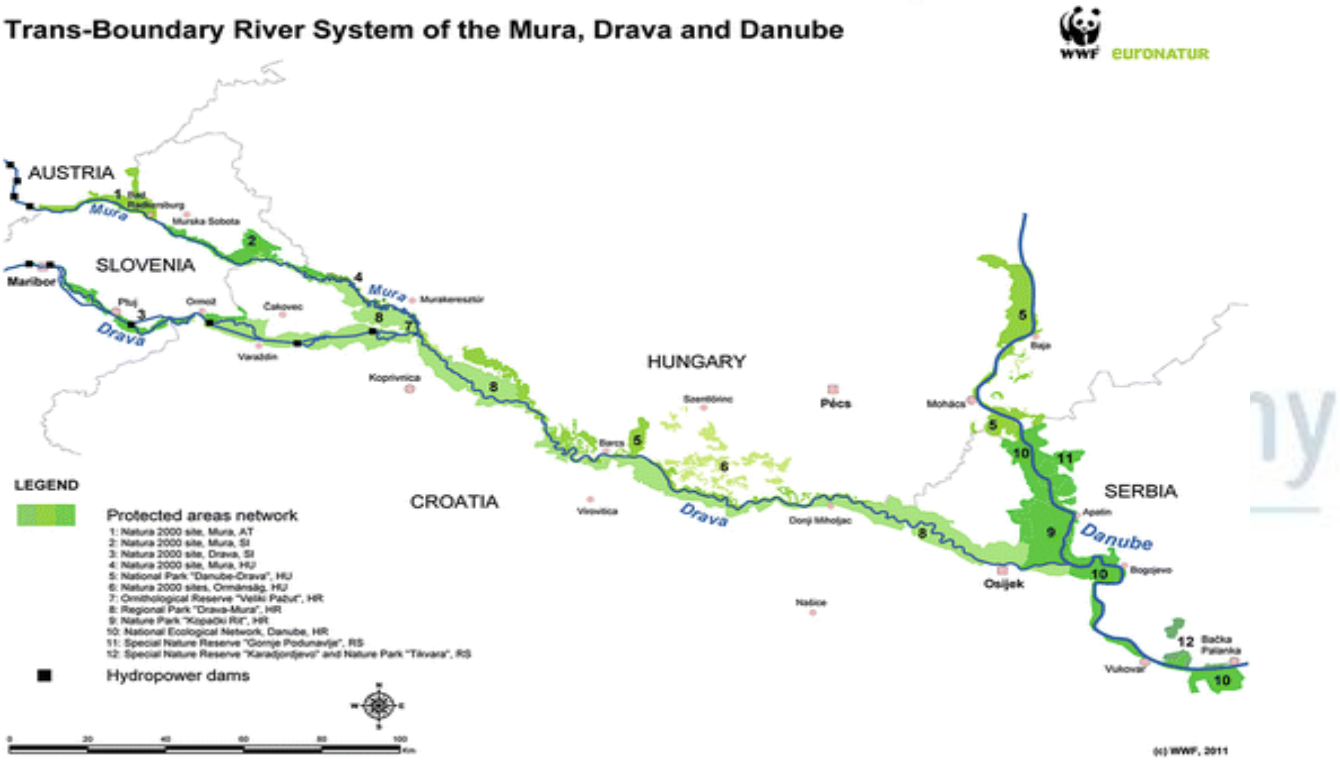
a) Great Himalayan National Park b) Kaziranga National Park
b) Keoladeo National Park d) Khangchendzonga National Park

2. Zemu Glacier, one of the largest in Asia is located in which National park

a) Mouling National Park b) Kanchenjunga NP c) Hemis NP d) Namdapha NP

AMAZON OF EUROPE: UNESCO declares world's first 5-country biosphere reserve in 'Amazon of Europe'

- The 1-million hectare Mura-Drava-Danube is the now the largest riverine protected area in Europe
- so-called 'Amazon of Europe', makes it the largest riverine protected area on the continent.
- Recently, Mura-Drava-Danube (MDD) was declared as the world's first 'five-country biosphere reserve' by the United Nations Educational, Scientific and Cultural Organization (UNESCO). stretches across Austria, Slovenia, Croatia, Hungary and Serbia.
- The strategy's aim is to revitalise 25,000 km of rivers and protect 30 per cent of the European Union's land area by 2030.
- The reserve is home to floodplain forests, gravel and sand banks, river islands, oxbows and meadows.
- It is also an important annual resting and feeding place for more than 250,000 migratory birds, according to WWF.
- Almost 900,000 people live in the biosphere reserve



About Danube River

- The longest river in the European Union, the Danube River is the second-longest river in Europe after Russia's Volga.
- It begins in the Black Forest region of Germany and runs through 10 countries (Germany, Austria, Slovakia, Hungary, Croatia, Serbia, Romania, Bulgaria, Moldova and Ukraine) on its way to the Black Sea.

19 countries share the Danube River Basin, which makes it the world's most international river basin.

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CHAPTER 8 INTERNATIONAL MEASURE FOR BIODIVERSITY CONSERVATION

UN-CBD: Convention on Biological Diversity :

CBD, approved 1992 at Earth Summit, Rio de Janerio and came into force in 1993.

Is a multilateral treaty. and Signed 5 June 1992 Parties 196, it is legally binding convention

- **Secretariat:** Montreal, **Canada operates under UNEP**

The Convention has three main goals including:

1. **the conservation of biological diversity (or biodiversity);**
2. the sustainable use of its components; and
3. the fair and equitable sharing of benefits arising from genetic resources.

Two CBD Protocol till

1. Cartagena protocol: on Biosafety adopted in year 2000 and forced in 2003
2. Nagoya Protocol on Access to Genetic Resources adopted in 2010 and forced in 2014

About Cartagena Protocol

- **on Biosafety to the** Convention on Biological Diversity
- **seeks to protect biodiversity from the potential risks caused by LMOs arising from modern technology.**
- It is a supplementary agreement to the CBD like the Nagoya Protocol.
- The Protocol was adopted in 2000 and it came into force in 2003.
- The protocol was adopted in Montreal in 2000 but is named after Cartagena, the original city in Colombia where the protocol was supposed to be adopted.
- It addresses technology development and transfer, benefit-sharing, and biosafety issues.
-

The concept of Advance Informed Agreement (AIA) and Biosafety Clearing House

- it is procedure used in Caretgena Protocol
- It include provision for ensuring the countries to make informed decisions before agreeing to import LMOs into their country
- Ex: seeds for planting, fish for release, and microorganisms for bioremediation)
- Agricultural products originating from GM crops fall under the category of "living modified organisms intended for direct use as food or feed, or for processing

AIA includes notification from the exporter, acknowledgment of the importer's receipt, decision-making process, and review of decisions.

- It establishes online platform "Biosafety Clearing-House" to help countries exchange scientific, technical, environmental, and legal information about LMOs.
- It is a website and global repository of information on LMOs;
- The BCH functions as a central information marketplace where the providers and users interact and exchange information on biosafety.
- The Protocol gives a precautionary approach to the issue of the transfer of LMOs from one country to another

CARTAGENA PROTOCAL AND INDIA:

- India is a signatory to the Cartagena Protocol since its ratification in 2003.
- The Ministry of Environment, Forest and Climate Change (MOEF&CC) in India serves as the nodal agency (Competent National Authority-CNA) for implementing the Protocol.
- India has pioneered the creation of a biosafety regulatory framework since the 1980s, ensuring a science-based approach.
- Indian legislation uses phrases like "genetically engineered organism" or "genetically modified organism"

interchangeably with LMOs.

- Guidelines for risk management and risk evaluation of GMOs are available in India.
- India Biosafety Clearing House :The Genetic Engineering Appraisal Committee (GEAC) is the statutory committee constituted under the "Rules for the Manufacture, Use/Import/Export and Storage of Hazardous Micro Organisms/Genetically Engineered Organisms or Cells (Rules, 1989)" framed under Environment (Protection) Act, 1986.
- GEAC is India's apex biotechnology regulatory body.
- Bt cotton is the only commercially approved crops in India.

With reference to 'Genetic Engineering Appraisal Committee (GEAC)', consider the following statements:
1. It is established under Ministry of agriculture and farmers welfare.
2. It is the apex body for approval of activities involving large scale use of hazardous microorganisms and recombinants.
3. It is responsible for approval of proposals relating to release of genetically engineered organisms and products including experimental field trials.
Which of the above statement(s) is/are correct?

Ans ? 2 and 3 correct

Que : Which of the following Protocol has arrangement of Advance Informed Agreement
a) Kyoto Protocol
b) Cartegana protocol
c) Nagoya Protocol
d) Paris Agreement

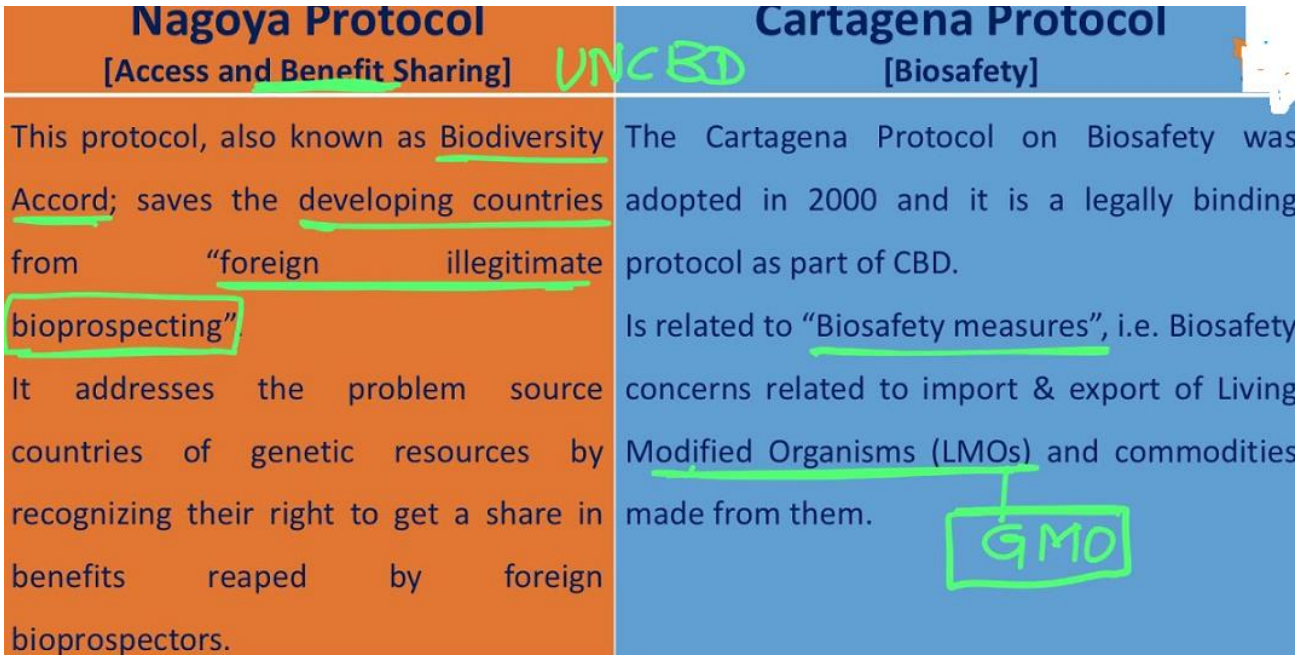
The **Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS)** is a supplementary International agreement to the UN Convention on Biological Diversity (CBD)

- The protocol was adopted in 2010 in Nagoya, Japan. It entered into force in October 2014.
- it address traditional Knowledge associated with Genetic Resources where indigeneous and local communittes have the established right to grant access to them .

Some Examples of Traditional Knowledge in India

- **Bamboo Irrigation System**: Meghalaya
- Apatami **Rice-fish conservation farming system : Arunachal Pradesh**
- **Ahar Pynes**: tradtional floodwater harvesting system in South Bihar
- **Bathukamma** -Floral festival of Telegana
- **"Zabo"** is an indigenous farming system of Nagaland. It has a combination of forest, agriculture and animal husbandry with well-founded soil and water conservation bas
- **Bun system of cultivation:**This system of cultivation is practiced mainly in the state of Meghalaya. Under this system, the crops are grown on a series of raised beds locally referred to as "Bun" formed along the slope of the hills.

Is Nagoya Protocol legally binding? **Yes, it is legally binding.**
Is India signatory to Nagoya Protocol? Yes, India is a signatory to the Protocol.



Term 'bioprospecting' can be best describing as_____

(a) It refers to unauthorized appropriation of biological materials.

(b) It is an ex situ treatment technology that leverages biological processes to convert contaminants to low-toxicity byproducts.

(c) It is the exploration of plant and animal species for the utilization of their genetic resources in the production of commercial products.

(d) It is a remediation technique that uses indigenous microorganisms to stimulate in-situ aerobic biological activity

About Bioprospecting

- is the exploration of plant and animal species for the utilization of their genetic resources in pharmaceutical and biochemical industries and in the production of a wide array of commercially viable products.
- can also involve the study of traditional knowledge and practices of indigenous communities to identify valuable resources .

About Biopiracy :

- When a region's biological resources or indigenous knowledge are unethically appropriated or commercially exploited without providing fair compensation, this is known as biopiracy.
- is a violation of the rights of traditional communities over their biological resources and related knowledge.
- Various international treaties have been negotiated to provide countries legal recourse in the event of biopiracy
- To check Biopiracy :

1. UN Convention on Biological Diversity
2. Nagoya Protocol.
3. The WIPO is currently negotiating more treaties to bridge gaps in this field

About Traditional Knowledge (TK)

Define :

- Traditional knowledge refers to the knowledge, practices, skills, and innovations that are passed down through generations within a community, often rooted in indigenous cultures and tied to the local environment natural resources.
- essentially culturally oriented and integral to cultural identity of the social group in which it operates and preserved .

It Includes What ?

The definition of traditional knowledge used by the World Intellectual Property Office (WIPO) includes indigenous knowledge relating to categories such as agricultural knowledge, medicinal knowledge, biodiversityrelated knowledge, and expressions of folklore in the form of music, dance, song, handicraft, designs, stories and artwork

1. Ayurveda: Ancient Indian system of medicine and healthcare that emphasizes natural remedies and holistic healing practices.
2. Yoga: Traditional physical, mental, and spiritual discipline originating in ancient India that focuses on breath control, meditation, and specific postures (asanas) for promoting physical and mental wellbeing.
3. Sanskrit: Ancient Indian language considered sacred and used for religious and philosophical texts.
4. Vedic Astrology: Astrological system based on ancient Indian scriptures that offers guidance and predictions by studying the positions of celestial bodies.
5. Classical Dance Forms: Bharatanatyam, Kathak, Odissi, Kuchipudi, Mohiniyattam, and Manipuri—these traditional dance forms, each with its distinct style and origins, have been passed down through generations in India.
6. Indian Classical Music: Traditional music rooted in the ancient scripts of Samaveda, with two main traditions—Hindustani and Carnatic. These intricate musical systems involve ragas and talas.
7. Vedas and Upanishads: Ancient religious texts regarded as the foundation of Hindu philosophy and spirituality.
8. Yoga Sutras: Written by Sage Patanjali, this classical text outlines the principles and practice of yoga.
9. Ayurvedic Cuisine: Traditional Indian food preparation techniques and principles that aim to balance the different doshas (humors) of the body through the use of specific herbs, spices, and cooking methods.
10. Indian Handicrafts: Traditional crafts passed down through generations, such as pottery, weaving, embroidery, woodwork, metalwork, and jewelry making.
11. Panchatantra: Ancient collection of Indian fables and folk tales that impart moral lessons and wisdom.
12. Natya Shastra: Ancient text on performing arts that encompasses acting, dance, and music.
13. Hindu Temple Architecture: Intricate and distinct architectural styles, such as Nagara, Dravida, and Vesara, prevalent in temple construction across India.
14. Mudras: Hand gestures used in Indian dance, yoga, and spiritual practices to convey specific meanings or energies.
15. Indian Martial Arts: Various traditional martial arts forms from different regions of India, such as Kalaripayattu from Kerala and Silambam from Tamil Nadu.

Importance of traditional knowledge in India:

- **is critical for preserving culture, promoting**
- sustainable resource management and holistic well-being.
- supporting community resilience and self-reliance
- fosters a sense of identity and belonging among indigenous communities.
- promotes cultural diversity and intergenerational knowledge transfer.
- providing solutions to social, economic and environmental challenges

Issues related to traditional knowledge in India:

- The development of new technology and the new use of traditional knowledge based products today is the major threat to the survival of many of these communities.
- The modern cultural industries as well as the manufacturing industries now commercially exploit the traditional knowledge based products using new technology without the permission and sharing of profits with the communities

- Loss of traditional knowledge due to modernization and globalization, urbanization and industrialization.
- Lack of recognition /protection of indigenous intellectual property rights.
- Exploitation of traditional knowledge without the consent of indigenous communities.
- Limited documentation and dissemination of traditional knowledge.
- Lack of funding support and Inadequate legal frameworks for the preservation and promotion of traditional knowledge.
- Displacement and marginalization of indigenous communities leading to the loss of traditional knowledge.
- . Conflict between traditional knowledge and Western scientific knowledge systems.
- Misappropriation of traditional knowledge for commercial purposes.

WHY TK NOT PROTECT UNDER IPR SYSTEM ?

Three Reason Are:

- the current system seeks to privatize ownership and is designed to be held by individuals or corporations, whereas traditional knowledge has collective ownership
- this protection is time-bound, whereas traditional knowledge is held in perpetuity from generation to generation.
- it adopts a restricted interpretation of invention which should satisfy the criteria of novelty and be capable of industrial application, whereas traditional innovation is incremental, informal and occurs over time.

The Convention on Biological Diversity is the first international agreement acknowledging the role and contribution of indigenous and local communities in the conservation and sustainable use of biodiversity.

So Documentation of TK is utmost Important and Therefore, India Prepared its TKDL.

About The Traditional Knowledge Digital Library (TKDL)

- **A tool for prevention of misappropriations of traditional knowledge**
- is an Indian digital knowledge repository of the traditional knowledge, especially about medicinal plants and formulations used in Indian systems of medicine.
- Set up in 2001,
- as a collaboration between the Council of Scientific and Industrial Research (CSIR) and the MINISTRY OF AYUSH
- objective to protect TK from exploitation through biopiracy and unethical patents
- TKDL is available to sixteen Patent Offices of the World
- TKDL acts as a bridge between these books (prior art) and International patent examiners.
- So, TKDL **translated into five languages — English, German, French, Spanish and Japanese**

Note :

- The Ministry of Ayush includes the seven traditional systems of healthcare.
- The Ministry of Ayurveda, Yoga, Naturopathy, Unani, Siddha, Sowa-Rigpa and Homoeopathy.
- The Union Cabinet , 2019 has approved setting up of National Institute of Sowa-Rigpa (NISR) at Leh, Union Territory of Ladakh. autonomous organization under the Ministry of AYUSH

About Sowa-Rigpa

- is a Traditional Medical system of the Himalayan belt in India.

- Areas: It has been popularly practiced in Sikkim, Arunachal Pradesh, Darjeeling (West Bengal), Himachal Pradesh, Union Territory of Ladakh and now all over India.

- Amchi System of medicine / Sowa-Rigpa means Knowledge of Healing and derives its meaning from the Bhoti Language. Originated in Tibet, and popularly practiced in countries namely, India, Nepal, Bhutan, Mongolia, and Russia. The majority of theory and practice of Sowa-Rigpa is similar to "Ayurveda" .

Define Biopiracy and its Implications ? How **Traditional Communities are Vulnerable** to It.?

- BIOPIRACY : is a violation of the rights of traditional communities over their biological resources and related knowledge.
- The implications of biopiracy are economic as well as ethical: Obtaining IPRs usually patents or Plant Breeders Rights to gain monopoly control over biological resources, related traditional knowledge, or commercial products based on these resources or knowledge, without the consent of, or any benefits going to, the original holders of the resources/knowledge

- **Traditional communities are especially vulnerable to biopiracy because** Traditional communities do not consider their seed, crop and livestock varieties forest and marine resources and related knowledge as private property, but as communal property.

- Traditional **communities are vulnerable because of social hierarchies and low levels of awareness** and literacy.

- There is an ignorance of the law and existing IPR-regime and even if the law is known, traditional community members are usually powerless to demand its enforcement to prevent biopiracy or get some form of benefit-sharing agreement, due to factors such as illiteracy, low social status and lack of financial resources

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CHAPTER 9 MISCELLANEOUS

TOPIC INCLUDED :

- **Environmental Movements**
- **Conservation and Community Reserve , Sacred Groves in India**
- **Carrying Capacity and Ecological Footprint**
- **Insectivorous Plants**
- **Types of Species**
- **India Environmental Institutional Organisations**
- **Key Acts,**
- **Keys Days**
- **Environmental Impact Assessment**

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INDIAN ENVIRONMENTAL MOVEMENTS

Bishnoi Movement

- Year: 1700s
- Place: Khejarli, Marwar region, Rajasthan state.
- Leaders: Amrita Devi along with Bishnoi villagers in Khejarli and surrounding villages.
- Aim: Save sacred trees from being cut down by the king's soldiers for a new palace.
- Amrita Devi, a female villager could not bear to witness the destruction of both her faith and the village's sacred trees. She hugged the trees and encouraged others to do the same. 363 Bishnoi villagers were killed in this movement.
- The Bishnoi tree martyrs were influenced by the teachings of Guru Maharaj Jambaji, who founded the Bishnoi faith in 1485 and set forth principles forbidding harm to trees and animals

Chipko Movement

- Year: 1973

- Place: In Chamoli district and later at Tehri-Garhwal district of Uttarakhand.
- Leaders: Sundarlal Bahuguna, Gaura Devi, Sudesha Devi, Bachni Devi, Chandi Prasad Bhatt, Govind Singh Rawat, Dhoom Singh Negi, Shamsher Singh Bisht and Ghanasyam Raturi.
- Aim: The main objective was to protect the trees on the Himalayan slopes from the axes of contractors of the forest.

Save Silent Valley Movement

- Year: 1978
- Place: Silent Valley, an evergreen tropical forest in the Palakkad district of Kerala, India.
- Leaders: The Kerala Sastra Sahitya Parishad (KSSP) an NGO, and the poet-activist Sughathakumari played an important role in the Silent Valley protests.
- Aim: In order to protect the Silent Valley, the moist evergreen forest from being destroyed by a hydroelectric project.
- The Kerala State Electricity Board (KSEB) proposed a hydroelectric dam across the Kunthipuzha River that runs through Silent Valley.

Jungle Bachao Andholan

- Year: 1982
- Place: Singhbhum district of Bihar
- Leaders: The tribals of Singhbhum.
- Aim: Against governments decision to replace the natural **sal forest** with **Teak**.

What was it all about: The tribals of the Singhbhum district of Bihar started the protest when the government decided to replace the natural sal forests with the highly-priced teak. This move was called by many "Greed Game Political Populism". Later this movement spread to Jharkhand and Orissa.

Appiko Movement

- Year: 1983
- Place: Uttara Kannada and Shimoga districts of Karnataka State
- Leaders: Appiko's greatest strengths lie in it being neither driven by a personality nor having been formally institutionalised. However, it does have a facilitator in Pandurang Hegde. He helped launch the movement in 1983.
- Aim: Against the felling and commercialization of natural forest and the ruin of ancient livelihood.

Narmada Bachao Andholan (NBA)

- Year: 1985
- Place: **Narmada** River, which flows through the states of Gujarat, Madhya Pradesh and Maharashtra.
- Leaders: Medha Patker, Baba Amte, Adivasis, farmers, environmentalists and human rights activists.
- Aim: A social movement against a number of large dams being built across the **Narmada** River.

What was it all about: The movement first started as a protest for not providing proper rehabilitation and resettlement for the people who have been displaced by the construction of the **Sardar Sarovar Dam.** Later on, the movement turned its focus on the preservation of the environment and the eco-systems of the valley. Activists also demanded the height of the dam to be reduced to 88 m from the proposed height of 130m. World Bank withdrew from the project.

Tehri Dam Conflict

- Year: 1990's
- Place: Bhagirathi River near Tehri in Uttarakhand.
- Leaders: Sundarlal Bahuguna
- Aim: The protest was against the displacement of town inhabitants and the environmental consequence of the weak ecosystem.

Tehri dam attracted national attention in the 1980s and the 1990s. The major objections include seismic sensitivity of the region, submergence of forest areas along with Tehri town etc. Despite the support from other prominent leaders like Sunderlal Bahuguna, the movement has failed to gather enough popular support at the national as well as international levels.

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CONCEPT OF CONSERVATION AND COMMUNITY RESERVE, SACRED GROVES

- All concepts are outcome of Amendments of the Wild life Protection Act in 2003
- The Key Difference lies in Management control, scale and objectives between Conservation and community reserve .

CONSERVATION RESERVE

- It is a state-owned area **adjacent to National Parks and sanctuaries** for the protection of the landscape, seascape, and habitat of fauna and flora. It is overseen by a **Conservation Reserve Management Committee**.
- After consulting with local communities, the State Government may declare any area owned by the Government as a conservation reserve.
- Tiruppaddaimarathur Conservation reserve in Tirunelveli ,Tamilnadu is the first conservation reserve in India
- **State-wise break up of Conservation Reserves**

State & UT	State Area (km²)	No. of Con R	Area (km²)	% of State Area
Gujarat	1,96,022	1	227.00	0.116
Haryana	44,212	2	48.72	0.110
Himachal Pradesh	55,673	3	19.17	0.034
Karnataka	1,91,791	17	291.19	0.090
Maharashtra	3,07,713	15	1114.63	0.362
Odisha	155707	1	29.41	0.02
Punjab	50,362	4	25.71	0.051
Rajasthan	3,42,239	21	1191.06	0.325
Sikkim	7,096	1	0.06	0.001
Tamil Nadu	1,30,058	2	4.88	0.004
Tripura	10486	1	12.93	0.123
Uttarakhand	53,483	4	212.45	0.397
West Bengal	88,752	5	1415.91	1.595
Jammu & Kashmir	1,63,090	33	706.63	0.425
Ladakh	59146	5	249.00	0.421
	TOTAL	**115**	**5548.75**	**0.170**

-

COMMUNITY RESERVES:

- are created by State Government on community land or Private land
- Provided that members of the community offer their land to be declared as Protected areas
- Such protected areas would conserve flora, fauna and customs and traditions of local communities
- objective : to improve socio economic conditions of local communities as well as protect Wildlife
- Nagaland , then Meghalaya has most number of community reserve

State-wise break up of Community Reserves

State & UT	State Area (km²)	No. of Com R	Area (km²)	% of State Area
Arunachal Pradesh	83743	9	131.60	0.157
Bihar	94163	1	0.57	0.000
Haryana	44212	5	115.84	0.262
Karnataka	1,91,791	1	3.12	0.002
Kerala	3,88,63	1	1.50	0.004
Manipur	22327	11	112.60	0.464
Meghalaya	22,429	74	141.69	0.632
Nagaland	16,579	114	851.78	5.138

Punjab	50,362	4	96.46	0.191
	TOTAL	**220**	**1455.16**	**0.043**

An Ancient Tradition of Nature Conservation

CONCEPT OF SACRED GROVES

- cultural conservation areas / communally protected forests
- Patches of forest or natural vegetation protected on the basis of religious faith are called sacred groves.
- tracts of virgin forests that are left untouched by the local inhabitants and are protected by the local people due to their culture and religious beliefs
- dedicated to local deities or tree spirits
- India has well over 13,000 documented Sacred Groves.
- Sacred groves have been legally protected under 'community reserves' in the Wildlife (Protection) Amendment Act, 2002.
- People believe that any kind of disturbance will offend the local deity, causing diseases, natural calamities, or failure of crops
- Sacred Groves in India are often associated with temples, monasteries, shrines or with burial grounds.
- Sacred Groves originated in Meghalaya since time immemorial much before the advent of Christianity. They are unique feature of Khasi and Jaintia Hills. There are 125 Sacred groves in Meghalaya
- Sacred groves are found all over India - especially in states like Maharastra, Karnataka, Kerala, and Tamil Nadu
- Among the largest sacred groves of India are the ones in Hariyali, near Gauchar in Chamoli District of Uttarakhand, and the Deodar grove in Shipin near Shimla in Himachal Pradesh
- Dev Bhoomi - also known as the "Land of Gods" - is part of the 133 sacred groves at the foothills of the Himalayas in Uttarakhand.

News :

Orans :

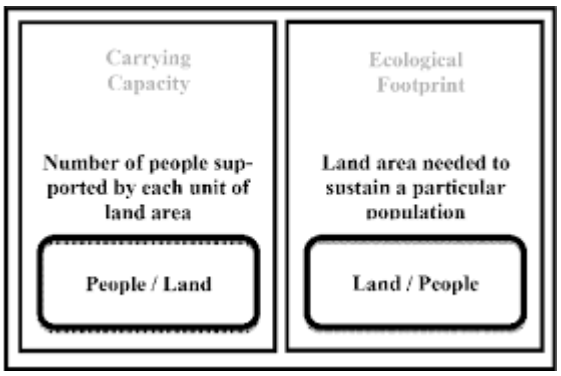
- traditional sacred groves found in Rajasthan.
- These are community forests, preserved and managed by rural communities for centuries
- Orans are also spaces where herders take their livestock for grazing and are places for communal congregations, festivals, and other social events, the performance of which is linked to agrarian rhythms and the continued commitment of the communities towards environmental conservation.
- Orans : natural habitat for India's most critically endangered bird, the Great Indian Bustard (Schedule 1 Wildlife Protection Act) which is also the State bird of Rajasthan.
- But Now , Villagers in western Rajasthan are worried about the State's plan to classify orans (sacred groves) as deemed forests.
- The recent declaration of Orans as deemed forests raises concerns about access to resources and movement restrictions.

List of Scared Groves in Each State:

S.No	State	Term for Sacred Grove	No. of documented sacred forest
1	Andhra Pradesh	Pavithravana	677
2	Arunachal Pradesh	Gumpa Forests	159
3	Assam	Sacred Grove	29
4	Bihar	Sarhuli Mander	43

5	Chhattisgarh	Matagudi	63
6	Goa	Deorai, Pann	93
7	Gujarat	Sabarkantha, Dahod, Banaskantha	42
8	Haryana	Gurudwara grove	57
9	Himachal Pradesh	Kul Deveta	329
10	Jammu & Kashmir	Bani	92
11	Jharkhand	Sarana/ Jaherthan	29
12	Karnataka	Devara Vana, Devara Kadu, Huli devarakadu, Nagavan, Bhatappavana, Jatakappan bana, Ghowdibana, Kan	1476
13	Kerala	Kavu, Sarp Kavu	1096
14	Madhya Pradesh	Sharana, Devkot, Matikot, Devsthali, Budhadev	170
15	Maharashtra	Pavithravan, Deovan, Deorai, Devgudi, Pen Gada/ Gonds, Devarahati	2820
16	Manipur	Gamkhap, Mauhak	166
17	Meghalaya	Ki Law Lyngdoh, Ki Law Kyntang, Ki Law Niam	105
18	Odisha	Jahera, Thakuramma	188
19	Puducherry	Kovil Kadu	108
20	Rajasthan	Vani, Malvan, Kenkri, Orans, Shamalt deh, Devabani, Jogmaya	560
21	Sikkim	Pandam	16
22	Tamil Nadu	Swami Shola, Koil Kadu, Kattu Koil, Vanakkoil	1275
23	Telangana	Pavithravana	57
24	UttaraKhand	Deo Bhumi, Bugyal	133
25	Uttar Pradesh	Dev van, Pavithravan	32
26	West Bengal	Gramthan, Santalburitan, Shitalatan, Haritan, Sabitritan, jahera, Deo Tasara, Mawmund	562

KEY CONCEPTS



In terms of Ecology, 'Carrying Capacity' refers to_____

(a) The maximum number of individuals of a given species that resources in an area can sustain indefinitely without significantly degrading the life supporting resources.

(b) A state where the size of the population of a species is neither greater nor lower than the socially desirable level

(c) The maximum number of individuals a species can produce.

(d) None of the above

Ans A

- Carrying capacity can be defined as the population that can be supported indefinitely by its supporting systems.
- Ecologically, the carrying capacity of an ecosystem is the size of the population that can be supported indefinitely up and available resources and services of that ecosystem.
- The carrying capacity concept is related to sustainable development because development is sustainable as long as an economy is operating within the carrying capacity of the environment.
- The carrying capacity of an ecosystem may vary for different species

CONCEPT OF ECOLOGICAL FOOTPRINT :

- **William Rees** proposed the concept of ecological footprint in 1992
- measure of human impact on environment
- measure human demand on natural capital
- it is accounting tool measures the demand on and supply of nature
- in terms of supply and demand, ecological footprint covers only the demand side of the equation
- amount of resources needed to support a person's lifestyle

Examples

- land and water resources needs for food production/ person's lifestyle
- transportation needs
- energy consumption
- waste generation

WHY TO STUDY THIS CONCEPT OF ECOLOGICAL FOOTPRINT ?

- To understand resources usage
- To address climate change
- To Promote sustainability
- Informing policy decisions and Urban planning and key practices to reduce ecological footprint
- To encourage personal responsibility

WHAT IS THE DIFFERENCE BETWEEN ECOLOGICAL FOOTPRINT AND BIOCAPACITY?

- Ecological Footprint is defined as the demand humanity has on Earth's resources
- Biocapacity is defined as the supply of Earth's resources available for consumption Biocapacity: The capacity of ecosystems to produce useful biological materials and to absorb waste materials generated by humans.
- Both the Ecological Footprint and biocapacity are expressed in **global hectares**—globally comparable hectares with world average productivity.

Difference Biocapacity deficit and Biocapacity reserve :

- **Ecological Reserve /Biocapacity Reserve: I**f a region's biocapacity exceeds its Ecological Footprint .

- **Biocapacity deficit:** If a population's Ecological Footprint exceeds the region's biocapacity, that region runs a **biocapacity deficit** OR ecological deficit .
- Highest ecological deficit countries (Decreasing wise) China, US, India .
- When the entire planet is running an ecological deficit, we call it "overshoot."

Earthovershoot Day :

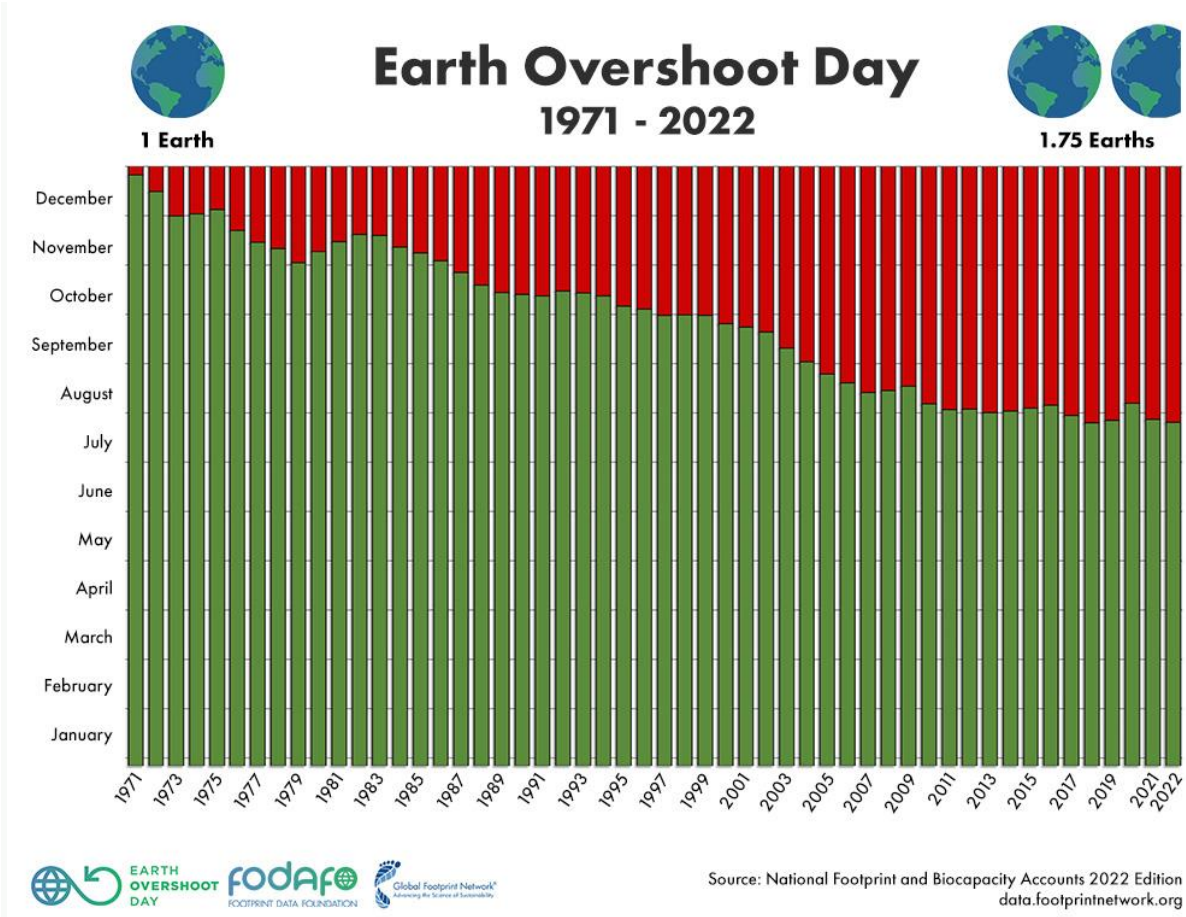
- Earth Overshoot Day marks the date when humanity's demand for ecological resources and services in a given year exceeds what Earth can regenerate in that year.

How is Earth Overshoot Day Calculated?

For calculating Earth Overshoot Day, you need to divide the biocapacity of the world by the ecological footprint of the world. Now you multiply the result you get from this division with 365. If the year is a leap year, multiply it with 366.

The equation is as follows:

$$EOD = \frac{worldbiocapacity}{worldeclogical\,footprint} \times 365'$$



Earth Overshoot Day over the Years

- Overshoot Day 2023 | 2 August
- Overshoot Day 2022 | 28 July
- Overshoot Day 2021 | 29 July
- Overshoot Day 2020 | 22 August

What is Ecological Debt Day?
The Earth Overshoot Day was previously called the Ecological Debt Day. The first Earth Overshoot Day was the 19th of December, 1987.

Ecological footprint is a metric computed by the Global Footprint Network

Key

About Global Footprint Network

- founded in 2003
- HQ California USA
- charitable not-for-profit organization
- independent think tank originally based in the United States, Belgium and Switzerland
- aim is to develop and promote tools for advancing sustainability, including the ecological footprint and biocapacity

Carbon Concepts :

- **Carbon Source:** is anything that releases more carbon than it absorbs.
- **Carbon Sink**: is anything that absorbs more carbon than it releases.(Forest, Ocean, soil)

Carbon Sequestration :

- process of storing carbon in a carbon pool
- process of capture and long-term storage of atmospheric carbon dioxide
- The process by which carbon sinks remove carbon dioxide (CO2) from the atmosphere is known as carbon sequestration
- Forest, soil carbon sequestration in certain agricultural practices : No- Till Farming , mulching .
- Capture carbondi oxide can be stored in underground geological formations

Potential Sites for Carbon Sequestration are:

- deep subsurface rock formations for long-term storage.
- Abandoned coal seams,
- depleted oil and Gas reservoirs and
- subterranean deep saline formations
- enhanced weathering sites : certain rock formations like Basalt , Peridotite have the ability to absorb carbon dioxide through chemical reactions

[UPSC 2017] In the context of mitigating the impending global warming due to anthropogenic emissions of carbon dioxide, which of the following can be the potential sites for carbon sequestration?
1) Abandoned and uneconomic coal seams
2) Depleted oil and gas reservoirs
3) Subterranean deep saline formations

Select the correct answer using the code given below:
a) 1 and 2 only
b) 3 only
c) 1 and 3 only
d) 1, 2 and 3
Ans D

Question: Some species of plants are insectivorous. Why? [UPSC 2010]
(a) Their growth in shady and dark places does not allow them to undertake sufficient photosynthesis and thus they depend on insects for nutrition
(b) They are adapted to grow in nitrogen-deficient soil and thus depend on insects for sufficient nitrogenous nutrition
(c) They cannot synthesize certain vitamins themselves and depend on the insects digested by them
(d) They have remained in that particular stage of evolution as living fossils, a link between autotrophs and heterotrophs

INSECTIVOROUS PLANTS or Carnivorous plants

Define :

- ***"Insectivorous plants are the plants that derive their nutrition by feeding on insects and other organisms."***
- Even insectivorous plants derive energy from photosynthesis.
- Insectivorous plants are partial heterotrophs whereas other plants are autotrophs.
- they are very attractive research subject for biomaterials or for nanobiotechnology for their unique nature

How they attract others?

- brilliant colors, sweet secretions shiny in appearance to attract insects
- They often have nectars and a pleasant odour to attract insects
- Plants digest the prey chemically using digestive enzymes and bacteria.
- They digest the prey for absorption by the plants.

Locational Factors :

- Need Wet , Dampy , humid areas, More sunlight and moisture is found
- acidic soil, that is deficient in nutrients
- They are found in the nitrogen deficient soil.
- That is why they trap and digest insects to absorb nutrients
- These plants are usually associated with rain-washed, nutrient-poor soils, or wet and acidic areas that are ill-drained.
- infertile soil or marshy places
- areas example swamps, bogs, wetlands, coastal plains, etc.
- They are found in the wet regions of North America, Australia, and tropical regions.
- Ordinary plants struggle to live in such nutrient-deficient environments.

Type of Insectivorous Plants:

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

Insectivorous plants of India belong mainly to three families:

- Droseraceae (3 species),
- Nepenthaceae (1 species) and
- Lentibulariaceae (36 species

- **Conservation Status of Indian Insectivores :** Because species are frequently specifically suited to a particular area and set of characteristics, environmental change is another risk.

In India, species like

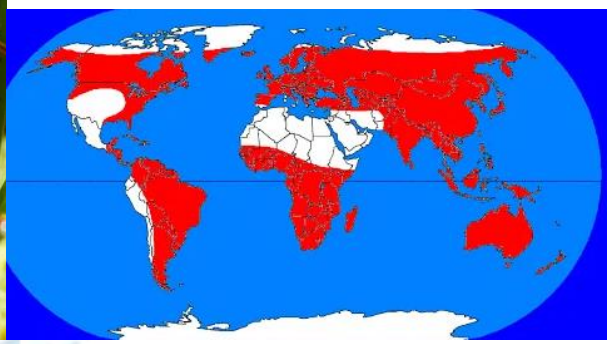
- Drosera peltata (sundews),
- Aldrovanda vesiculosa
- Utricularias (bladderworts)
- Pinguiculas (Butterworts)
- Nepenthes khasiana have been included in the Red Data Book as endangered plants

- Sarracenias (American Pitcher Plant)native to America

- Venus flytraps (not a tropical plant)native to America

Key details :

1. Drosera and Aldrovanda : Drosera and Aldrovanda belong to family Droseraceae.



Drosera or Sundew

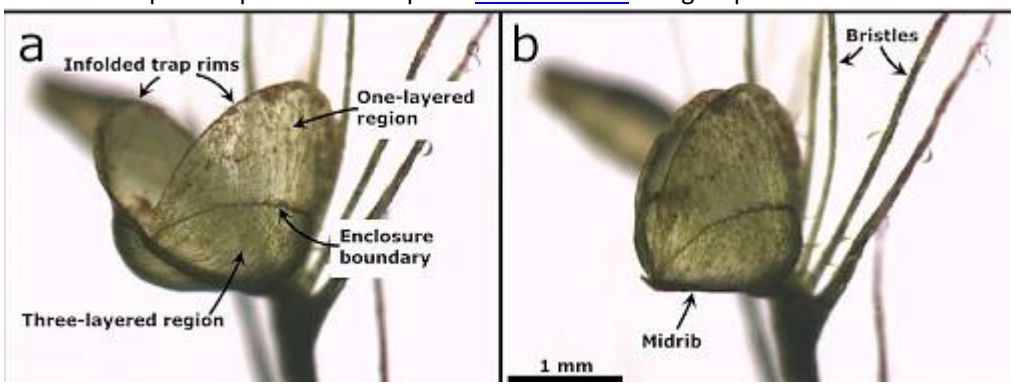
- This genus is frequently referred to as **cosmopolitan**, which denotes its global range.
- inhabit wet infertile soils or marshy places.

- Insect trapping mechanism of Drosera :The tentacles on the leaves secrete a sticky fluid that shines in the sun like dew-drops.
- Therefore the Drosera are commonly known as 'sundews'.
- When an insect lured by these glistening drops alights on the leaf surface it gets stuck in this fluid and are absorbed and digested.
- These plants trap and digest insects.
- Drosera is used to treat conditions like stomach ulcers, lung infections, coughs, and asthma.

Image of Aldrovanda

Aldrovanda or **waterwheel plant (endangered Plant)**

- in the flowering plant genus *Aldrovanda* of the family Droseraceae.
- is a free-floating, rootless aquatic plant, the only species found in India, occurs in the salt marshes of Sunderbans, south of Calcutta.
- It can also grows in fresh water bodies like ponds, tanks and lakes
- The plant captures small aquatic invertebrates using traps



Insect trapping mechanism of Aldrovanda :On the leaf midrib are found some sensitive trigger hairs. The two halves of the leaf blade of Aldrovanda close along the midrib the moment an insect comes into contact with the leaf, trapping the victim inside.

Pitcher Plants Family: Nepenthaceae

- The members of the family are commonly known as ‘pitcher plants’ because their leaves bear jar-like structures or monkey cups or tropical pitcher plants.

- Pitfall mechanism : The passive plants feature a device known as a "pitfall," which resembles a jar or pitcher and into which an insect can fall and finally be digested.

The insects are attracted by the odour of the plant. Once the insect is trapped and produces movement in the plant, the plant starts secreting the digestive liquid. The organism is digested and the nutrients are absorbed.

World and India Distribution:

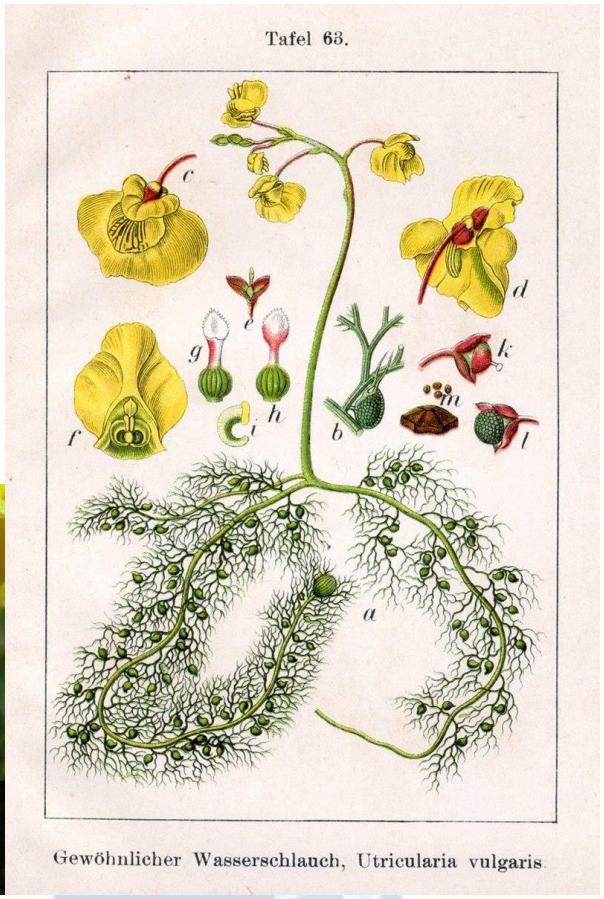
The genus *Nepenthes* is mostly found within the Malay Archipelago, with the greatest biodiversity found on Borneo, Sumatra, and the Philippines (Borneo montane rain forests.)

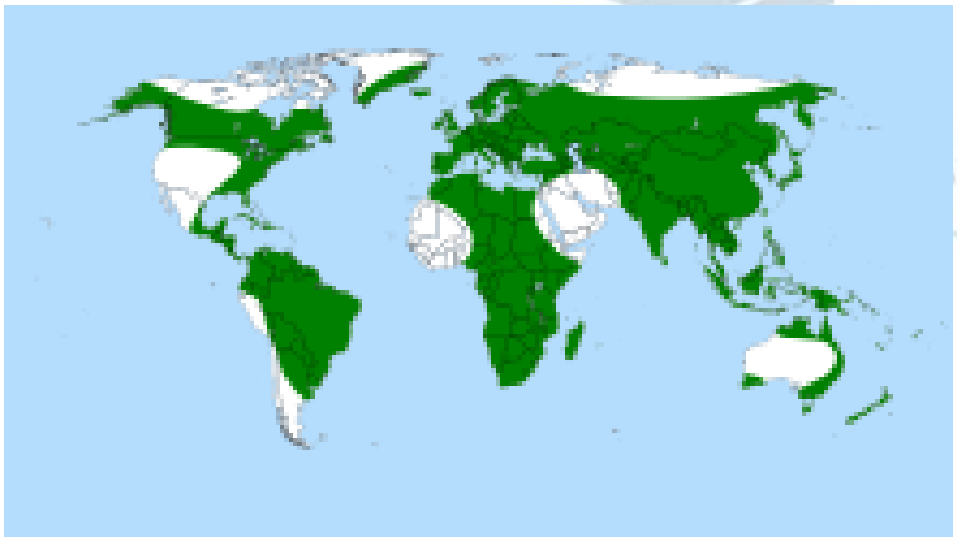
Indian Distribution:

- Nepenthes khasiana, an evergreen shrub considered to be native to Meghalaya, is the only species of pitcher plant known to exist in India. particularly in Garo, Khasi and Jaintia hills of Meghalaya

❖ **Utricularia and Pinguicula (both belong to family Lentibulariaceae.)**

Utricularia or Bladderworts:





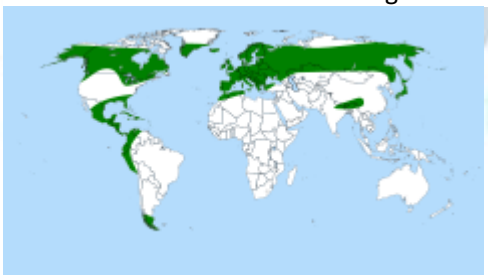
- The Bladderworts generally inhabit freshwater wetlands and waterlogged areas.
- Except for Antarctica, they are found as terrestrial or aquatic species in freshwater and moist soil.

Insect trapping: Utricularia in its bladders mouth, has sensitive bristles or hairs. When an insect happens to contact these hairs the door opens, carrying the insect into the bladder along with a little current of water. The door is shut when water fills the bladder, The enzymes produced by the inner wall of the bladder digest the insect.

In contrast to Venus flytraps, waterwheels (Aldrovanda), and many sundews, the trapping mechanism of Utricularia is entirely **mechanical**

Pinguicula or Butterwort:

- genus of carnivorous flowering plants in the family Lentibulariaceae.
- It grows in the alpine heights of Himalayas, from Kashmir to Sikkim, along stream-sides in cool boggy places.
- They produce bright, colourful **flowers** to attract prey. They have dewy sticky leaves to trap the insects. These plants are dormant during the winter season. (adapation mechanism)
- They use sticky, glandular leaves to lure, trap, and digest insects in order to supplement the poor mineral nutrition they obtain from the environment
- Insect trapping mechanism: In Pinguicula, an entire leaf works as trap. When an insect lands on the leaf surface, it gets stuck in the sticky exudate. the leaf margins roll up thus trapping the victim.
- Butterworts are distributed throughout the northern hemisphere



- Most endangered are the species which are endemic to small areas


image of venus flytrap

Venus Flytrap

- is a carnivorous plant native to subtropical wetlands on the East Coast of the United States
- These plants have a wide mouth lined with hair. These hair are sensitive structures. As soon as an organism touches this hair, the mouth snap shuts trapping the insect inside. Once the organism is digested, the leaves of this plant open up again to trap another prey.
- It catches its prey—chiefly insects and arachnids like spider, mites , ticks
- which belong to the family Droseraceae.

Importance / Medicinal Properties of Insectivorous Plants

- Drosera are capable of curdling milk, its bruised leaves are applied on blisters and used for dyeing silk.
- Nepenthes in local medicine to treat cholera patients, the liquid inside the pitcher is useful for urinary troubles, it is also used as eye drops.
- Utricularia is useful against cough, for dressing of wounds, as a remedy for urinary disease

Threats

- Gardening trading for medicinal properties is one of the main causes for their decline.
- Habitat destruction is also rampant, the wetlands harbouring such plants being the main casualties during the expansion of urban and rural habitation.
- Pollution caused by effluents containing detergents, fertilizers, pesticides, sewage etc. into the wetlands is yet another major cause for their decline (Since insectivorous plants do not tolerate high nutrient levels).
- Moreover, polluted water bodies are dominated by prolific water weeds which cause elimination of the delicate insectivorous plants.

CHAPTER :

Types of Species and Invasive alien Species

Edge Species : Found abundantly in ecotone boundary

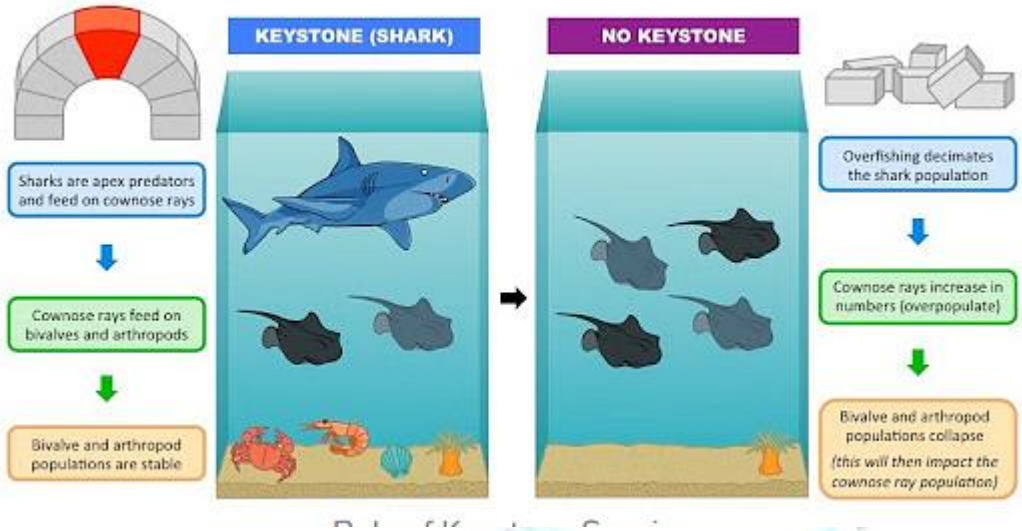
Key concept:

Umbrella Species : Species require large habitat to survive and term umbrella means conservation of many other species along with that organism. Umbrella and key stone concept prettysimilar . Umbrella species are migratory and need large habitat .

Umbrella Effect : is the extension of conservation to other species inside the habitat

EX: Tiger , Giant Panda, Sharks

Key stone Species : Significant impact on their ecosystem compared to their abundance ; Thereby Maintaining Balance in the Ecosystem . If keystone species lost it can lead to decline of extinction of other species (domino effect: other species in the habitat would also disappear and become extinct)



Key stones examples : Sea otters ,Sea stars , Bats , Bees , Tiger shark,
Flagship Species: Use for Symbols, icons , ambassadors to raise awareness and support for conservation efforts ; Create momentum for conservation activities

Examples of Flagship Species:
- **Bengal Tiger (Panthera tigris tigris)**
- **Indian Elephant (Elephas maximus indicus)**
- **Indian Peacock (Pavo cristatus)**
- **Indian Rhinoceros (Rhinoceros unicornis)**
- **Asiatic Lion (Panthera leo persica)**
- **Indian Giant Squirrel (Ratufa indica)**
- **Lion-tailed Macaque (Macaca silenus)**
- **Indian Wild Ass (Equus hemionus khur)**
- **Ganges River Dolphin (Platanista gangetica)**
- **Indian Flying Fox (Pteropus giganteus)**

Foundational Species :
- **Term Coined in 1972 by Paul K Dayton**
- Dominant primary producer in an ecosystem both in terms of abundance and influence
- are referred to as the **"engineers of ecosystems"** by biologists.
- play an important role in the creation or maintenance of a habitat.
- The presence of foundation species has the potential to reduce or increase species
- This term refers to a variety of terrestrial and aquatic ecosystems.

Examples of Foundation Species :
- Coral in Coral Reefs; and Kelp , a brown algae seaweeds in Kelp Forest . Kelp grows in "underwater forests" (kelp forests) in shallow oceans. Kelp belong to kingdom protist not plant kingdom
- Seaweeds a variety of algae, they are non flowering . seaweed are multi-cellular algae and have little or no vascular tissues.
- Sea grass : Seagrasses are flowering plants that grow submerged in shallow marine waters like bays and lagoons. seagrasses are considered vascular plants and have roots, stems and leaves,

- Hardwood Forest
- Beavers : The beaver: a keystone species, and habitat creator, responsible for the creation of lakes, canals and wetlands irrigating large forests and creating ecosystems

Examples :

1. Oak trees in a forest ecosystem
2. Coral reefs in marine ecosystems
3. Grasses in a grassland ecosystem
4. Seagrasses in coastal marine ecosystems
5. Mangrove trees in coastal wetland ecosystems
6. Kelp forests in marine ecosystems
7. Beavers in freshwater ecosystems

Question: Consider the following statements regarding foundation species:

1. The term "foundation species" describes a species that builds or sustains an ecosystem.
2. As the name indicates the foundation species are always at the lower trophic level.

Which of the statement(s) given above is/are correct?
(a) 1 only
(b) 2 only
(c) Bothe 1 and 2
(d) Neither 1 nor 2
Answer: (a)

Question: Consider the following statements:

1. Foundation species are also known as ecosystem engineers.
2. Paul K. Dayton introduced the term "foundation species".

Which of the statement(s) given above is/are correct?
(a) 1 only
(b) 2 only
(c) Bothe 1 and 2
(d) Neither 1 nor 2

ENDEMIC SPECIES :

- They are native to a single specific geographic location
- Called " Precinctive" : Species restricted to a defined geographical area
- Red Panda in Eastern Himalayas. Monal in Western Himalayas
- Lion Tailed Macaque and Niligiri Thar in Western Ghats
- Indian Rhino, Indian Elephant , Great Indian Bustard

Endemism:

- is the ecological state of a species being unique to a define geographical area or location
- Its opposite is Cosmopolitan distribution.
- **the killer whale, the blue whale, and the great white shark** all have cosmopolitan distribution,

KEY STONE SPECIES (1969 : Robert T. Paine): first proposed the concept

- A **keystone species** is one **whose presence or absence** in an ecosystem **causes significant changes** in the abundance or occurrence of at least one other species
- It is species whose addition to or loss from an ecosystem leads to major changes in the occurrence of an at least one other species .
- it is lost will result in the degradation of the Whole Ecosystem
- determine the presence of many other species in that Ecosystem
- All top predators **are considered keystone species** because they indirectly regulate the populations of all other animals

Keystone Species :

- is an organism that helps de fi ne an entire ecosystem.

- Without its keystone species, the ecosystem would be dramatically different or cease to exist altogether.
- Keystone species have low functional redundancy. This means that if the species were to disappear from the ecosystem, no other species would be able to fi ll its ecological niche
- The ecosystem would be forced to radically change, allowing new and possibly invasive species to populate the habitat.
- Any organism, from plants to fungi, may be a keystone species; they are not always the largest or most abundant species in an ecosystem
- Keystone species can also include herbivores.
- For instance, elephants are a keystone species in African savannas. It manages the tree population, causing the grasses to flourish and support grazing
- As a result, top predators are given special consideration in conservation
- Conservationists should pay special attention to keystone species.

- Lion, Tiger, Elephant, Crocodile, Bees, Coral reef
- **Bats:** When the bat population is reduced, regeneration of specific plants becomes more difficult. This alters the vegetation structure, which has a negative impact on the dependent animals.
- Note Bats are social animals the hang upside down when they sleep. They are second largest group of mammals after rodents.
- **Sea Stars:** When there are no natural predators nearby, sea stars eat mussels. The abundance of mussels would skyrocket if sea stars were eliminated from an ecosystem, which would have a negative impact on the resources available to other species
- **Sea Otter:** They limit the number of sea urchins by feeding on them. Sea urchins would consume seaweed, a significant source of food for the ecology if their number was not kept in check. Sea otters protect kelp forests from damage by sea urchins.
- Beavers , star fish, flying fox, prairie dogs , Humming birds
  Which of the following is/are the keystone species?
  (a) Sea Stars
  (b) Bees
  (c) Tiger Sharks
  (d) All of the above

Que : Consider the following statements regarding 'Key stone' species :
1. If a keystone species disappears from the ecosystem, no other species will be able to fill its ecological niche.
2. Due to limited consumption habits, herbivores cannot be Keystone species.
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

Note : A keystone species is an organism that helps define an entire ecosystem. Without its keystone species, the ecosystem would be dramatically different or cease to exist altogether. Keystone species have low functional redundancy. This means that if the species were to disappear from the ecosystem, no other species would be able to fill its ecological niche. The ecosystem would be forced to radically change, allowing new and possibly invasive species to populate the habitat. Hence statement 1 is correct.

 Any organism, from plants to fungi, may be a keystone species; they are not always the largest or most abundant species in an ecosystem. However, almost all examples of keystone species are animals that have a huge influence on food webs. The way these animals influence food webs varies from habitat to habitat.Herbivores can also be keystone species. Their consumption of plants helps control the physical and biological aspects of an ecosystem. In African savannas such as the Serengeti plains in Tanzania, elephants are a keystone species.Hence statement 2 is not correct.

INDICATOR SPECIES :

Indicator Species

- An indicator species is an organismbacteria, plant, or animal
- that refl ects the condition of the environment around it.
- indicate overall health and condition of the ecosystem
- it is one who's presence or absence reflects the specific environmental conditions
- They serve as early warming mechanism or signals because they are sensitive to environmental conditions .
- They're often the fi rst in their ecosystem to be affected by a particular environmental change, such as a warming climate, pollution, human development, and other environmental degradation.
- By monitoring changes in the behavior, physiology, or number of an indicator species, scientists can monitor the health of its whole environment.
- Also known as Sentinel Species
- Ex Frogs, Lichens, Salmon Fish , river otter

Examples :

- The health of corals can indicate trends such as seawater rise and sea temperature fl uctuation, which in turn are signals of climate change
- Lichens are capable to indicate air pollution, water pollution, heavy metals as well as radioactive particles
- Algae (seaweeds) are good indicators of heavy metal levels in marine environments and could be used for monitoring such pollutants in seas.
- According to a new study in the Gulf of Kutch, which receives discharges containing heavy metals from several industries, various species of brown, red and green algae accumulate heavy metals from seawater and sediments.
- Birds are considered to be excellent indicator species. There are three main reasons for this. Firstly, they live in every climate and biome; Secondly, they respond quickly to environmental change and thirdly, they are relatively easy to track and count
- Certain molluscs indicate water pollution, while some mosses indicate soil pollution. The Mussel Watch Programme is a global project to assess environmental impacts in coastal regions
- Peregrine falcons are an indicator of pesticides; DDT, for example, causes their eggshells to thin.
- Cray fi sh, for example, can indicate the quality of freshwater, because changes in water acidity are stressful to them

Lichens as Indicator Species Lichens are capable to indicate air pollution, water pollution, heavy metals as well as radioactive particles.

Mosses are reliable indicators of air pollution risks to ecosystems, because they get most of their nutrients direct from the air and rain, rather than the soil

Algae as Indicator Species Algae (seaweeds) are good indicators of heavy metal levels in marine environments and could be used for monitoring such pollutant in sea

Tubifextubifex is used as a water quality indicator because of its ability to tolerate low oxygen conditions, the presence of heavy metals, and other environmental conditions.

Birds as Indicator Species: There are three main reasons for this. Firstly, they live in every climate and biome; Secondly, they respond quickly to environmental change and Third they are relatively easy to track and count

Certain molluscs indicate water pollution, while some mosses indicate soil pollution.

River otter are an important indicator species. This is because the otter is a strict carnivore and contaminants that occur in the environment may concentrate in the otter over time in a process known as biomagnifications.

6. Which of the following are indicator species?
1. Tubifex tubifex
2. Sparrow
3. Mosses
4. River otter
Select the correct answer using the code
given below.
(a) 1, 2 and 3 only
(b) 1 and 4 only
(c) 2 and 3 only

key difference between flagship and umbrella species is that **flagship species is a species that acts as a symbol or icon for a defined habitat while umbrella species is the species indirectly involved in the conservation of many other species at the ecosystem or landscape level.**

UMBRELLA SPECIES:

- require large areas of habitats to survive.
- By protecting their habitat , other species of same habitat also protected .
- conservation indirectly protects many other species in the ecosystem.
- used to make conservation-related decisions.
- Umbrella species are very similar to keystone species, but umbrella species are usually migratory and need a large habitat.
- Protecting umbrella species automatically protect a host of other species.
- **Tigers, Giant panda Ganga dolphin** are an example of an umbrella species.
- Many umbrella species are migratory since they need larger habitat requirements.

FLAGSHIP SPECIES :

- Flagship species are also known as charismatic species
- A flagship species is **a species selected to act as an ambassador, icon or symbol for a defined habitat, issue, campaign or environmental cause**.
- Flagship species generally draws peoples' attention towards the need to conserve them.
- The flagship species attract people's attention and encourage people to conserve these species.
- The species are chosen for thier vulnerability, attractiveness or distinctiveness to support andd acknowledgement from public at large.
- Tiger, Kangaroo, Giant Panda of China, African Elephant , polar bears, turtles, tigers, rhinoceros, etc

ECOSYSTEM ENGINEERS:

- These are organisms that create, modify and maintain habitats.
- Ecosystem engineering can alter the distribution and abundance of large numbers of plants and animals, and significantly modify biodiversity.
- The best known examples of ecosystem engineers are humans (Homo sapiens).
- Two types of Ecosystem Engineers

1. **Allogenic engineers** - change the environment by transforming living or nonliving materials around them.
   e.g **Beavers** create dams in the streams, which slows the movement of water. Behind the beaver dam, a pond of still water is formed. This pond is then colonized by animals and plants that typically live in lakes rather than streams.

2. **Autogenic engineers** - change the environment via their own physical structures, i.e. their living and dead tissues create habitats for other organisms to live on or in.
e.g. **Trees, corals, and giant kelps** are good examples of autogenic engineers.

****

1. Ministry of Environment, Forest and Climate Change (**MoEFCC**)

- formed in 1985, (MOEF)
- in 2014 climate change added as nomenclature
- cadre controlling authority of the Indian Forest Service (IFoS), one of the three All India Services.

The Ministry also serves as the nodal agency in the country for the :

- United Nations Environment Programme (UNEP),
- South Asia Co-operative Environment Programme (SACEP),
- International Centre for Integrated Mountain Development (ICIMOD) and for the follow-up of the
- United Nations Conference on Environment and Development (UNCED).or Earth Summit, Rio de Janeiro ,1992

The Ministry is also entrusted with issues relating to multilateral bodies such as the

- Commission on Sustainable Development (CSD),
- Global Environment Facility (GEF) and of regional bodies like
- Economic and Social Council for Asia and Pacific (ESCAP- hq-Thailand, 1947) and
- South Asian Association for Regional Co-operation (SAARC) on matters pertaining to the environment.HQ-Kathmandu, 8 December 1985, 8 members(Afghanistan, Bangladesh, Bhutan, India, Nepal, the Maldives, Pakistan and Sri Lanka. SAARC comprises 3% of the world's area, 21% of the world's population)

Organizational Structure: Authorities

- Central Zoo Authority of India, New Delhi
- National Biodiversity Authority, Chennai
- National Tiger Conservation Authority, New Delhi

SUBORDINATE OFFICES

- Andaman & Nicobar Islands Forest and Plantation Development Corporation (Public Sector Undertaking)
- Animal Welfare Board of India , Chennai, Ballabhgarh in Haryana
- Botanical Survey of India (BSI), Kolkata
- Central Pollution Control Board
- Directorate of Forest Education (DFE), Dehradun
- Forest Survey of India (FSI), Dehradun
- Indira Gandhi National Forest Academy (IGNFA), Dehradun
- National Afforestation and Eco-Development Board
- National Board of Wildlife
- National Institute of Animal Welfare
- National Museum of Natural History (NMNH), New Delhi
- National Zoological Park (NZP), New Delhi
- Zoological Survey of India (ZSI), Kolkata

CENTRES OF EXCELLENCE

- Centre for Environment Education, Ahmadabad
- C. P. R. Environmental Education Centre, Chennai
- Centre for Animals and Environment, Bangalore
- Centre of Excellence in Environmental Economics, Chennai
- Foundation for Revitalisation of Local Health Traditions, Bangalore
- Centre for Ecological Sciences, Bangalore
- Centre for Environmental Management of Degraded Ecosystem, Delhi
- Centre for Mining Environment, Dhanbad
- Sálim Ali Centre for Ornithology and Natural History (SACON), Coimbatore
- Tropical Botanic Garden and Research Institute,[7] Thiruvananthapuram

AUTONOMOUS INSTITUTIONS

- G. B.Pant Institute of Himalayan Environment and Development, Almora
- Indian Institute of Forest Management, Bhopal
- Indian Plywood Industries Research and Training Institute, Bengaluru
- Indian Institute of Ecology and Environment, New Delhi
- Indian Council of Forestry Research and Education (ICFRE), Dehradun

भारतीय वनस्पति सर्वेक्षण
BOTANICAL SURVEY OF INDIA

Botanical Survey of India (**BSI**),

- founded 13 February **1890,**
- **HQ Kolkatta**,
- under Moefcc
- objective : survey, research and conservation of plant resources, flora and endangered species of India, including by collecting and intaining germplasm and gene bank of endangered, patent and vulnerable plant species.

Its Logo : ***Ficus bengalensis***

Key Note :

- **Indian fig tree, also known as Banyan tree (*Ficus bengalensis)*** is the National tree of India/ kalpavriksha/ Banyan Tree is found all over the country
- Lotus *(Nelumbo Nucifera Gaertn)* is the National Flower of India.
- The Indian peacock, Pavo cristatus, the national bird of India,
- Panthera tigris is a striped animal.
- The Elephant/ Elephas maximus. is the official National Heritage Animal of India.
- Ganges River Dolphins (Platanista Gangetica) or also called 'Susu,' is the National Aquatic Animal of India

The Zoological Survey of India (ZSI)

- was launched in 1916 to promote survey, exploration, and research to enhance the knowledge regarding the flora and fauna of the British Indian Empire. It is India's apex organization on animal taxonomy.

1. The headquarters is in Kolkata.
2. ZSI publishes the Red Data Book on Indian Animals. It was first published in 1983 and is similar to the Red Data Book published by IUCN.
3. It is responsible for the preparation of Red Data Book, Fauna of India, and Fauna of States.

भारतीय वन सर्वेक्षण
Forest Survey of India

Forest Survey of India (**FSI**),

- was founded in June 1981
- headquartered at Dehradun in Uttarakhand,
- Under MOEfcc
- conducts forest surveys, studies and researches /national planning, conservation and sustainable management of environmental protection as well for the implementation of social forestry project
- FSI assesses forest cover of the country every 2 years by digital interpretation of remote sensing satellite data and publishes the results in a biennial report called 'State of Forest Report'(SFR).Beginning in 1987, 16 SFRs have come so far.

The **Forest Research Institute**

- training institute of the Indian Council of Forestry Research and Education and is an institution in the field of forestry research in India for Indian Forest Service cadres and all **State Forest Service** cadres.
- It is located at Dehradun in Uttarakhand..
- it hosts the Indira Gandhi National Forest Academy **(**IGNFA), the staff college that trains officers selected for the Indian Forest Service (IFS)

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Wildlife Institute of India (WII)

- an autonomous natural resource service institution under the Ministry of Environment Forest and Climate change, Government of India,
- was established in 1982.
- The institute is based in Dehradun.
- It is close to Rajaji National Park. Wildlife Institute of India (WII) offers training program, academic courses and advisory in **wildlife research** and management.

Animal Welfare Board of India (AWBI)

- headquartered at Ballabhgarh in Haryana state
- Previously in Chennai
- It was established in **1962**
- is a statutory advisory body advising the Government of India's Ministry of Fisheries, Animal Husbandry and Dairying (Department of Animal Husbandry and Dairying)
- The Animal Welfare Board of India was established in 1962 under Section 4 of The Prevention of Cruelty to Animals Act, 1960.
- The subject of Animal Cruelty Prevention was transferred to the Ministry of Environment and Forests in 1990, where it currently resides.
- Well-known humanitarian Rukmini Devi Arundale participated in setting up the board and was its first chair

- World Animal Day celebrated globally on 4th October each year, provides an opportunity to recognize the remarkable diversity of life on Earth and the critical role that animals play in our ecosystems. The AWBI organised the event on this significant day collectively working towards a world where animals are not just protected but also cherished

Question: Consider the following statements: (UPSC 2014)

1. Animal Welfare Board of India is established under the Environment (Protection) Act of 1986.
2. National Tiger Conservation Authority is a statutory body.
3. National Ganga River Basin Authority is chaired by the Prime Minister.

Which of the following statements given above is/are correct?
(a) 1 only
(b) 2 and 3 only
(c) 2 only
(d) 1, 2 and 3

Ans : option (b) is the correct answer.

Question: Consider the following statements regarding the Animal Welfare Board of India:

1. It was established in accordance with the provisions of the Wildlife Protection Act, 1972.
2. It is a statutory advisory body under the Ministry of Environment, Forests, and Climate Change (MoEFCC).

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

Ans B / D

Environmental Laws in India

1. The Water (Prevention and Control of Pollution) Act, 1974
2. The Water (Prevention and Control of Pollution) Rules, 1975
3. The Water (Prevention and Control of Pollution) Cess Act, 1977
4. The Water (Prevention and Control of Pollution) Cess Rules, 1978
5. The Air (Prevention and Control of Pollution) Act, 1981
6. The Air (Prevention and Control of Pollution) Rules, 1982
7. The Environment (Protection) Act, 1986
8. The Environment (Protection) Rules, 1986
9. Hazardous Wastes (Management and Handling) Rules, 1989
10. Manufacture, Storage and Import of Hazardous Chemical Rules, 1989
11. The Forest (Conservation) Act, 1980
12. The Forest (Conservation) Rules, 1981
13. The Wildlife Protection Act, 1972
14. The Wildlife (Transactions and Taxidermy) Rules, 1973
15. The Wildlife (Stock Declaration) Central Rules, 1973
16. The Wildlife (Protection) Licensing (Additional Matters for Consideration) Rules, 1983
17. The Wildlife (Protection) Rules, 1995
18. The Wildlife (Specified Plants - Conditions for Possession by Licensee) Rules, 1995
19. The Public Liability Insurance Act, 1991
20. The Public Liability Insurance Rules, 1991
21. The National Environment Tribunal Act, 1995
22. The National Environment Appellate Authority Act, 1997

Q.1 Consider the following statements regarding:

1. CPCB was established as a statutory body under the Environment (Protection) Act, 1986.

2. CPCB has the responsibility to address both water and air pollution under the respective Acts.
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

About **Central Pollution Control Board**

- located New Delhi
- It is the apex organization in country in the field of pollution control
- statutory organization under the Ministry of Environment, Forest and Climate Change
- It was established in 1974 under the Water (Prevention and Control of pollution) Act, 1974
- also entrusted with the powers and functions under the Air (Prevention and Control of Pollution) Act, 1981
- also provides technical services to the Ministry of Environment and Forests under the provisions of the Environment (Protection) Act, 1986.
- It coordinates the activities of the State Pollution Control Boards by providing technical assistance and guidance and also resolves disputes among them.
- CPCB monitoring In India both air and water .

National Air Quality Monitoring Programme

- CPCB runs nationwide programs of ambient air quality monitoring
- Under N.A.M.P., four air pollutants viz., Sulphur Dioxide (SO_2), Oxides of Nitrogen as NO_2, Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM/ PM10) have been identified for regular monitoring at all the locations
- The National Air Quality Index (NAQI) was launched in New Delhi on September 17, 2014, under the Swachh Bharat Abhiyan
- Central Pollution Control Board (CPCB) has developed this Air Quality Index in consultation with IIT-Kanpur and air quality-professionals and experts.

AQI keeps a tab on 8 major air pollutants in the atmosphere namely,
1. Particulate Matter (PM10)
2. Particulate Matter (PM2.5)
3. Nitrogen Dioxide (NO2)
4. Sulphur Dioxide (SO2)
5. Carbon Monoxide (CO)
6. Ozone (O3)
7. Ammonia (NH3)
8. Lead (Pb)

Suspended Particulate Matter (SPM)

refers to solid particles or liquid droplets suspended in the air. These particles can vary in size and composition, ranging from dust and dirt to smoke and soot. SPM can be emitted from various sources, including industrial processes, vehicle exhaust, construction sites, and natural events like wildfires.

Particulate matter (PM) pollution or particle pollution : consists of solid and liquid particles in the air.

Particulate matter is a complex mixture of soot, smoke, metals, nitrates, sulphates, dust water and rubber etc

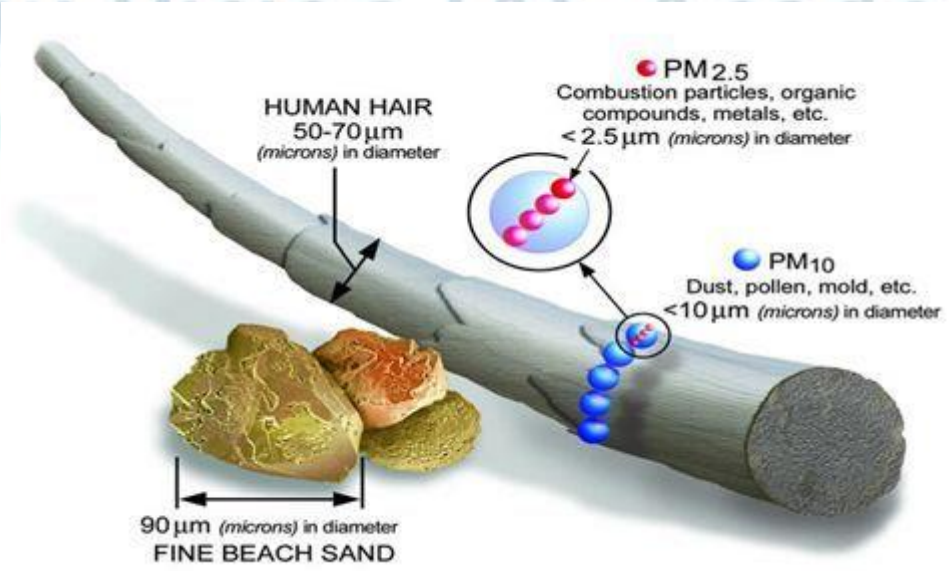
Examples

1. Dust particles
2. Smoke from industrial sources
3. Pollen from trees and plants
4. Ash from wildfires
5. Soot from vehicle emissions
6. Construction debris
7. Sea salt spray
8. Aerosols from spray cans
9. Emissions from agricultural activities
10. Microscopic particles from the combustion of fossil fuels

Some particles are so small that they can only be detected by using electron microscope. Particle pollution consists of PM2.5 and PM10 which are very dangerous.

Pm 10 : are the particles with a diameter of 10 micrometers . its other name fine particles or respirable particulate matter.

PM2.5: refers to the atmospheric particulate matter that has a diameter of less than 2.5 micrometres



With reference to Volatile Organic Molecules, consider the following statements.

1.VOCs does not produced in nature.

2.VOCs can drive the formation of other dangerous pollutants.

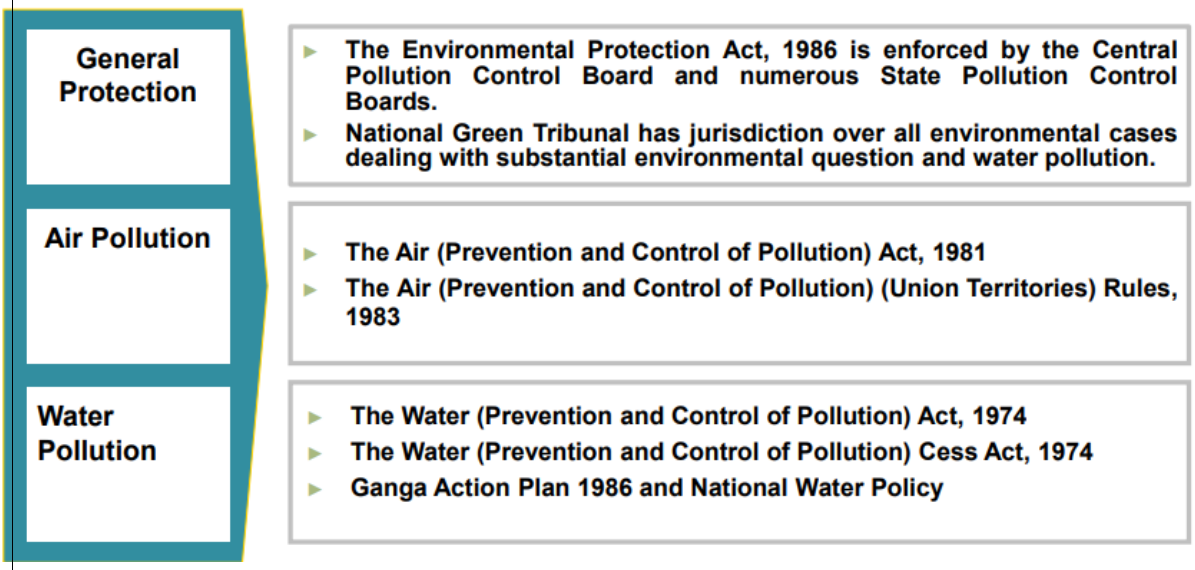
3.VOCs can irritate the eyes, nose and throat, damage body organs and cause cancer.
Ans ?

Volatile organic compound

- are compounds that contain carbon and can quickly turn into vapors or gases.
- are chemicals that are lighter than air at room temperature
- Found in perfumes., petroleum products,paint thinners
- Benzene is most harmful of all the VOCs. It is called a carcinogen. It is commonly found in fuels, cigarette smoke, cars, paints.
- Perchloroethylene: It is used for dry cleaning. It is also a VOC. The dry cleaned clothes carry these VOCs.
- They are also produced by plants, animals and micro organisms.
- 90% of the VOC in the atmosphere is produced by the plants emissions through their metabolic activities .
- Plants emit VOCs to attract pollinators, defend themselves from pests and predators and adapt to environmental stress.
- In nature, this behavior of plants releasing VOCs is often considered to be a defense mechanism or other mechanism
- decomposition of organic matter and volcanic eruptions also release VOcs
- Common examples of VOCs that may be present in our daily lives are: benzene, ethylene glycol, formaldehyde, methylene chloride, tetrachloroethylene, toluene, xylene, and 1,3-butadiene

Sources of VOCs

Building Materials	Home & Personal Care Products	Activities
Paint, varnishes, caulks, adhesives	Air fresheners, cleaning products	Smoking
Carpet, vinyl flooring	Cosmetics	Dry cleaning, photocopiers
Composite wood products	Fuel oil, gasoline	Cooking, hobbies
Upholstery and foam		Burning wood



Which of the following are the key features of 'National Ganga River Basin Authority (NGRBA)'?

1. River basin is the unit of planning and management.
2. It spearheads the river conservation efforts at the national level.
3. One of the Chief Ministers of the States through which the Ganga flows becomes the Chairman of NGRBA or rotation basis.

Select the correct Answer using the code given below.

A. 1 and 2 only
B. 2 and 3 only
C. 1 and 3 only
D. 1,2 and 3

National Ganga River Basin Authority (**NGRBA**

- is a financing, planning, implementing, monitoring and coordinating authority for the Ganges River, functioning under the Ministry of Jal Shakti
- It was established by the Government of India, on 20 February 2009 under Section 3(3) of the Environment Protection Act, 1986, which also declared Ganges as the "National River" of India
- The Prime Minister is the chair of the Authority
- The authority is chaired by the Prime Minister and has as its members the Union Ministers concerned, the Chief Ministers of the States through which Ganga flows, viz., Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal, among others

objectives of
(a) ensuring effective abatement of pollution and conservation of the river Ganga by adopting a river basin approach to promote inter-sectoral co-ordination for comprehensive planning and management; and
(b) maintaining environmental flows in the river Ganga with the aim of ensuring water quality and environmentally sustainable development.

At the national level, which ministry is the nodal agency to ensure effective implementation of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006?
(a) Ministry of Environment, Forest and Climatic Change.
(b) Ministry of Panchayat Raj
(C) Ministry of Rural Development
(d) **Ministry of Tribal Affairs**

Under the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, who shall be the authority to initiate the process for determining the nature and extent of individual or community forest rights or both?

a) **State Forest Department**
b) **Gram Sabha**
c) **District Collector / Deputy Commissioner**
d) **Tahsildar/ Block Development Officer / Mandal Revenue Officer**

About The Forest Rights Act (FRA), 2006

Other Names :

- Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006
- the **Tribal Rights Act**, the **Tribal Bill**, and the **Tribal Land Act**.

- recognizes the rights of the forest dwelling tribal communities and other traditional forest dwellers to forest resources.
- The Act encompasses Rights of Self-cultivation and Habitation which are usually regarded as Individual rights; and Community Rights as Grazing, Fishing and access to Water bodies in forests, Habitat Rights for PVTGs, Traditional Seasonal Resource access of Nomadic and Pastoral community, access to biodiversity, community right to intellectual property and traditional knowledge, recognition of traditional customary rights and right to protect, regenerate or conserve or manage any community forest resource for sustainable use.
- It also provides rights to allocation of forest land for developmental purposes to fulfil basic infrastructural needs of the community.
- In conjunction with the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Settlement Act, 2013 FRA protects the tribal population from eviction without rehabilitation and settlement.
- The Act further enjoins upon the Gram Sabha and rights holders the responsibility of conservation and protection of bio-diversity, wildlife, forests, adjoining catchment areas, water sources and other ecologically sensitive areas as well as to stop any destructive practices affecting these resources or cultural and natural heritage of the tribals.

Objective:

- To undo the historical injustice occurred to the forest dwelling communities
- To ensure land tenure, livelihood and food security of the forest dwelling Scheduled Tribes and other traditional forest dwellers
- To strengthen the conservation regime of the forests by including the responsibilities and authority on Forest Rights holders for sustainable use, conservation of biodiversity and maintenance of ecological balance.

Eligibility criteria

- Must be a Scheduled Tribe in the area where the right is claimed;
- Primarily resided in forest or forests land for three generations (75 years) prior to 13-12-2005
- Depend on the forest or forests land for bonafide livelihood needs.

According to the Forest Rights Act 2006, which of the following rights are granted to forest-dwelling communities?
(A) Ownership rights over forest land,
(B) Timber extraction rights for commercial purposes,
(C) Hunting rights for sustenance,
(D) Exclusive rights to exploit forest resources for industrial purposes

Which of the following ministries launched the Minimum Support Price (MSP) for Minor Forest Produce (MFP)?
a)Ministry of Tribal Affairs
b)Minister of Environment, Forest and Climate Change
c)Ministry of Agriculture & Farmers' Welfare
d)None of the above

About Minor Forest Produce ?

- The Ministry of Tribal Affairs launched the Minimum Support Price (MSP) for Minor Forest Produce (MFP).
- The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act,2006 defines minor forest produce as all non-timber forest produce of plant origin.
- These include bamboo, brushwood, stumps, canes, cocoon, honey, waxes, Lac, tendu leaves, medicinal plants and herbs, roots among others
- Total 87 items
- Source : https://sansad.in/getFile/loksabhaquestions/annex/177/AS214.pdf?source=pqals
-

Que :

Consider the follwing statements:
1. The definition of "Critical Wildlife Habitat" is incorporated in the Forests Rights act, 2006.
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.
Which of the statements given above is/are correct?

Ans 1 and 2 only

-
  - Out of 75 PVTG in India, **only three have habitat rights- the Bharia PVTG in Madhya Pradesh was the first,** followed by the Kamar tribe and now the Baiga tribe in Chhattisgarh.

    Habitat rights are granted to PVTGs under Section 3(1)(e) of the **Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006** (also known as FRA)

Consider the following statements about Particularly Vulnerable Tribal Groups (PVTGs) in India: (2019)

1. PVTGs reside in 18 States and one Union Territory.
2. A stagnant or declining population is one of the criteria for determining PVTG status.
3. There are 95 PVTGs officially notified in the country so far.
4. Irular and Konda Reddi tribes are included in the list of PVTGs.

Which of the statements given above are correct?
(a) 1, 2 and 3
(b) 2, 3 and 4
(c) 1, 2 and 4
(d) 1, 3 and 4
Ans: (c)
Concept of PVGT

- Particularly Vulnerable Tribal Groups (PVTG)
- PVTGs are more vulnerable among the tribal groups
- in **1973,** the **Dhebar Commission created Primitive Tribal Groups (PTGs)** as a separate category, who are less developed among the tribal groups. In **2006,** the Government of India **renamed the PTGs as PVTGs.**
- Ministry of Tribal Affairs administers a scheme namely '**Development of Particularly Vulnerable Tribal Groups (PVTG)'** specifically for the PVTG population**.** The scheme covers the 75 identified PVTGs in 18 States, and Union Territory of Andaman & Nicobar Island
- the 75 listed PVTG's the **highest number are found in Odisha.**

Four Criteria for PVGT:
1. Pre-agricultural level of technology,
2. Low level of literacy,
3. Economic backwardness,
4. A declining or stagnant population.

Name of the States /UT	**Name of Primitive Tribal Group**	**Population as per 2001 Census** (Figures in actual)

Andhra Pradesh	1. Bodo Gadaba	-	
	2. Bondo Porja	-	
	3. Chenchu	49232	
	4. Dongria Khond	-	
	5. Gutob Gadaba	-	
	6. Khond Porja	-	
	7. Kolam	-	
	8. Konda Reddi	-	
	9. Konda Savara	83096	
	10. Kutia Khond	-	
	11. Parengi Porja	-	
	12. Thoti	2074	
	Total	134402	
Bihar & Jharkhand		**Bihar**	**Jharkhand**
	13. Asur	181	10347
	14. Birhor	406	7514
	15. Birjia	17	5356
	16. Hill Kharia	-	-
	17. Korwas	703	27177
	18. Mal Paharia	4631	115093
	19. Parhaiya	2429	20786
	20. Sauria Paharia	585	31050
	21. Savar	420	6004
	Total	9372	223327
Gujarat	22. Kathodi	5820	
	23. Kolgha	-	
	24. Kotwalia	-	
	25. Padhar	22421	
	26. Siddi	8662	
	Total	36903	
Karnataka	27. Jenu Kuruba	29828	
	28. Koraga	16071	
	Total	45899	
Kerala	29. Cholanaikayan	-	
	30. Kadar	2145	
	31. Kattunayakan	14715	
	32. Koraga	1152	
	33. Kurumba	2174	
	Total	20186	
Madhya Pradesh &		**Madhya Pradesh**	**Chhattisgarh**

Chhattisgarh	34. Abujh Maria	-	-
	35. Baiga	332936	6993
	36. Bharia	152470	88981
	37. Birhor	143	1744
	38. Hill Korwa	-	-
	39. Kamar	2424	23113
	40. Saharia	450217	561
	Total	938190	121392
Maharashtra	41. Kathodi	235022	
	42. Kolam	173646	
	43. Maria Gond	-	
	Total	408668	
Manipur	44. Maram Naga	1225	
Orissa	45. Birhor	702	
	46. Bondo	9378	
	47. Chuktia Bhunjia	-	
	48. Didayi	7371	
	49. Dongria Khond	-	
	50. Juang	41339	
	51. Kharia	188331	
	52. Kutia Khond	-	
	53. Lanjia Saura	-	
	54. Lodha	8905	
	55. Mankidia	1050	
	56. Paudi Bhuyan	-	
	57. Sauura	473233	
	Total	730309	
Rajasthan	58. Saharia	-	
Tamil Nadu	59. Irular	155606	
	60. Kattu Nayakan	45227	
	61. Korumba	-	
	62. Kota	925	
	63. Paniyan	9121	
	64. Toda	1560	
	Total	165103	
Tripura	65. Riang	165103	
Uttar Pradesh & Uttrakhand		**Uttar Pradesh**	**Uttrakhand**
	66. Buksa	4367	46771
	67. Raji	998	517
	Total	5365	47288

West Bengal	68. Birhor	1017
	69. Lodha	84966
	70. Toto	-
	Total	85983
Andaman & Nicobar Islands	71. Great Andamanese	43
	72. Jarawa	240
	73. Onge	96
	74. Sentinelese	39
	75. Shom Pen	254
	Total	672
All India	**Grand Total**	3262960

Critically Wildlife Habitat

- CWLHs are meant to be **areas of national parks and wildlife sanctuaries** that are required to be kept as **inviolate for the purpose of wildlife conservation**
- CWLH **mandatorily requires settlement of forest rights under FRA**.
- Critical Wildlife Habitats are to be **declared by the Central Government** in the Ministry of Environment and Forests after a process of **consultation by Expert Committees.**
- Government of India (Ministry of Environment & forest) notifies such areas as CWH which meets a scientific criteria decided by an expert committee including experts from locality appointed by the government and from that of the Ministry of Tribal Affairs.

Critical Tiger Habitats

- Critical 'tiger' habitats (CTHs), also known as **core areas of tiger reserves**—are identified **under the Wild Life Protection Act (WLPA), 1972** based on scientific evidence that "such areas are required to be kept as **inviolate for the purpose of tiger conservation**, without affecting the rights of the Scheduled Tribes or such other forest dwellers".
- The notification of CTH is **done by the state government** in **consultation with the expert committee** constituted for the purpose.

Issue :

- **New 2022 Forest Conservation Amendment Rules,** under the Ministry of Environment, Forest and Climate Change (MoEFCC) introduced an amendment to the Forest Conservation Act of 1980 **,** which violates the Forest Rights Act of 2006

- This amendment transferred the rights of forests from tribal communities to large corporations such as private mining and pharmaceutical companies.

- The amendment allows district collectors to override the approval of Gram Sabhas and transfer the forest land to private entities

INDIA FOREST LAWS

India's forests are governed by three laws, the Indian Forest Act, 1927 and the Wild life (Protection) Act, 1972.

Wild life (Protection) Act, 1972. : allows any area to be constituted as a "protected area", namely a national park, wildlife sanctuary, tiger reserve or community conservation area

Indian Forest Act, 1927 :

- empowers the government to declare any area to be a reserved forest, protected forest or village forest.

o Degree of protection **Reserved forests > Protected forests > Village forests**

- Villagers could not take anything from the Reserved Forests for their own use.
- Fishing, hunting, collecting roots and fruits, grazing the cattle, and cutting wood became illegal activities.
- Due to the restrictions imposed by Indian Forest Act, villagers were compelled to steal wood by entering forests without permission.
- The villagers were forced to offer bribes to forest guards as they were at the mercy of these forest guards who would capture these villagers.
- Through the Indian Forest Act, the British colonial government decided to **ban shifting cultivation**
- This Act impacted the life of forest-dependent communities
- The village communities were alienated from their age-old symbiotic association with forests.
- extend the state's control over forests as well as diminishing the status of people's rights to forest use.

Rebellion in the Forests

- Forest Communities in different parts of India rebelled against the British colonial Government due to the restrictions imposed on them.
- Some of the most popular leaders who carried out rebellion in forests were Alluri Sitarama Raju of Andhra Pradesh, Birsa Munda of Chhotanagpur, Siddhu and Kanu in the Santhal Parganas.

- To address the problem of deforestation, the Forest Conservation Act (FCA), 1980, came into force.

Forest (Conservation) Act, 1980

- provide for the conservation of forests and for matters connected therewith
- It was enacted by Parliament of India to control further deforestation of Forest Areas in India
- Forest Conservation Act 1980 given permission Forest clearance

Its key objectives include:

- To conserve forests and ensure their sustainable management.
- To regulate the diversion of forestland for non-forestry purposes, such as mining, industrial projects, or infrastructure development.
- To ensure that any diversion of forestland is done only for a specific purpose and with the prior approval of the central government.

- To compensate for any loss of forest cover that may occur due to such diversion by undertaking afforestation and reforestation activities

Amendment	Key Features
Amendment in 1988	This amendment introduced the concept of "deemed forest" and brought all forestland under the purview of the Act, regardless of its legal classification.
Amendment in 1991	This amendment made the central government's approval mandatory for the diversion of forestland for non-forestry purposes, even if it is less than one hectare.
Amendment in 2003	This amendment made it mandatory for the user agency to provide an undertaking to carry out compensatory afforestation before the diversion of forestland.
Amendment in 2015	This amendment introduced the provision for granting forest clearance through a transparent online process, which is now known as the Forest Clearance Portal.
Amendment in 2017	This amendment allows state governments to carry out compensatory afforestation activities on non-forest land with the approval of the central government.

Proposed Amendments

2023, the Forest Conservation Amendment Bill, 2023 has proposed the following changes:

- exempts certain categories of land from its purview
- expands the gamut of activities that can be carried out on forest land
- Amending the name of the Act to Van Adhiniyam from the existing FCA .
- The Act would only apply to Lands notified in any government records as forest on or after 1980

News : SC told states and UT to act as per definition of Forest laid down in 1996 Judgement for identifying and preserving forest land .

SC asked to refrain from using the 2023 amendment to the FCA 1980. The amendment act allegedly removed 1.97 lakh square km of land from forest area.

SC also mandated that no government or authority should proceed with the establishment of Zoos or safari without the final approval of the apex court

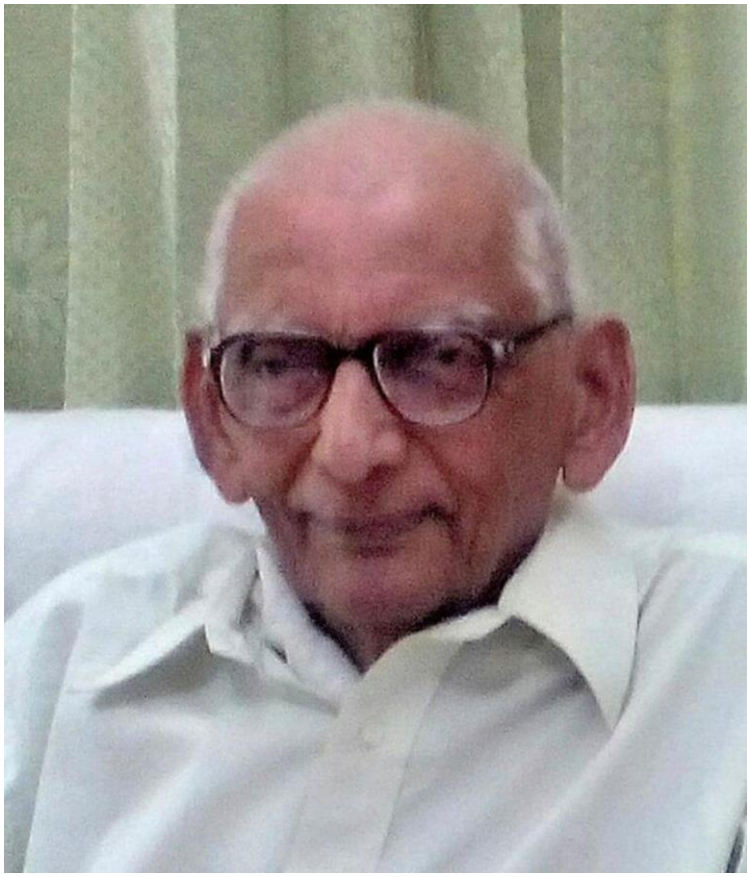
Definition of forest in India

At Present there is no clear nationally accepted definition of " Forest ".

States are responsible for determing their definition of forest .

forest conservation case :***The Godavarman case ame to be known as the Forest Conservation case***.

TN Godavarman, Forest conservation case change the definition of forest



Godavarman Thirumulpad Thirumulpad, of Malabar region of Kerala filed a writ petition with the Supreme Court of India to protect the Nilgiris forest land from deforestation by illegal timber operations

Now , How Forest Define

- Now, "forest" also included all areas recorded as "forest" in any government record, irrespective of ownership, recognition and classification;
- all areas that conformed to the "dictionary" meaning of "forest", and all areas which are identified as "forest" by an expert committee constituted by the Supreme Court following the 1996 order.

Judgement Outcome

- meaning of the word forest.
- paved the way for the calculating the net present value
-
- the creation of a compensatory afforestation fund;
- and providing non-forestry land in lieu of the diverted forest.

SC Issued Order in 2009 that there will be a Compensatory Afforestation Fund Management and Planning Authority (CAMPA) for monitoring, technical assistance and evaluation of compensatory afforestation activities.

Compensatory Afforestation Fund Management and Planning Authority (CAMPA)

- as National Advisory Council under the chairmanship of the Union Minister of Environment & Forests
- are meant to promote afforestation and regeneration activities as a way of compensating for forest land diverted to non-forest uses.

Concept of NPV

- **Net Present Value (NPV):** It is a mandatory one-time payment that a user has to make for diverting forestland for non-forest use, under the **Forest (Conservation) Act, 1980.**

- **Calculation:** This is calculated on the basis of the services and ecological value of the forests.

  - It depends on the **location and nature of the forest and the type of industrial enterprise** that will replace a particular parcel of forest.
  - These payments go to the **Compensatory Afforestation Fund (CAF)** and are **used for afforestation and reforestation.**
  - The CAF is managed by the **Compensatory Afforestation Management and Planning Authority (CAMPA).**

Compensatory afforestation is mandatory in case of diversion of Forest Land

- Whenever forest land is diverted for non-forest purposes, it is mandatory under the Forest (Conservation) Act, 1980 that an equivalent area of non-forest land has to be taken up for compensatory afforestation.

CAMPA: Act 2016

- Compensatory Afforestation Fund Act is an Indian legislation that seeks to provide an appropriate institutional mechanism, both at the Centre and in each State and Union Territory,
- to ensure expeditious utilization in efficient and transparent manner of amounts released in lieu of forest land diverted for non-forest purpose which would mitigate impact of diversion of such forest land.
- This Act has provisioned that CAMPA funds shall be kept in interest bearing non-lapsable Public Account.

- The Act established a National Compensatory Afforestation Fund under the Public Account of India and State Compensatory Afforestation Fund under the Public Account of each state.

- **Exemptions:** Some projects have been provided exemption from paying NPV like construction of **Schools, Hospitals, village tanks, laying down of optical fibre** etc. Projects like underground mining and wind energy plants have been given a 50% exemption from NPV.

- Wildlife is a component of 'forests,' and it was a state topic until Parliament approved this legislation in 1972. It is now a **Concurrent List.**

Wild Life (Protection) Act, 1972

- enacted for protection of plants and animal species
- It has six schedules which give varying degrees of protection.
- it amended many times

S. No.	Short title of amending legislation	No.	Year
1	Wild Life (Protection) Amendment Act,1982	23	1982
2	Wild Life (Protection) Amendment Act, 1986	28	1986
3	Wild Life (Protection) Amendment Act,1991	44	1991
4	Wild Life (Protection Amendment Act, 1993	26	1993
5	Wild Life (Protection) Amendment Act, 2002	16	2003
6	Wild Life (Protection) Amendment Act, 2006	39	2006
7	Wild Life (Protection) Amendment Bill, 2013		2013
8	Wild Life (Protection) Amendment Bill, 2021		2021
9	Wild Life (Protection) Amendment Act, 2022	18	2022

- According to the Act, there are five categories of protected places.
    - **Sanctuaries**
    - **National Parks**
    - **Conservation Reserves**
    - **Community Reserves**
    - **Tiger and Elephant Reserves**

The Wildlife Protection Act, 1972, established several bodies to support the effective implementation of wildlife conservation measures in India.
Central Zoo Authority (CZA) 1992
National Tiger Conservation Authority (NTCA) 2005
Wildlife Crime Control Bureau (WCCB) 2006
State Wildlife Advisory Boards
National Board for Wildlife (NBWL): chaired by the **Prime Minister of India**

The Wildlife Protection Act has six schedules.
Schedule I: Protection to Endangered species, from hunting and poaching, unless the animal posses' threat to Human lives. Strict penalties and punishment to offenders

- Tiger, blackbuck, Himalayan Brown Bear, Brow-Antlered Deer, Blue whale, Common Dolphin, Cheetah, Clouded Leopard, hornbills, Indian Gazelle, and other animals are examples.

- Some of the animals granted protection under the Schedule I include:

- The Black Buck
- Bengal Tiger
- Clouded Leopard
- Snow Leopard
- Swamp Deer
- Himalayan Bear
- Asiatic Cheetah

- Kashmiri Stag
- Fishing Cat
- Lion-tailed Macaque
- Musk Deer
- Rhinoceros
- Brow Antlered Deer
- Chinkara (Indian Gazelle)
- Capped Langur
- Golden Langur
- Hoolock Gibbon

Schedule II: Protection of animals from hunting and poaching, for the purposes of trading

- Animals on this list are also given special protection.
- Their business is **illegal.**
- They cannot be hunted unless there is a threat to human life.
- Kohinoor (insect), Assamese Macaque, Bengal Hanuman langur, Large Indian Civet, Indian Fox, Larger Kashmir Flying Squirrel, Kashmir Fox, , common langur , chameleon and king cobra : and more species are examples.

- Some of the animals granted protection under the Schedule I include:

- The Black Buck
- Bengal Tiger
- Clouded Leopard
- Snow Leopard
- Swamp Deer
- Himalayan Bear
- Asiatic Cheetah
- Kashmiri Stag
- Fishing Cat
- Lion-tailed Macaque
- Musk Deer
- Rhinoceros
- Brow Antlered Deer
- Chinkara (Indian Gazelle)
- Capped Langur
- Golden Langur
- Hoolock Gibbon

Schedule III & IV Protection of animals not considered endangered, in this schedule penalities and punishments are not as harsh as Schedule 1 & 2

- This list only includes species that are **not endangered.**
- This includes protected species, however the punishment for infringement is less severe than in the previous two schedules.
- Chital, Bharal (blue sheep) , Nilgai (largest antelope of Asia) , Sambhar (deer) Hyena, Himalayan rat, porcupine, flying fox, Malabar tree toad, etc. are some examples.
- Some Animals examples protected under Schedule IV include:

    - Flamingo
    - Hares
    - Falcons
    - Kingfishers
    - Magpie
    - Horseshoes Crabs

Schedule V: Vermins

- Vermins (common crows, fruit bats, rats, and mice) that can be hunted as they are carriers of diseases
- Mice, rats, common crows, fruit bats, and other animals are examples.
- Section 62, of the Act, gives government power to declare an animal a Vermin. It is done when an animal is considered dangerous for humans or crops
- Rats have broader and blunter snouts and larger ears, while mice have smaller and more delicate facial features. The tail of a rat is longer and thicker than that of a mouse (mouse plural :mice)

Schedule VI : Restricted plants that require specific permission for cultivating

- This list comprises plants that are **not allowed to be cultivated.**

o It provides for **regulation in cultivation of a specified plant** and restricts its possession, sale and transportation.

o Both cultivation and trade of specified plants can only be carried out with prior permission of competent authority.

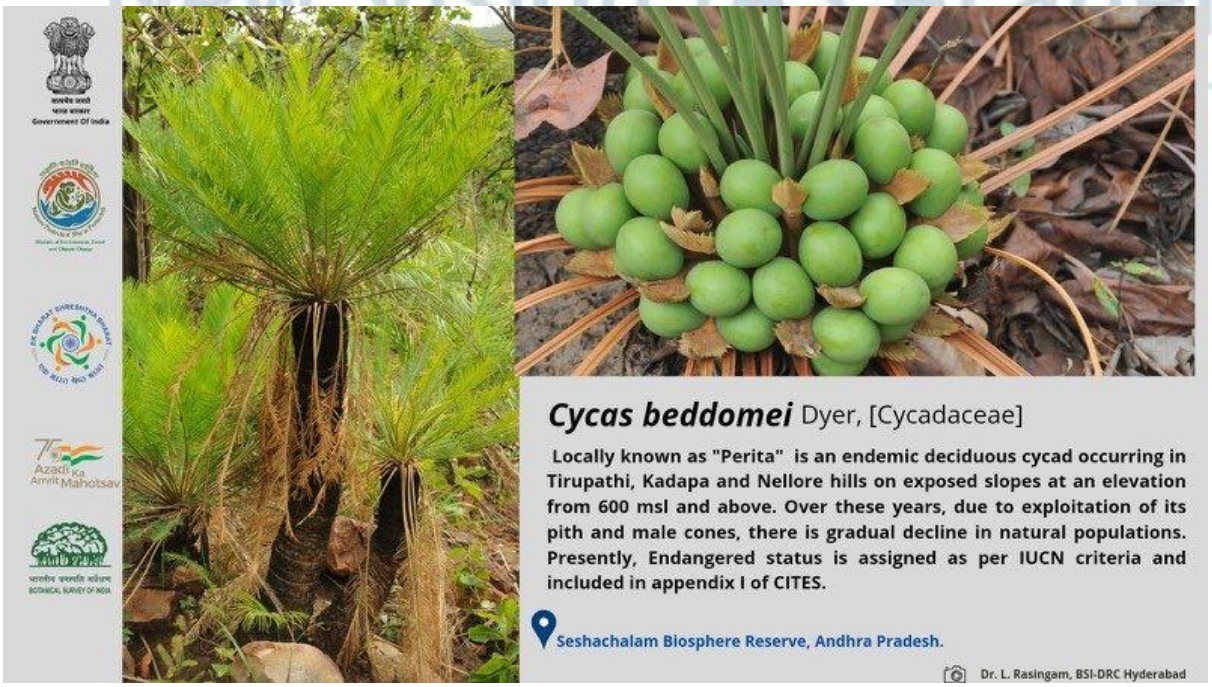
- Plants protected under Schedule VI include:

    - Beddomes' cycad (Native to India)
    - Blue Vanda (Blue Orchid)
    - Red Vanda (Red Orchid)
    - Kuth (Saussurea lappa)
    - Slipper orchids (Paphiopedilum spp.)
    - Pitcher plant (Nepenthes khasiana)

Red Vanda :

An endangered species, Red Vanda is restricted to the State of Manipur and neighbouring areas in NE India. It grows on small shrubs and trees at elevations of 300-500 m flowering during spring.

Kuth (Saussurea lappa) (Himachal Pradesh, Jammu-Kashmir- its native place of origin. Kashmir Himalaya and some area of Western Ghats) Essential oils extracted from the root have been used in traditional medicine and in perfumes since ancient times.



Because these are endemic plants in india.

if they plant with other plants , then, the Genetic diversity of these plants may get affected due to pollination.These plants also have medicinal Significance .

What does it mean when a specific plant species is listed under Schedule VI of The Wildlife Protection Act, 1972?
(A) A license is necessary to cultivate that plant,
(B) Cultivation of such a plant is strictly prohibited,
(C) It is a genetically modified crop plant,
(D) The plant is invasive and poses a threat to the ecosystem

Ans A

Que : If a species of tortoise in India is listed as protected under Schedule I of the Wildlife (Protection) Act, 1972, what does it signify?
(A) It receives the same level of protection as tigers,
(B) The species no longer exists in the wild, with only a few individuals being protected in captivity, making its extinction unavoidable,
(C) It is exclusive to a specific region in India
(D), Both options (B) and (C) mentioned above are correct in this scenario
Answer: (A) It receives the same level of protection as tigers

Which objective is not included in the Wildlife Protection Act of 1972?
(A) Setting up sanctuaries and national parks, tiger reserves
(B) Impose penalties through the judicial system for violating the Act
(C) Consolidate laws pertaining to forests
(D) Establish regulations for hunting wild animals and birds

Ans C

- **Authorities Appointed under the Act:**
    - The **Central Government appoints the Director of Wildlife Preservation** and assistant directors and other officers subordinate to the Director.
    - The **State Governments appoint a Chief Wildlife Warden (CWLW)** who heads the Wildlife Wing of the department and exercises complete administrative control over Protected Areas (PAs) within a state.
        - The state governments are also entitled to appoint **Wildlife Wardens in each district.**

- **Wildlife (Protection) Amendment Act, 2022:**
    - The Act seeks to **increase the species** protected under the law and implement CITES.
    - The **number of schedules has been reduced to four:**
        - **Schedule I containing animal species enjoying the highest level of protection.**
        - **Schedule II for animal species subject to a lesser degree of protection.**
        - **Schedule III for protected plant species,** and
        - **Schedule IV for scheduled specimens under CITES.**
    - The Act permits the **use of elephants** for **'religious or any other purposes'.**
    - The penalties have also been increased for general and specially protected animals' violations.

Concept of EPA 1986:

- The roots of the enactment of the EPA lies in the United Nations Conference on the Human Environment **held at Stockholm** in June,1972 (Stockholm Conference)
- The **Act implements the decisions made at the** Stockholm Conference.
- EPA empowers the **Central Government** to establish authorities charged with the **mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems** that are peculiar to different parts of the country.

- EPA empower Central government **Plan and execute a nation-wide programme** for the prevention, control and abatement of environmental pollution.
- **Lay down standards for the quality of the environment** in its various aspects like **emission or discharge of environmental pollutants from various sources.**

Which one of the following has been constituted under the Environment (Protection) Act, 1986? (2022)

a. Central Water Commission
b. Central Ground Water Board
c. **Central Ground Water Authority**
d. National Water Development Agency

- **The Central government as per the Act has the power to direct:**
  - The closure, prohibition or regulation of any industry, operation or process.
  - The stoppage or regulation of the supply of electricity or water or any other service.

- **Constitutional Provisions:**
  - The **EPA Act was enacted under** Article 253 of the Indian Constitution which provides for the **enactment of legislation for giving effect to international agreements.**
  - **Article 48A** of the Constitution specifies that the **State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country.**
  - **Article 51A** further provides that **every citizen shall protect the environment.**

Penalties :

- In case of any non-compliance or contravention of the current provisions of the EPA, or of the rules under this Act, the violator can be punished with imprisonment up to 5 years or with a fine up to Rs 1,00,000, or with both.
- In case of continuation of such violation, an additional fine of up to Rs 5,000 for every day during which such contravention continues after the conviction for the first such contravention can be levied.

DRAWBACKS OF ENVIRONMENT PROTECTION ACT, 1986

- **Complete Centralisation of the Act**
- While such wide powers are provided to the Centre and **no powers to the state governments,** the former is liable to its arbitrariness and misuse.
- **No Public Participation:** The Act also says **nothing about public participation** as regards environmental protection.
- There is a **need to involve the citizens in environmental protection to check arbitrariness and raise awareness** and empathy towards the environment.

Note: A Committee had been constituted under Shri T.S.R. Subramanian to review the Acts administered by the Ministry and to suggest appropriate amendments to bring them in line with their objectives and current requirements.

About Shri T.S.R. Subramanian Commitee

- The high-level committee was constituted in August 2014 under the chairmanship of Subramanian by the **Ministry of Environment, Forests And Climate Change** (MoEF & CC).
  - India had a **strong environmental policy and legislative framework** but weak implementation has resulted in environmental governance being criticised by conservation experts and the judiciary.

- **Lack of Specailised Cadre:** There is a **lack of trained personnel involved in the administration**, policy formulation, and supervising the implementation of policies of the state and central governments.
- The committee was established to **review environmental laws in the country** and to bring them in line with the then required needs
  - Recently, the Supreme Court asked the Centre to establish a dedicated **Indian Environment Service (IES)** at the all-India level.
- The creation of IES was recommended by a committee headed by former Cabinet Secretary **TSR Subramanian in 2014.**

Consider the following statements: (2019)
The Environment Protection Act, 1986 empowers the Government of India to:

1. State the requirement of public participation in the process of environmental protection, and the procedure and manner in which it is sought.
2. Lay down the standards for emission or discharge of environmental pollutants from various sources.

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

Ans: (b)
EIA In India is done under which of the following enactment

a) Wildlife Protection Act 1972
b) Indian Forest Act 1927
c) Biological Diversity Act 2002
d) Environment Protection Act 1986

What is EIA?

- ❖ is a planning tool to integrate environmental concerns into the developmental process from the initial stage of planning.
- ❖ therefore assist planners and government authorities in decision making process by identifying environmental, social and economic impacts and formulating mitigation measures
- ❖ essentially refers to the assessment of environmental impacts likely to arise from a project
- ❖ thereby provide a balance mechanism between Environment and Developmental activities .
- ❖ focused on sustainable development practices and Conserving solutions

what are the Important aspect of EIA

- Risk Assessment
- Environmental management
- Post Product Monitoring

Evolution :

- first country : USA (1969)
- Canada , Australia and New Zealand 1973-74
- Columbia 1974
- Philippines 1978

When EIA Concept Started in India :

- ❖ *1976-77/ 78* When Planning Commission asked Deptt of Science and Tech: to examine the river valley projects from environmental Angle.
- ❖ first EIA notification issued 27th January, 1994 NEED EC: environmental clearance for 29 categories of projects/processes and now 32 categories

EIA Notification 27 January 1994 . Since then there have been 12 amendments made in the EIA notification of 1994.

What was the basis of review of EIA Notification, 1994?
Ans. Review of EIA Notification, 1994 was undertaken based on recommendations of a project by World Bank as well as by Govindrajan Committee on Disinvestment.

present EIA Notification was issued on 14th September, 2006.

amended Years : 2006, 2014 ,2015 , 2016 2020, 2021, 2022.

Reason for Various amendments / objectives of EIA 2006

- purpose of decentralizing power and empowering local bodies .
- to formulate a transparent, decentralized and efficient regulatory mechanism to integrate environmental concerns into developmental process with a view to facilitating sustainable development.
- to ensure incorporation of necessary environmental safeguards at planning stage in the project cycle, so as to ensure minimal impact on different components of environment.
- to ensure involvement of stakeholders in public consultation process through public hearing and to ascertain the views of the public on the proposed project or activity.

EIA comes under Which Act ?

- Environment Impact Assessment in India is statutorily backed by **the Environment Protection Act, 1986** which contains various provisions on EIA methodology .

- EIA notification making Environmental Clearance (EC) mandatory for expansion or modernisation of any activity or for setting up new projects

like :

- Industry sector
- mining sector ,
- thermal power plants,
- river valley projects,
- building construction
- infrastructure (road, highway, ports, harbours and airports) and industries and CRZ. ,
- Nuclear Power Project and strategic defence projects

Do the projects attracting both EIA, and CRZ notifications need to obtain two separate clearances?
Ans. NO,
The projects attracting both EIA Notification, 2006 and CRZ Notification, 1991/ 2011, need not undergo two separate appraisal processes and do not require two separate clearances. Such projects will require only environmental clearance under the EIA Notification that will be considered based on the recommendations of the concerned State Coastal Zone Management Authority.

NEW PATTERN:

- then MOEFCC notified **new EIA legislation in September 2006.**
- According to the Environment Impact Assessment (EIA) Notification, 2006, evaluation of proposals involves four steps: screening, scoping, public hearing and appraisal. (stages of EC)

After 2006 Amendment the EIA cycle comprises of four stages:

- Screening:
  reviewing application form/and which only applies for Category B projects / Projects are then further categorised according to whether they require an EIA (Category B1) or not (Category B2).
- Scoping:
  - detailed and comprehensive Terms of Reference (TOR) addressing all relevant environmental concerns for the preparation of an EIA report are determined.

- done for A and B1 not for B2
- Public hearing:
  - involves consultation with project affected persons on the effects of the project.
- Appraisal:
  - sees the overall and detailed scrutiny of the final EIA report, which will have been presented to EAC or SEAC

Steps in EIA process (EIA process is cyclical with interaction between the various steps):

- ✓ **Screening:** the project plan is screened for scale of investment, location and type of development and if the project needs statutory clearance.
- ✓ **Scoping:** identifying the project's potential impacts, zone of impacts, mitigation possibilities and need for monitoring needs to be worked out.
- ✓ **Collection of baseline data** (environmental status of study area).
- ✓ **Impact prediction:** positive and negative, reversible and irreversible and temporary and permanent impacts need to be predicted.
- ✓ **Mitigation measures:** the EIA report should include the actions and steps for preventing, minimizing or bypassing the impacts or else the level of **compensation** for probable environmental damage or loss.
- ✓ **Public hearing:** On completion of the EIA report, public and environmental groups living close to project site may be informed and consulted.
- ✓ **Decision making: Impact Assessment Authority** along with the experts consult the project-in-charge to take the final decision, keeping in mind EIA and **Environment Management Plan (EMP)**.
- ✓ **Monitoring** and implementation of EMP
- ✓ **Assessment of Alternatives, Delineation of Mitigation Measures and EIA Report**
- ✓ **Mitigation plan:** Once alternatives have been reviewed, a mitigation plan should be drawn up for the selected option and is supplemented with an Environmental Management Plan (EMP).
- ✓ **Risk assessment:** Inventory analysis and hazard probability and index also form part of EIA procedures.

Features of 2006 Amendments to EIA Notification

- decentralized the environmental clearance projects by categorizing the developmental projects in two categories,
- Category A (national level appraisal)

Category A projects require mandatory environmental clearance and thus they do not undergo the screening process.

example: All new National Highways are classified as Category A

Note, all Railway Projects, with no exception, are totally exempted from seeking Environmental Clearance under Government regulations.

Category B (state level appraisal): Category B projects undergoes screening process and they are classified into two types.

- **Category B1 projects (Mandatorily requires EIA).**
- **Category B2 projects (Do not require EIA).**

- Note : Projects falling under Category B2 are exempted from requirement of collection of Base line data, EIA Studies and public consultation.
- **Thus, Category A projects and Category B, projects undergo the complete EIA process whereas Category B2 projects are excluded from complete EIA process.**

****

Recently :

A draft notification issued by the ministry on April 12 2022:

- environmental clearances granted to hydro projects will be valid for 13 years.
- The clearances given to nuclear projects will last for 15 years
- for mining projects, upto 50 years.

Reason to do So:

"Based on the past experiences, it is noted that nuclear power projects and hydro power projects have high gestation period due to various issues such as

- geological surprises,
- delay in forest clearance,
- land acquisition,
- local issues,
- time taken for addressing local concerns
- rehabilitation and resettlement, etc

Therefore, the Central Government Seems it necessary to extend the validity of Environmental Clearance (EC) for such projects and regulating the file Movement in all concerned ministries .

Criticism:

"Finally, long gestation environmental clearances can allow project proponents to secure and fence off land in their possession for over a decade, without any assurance of the project being set up. This is neither economically rational nor socio-ecologically desirable.

****

Positive and Negative points of EIA.

Benefits	Flaws
Provides systematic methods of impact assessment	Time-consuming
Estimates the cost/benefit trade-off of alternative actions	Costly
Facilitates the public participation	Little public participation in actual implementation
Provides an effective mechanism for •coordination, •environmental integration, •negotiations, •feedback.	Unavailability for reliable data (mostly in developing countries)
Top-level decision-making	Too focused on scientific analysis (sometimes)
Triggers an institutional building	Poor presentation of EIA report (bulky volumes, scientific explanation, difficult to understand)
Achieve a balance between the impact of developmental and environmental concern	Compliance monitoring after EIA is seldom carried out

Concept of Parivesh

Define PARIVESH :

PARIVESH stands for Pro Active and Responsive facilitation by Interactive, Virtuous and Environmental Single window Hub.

Scope of PARIVESH :

The PARIVESH is a single window system for appraisal and granting Environmental Clearances and Forest Clearances

Benefit of PARIVESH

- improve the entire process of appraisal and environmental clearance in the Ministry.
- It will ensure transparency and expedite the process of granting clearance.
- The important features are that the Project Proponent gets a confirmation on mail about acceptance of his application or can receive objections raised on the application online and can file his reply to such objections online.
- The Project Proponent can also track the movement of their application at different stages and can see the findings of the Expert Appraisal Committee on their project proposal.
- This online system has also provided access to previous Environment Impact Assessment Reports, which is a valuable reservoir of information.

Single window clearance like PARIVESH

- Environmental clearance + Forestry clearance.
- When a project requires both environmental clearance as well as approval under the Forest (Conservation) Act, 1980, proposals for both are required to be given simultaneously to the concerned divisions of the Ministry.
- The processing is done simultaneously for clearance or rejection.
- If the project does not involve the diversion of forestland, the case is processed only for environmental clearance.

ESZ IMPORTANCE AND ISSUE

As part of Wildlife Conservation Strategy, in the year 2002, it was decided that an area around each PA (National Park, Biosphere Reserve, Wildlife Sanctuary, Tiger Reserve, etc.), requires to be notified as Eco-Sensitive Zone for creating a buffer as further protection around PAs.

The National Environment Policy, 2006 defines

Eco-Sensitive Zones as areas/ zones: 'with identified environmental resources having incomparable values which require special attention for their conservation'

purpose:

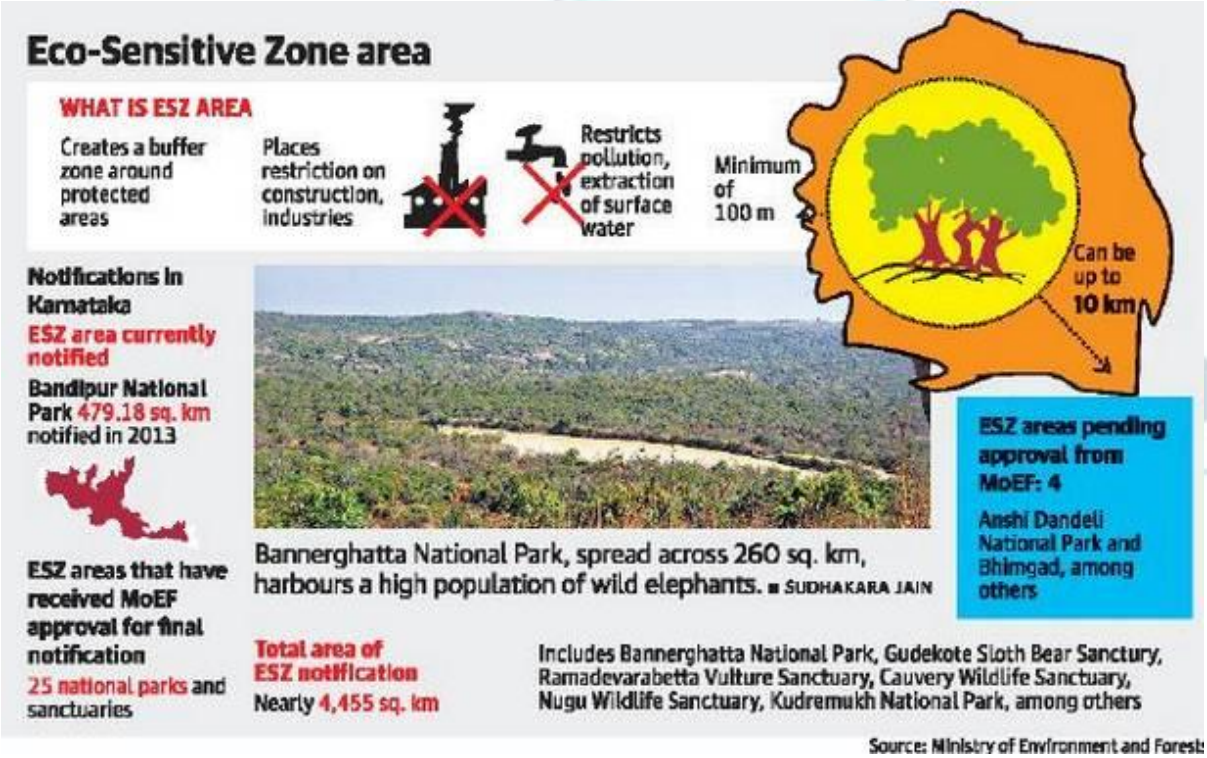
- **In order to protect the biodiversity in areas having ecological significance, which have unique biological resources, and require special attention for their conservation.**
  - is to create some kind of "Shock Absorber" for specialized Ecosystems such as Protected Areas (Pas) which include National Parks and Wildlife Sanctuaries.
  - The ESZs act as transition zones for areas requiring high protection to areas where development may be permitted.
  - Notifying ESZ play imp role of Moefcc for sustainable development and for conservation of Wildlife and Biodiversity.

→ The Environment (Protection) Act, 1986 does not mention the word "Eco-Sensitive Zones".

- An ESZ could go up to 10 kilometres around a protected area as provided in the Wildlife Conservation Strategy, 2002.
- "Survey and identification of ESZs are conducted by the respective State Governments for consideration of the Central Government for declaration of the ESZs in respective States around National Parks and Wildlife Sanctuaries under EPA 1986

ecologically sensitive areas notified by the Ministry

Dahanu Taluka, Mahableshwar-Panchgani, Matheran Mount Abu, Bhagirathi, Doon Valley and Western Ghats,
ESZ notifications in respect of 77 Protected Areas in the country were issued.

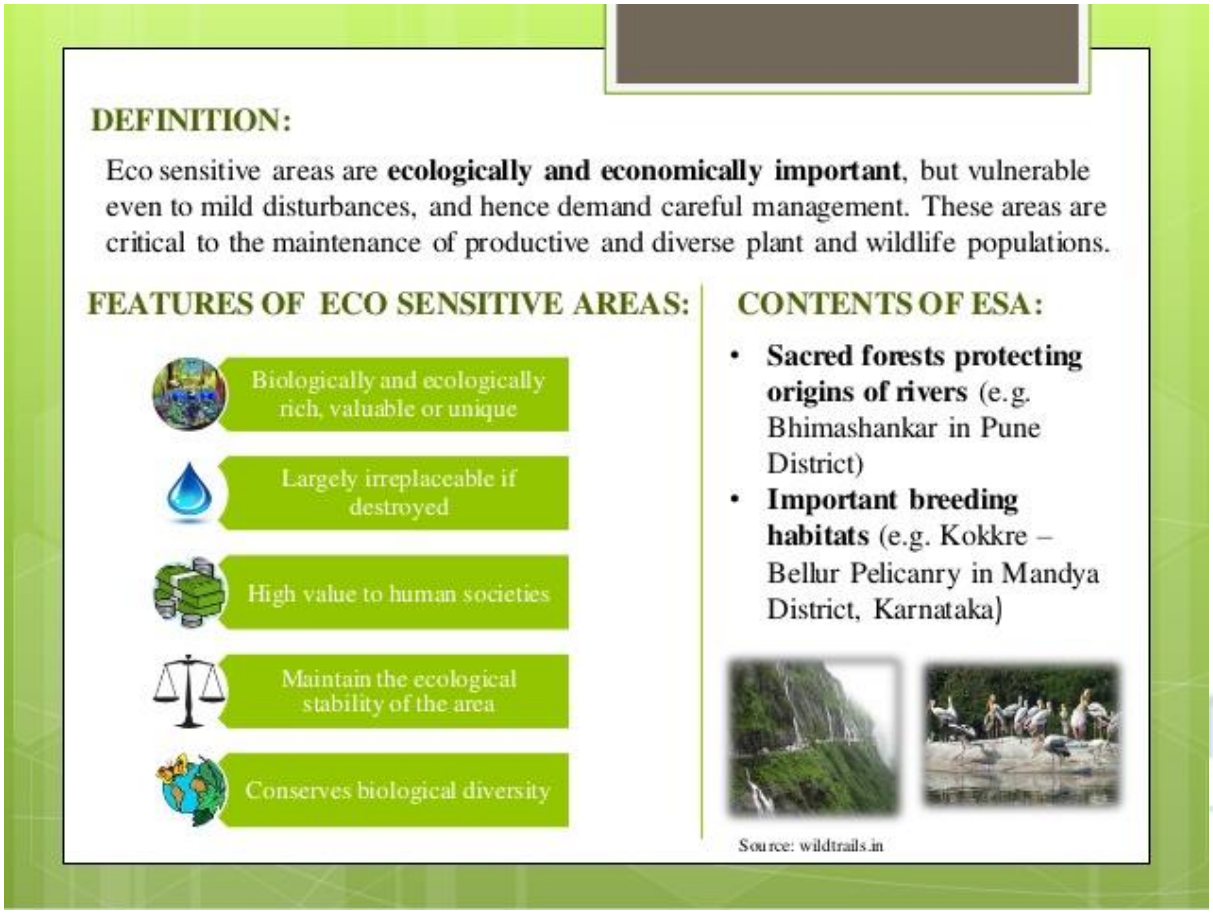


Eco-Sensitive Zones (ESZ)

- areas declared under the Environment Protection Act (EPA), 1986
- are created as "shock absorbers" for the protected areas, to minimize the negative impact on the "fragile ecosystems" by certain human activities taking place nearby.
- As per the National Wildlife Action Plan (2002-2016), land within 10 km of the boundaries of national parks & wildlife sanctuaries is to be notified as eco-fragile zones or ESZ.
- Ministry of Environment, Forest and Climate Change notifies Eco-Sensitive Zones (ESZs) on the basis of proposals and recommendations of the State Government

Classification of Activities in ESZ

Prohibited	Regulated	Permissible
• Commercial mining • Setting of industries causing pollution • Commercial use of firewood • Establishment of major hydroelectric projects	• Felling of trees • Establishment of hotels • Widening of roads • Introduction of exotic species • Sign boards & hoardings	• Ongoing agriculture & horticulture practices by local communities • Rainwater harvesting • Organic farming & Use of renewable energy sources



What are Eco-Sensitive Zones (ESZs)?

- ❖ Eco-Sensitive Zones or Ecologically Fragile Areas are areas within 10 kms around Protected Areas, National Parks and Wildlife Sanctuaries.
- ❖ ESZs are notified by MoEFCC, Government of India under Environment Protection Act 1986.
- ❖ In case of places with sensitive corridors, connectivity and ecologically important patches, crucial for landscape linkage, even area beyond 10 km width can also be included in the eco-sensitive zone.

basic aim:

is to regulate certain activities around National Parks and Wildlife Sanctuaries so as to minimise the negative impacts of such activities on the fragile ecosystem encompassing the protected areas.

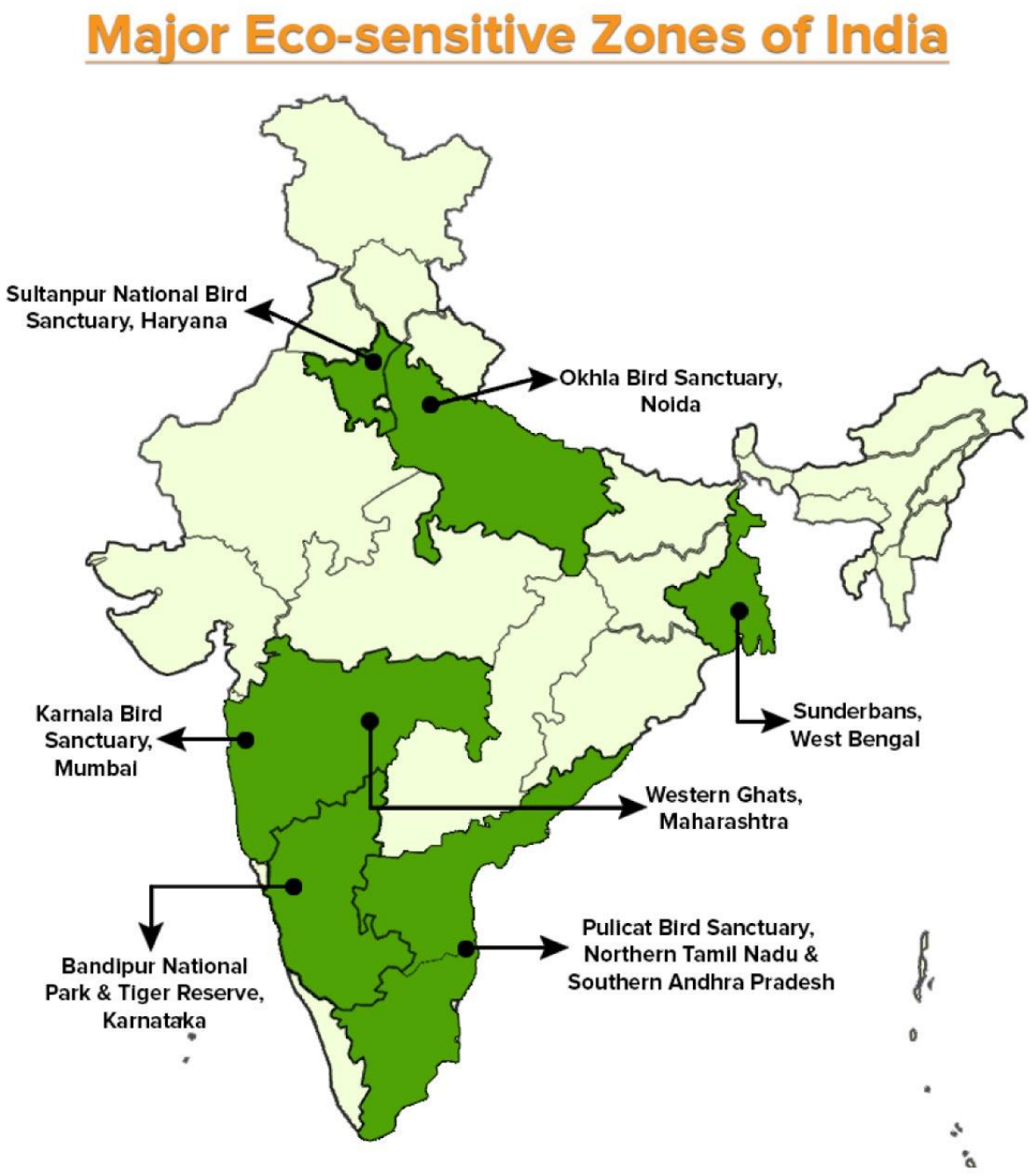
→ The purpose of declaring ESZs is to create some kind of "shock absorbers" to the protected areas by regulating and managing the activities around such areas.

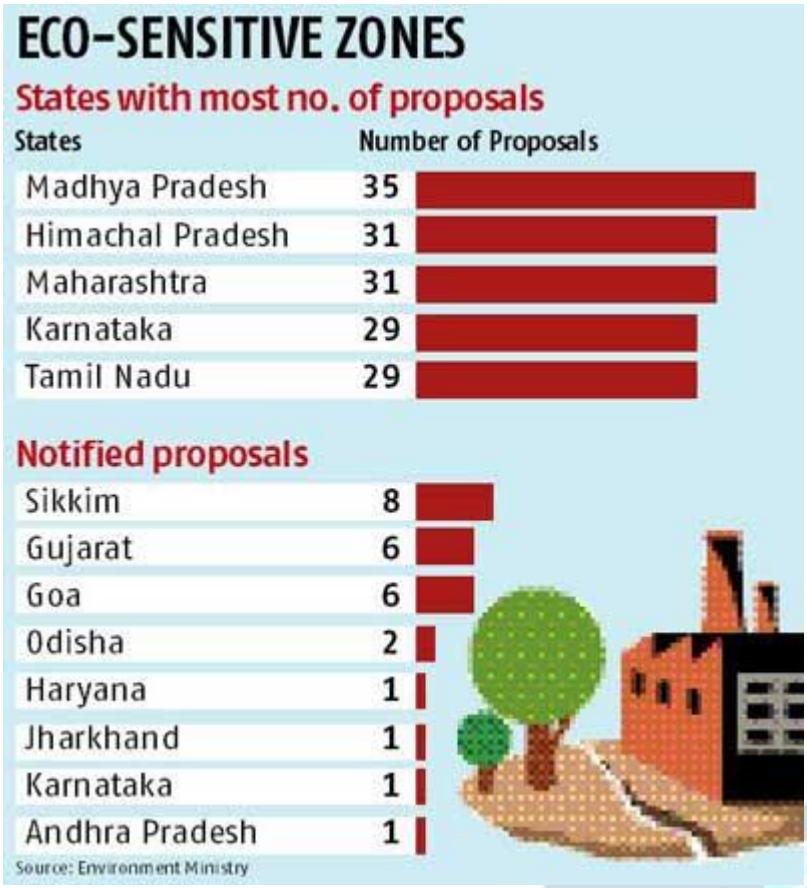
→ They also act as a transition zone from areas of high protection to areas involving lesser protection.

Activities Allowed in ESZs

- Prohibited activities: Commercial mining, saw mills, industries causing pollution (air, water, soil, noise etc), establishment of major hydroelectric projects (HEP), commercial use of wood, Tourism activities like hot-air balloons over the National Park, discharge of effluents or any solid waste or production of hazardous substances.
- Regulated activities: Felling of trees, establishment of hotels and resorts, commercial use of natural water, erection of electrical cables, drastic change of agriculture system, e.g. adoption of heavy technology, pesticides etc, widening of roads.

Permitted activities: Ongoing agricultural or horticultural practices, rainwater harvesting, organic farming, use of renewable energy sources, adoption of green technology for all activities.





Significance of ESZs

- To minimise the impact of urbanisation and other developmental activities, areas adjacent to protected areas have been declared as Eco-Sensitive Zones.
- The purpose of declaring eco-sensitive zones around protected areas is for creating some kind of a 'Shock Absorber' for the protected area.
- They also act as a transition zone from areas of high protection to areas involving lesser protection.
- ESZs help in in-situ conservation, which deals with conservation of an endangered species in its natural habitat, for example the conservation of the One-horned Rhino of Kaziranga National Park, Assam.
- Eco-Sensitive Zones minimise forest depletion and man-animal conflict. The protected areas are based on the core and buffer model of management, through which local area communities are also protected and benefitted.

Challenges and Threats to Eco-Sensitive Zones

- Developmental activities:
  - Activities such as construction of dams, roads, urban and rural infrastructures in the ESZ, create interference, negatively impact upon the environment and imbalance the ecological system.
  - For example, construction of road would lead to cutting down of trees which would further impact upon, soil erosion thereby destroying the habitats of the species preserved under the ESZ.
- Governance and new laws:
  - By failing to recognize the rights of forest communities and curbing poaching of animal, legislations like Environmental Protection Act 1986, and Wildlife Protection Act 1972, undermine the ESZs in favour of developmental activities.
  - For example - the new draft notification for reducing the ESZs of Bannerghatta National Park.
- Tourism:
  - As the pressure of tourism is rising, the government is developing new sites and gateways to the ESZ.
  - To cater to the increasing demand for eco-tourism, land around parks and sanctuaries is being cleared through deforestation, displacement of local people etc.
  - The tourists leave behind garbage such as plastic bags and bottles etc. which lead to environmental degradation.
- Introduction of exotic species: Exotic species like Eucalyptus and Acacia auriculiformis etc., and their plantations create a competing demand on naturally occurring forests.

- Climate change: Biodiversity and climate change are interconnected, for example, the rise in global temperature has generated land, water and ecological stress on the ESZs.
- For example, forest fires or the Assam floods which badly affected the Kaziranga National Park and its wildlife.

- Local communities: Slash and burn techniques used in agriculture, pressure of increasing population and the rising demand for firewood and forest produce, etc. exerts pressure on the protected areas.

Conclusion :

- Afforestation and reforestation of degraded forest, regeneration of lost habitats, reducing climate change impacts by promoting carbon footprints and through education, is needed.
- Conservation techniques, awareness about overexploitation of resources and its adverse impacts should be propagated among masses.
- Government, civil societies and stakeholders are largely required to collaborate with each other for balancing sustainable development with development.

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CHAPTER 10 : INVASIVE ALEIN SPECIES/ EXOTIC SPECIES / FOREIGN SPECIES / INTRODUCED SPECIES / IAS

After Global Warming , The second worst threat is the biological invasion of alien species (Convention forBiological diversity, 1992)" A potential Threat to Biodiversity

INVASIVE ALIEN SPECIES:

- is a plant, fungus, or animal species, microbes
- Other Names : Exotic, introduced, foreign , non-indigenous or non-native. ,
- is one that has been introduced by humans intentionally or otherwise human agency or accidently from one region to another.
- Biggest Threat to Biodiversity
- Global Threat to Food Security and Ecology security
- Negatively Impact Natural ecosystems, and ecosystem services
- Invasive Alien Species like pioneer Species in varied landscapes, tolerant of wide range of soil and weather conditions
- About 66 Per cent India natural systems are threatened with exotic species

Features of Invasive alien Species:

- Introduced like Pioneer Species
- But Alter Ecosystem Dynamics
- Ecological Tolerance - Wide
- Environmental Adaptability - Wide
- Rapid Reproduction (They are locally abundant in any place where they are)
- High dispersal ability+ Geographically widespread + high Adaptability
- short generation time+ Broad native range+ prefer wide range of habitat
- Phenotype plasticity (the ability to alter growth form to suit current conditions)
- Tolerance of a wide range of soil and weather conditions, environmental conditions (Ecological competence) + Generalist in distribution+ grows aggressive root systems
- Ability to live off of a wide range of food types (generalist)
- the cells in these plants are able to divide and multiply more quickly and consequently the entire plant can grow more rapidly than species with higher cellular DNA content. This gives them a leg up in disturbed sites.
- **Not all alien invasive species have negative impacts**
- **Nearly 80% of the documented impacts of invasive species** on nature's contribution to people **are negative.**

Effects:

- Loss of Biodiversity and
- Decline of Native Species
- Habitat loss and

- Introduced Pathogens reduce crop and stock yields
- degradation of marine and freshwater ecosystem
- they change the food web and impact ecological balance of the area

Examples: of IAS: huge threat to the local flora, fauna and agriculture

- North African catfish threatened aquatic biodiversity of kerala ,
- Forked Fanwort/***Cabomba furcata*** is a species of aquatic plant in the water shield family known by the common names **red cabomba** and **forked fanwort**. It bears purple flowers and has been reported as an invasive species in Kerala
- Indian bull frog impacting andaman island
- Grass Paspalum distichum reduced waterbird species like Siberian crane in Kelodeo NAtional Park .
- Common Myna, Pigeon, Donkey, House Gecko, Tilapia, Giant African Snail, Crazy ant, Pig, ship rat, domestic cat,
- Brown treeeSnake, red deer , red vented bulbul, Asian tiger mosquito,
- Needle Bush, Black Wattle problems for western ghats -regenrate rapidly after fire and form dense thickets , Goat Weed-Aggresive colonizer ,
- Prickly Poppy,
- Touch me not Plant, 4'0' clock plant,
- The rapid and dense growth of the invasive *Passiflora mollissima* inhibits the regeneration of native tree species in the Shola forest patches.
- The wet grasslands in the world heritage site in the Northeast, Kaziranga National Park, are under stress due to the spread of Mimosa diplotricha(climber type) It outcompetes the existing plants
- *Each of Assam state's four rhino reserves currently faces threats from invasive plants including Parthenium, Mimosa, Mikania and water hyacinth.*
- Lantana Camara,Parthenium(congress grass) ,
- datura,
- Prosopis Juliflora.
- Water Hyacinth(Ecichhornia)
- The desert locust/ type of grasshopper, is an invasive species that is both well known and feared because of the large-scale agricultural damage it can cause.

Why is a plant called Prosopis juliflora often mentioned in the news?

A Its extract is widely used in cosmetics.
B It tends to reduce the biodiversity in the area in which it grows.
C Its extract is used in the synthesis of pesticides.
D None of the above

1. ***Prosopis juliflora*** is a shrub or small tree . It is native to Mexico, South America and the Caribbean. It has become established as an invasive weed in Africa, Asia, Australia and elsewhere.
This species has since become naturalised in the arid and semi-arid parts of the country. With its wide adaptability to arid environments and its drought and disease tolerance, it has virtually exceeded all indigenous species in covering the arid and semi-arid tract.and is now one of the major sources of fuelwood to the landless and poor populations.

Prosopis Juliflora impact Banni grassland of Rann of Kutch

- The plant take away all rechargeable water increase droughts in the region
- Impacting Maldhari community
- But these communities make profit from it . this Plant wood has high carbon content so charcoal derived from plant is in high demand. so they sell this prosopis charcoal and bought fodder during dry season

Wildlife Institute of India : identified Banni Grassland of Kutch under the Protected Areas. it is important last remaining habitat for cheetah in India.

Que : UPSC: A sandy and saline area is the natural habitat of an Indian animal species. The animal has no predators in that area but its existence is threatened due to the destruction of its habitat. Which one of the following could be that animal?

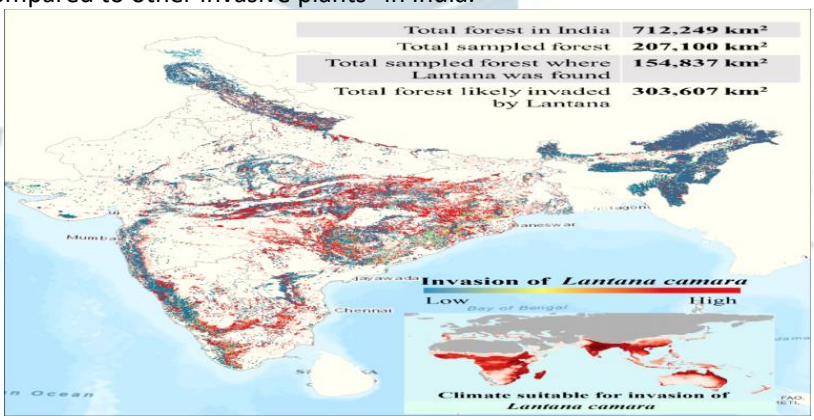
- a) Indian wild buffalo.
- b) Indian wild ass.
- c) Indian wild boar.
- d) Indian gazelle.

India Wild Ass located in Indian Wild Ass Sancturary located in little rann of kutch .

threat to this animal

- habitat degradation due to salinity ingress
- invasive species like P. Juliflora
- encroachment and grazing by the Maldhari community (pastoral community)

2.***Lantana camara*** is a species of flowering plant/ shrub within the , native to the American tropics. Arriving in India as an ornamental plant in the early 1800s, lantana has escaped from gardens and taken over entire ecosystems, now occupying 40 percent of India's tiger range alone *The Shivalik hills, Central India, and Southern Western Ghats are the worst hit.*
With the ability to adapt to the changing climate, lantana can tolerate high temperature and moisture. The species now threatens about 300,000 sq.km of Indian forests.
Lantana Invasion Threatens 40 Percent of India's Tiger Habitat: Study Lantana is "probably the most widely distributed invasive plant in India, as compared to other invasive plants" in India.



herbivores animal, deer, deprive of their food due to lantana.
Lantana is one of the world's ten worst invasive species and a species of High Concern for India. It competes with native plants for space and resources, and also alters the nutrient cycle in the soil. This invasion has resulted in the scarcity of native forage plants for wild herbivores. If eaten, the leaves can induce allergies on the muzzles of animals. In some cases, extensive feeding on lantana has led to diarrhoea, liver failure, and even the animal's death.
3. prickly poppy is a species of poppy found in Mexico and now widely naturalized in many parts of the world. It is also referred to as "kateli ka phool" in India.
4. Mimosa plants also called sensitive plant, sleepy plant touch-me-not, shameplant[is a creeping annual or perennial flowering plant. *Mimosa pudica* is well known for its rapid plant movement. The **species is native to the Caribbean and South and Central America, but is now a pantropical weed,**
It is not shade tolerant, and is primarily found on soils with low nutrient concentrations
Mimosa plants in Orang National Park, Assam. The plant is believed to be responsible for a decline in the park's wet alluvial grassland.

- Commercial production of *Kappaphycus*began in the 1960s in the Philippines, the native land of the species. It has since been introduced in over 20 nations.**One of the prime threats that killed the corals near Kurusadai is *Kappaphycus alvarezii***. It is a seaweed (alga) species deliberately introduced in Ramanathapuram for commercial cultivation some two decades ago. The International Union for Conservation of Nature lists it as one of the world's 100 most invasive species.
- Black Watte Shrub (Acacia Mearnsii) Threat to Western Ghats
- Carijoa Riisei also known as snowflake coral is an invasive species discovered recently by the scientists off the coast of Thiruvananthapuram and Kanyakumari.

Que: If you walk through countryside, you are likely to see some birds stalking alongside the cattle to seize the insects, disturbed by their movement through grasses, Which of the following is/are such bird/birds?

1. Painted Stork
2. Common Myna
3. Black-necked Crane

Select the correct answer using the code given below.

a) 1 and 2 B 2 only C 2 and 3 d . 3 only

Black-necked crane feeds on meadows in higher altitudes of Tibetan plateau.

Common myna

- *Acridotheres tristis*
- Calcutta myna, common myna, house myna, Indian myna,
- " Farmer Friend "is a bird native to Asia. An omnivorous open woodland bird with a strong territorial instinct, the common myna has adapted extremely well to urban environments.
- Invasive in Australia, Hawaii, and Fiji. Established and potentially invasive in parts of Europe. Native to South Asia.

The IUCN declared the common myna as one of only three birds among the world's 100 worst invasive species (the other two being the red-vented bulbul and the common starling). The French introduced it in the 18th century from Pondicherry to Mauritius with the aim of controlling insects

Native Range: Asia
Introduced Range: South Pacific Islands, Australia, New Zealand, Madagascar, United States (Florida), and more.

Introduction: Myna birds were intentionally introduced to Fiji in the late 1800s to control pests on sugar cane crops. Now, have become one of the worst invasive species in Fiji

They also harass other native birds by pushing hatchlings from their nests and chasing birds away from food sources, sometimes just for fun. Although they only use one nest during breeding season, they create many nests simply to reduce the available nesting space for other birds.

In News: The red-vented bulbul is a member of the bulbul family.
It is a resident breeder across the Indian subcontinent.
It is included in the list of the world's 100 worst invasive alien species

Cosmos flowers: An invasive species

- Type of weed
- yellow flowers commonly found on the roadside and on hill slopes
- native to mexico
- slow killer of native plants and shrubs.

Social threats related with IAS

Invasive species are a major threat to the livelihoods of the people who live in the areas they colonize. Through disrupting ecosystems, invasive plants, insects and diseases impair many of the things humans need to sustain a good quality of life – including food and shelter, health, security and social interaction. The impacts of invasive species include:

- Livelihood options narrowed
- Food security decreased
- Recreational and social opportunities limited
- Risks to human and animal health
- Increased social challenges

Economic threat RELATED WITH IAS :

- Value and quality of land degraded
- Lower crop productivity
- High cost of controlling pests, weeds and diseases
- Routes to domestic and global markets blocked
- Livestock forced into marginal, sub-optimal grazing lands
- Invasive alien species introduced by human activity have some of the most dramatic effects on isolated ecosystems such as islands and are a leading cause of species extinctions.
- Islands, such as Australia, New Zealand, Madagascar, the Hawaiian Archipelago, and the Galapagos, have a high proportion of endemic and specialized flora and fauna
- Islands are more prone to invasion by alien species because of the lack of natural competitors and predators that control populations in their native ecosystems.
- Invasive alien species pose a particular risk to small island developing States (SIDS) by threatening the ecosystems, livelihoods, economies and public health of inhabitants.
- Increased trade, tourism,transportation R significant vectors, and the most common pathways are ship ballast water, cargo containers and packaging materials, unprocessed commodities such as timber/agricultural goods, imported food species such as fish, horticultural/plant imports, waste material, military activities, and biological agents to combat pests

IAS are the most common threat to amphibians, reptiles and mammals on The IUCN Red List; they may lead to changes in the structure and composition of ecosystems detrimentally affecting ecosystem services, human economy and wellbeing.

KEY NOTE : SILENT INTRUDERS: INVASIVE PEST AND WEED ATTACKS IN INDIA

In the Past 15 years, India has faced many invasive pest attacks :

- fall armyworm
- onion weed
- double gee
- coffee berry borer
- whitefly

Major Invasive Alien Species[15]

Acacia farnesiana (tree, shrub)
Achatina fulica (mollusc)
Ambrosia artemisiifolia (herb)
Aristichthys nobilis (fish)
Bemisia tabaci (insect)
Cabomba caroliniana (aquatic plant)
Chromolaena odorata (herb)
Chromolaena odorata (herb)
Columba livia (bird)
Cryphonectria parasitica (fungus)
Cyprinus carpio (fish)
Eichhornia crassipes (aquatic plant)
Eugenia uniflora (tree, shrub)
Gambusia affinis (fish)
Gymnocoronis spilanthoides (aquatic plant)
Hypophthalmichthys molitrix (fish)
Lantana camara (shrub)
Ludwigia peruviana (aquatic plant)
Mikania micrantha (vine, climber)
Mimosa diplotricha (vine, climber, shrub)
Monomorium pharaonis (insect)
Oncorhynchus mykiss (fish)
Oreochromis mossambicus (fish)
Oreochromis spp. (fish)
Phalaris arundinacea (grass)
Parthenium hysterophorus (herb)
Prosopis spp. (tree, shrub)
Ricinus communis (tree, shrub)
Salmo trutta (fish)
Salvelinus fontinalis (fish)
Salvinia molesta (aquatic plant, herb)
Solenopsis geminata (insect)
Tinca tinca (fish)
Vibrio cholerae (micro-organism)
Zosterops japonicus (bird)

Native Species Exported/Introduced to Non-Native Environments[15]

Acridotheres fuscus (bird)
Albizia julibrissin (tree)
Alternanthera sessilis (herb)
Axis axis (mammal)
Caesalpinia decapetala (tree, shrub)
Casuarina equisetifolia (tree)
Channa marulius (fish)
Clarias batrachus (fish)
Dalbergia sissoo (tree)
Dioscorea bulbifera (herb, vine, climber)
Dioscorea oppositifolia (herb, vine, climber)
Hedychium flavescens (herb)
Hiptage benghalensis (vine, climber, shrub)
Hygrophila polysperma (aquatic plant)
Hypericum perforatum (herb)
Landoltia punctata (aquatic plant)
Lepidium latifolium (herb)
Lutjanus kasmira (fish)
Microstegium vimineum (grass)
Paspalum scrobiculatum (grass)
Pennisetum polystachion (grass)
Rattus rattus (mammal)
Streptopelia decaocto (bird)
Suncus murinus (mammal)
Syzygium cumini (tree)
Ziziphus mauritiana (tree, shrub)

About 28 species native to India have been found to be invasive to other biogeographical zones.[14]

See Chital (Axis Axis) : Recently Ban in Europe (they declared it IAS)

Indian Muntjac/ Barking Deer, protected under Schedule III of the Wildlife (Protection) Act, 1972 is considered as invasive alien species to the Andaman & Nicobar Island (Photo: Debadityo Sinha)

Legal framework in India

- Indian Forest Act 1927
- Forest Conservation Act 1980
- The Wildlife Protection Act of 1972 was updated in 2021 with a new amendment that addresses invasive alien species.
- Bioloogical Diversity Act 2002
- National Biodiversity Authority
- Environment proctection Act 1986
- Livestock Importation Act 1898 (2001 amended)
- The Destructive Insects and Pest Act, 1914
- The Plants, Fruits and Seeds (Regulation of Import into India) Order 1989
- Prevention and Control of Infectious and Contagious Diseases in Animals Act 2009
- National Action Plan of Invasive alien species by MOEFCC

Responsibility for IAS dealing In India

- Ministry of Environment Forest and Climate Change(NBA)
- Ministry of Agriculture (ICAR, National Bureau of Fish Genetic Resources etc)
- Wildlife Institute of India
- Agricultural Marketing Information Network (Ministry of Communications and IT)

Opinion:

- We Have Number of legislation and polices to deal with IAS but some of these existed before invasive species were ever recognised as an issue .
- Responsibility is divided across many different government department and agencies
- for instance, the National Bureau of Plant Genetic Resources and Animal Genetic Resources that deal with quarantine issues are responsible for prevention of introductions

- This creates challenges for a comprehensive approach to the prevention and management of invasive species.

- We need a single comprehensive legislation devised specifically to deal with invasive species. And there needs to be a single nodal agency responsible.

International Instruments and Programmes on Invasive Species

1. Convention on Biological Diversity (CBD): 1992 : also recognised the biological invasion of alien species of plants as the second-worst threat to the environment after habitat destruction.

2. Convention on the Conservation of Migratory Species (CMS) or Bonn Convention (1979):
   - It is an intergovernmental treaty that aims to conserve terrestrial, marine and avian migratory species throughout their range.
   - It also aims to control or to eliminate already present invasive alien species.

3. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): 1975
   - aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival.
   - It also considers the problems of invasive species when it is involved in trade and threatens the survival of live animals or plants.

4 Ramsar Convention (1971):
   - The Ramsar Convention on Wetlands of International Importance is an international treaty for the conservation and sustainable use of wetlands.

- It also addresses the environmental, economic and social impact of invasive species on wetlands within their jurisdictions and to take account of the methods of control and solutions for combating invasive species.

5 . Kunming-Montreal Global Biodiversity Framework (2022): Governments have committed to reducing the rate of introduction and establishment of invasive alien species by at least 50% by 2030.

6 The IUCN SSC Invasive Species Specialist Group (ISSG)aim to reduce threats to ecosystems and their native species by increasing awareness of ways to prevent, control or eradicate IAS.

7 The **Global Invasive Species Database** is a database of invasive species around the world run by the Invasive Species Specialist Group (ISSG) of the International Union for Conservation of Nature. It publishes the list 100 of the World's Worst Invasive Alien Species

CHAPTER :11 AIR POLLUTION AND WATER POLLUTION

Industry Classification for Pollution

Beginning March 5th 2016, the Ministry of Environment, Forests, and Climate Change has adopted a new method of classifying each type of industry. A concept of "white industries" has been introduced for classifying "non-polluting" companies. They do not need a permit or consent and just require to notify the relevant State Pollution Control Board.

For all the others (red, orange and green industries), there are certain environmental permits that are required to be obtained. You might require multiple numbers of permits depending on what kind of activity your business is delving into and the size of the business. Your company will be given a Pollution Index (PI) score, depending on the utilization of the resources, the air emissions, water effluents, and hazardous waste generated. You will be required to obtain consents and permits from the apt board. As per this article, the PI score is allocated in the following manner:

•Red category: PI score of 60 and above. Including but not restricted to asbestos, nuclear power plants, shipbreaking, oil and gas extraction, etc.
•Orange category: PI score of 41 to 59. For example, food processing, printing ink manufacturing, paint blending, and pharmaceutical formulations.
•Green category: PI score of 21 to 40. 63 sectors have been identified under it. For example sawmills, tyres/rube retreating, polythene and plastic products.
•White category: PI score up to 20. For example solar power generation through solar photovoltaic cells, wind power, and mini hydro-electric power less than 25 megawatts.

four colour categorizations for industries as per the following Pollution Index (PI) score between 0 and 100:

Industries with pollution index

Score	Colour Category	Sectors/ Industries
60 +	Red	60
41-59	Orange	83
21-40	Green	63
0-20	White	36

'White' category

- LED and CFL bulb assembly, power generation using solar photovoltaic technology, wind power generating units, hydel units less than 25 MW cotton and woolen hosiers using dry processes

Table 1 : List of White category of Industries

Sl. No.	**Industry Sector**
1.	Air coolers /conditioners
2.	Bicycles ,baby carriages
3.	Bailing of waste papers
4.	Bio fertilizer /bio-pesticides
5.	Biscuits trays
6.	Blending / packing of tea
7.	Block making of printing
8.	Chalk making
9.	Compressed oxygen gas
10.	Cotton and woolen hosiers
11.	Diesel pump repairing
12.	Electric lamp (bulb) and CFL
13.	Electrical and electronic item
14.	Engineering and fabrication units
15.	Flavoured betel nuts
16.	Fly ash bricks/ block
17.	Fountain pen
18.	Glass ampules
19.	Glass putty and sealant
20.	Ground nut decorticating
21.	Handloom/ carpet weaving
22.	Leather cutting and stitching
23.	Coir items from coconut husks
24.	Metal caps containers etc
25.	Shoe brush and wire brush
26.	Medical oxygen
27.	Organic and inorganic nutrients
28.	Organic manure
29.	Packing of powdered milk
30.	Paper pins and u clips
31.	Repairing of electric motors /generators
32.	Rope (plastic and cotton)
33.	Scientific and mathematical instrument
34.	Solar module non-conventional energy apparatus
35.	Solar power generation through solar photovoltaic cell, wind power and mini hydel power (less than 25 MW)
36.	Surgical and medical products assembling

- No Red category of industries shall normally be permitted in the ecologically fragile area / protected area.

- List of Red Category of Industries

Sl No	Industry Sector	Sl No	Industry Sector
1	Isolated storage of hazardous chemicals	39	Yarn / Textile processing
2	Automobile Manufacturing (integrated)	40	Chlor Alkali
3	Hazardous waste recycling (Spent cleared metal catalyst)	41	Ship Breaking
4	Lubricating oils and grease mfg.	42	Oil and gas extraction
5	DG Set (> 5 MVA)	43	Metal surface treatment
6	Carbon black & allied	44	Tanneries
7	Lead acid battery	45	Ports /harbor/jetties
8	Phosphate rock processing	46	Synthetic fibers
9	Power generation plant	47	Thermal Power Plants
10	Hazardous Waste Recyclers (Spent catalyst)	48	Slaughter house
11	Chlorinated hydrocarbons	49	Aluminium Smelter
12	Sugar	50	Copper Smelter
13	Fibre glass production	51	Fertilizer (basic)
14	Fire crackers	52	Integrated Iron & Steel
15	E-Waste Recyclers	53	Pulp & Paper (bleaching)
15	Milk and dairy products	54	Zinc Smelter
17	Phosphorous	55	Oil Refinery
18	Pulp & Paper	56	Petrochemicals
19	Coke making	57	Pharmaceuticals
20	Explosives / detonators	58	Pulp & Paper (Large-Agro + wood),
21	Paints varnishes, pigments	59	Distillery
22	Organic Chemicals	60	Railway locomotive work shop/ service centers
23	Airports and Commercial Air Strips		
24	Asbestos		
25	Basic chemicals		
26	Cement		
27	Chlorates, per-chlorates & peroxides		
28	Chlorine, fluorine, bromine, iodine		
29	Dyes and Dye- Intermediates		
30	Health-care Establishment		
31	Hotels (Big)		
32	Lead acid battery -recyclers		
33	Waste electrical and electronic recyclers		
34	Glue and gelatin		
35	Mining and ore beneficiation		
36	Nuclear power plant		
37	Pesticides		
38	Photographic film /chemicals		

- Table 2 : List of Orange Category of Industries

Sl. No.	Industry Sector	Sl. No.	Industry Sector
1	Almirah, Grill Manufacturing	43	Large Cotton spinning and weaving
2	Aluminium & copper extraction from scrap	44	Lime manufacturing (using lime kiln)
3	Automobile servicing, repairing	45	Liquid floor cleaner, black phenyl
4	Ayurvedic and homeopathic medicine	46	Manufacturing of glass
5	Brickfields	47	Manufacturing of mirror from sheet glass
6	Building and construction >20,000 sq. m	48	Manufacturing of mosquito repellent coil
7	Cashew nut processing	49	Manufacturing of Starch/Sago
8	Ceramics and Refractories	50	Mechanized laundry using oil fired boiler

9	Chanachur and ladoo using husk fired oven	51	Medium scale Hotels
10	Coal washeries	52	Modular wooden furniture
11	Coated electrode	53	New highway construction project
12	Coffee seed processing	54	Non-alcoholic beverages(soft drink)
13	Compact disc computer floppy	55	Paint blending and mixing (Ball mill)
14	Copper waste recyclers	56	Paints and varnishes (mixing and blending)
15	Dairy and dairy products (small scale)	57	Parboiled Rice Mills
16	DG set (>1MVA but < 5MVA)	58	Pharmaceutical formulation
17	Dismantling of rolling stocks	59	Ply-board manufacturing
18	Dry cell battery	60	Potable alcohol (IMFL) by blending
19	Dry coal / mineral processing	61	Printing ink manufacturing
20	Fermentation (Extra Neutral Alcohol)	62	Printing or etching of glass sheet
21	Ferrous and Non- ferrous metal extraction	63	Printing press
22	Fertilizer (granulation / formulation / blending	64	Producer gas plant
23	Fish feed, poultry feed and cattle feed	65	Recyclers - used oils
24	Fish processing and packing	66	REcyclers - waste oils
25	Flakes from rejected PET bottle	67	Recycling - Paint and ink Sludge
26	Foam manufacturing	68	Reprocessing of waste plastic /PVC
27	Food and food processing	69	Rolling mill (oil or coal fired)
28	Forging of ferrous and non- ferrous	70	Silica gel
29	Formulation/pelletization of camphor tablets etc.	71	Silk /saree screen printing
30	Glass ceramics, earthen potteries and tile	72	Spray painting
31	Gravure printing, digital printing on flex, v	73	Steel and steel products with furnaces
32	Heat treatment using oil fired furnace	74	Stone crushers
33	Hot mix plants	75	Surgical and medical products (latex)
34	Ice cream	76	Synthetic detergents and soaps
35	Industry or processes involving foundry operations	77	Synthetic resins
36	Iodized salt from crude/ raw salt	78	Synthetic rubber excluding molding
37	Jute processing without dyeing	79	Tephlon based products
38	large Bakery and confectionery	80	Thermocol manufacturing (with boiler)
39	Transformer repairing/ manufacturing	81	Thermometer
40	Tyres and tubes vulcanization/ hot retread	82	Tobacco products including cigarettes
41	Vegetable oil manufacturing	83	Tooth powder, toothpaste, talcum powder
42	Wire drawing and wire netting		

- Table 3 : List of Green category of Industries

Sl. No.	Industry Sector	Sl. No.	Industry Sector
1	Aluminium utensils	36	Ready mix cement concrete
2	Ayurvedic medicines	37	Reprocessing of waste cotton
3	Small Bakery /confectionery	38	Rice mill (Rice hullers only)
4	PP film	39	Rolling mill (gas fired) and cold rolling mill
5	Biomass briquettes	40	Rubber goods (gas operated baby boiler)
6	Melamine resins	41	Saw mills
7	Brass and bell metal utensils	42	Soap manufacturing
8	Candy	43	Spice Blending
9	Cardboard / corrugated box	44	Spice grinding
10	Carpentry & wooden furniture	45	Steel furniture
11	Cement products	46	Grains processing
12	Ceramic colour by mixing	47	Tyres /tube retreating
13	Chilling plant and ice making	48	Chilling /ice plant

14	Coke briquetting	49	CO2 recovery
15	Small Cotton spinning and weaving	50	Distilled water
16	Dal Mills	51	Small Hotels
17	Decoration of ceramic cups	52	Optical lenses
18	Digital printing on PVC clothes	53	Mineralized water
19	Handling, storage of food grains	54	Tamarind powder
20	Flour mills	55	Marble stone
21	Electrical Glass , ceramic, earthen potteries	56	Emery powder
22	Glue from starch	57	Flyash export
23	Gold and silver smithy	58	Mineral stack yard
24	Non-polluting Heat treatment	59	Oil and gas transportation pipeline
25	Insulation /coated papers	60	Seasoning of wood
26	Leather foot wear /products	61	Synthetic detergent
27	Blending of Lubricating oil, greases	62	Tea processing
28	Pasted veneers	63	Pulverization of bamboo
29	Oil mill Ghani		
30	Packing materials		
31	Phenyl/toilet cleaner		
32	Polythene and plastic products		
33	Poultry, Hatchery and Piggery		
34	Power looms (without dye and bleaching)		
35	Puffed rice (muri) (gas or electrical heating)		

Which of the following Industries comes under Red Category in terms of Pollutiion in India

1. **Pesticides**

2 Sugar

3. Chlorine , fluorine, bromine, iodine

4 Asbestos

5 Pulp and paper

- **Select the Correct Code :**

Water Pollution or Aquatic Pollution

- is the contamination of water bodies, usually as a result of human activities, so that it negatively affects its uses
- Water pollution is a problem in developing countries as well as in developed countries.
- Water pollution is a major environmental issue in India.
- The largest source of water pollution in India is untreated sewage, then soild waste , agricultural runoff and unregulated small-scale industry, industrial activities, agricultural activities, and urban runoff
- Issue: There is a large gap between generation and treatment of domestic waste water in India. The problem is not only that India lacks sufficient treatment capacity but also that the sewage treatment plants that exist do not operate and are not maintained

Major Source

Point Source : When Pollutant are discharged from a specific location like pipe, represent point source pollution
Non Point Source : When Pollutant are discharged from diffused sources or larger area like agricultural fields, grazing lands ,construction sites , abandoned mines etc .

Cause :

- Sewage Water : Domestic and hospital sewage
- Industrial waste
- Agricultural sources
- Thermal and Radiation pollution from Industrial region(Heat can also be a pollutant, and this is called thermal pollution.)
- Invasive alien species also increase eutrophic water bodies ie excessive growth leading to stagnation of polluted water

Groundwater pollution (also called groundwater contamination) occurs when pollutants are released to the ground and make their way into groundwater.

Four Types of Surface Water Pollution

A. Nutrient pollution refers to contamination by excessive inputs of nutrients.
B. Marine pollution occurs when substances used or spread by humans, such as industrial, agricultural and residential waste, particles, noise, excess carbon dioxide or invasive organisms enter the ocean and cause harmful effects there. The majority of this waste (80%) comes from land-based activity, although marine transportation significantly contributes as well
C. The introduction of aquatic invasive organisms is a form of water pollution as well. It causes biological pollution
D. Thermal pollution, sometimes called "thermal enrichment", is the degradation of water quality by any process that changes ambient water temperature.

Impacts :

- Ecosystems: Water pollution is a major global environmental problem because it can result in the degradation of all aquatic ecosystems – fresh, coastal, and ocean waters
- **Public health and waterborne diseases**
- Rivers Yamuna, Ganga, Gomti, Ghaghara, Chambal, Mahi, Vardha and Godavari, are amongst the other most coliform polluted water bodies in India.
- **Eutrophication from nitrogen pollution:** Eutrophication is an increase in the concentration of chemical nutrients in an ecosystem to an extent that increases the primary productivity of the ecosystem. Depending on the degree of eutrophication, subsequent negative environmental effects such as anoxia (oxygen depletion) and severe reductions in water quality may occur, affecting fish and other animal populations
- Ocean acidification is another impact of water pollution. Ocean acidification is the ongoing decrease in the pH value of the Earth's oceans, caused by the uptake of carbon dioxide (CO_2) from the atmosphere

DO: Dissolved Oxygen

- Presence of Organic and Inorganic waste decrease the DO content of the water
- DO content of water is important for survival of aquatic organisms
- Inorganic waste : ammonia (from food processing waste) , heavy metals (from motor vehicles), nitrate and phosphates (from sewage and agriculture)
- Organic compounds like petroleum hydrocarbons and volatile organic compounds such as polychlorinated biphenyl (PCBs)
- The higher amounts of waste increase the rates of decomposition and oxygen consumption thereby decrease the DO content of water

BOD:

- Water Pollution by Organic waste is measured in terms of Biological Oxygen Demand .
- BOD expressed in miligrams of oxygen per litre of water
- The higher value of BOD indicates low Do content of water
- Since BOD is limited to biodegradable materials, it is not reliable method of measuring Water Pollution
- BOD is standard criteria for Pollution assay in aquatic ecosystems

COD:

- is slightly better mode than BOD
- measures biodegradable and non biodegradable waste in water

Riparian Buffers

- A riparian forest buffer is an area adjacent to a stream, lake, or wetland that is managed differently than the surrounding landscape, primarily to provide conservation benefits.
- Riparian forest buffers can provide a variety of benefits, such as:
    - filtering nutrients, pesticides, and animal waste from agricultural land runoff
    - stabilising eroding banks
    - filtering sediment from runoff
    - providing shade, shelter, and food for fish and other aquatic organisms
    - providing wildlife habitat and corridors for terrestrial organisms
    - protecting cropland and downstream communities from flood damage
    - producing income from farmland that is frequently flooded or has previously been flooded.

Bioremediation

- The utilization of microorganisms (bacteria and fungus) to break down environmental pollutants into less hazardous forms is known as bioremediation.
- Using genetic engineering approaches, microorganisms can be precisely created for bioremediation.
- In situ bioremediation - It includes treating contaminated material on-site.
    - Bioventing: Bioventing is the process of supplying air and nutrients to contaminated soil via wells in order to encourage the growth of indigenous bacteria.
    - Biosparging: Biosparging comprises injecting pressurized air beneath the water table to raise groundwater oxygen levels and speed up the biological breakdown of pollutants by naturally occurring bacteria.
    - Bioaugmentation: Microorganisms are introduced to a contaminated location to speed up the breakdown process.
- Ex situ bioremediation - The contaminated material is removed from its original location and treated elsewhere in ex situ bioremediation.
    - Landfarming: Landfarming entails excavating polluted soil, spreading it over a prepared bed, and tilling it periodically until pollutants have degraded. The idea is to encourage indigenous biodegradative bacteria and make it easier for them to degrade pollutants aerobically.
    - Bioreactors: Bioreactors are designed to process polluted solid material (soil, silt, sludge) or water in a controlled environment.
    - Composting: Composting is the natural recycling of decayed organic matter into a fertile soil known as compost.

Phytoremediation

- The use of plants and associated soil microbes to reduce the concentrations or toxic effects of contaminants in the environment is known as phytoremediation.
- Phytoremediation is widely regarded as a low-cost environmental restoration technique.
- Phytoremediation is an alternative to more destructive engineering procedures for the soil.
- To achieve acceptable levels of contaminants in the environment, phytoremediation of contaminated sites should ideally not take more than a decade. However, phytoremediation is limited to the root zone of plants.
- Plants are used in phytoremediation to remove pollutants from soil and water.
- Mangroves, estuary vegetation, and other wetland vegetation perform natural phytoremediation.
- Plants acquire pollutants in their roots, above ground shoots, and leaves (phytoextraction/phytoaccumulation).

Coagulation / Flocculation

- The most common coagulant used for water treatment is aluminum sulfate (alum).
- Other compounds, such as ferric sulphate or sodium aluminate, could be utilized as well.
- Liquid aluminium sulphate (alum) is added to untreated water during coagulation. This causes the dirt particles in the water to coagulate (stick together).
- The dirt particles then join together to form flocs, which are bigger particles.
- Flocs can be removed more easily through settling or filtration.

Sewage Water Treatment for Domestic Use

- Suspended particles, bacteria, algae, viruses, fungi, and minerals like iron and manganese are all removed during the drinking water purification process.
- Physical procedures like settling and filtration, chemical processes like disinfection and coagulation, and biological processes like gradual sand filtration are all used to remove pollutants.

Sedimentation

- Water and floc particles migrate into sedimentation basins as they proceed through the treatment process, where the water moves slowly and the heavier floc particles settle to the bottom.
- Sludge is the floc that settles at the bottom of the basin and is routed to drying lagoons.
- The sedimentation stage is skipped in Direct Filtration, and the floc is only eliminated through filtration.

Filtration

- A filter removes particulates from the water as it goes through it. The filters are constructed of layers of sand and gravel, as well as crushed anthracite in some situations.
- Filtration removes suspended contaminants in water and improves disinfection effectiveness. Backwashing cleans the filters on a regular basis.

Disinfection

- Before entering the distribution system, water is disinfected to eliminate disease-causing bacteria, viruses, and parasites.
- Chlorine is utilized because it is a very powerful disinfectant with low residual concentrations that can protect the water distribution system from biological contamination.
- Chlorination is the process of adding chlorine or chlorine compounds to drinking water.
- Chlorine can develop chloroform and other potentially dangerous by-products when it reacts with certain naturally existing organic chemicals in water.
- When chlorine is added after coagulation, sedimentation, and filtration, the likelihood of this happening is very low.
- Drinking water can also be disinfected with ozone gas.
- Due to the instability of ozone, it cannot be stored and must be created on-site, making the method more expensive than chlorination.
- Ozone has the benefit of not generating a bad taste or odour. In addition, no residue is left in the disinfected water.
- However, because there is no ozone remnant, it is impossible to measure its effectiveness as water passes through the distribution system.

Sludge Drying And Fluoridation

- Sedimentation and filtration take and settle solids out of the water, which are then transferred to drying lagoons.
- Water fluoridation is the process of changing the concentration of the free fluoride ion in community water sources to the optimal amount for reducing dental cavities.
- Fluoride is found in all natural water sources.
- Its concentration is not dangerous up to a certain point. The bones begin to disintegrate beyond that point. Fluorosis is the name for this condition.
- Domestic defluoridation can be accomplished by treating water with an appropriate amount of aluminium sulphate (alum) solution, lime or sodium carbonate, and bleaching powder, depending on the alkalinity (concentration of bicarbonates and carbonates in water) and fluoride content.

pH Correction and Removal of Iron

- To prevent corrosion in the distribution system and within customers' plumbing, lime is added to the filtered water to balance the pH and stabilize the naturally soft water.
- Excess iron in drinking water is an issue in many sections of our country, particularly in the North-East.
- Drinking water with iron has an unpleasant flavour and smell.
- The acceptable limit for iron is 0.3 mg/l, according to the Bureau of Indian Standards.
- Iron is oxidized to a large extent. The water is then exposed to oxidizing agents (limestone).
- The dissolved iron is transformed to insoluble ferric hydroxide by aeration and subsequent oxidation.
- As a result, the insoluble iron may be easily removed through filtration.

Removal of Arsenic

- Groundwater in several places of West Bengal contains arsenic. Arsenic is extremely poisonous.
- The Bureau of Indian Standards recommends a limit of 0.05 mg/l for arsenic.
- Arsenic is removed by using bleaching powder and alum.

Measures Taken By Indian Government

Measures Taken By Indian Government

- State governments must develop an action plan for sewage management and water quality restoration in aquatic resources.
- Installation of an online effluent monitoring system to monitor effluent discharge directly into rivers and bodies of water.
- Establishing a monitoring network to assess water quality.
- SPCBs and PCCs take action to improve river water quality by complying with effluent standards.
- Installation of Common Effluent Treatment Plants for a cluster of Small Scale Industrial Units.
- Directions for the implementation of Zero Liquid Discharge.

- Directions to industries under Section 5 of the Environment (Protection) Act of 1986 and Section 18(1)(b) of the Water (Prevention and Control of Pollution) Act of 1974.
- Implementation of the National Lake Conservation Plan (NLCP) and the National Wetland Conservation Programme (NWCP) for the conservation and management of identified lakes and wetlands in the country, which were merged in February 2013 into an integrated scheme of the National Plan for Conservation of Aquatic Ecosystems (NPCA) to carry out various conservation activities such as waste water interception, diversion, and treatment, pollution abatement, lake beautification, and lake restoration.
- The Indian government recognised the necessity of maintaining the purity of water bodies and passed the Water (Prevention and Control of Pollution) Act, 1974 to protect our water resources.
- In 1985, the Ganga Action Plan, an ambitious plan to save the river, was started.
- The Central Pollution Control Board (CPCB), India's primary water quality management authority, has created the idea of "approved best use."
- On the basis of pH, dissolved oxygen, BOD, total coliform, free ammonia, electrical conductivity, and other factors, the water body is classified as A, B, C, D, or E.
- The CPCB has categorized all water bodies in the country, including coastal waters, according to their "approved best uses," in consultation with the appropriate State Pollution Control Boards.
- This classification aids water quality managers and planners in establishing water quality goals and determining the needs and priorities for water quality restoration programmes across the country.
- This effort resulted in the famous Ganga Action Plan and, later, the National River Action Plan.
- Sewage water and industrial effluents are treated before being released into bodies of water.
- BioToilets - Indian Railways collaborated with DRDO to develop bio-toilets.
    - The direct release of human waste from trains in the present toilet systems causes track corrosion, which costs millions of dollars to replace.
    - The bio-toilets are installed beneath the lavatories, and the human waste released into them is converted into non-corrosive neutral water by a certain type of bacteria.

Conclusion

Conclusion

Our globe is already experiencing severe water pollution and shortage as a result of increased global warming and climate change. Furthermore, as the world's population grows at an exponential rate, water resources are becoming increasingly polluted. Water pollution-related concerns and issues have been rapidly increasing, resulting in an increase in waterborne infections. While there is no one-size-fits-all solution to water pollution, there are a number of things we can do in our daily life to support. Stopping pollution rather than cleaning polluted water is the best strategy to clean polluted water.

Pollutants and their effects*

Pollutant	Main representative parameter	Possible effect of the pollutant
Suspended solids	Total suspended solids	• Aesthetic problems • Sludge deposits • Pollutants adsorption • Protection of pathogens
Biodegradable organic matter	Biological oxygen demand (BOD)	• Oxygen consumption • Death of fish • Septic conditions
Nutrients	• Nitrogen • Phosphorus	• Excessive algae growth • Toxicity to fish (ammonia) • Illnesses in new-born infants (Blue baby syndrome from nitrate) • Pollution of groundwater
Pathogens	• Coliforms, such as E. coli • Helminth eggs[9]	Waterborne diseases
Non-biodegradable organic matter	• Pesticides • Some detergents • Others	• Toxicity (various) • Foam (detergents) • Reduction of oxygen transfer (detergents)

		• Non-biodegradability • Bad odors (e.g.: phenols)
Inorganic dissolved solids	• Total dissolved solids • Conductivity	• Excessive salinity – harm to plantations (irrigation) • Toxicity to plants (some ions) • Problems with soil permeability (sodium)
* Sources of these pollutants are municipal and industrial wastewater, urban runoff, agricultural and pasture activities[10]		

Desalination

Concept of Desalination

- Desalination is a process that takes away mineral components/ removal of salts from saline water.
- These plants are mostly set up in areas that have access to seawater.
- Major urban cities in India experience chronic water problem
- Desalination plants can also reduce pressure on freshwater supplies underground aquifers.
- most eco-friendly and cost-effective solution for the water scarcity issue in the country.
- Minjur Desalination plant in Tamil Nadu started in 2010 and was the first desalination project in the country.
- The desalination plant of Jamnagar is the second-largest desalination plant in India with a capacity of 96000 m3 per day.
- The National Institute of Ocean Technology (NIOT) in association with the Lakshadweep Administration on Thursday initiated a pilot project of Ocean Thermal Energy Conversion (OTEC) powered desalination plant in Kavaratti.
- The OTEC technology uses the temperature difference between the cold water in the deep sea (5°C) and the warm surface seawater (25°C) to generate clean, renewable electricity.

CHAPTER 12 : INTERNATIONAL PERSPECTIVE OF ENVIRONMENT

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INTERNATIONAL ENVIRONMENTAL CONVENTIONS

❖ **RAMSAR CONVENTION (1971)**

- on Wetlands of International Importance called Ramsar Sites
- Especially as Waterfowl Habitat
- (Wetland day : 2 February)
- Ramsar city , Iran near Caspian Sea

❖ **UNITED NATIONS CONFERENCE ON THE HUMAN ENVIRONMENT (1972)**

The UN Conference on the Human Environment (Stockholm Conference) was held in Stockholm, Sweden, in 1972
It marked the emergence of international environmental law.
The participants adopted Stockholm Declaration and Action Plan for the Human Environment.
Stockholm Declaration is also known as The Declaration on the Human Environment.

STOCKHOLM DECLARATION PRINCIPLES

Natural resources must be safeguarded.
Poverty alleviation for protecting the environment.
Weapons of Mass destruction must be destroyed.
Non-renewable sources must not exhaust

Key Outcome

- The Stockholm Conference motivated countries, including India, to create environmental ministries and agencies.
- Department of Environment was created in 1980 (in India)
- Ministry of Environment and Forests (MoEF) in 1985

- In 2014, the MoEF was renamed to the Ministry of Environment, Forest, and Climate Change (MoEFCC)
- Stockholm Conference help in Formation of the UN Environment Programme (UNEP)
- Help in Creation of World Environment Day
- First Environment day (5 June 1973)

About **United Nations Environment Programme (**UNEP)

- Formed 5 June, 1972 outcome of Stockholm Conference / Declaration
- **Headquarter:** Nairobi, Kenya
- is an agency of the UN.
- Also called " UN Environment. "
- It is the world's highest-level decision-making body on the environment
- It coordinates the UN's environmental activities. It assists developing countries in implementing environmentally sound policies and practices.
- It has overall responsibility for environmental problems among UN agencies.
- It was established by Maurice Strong, its first director, after the United Nations Conference on the Human Environment in Stockholm in June 1972.

Major Reports Published by UNEP

- Emission Gap Report,
- Adaptation Gap Report,
- Global Environment Outlook,
- Frontiers,
- Invest into Healthy Planet.
- **'Making Peace with Nature'**

Major Campaigns: Beat Pollution, UN75, World Environment Day, Wild for Life. Faith for Earth Initiative

Award of UNEP

- **Champions of the Earth** established in 2005
- as an annual awards programme to recognize outstanding environmental leaders from the public and private sectors, and from civil society.
- Prime Minister Narendra Modi was awarded the UN's highest environmental honour 'Champions of the Earth' in 2018, for his leadership of the International Solar Alliance and pledge to eliminate single-use plastic in India by 2022.
- In the same year, Cochin International Airport was also given the same award for Entrepreneurial Vision, for being the world's first fully solar-powered airport

India and UNEP

- India has had a close engagement with United Nations Environment Programme (UNEP) since its inception and there are ongoing and implemented UNEP projects in India.
- Ministry of Environment, Forests & Climate Change is the nodal Ministry dealing with India's engagement with UNEP
- India makes an annual financial contribution (US$ 100,000) to the General-Purpose Funds of UN Environment and to several Multilateral Environment Agreements.

UNEP hosts the secretariats of several multilateral environmental agreements and research bodies,

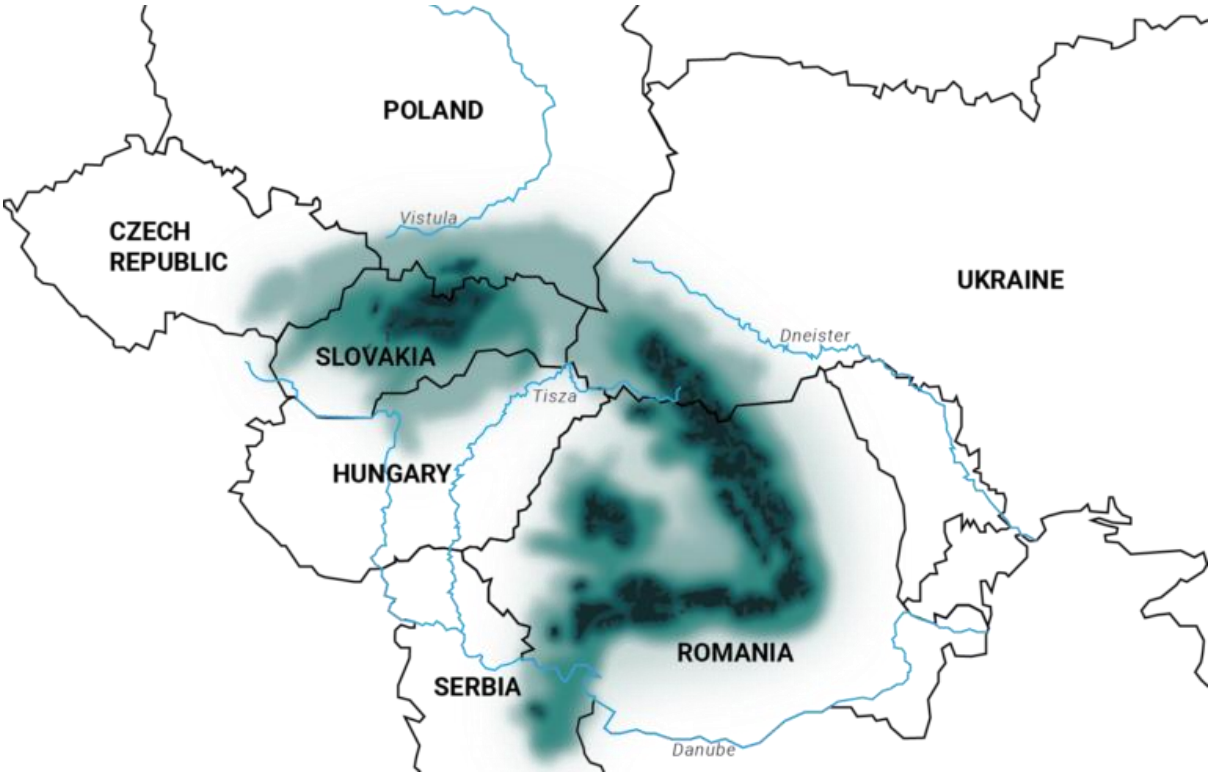
- United Nations Convention on Biological Diversity (CBD),
- The Minamata Convention on Mercury,
- The Basel Convention : Transboundary movements of Hazardous waste & Disposal
- Rotterdam Convention: Certain chemical and pesticides

- Stockholm Convention: Persistent organic pollutants
- The Convention on Migratory Species
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Montreal Protocol
- Vienna Convention for the protection of the Ozone layer
- Climate & Clean Air Coalition (CCAC)

Regional Conventions of UNEP

- **Bamako Convention:** (Country : Mali): Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa

- **Carpathian Convention:** Framework Convention on the Protection and Sustainable Development of the Carpathians. Carpathian Mountains, a major transboundary mountain range shared by the seven countries (Romania , Ukraine , Serbia, Slovakia, Hungary , Poland , Czech Republic)



UNEP Regional Sea Conventions : **Protection and Management of Coastal and Marine Environment**

- **Tehran Convention:** Protection of Marine Environment of the Caspian Sea of five littoral Caspian states: Azerbaijan, Iran, Kazakhstan, Russian Federation and Turkmenistan

- **Abidjan Convention** : (Capital of Ivory Coast . Africa) : Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the Atlantic Coast of the West, Central and Southern African Region
- **Barcelona Convention: (located in Spain)** Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean pollution is a regional convention adopted in 1976 to prevent and abate pollution from ships, aircraft and land based sources in the Mediterranean Sea.

- **Cartegana Convention** : (Located in Colombia) Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region of 26 countries , It covers the marine environment of the Gulf of Mexico, the Caribbean Sea and the areas of the Atlantic Ocean adjacent thereto, south of 30 north latitude and within 200 nautical miles of the Atlantic Coasts of the States.

Nairobi Convention : Protection, Management , Development of the Marine and Coastal Environment of the Western Indian Ocean : Comoros, France, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, Tanzania and the Republic of South Africa — provides a platform for governments, civil society, and the private sector to work together for the sustainable management and use of the marine and coastal environment.

Prelims Practice :

Consider the Following Conventions about Protection and Management of Marine and Coastal Regions .

(Conventions) (Region / Purpose / Management of)

1. Nairobi Convention : Western India Ocean
2 . Cartegana Convention: Wider Caribbean Region
3 Tehran Convention : Caspian Sea
4 . Barcelona Convention : Mediterranean Pollution

How Many Pairs are correct ?

a) one only
b) two only
c) three only
d) All Four

Note :

- In 1988, the World Meteorological Organization and UNEP established the Intergovernmental Panel on Climate Change (IPCC)

- UNEP is also one of the several implementing agencies for the Global Environment Facility (GEF) and the Multilateral Fund for implementing the Montreal Protocol.

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GLOBAL DEVELOPMENT FRAMEWORKS

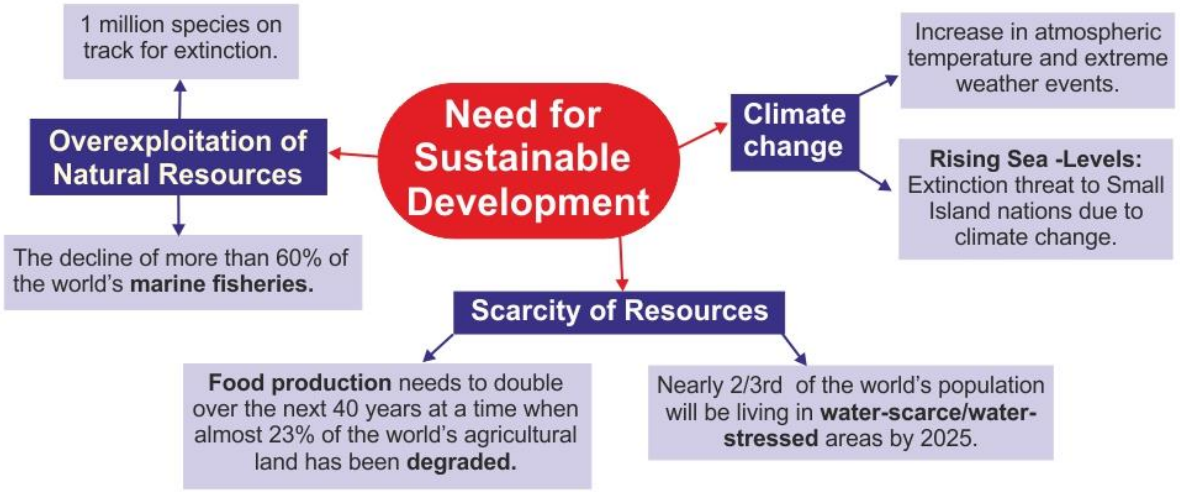
❖ **''Brundtland Commission** 1983 :

- World Commission on Environment and Development released report: OUR COMMON FUTURE, called Brundtland Report, and report published 1987
- **Background:**
- Rachel Carson's: Silent spring 1962,
- Kenneth E. Boulding : The Economics of the Coming Spaceship Earth, 1966
- Club of Rome : report " Limits to Growth" 1972

Define **SUSTAINABLE DEVELOPMENT**

- **'**Development which meets the needs of the present without compromising the ability of future generations to meet their own needs'.

- is the organizing principle for sustaining finite resources necessary to provide for the needs of future generations of life on the planet.



Sustainable Development Goal

- Transforming our World: the 2030 Agenda for SD
- Include 17 Goals/169 Targets
- SDGs are **not legally binding**
- post 2015 Development Agenda successor to MDG based on the resolution called" The Future We Want"
- Niti Aayog has been entrusted with role to coordinate SDG
- **Who released** Sustainable Development Goals (SDGs) India Index **(SDG Index 2.0)**.: NITI Aayog
- The **Millennium Development Goals** (**MDGs**) were eight international development goals for the year 2015 that had been established following the Millennium Summit of the United Nations in 2000, following the adoption of the United Nations Millennium Declaration.

MDG : Target Year : 2015:

1. To eradicate extreme poverty and hunger
2. To achieve universal primary education
3. To promote gender equality and empower women
4. To reduce child mortality
5. To improve maternal health
6. To combat HIV/AIDS, malaria, and other diseases
7. To ensure environmental sustainability
8. To develop a global partnership for development

SDG:

1. No poverty;
2. Zero hunger;
3. Good health and well-being;
4. Quality education;
5. Gender equality;
6. Clean water and sanitation;
7. Affordable and clean energy;
8. Decent work and economic growth;
9. Industry, innovation, and infrastructure;
10. Reduce inequality;
11. Sustainable cities and communities;
12. Responsible consumption and production;
13. Climate action;
14. Life under water;
15. Life on land;
16. Peace, justice, and strong institutions; and
17. Partnership for the goals.

[UPSC 2016] Consider the following statements: (2016)

1) The SDGs were first proposed in 1972 by a global think tank called the 'Club of Rome'.
2) The SDGs have to be achieved by 2030.

Which of the above statements is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Answer: b) 2 only

Key Differences

- **Scope :** SDGS have much broader scope and wide range of issues than MDGs
- **Design :** MDGs were primarily designed for developing countries and SDGS apply to all countries, both developing and developed, recognizing that global challenges require collective action from all nations.
- MDGs were drawn up by a group of experts in the 'basement of UN headquarters' whereas SDGs have evolved after a long and extensive consultative process including 70 Open Working Groups, Civil Society Organizations, thematic consultations, country consultations, participation of general public through face-to-face meetings and online mechanisms and door to door survey;
- While MDGs were focused with only 8 goals, 21 targets and 63 indicators, SDGs include 17 goals with 169 targets
- **Integration:** The SDGs are more integrated and interconnected compared to the MDGs. They are designed to work together in a holistic manner, recognizing that progress in one goal can have positive impacts on others. This approach encourages systemic and interconnected solutions to global challenges.
- **Inclusivity:** The SDGs emphasize inclusivity and leaving no one behind. They aim to address the needs and concerns of all individuals, including women, children, indigenous people, persons with disabilities, and marginalized communities. The MDGs, although they did address some of these issues, did not explicitly prioritize inclusivity to the same extent**.**
- **Data and monitoring:** The SDGs focus heavily on data collection, monitoring, and accountability. They aim to measure progress through global indicators and identify progress or gaps within different social groups. This data-driven approach helps countries track their progress and make informed policy decisions.
- **Financing:** Unlike the MDGs, the SDGs recognize the importance of domestic resource mobilization, private sector engagement, and partnerships with various stakeholders, including the public sector, civil society, and international organizations, to secure the necessary funding for achieving the goals.
- MDGs had no concrete role for the Civil Society Organizations (CSOs), whereas SDGs have paid attention to this right from the framing stage itself with significant engagement of civil society actors

So , the SDGs build upon the achievements and lessons learned from the MDGs while aiming for a broader and more equitable global sustainable development agenda.

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EARTH SUMMIT United Nations Conference on Environment and Development (UNCED)

- The United Nations Conference on Environment and Development (UNCED) is popularly known as Earth Summit 1992
- UNCED succeeded in raising public awareness of the need to integrate environment and development.
- At UNCED, 190 countries pledged their commitment to achieving by 2010, a significant reduction in the current rate of biodiversity loss at global, regional, and local levels.

Landmark Agreements : Important Legally binding Agreement were opened for signatories :

1. **UNFCCC :** United Nation Framework Convention on Climate Change:Kyoto protocol and Paris agreement
2. **CBD:** Convention on Biological Diversity ; Cartegana Protocol and Nagoya protocol
3. **UN** Convention to Combat Desertification

Four Crucial Document adopted at Summit:
1. Rio Declaration or Draft Earth Charter : Principles intended to guide countries in future sustainable development. 27 Guiding Principles relates to Conservation, Protection, Restoration of Health and Integrity of Earth Ecosystem . Document recognized: **"Polluter Should Bear the Cost"**

2. Convention of Climate Change and Biodiversity
3. Convention in Forestry : Forest Principles: Non-legally binding document on the Conservation and Sustainable Development of all types of forests
4. Agenda 21 Action Plan

Earth Summit 1992 (Rio de Janeiro) - UN Conference on Environment and Development
Earth Summit 2002 (Rio+10) (Johannesburg) -World Summit on Sustainable Development
Earth Summit 2012 (Rio+20) (Rio de Janeiro)- UN Conference on Sustainable Development

What is Agenda 21
Product of / Outcome of Earth Summit .
intended to set out an international program of action for achieving sustainable development during the 21st century.
is a non binding action plan of the United Nations with regard to sustainable development.
It aims to achieve global sustainable development.

[UPSC 2016] With reference to 'Agenda 21', sometimes seen in the news, consider the following statements:

1) It is a global action plan for sustainable development.
2) It originated in the World Summit on Sustainable Development held in Johannesburg in 2002.

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

Explanation: • Agenda 21 came out as a part of Earth Summit 1992. Answer: a) 1 only

After 1992: Post UNCED

- **CDS: Commission on Sustainable Development** was created after 1992 Earth Summit to oversee the implementation of various programme on SD at national and International level.

- Earth Summit 2002 : After 10 Years: Rio +10 : Johannesburg Declaration,**2002 :** WSSD: **World Summit on Sustainable Development at Johannesburg, South Africa**.
- Rio+10 affirmed the UN commitment to Agenda 21 alongside the Millennium Development Goals (MDGs).
- The ensuing Johannesburg Declaration committed the nations of the world towards sustainable development.
- Summit Recognized **:** Pressing Issues called "WEHAB Initiative
- **What is WEHAB? :** Water, Energy, Health, Agriculture, Biodivesity are five important elements in Sustainable development. "Johannesburg Declaration" recognizing that Poverty eradication and changing Production and consumption pattern as prerequisites in Sustainable Development .

Rio+20 (2012) or Earth Summit 2012:
- In 2012 : After 20 years: RIO+ 2012: at Rio de janeiro: The **United Nations Conference on Sustainable Development** (**UNCSD**) (Rio+20/Rio Earth Summit 2012) was also held in Rio, Brazil

- The document, "The Future We Want," called for the development of Sustainable Development Goals (SDGs), a set of measurable targets aimed at promoting sustainable development globally

[UPSC 2015] What is Rio+20 Conference, often mentioned in the news?

a) It is the UN Conference on Sustainable Development
b) It is a Ministerial Meeting of the WTO
c) It is a Conference of the IPCC
d) It is a Conference of the Member Countries of the CBD

Answer A

Partnership for Action on Green Economy (PAGE)

- PAGE, launched in 2013,
- is a direct response to the Rio+20 Declaration, The Future We Want.
- It seeks to assist countries in achieving SDG (2030 Agenda), especially SDG 8: "Promote sustained, inclusive and sustainable economic growth, full and productive employment."

[UPSC 2018] The Partnership for Action on Green Economy (PAGE), a UN mechanism to assist countries in transition towards greener and more inclusive economies, emerged at (2018)

a) The Earth Summit on Sustainable Development 2002, Johannesburg
b) The United Nations Conference on Sustainable Development 2012, Rio de Janeiro
c) The United Nations Framework Convention on Climate Change 2015, Paris
d) The World Sustainable Development Summit 2016, New Delhi

Ans B

Sustainable development Summit 2015 in New york :
Agenda 2030, also known as the Sustainable Development Goals,
a total of 17 interlinked goals have been agreed on, revolving around the same concepts of Agenda 21; people, planet, prosperity, peace, and partnership

Agenda 2030:
also known as the Sustainable Development Goals, was a set of goals decided upon at the UN Sustainable Development Summit in 2015.
it takes all of the goals set by Agenda 21 and re-asserts them as the basis for sustainable development,
revolving around the same concepts of Agenda 21; people, planet, prosperity, peace, and partnership.

****

Kindly Note The Three Clauses :

1. Rio Declaration 1992 = 27 Guiding Principles relates to Conservation, Protection, Restoration of Health and Integrity of Earth Ecosystem . Document recognized: **"Polluter Should Bear the Cost"**

Here, developed Countries Like USA, talking about **Common Responsibility** and developing countries -focus on **Differential Responsibility.**

2. Kyoto Protocol, 1997 Document recognized: **Common but Differential Responsibility** to conserve Earth Ecosystem.

3. Paris Agreement, 2015 : the clause termed as:" Common but Differentiated Responsibilities and Respective Capabilities (CBDR–RC)" is a principle within the United Nations Framework Convention on Climate Change (UNFCCC) that acknowledges the different capabilities and differing responsibilities of individual countries in addressing climate change.

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[UPSC 2014] With reference to 'GEF', which of the following statements is/are correct?

a) It serves as financial mechanism for 'Convention on Biological Diversity' and 'United Nations Framework Convention on Climate Change'.
b) It undertakes scientific research on environmental issues at global level
c) It is an agency under OECD to facilitate the transfer of technology and funds to underdeveloped countries with specific aim to protect their environment.
d) Both (a) and (b)

Explanation:
• GEF is an independent financial organisation (not a research body). It may fund scientific research but is not directly involved in it.
• IPCC takes care of most of the research work.
Answer: a)

What is GEF or Global Environment Facility

was established in 1992 Rio Earth Summit
an independently operating financial organisation.
HQ: Since 1994, however, the World Bank has served as the Trustee of the GEF Trust Fund and provided administrative services.
So HQ is in Washington DC
The GEF runs a Small Grants Programme that provides financial and technical support to projects which embody a community-based approach

The GEF is jointly managed by the United Nations Development Programme (UNDP), the World Bank, and the United Nations Environment Programme (UNEP).

The GEF also serves as Multilateral financial mechanism for the following conventions:
Convention on Biological Diversity (CBD)
United Nations Framework Convention on Climate Change (UNFCCC)
United Nations Convention to Combat Desertification (UNCCD)
Stockholm Convention on Persistent Organic Pollutants
Minamata Convention on Mercury

Note : The GEF, although not linked formally to the Montreal Protocol on Substances that Deplete the Ozone Layer (MP), supports implementation of the Protocol in countries with economies in transition.

Multilateral Fund (MLF) for the Implementation of the Montreal Protocol

The MLF provides funds to help developing countries comply with their obligations under the Montreal Protocol to phase out the use of ozone-depleting substances (ODS) at an agreed schedule. It was established by the London Amendment to the Montreal Protocol in 1990.

The GEF works with18 agencies

1) United Nations Development Programme (UNDP)
2) United Nations Environment Programme (UNEP) 3) World Bank (WB)
4) Food and Agriculture Organization (FAO)
5) Asian Development Bank (ADB)
6) International Fund for Agricultural Development (IFAD)
7) World Wide Fund for Nature (WWF)
8) Conservation International (CI)
9) International Union for Conservation of Nature (IUCN)

India is a major player in the GEF.

It is both a donor and a recipient of funding from the GEF.
The political focal point for GEF in India is the Finance Ministry while the operational focal point is the Environment Ministry.
India, Bhutan, Maldives, Sri Lanka, Nepal, and Bangladesh have together formed a Permanent Constituency in the Executive Council of the GEF.
India receives funding from the GEF for work in three major areas namely, biodiversity, climate change, and land degradation.

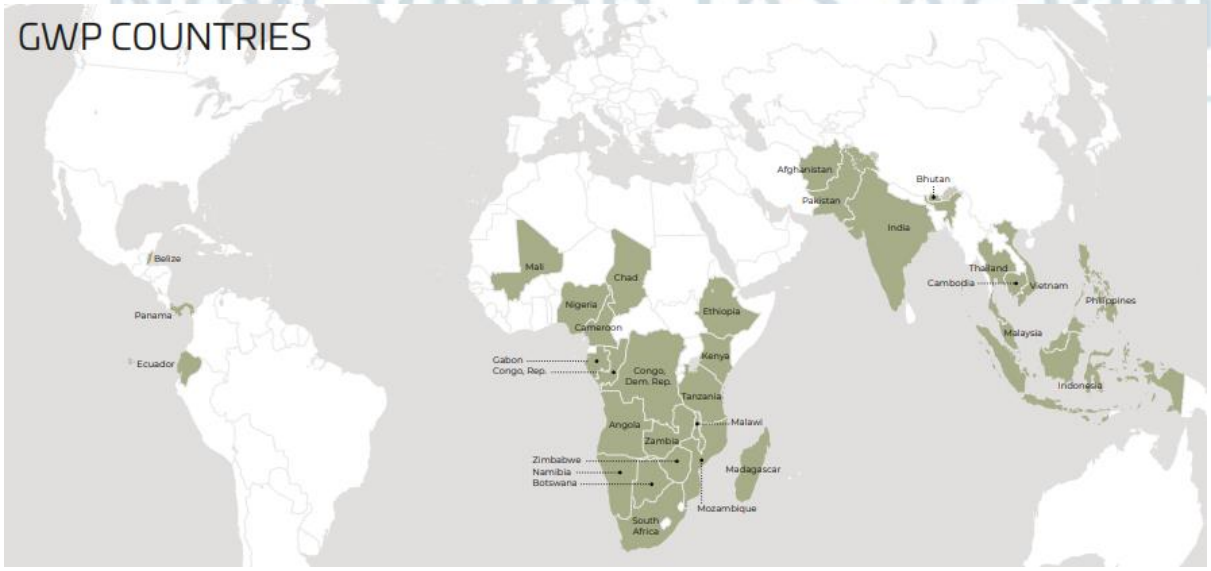
GEF Climate Change Adaptation Funds (operated by GEF)

- LDCF : Least Developed Countries Fund (2001) to support work programme under UNFCCC
- SCCF: Special Climate Change Fund (2001)- administered by GEF, for developing countries under UNFCCC

GBFF

Global Wildlife Programme

- Launched in 2015
- to Combat trafficking in wildlife (which is Global Challenge)
- It is a World Bank led and GEF funded partnership
- GWP projects across 32 Countries , Africa, Asia, Latin America, Caribbean
- It Address Issues : Illegal Wildlife Trade , Human Wildlife Conflict



Example

What is Secure Himalaya Project of GWP?

- Securing Livelihoods, Conservation, Sustainable Use and Restoration of High Range Himalayan Ecosystems (SECURE) Himalayas:
- Project Period : 2017 to 2024

- A joint project of the Ministry of Environment, Forest and Climate Change (MOEFCC) and United Nations Development Programme (UNDP), India, funded by the Global Environment Facility (GEF)
- SECURE Himalaya is implementing a landscape based approach for the conservation and protection of the high-altitude ecosystems of the Himalayas.
- GEF Agency UNDP
- Executing Partner(s) Ministry of Environment, Forest and Climate Change

.Que Consider the below statements about Global Wildlife Programme (GWP):
1) GWP is a CITES led global partnership that promotes wildlife conservation and sustainable development by combating illicit trafficking in wildlife.

2) The GWP is funded by the Global Environment Facility.

Which of the statements given above are correct?
a) 1 only
b) 2 only
c) Both
d) None Correct

Answer: b) 2 only

[UPSC 2014] Consider the following international agreements:

1) The International Treaty on Plant Genetic Resources for Food and Agriculture
2) The United Nations Convention to Combat Desertification
3) The World Heritage Convention
Which of the above has/have a bearing on the biodiversity?
a) 1 and 2 only
b) 3 only,
c) 1 and 3 only
d) 1, 2. and 3

Answer: d) all

EXp

About Plant Treaty

- The **International Treaty on Plant Genetic Resources for Food and Agriculture International Seed Treaty** or **Plant Treaty**

- is a comprehensive legally binding international agreement in harmony with the Convention on Biological Diversity,
- which aims at guaranteeing food security through the conservation, exchange and sustainable use of the world's plant genetic resources for food and agriculture (PGRFA), the fair and equitable benefit sharing arising from its use, as well as the recognition of farmers' rights.
- signed 2001 location Rome FAO
- currently has 149 Contracting Parties, including India.
- The treaty provides solutions to achieve food and nutritional security as well as climate resilient agriculture.

About World Heritage Convention

- is an international treaty signed on 23 November 1972
- which created the World Heritage Sites,

- with the primary goals of nature conservation and the preservation of cultural properties
- Under UNESCO
- UNESCO lists sites under ten criteria; each entry must meet at least one of the criteria. Criteria i through vi are cultural, and vii through x are natural
- There are 42 World Heritage Sites in India
- Out of these, 34 are cultural, seven are natural, and one, Khangchendzonga National Park, is of mixed type.
- There are currently 1,172 World Heritage Sites across 166 countries, of which 913 are cultural, 220 are natural, and 39 are mixed properties that have outstanding universal value as the heritage of humanity.

Selection Criteria for UNESCO World Heritage Site

- For a site to be inscribed as a World Heritage Site, it must go through a rigorous nomination and evaluation process.
- UNESCO's advisory bodies - the International Council on Monuments and Sites (ICOMOS) and the International Union for Conservation of Nature (IUCN) - assess each nominated site.
- A site must demonstrate Outstanding Universal Value (OUV) by meeting one or more criteria defined in the Convention to make it worthy of special protection for all humanity.

What is the selection and evaluation process for World Heritage Sites?

- Sites nominated by member states are assessed by UNESCO advisory bodies against criteria of Outstanding Universal Value before being inscribed on the World Heritage List if they meet the benchmarks.

What benefits does being a World Heritage Site confer?It promotes conservation, protection and restoration of the heritage site while also facilitating tourism and boosting prestige. UNESCO provides expert advice and access to funding for listed sites.

Key Facts :

- first world heritage site in India: Agra Fort, It was tagged as a World Heritage site by UNESCO in 1983.
- The first sites inscribed from India in 1983 were the Ajanta Caves, Ellora Caves and Agra Fort.
- Which country has the highest World Heritage sites? China and Italy have the highest number of World Heritage Sites, both with 55 entries.
- Which state in India has the highest UNESCO World Heritage sites?
- Rajasthan has 6 inscribed World Heritage Sites - the most for any state in India.
- Currently, Maharashtra has a total of five UNESCO World Heritage Sites and this number is highest among all states and UTs in India. The sites include Ajanta Caves, Ellora Caves, Elephanta Caves, Chhatrapati Shivaji Maharaj Terminus, and the Victorian Gothic and Art Deco buildings of South Mumbai.

Cultural Heritage Sites in India	Year of Entry	State
#1 Agra Fort	1983	Uttar Pradesh
#2 Ajanta Caves	1983	Maharashtra
#3 Ellora Caves	1983	Maharashtra
#4 Taj Mahal	1983	Uttar Pradesh
#5 Group of Monuments at Mahabalipuram	1984	Tamil Nadu
#6 Sun Temple, Konark	1984	Odisha
#7 Churches and Convents of Goa	1984	Goa

Cultural Heritage Sites in India	Year of Entry	State
#8 Fatehpur Sikri	1986	Uttar Pradesh
#9 Group of Monuments at Hampi	1986	Karnataka
#10 Khajuraho Group of Monuments	1986	Madhya Pradesh
#11 Elephanta Caves	1987	Maharashtra
#12 Great Living Chola Temples	1987	Tamil Nadu
#13 Group of Monuments at Pattadakal	1987	Karnataka
#14 Santiniketan	2023	West Bengal
#15 Buddhist Monuments at Sanchi	1989	Madhya Pradesh
#16 Mountain Railways of India	1999	West Bengal, Tamil Nadu, Himachal Pradesh
#17 Humayun's Tomb, Delhi	1993	Delhi
#18 Qutub Minar and Monuments, Delhi	1993	Delhi
#19 Mahabodhi Temple Complex at Bodh Gaya	2002	Bihar
#20 Rock Shelters of Bhimbetka	2003	Madhya Pradesh
#21 Champaner-Pavagadh Archaeological Park	2004	Gujarat
#22 Chhatrapati Shivaji Terminus (formerly Victoria Terminus	2004	Maharashtra
23 Red Fort Complex	2007	Delhi
#24 Jantar Mantar	2010	Jaipur
#25 Hill Forts of Rajasthan	2013	Rajasthan
#26 Rani Ki Vav (The Queen's Stepwell)	2014	Gujarat
#27 Archaeological Site of Nalanda Mahavira at Nalanda	2016	Bihar
#28 The Architectural Work of Le Corbusier, an Outstanding Contribution to the Modern Movement	2016	Chandigarh
#29 Historic City of Ahmedabad	2017	Gujarat
#30 Victorian Gothic and Art Deco Ensembles of Mumbai	2018	Maharashtra
#31 Jaipur City	2019	Rajasthan
#32 Kakatiya Rudreshwara (Ramappa) Temple	2021	Telangana
#33 Dholavira, a Harappan City	2021	Gujarat
#34 Sacred Ensembles of the Hoysala	2023	Karnataka

Natural Heritage Site in India	Year of Entry	State
#1 Sundarbans National Park	1987	West Bengal
#2 Western Ghats	2012	Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra, and Gujarat
#3 Nanda Devi and Valley of Flowers National Parks	1988	Uttarakhand
#4 Manas Wildlife Sanctuary	1985	Assam
#5 Great Himalayan National Park	2014	Himachal Pradesh
#6 Keoladeo National Park	1985	Rajasthan
#7 Kaziranga National Park	1985	Assam

UNESCO Mixed World Heritage Sites

1. Khangchendzonga National Park- (2016)

- **Location Sikkim**
- **Cultural Significance:** Associated with indigenous Sikkimese culture and sacred meaning of the mountain peak
- **Natural Significance:** Protects a huge range of eastern Himalayan biodiversity across different vegetation zones from subtropical to alpine meadows

2 Rani-ki-Vav (Queen's Stepwell) at Patan (2014)

- **Location Gujarat**
- Unique 11th-century stepwell demonstrating mastery of engineering and architecture
- Conserves knowledge of Traditional Water Management Systems forming the cultural landscape around the Stepwell

[UPSC 2016] Consider the following pairs:

Terms sometimes in the news	Their origin
1) Annex-I Countries	Cartagena Protocol
2) Certified Emissions Reductions	Nagoya Protocol
3) Clean Development Mechanism	Kyoto Protocol

Which of the pairs given above is/are correctly matched?
a) 1 and 2 only
b) 2 and 3 only
c) 3 only
d) 1, 2 and 3

Explanation:
• Annex-I Countries, Clean Development Mechanism, Certified Emission Reductions (CERs) or carbon credits \ Kyoto Protocol.
Answer: c) 3 only

International Measure for Biodiversity Conservation

UN-CBD: Convention on Biological Diversity :

CBD, approved 1992 at Earth Summit, Rio de Janerio and came into force in 1993.
Is a multilateral treaty. and Signed 5 June 1992 Parties 196, it is legally binding convention
International Day for Biological Diversity (Convention on May 22, 1992, at the Rio de Janeiro Earth Summit)

- **Secretariat:** Montreal, **Canada operates under UNEP**

The Convention has three main goals including:
1. the conservation of biological diversity (or biodiversity);
2. the sustainable use of its components; and
3. the fair and equitable sharing of benefits arising from genetic resources.

Two CBD Protocol till
1. Cartagena protocol: on Biosafety adopted in year 2000 and forced in 2003
2. Nagoya Protocol on Access to Genetic Resources adopted in 2010 and forced in 2014

About Cartagena Protocol
- **on Biosafety to the** Convention on Biological Diversity
- **seeks to protect biodiversity from the potential risks caused by LMOs arising from modern technology.**
- It is a supplementary agreement to the CBD like the Nagoya Protocol.
- The Protocol was adopted in 2000 and it came into force in 2003. The protocol was adopted in Montreal in 2000 but is named after Cartagena, the original city in Colombia where the protocol was supposed to be adopted. It was delayed due to some outstanding issues.

- The Protocol has provisions for an **Advance Informed Agreement (AIA)** procedure.
  - The AIA is for ensuring that countries are given enough information to make informed decisions before agreeing to import LMOs into their country.
  - There are four components to the AIA:
    - Notification by the exporter (This is a detailed written description of the LMO by the exporter, well in advance of the first shipment)
    - Acknowledgement of notification receipt by the importer
    - Decision procedure (Approve/prohibit/ask for more information, etc.)
    - Review of decisions
- The Cartagena Protocol also sets up a **Biosafety Clearing-House (BCH)** to enable information exchange on LMOs between countries.
  - It is also intended to help countries implement the Cartagena Protocol.
  - The BCH is an information-sharing mechanism for relevant technical, scientific and legal information.
- The Protocol gives a precautionary approach to the issue of transfer of LMOs from one country to another.

Que : Which of the following Protocol has arrangement of Advance Informed Agreement
e) Kyoto Protocol
f) Cartegana protocol
g) Nagoya Protocol
h) Paris Agreement

The **Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS)** is a supplementary International agreement to the UN Convention on Biological Diversity (CBD)

- The protocol was adopted in 2010 in Nagoya, Japan. It entered into force in October 2014.

➢ it address traditional Knowledge associated with Genetic Resources where indigeneous and local communittes have the established right to grant access to them .

- like

Traditional Knowlege: **Bamboo Irrigation System**: Meghalaya

- Apata

mi Water conservation farming system: Arunachal Pradesh: **Rice-fish system of Apatani plateau.**

- **Ahar**

Pynes: tradtional floodwater harvesting system in South Bihar

- ***Bathukamma** -Floral festival of Telegana
- **"Zabo"** is an indigenous farming system of Nagaland. The word "Zabo" means impounding of water. It has a combination of forest, agriculture and animal husbandry with well-founded soil and water conservation base
- **Bun system of cultivation:**This system of cultivation is practiced mainly in the state of Meghalaya. Under this system, the crops are grown on a series of raised beds locally referred to as "Bun" formed along the slope of the hills.

Is Nagoya Protocol legally binding? **Yes, it is legally binding.**
Is India signatory to Nagoya Protocol? Yes, India is a signatory to the Protocol.

Nagoya Protocol [Access and Benefit Sharing]	Cartagena Protocol [Biosafety]
This protocol, also known as Biodiversity Accord; saves the developing countries from "foreign illegitimate bioprospecting". It addresses the problem source countries of genetic resources by recognizing their right to get a share in benefits reaped by foreign bioprospectors.	The Cartagena Protocol on Biosafety was adopted in 2000 and it is a legally binding protocol as part of CBD. Is related to "Biosafety measures", i.e. Biosafety concerns related to import & export of Living Modified Organisms (LMOs) and commodities made from them.

Nagoya -Kuala Lumpur Supplementary Protocol on liability and redress: provides international rules and procedure on liability and redress for damage to biodiversity resulting from LMOs. living microorganisms.

WHAT IS THE AICHI TARGET?

- Related with Biodiversity
- Adopted by Convention on Biological Diversity at Nagoya Conference , 2010
- Nagoya and Aichi Place located in Japan
- Aichi Target is 10 Year Plan : Strategic Plan for Biodiversity -2011 to 2020.
- To generate support and momentum for this critical task, the United Nations General Assembly declared 2011-2020 the "United Nations Decade on Biodiversity,"
- Twenty Global Biodiversity Targets divided under Five Strategic Goals

Five Strategic Goals are :

- **Strategic Goal A:**Address the underlying **causes of biodiversity loss** by mainstreaming biodiversity across government and society
- Strategic Goal B:**Reduce the direct pressures on biodiversity** and promote sustainable use
- Strategic Goal C:To **improve the status of biodiversity** by safeguarding ecosystems, species and genetic diversity
- Strategic Goal D:**Enhance the benefits** to all from biodiversity and ecosystem services
- Strategic Goal E **Enhance implementation** through participatory planning, knowledge management and capacity building.

Outcome :

- reducing deforestation by at least half during the coming decade and curbing pollution
- aimed to protect or conserve 17% of all land and inland waters and 10% of the ocean by the end of the decade.
- Many of the targets, however, included vague language and did not hold countries to a specific action
- After parties adopted the Aichi Targets, they were expected to devise their own national biodiversity strategies that would mimic the goals laid out by Aichi.
- Nearly all parties created these strategies, but most were never fully implemented.
- No single country met all 20 Aichi Targets within its own borders
- A lack of financing to help developing countries meet the Aichi goals was also an obstacle to their success
- In the end, Aichi was deemed a failure by the United Nations and the CBD secretariat called on parties to come up with another guiding document to direct conservation efforts through 2030 and beyond.

The Kunming-Montreal Global Biodiversity Framework (GBF)

- adopted in Montreal ,Canada during the fifteenth meeting of the Conference of the Parties (COP 15), 2022
- It has been promoted as a "Paris Agreement for Nature"
- The Framework is named after two cities
- First COP was scheduled for Kunming , China but postponed due to covid to Montreal.
- A new Global Biodiversity Framework Fund will be established under the Global Environment Facility. It targets at least USD 200 billion annually by 2030.

GBF contains

- 4 global goals ("Kunming-Montreal Global Goals for 2050") and
- 23 targets ("Kunming-Montreal 2030 Global Targets")

Four Goals :

- **conservation,**
- **sustainable use of biodiversity,**
- **fair benefit-sharing, and**
- **adequate means of implementation – meaning money, as well as technical capacities.**

The 23 targets by 2030 are categorized into three areas as

1. Reducing threats to biodiversity. (8 Targets)
2. Meeting people's needs through sustainable use and benefit-sharing.(5 Targets)
3. Tools and solutions for implementation and mainstreaming. (10 Targets)

1. Reducing threats to biodiversity (by 2030) – 8 Targets

1. Bring biodiversity loss in areas of high biodiversity close to zero.
2. 30×30 Pledge: Restore at least 30% of areas of degraded ecosystems (terrestrial, inland water, coastal, marine).
3. Conserve at least 30% of ecosystems (terrestrial, coastal, marine), especially areas of high biodiversity.
4. Halt human-induced extinction of known threatened species and significantly reduce extinction risk.
5. Ensure that the harvesting/trade of wild species is sustainable and safe (reducing pathogen spill-over).

6. Reduce invasive alien species by at least 50%.
7. Reduce pollution risks, by 2030, to levels that are not harmful to biodiversity and reduce the nutrients lost and overall risk from pesticides and hazardous chemicals by 50%.
8. Minimize the impact of climate change and ocean acidification on biodiversity

2) Meeting people's needs through sustainable use and benefit-sharing (by 2030) – 5 Targets

1. Sustainable use of wild species.
2. Ensure that areas under agriculture, aquaculture, fisheries, and forestry are managed sustainably.
3. Enhance ecosystem functions and services —pollination, disaster protection, etc.
4. Sustainable urbanisation by increasing green and blue spaces (trees and water bodies).
5. Ensure fair and equitable benefit-sharing for utilising genetic resources and information.

3) Tools and solutions for implementation and mainstreaming (by 2030) – 10 Targets

1. Ensure the full integration of biodiversity into policies, planning, national accounting, etc.
2. Take measures to encourage corporations to reduce negative impacts on biodiversity.
3. Ensure sustainable consumption choices and reduce overconsumption, food waste, etc.
4. Strengthen the handling of biotechnology and biosafety measures in CBD.
5. Phase out subsidies harmful to biodiversity and reduce them by at least USD 500 billion annually.
6. Increase finance by 2030 by mobilising at least 200 billion $ per year. Wealthier countries should contribute at least 20 billion $ of this annually by 2025 and at least 30 billion $ annually by 2030.
7. Ensure the transfer of technology and scientific cooperation.
8. Ensure the best available data, information, and knowledge for decision-makers.
9. Ensure social and gender-responsive representation and participation in decision-making.
10. Ensure gender equality in the implementation of the framework.

What is Global Biodiversity Outlook (GBO)

- is the flagship publication of the Convention on Biological Diversity.
- It is a periodic report that summarizes the latest data on the status and trends of biodiversity and draws conclusions relevant to the further implementation of the Convention.

Global biodiversity outlook: CBD
Global Environment outlook: UNEP

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CLIMATE CHANGE

About Climate Change :

- Climate change refers **cumulative change** to **long-term shifts** in temperatures and weather patterns
- it is a periodic modification of Earth's climate.
- attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

Effects of Climate Change :

- **Global Warming :** is an average increase in Earth temperature near surface and in the troposphere, Due to result of increased emission of GHG from human activities

- Change in weather and Rainfall Patterns
- A rise in Atmospheric Temperature due to GHG mainly emitted by Man made activities thereby increases intensity of natural disasters.
- The moisture from land and water is rapidly evaporating due to the high atmospheric temperature
- Rising sea levels due to the thermal expansion, coastal inundation, shrinking islands and coasts.
- It erodes and submergence of shorelines, damage properties and destroys ecosystems like mangroves and wetlands
- Glacial retreat : Shrinking mountain glaciers including in the Alps, Himalayas, Andes, Rockies, Alaska, and Africa.
- Shrinking Ice Sheets : melting at a faster rate than usual in Greenland, Antarctica and the Arctic
- Decreased Snow cover , freshwater inflows in sea , affects sea salinity
- Oceans warning and Ocean acidification : are currently warming and becoming more acidic due to atmospheric CO2 absorption in the ocean
- Bleaching of coral reefs
- Loss of Plankton due to warming of seas
- Spread of New disease: like Zika and Nipah virus, and Corona virus and increased Health risk .
- Changes in flower and plant blooming times.
- Disruption of Ecosystems and loss of biodiversity
-

Economic and Social Impacts :

- Annual global GDP loss
- increased cost for business, government , individuals including cost associated with repairing damage by disasters .
- impacts Food Security, Health Security , Employment Security and Environmental Security
- Declining crop yields and decreased productivity due to the lengthy droughts and high temperatures can lead to a risk of starvation of thousands of people
- can alter shoreline habitats.
- The vulnerability of the landless and the poor has increased
- Displacement of communities due to rising sea levels, extreme weather events ; food and water scarcity .
- Increase social inequalities, marginalized communities are often disproportionally affected by its impacts . This can lead to social unrest , conflict and human displacement .

Consequences of Climate Change

- Rise in sea level gradually inundates coastal areas
- Change in pressure belts and atmospheric circulation.
- Change in the direction of permanent and periodic winds.
- Change in the directions of warm and cold water currents.
- Increase in the frequency of tropical and temperate cyclones, cloud cover, tornadoes and storms
- Change in the intensity and patterns o precipitation altering natural vegetation, cropping patterns, crop combination, agricultural productivity and soil belts
- Change in hydrological cycle and water supply will bring changes in the soil-moisture and humus content of the soils.
- The marine life will be adversely affected. Warming of temperature of the oceans may endanger the corals worldwide
- Agricultural fields in the deltaic regions may submerge. This would effect the food supply and international trade of grains.
- Climatic change will effect the nutrious value of the food crops. The rising carbon dioxide emissions will lead to deficiencies in iron and zinc
- Change in the international trade pacts and geopolitics of world

CONSEQUENCES OF GLOBAL WARMING AND CLIMATE CHANGE IN INDIA:

- The hydrological cycle will be adversely affected. The discharge of water even in the perennial rivers may decrease by about 20 per cent by 2050 resulting in decrease in fresh water availability.

- In several areas, rainfall will increase, while in others there will be decrease
- With Increased temperatures the rate of evaporation will increase resulting in more of rainfall and most of it would be in the oceans.
- Decrease in soil moisture in the northern plains of India and the consequent increase in saline affected areas would effect the Agricultural production
- The unseasonality of hot and cold spells will not be conducive for good agricultural productivity. Such conditions would have a lasting influence on cropping patterns too
- The forest cover will change in nature and the vegetation belts will shift which will effect the areas of Biosphere Reserves and National parks
- With increasing temperatures effecting the Himalayan glaciers, the proneness to floods in the plains of Indus, Satluj, Ganga and Brahmaputra will increase in the initial years
- The deltas along coast of Tamil Nadu, Andhra Pradesh, Odisha, and West Bengal may submerge under water. This would result in submergence of islands in front of Sundarban Delta and the Lakshadweep.
- There will be increased inter-regional and international migration of people in search of jobs and better quality of life.

STEPS TO REDUCE EMISSION OF GREENHOUSE GASES

- Promote sustainable agricultural practices
- Promote energy efficiency : Building designing: To use the solar heat and light resources in the construction design and also to use insulation and high efficiency appliances
- Alternative sources of energy: There is a need to increase the use of alternate sources of energy: solar , wind, tidal energy
- Generation of Nuclear Power
- Afforestation: Planting instead of felling more trees
- Urban Planning: encroachment of agricultural land for non-agricultural purposes should be avoided. The urban areas should implement environmentally protective measures like multiple transport choices, green areas and 'green belts
- Controlled burning of biomass: Promoting biomass fuelled power plants to reduce the emission of greenhouse gases
- Reduction in the growth of population: Framing of measures and policies to control population growth.
- Reduction in consumerism: With consumerism, the judicious use of goods has come down resulting in more and more of wastage of resources.
- Mass education about ecology and environment: Proactive use of media, holding workshops, conferences and seminars can train and tune the general public into cultivating habits to Conserve resources and protect the environment.

About GWP :

- **Global warming potential** (**GWP**)
- was created to allow a **comparison of the global warming impact of different gases**
- GWP is used to calculate carbon dioxide equivalent
- is the **heat absorbed by any greenhouse gas in the atmosphere expressed as a multiple of the heat absorbed by the same mass of carbon dioxide (CO2)**.
- **The greater the GWP, the more a given gas warms the Earth**
- **The standard time period for GWP is 100 years.** when compared to carbon dioxide
- CO2 has a GWP of 1.

Gas	GWP (100-year)	Lifetime (years)
Carbon Dioxide	1	100
Methane	27	12
Nitrous Oxide	273	109
Hydrofluorocarbons (HFCs)	1530 - 14600	14 - 228
Perfluorocarbons (PFCs)	7380	50000
Sulfur Hexafluoride (SF6)	25200	3200

UNFCCC: United Nation Framework Convention on Climate Change

- is an international environmental treaty
- It was negotiated in 1992 in New York City and was signed in 1992 at the Rio Earth Summit (UNCED).
- entered into force in 21 March 1994 adopted in 1992. **,**
- As of Feb 2023, the UNFCCC has 198 parties.
- On the 15th of May, the whole world celebrates International Climate Day
- Legal Effect: it is considered legally non-binding.
- UNFCCC HQ **Location:** Bonn, Germany
- **Objective:** Stabilize GHG Concentration in Atmopshere at a level that would prevent dangerous anthropogenic interference with the climate system .
- **Role:** provide a framework for negotiating specific international treaties (called "protocols") that aim to set binding limits on greenhouse gases (GHGs). (UNFCCC itself sets no binding limits)
- The first UNFCCC Conference of the Parties took place from 28 March to 7 April 1995 in Berlin, Germany.
-

- 1996: Geneva
- 1997: Kyoto, Japan
- 1998: Bueno Aires, Argentina
- 1999: Bonn, Germany
- 2000: The Hague , Netherlands
- 2001: July: Bonn, Germany
- 2001: November : Marrakech Morocco
- 2002: Newdelhi
- 2003: Milan, Italy
- 2004: Bueno Aires , Argentina
- 2015:Paris, France
- 2017: Bonn Germany
- 2005: Montreal Canada
- 2006: Nairobi Kenya
- 2007: Bali, Indonesia
- 2008: Poznan, Poland
- 2009: Copenhagen , Denmark
- 2010: Cancun Mexico
- 2011: Durban, South Africa
- 2012: Doha, Qatar
- 2013: Warsaw, Poland
- 2014: Lima, Peru
- 2016:Marrakech, Morocco
- 2018 Katowice, Poland
-

- 2019 Madrid Spain
- 2021 Glasgow UK
- 2022 Sharm El Sheikh. Egypt
- 2023 Expo city , Dubai UAE
- 2024 Baku , Azerbaijan

What is Mean by Protocol and COP ?

- Protocol Means Commitments to do so.
- Conference Of Parties, called COP, is the supreme decision-making body of UNFCCC.
- All States that are Parties to UNFCCC are represented at COP.

Climate change two Agreement

1. Kyoto Protocol, 1997:

- **International agreement adopted in Kyoto, Japan , 1997, under UNFCCC.**
- **set bindings targets for 37 Industrialised countries and EU to reduce GHGs.**
- **first legally binding treaty to address climate change on global scale.**
-

Two Commitment Period

- 1st Commitment Period 2008-2012: reduce GHG by 5% against 1990 level
- 2nd Commitment Period:1 Jan 2013- 31 Dec 2020: reduce at least 18% beyond 1990 level (legally nonbinding)

Kyoto Protocol in 1997 to curb global warming, nowadays covers seven **greenhouse gases**:

- the non-fluorinated gases:
  - carbon dioxide (CO_2)
  - methane (CH_4)
  - nitrous oxide (N_2O)
- the fluorinated gases:
  - hydrofluorocarbons (HFCs)
  - perfluorocarbons (PFCs)
  - sulphur hexafluoride (SF_6)
  - nitrogen trifluoride (NF_3)

Each gas is weighted by its global warming potential and aggregated to give total greenhouse gas emissions in CO_2 equivalents

Also reported are four indirect greenhouse gases/ effect :

- Nitrogen oxides (NO_x)
- Carbon monoxide (CO)
- Non-methane volatile organic compounds (NMVOC)
- Sulphur dioxide (SO_2)

Which international agreement deals with Carbon Credits?
A) Kyoto Protocol
B) Montreal Protocol
C) Paris Agreement
D) Vienna Convention

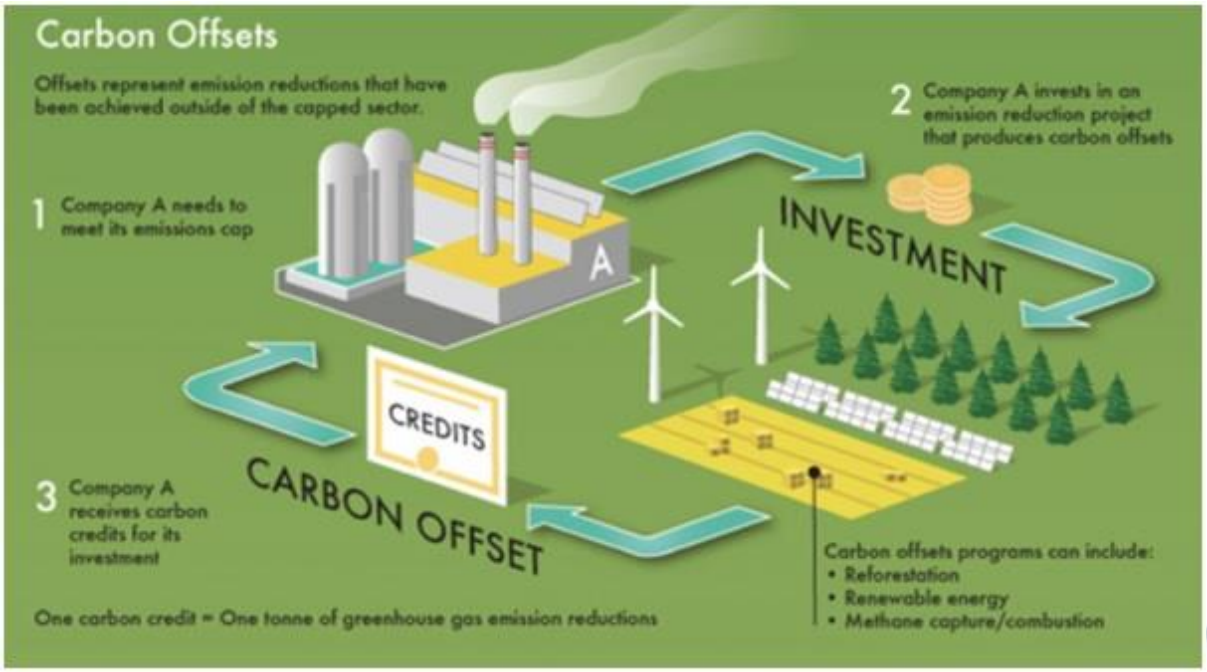
What is a Carbon Credit?
A) A permit to emit greenhouse gases
B) A license to use renewable energy
C) A certification of carbon neutrality
D) A subsidy for reducing carbon emissions

About Carbon Credit

- is a financial instrument / tradable certificate or tradable permit that allows the holder of the credit the right to emit 1 ton of carbon dioxide or other greenhouse gases of the same amount.
- Goal: reduce the emission of carbon dioxide and other greenhouse gases that contribute highly to global warming.
- Carbon Credits can also be traded on both public and private markets

Carbon Trading : refers to buying and selling of carbon credits or allowances in order to meet emissions reductions targets .
"cap-and-trade" is an incentive to reduce emissions.

Which agency in India is responsible for issuing Carbon Credits?
A) Ministry of Environment, Forest and Climate Change
B) Bureau of Energy Efficiency
C) National Green Tribunal
D) Central Pollution Control Board



Explain carbon offset with Examples?

- Carbon offsetting is the act of compensating for carbon dioxide emissions by investing in projects that reduce or remove an equivalent amount of greenhouse gases from the atmosphere.

- Carbon offsetting is often used by individuals or companies to mitigate their carbon footprint and reduce their impact on the environment

- is a credit that a person or organization can buy to decrease its carbon footprint.

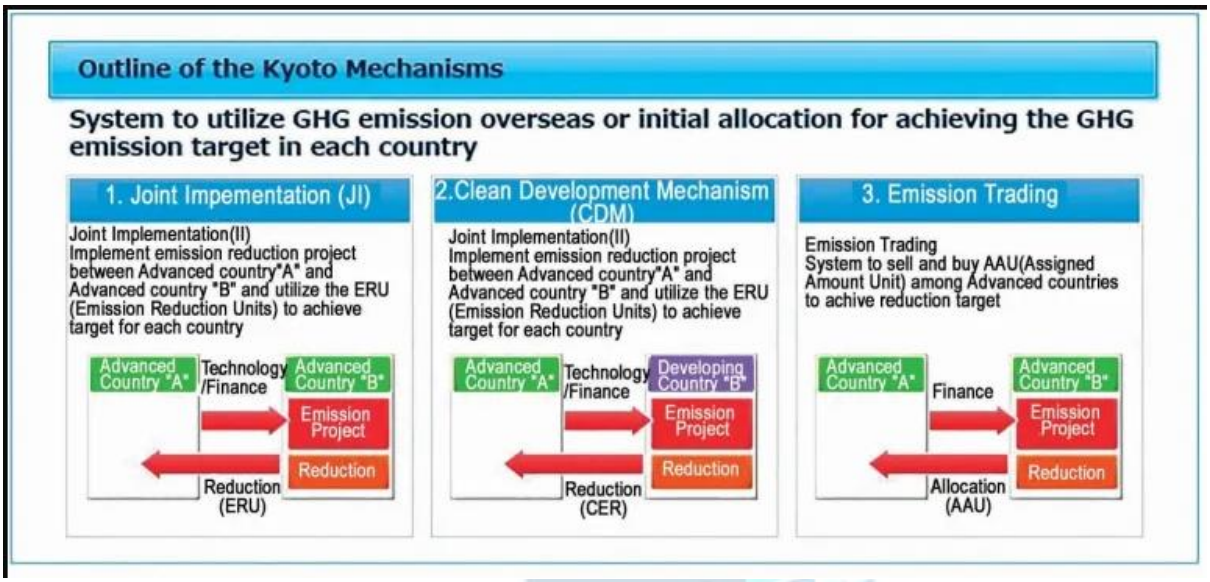
- This can include projects such as renewable energy development, forest conservation, or methane capture. carbon-storing agricultural practices, and waste and landfill management.

The key difference between carbon trade, carbon offset, and carbon credit is as follows:

1. Carbon trade: Carbon trading refers to the buying and selling of permits or credits that allow companies to emit a certain amount of carbon dioxide or other greenhouse gases. Companies can either purchase permits to emit greenhouse gases or sell excess permits they have earned through emission reduction projects.

2. Carbon offset: Carbon offsetting is the process of compensating for greenhouse gas emissions by funding projects that reduce or sequester emissions elsewhere. Companies or individuals can purchase carbon offsets to counterbalance their own emissions, such as by investing in renewable energy projects or reforestation initiatives.

3. Carbon credit: A carbon credit is a unit of measurement used to quantify greenhouse gas emissions that have been reduced, avoided, or sequestered as part of an emission reduction project. These credits can be traded on carbon markets, allowing companies to offset their emissions by purchasing credits from projects that have completed emission reduction activities.



See Three Trading Units in Three Mechanism

ERU: generated by JI Project
CER: certified emission reduction: by CDM Project
AAU : assigned amount unit by Emission Trading
The three flexibility mechanisms of the Kyoto Protocol are:

1. Emissions Trading: This mechanism allows countries with emission reduction targets to buy and sell emissions allowances among themselves. The unit used in emissions trading is a assigned amount unit (AAU).

For example, Country A can purchase emissions credits from Country B to meet its target, or Country C can invest in a renewable energy project in Country D and receive emissions credits in return.

2. Clean Development Mechanism (CDM): This mechanism allows developed countries to invest in emission reduction projects in developing countries and receive credits for those reductions. The unit used in the CDM is a certified emission reduction (CER). For example, a developed country can invest in a wind farm project in a developing country and receive CERs for the emissions reductions achieved, or a company can invest in a project to reduce methane emissions from landfill sites and receive CERs.

3. Joint Implementation (JI): This mechanism allows developed countries to invest in emission reduction projects in other developed countries and receive credits for those reductions. The unit used in JI is an emission reduction unit (ERU).
For example, Country X can invest in a reforestation project in Country Y and receive ERUs for the carbon sequestration achieved, or a company can invest in a project to enhance energy efficiency in another country and receive ERUs.

Criticism of Kyoto Protocol

1) Kyoto Protocol is based on the "**common but differentiated responsibility" approach to global warming.**
2) **Under CBDR, many countries were allowed to increase pollution.**
3) not include binding emission targets for developing countries .
4) It excluded most polluting countries like China and India, which have since become the world's largest polluters.
5) Limited participation of countries and withdrawal of some countries like USA

Despite Shortcomings, it laid the groundwork for future international climate agreements and raised awareness about urgent need to combat climate change.

Paris Agreement 2015:

- The Paris Agreement is an international treaty that aims to limit global temperature rise to well below 2 degrees Celsius above pre-industrial levels, with the ambition to limit the increase to 1.5 degrees Celsius. It was adopted in 2015 at the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21) in Paris, France.
- while the Paris Agreement itself is legally binding, the specific commitments made by countries are not legally enforceable and the emission reduction targets and climate actions that countries commit to are not legally binding.
- Each country sets its own targets, known as Nationally Determined Contributions (NDCs), and is responsible for reporting on their progress.
- It covers climate change mitigation, adaptation, and finance.
- The Agreement was negotiated by 196 parties at the 2015 United Nations Climate Change Conference near Paris, France.
- **D**rafted 2015:
- Signed : 22 April 2016 (Earth Day) at a ceremony in New York and
- Effective from 4 Nov 2016
- Signatories : 195 countries (194 States and EU)
- This agreement has bottom up structure having National Determined Contributions
-
- Additionally, countries are required to submit updated NDCs every five years, with the goal of progressively increasing their ambition.
- Overall,. However, the agreement serves as a critical framework for global cooperation on addressing climate change and reducing greenhouse gas emissions.

Article 6 of the Paris Agreement established the Sustainable Development Mechanism (SDM) as a new carbon market instrument for the period after 2020. Its purpose is inter alia to replace the existing mechanisms under the Kyoto Protocol, the CDM and JI with a more effective climate tool.

Sustainable Development Mechanism (SDM)

Under SDM, the aim was to create a new international carbon market for the trade of emissions cuts, created by the public or private sector anywhere in the world, shaped on the previous CDM.

- The SDM will function in a radically changed world, where all Parties have commitments to contribute to the common objectives of limiting global warming to 1.5 degrees, de-carbonization by the second half of this century, and the Sustainable Development Goals laid out in the UN 2030 Agenda.

Comparing SDM and CDM building blocks

SDM	CDM
Must contribute to overall emission reductions/net mitigation	Established as a pure offsetting mechanism, shifting, not reducing, emissions
Must account for mitigation targets of all countries under the Paris Agreement, including their progression over time	Based on Kyoto Protocol where developing countries did not have a reduction target and did not take future climate commitments into account
Should promote ambition and encourage implementation of climate friendly policies	Created perverse incentives to continue business as usual practices and in some cases increase emissions beyond business as usual in order to be paid to reduce them
Must reflect and reinforce changing low emission technology and policy landscape	Credited many non-additional projects
Must contribute to real, measurable and long-term mitigation and sustainable development that contributes to overall shift away from fossil fuel lock in	Made questionable contribution to sustainable development, including a lock in of fossil fuels

About Internationally Transferred Mitigation Outcomes

- key mechanism of Paris Agreement
- For promoting global cooperation and reduce GHGs
- refers to the transfer of emission reductions / units from one country to another in order to fulfil climate commitments
- ITMOs differ from previous offset schemes, as they count toward countries' Nationally Determined Contributions (NDCs), support overall mitigation in global emissions

MARKET MATTERS

There are two types of market instruments under the Paris Agreement

Internationally Transferred Mitigation Outcomes		Sustainable Development Mechanism
Bilateral and multilateral	TYPE OF MARKET	Global and centralised
No direct precursor but it would apply to markets like the EU Emissions Trading System	PRECURSOR	Clean Development Mechanism
Internationally Transferred Mitigation Outcomes; not standardised	UNIT	Article 6, para 4, emission reduction; Equivalent of one
●Promote sustainable development ●Ensure environmental integrity ●Avoid double counting	TRADING SHOULD	●Foster sustainable development ●Ensure overall mitigation of global green house gas emissions
No provision	SHARE OF PROCEEDS	Will go toward adaptation in developing countries

Source: UNFCCC

Both the Paris Agreement and the Kyoto Protocol are international agreements aimed at addressing climate change and reducing greenhouse gas emissions. However, there are several key differences between the two agreements:

1. Scope: The Kyoto Protocol was a legally binding treaty that required developed countries to reduce their greenhouse gas emissions by a certain percentage below 1990 levels. The Paris Agreement, on the other hand, is a non-binding agreement that sets broad goals for all countries to limit global warming to well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 degrees.

2. Participation: The Kyoto Protocol only included commitments for developed countries, while developing countries were exempt from emission reduction targets. The Paris Agreement includes commitments from all countries, with each country setting their own targets for reducing emissions.

3. Flexibility: The Kyoto Protocol had a rigid structure with specific targets and timelines for emission reductions. The Paris Agreement allows countries to set their own targets based on their national circumstances and capabilities, and to regularly update and revise their targets.

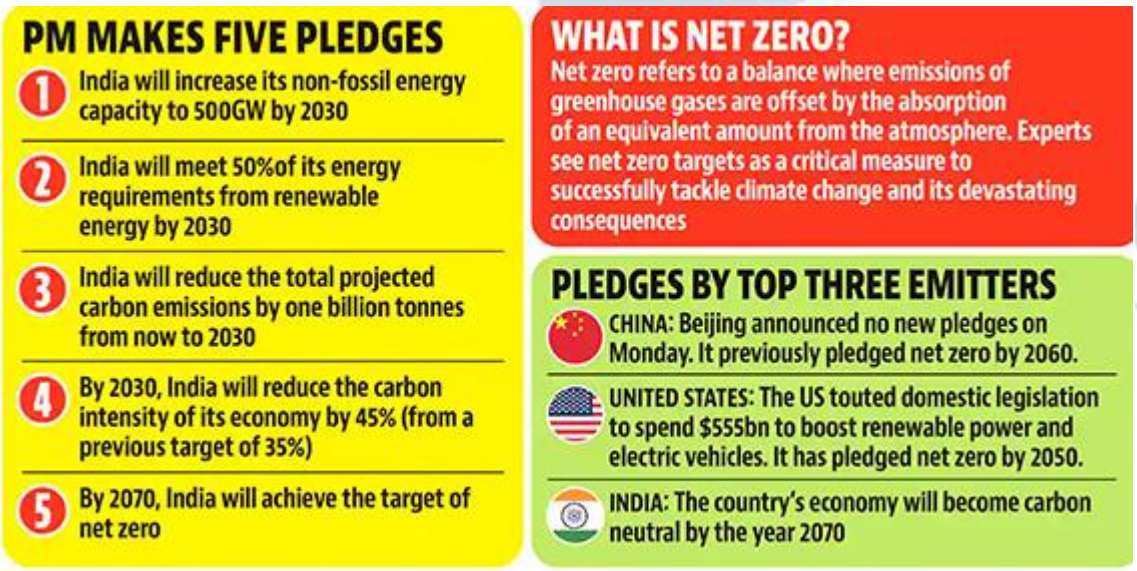
4. Enforcement: The Kyoto Protocol had a compliance mechanism to ensure that countries were meeting their emission reduction targets, with penalties for non-compliance. The Paris Agreement relies on voluntary commitments and peer pressure to encourage countries to meet their targets.

So the Paris Agreement is seen as a more transparent , less comprehensive and inclusive and flexible approach to addressing climate change, while the Kyoto Protocol was more focused on setting specific targets for developed countries.

What is INDC ?

INDC stands for Intended Nationally Determined Contribution, which are pledges made by countries as part of the Paris Agreement to reduce their greenhouse gas emissions and adapt to climate change. Each country sets its own INDC based on its national circumstances and capabilities.

Net zero emission refers to the balance between the amount of greenhouse gases emitted into the atmosphere and the amount removed or offset.



- The concept emerged in the lead-up to the 2015 Paris Agreement, where countries collectively agreed to limit global temperature increases.
- INDCs serve as a crucial tool for promoting transparency, accountability, and collective global efforts to mitigate the impacts of climate change

1. European Union: The EU aims to achieve climate neutrality by 2050.

2. United States: President Joe Biden has set a target of achieving net zero emissions by 2050.

3. United Kingdom: The UK aims to reach net zero emissions by 2050.

4. China: President Xi Jinping has pledged for China to become carbon neutral by 2060.

5. Japan: Japan aims to achieve carbon neutrality by 2050.

6. Australia: The Australian government has set a goal of reaching net zero emissions by 2050.

7. Canada: Canada aims to achieve net zero emissions by 2050.

8. South Korea: South Korea has set a goal of becoming carbon neutral by 2050.

9. New Zealand: New Zealand aims to reach net zero emissions by 2050.

10. Brazil: Brazil has committed to achieving net zero emissions by 2050.
11 India : Committed to achieving net zero emissions by 2070 (COP 26 Glasgow Conference Nov 2021 .

List of Major UNFCCC Summits

List of Major UNFCCC Summits

- ✓ **1995: COP 1, Berlin, Germany — The Berlin Mandate** calls to establish **specific, legally-binding targets** and **timetables** for **reducing GHG emissions** by **developed countries**.
- ✓ **1997: COP 3, Kyoto, Japan** — the **Kyoto Protocol** established **legally binding obligations for 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 (Oct-Nov 2021)/CMP 16, Glasgow (hosted by the UK in partnership with Italy).**
- ✓ **2022: COP 27 (Nov 2022)/CMP17, Sharm El Sheikh, Egypt**
- ✓ **2023: COP 28 (Nov-Dec 2023)/CMP18, Expo City, Dubai**

Parties to the UNFCCC are classified as:

- **Annex I**: There are 43 Parties to the UNFCCC including the European Union. These Parties are classified as industrialized (developed) countries and "economies in transition" (EITs)

- **Annex II** These Parties are made up of members of the Organisation for Economic Co-operation and Development (OECD) nnex II Parties are required to provide financial and technical support to the EITs and developing countries to assist them in reducing their greenhouse gas emissions

- **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

- **Non-Annex I**: Parties to the UNFCCC not listed in Annex I of the convention are mostly low-income developing countries. Developing countries may volunteer to become Annex I countries when they are sufficiently developed.

- India is related with **Non-Annex I**

INDIA'S CLIMATE TARGETS: EXISTING AND NEW

Target (for 2030)	Existing: First NDC (2015)	New: Updated NDC (2022)	Progress
Emission intensity reduction	33-35 per cent from 2005 levels	45 per cent from 2005 levels	24 per cent reduction achieved in 2016 itself. Estimated to have reached 30 per cent
Share of non-fossil fuels in installed electricity capacity	40 per cent	50 per cent	41.5 per cent achieved by the end of June this year
Carbon sink	Creation of 2.5 to 3 billion tonnes of additional sink through afforestation	Same as earlier	Not clear.

Major Features of India's INDC

- Emission Intensity : India is now committing itself to at least **45% reduction in emissions intensity of GDP (emissions per unit of GDP)** from 2005 levels. The existing target was a **33% - 35% reduction.**

Electricity Generation : India is also promising to ensure that at least **50% of installed electricity generation** capacity in 2030 would be based on **non-fossil fuel-based sources.**This is an increase from the **existing 40% target.**

- Increase **non-fossil energy capacity** to 500 GW (gigawatts) by 2030.
- Reduce the **total projected carbon emissions** by 1 billion tonnes (BT) by 2030.
- Achieve **net zero carbon** by 2070.

About Intergovernmental Panel on Climate Change (IPCC)

is an international body tasked with providing policymakers with regular assessments of the scientific basis of climate change, its impacts, and possible adaptation and mitigation strategies. It plays a crucial role in informing global climate policies and actions.

- It was first established in 1988 by two United Nations organizations, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), and later endorsed by the United Nations General Assembly.

- **Headquarter:** Geneva, Switzerland

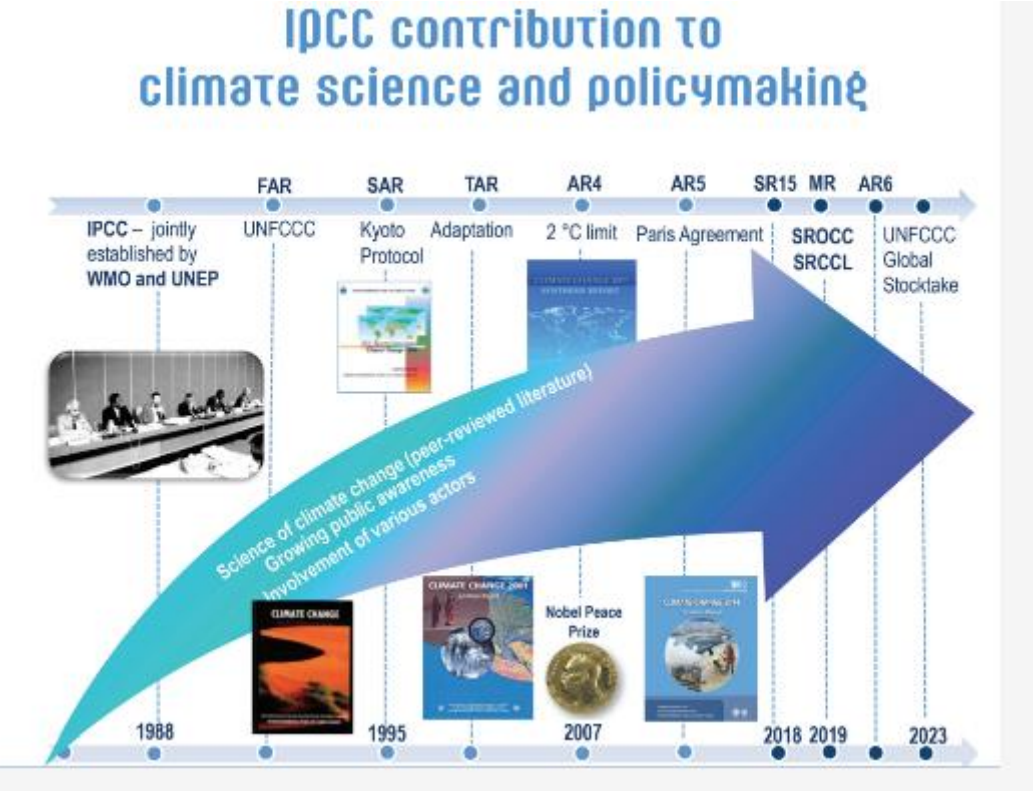
Key Functions:

- The IPCC produces reports that support the United Nations Framework Convention on Climate Change (UNFCCC).
- IPCC reports cover all relevant information to understand the risk of human-induced climate change, its potential impacts and options for adaptation and mitigation.
- The IPCC does not carry out its own original research.
- Thousands of scientists and other experts contribute on a voluntary basis.
- The 2007 Nobel Peace Prize was shared, in two equal parts, between the IPCC and an American Environmentalist.

The aims of the IPCC are to assess scientific information relevant to:

1. Human-induced climate change,
2. The impacts of human-induced climate change,
3. Options for adaptation and mitigation.

Funding: The IPCC receives funding through the IPCC Trust Fund, established in 1989 by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO).



So far, six assessment reports have been produced, the **first one being released in 1990.** The fifth assessment report **had come out in 2014** in the run up to the **climate change conference in Paris.**

News The Intergovernmental Panel on Climate Change (IPCC) recently released the 1st part of its Sixth Assessment Report (AR6) titled 'Climate Change 2021: The Physical Science Basis'. The Sixth Assessment Report concluded with a Synthesis Report in March 2023.

The IPCC began its seventh assessment cycle in 2023

- **What are the IPCC working groups?** It comprises **three working groups**, which **focus on different aspects** of climate science and climate change response.
  - **Working Group I:** looks at the **physics of climate change;**
  - **Working Group II:** examines climate change **impacts and adaptation**;

- **Working Group III:** focuses on climate change **mitigation**;
- The three working groups **release separate reports**, which are then **compiled into a synthesis report.**

IPCC's assessments are

- **widely considered to be the most authoritative and comprehensive on climate change,**
- **as they are based on a rigorous review of the latest scientific research by thousands of experts from around the world.**
- **The reports produced by the IPCC are used by governments, businesses, and organizations to guide their decision-making on climate-related issues.**

CHALLENGES AND CRITICISMS.

- The **IPCC does not itself engage in scientific research**. Instead**, it asks scientists from around the world** to go through all the relevant scientific literature related to climate change and **draw up logical conclusions.**
- **Bias and Politicization of reports** : concerns raised about the politicization of the IPCC, with some accusing the organization of being influenced by political agendas and biases.
- IPCC reports tend to be too conservative in their assessments of climate risk.
- One issue is the slow pace at which the organization produces its assessment reports, with major reports typically being released every five to seven years. This can lead to outdated information being used in policy decisions and a lack of urgency in addressing climate change**.**

- **the complexity and technical nature of the IPCC's assessments, which can make it difficult for policymakers and the public to understand and act upon the findings. There have also been**

Despite these challenges, the IPCC remains a vital and important resource for understanding and addressing climate change. It is essential that the organization continues to improve its processes and communication strategies to ensure that its assessments are accessible, up-to-date, and widely used in decision-making at all levels.

CHAPTER 13 : LAND DEGRADATION AND DESERTIFICATION

- Land is being degraded rapidly worldwide. Ensuring food security for a growing global population requires healthy land resources and flourishing ecosystems

- LD one of the world's most pressing environmental problems
- Soil is the biggest terrestrial carbon sink. The world's soils store more carbon than the planet's biomass and atmosphere combined. This includes soil organic carbon, which is essentially biodiversity: microbes, fungi and invertebrates, as well as root matter and decomposing vegetation
- Loss of soil organic carbon is one of the principal signs of land degradation, and land degradation is one of the leading challenges for sustainable development, biodiversity conservation, and mitigating and adapting to climate change
- Globally, about 25 percent of the total land area has been degraded. When land is degraded, soil carbon and nitrous oxide is released into the atmosphere, making land degradation one of the most important contributors to climate change.
- Land degradation also changes and disrupts rainfall patterns, exacerbates extreme weather like droughts or floods, and drives further climate change.

- It results in social and political instability, which drives poverty, conflict, and migration.

WHICH GLOBAL CONVENTION RELATED THIS DOMAIN ?

- United Nations has 3 Rio Conventions namely, United Nations Framework Convention on Climate Change (UNFCCC), Convention on Biological Diversity (CBD) and United Nations Convention to Combat Desertification (UNCCD).

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UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION (UNCCD)

- United Nations Convention to Combat Desertification (UNCCD)
- HQ Paris, 197Member states, Established in 1994, is the sole legally binding international agreement linking environment and development to sustainable land management.
- It is the only internationally legally binding framework set up to address the problem of desertification.
- The World Day to Combat Desertification and Drought is observed every year on 17th June
- The ***Global Land Outlook*** (GLO), the UNCCD flagship publication, underscores land system challenges, showcases transformative policies and practices

LAND DEGRADATION :

- It is defined as a reduction or loss of the biological or economic productivity and complexity of land.
- refers to the loss of land quality and productive capacity for present and future.
- it is Global Challenge: that affects everyone through food insecurity, higher food prices, climate change, environmental hazards, and the loss of biodiversity and ecosystem services. Also land degradation affected , especially rural communities, smallholder farmers, and the very poor.
- typically through human activities such as agriculture, deforestation, and urbanization.
- can occur in various forms, including soil erosion, loss of biodiversity, and contamination of land and water resources.
- is a gradual and long-term process that can occur in any geographical region
- can be mitigated through sustainable land management practices such as terracing, reforestation, and crop rotation
- While land degradation is a global issue that affects both developed and developing countries

DESERTIFICATION:

In drylands, land degradation is known as desertification.

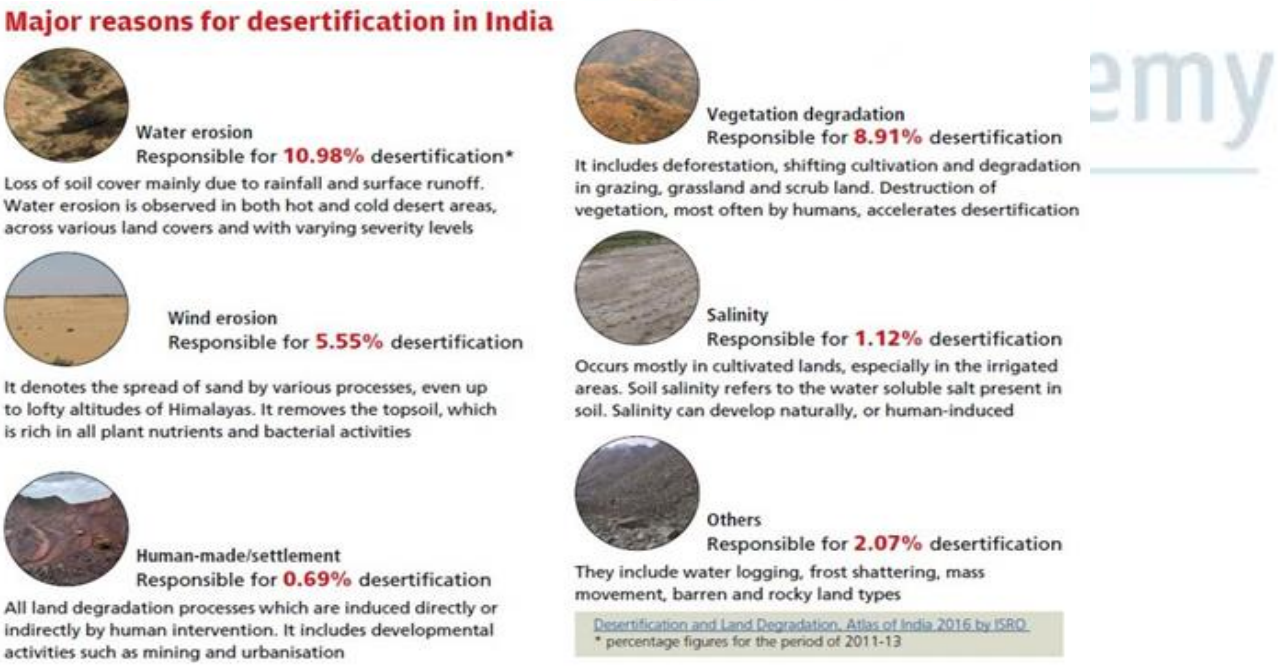
refers to the process by which fertile land becomes desert-like due to various factors such as climate change, overgrazing, and drought.

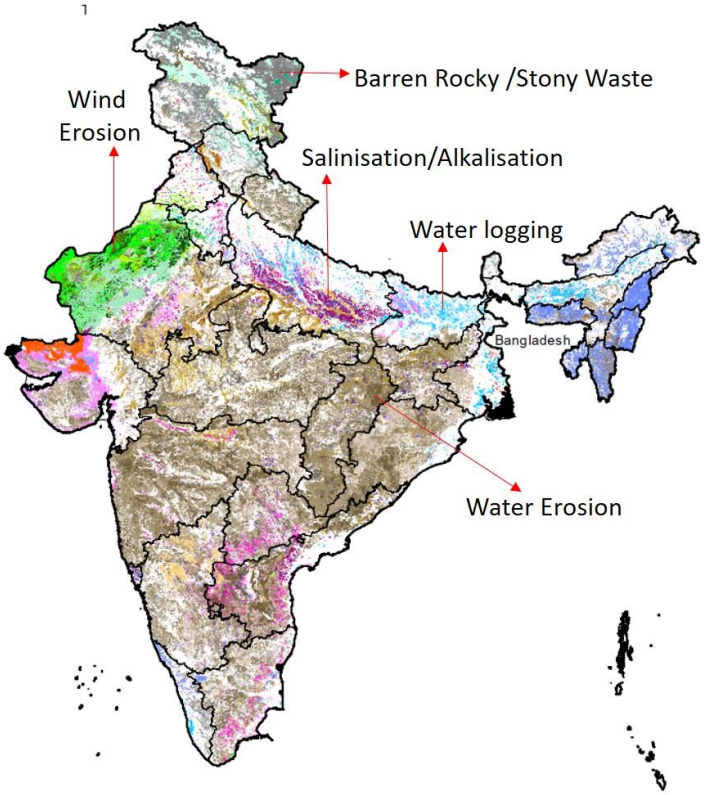
- primarily involves the loss of vegetation cover and the resulting transformation of land into arid, desert-like conditions.
- tends to occur in arid and semi-arid regions
- desertification requires more intensive measures such as desert reclamation, water conservation, and drought-resistant crop cultivation.
- desertification is more prevalent in developing countries with fragile ecosystems and limited resources to address the problem effectively.

ABOUT : **DESERTIFICATION**

- a process of productivity loss of lands
- is not the natural expansion of existing deserts
- Land degradation within dryland regions
- **Desertification** is a consequence of **severe land degradation**
- It is a gradual process of **"soil productivity loss and the thinning out of the vegetative cover"** because of human activities and climatic variations such as prolonged droughts and floods.
- *degradation in arid, semi- arid and dry sub- humid areas brought about by factors such as climatic variations and human activities, is called as desertification (ncert/ UNCCD)*

Major Reasons :





MAJOR REASON IS WATER EROSION

1. **Water Erosion:**

- Loss of soil cover, mainly due to rainfall and surface runoff, is one of the biggest reasons for desertification.
- It is responsible for 98 per cent of desertification in the country.
- Water erosion is observed in both hot and cold desert areas, across various land covers and with varying levels of severity.
- The next big reason is wind erosion
- Massive deforestation for various activities like extension of agriculture, pasture development, industrialization, mining, urbanization etc.
- Overgrazing by cattle that renders the earth- surface bare, infertile, and thus unproductive.
- Over cultivation that depletes most of the organic content of the soil and makes it prone to soil erosion by wind and water.
- Growth of human population and consequent degradation of land through increasing human activities.
- Unscientific irrigation practices and flooding of fields makes the soil saline and unproductive.

CONSEQUENCES OF DESERTIFICATION:

(i) It reduces the ability of land to support life.
(ii) It adversely affects the lives of wild species, domestic animals, agricultural crops and people.
iii) Desertification reduces plant cover from the earth surface and accelerates soil erosion through wind and water. Here is an example: South Africa is loosing about 300 to 400 million tones of top soil every year.
iv) Desertification is a self-reinforcing process. It means, once the process of desertification starts, the conditions are set for continual deterioration of land.
(v) Desertification causes a drop in biological productivity which leads to decline in economic productivity. It further forces farmers into poverty and compels them to migrate.

INDIA REFERENCE :

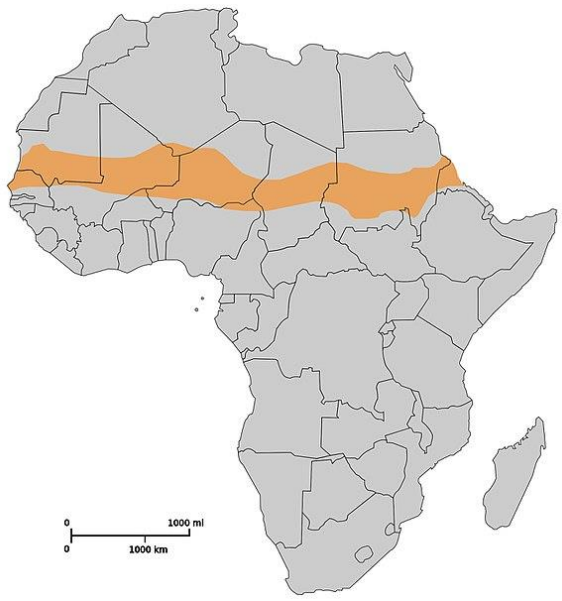
- Desertification and Land Degradation Atlas, in 2016 published by the **Indian Space Research Organisation's Space Application Centre (SAC),** Ahmedabad
- **about 30 per cent of the country's total area, is undergoing degradation**

- In eight states—Rajasthan, Delhi, Goa, Maharashtra, Jharkhand, Nagaland, Tripura and Himachal Pradesh—around **40 to 70 per cent of land has undergone desertification**
- India is striving towards achieving the national commitments of Land Degradation Neutrality (LDN) and restoration of 26 Million ha of degraded land by 2030 which focus on sustainable and optimum utilisation of land resources.

GLOBAL EFFORTS TO CHECK DESERTIFICATION:

Ordos Declaration: Kubuqi Desert in Ordos, Inner Mongolaia, The Ordos Desert is a desert and steppe region lying on a plateau in the south of the Inner Mongolian Autonomous Region of the People's Republic of China. The soil of the Ordos is a mixture of clay and sand and, as a result, is poorly suited for agriculture.Recently in News, this desert is first in world to achieve large scale desertification control

To Solve Desertification : **Africa's Great Green Wall project:** The **Great Green Wall** or **Great Green Wall of the Sahara and the Sahel** (French: *Grande Muraille Verte pour le Sahara et le Sahel*) is a project led by the African Union, initially conceived as a way to combat desertification in the Sahel region and hold back expansion of the Sahara, by planting a wall of trees stretching across the entire Sahel.



Bonn Challenge : (Germany)

- is a global effort to bring 150 million hectares of the world's deforested and degraded land into restoration by 2020, and 350 million hectares by 2030.

- International Union for Conservation of Nature (IUCN) - India, has been assigned for reporting India's progress on achieving Bonn Challenge target.
-
- At the UNFCCC Conference of the Parties (COP) 2015 in Paris, India also joined the voluntary Bonn Challenge pledge to bring into restoration 21 million hectares of degraded and deforested land by the year 2030. The target now revised to restore 26 million hectares of degraded and deforested land by 2030''
- The Bonn Challenge is aligned with the Sustainable Development Goals (SDGs), the Aichi Targets, the Paris Climate Agreement and the Land Degradation Neutrality (LDN) goal.

ABOUT LAND DEGRADATION NEUTRALITY (LDN)

- is a state where the amount and quality of land resources necessary for sustainable development are maintained or enhanced, while land degradation is either avoided or reduced.
- The UNCCD's goal of land degradation neutrality (LDN) India has set targets for achieving Land Degradation Neutrality by 2030.
- The country aims to restore 26 million hectares of degraded land by 2030 through a combination of afforestation, sustainable land management practices, and rehabilitation of degraded ecosystems.
- This goal is part of India's commitment to the United Nations Convention to Combat Desertification (UNCCD) and its efforts to address land degradation and desertification issues in the country.

The UNCCD's objectives for LDN include:

- maintaining or improving the sustainable delivery of ecosystem services
- maintaining or improving land productivity to enhance global food security
- Increasing the resilience of land and the populations dependent on it
- seeking synergies with other social, economic, and environmental objectives
- reinforcing and promoting responsible and inclusive land governance

MEASURES TAKEN BY INDIA TO CURB DESERTIFICATION

1. Ministry of Environment, Forest and Climate Change is the nodal Ministry for the Convention. UNCCD

2. COMMAND AREA DEVELOPMENT: It was launched in **1974** to improve the irrigation potential utilization and to optimize agricultural production through efficient water management.

3. The **Ministry of Water resources** coordinates the implementation of the program with respective state governments.

4. Integrated Watershed Management Programme: It was launched in **1989-90.**

- It aims to restore ecological balance by harnessing, conserving and developing degraded natural resources with the creation of Rural Employment.
- It was named as **"**Haryali Guidelines" in 2003.
- Now it is subsumed under Pradhan Mantri Krishi Sinchai Yojana (2015-16 to 2019-20) which is being implemented by NITI Ayog.

5. Desert Development Programme:

- It was launched in 1995 to minimize the adverse effect of drought and to rejuvenate the natural resource base of the identified desert areas.
- It was launched for hot desert areas of Rajasthan, Gujarat, Haryana and cold desert areas of Jammu & Kashmir and Himachal Pradesh.

- It is implemented by the Ministry of Rural Development.
- India became a signatory to the United Nations Convention to Combat Desertification (UNCCD) in 1994 and ratified in 1996.
- Soil Conservation in the Catchment of River Valley Projects and Flood Prone Rivers:
- It is being implemented by the Ministry of Agriculture and Farmers Welfare.

6. National Afforestation Programme

- It is being implemented since **2000** for the afforestation of degraded forest lands.
- It is being implemented by the **Ministry of Environment, Forest and Climate Change**

7. National Action Programme to Combat Desertification

- It was prepared in **2001** to address issues of **increasing desertification and to take appropriate actions.**
- It is implemented by the **Ministry of Environment, Forest and Climate Change.**

8. National Mission on Green India

- It is a part of **the National Action Plan on Climate Change (NAPCC).**
- It was approved in **2014** with the objective of protecting, restoring and enhancing India's diminishing forest cover with **a deadline of 10 years.**
- It is being implemented by the **Ministry of Environment, Forest and Climate Change**

9. Desertification and Land Degradation Atlas of India : It was released by **ISRO** in **2016.** Combating desertification and land degradation is one of the thrust areas covered by it.

Other Government schemes

- like 'Rashtriya Krishi Vikas Yojana' (Ministry of Agriculture)
- Pradhan Mantri Krishi Sinchayee Yojana' (Ministry of Water Resources)
- Deen Dayal Antyodaya Yojana - National Rural Livelihoods Mission (Ministry of Rural Development), the flag bearer scheme for promotion of skill development and livelihood opportunities for people in rural areas
- Deen Dayal Upadhyay Grameen Kaushalya Yojana and Integrated Watershed Management Programme (Ministry of Rural Development),
- Swacchh Bharat Mission, National Mission for a Green India and
- National Afforestation Programme (Ministry of Environment, Forest and Climate Change) that have been at the forefront of India's efforts to mitigate concerns over desertification, land degradation and drought problems

Key Line :
By restoring land, we restore life, restore our economies, restore our communities, and so much more. We cannot stop the climate crisis today, biodiversity loss tomorrow, and land degradation the day after. We need to tackle all these issues together.

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CHAPTER 14 :CHEMICAL RELATED INTERNATIONAL CONVENTIONS

- **Rotterdam Convention** : on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
- **Stockholm Convention** : on Persistent Organic Pollutants (POPs Convention, 2001)
- **The Basel Convention :** on the Control of Transboundry Movements of Hazardous Wastes and their disposal
- **Minamata convention:** on Mercury, 2017
- **Vienna Convention** : on Civil Liability for Nuclear Damage, Vienna, 1963
- **Benzene Convention** : **created** by International Labour Organization , adopted 1971, Force: 1973. Objective: is to protect workers who are exposed during course of their work to C_6 **C_6 /Benzene, a recognized carcinogen.**
- **Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone** (known as the **Multi-effect Protocol** or the **Gothenburg Protocol**) , **1999**

Gothenburg Protocol

- **Located in Sweden**
- **established in 1999**

- aims to Abate Acidification, Eutrophication and Ground-level Ozone and is a part of the Convention on Long-Range Transboundary Air Pollution.
- is an international agreement under the **United Nations Economic Commission for Europe (UNECE)** that aims **to reduce transboundary air pollution, including the formation of photochemical smog**
- It aims to control and reduce emissions of sulphur dioxide, nitrogen oxides, ammonia, volatile organic compounds (VOCs) and particulate Matter (PM) that are caused by human activities.
- played a **significant role in reducing air pollution and improving air quality across Europe by setting targets and promoting concerted efforts among participating countries to mitigate the formation of photochemical smog and other pollutant**s.

Sometimes in the News , Consider the statements with respect to " Gothenburg Protocol".

1. It is international agreement aimed at reducing air pollution and acidification , eutrophication world wide .
2. It focuses on limiting emissions for four pollutants mainly are sulfur dioxide (SO_2), nitrogen oxides (NO_x), ammonia (NH_3), and volatile organic compounds (VOCs) from various sources.
3 India signed this Protocol.

How many of the statements are correct ?

a) one only
b) two only
c) All three
d) None

EXP : Ans B

Que 2. Consider the Pairs of Protocol /Agreements with their key context :

1. Aarhus Protocol: Persistent Organic Pollutants and Heavy Metals
2. Oslo Protocol : Further Reduction of Sulphur Emissions
3 Geneva Protocol : Control of emissions of Volatile Organic Compounds

How many of the pairs are correct ?

a) one only
b) two only
c) All Three
d) None

EXP: Ans c

International Air Pollution Legal Laws in the World :

International Legal Framework:

- Convention on Long Range Transboundary Air Pollution
- Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone
- Aarhus Protocol on Persistent Organic Pollutants (POPs)
- Aarhus Protocol on Heavy Metals
- Oslo Protocol on Further Reduction of Sulphur Emissions
- Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes
- Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes
- Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes

EXP:

The **Aarhus Protocol:**

- founded on 1998,

- on Persistent Organic Pollutants is an addition to the 1979 Geneva Convention on Long-Range Transboundary Air Pollution (LRTAP)
- The Protocol seeks "to control, reduce or eliminate discharge, emissions and losses of persistent organic pollutants" in Europe, and the United States, in order to reduce their transboundary fluxes so as to protect human health and the environment from adverse effects.
- Aarhus is a city in Denmark on the Jutland peninsula's east coast

1998 Aarhus Protocol on Heavy Metals:

- The **Protocol on Heavy Metals**, a protocol to the Convention on Long-Range Transboundary Air Pollution, was adopted in Aarhus, Denmark, in 1998.
- It targets three particularly harmful metals: cadmium, lead and mercury.
- The Protocol aims to cut emissions from industrial sources (iron and steel industry, non-ferrous metal industry), combustion processes (power generation, road transport) and waste incineration.
- In addition, the Protocol requires Parties to phase out leaded petrol.
- It also introduces measures to lower heavy metal emissions from other products, such as mercury in batteries, and proposes the introduction of management measures for other mercury-containing products, such as electrical components (thermostats, switches), measuring devices (thermometers, manometers, barometers), fluorescent lamps, dental amalgam, pesticides and paint.

Oslo Protocol 1994 ,

- The **Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Further Reduction of Sulphur Emissions** is an agreement to provide for a further reduction in sulphur emissions or transboundary fluxes.
- It is a protocol to the Convention on Long-Range Transboundary Air Pollution and supplements the 1985 Helsinki Protocol on the Reduction of Sulphur Emissions.

Geneva **Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution Concerning the Control of Emissions of Volatile Organic Compounds or Their Transboundary Fluxes** (known as the **Volatile Organic Compounds Protocol** or the **VOC Protocol**) is a protocol to the Convention on Long-Range Transboundary Air Pollution which aims to provide for the control and reduction of emissions of volatile organic compounds in order to reduce their transboundary fluxes so as to protect human health and the environment from adverse effects. The protocol was concluded at Geneva, Switzerland.

India Not Signed : See Convention : Agreements / Names of Treaty and objective

160	Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Long-term Financing of the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP). Geneva, 28 September 1984	Not Signed
161	Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent. Helsinki, 8 July 1985	Not Signed
162	Protocol to the 1979 Convention on long-range transboundary air pollution concerning the control of emissions of nitrogen oxides or their transboundary fluxes. Sofia, 31 October 1988	Not Signed
163	Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes. Geneva, 18 November 1991	Not Signed
164	Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Further Reduction of Sulphur Emissions. Oslo, 14 June 1994	Not Signed
165	Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Heavy Metals. Aarhus, 24 June 1998	Not Signed
166	Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants. Aarhus, 24 June 1998	Not Signed
167	Protocol to the 1979 Convention on Long-range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone. Gothenburg (Sweden), 30 November 1999	Not Signed

Source : https://www.mea.gov.in/Images/attach/lu6353.pdf

About Rotterdam Convention :

- **United Nations Treaty**
- **Mulitlateral Treaty to promote shared responsibilites related with hazardous chemicals .**
- on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
- The Convention creates legally binding obligations for the implementation of the Prior Informed Consent (PIC) procedure.
- This place located in Netherlands
- Related with certain Hazardous chemicals and pesticides
- Convention Signed and adopted 1998, entered in force in 2004 and
- Ratified by India , 2005
- Examples: Aldrin, Asbestos, Chlordane, , Dieldrin, DDT (**Dichlorodiphenyltrichloroethane)**, Endosulfan, Heptachlor, Lindane, Mercury Compounds, PCB,, Toxaphene,
- Under the Rotterdam Convention, two new chemicals (Phorate and HBCD) were added in the list for mandatory PIC procedure in international trade.
- HBCD : **Hexabromocyclododecane** is a brominated flame-retardant additive having health and environmental concerns

phorate : Local name " Thimet ".

- a powerful pesticide effective against insects, mites, and nematodes but
- Phorate is highly toxic to birds, fish, and mammals
- it exposure is link with cancer in Agricultural study

- **Pesticide poisoning** is a term that refers to the **adverse effects of exposure to pesticides on humans or animals.**

- According to the **World Health Organization (WHO)**, **pesticide poisoning** is one of the leading causes of **death** among **agricultural workers** worldwide.

Over 100 Pesticides used in India but Banned Pesticides in India Are :

- The government has banned three more insecticides in **2023: Dicofol, Dinocap,** and **Methomyl,** in addition to **monocrotophos.(ban on vegetables)**
- The list of banned pesticides are:
- **Insecticides:** Cabofuran, Methyl Demeton, Methyl Parathion, Monocrotophos, Phorate, Methymol, Profenofos, Triazophos, Endosulfan
- **Fungicides:**, Ediphenphos, Tricyclazole, Oxythioquinox
- **Weedicides:** Anilophos, Paraquat, Thiobencarb, Atrazine
- DDT, Fenitrothion : Ban in Agriculture in India
- Lindane , Malathion, Thiram , Endrin,
-

How Pesticides are Regulated in India?

- under the **Insecticides Act, 1968** and the **Insecticides Rules, l971**
- **it covers** covers the **registration, manufacture** and **sale of pesticides in India.**
- The Act is administered by the **Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare.**

In India, the use of carbofuran, methyl parathion, phorate and triazophos is viewed with apprehension. These chemicals are used as (2019)
(a) pesticides in agriculture
(b) preservatives in processed foods
(c) fruit-ripening agents
(d) moisturizing agents in cosmetics
Ans: (a)

Que Sometimes in the News , the terms like " crocidolite, actinolite, anthophylite, amostile, tremolite and chrysotile" are related with

a) Aluminium dust
b) Manganese dust
c) Asbestos varieties
d) Nuclear waste varieties

Asbestos Issue :

- India banned asbestos mining in 1993, when the government stopped reissuing licences, but it imports more of the toxic mineral than any other country.
- In 2021, India accounted for 44% of global imports, a 29% increase on 2020. Russia and Brazil are its key sources
- Asbestos is used in everything from cement to automobile industry brake parts
- 2022, the Ministry of Environment, Forests and Climate Change reiterated the Government's position that there was no proposal to prohibit the use of asbestos in the country
- Types of Asbestos : the Ministry of Chemicals and Fertilisers of the Indian Government stated that it recognised six varieties of asbestos: crocidolite, actinolite, anthophylite, amostile, tremolite and chrysotile
- Rotterdam Convention, which lists crocidolite, actinolite, anthophyllite, amosite and tremolite in Annexure III (the list of hazardous chemicals and pesticides)
- Annexure III excludes chrysotile (white asbestos)

Asbestos Used in :

Firebricks, insulation, machinery, automotive parts, construction materials**, fireproof textiles, ship parts**

Exposure :

all forms of asbestos cause lung cancer, mesothelioma, cancer of the larynx and ovary and asbestosis (fibrosis of the lungs)

Key Facts :

- Rajasthan accounts for 59 % of asbestos in India Karnataka 36%
- Presently there is no working mine in India.
- Materials substituted for asbestos include calcium silicate, carbon fibres, fibres of cellulose, ceramic, glass & steel, wollastonite and several organic fibres like aramid, polyethylene, polypropylene and polytetrafluoroethylene.

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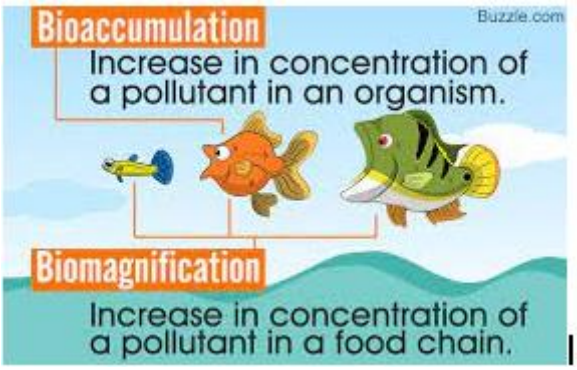
STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTSSTOCKHOLM

- is an international treaty enacted in 2004 to eliminate or restrict the production and use of POPs
- Persistent Organic Pollutants (POPs) are carbon-based organic chemical substances
- India is a party to the Stockholm Convention. In May 2002, India signed the global treaty whereas it brought it in force in January 2006.
- Global Environmental Facility (GEF) is the designated interim financial mechanism for the Stockholm Convention.

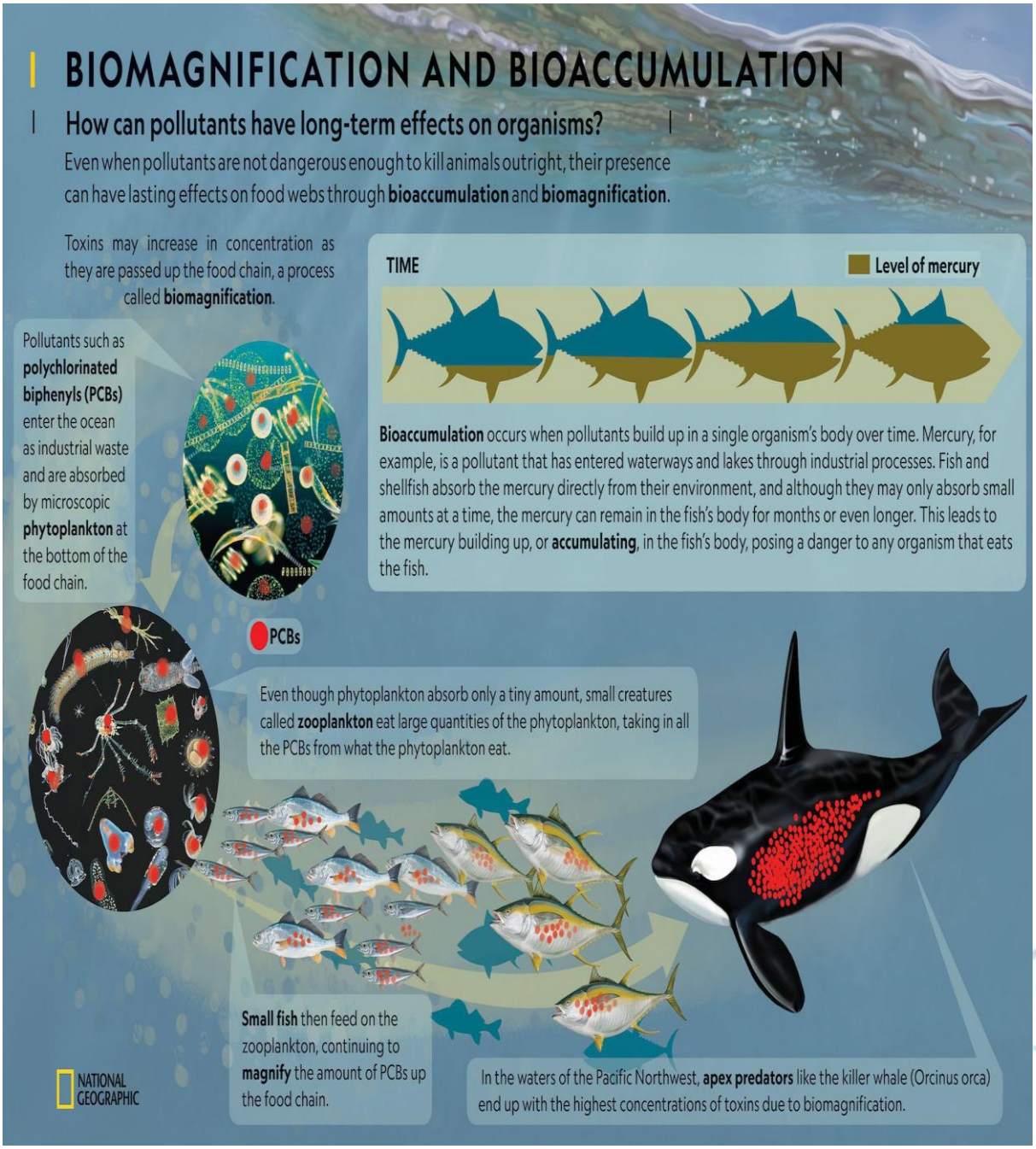
Properties of POPs

- **remain in the Environment for Long time span.**
- **They are toxic to Human and Wildlife**

- **They became part of food chain and tropic level interaction**
- **Bioaccumulation –** The P OPs get accumulated in the fatty tissues and its concentration gets magnified. The species including at the higher level of the food chain absorb greater concentrations of POPs and carry it along



1. Bioaccumulation :
   - refers to how pollutants enter a food chain .
   - General accumulation of pollutants, chemcials or other substances in an organism.
2. Biomagnification:
   - refers to tendency of pollutants to concentrate as they move from one trophic level to the next.
   - Progressive bioaccumulation (ie increase in concentration) at each trophic level with the passage of time.



Effect – The exposure to POPs can cause:

- Cancer
- Allergies
- Damage to the central and peripheral nervous systems
- Reproductive disorders, and
- Disruption of the immune system
- Endocrine disruptors

The 12 POPS under these three categories are given in the table below: **There were initially twelve distinct chemicals: They were called "Dirty Dozen".**

Stockholm Convention categorized POPs into three different categories, which are as follows:

- Annex A: Pesticides : Toxaphene, Heptachlor, DDT, Aldrin, Chlordane, Dieldrin, Hexachlorobenzene, Mirex, Endrin.

- Annex B: Industrial Chemicals: Hexachlorobenzene, Polychlorinated biphenyls

- Annex C: By-products: Polychlorinated dibenzo-p-dioxins, Polychlorinated dibenzofurans.

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

In 2017, 16 additional POPs were added under the Stockholm Convention.

16 new POPs were further added in 2017 under the Stockholm Convention. Those POPs are as follows:

1. Alpha hexachlorocyclohexane,
2. Perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF),
3. Beta hexachlorocyclohexane, Pentachlorophenol, and its salts and esters,
4. Chlordecone,
5. Pentachlorobenzene,
6. Hexabromobiphenyl,
7. Technical endosulfan, and its related isomers,
8. Polychlorinated naphthalenes,
9. Hexabromocyclododecane,
10. Tetrabromodiphenyl ether and pentabromodiphenyl ether (commercial pentabromodiphenyl ether),
11. Lindane,
12. Decabromodiphenyl ether (Commercial mixture, DecaBDE),
13. Short-chain chlorinated paraffin (SCCPs),
14. Hexabromodiphenyl ether and
15. heptabromodiphenyl ether (commercial octabromodiphenyl ether), and
16. Hexachlorobutadiene.

In Which Indian Act POPs is regulated ?

- **Insecticide Act, 1968** – Banning of use, manufacture and import of most of the listed POPs under Stockholm Convention into India Insecticide Act, 1968
- The Ministry of Environment, Forest and Climate Change (MoEFCC) had notified the 'Regulation of Persistent Organic Pollutants Rules in 2018 under the provisions of Environment (Protection) Act, 1986.
- The regulation inter alia prohibited the manufacture, trade, use, import and export seven chemicals namely
- Chlordecone, Hexabromobiphenyl, Hexabromodiphenyl ether and Heptabromodiphenylether (Commercial octa-BDE),Tetrabromodiphenyl ether and Pentabromodiphenyl ether (Commercial penta-BDE), Pentachlorobenzene, Hexabromocyclododecane, and Hexachlorobutadiene.

Which multilateral environment agreements (MEAs) are wrongly paired with the issue it deals with?

1. A) Montreal Protocol of 1987 – Ozone Depleting Substances
2. B) Bonn Convention of 1979 – The conservation of Migratory Species
3. C) Basel Convention of 1989 – Regulation of transboundary movement, transit, handling and use of Living Modified Organisms.
4. D) Rotterdam Convention of 1998 – Consensual International Trade in certain Hazardous Chemicals and Pesticides.

Correct Answer: C Basel Convention is an international and wide-ranging agreement or settlement for the Command of Transboundary Movements of Harmful Wastes and their Discarding.

BASEL CONVENTION

- BASEL : SWITZERLAND
- on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
- is an international treaty, Signed 1989, that entered into force in 1992
- The United States has signed the Convention but has not ratified it

Basel Convention was designed to:
- Reduce the movement of hazardous waste between nations.
- Prevent the transfer of hazardous waste from developed to less developed countries (LDCs).
- Minimize the amount and toxicity of wastes generated.
- Assist LDCs in environmentally sound management of the hazardous and other wastes they generate
- It does not address the movement of radioactive waste.

Key Lines :
- India is a member of the Basel Convention. It ratified the convention in June 1992 and brought it into force on 22nd September 1992.
- The Ministry of Environment, Forest & Climate Change (MOEF&CC) introduced **Hazardous and Other Wastes (Management and Transboundary Movement) Rules of 2016**.

- New Bio-Medical Waste Management Rules 2016 too have been brought by the MOEF&CC.
- Electronic Waste – E-waste Management Rules 2016 – MOEF&CC announced these rules replacing E-Waste (Management and Handling) Rules of 2011
- .

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

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

Minamata Convention

- is an international environmental treaty that aims to protect human health and the environment from the harmful effects of mercury and its compounds
- The Convention was signed in 2013 and entered into force in 2017.
- It is a UN treaty coming under the United Nations Environment Programme (UNEP).
- 128 countries are signatories to the Convention, and 119 countries are parties to it.
- India is a party to the Minamata Convention and ratified it in 2018.
- The Convention will encourage Indian companies to shift to mercury-free alternatives in products and non-mercury technologies in manufacturing processes.
- The Convention also excludes the use of mercury in Ayurvedic, Siddha and Unani medicines.

Background and Source of Mercury

- In Japan, mass mercury poisoning (Minamata disease) was observed in the 1960s, caused by eating fish from Minamata Bay contaminated with methylmercury (bioaccumulates & biomagnifies)

- Methylmercury is a very poisonous form of mercury. In the environment, methylmercury forms when bacteria react with mercury in water, soil, or plants.

Sources:
- fluorescent (CFL) lights, batteries, polyvinyl chloride (PVC), etc

- Natural: Volcanic eruptions, fossil fuels, metal ores, and other minerals.
- Human-made: mining and refining of metals such as copper, gold, lead, and zinc, coal burning, manufacture of cement (present in limestone and/or coal), caustic soda production, etc. • E-waste Sources: most electrical and electronic goods contain significant quantities of mercury — LCD screens, CFL bulbs, CRT monitors, switches, printed solders (as an alloy with tin), batteries, mercury thermometers, thermostats, sensors, medical equipment, lamps, mobile phones, etc.

- Health effects: Methylmercury (neuro-toxicant) poisoning leads to brain and nervous system damage. The developing foetus is highly vulnerable to mercury exposure.

Note Hong Kong International Convention

- for the Safe and Environmentally Sound Recycling of Ships, 2009,
- was developed in cooperation with the International Labour Organization
- It also addresses concerns about the working conditions at many of the world's ship recycling locations.

About E Waste

- The discarded and end-of-life electrical and electronic equipment (EEE) and products ranging from computers, equipment, home appliances, audio and video products and all of their peripherals are known as electronic waste.

- E-waste is not hazardous if it is stocked in safe storage or recycled by scientific methods, or transported from one place to the other in parts or totality in the formal sector

- The e-waste can, however, be considered hazardous if recycled or disposed of unscientifically
- India is only next to China and the US in e-waste generation.
- Along with hazardous substances such as lead, mercury, polychlorinated biphenyls (PCBs), polybrominated biphenyls (PBBs), polybrominated biphenyl ethers (PBDEs), brominated flame retardants (BFRs), etc.
- E-waste also contains valuable substances such as gold, silver, copper, palladium, iron, steel, copper, aluminium and plastics
-

Particulars	Source	Health Effects
Toners	Found in the plastic printer cartridge containing black and colour toners.	Respiratory tract irritant. **Carbon black** is a **carcinogen**.
Phosphor additives	The phosphor coating on cathode ray tubes contains toxic heavy metals, such as **cadmium**, and other rare earth metals, for example, **zinc**, and **vanadium** as additives.	
PVC	Plastics, cables, computer housings and mouldings, Chlorinated PVC (Chloro-benzenes)	**Dioxins** produced on burning are endo-crine disrupters.
Phthalates	Used to soften plastics, especially PVC	Toxic to reproduction
Lithium	PVC stabilisers, lasers, LEDs, thermoelectric elements, circuit boards, etc. **Lithium-ion batteries** contain metals such as cobalt, nickel, and manganese, which are toxic.	
Acid	**Sulphuric** and **hydrochloric acids** are used to separate metals from circuit boards. Fumes con-tain **corrosive chlorine** and **sulphur dioxide**, which cause respiratory problems.	
Plastics	Found in circuit boards, cabinets and cables, they contain carcinogens.	
BFR	**Brominated Flame Retardants (BFR)** are used in circuit boards (plastic), cables and PVC cables. BFRs give out carcinogenic brominated **dioxins** and **furans**.	

PCB	**Polychlorinated biphenyls (PCB)** are used in transformers, capacitors, as softening agents for paint & plastics.
Selenium	Photoelectric cells, pigments, photocopiers, fax machines
Silver	Capacitors, switches (contacts), batteries, resistors
Cobalt	Insulators

Major E-waste component	Environmental hazards
Cathode Ray Tubes (used in TVs, computer monitors, etc.)	**Cadmium**, **lead**, **barium**, and **nickel** leach into the groundwater
Printed Circuit Board (PCB) and switches	Atmospheric release and discharge into rivers of **tin**, **lead**, **brominated dioxin**, **cadmium and mercury** due to desoldering/open burning
Batteries	**Cadmium**, **lead**, **lithium**, **mercury**, **nickel**, etc., depending upon the type of batteries.

[UPSC 2013] Due to indiscriminate disposal of old and used computers or their parts, which of the following are released into the environment as e-waste?

1. Beryllium
2. Cadmium
3. Chromium
4. Heptachlor
5. Mercury
6. Lead
7. Plutonium

Select the correct answer using the codes given below.

a) 1, 3, 4, 6 and 7 only b) 1, 2, 3, 5 and 6 only c) 2, 4, 5 and 7 only d) 1, 2, 3, 4, 5, 6 and 7

EXP

Heptachlor is a Chlorohydrocarbon (CHC) which is used as an insecticide

Plutonium is a radioactive metal and hence not used in computers

About **Benzene Convention :**

- **created** by International Labour Organization (ILO)
- adopted 1971, Force: 1973.
- Objective: is to protect workers who are exposed during course of their work to C_6 **C_6 /**
- **Benzene, a recognized carcinogen.**
- **Note: ILO: formed in 1919 , HQ at Geneva**
- India is a founder member of the International Labour Organization, which came into existence in 1919.
- India member of This Convention

About **Vienna Convention on Civil Liability for Nuclear Damage**

- Signed 1963
- governs issues of liability in cases of nuclear accident
- It was concluded at Vienna on 21 May 1963

- The depository is the International Atomic Energy Agency.

About IAEA:

- International Atomic Energy Agency
- Old Name : Atoms For Peace
- is an Intergovernmental Organisation within UN
- Reports Annually to UNGA: United Nations General Assembly
- established in 1957
- HQ : Vienna, Austria
- Was Created in Cold War Period
- In Response to growing International concerns towards Nuclear Weapons between US and SU.(Soviet Union)
-
- The IAEA is not a party to the NPT but is entrusted with a key verification role under it. Under the NPT, the IAEA has a specific role as the international safeguards inspectorate.

AIM : promote the peaceful use of nuclear energy and prohibit its use for any military purpose, including nuclear weapons.

The IAEA Has Three Missions :

1. **Peaceful uses**: Promoting the peaceful uses of nuclear energy by its member states,
2. **Safeguards**: Implementing safeguards to verify that nuclear energy is not used for military purposes, and
3. **Nuclear safety**: Promoting high standards for nuclear safety.

Key Notes :

- All UN Members countries were member of the IAEA?
- No
- The IAEA has 176 member states
- India and Pakistan, Afghanistan became a member in 1957 itself
- Iran become member in 1958
- China become member in 1984
- This Organisation was awarded the Nobel Peace prize in 2005.
- NO relations with IAEA : North Korea, Bhutan, Maldives Palestine etc

In India, why are some nuclear reactors kept under "IAEA safeguards" while others are not ?
(a) Some use uranium and others use thorium
(b) Some use imported uranium and others use domestic supplies
(c) Some are operated by foreign enterprises and others are operated by domestic enterprises
(d) Some are State-owned and others are privately-owned

Reason

- The nuclear facilities are kept under International Atomic Energy Agency (IAEA) safeguards if the source of Uranium which is the fissile material for a nuclear reactor is from outside the territory of India or if the new reactor plants are established with foreign collaboration.
- This is to ensure that imported uranium was not diverted for military use and assure that the imported uranium is used to generate nuclear energy for civilian purposes.
- There are at present 22 operational reactors, of which 14 are under the International Atomic Energy Agency (IAEA) safeguards as these use imported fuel.
- Under safeguards agreement, the International Atomic Energy Agency (IAEA) has the right and obligation to ensure that safeguards are applied on all nuclear material in the territory, jurisdiction or control of the State for the exclusive purpose.

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CHAPTER 15 : OZONE: IMPORTANCE ,ISSUE, MEASURES INTERNATIONAL CONVENTIONS

Topic: OZONE

About Ozone and Ozone Layer :

- *In 1957, Professor Gordon Dobson of Oxford University discovered the ozone layer.*
- *Ozone is made up of three atoms of oxygen.*
- *It is a highly reactive gas and is represented by O3.*
- *It occurs naturally as well as a man-made product in the Earth's upper atmosphere,i.e. stratosphere and lower atmosphere,i.e. troposphere.*
- *That is the Ozone layer is present in Earth`s atmosphere (15-35km above Earth) in the lower portion of the stratosphere and has relatively high concentrations of ozone (O3).*
- *Naturally, it is formed through the interactions of solar ultraviolet (UV) radiation with molecular oxygen O2.*
- *It reduces the harmful UV radiation reaching the Earth's surface.*

What is Ozone?

Ozone (composed of three atoms of oxygen) is a gas that occurs both in the Earth's upper atmosphere and at ground level. Ozone can be "good" or "bad" for your health and the environment, depending on its location in the atmosphere.

The ozone layer is a part of the atmosphere that has high concentrations of ozone, compared to oxygen molecules that exist in nature as a pair of oxygen atoms. It exists 10-40 kms/ 50 kms above the surface of the earth in a region called the stratosphere and contains 90% of all the ozone in the atmosphere

Ozone (O_3) is a **highly reactive** molecule containing **three oxygen** atoms.

This **ozone layer serves as a natural filter** for blocking deadly incoming uv radiation from the sun. **Ultra violet (UV) radiation, with wavelengths shorter than visible spectrum has high energy.**

UVradiations can be divided into three forms:

- UV-A (wavelength between 320-400nm),
- UV-B (wave length lesser than 280 nm), and

- UV-C (wavelength lesser than 280 nm).

So **UV-C is most damaging to biological systems**.

Ozone is found in two different parts of our atmosphere.

1. **Tropospheric ozone/Ground level or "bad" ozon**e is a human health irritant and component of smog. It is found in the lower atmosphere (troposphere) and **has nothing to do with the "ozone hole**." Tropospheric ozone contain **10%**of Atmospheric ozone, **harmful effect**:Toxic effects on human and vegetation

2. High level or "good" ozone occurs in the **stratosphere** and accounts for the vast majority of atmospheric **ozone ie 90%..**

Beneficial role: act as a primary UV radiation shield .The term 'ozone hole' refers to the depletion of the protective ozone layer in the upper atmosphere (stratosphere) over Earth's polar regions. People, plants, and animals living under the ozone hole are harmed by the solar radiation now reaching the Earth's surface—where it causes health problems, from eye damage to skin cancer.

Stratospheric ozone is constantly produced by the action of the sun's ultraviolet radiation on oxygen molecules (known as photochemical reactions). **Although ozone is created primarily at tropical latitudes, large-scale air circulation patterns in the lower stratosphere move ozone toward the poles, where its concentration builds up.**

In addition to this global motion, strong winter polar vortices are also important to concentrating ozone at the poles. During the continuously dark polar winter, the air inside the polar vortices becomes extremely cold, a necessary condition for polar stratospheric cloud formation.

Polar stratospheric clouds or nacrecous clouds or mother of clouds : create the conditions for drastic ozone destruction, providing a surface for chlorine to change into ozone-destroying form. They generally last until the sun comes up in the spring.

Is the sun causing global warming? No, Lower atmosphere is warmer, whereas upper atmosphere is cooler.

OZONE LAYER DEPLETION

Define Ozone Layer Depletion:

- **"Ozone layer depletion is the gradual thinning of the earth's ozone layer in the upper atmosphere caused due tho release of chemical compounds containing gaseous bromine or chlorine from industries or other human activities."**

- Ozone layer depletion is the thinning of the ozone layer present in the atmosphere. This happens when the chlorine and bromine atoms in the atmosphere come in contact with ozone and destroy the ozone molecules.

Which of the following is ozone depleting substances :
1. Carbon tetrachloride
2 carbon dioxide
3. methyl bromide
4. Methyl chloroform
5. Halons

Select the code **:**
a) 1, 3 ,4 and 5 : Ans

Que: Which of the following is play a active role in ozone layer depletion:
1. chlorine
2. fluorine

3. bromine

Select the code :

a) 1 only

b) 2 and 3

c) 1, 2 and 3

d) **1 and 3 only ,**

- One chlorine can destroy 100,000 molecules of ozone. It is destroyed more quickly than it is created. Although chlorine and bromine have been proven to be main responsible for the destruction of the ozone layer in the polar regions
- Is fluorine ozone-depleting? **Fluorine will react with water to produce oxygen and ozone, so fluorine by itself does not contribute to ozone depletion**.

Bromine : ozone depleting ? yes :

The **bromine cycle** is a biogeochemical cycle of bromine through the atmosphere, biosphere, and hydrosphere.

Bromine is present naturally as bromide salts in evaporite deposits. Bromine is also present in soils and in marine algae that synthesize organic bromine compounds. Other natural sources of bromine come from polar regions, salt lakes, and volcanoes.

The primary natural source of bromine to the atmosphere is sea spray aerosols.

Bromine is used in flame retardants, pesticides, lighter fuel, antiknocking agents, and for water purification

In polar areas, decreasing sea ice releases bromine and at the Arctic and Antarctic boundary layer, bromine is released in the spring when the ice melts.

Bromine gas (Br_2) undergoes an autocatalytic cycle known as the 'bromine explosion', which occurs in the ocean and salt lakes such as the Dead Sea, where a high quantity of salts are exposed to the atmosphere.

An antiknock agent is a gasoline additive used to reduce engine knocking and increase the fuel's octane rating by raising the temperature and pressure at which auto-ignition occurs.

The main difference between octane number and cetane number is that **octane number gives an idea about the performance of a fuel whereas cetane number gives an idea about the ignition of a fuel. ethanol has antiknocking properties .**

****

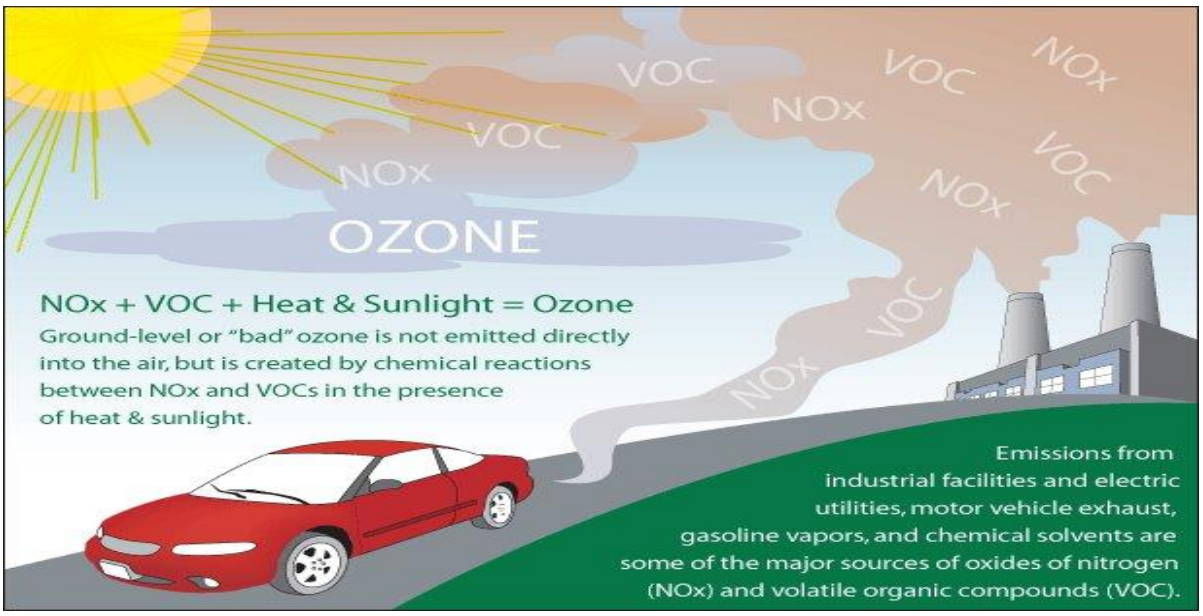
- **September 16th every year is marked as the International Day for the Preservation of the Ozone Layer.**

What does ozone layer do?

- Absorbs a range of ultraviolet energy
- Ozone molecule absorbs even low-energy ultraviolent radiation.
- Splits into ordinary oxygen molecule and free oxygen atom.
- Free oxygen atom quickly re-joins with an oxygen molecule to form another ozone molecule
- Ozone-oxygen cycle converts harmful UV radiation into heat and acts as a shield
- Weakening ozone layer causes skin cancer, cataracts and impairs immune systems.

Good Ozone

Called stratospheric ozone, good ozone occurs naturally in the upper atmosphere, where it forms a protective layer that shields us from the sun's harmful ultraviolet rays. This beneficial ozone has been partially destroyed by manmade chemicals, causing what is sometimes called a "hole in the ozone."



Ground-level or "bad" ozone is not emitted directly into the air, but is created by **chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC)** in the presence of sunligt

Bad Ozone

Tropospheric, or ground level ozone, is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC). This happens when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources chemically react in the presence of sunlight. Ozone at ground level is a harmful air pollutant, because of its effects on people and the environment, and it is the main ingredient in "smog." Ozone can also be transported long distances by wind, so even rural areas can experience high ozone levels.

Ground-Level Ozone

Ozone (O3) is a colourless, reactive oxidant gas that is a major constituent of atmospheric smog. Many factors impact ground-level ozone development, including temperature, wind speed and direction, time of day, and driving patterns.

Ozone day celebrated on the basis of :

a) Kyoto protocol
b) kigali Amendment
c) Montreal protocol . 16 sep 1987.
d) Vienna Convention

The Montreal Protocol was signed on 16 September, 1987 on substances that deplete the Ozone Layer and marks the International Day for the Preservation of the Ozone Layer. United Nations General Assembly in its resolution 49/114 in 1987 chooses this day

Que : On 15 October 2016, at the 28th meeting of the parties to the Montreal Protocol on Substances that Deplete the Ozone layer reached an agreement to phase down hydrofluorocarbons (HFCs). This agreement is known as

a) Doha Amendment
b) london Amendment
c) Kigali Amendment
d) Copenhegan Amendment

Ozone Depleting Substances

- Chlorofluorocarbons

→ Hydrochlorofluorocarbons:

→ **Hydrofluorocarbons (HFCs)** are used since as an alternative to CFCs and HCFCs.

→ HFCs **do not contribute to ozone depletion**.

→ However, they are potent greenhouse gases with **high global warming potential**.

- Carbon tetrachloride((formerly widely used in fire extinguishers, refrigerant and as a cleaning agent)
-
- Methyl chloroform
- Halons
- Methy bromide(was used as fumigant. Fumigation is a method of pest control by suffocating pests with poison)
-
- Following is the list of some of the main ozone depleting substances and the sources from where they are released:
-

Ozone-Depleting Substances	Sources
Chlorofluorocarbons (CFCs)	Refrigerators, air-conditioners, solvents, dry-cleaning agents, etc.
Halons	Fire-extinguishers
Carbon tetrachloride	Fire extinguishers, solvents
Methyl chloroform	Adhesives, aerosols
Hydrofluorocarbons	Solvent cleaning, fire extinguishers, solvent cleaning

What is CFC?

➢ Chlorofluorocarbons are nontoxic, non-flammable chemicals containing atoms of carbon, chlorine, and fluorine.

➢ They are used in the manufacture of aerosol sprays, blowing agents for foams and packing materials, as solvents, and as refrigerants.

➢ Whereas CFCs are safe to use in most applications and are inert in the lower atmosphere, they do undergo significant reaction in the upper atmosphere or stratosphere where they cause damage.

Q. Consider the following statements: Chlorofluorocarbons, known as ozone-depleting substances, are used

1. in the production of plastic foams
2. in the production of tubeless tyres
3. in cleaning certain electronic components
4. as pressurizing agents in aerosol cans

Which of the statements given above is/are correct?

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

Answer: c) CFCs were used as refrigerants, pressurizing agents (foam and aerosol cans) and for cleaning electronic equipment.

Causes of Ozone Layer Depletion

The ozone layer depletion is a major concern and is associated with a number of factors. The main causes responsible for the depletion of the ozone layer are listed below:

1. ***Chlorofluorocarbons:***

Chlorofluorocarbons or the CFC are the main cause of ozone layer depletion. These are released by soaps, solvents, spray aerosols, refrigerators, air-conditioners, etc.

The molecules of chlorofluorocarbons in the stratosphere are broken down by the ultraviolet radiations and release chlorine atoms. These atoms react with ozone and destroy it.

2. ***Unregulated Rocket Launches:***

Researches say that the unregulated launching of rockets result in much more depletion of ozone layer than the CFCs do. If not controlled, this might result in a huge loss of the ozone layer by the year 2050.

3. Nitrogenous Compounds

The nitrogenous compounds such as NO2, NO, N2O are highly responsible for the depletion of the ozone layer.

4. Natural Causes

The ozone layer has been found to be depleted by certain natural processes such as Sun-spots and stratospheric winds. But it does not cause more than 1-2% of the ozone layer depletion.The volcanic eruptions are also responsible for the depletion of ozone layer.

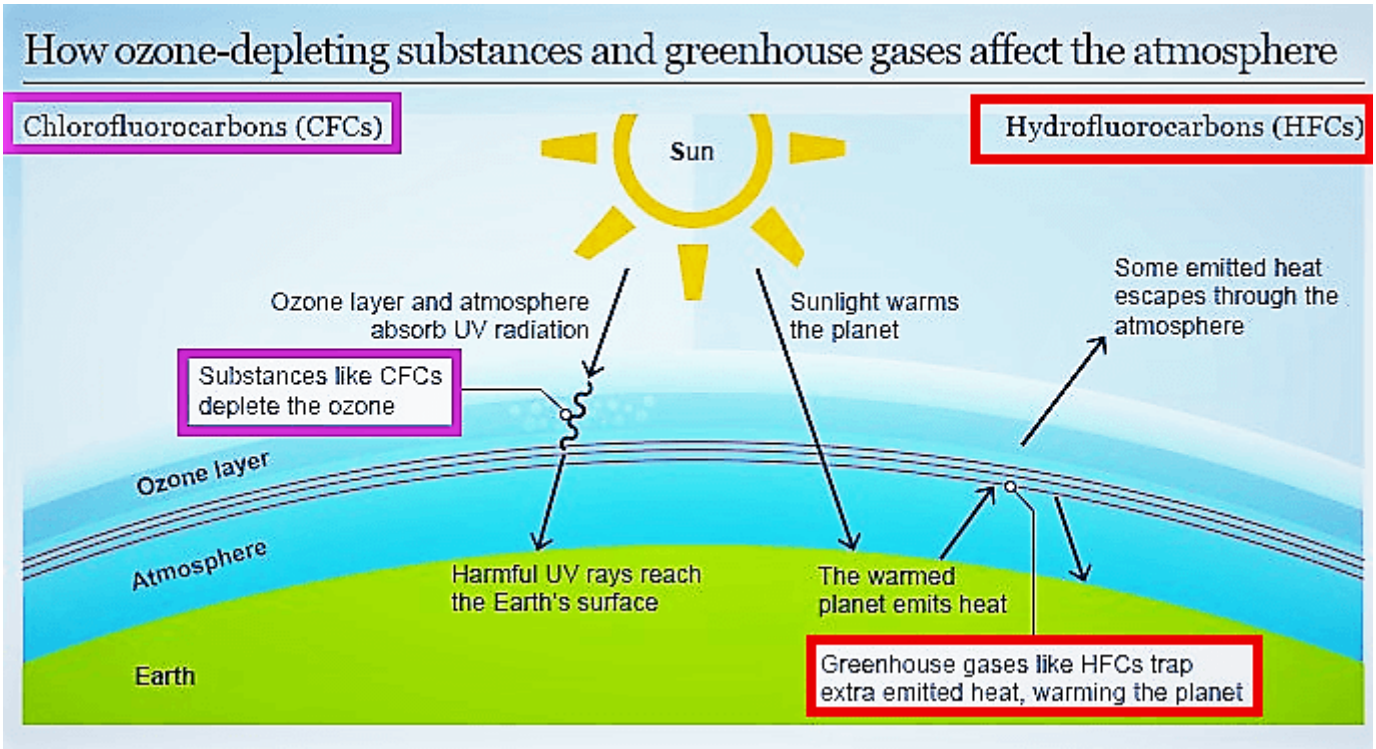
HFO Alternatives to HFCs

- HFO stands for **hydrofluoro olefin**.
- HFO refrigerants are composed of hydrogen, fluorine and carbon atoms, but contain at least **one double bond** between the carbon atoms.

Advantages of HFCs

Fluorochemical	Ozone Depleting Potential	Global Warming Potential
CFc	**High**	**High**
HCFCs	**Low**	**High**
HFCs	**Zero**	**High**
HFOs	**Zero**	**Very Low**

Effect/ Impacts of Ozone



❖ *Effects on Human Health: The main health concern of exposure to ambient ground-level ozone is its effect on the respiratory system, especially on lung function. sunburns, cataract, quick ageing, and weekend immune system.*

❖ *Effects on Animals: Direct exposure to ultraviolet radiations leads to skin and eye cancer in animals.*
❖ *Effects on the Environment :*
→ *Strong ultraviolet rays may lead to minimal growth, flowering and photosynthesis in plants.*
→ *The forests also have to bear the harmful effects of the ultraviolet rays.*

→ Ozone damages the leaves and needles of sensitive plants, causing visible alterations such as defoliation and change of leaf colour.
→ Elevated ground-level ozone exposures affect agricultural crops and trees, especially slow growing crops and long-lived trees.

❖ *Effects on Marine Life*
Planktons are greatly affected by the exposure to harmful ultraviolet rays. These are higher in the aquatic food chain. If the planktons are destroyed the organisms present in the lower food chain are also affected.

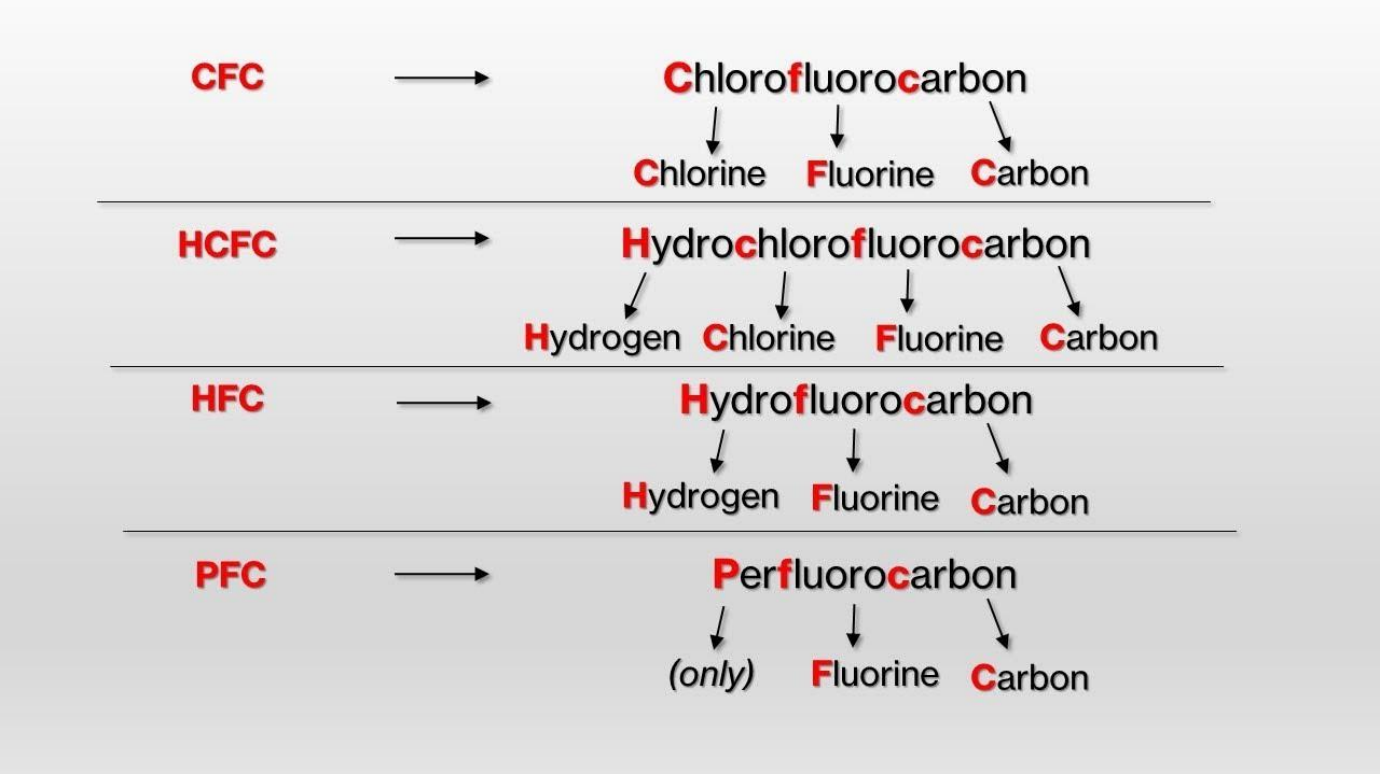
The IMO (International Maritime Organisation) mandated that cargo ships must not use fuel that has sulphur content any higher than 0.5%. This will be implemented from 1st January 2020 as this is one of the many environmental related issues that is associated with the shipping industry. •

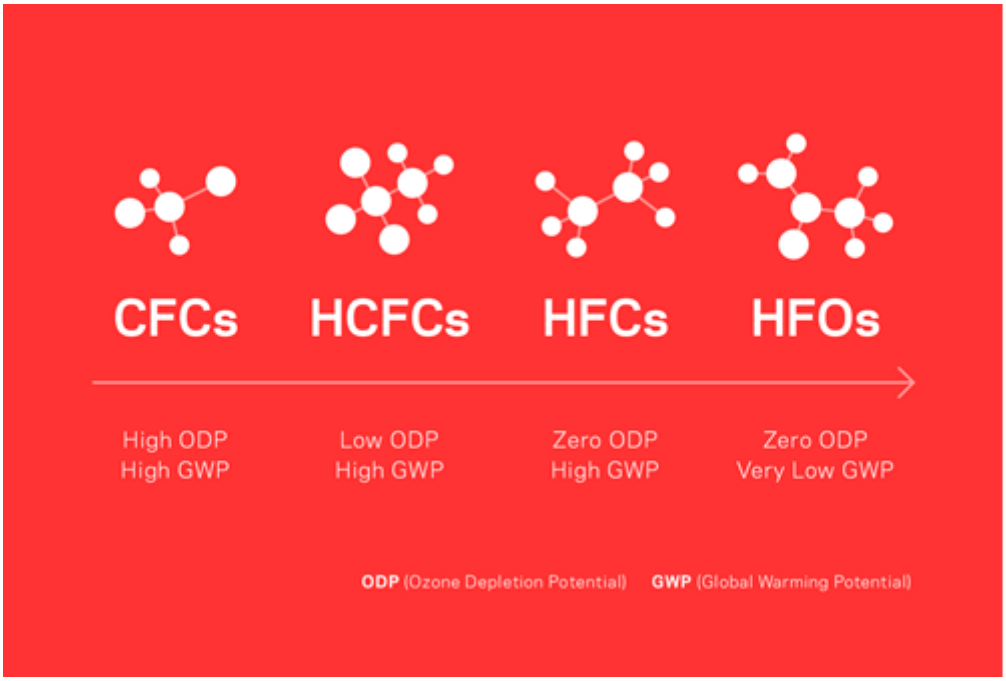
The Vienna Convention
➢ for the Protection of the Ozone Layer was signed in 1985 under which UN member countries recognized the importance of curbing damage to the ozone layer. As per the Convention's provisions, countries agreed to adopt the Montreal Protocol to further the goals of the Vienna Convention.

• The Montreal Protocol was signed in 1987 and entered into force in January 1989. o The protocol gives provisions to reduce the production and consumption of ODSs in order to protect the ozone layer

Montreal protocol: The Montreal Protocol on Substances that Deplete the Ozone Layer was designed to reduce the production and consumption of ozone depleting substances The original Montreal Protocol was agreed on 16 September 1987 and entered into force on 1 January 1989.

- Montreal Protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere-chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform-are to be phased out by 2000 (2005 for methyl chloroform). These compounds significantly deplete the stratospheric ozone layer that shields the planet from damaging UV-B radiation.





In the Context of Ozone Deplation Issue, the Term " HFO : Hydrofluoro Olefin ". Why This HFO is Known for ?

a) High Ozone Depleting Potential and High Global Warming Potential
b) Low Low Ozone Depleting Potential and High Global Warming Potential
c) Zero Ozone Depleting Potential and High Global Warming Potential
d) Zero Ozone Depleting Potential and Very Low Global Warming Potential

Ans D

Kigali Agreement

- Around 197 countries, including India, China and the USA, agreed at Kigali to reduce the use of HFCs by roughly 85% of their baselines by 2045.
- It amends the 1987 Montreal Protocol.
- It is proposed to reduce Hydro fluorocarbons (HFCs).
- The agreement has got three separate pathways for different countries.
- Overall, Kigali deal will result in reducing the global temperature rise by 0.50C
- As it is an amendment to Montreal Protocol, it will bind countries to their HFCs reduction schedules from 2019.
- The Agreement upholds the principle of Common but Differentiated Responsibilities and Respective Capabilities.
- The countries negotiating at Kigali also agreed to provide adequate financing for HFCs reduction— which runs in billions of dollars globally.
- The agreement at Kigali provides for exemptions for countries with high ambient temperatures to phase down HFCs at a slower pace

Solutions to Ozone Layer Depletion

Following are some of the points that would help in preventing this problem at a global level:

- ***Avoid Using Pesticides*** *-Natural methods should be implemented to get rid of pests and weeds instead of using chemicals. One can use eco-friendly chemicals to remove the pests or remove the weeds manually.*
- ***Minimise the Use of Vehicles****-The vehicles emit a large amount of greenhouse gases that lead to global warming as well as ozone depletion. Therefore, the use of vehicles should be minimised as much as possible.*
- ***Use Eco-friendly Cleaning Products****-Most of the cleaning products have chlorine and bromine releasing chemicals that find way into the atmosphere and affect the ozone layer. These should be substituted with natural products to protect the environment.*
- ***The Use of Nitrous Oxide should be Prohibited****-The government should take actions and prohibit the use of harmful nitrous oxide that is adversely affecting the ozone layer. The people should be made aware of the harmful effects of nitrous oxide and the products emitting the gas so that its use is minimised at the individual level as well.*

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OZONE AND CLIMATE CHANGE

Topic: Is the ozone hole causing climate change?

Yes and no?

The ozone hole is not causing global warming, but it is affecting atmospheric circulation. Explain ?

- The ozone hole is basically a man-made hole in the ozone layer above the South Pole during the Southern Hemisphere's spring.
- The ozone layer, which lies high up in the atmosphere, shields us from harmful ultraviolet (UV) rays that come from the sun. Unfortunately we punched a hole in it, through the use of gases like chlorofluorocarbons (CFCs) in spray cans and refrigerants, which break down ozone molecules in the upper atmosphere.

What scientists have uncovered recently, however, is that the ozone hole has been affecting climate in the Southern Hemisphere.

That's because ozone is also a powerful greenhouse gas, and destroying it has made the stratosphere (the second layer of the atmosphere going upwards) over the Southern Hemisphere colder**.**

The colder stratosphere has resulted in faster winds near the pole, which somewhat surprisingly can have impacts all the way to the equator, affecting tropical circulation and rainfall at lower latitudes.

The ozone hole is not causing global warming, but it is affecting atmospheric circulation.

Ozone (O_3) depletion **does not** cause global warming, but both of these environmental problems have a common cause: **human activities that release pollutants into the atmosphere altering it.**

CAUSES OF OZONE DEPLETION

Causes of ozone layer depletion:

(i) Natural causes: A number of naturally occurring substances destroy stratospheric ozone. Most important of these compounds are: Hydrogen oxide (HOx), Methane (CH4), Hydrogen gas (H2), Nitrogen oxides (NOx). Chlorine monoxide (ClO); during volcanic eruptions, significant amount of chlorine may be released in the stratosphere. Tiny particulate matter in the stratosphere, known as stratospheric aerosols, may also lead to ozone destruction.

(ii) Human activity related causes: Any event, which release chlorine atoms into the atmospheric, can cause severe ozone destruction, because chlorine atoms in the stratosphere can destroy ozone very efficiently. Most damaging among such agents are human made chlorofluorocarbons (CFCs), which is widely used as refrigerants and to pressurize sprays cans. In stratosphere, chlorine atoms from CFCs react with ozone to form chlorine monoxide and oxygen molecule

EFFECTS OF OZONE DEPLETION

Effect of O3 -layer depletion: increased UV dose is highly dangerous to living organisms.

****Harmful effects on human beings** - Increase susceptibility of skin-cancer - Increase cataract - Damage DNA - Damage cornea - Cause retinal diseases - Suppers human immune systems

****Harmful effects on plants** - Inhibit photosynthesis - Inhibit metabolism - Repress growth - Destroy cells - Cause mutation - Decline forest productivity

Harmful effects on other organisms - Marine/freshwater organisms are very sensitive to UV-rays - Fish larvae are very sensitive - Plankton population severely damaged. - Affect fish/shrimp/crab larvae

Harmful effects on non-living materials - Accelerate breakdown of paints - Accelerate breakdown of plastics - Affect temperature gradient levels in the atmosphere - Affect atmospheric circulation pattern, climatic changes.

****

Prelims question: The formation of ozone hole in the Antarctic region has been a cause of concern. What could be the reason for ozone depletion at poles?

a) Presence of prominent tropospheric turbulence; and inflow of chlorofluorocarbons
b) Presence of prominent polar front and stratospheric Clouds and inflow of chlorofluorocarbons
c) Absence of polar front and stratospheric clouds; and inflow of methane and chlorofluorocarbons
d) Increased temperature at polar region due to global warming

The polar vortex is a large area of low pressure and cold air surrounding both of the Earth's poles**. It ALWAYS exists near the poles, but weakens in summer and strengthens in winter. The term "vortex" refers to the counter-clockwise flow of air that helps keep the colder air near the Poles**

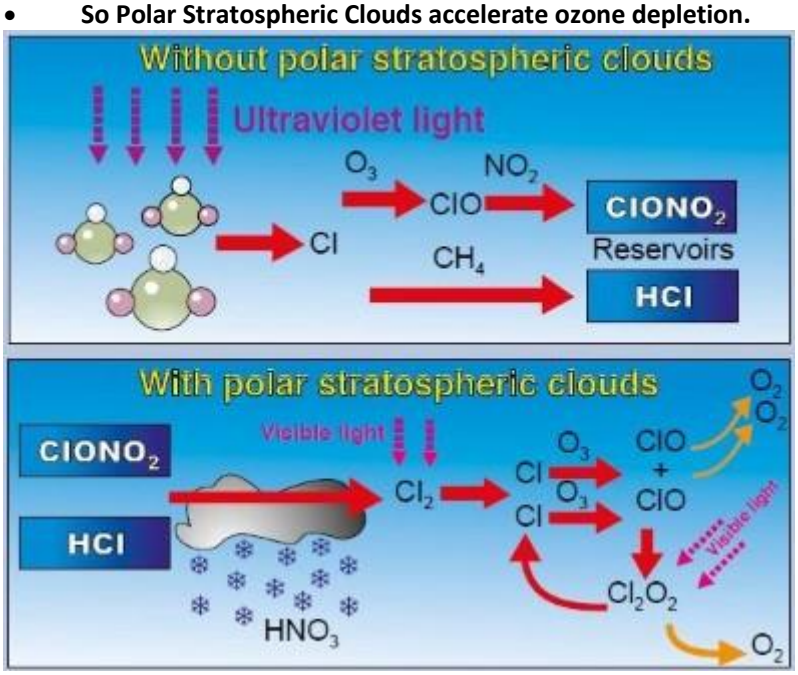
During winters, the polar vortex at the North Pole expands, sending cold air southward. An ozone hole is the thinning of the ozone layer boosted in size by colder temperatures. As the temperatures high up in the stratosphere starts to rise, ozone depletion slows, the polar vortex weakens and breaks down**.**

The expansion of the hole was driven by a strong, stable and cold polar vortex and very cold temperatures in the stratosphere. The same meteorological factors also contributed to the record 2020 Arctic ozone hole, which has also closed.

Human-made chemicals migrate into the stratosphere and accumulate inside the polar vortex. It begins to shrink in size as warmer temperatures dominate.

Polar Stratospheric Clouds (PSCs)

- Extend from 12 km – 22 km above the surface.
- They are nacreous clouds.
-
- Polar Stratospheric Clouds or nacreous clouds contain **water, nitric acid and/or sulfuric acid**.
- **They are formed mainly during the event of polar vertex in winter; more intense at south pole.**
- The Cl-catalyzed ozone depletion is dramatically enhanced in the presence of polar stratospheric clouds (PSCs)
- **So Polar Stratospheric Clouds accelerate ozone depletion.**



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CHAPTER 16 CURRENT AFFAIRS
DECEMBER - MARCH NEWS 2023-2024

NEWS : SHETTIHALI WILDLIFE SANCTUARY , KARNATAKA

- Context : National Green Tribunal given deadline to Karnataka Government to resolve the issues in delay in notification of ESZ status for this Sanctuary.

- Jog Falls on Sharavati river located near this Sanctuary
- Recently Environment Minister issued Notification to declare 1 km area from the boundaries of Pong Dam Wildlife Sanctuary in Kangra, HP as ESZ (River Beas)

ECO-SENSITIVE ZONES (ESZ)

- areas declared under the Environment Protection Act (EPA), 1986
- are created as "shock absorbers" for the protected areas, to minimize the negative impact on the "fragile ecosystems" by certain human activities taking place nearby.
- As per the National Wildlife Action Plan (2002-2016), land within 10 km of the boundaries of national parks & wildlife sanctuaries is to be notified as eco-fragile zones or ESZ.
- Ministry of Environment, Forest and Climate Change notifies Eco-Sensitive Zones (ESZs) on the basis of proposals and recommendations of the State Government

Classification of Activities in ESZ

Prohibited	Regulated	Permissible
• Commercial mining • Setting of industries causing pollution • Commercial use of firewood • Establishment of major hydroelectric projects	• Felling of trees • Establishment of hotels • Widening of roads • Introduction of exotic species • Sign boards & hoardings	• Ongoing agriculture & horticulture practices by local communities • Rainwater harvesting • Organic farming & Use of renewable energy sources

VALMIKI TIGER RESERVE

- News : Rise in Tiger Population due to reduce Human activity, and ban on sand and stone mining and strict restrictions in ESZ area.
- Location : India- Nepal Border , Shiwalik Foothills, West Champaran Bihar
- Only National Park and Tiger Reserve in Bihar
- Part of Himalayan Terai Forest
- River : Gandak
- Region : Deciduous Forest, Freshwater Swamps, Alluvial Grasslands, Wetlands
- Kaimur Wildlife Sanctuary (KWS) : Bihar waiting for NTCA approval to declare KWS as State Second TR .

About NTCA:

- National Tiger Conservation Authority
- It was **established in 2006 under Wildlife (Protection) Act 1972**
- Under : MOEFCC
- Chairperson : Environment Minister
- it is supervising agency for "Project Tiger- 1973"

FIELD PARISIAN PANSY OR VIOLA ARVENSIS

- News : Self Pollinating Plant, Produce Less Nectar and small flowers than 20 to 30 years ago to attract fewer pollinators.
- This Plant evolved itself (Reason : decreasing availability of Insects)
- Herbaceous annual Plant , Wildflower native to Europe ,Western Asia and North America

INVASIVE ALIEN SPECIES IN NEWS

- Lantana Camara: Native to Western Hemisphere , introduced in India as Ornamental Plant but now impacted Indian Biodiversity . This Plant toxic to animals like livestock, pets etc causing liver damage etc
- Senna Spectabilis : Impacting Tamilnadu biodiversity especially in Satyamangalam TR

This plant introduced as Shade tree for coffee cultivation

-

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REJUPAVE TECHNOLOGY

- an indigenous road construction tech by CSIR for high-altitude bituminous roads near the India-China border in Arunachal Pradesh, designed for low/sub-zero temperatures' challenges.
- Used by Border Road Organisation
- Roads constructed using the 'Rejupave' asphalt modifiers in cold climatic regions are expected to have improved long-term durability. The technology enhances the resistance of roads to thermal cracking under low-temperature conditions, contributing to a longer lifespan.
- The asphalt modifier used in 'Rejupave' is bio oil-based. This modifier plays a crucial role in decreasing the heating requirements of bituminous mixes. Additionally, it helps in preserving the temperature of the bituminous mix during transportation.
- The use of 'Rejupave' is expected to reduce greenhouse gas emissions in the eco-sensitive mountainous environment of Arunachal Pradesh. This aligns with environmental sustainability goals.

HUMBOLDTS ENIGMA

- Concept Challenges Conventional Thinking
- Generally , Biodiversity Decreases with Altitude (Alexandor Von Humboldt thought)
- Humboldt's enigma is a term that describes the observation that mountain regions are generally more diverse than tropical regions
- Challenges the traditional beliefs, prevailing belief that biodiversity is concentrated in tropical regions
- Proposed by contemporary biogeographers.
- Challenge to traditional explanation: While the tropics generally boast higher biodiversity due to abundant sunlight and energy, mountains stand out as hotspots even outside this zone. This contradicts explanations solely based on climate.
- This observation contradicts the common belief that the most diverse areas on Earth are the rainforests around the equator (areas are the lowland tropical forests).
- The eastern Himalayas serve as an illustration, showcasing how differences in climate and varied geological composition contribute to the region's rich biodiversity.

Q: Humboldt’s enigma, which explores the factors influencing biodiversity in mountainous regions, involves key concepts. Consider the following statements:

1.Humboldt's enigma challenges the assumption that biodiversity is highest in regions receiving maximum solar energy.

2.Geological processes play a significant role in Humboldt’s enigma, contributing to the formation of diverse habitats on mountains.

3.Coastal tropical sky islands, like the Shola Sky Islands in the Western Ghats, are exceptions to Humboldt’s enigma, showcasing biodiversity patterns contrary to expectations.

Which of the statements above is/are correct?

A. Statements 1 and 2 only

B. Statements 2 and 3 only
C. Statements 1 and 3 only
D. All of the above
Correct Answer:
A. Statements 1 and 2 only
Explanation:

- **Statement 1: Humboldt's enigma challenges the assumption that biodiversity is highest in regions receiving maximum solar energy.**
-
  - This statement is correct. Humboldt's enigma challenges the conventional belief that regions receiving the most solar energy (tropics) exhibit the highest biodiversity. It highlights exceptions, particularly in mountainous regions, where biodiversity is not solely determined by solar energy.
- **Statement 2: Geological processes play a significant role in Humboldt's enigma, contributing to the formation of diverse habitats on mountains.**
-
  - This statement is correct. Humboldt's enigma emphasizes the role of geological processes, such as uplifts, in biodiversity. Mountains serve as "cradles" for new species due to the creation of new habitats and as "museums" where species persist over time.
- **Statement 3: Coastal tropical sky islands, like the Shola Sky Islands in the Western Ghats, are exceptions to Humboldt's enigma, showcasing biodiversity patterns contrary to expectations.**
-
  - This statement is incorrect. Coastal tropical sky islands, like the Shola Sky Islands, are not exceptions but align with Humboldt's enigma. They exemplify how old lineages persist on mountaintops despite fluctuating climates in the lower elevations.

Therefore, the correct answer is: **A. Statements 1 and 2 only**

Which of the Following Statement related with the concept of " Humboldt Enigma ".

1. The Concept proposes that biodiversity is not confined solely to Earth Tropical Regions .
2. It Suggest that various regions beyond the Tropics like Mountain Regions also exhibits significant Biodiversity.
3. The History of the Earth , its Geography and the Climate , Geological Processes of Mountains are the key drivers of biodiversity .

How Many of the Statements is /are correct ?

e) one only
f) two only
g) All Three
h) None

Que: In which of the following places in India, the two new species of songbird named as Sholicola and Montecincla respectively have been found?

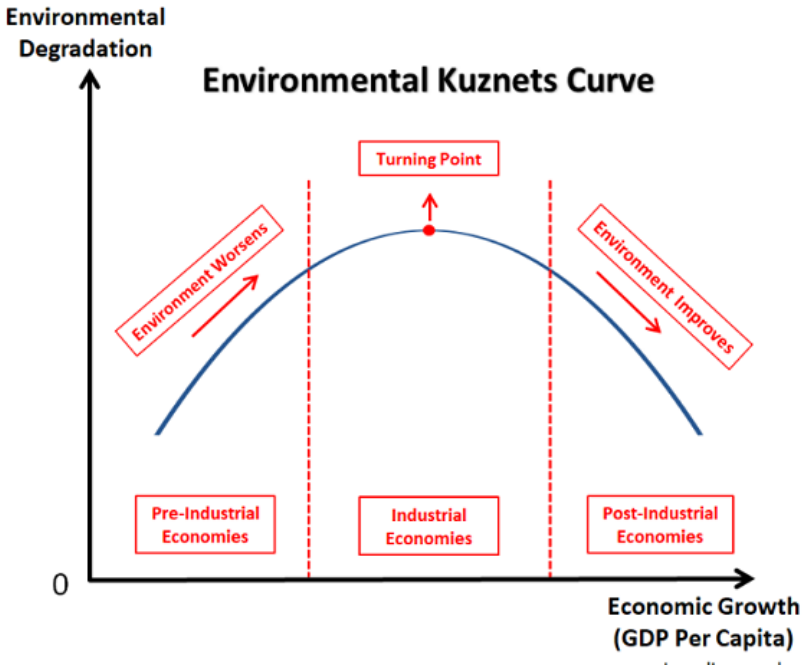
a)Western Ghat
b)Eastern Ghat
c)Andaman and Nicobar
d)Lakshadweep

The research team has designated two new genera, the Western Ghats short-wings as Sholicola (closely related to flycatchers) and the laughing thrushes as Montecincla (closely related to babblers).

Sky islands are isolated mountains surrounded by radically different lowland environments The complex dynamics of species richness on sky islands draws attention Indian Example : Shola Sky Island of Grasslands

Que: Environmental Kuznets Curve interconnects the Economy and Environment. It can be express as_____

(a) An increase in the Environmental pollution rate decreases the National income of an economy.
(b) At higher globalisation of the economy happens, environmental pollution lowers.
(c) Environmental degradation increases in the early stages of economic growth, but a higher level of economic growth provides reduced environmental degradation.
(d) Higher greenhouse gas emissions and Per Capita income have an inverse relationship.
Ans C



- The Environmental Kuznets Curve is a hypothesised relationship between various indicators of environmental degradation and per capita income.
- shows the relationship between economic progress and environmental degradation
- In the early stages of economic growth, pollution emissions increase and environmental quality declines, but beyond some level of per capita income (which will vary for different indicators) the trend reverses so that at high-income levels, economic growth leads to environmental improvement. This implies that environmental impacts or emissions per capita are an inverted U-shaped function of per capita income.
- When the stages of economic development is expressed on the X axis and Environmental degradation on the Y axis, the Environmental Kuznet curve gives an inverted 'U' shape **(∩)**
- The Environmental Kuznets Curve is used to graph the idea that as an economy develops, market forces begin to increase and economic inequality decreases.
- The Environmental Kuznets Curve suggests that there may be an optimal level of economic development beyond which environmental quality begins to improve
- The Environmental Kuznets curve shows an increasing pollution with initial development. But further economic progress brings down pollution
- So The relationship between environment and economic activities is very strong.

Location of Wadge Bank with respect to Project site

The Wadge Bank is situated south of Kanyakumari and lies between latitudes 7°10 and 8°00'N and longitudes 76°40'E and 78°00'E.

WADGE BANK : Where it is ? Why it is Meant to India ?

- India recognized the barren and uninhabited island of Katchatheevu as Sri Lankan territory in 1974 and Srilanka later recognized the resource-rich, deep-sea fishing grounds of Wadge Bank as Indian Territory in 1976.(about 80 km from Kanyakumari)
- Wadge Bank is a 10,000 square kilometre submarine plateau, a continental shelf of the sea south of **Kanyakumari near cape comorin** -that is rich in biodiversity and considered India's richest fishery resource.
- Located about 7 and 8 degree North Latitudes
- This bank under India EEZ and shall have sovereign rights over the area and its resources
- **But Now** Wadge Bank, is under threat due to the **Indian government's proposal to offer three oil and gas blocks for exploration and development.**

"If the Government of India decides to explore the Wadge Bank for petroleum and other mineral resources during the period mentioned in sub-paragraph (2), the Government of India shall notify to the Government of Sri Lanka the zones reserved for such exploration and the date of commencement of exploration. Sri Lanka fishing vessels shall terminate fishing activity, if any, in these zones with effect from the date of commencement of exploration."

About Sea Slug :

- They are Marine Invertebrates
- They are decomposers and some are Omnivores .
-
- They feeds on plankton and decaying matter
- They are Gastropods (are the most diverse group of molluscs)

Two venomous marine organisms, Blue sea dragon and Blue Button, usually found in deep sea were recently spotted at Chennai's shoreline

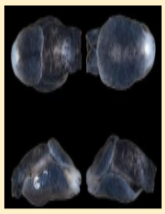
- The recently-hit Cyclone Michaung would be the reason why Blue Sea Dragons and Blue Buttons were thrown off the Chennai coast.

Blue Dragon :

- Type of Sea slug found in chennai open sea surface waters
- **type of mollusc**
- These Tiny Organisms are mildly Venomous and their sting can cause problems
- An air bubble stored in its stomach keeps the blue dragon afloat.
- They are **hermaphrodites**, meaning they have both male and female reproductive organs.
- Blue Sea Dragon is a unique underwater creature that has the ability to camouflage.
- Distribution: Mostly found throughout the Atlantic, Pacific, and Indian Oceans in tropical and subtropical waters.
- Often spotted in deep oceans, Blue Sea Dragons would go in groups, which gave them the name 'Blue Fleets'.
- It would store venom that it consumes from other creatures to inject venom on the foreign bodies they come into contact. But the venom isn't lethal.

- Blue Buttons, resembling button-like shapes, are not singular organisms but colonies of small predators called hydroids.
- These colonies float "passively" along the ocean, "performing specialised roles– stinging and preying, defending the colony from predators, and producing more of their kind.
- Distribution: Found in the tropical and subtropical waters of the Pacific, Atlantic, and Indian Oceans.
- Blue Button has a blue float made of a flat, circular disc with many gas-filled tubes that keep it afloat. The disc is surrounded by tiny blue tentacles.
- They have a 'man of war' mechanism, which means that they use the tentacles like body parts to sting any foreign body that comes into contact to defend themselves.
- Their venom isn't lethal.

Melanochlamys Droupadi



The Zoological Survey of India named a new marine species of head-shield sea slug after President of India Droupadi Murmu.

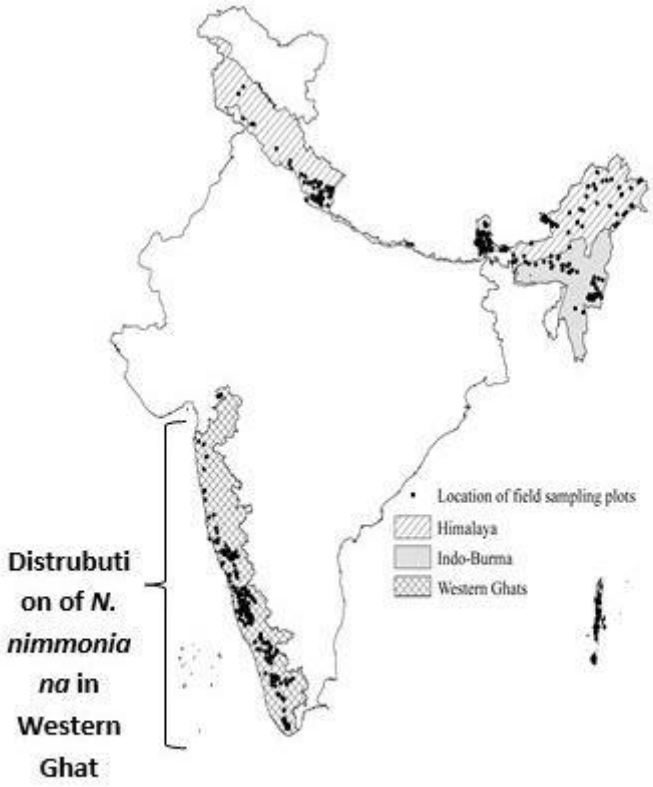
- Sea slugs are hermaphroditic, meaning they possess both male and female reproductive organs.
- Belonging to Melanochlamys genus was discovered from Digha of West Bengal coast and Udaipur of Odisha coast.
- Live primarily in marine habitats and are slug-like

NEWS: NATHAPODYTES NIMMONIANA

Researchers at the Indian Institutes of Technology Madras and Mandi have metabolically engineered plant cells to increase production of anti-cancer drug camptothecin (CPT).

Nathapodytes nimmoniana

- Nathapodytes nimmoniana is an endangered medicinal plant widely distributed throughout the Western Ghats of India.
- The plant contains camptothecin (CPT) which is renowned anticancer drugs.
- Though, CPT found in many plant species but maximum amount of CPT has been reported from N. nimmoniana.
- Due to very good source of CPT, this plant has been explored for its Phytochemical, Biotechnological and Pharmacological aspects.
- The plant has been overharvested, pushing it to the endangered list.
- The International Union for Conservation of Nature has red-listed the plant as in the past decade alone there has been a 20% decline in the plant's population.



***N. nimmoniana* occurrences in Western Ghats of India.**

NEWS NITROGEN HYPOXIA

Alabama carried out the 1st ever execution using nitrogen gas in the United States.

- Execution method – Forcing the inmate *to breathe in pure nitrogen* which *deprives the body of oxygen* needed to maintain bodily functions and ultimately causes death.
- Technology used – NIOSH approved '*Type-C full face piece supplied air respirator*', a type used in industrial settings to deliver life-preserving oxygen was used to deliver the nitrogen.
- Issues – Human rights advocates criticise it as a method of *cruel and inhumane action*.

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NEWS : BRUMATION

Researchers have observed instances of brumation in various reptilian species across habitats.

It is a state of reduced activity and physiological slowdown experienced by certain reptiles during coldermonths. (Similar to hibernation in mammals).

Purpose: Brumation is a survival strategy that helps reptiles conserve energy during periods of environmentalstress, such as cold temperatures or reduced food availability.

Commonly Brumating Species: Brumation is observed in various reptiles (Primarily ectothermic (coldblooded)), including snakes, turtles, and some lizards. For example, certain snake species may seek refuge inunderground burrows or other sheltered locations during the winter months

Recently, for the first time in our country, which of the following States has declared a particular butterfly as State Butterfly? (2016)
(a) Arunachal Pradesh
(b) Himachal Pradesh
(c) Karnataka
(d) Maharashtra
Ans: (d)

- Maharashtra became the first State in the country to have a 'State Butterfly'. It declared the Blue Mormon (Papilio polymnestor) as the State Butterfly.
- It is the second largest butterfly in India after the Troides minos commonly known as the Southern Birdwing.
- It is found only in Sri Lanka, Western Ghats of Maharashtra, South India and coastal belts of the country.
- It has velvet and black wings with bright blue spots. **Therefore, option (d) is the correct answer.**

Other State butterflies in India: States have declared State Butterflies in India.

- Maharashtra: Blue Mormon (First State to declare a State butterfly)
- Uttarakhand: Common Peacock
- Karnataka: Southern Birdwings or Sahyadri Birdwing (Largest Butterfly in India)
- Kerala: Malabar banded Peacock.
- Tamil Nadu: Tamil Yeoman
- State Butterfly of Tripura: Common Birdwing (Troides helena). Notified in 2019.
- Arunachal Pradesh: Kaisar-i-Hind, Notified in 2021
- Goa: Malabar Tree Nymph (Black & White Wing pattern)
- State Butterfly of Sikkim: Blue Duke (Bassarona durga). Notified in 2022
- Butterfly of Union Territory of Jammu and Kashmir: Blue Pansy (Junonia orithya). Notified in 2023.

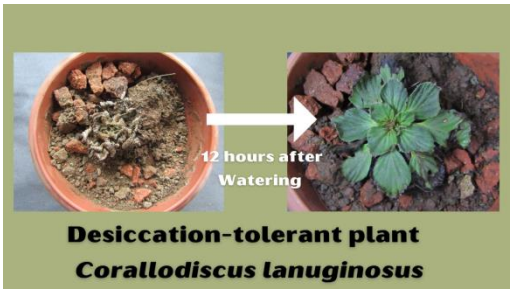
NEWS: Dusted Apollo, Bromus Swift

- Dusted Apollo : Type of Butterfly , Rare Altitude Butterfly found in Chamba district ,HP and their Distribution : Ladakh to West Nepal
- Bromus Swift : Butterfly discovered in Western Ghats

News : New study discovers 62 desiccation-tolerant vascular plant species in India's Western Ghats,

with potential applications in agriculture & conservation

Pune based Agharkar Research Institute researchers discover plant species from Western Ghats that survive without water for 8 months



Desiccation-tolerant (DT) vascular plants

- India's biodiversity hotspot, the Western Ghats (WG), is home to 62 Desiccation-Tolerant Vascular Plant Species
- Vascular plants are equipped with specialized tissues dedicated to transporting water, nutrients, and sugars across their anatomies. These specific tissues, known as vascular tissues, includes the xylem and phloem components.
- Desiccation-tolerant (DT) plants: DT plants can withstand extreme dehydration, losing up to 95% of their water content, and re-emerge once water is available again.

- Key Points: These plants are able to withstand long periods of drought and extreme temperatures by entering a state of suspended animation when water is scarce

- Distribution: World: found in a variety of habitats, including deserts, tundras, and alpine regions. India: In the inventory of 62 species, 16 are Indian endemic, and 12 are exclusive to the Western Ghats outcrops, highlighting WG's importance as a global DT hotspot

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Atlantification

Atlantification is a process causing the Arctic Ocean to become saltier and warmer, driven by the increasing flow of warm water from the Atlantic.

Mechanism of Atlantification:

- Warm water from the Atlantic is transported into the Arctic, particularly affecting parts of the Barents Sea.
- Some areas in the Barents Sea now more closely resemble the Atlantic due to Atlantification
- The Arctic Ocean typically has a layered structure: sea ice on top, cool freshwater beneath, and a deeper layer of warmer, saltier water from the Atlantic.
- Differences in water salinity help maintain these layers, protecting sea ice from melting due to warm Atlantic water.
- The decline in Arctic ice cover disrupts the layered structure, promoting the mixing of ocean layers.
- This disruption drives the process of Atlantification, contributing to the warming trend in the Arctic Ocean

Feedback Loop of Atlantification:

- Once Atlantification begins, it leads to further melting of sea ice. This creates a feedback loop, exacerbating the Atlantification process and contributing to ongoing sea ice decline

Role of Arctic Dipole in Atlantification:

- Atlantification is associated with a process called the Arctic Dipole, influenced by alternating anticyclonic winds over North America and cyclonic winds over Eurasia.
- The positive phase of the Arctic Dipole restricts Atlantic water entry via the Fram Strait, slowing Arctic seaice loss, while the negative phase accelerates sea-ice decline.

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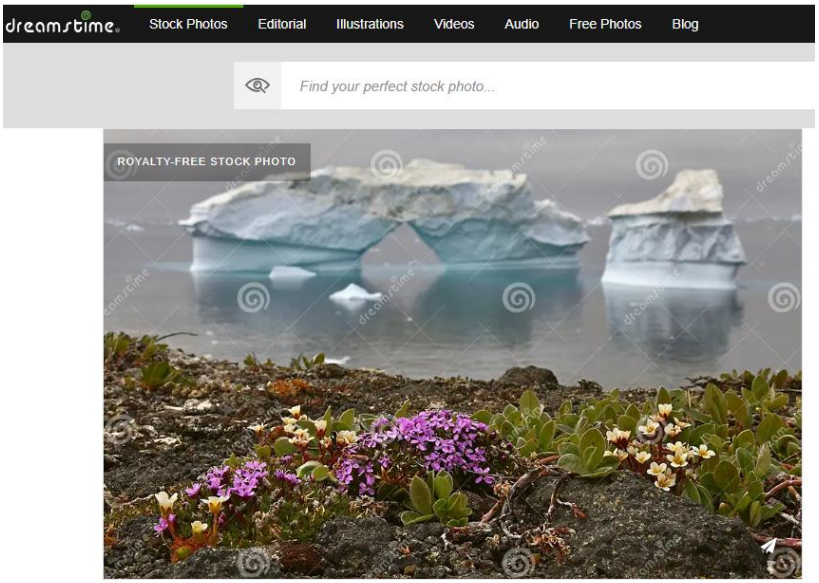

Iceberg and flowers. Flowers on the shore. Nature and landscapes of Greenland. West Greenland. Disko Bay.

Notably, Antarctica only has two species of flowering plants: the Antarctic hair grass (Deschampsia antarctica) and Antarctic pearlwort (Colobanthus quitensis), owing to its harsh conditions. However, these two species are now growing at a much faster rate than before, as temperatures rise and ice begins to melt.

The study showed that Antarctic hair grass grew as much in 2009-2019 as it had in the 50 years from 1960 to 2009, while Antarctic pearlwort grew five times more over the same period

Land Degradation Neutrality (LDN)

- The concept of LDN emerged from the UN Conference on Sustainable Development **(Rio+20)** in 2012.
- The LDN concept was developed under the UN Convention to Combat Desertification **(UNCCD)** and is aligned with the Sustainable Development Goals (SDGs- Target 15.3).

World's Commitment

- **New York Declaration** on Forests (goal: 350 million hectares of forest to be restored by 2030, also incorporating the Bonn Challenge).
- **The Bonn Challenge** is a global goal to bring 150 million hectares of degraded and deforested landscapes into restoration by 2020 and 350 million hectares by 2030.

India's Target

Restoration of 26 million hectares of degraded land aimed by 2030 to achieve an additional carbon sink of 2.5 to 3 billion tonnes of carbon dioxide equivalent.

Related Report & Pledges

- **Global Land Outlook report** is released by the UNCCD.
- **The Delhi Declaration**, adopted at the 14th Conference of Parties to UNCCD in 2019, called for better access and stewardship of land.

The Bonn Challenge:
It was launched in 2011 by the International Union for Conservation of Nature (IUCN) and the German government to bring 150 million hectares of degraded and deforested lands into restoration by 2020 and 350 million hectares by 2030.

Miscellaneous Efforts

- **India joined voluntary Bonn Challenge** pledge to bring into restoration 26 million hectares of degraded and deforested land by 2030.
- Desertification & **Land Degradation Atlas** of India (**published by ISRO**), for state-wise areas of degraded land.
- **Aravali Green Wall Project**, which is an ambitious plan to create a 1,400km long and 5km wide green belt buffer around the Aravali Mountain range covering states of Haryana, Rajasthan, Gujarat and Delhi.
- India set up a **Centre of Excellence at the Forest Research Institute, Dehradun**, for providing technical assistance to meet the challenges.

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Brazzaville Summit or Three Basins Summit 2023

- The Brazzaville Summit of the Three Basins of the Amazon, Congo, and Borneo-Mekong-Southeast Asia concludes with a declaration in Brazzaville (capital of the Republic of the Congo)

- The seven-point Brazzaville Declaration aimed to halt and reverse biodiversity loss by 2030

About Three Basins

Amazon Basin (Amazon Rainforest/"lungs of the Earth.")

• It is the largest tropical rainforest in the world spanning across several South American countries. • The Amazon River, second-longest river in world (after the Nile), runs through the heart of the Amazon Basin.

• The Amazon Rainforest plays a crucial role in regulating the earth's climate. It acts as a significant carbon sink, absorbing and storing large amounts of CO_2, and contributes to production of oxygen through photosynthesis.

Congo Basin ("Lungs of Africa.")

• It is the second-largest tropical rainforest in the world, after the Amazon Rainforest.

• The Congo Basin spans across six countries—Cameroon, Central African Republic, Democratic Republic of the Congo, Republic of the Congo, Equatorial Guinea and Gabon.

• The Congo River, the second-longest river in Africa, flows through the basin.

The Borneo-Mekong-Southeast Asia Basin (Island of Borneo + Mekong River)

• Southeast Asia is a subregion of Asia, consisting of 11 countries: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar (Burma), the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam.

• Borneo is the third-largest island in the world and is located in Southeast Asia. It is divided among three countries: Malaysia, Indonesia (Kalimantan), and Brunei.

• The Mekong River Basin includes parts of China, Myanmar, Laos, Thailand, Cambodia, and Vietnam.

These Three Basins collectively house 80% of the world's tropical forests and two-thirds of terrestrial biodiversity.

SPECIES IN NEWS

NAMDAPHA FLYING SQUIRREL

- **Missing for 42 Years has resurfaced again in Arunachal Pradesh**
- **Found : Namdapha Tiger Reserve**
- **Catchment Region : Brahmaputra River Basin (Burhi Dihing River)**
- **Behaviour : An Arboreal and Nocturnal and Herbivores Mammal**
- **Status : Critically Endangered and Schedule II of WPA, 1972**
- **Threats: Habitat Loss, Deforestation, Landslides, Poaching**

Namdapha National Park and Tiger Reserve

Context: A rare sighting of a tiger in India's Namdapha National Park and Tiger Reserve led officials to uncover several timber depots in the core area of the reserve.

Namdapha flying squirrel (CR)

About the park

- **Namdapha National Park (est. 1983)** is nearly 2000 km² large protected area in Arunachal Pradesh (in the biodiversity hotspot in the Eastern Himalayas)
- **Name**: From the name of a river originating in the park and it meets Noa-Dehing river (tributary of the Brahmaputra)
- Lies between the **Dapha bum range of the Mishmi Hills and the Patkai range**.

The park lies in close proximity to Indo-Myanmar-China trijunction.

Hoolock Gibbons (the only 'ape' species found in India)

- **Namdapha is the Fourth largest** national park in India (Hemis NP (Ladakh)> Desert NP (Rajasthan)> Gangotri NP (Uttarakhand)
- On the **Tentative Lists of UNESCO World Heritage Sites** in India.
- Only Park in the World to have the four Feline species: **Tiger, Leopard, Snow Leopard and Clouded Leopard**

To know more Visit Insights IAS Daily Current Affairs

Which one of the following National Parks has a climate that varies from tropical to subtropical, temperate and arctic? (2015)

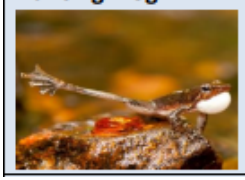
(a) Khangchendzonga National Park
(b) Nandadevi National Park
(c) Neora Valley National Park
(d) Namdapha National Park

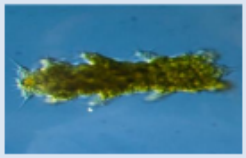
Consider the following pairs: (2013)

1. Nokrek Biosphere Reserve: Garo Hills
2. Logtak (Loktak) Lake: Barail Range
3. Namdapha National Park: Dafla Hills

Which of the above pairs is/are correctly matched?

(a) 1 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) None

Dancing Frog 	• It is endemic to the Western Ghats and can be found in High altitude shola forests, wet evergreen forests, Myristica swamps, and secondary forests. • It popularly known as "dancing frogs" due to their peculiar habit of waving their feet to attract females and ward off competition during the breeding season. • They have prominent white vocal sacs.

Batillipes Kalami 	• Researchers named a new species of marine tardigrade after former President A.P.J. Abdul Kalam • Tardigrades are also known as water bears. They are microscopic eight-legged animals. • It belongs to species known as extremophiles, that survive in extreme conditions, without food or water.
Mithun 	• Mithun descendant of the Indian Gaur or bison gets a 'food animal' tag from the Food Safety and Standards Authority of India (FSSAI). • It is distributed in Northeast India, Bangladesh, northern Myanmar and in Yunnan, China. • It is the state animal of Arunachal Pradesh and Nagaland. • It is listed as Vulnerable in the IUCN Red List.
Indian skimmers 	• It is also known as Indian scissors bill. • It is native to India, Bangladesh, Myanmar, Nepal, Pakistan and Vietnam. • It is more widespread in winter; found in the coastal estuaries of western and eastern India. • It is listed as Endangered in the IUCN Red List.

Consider the statements with respect to Chilka Lake in India

1. It is Asia Largest and world Second Largest brackish water lagoon Region.
2. It is biggest lake of India after Vembanad Lake
3 It was designated the first Indian Wetland of International Importance under Ramsar Convention.
4. It is largest wintering ground for migratory birds on the Indian Subcontinent .
5. It is known for Nalabana Bird Sanctuary
6 It is Part of UNESCO World Heritage List

How Many of the Statements are correct ?

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

Recently National Tiger Conservation Authority (NTCA) has given the nod to Ramgarh Vishdhari Sanctuary for the Tiger Reserve, Which of the following Indian State it is related with :

a) Gujarat
b) Madhya Pradesh
c) Rajasthan
d) Chhatisgrah

Consider the statements with respect to Tiger Reserve ?

1. It is considered to be the wildlife corridor that connects the Eastern Ghats to the Western Ghats which in turn facilitates the gene flow between the population species inhabiting both the mountain ranges.
2 it is located in Karnataka state .
3. The Tiger reserve important for elephant corridors .

Select the Correct Code :

a) Bandipur Tiger Reserve
b) Periyar Tiger Reserve
c) Kalakad Mundanthurai Tiger Reserve
d) Biligiri Rangaswamy Temple Tiger Reserve

Ans The Biligiri Rangaswamy Temple Tiger Reserve (BRT) is located in Chamarajanagar district of Karnataka State. This unique Bio-geographical habitat is in the middle of the bridge between Western and Eastern ghats in South India. T

Que : Sometimes in the News , A study conducted by Indian Institute of Tropical Meteorology, Pune and some universities has found which of the following National Park to be a " Net Carbon Emitter".

a) Panna National Park
b) Keibul Lamjao National Park

c) Kaziranga National Park

d) Dachigam National Park

Ans C

according to latest research conducted by a group of scientists from the Indian Institute of Tropical Meteorology, Pune, Maharashtra and Tezpur University in Tezpur, Assam.

Reason : Kaziranga National Park is carbon emiiter due to unique soil properties. The area having large population of bacteria due to riverine grassland region. Bacteria release carbon dioxide.

The photosynthetic activity of trees during the monsoon decreases due to increased cloud cover. Hence, the ability of the forest to absorb carbon dioxide also decreases. The situation remains the same during the post-monsoon and winter months, making the forest a net carbon emitter.

How is KNP a Net Carbon Emitter?

- **Unique soil:**
  - The soil of the region is home to **a large population of bacteria that release carbon dioxide** as they breathe, which adds to the carbon dioxide being emanated by other organisms, including trees.
- **Decrease in Photosynthetic Activity:**
  - The photosynthetic activity of trees during the monsoon decreases **due to increased cloud cover.** Hence, the ability of the forest to absorb carbon dioxide also decreases.
  - The situation **remains the same during the post-monsoon and winter months, making the forest a net carbon emitter.**
- **Less rainfall from transpired water**:
  - The scientists analyzed the **isotopes in the transpired water and observed a strong link between the water and carbon cycles** of the forest.
  - There is a decreasing trend **in the rainfall coming from the transpired water** in the pre-monsoon months which are responsible for the highest carbon absorption.
- Transpiration is a process that involves loss of water vapour through the stomata of plants.
- Stomatal openings are necessary to admit carbon dioxide to the leaf interior and to allow oxygen to escape during photosynthesis.

Kaziranga National Park :

- Located south of Brahmaputra river , Assam
- it is National Park (1974)
- it is Unesco world heritage site (1985)
- it is Tiger Reserve (2006)
- Important Bird Area by Birdlife International
- Vegetation : four types : alluvial inundated grasslands, alluvial savanna woodlands, tropical moist mixed deciduous forests, and tropical semi-evergreen forests.
- home to the largest-population of the one-horned rhinoceros in the world

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Gravity Hole: an Anomaly in Indian Ocean

- Indian scientists have uncovered the cause of mysterious giant anomaly referred to as a gravity hole in the Indian Ocean.
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- It is also known as the Indian Ocean Geoid Low (IOGL) and was discovered in 1948 during a survey by Dutch geophysicist. It covers more than three million square kilometres of the ocean.

Concept of Gravity	• The prevailing notion of Earth as a flawless sphere with uniform gravity across its expanse is a common misconception. Our planet is flat at the poles, and it bulges at the equator. Also, it doesn't have uniform gravity everywhere. • For example, there is a massive "gravity hole" in the Indian Ocean and now, researchers have uncovered why that is the case.
About Gravity Hole & It's Cause	• These are areas where the **gravitational pull is significantly stronger** than in the surrounding areas. • These anomalies are caused by variations in the gravitational pull of the Earth due to **differences in the density of the materials** that make up the Earth's crust.
Effect of Gravity Hole	• It can have a profound **effect on the ocean currents** and the movement of water around them. • The gravitational pull of a gravity hole can **cause water to be pulled towards it, creating a vortex** that can suck in anything that comes too close. • This can be dangerous for ships and other vessels that are navigating the area. • It can also **influence the geology of the surrounding area.** The increased gravitational pull can cause the rocks and sediment in the area to be compressed, which can lead to the formation of new geological features.
Indian Ocean Geoid Low (IOGL)	• It is a **negative geoid anomaly**, meaning that the **sea level in this region is lower than what would be expected** based on the Earth's gravitational field. • It has important implications for oceanography, climate science, and geodynamics. • It **affects the ocean circulation patterns**, the distribution of heat and salt in the ocean, and the sea level rise projections for the Indian Ocean region.

Different Anomalies in the World

South Atlantic Anomaly (SAA) The SAA is a region in the Earth's magnetic field where it is significantly weaker than in other parts of the globe. This anomaly is located in the South Atlantic Ocean, extending from South America to the southern coast of Africa.

Karakoram Anomaly 'Karakoram Anomaly' is termed as the stability or anomalous growth of glaciers in the central Karakoram, in contrast to the retreat of glaciers in other nearby mountainous ranges of Himalayas and other mountainous ranges of the world

Temperature Anomaly

• The term temperature anomaly means a departure from a reference value or long-term average.
• A positive anomaly indicates that the observed temperature was warmer than the reference value, while a negative anomaly indicates that the observed temperature was cooler than the reference value.
• For Example, March 2023 was the second warmest March on record. The warmest March occurred in 2016, when the biggest El Niño of the 21st century triggered a 'mini' global warming

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Concept of Solar Maximum & Solar Minimum

	Solar Maximum	Solar Minimum
What is it?	The greatest number of sunspots in any given solar cycle is designated as "solar maximum."	The lowest number of sunspots in any given solar cycle is "solar minimum.
	Both are two distinct phases in the solar cycle, which is an **approximately 11-year cycle of varying solar activity.** The most recent solar maximum occurred in 2014, and the next one is expected to occur in 2025.	
Impact	Both can impact space weather, potentially affecting satellites, communication systems, power grids, and astronauts.	
Solar Flares and CMEs (Coronal Mass Ejections)	**More frequent and intense.** These events are driven by the increased magnetic activity associated with sunspots.	**Less frequent and less intense** during a solar minimum due to the reduced sunspot activity.
Auroras (Northern and Southern Lights)	**More frequent and can be more vivid**. This is because increased solar activity produces more charged particles interacting with Earth's atmosphere.	While auroras can still occur during a solar minimum, they tend to be **less frequent and less intense.**