ECOLOGY & ENVIRONMENT

FOR APSC

WORLD, INDIA & ASSAM

ACS

Academy of Civil Services

ECOLOGY AND ENVIRONMENT

Chapter 1: Introduction to Ecology

ECOLOGY

- **The study of the relationships between organisms and their environment**
- **The study of structure and functions of nature**

AUTECOLOGY AND SYNECOLOGY

- Ecology that seeks to explain the distribution and abundance of species by studying interactions of individual organisms with their environents is autecology
- The ecological study of whole plant or animal communities can be termed as synecology.

ENVIRONMENT

- The sum total of all surroundings of a living organism, including physical, biological and chemical factors, which provide conditions for development and growth of that living organism.

POPULATION

- Group of organisms of the same species, occupying a defined area during a specific time is called population
- Population growth rate is the percentage variation between the number of individuals in a population at two different times
- The movement of a population of species from one region to another can be termed as **migration**
- **Immigration** is the movement of species to a destination place of which they are not natives.
- **Emigration** is the relocation or process of leaving one place to reside in another
- **Birth and immigration increase population of species**
- **Death and emigration decrease population of species**
- Biotic and abiotic factors are called **limiting factors** because they have a certain limiting/ threshold value (both upper and lower limit).
- **Carrying Capacity:** Maximum population size that an ecosystem can sustainably support without degrading the ecosystem. Deaths and long-term damage to an ecosystem occurs when a population exceeds the carrying capacity of its ecosystem

COMMUNITY

- Population of different species forms a community
- Community is formed from the dominant species along with its associated species.

KEYSTONE SPECIES

- Not a dominant species but controls population of other species
- **Assists in establishing an entire ecosystem.**

- **An ecosystem that loses even only one of its keystone species could trigger a chain reaction of negative events, which could lead to the collapse of the entire food web**

ECOSYSTEM

- **Structural and functional unit of nature (biosphere) is ecosystem**
- Community of living beings and the physical environment, both interacting and exchanging materials between them
- Ecosystem can be as small as a single tree or large as entire forest

ECOTONE

- **Zone of junction between two or more diverse ecosystem**
- It has the **conditions intermediate to the adjacent ecosystems**. Hence it is a **zone of tension**.
- Sometimes the number of species and the population density of some of the species is much greater in this zone than either community. This is called **edge effect**. Example, the density of birds is greater in the mixed habitat of the ecotone between the forest and the desert

NICHE

- Unique functional role or place of a species in an ecosystem
- A description of all the biological, physical and chemical factors that a species needs to survive, stay healthy and reproduce
- No two species have exact identical niche

BIOSPHERE

- Part of the Earth where **life exists**
- **Interacting zone of atmosphere, hydrosphere and lithosphere**

ANIMAL RESPONSE TO ABIOTIC STRESS

- In order to prevent heat loss during winters, certain animals undergo **hibernation (winter sleep)**
- In order to keep a cooling effect on the body during summer, certain animals undergo **aestivation (summer sleep)**

ALLEN'S RULE

- Animals in colder climate tend to have shorter extremities (**ears, limbs and tails**) than animals in warmer climate. Larger extremities mean more surface area and less volume.

ECOLOGICAL INTERACTIONS

- **Mutualism**: Interaction between individuals of different species that results in positive (beneficial) effects on survival of the interacting populations.
    - Association between the pea plant and *Rhizobium* bacteria on its root nodules. The bacteria help in fixing atmospheric nitrogen, instead it derives oxygen from the pea plant. Nodules are filled with hemoglobin. So much of it, in fact, that a freshly-cut nodule is red. The hemoglobin of the legume (called leghemoglobin), like the hemoglobin of vertebrates, probably supplies just the right concentration of oxygen to the bacteria.
    - **Lichen is a symbiotic association of cyanobacteria (blue green algae) and fungi**
    - **Mycorrhiza is symbiotic association of fungi and roots of higher plants.** Ectomycorrhizas are symbiotic associations between the roots of around 10% of plant families, mostly woody plants including the birch, dipterocarp, eucalyptus, oak, pine, and rose families, orchids
- **Commensalism**: An association between two organisms in which one benefits and the other derives neither benefit nor harm.
- **Predation**: Predation is a biological interaction where one organism, the predator, kills and eats another organism, its prey.
- **Parasitism**: Parasitism is defined as the association of two organisms of same or different species, in which one lives at the cost of other. A parasite is that which lives on other organism called a host, receiving nourishment and shelter **without any compensation for the host.**
- **Amensalism:** An ecological interaction between two species, but in this association among organisms of two different species, one is destroyed or inhibited, and other remains unaffected

- **Competition**: Competition is a relationship between organisms in which one is harmed when both are trying to use the same resource related to growth, reproduction, or survivability.

FUNCTIONS OF ECOSYSTEM

- **Energy flow**
- **Nutrient cycling/ Biogeochemical cycle**
- **Ecological succession**

ENERGY FLOW

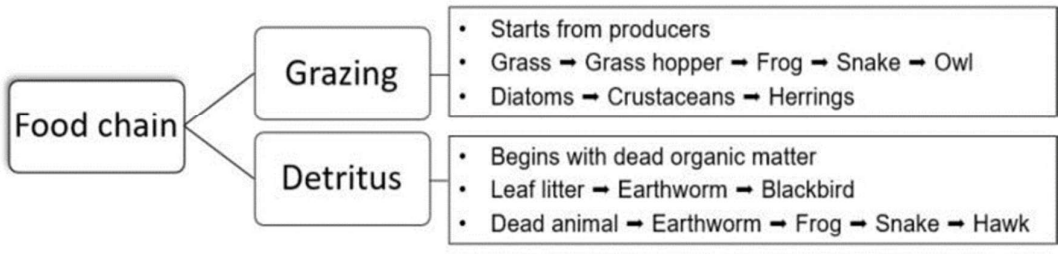
- The **flow of energy from producer to top consumers** is called energy flow which is **unidirectional**
- **Trophic level interaction** deals with how the members of an ecosystem are connected based on nutritional needs
- **10% Rule**: When energy is passed in an ecosystem from one trophic level to the next, only ten percent of the energy will be passed on to the next trophic level, the remaining is utilized and lost in the form of heat energy

Fact File:

- **Autotrophs**: An autotroph or primary producer is an organism that produces complex organic compounds (such as carbohydrates, fats, and proteins) using carbon from simple substances such as carbon dioxide, generally using energy from light (photosynthesis) or inorganic chemical reactions (chemosynthesis). All green plants and green protists are examples
- **Heterotroph**: A heterotroph is an organism that cannot produce its own food, instead taking nutrition from other sources of organic carbon, mainly plant or animal matter.
- **Heterotrophs are Herbivorous (plant eating), carnivorous (flesh eating) , omnivores (both plant and meat eating) and detrivores**
- **Detritivores** are heterotrophs which obtain nutrients by consuming detritus (decomposing plant and animal parts as well as feces). **Eg., earthworm, woodlice, millipedes, dung beetles, etc**
- **Saprotrophs** (also called lysotrophs) are chemoheterotrophs that use extracellular digestion in processing decayed organic matter. The process is most often facilitated through the active transport of such materials through endocytosis within the internal mycelium and its constituent hyphae. **Eg., Fungi**

FOOD CHAIN

- A food chain is a **linear sequence of organisms** in an ecosystem through which **matter and energy transfer** as one organism eats another (delete it)
- **A food chain refers to the linear sequence of organisms in an ecosystem, where one living organism eats another organism**
- Types of Food chain:
  - Grazing food chain
  - Detritus food chain



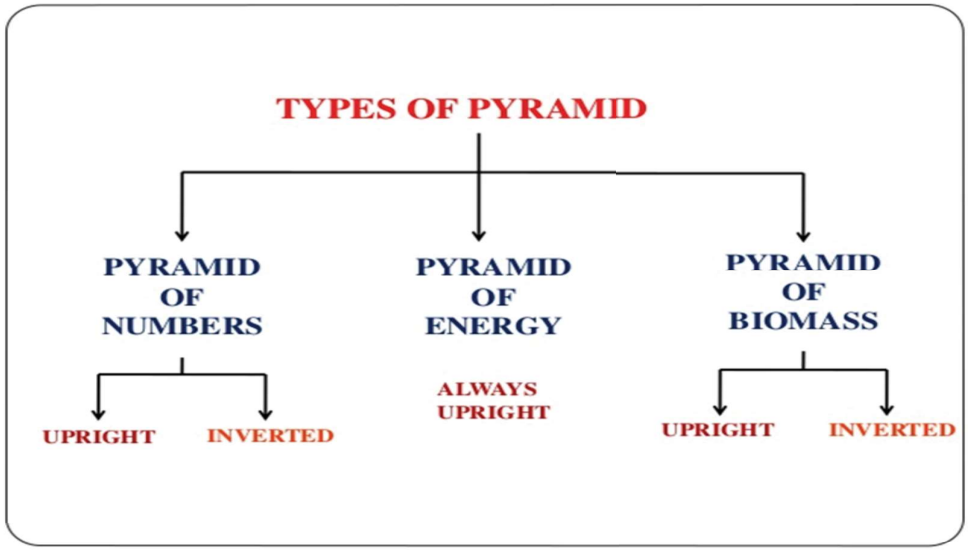
FOOD WEB

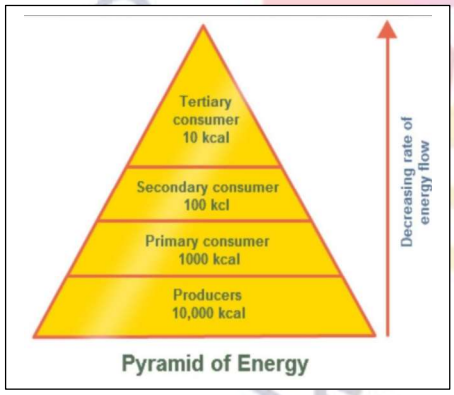
- Food webs consist of **many interconnected food chains** and are more realistic representation of consumption relationships in ecosystems

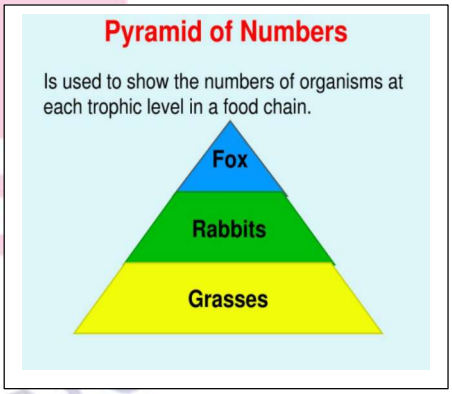
ECOLOGICAL PYRAMIDS

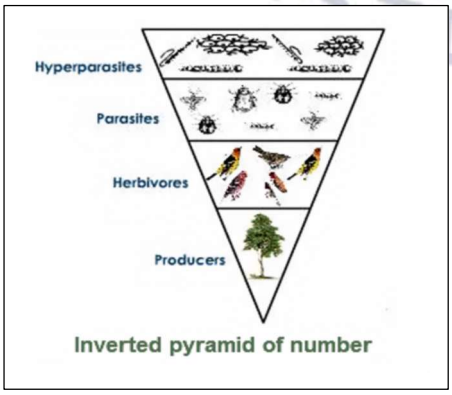
- It is a graphical representation of the **relationship between organisms at various trophic levels** in a food chain

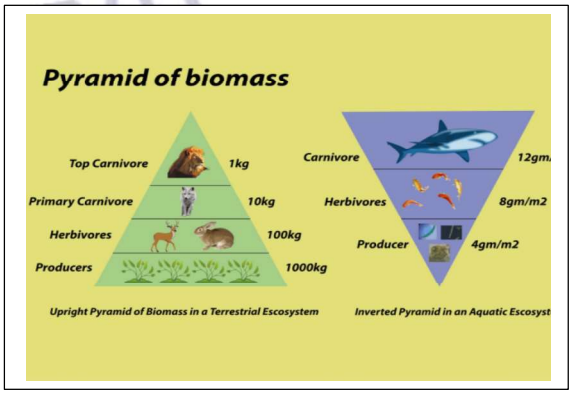
- **Types of ecological pyramid**
  - Pyramid of Energy
  - Pyramid of Numbers
  - Pyramid of Biomass











ECOSYSTEM PRODUCTIVITY

- It is the rate at which biomass is formed in the ecosystem

- Energy accumulated in the plants by photosynthesis

PRIMARY PRODUCTIVITY

- Primary productivity is the generation of biomass by autotrophy
- **Tropical rainforest** has highest primary productivity and is least in **extreme desert**
- Despite occupying about 70% of earth's surface, oceans contribute only 32% of total productivity
- In **aquatic ecosystem** primary productivity is limited by **light which decreases with increasing water depth**

SECONDARY PRODUCTIVITY

- It is the accumulation of energy at the consumer's level
- It is also referred to as the rate of increase in the biomass of heterotrophs
- Animals, fungi, bacteria, and numerous other protists influence Secondary Productivity

GROSS PRIMARY PRODUCTIVITY

- Gross primary productivity (GPP) is the rate of production of organic matter by producers

NET PRIMARY PRODUCTIVITY (NPP)

- Total amount of energy stored by the producers (plants)
- **NPP=GPP-R**, where R denotes respiratory energy loss

BIOACCUMULATION

- Build-up of toxic chemicals in a living organism
- Toxic chemicals such as pollutants, pesticides and other toxins accumulate directly into the human body either through air, water, food intake, or directly through the skin

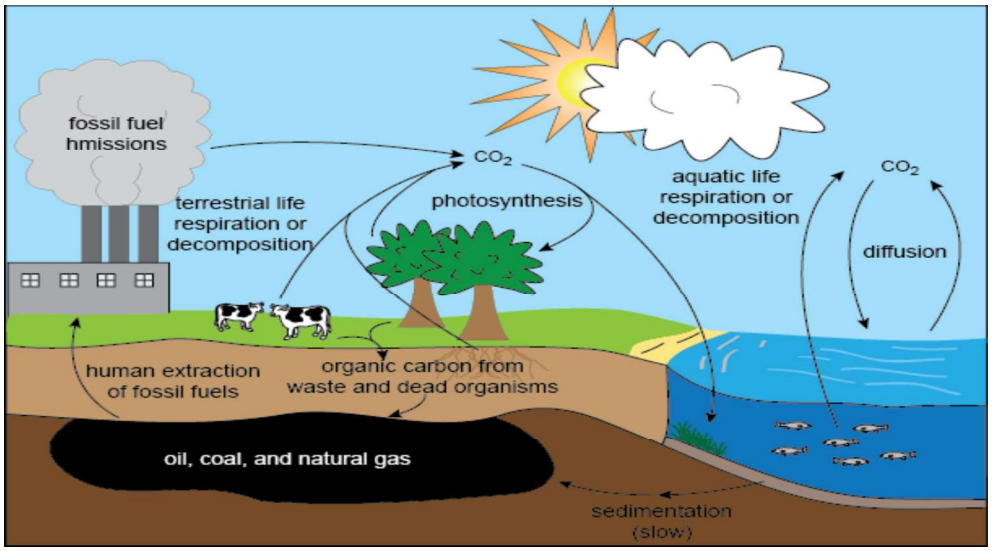
BIOMAGNIFICATION

- Biomagnification, also known as **bio amplification** or biological magnification, is any concentration of a toxin, such as pesticides, in the tissues of tolerant organisms at successively higher levels in a food chain
- One of the classic examples of bioaccumulation that resulted in biomagnification occurred with an insecticide called DDT

BIOGEOCHEMICAL CYCLES

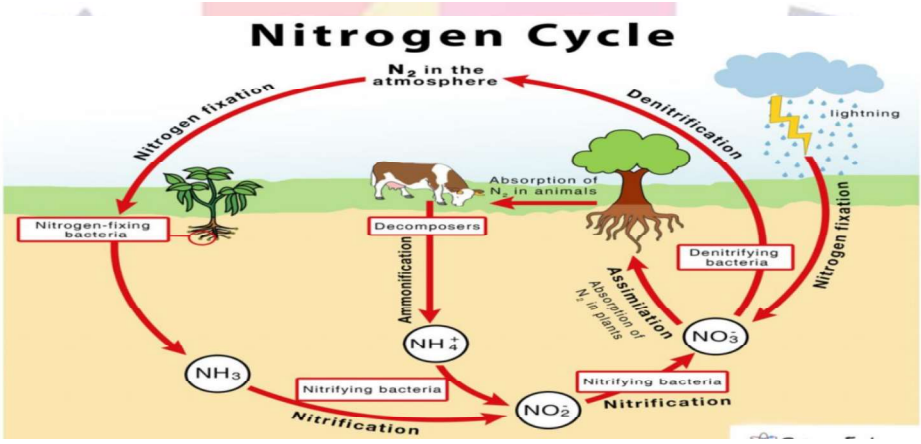
- Gaseous cycle: Water, Carbon and Nitrogen- Perfect cycle
- Sedimentary cycle: Phosphorus and Sulphur- Imperfect cycle

CARBON CYCLE

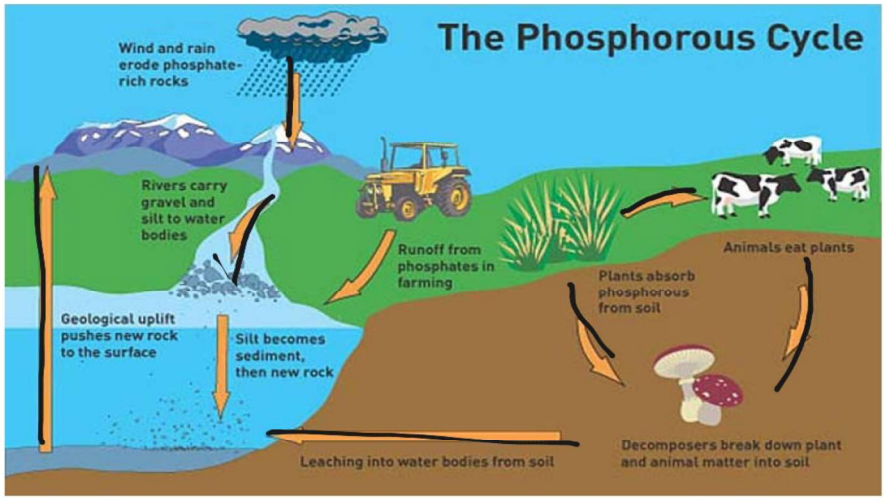


NITROGEN CYCLE

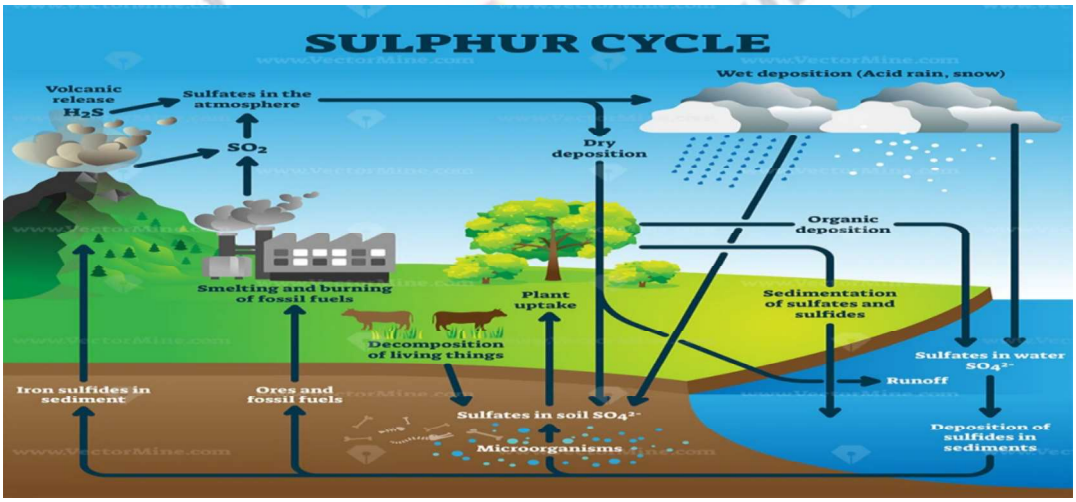
- **Biological Nitrogen Fixation -** Conversion of **nitrogen to ammonia** by **living organisms-mutualistic symbiotic relationships between legumes and *Rhizobium***
- To a limited extent by atmospheric phenomenon such as **thunder and lighting**
- **Nitrification** is the process by which ammonia is converted to nitrites (NO_2^-) and then nitrates (NO_3^-) by bacteria (e.g., ***Nitrosomonas***). Nitrite is then further transformed into nitrate by the bacteria ***Nitrobacter***



PHOSPHORUS CYCLE



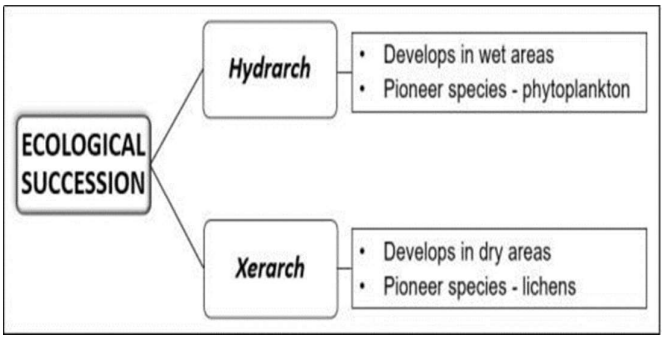
SULPHUR CYCLE



ECOLOGICAL SUCCESSION

- The **gradual** and progressive **replacement** of **one community** by **another,** till the **development** of a **stable community** in that area, or a process through which **eco systems** tend to **change** over a **period** of **time** is called asecological succession
- **Pioneer species** it is the **first organism** to **colonize** any **newly available area** and **begin** the process of **ecological succession.**E.g., Plankton, cyanophycean, algae, lichens etc.
- A climax community is a **mature**, **stable community** that is the **final stage** of **ecological succession**
- The stage leading to the climax community are called **successional stages or seres**
- **Primary succession involves the initial colonization of living things in a previously lifeless area**
- **Secondary succession involves recolonization of a region on well developed soil after a**

significant disturbance



AUTOGENIC SUCCESSION

- When succession is brought about living inhabitants of that community itself
- Driven by biotic factors

ALLOGENIC SUCCESSION

- Succession brought about by outside forces
- Examples of allogenic succession: Volcanic eruptions, Meteor or comet strike, Flooding, Drought, Earthquake

AUTOTROPHIC AND HETEROTROPHIC SUCCESSION

- When the population of autotrophs (plants) early dominate the population of heterotrophs, the succession caused is known as autotrophic succession
- Heterotrophic succession is characterized by early dominance of heterotrophs like bacteria, fungi and some animals in an organic environment

Previous Year Questions

1.Themaximumnumberofindividualsthatcanbesupportedbyagivenenvironmentis called: (2020)

a) Carrying capacity.
b) Population size
c) Biotic potential.
d) Environmental resistance

2.The group of organisms which the converts light into food is called (2018)

a) Autotrophs
b) Heterotrophs
c) Decomposers
d) Omnivores

Chapter 2: Biome

BIOME

- **Large community of vegetation and wildlife adapted to a specific climate and occupying a major habitat is called biome.**
- **Major Biomes include:**
  - Tundra biome
  - Taiga biome
  - Tropical rainforest biome
  - Temperate deciduous forest biome
  - Grassland biome
  - Desert biome
  - Freshwater biome
  - Marine water biome
- Terrestrial ecosystems cover approximately 140 to 150 million km^2, which is about **25 to 30 percent of the total earth surface area.**
- A **terrestrial ecosystem** is a **land-based community** of organisms and the interactions of biotic and abiotic components in a given area. Examples of terrestrial ecosystems include the tundra, taigas, temperate deciduous forests, tropical rainforests, grasslands, and deserts.
- The type of terrestrial ecosystem found in a particular place is dependent on the temperature range, the average amount of precipitation received, the soil type, and amount of light it receives.

Tundra

- The word tundra means a barren land.
- The tundra is the world's coldest and driest biomes.
- They have little precipitation, poor nutrients, short growing seasons and low biotic diversity
- Below a thin layer of tundra soil is its permafrost, a permanently frozen layer of ground called as **permafrost**
- Only certain small plants such as mosses, shrubs, sedges, lichens, and grasses can grow.
- Geographic location: Northern Canada, Alaska, European Russia, Siberia, Arctic and Antarctic etc
- CLASSIFICATION: **Arctic Tundra** and **Alpine Tundra**. The difference between the Arctic and Alpine tundra is that the soil in the Alpine tundra region is not permanently frosted. Therefore, small shrubs are visible in the Alpine tundra region

Forests

- **DECIDUOUS FORESTS:** Characterized by trees or plants, shedding its leaves annually is known as a deciduous forest. Out of the four seasons, the deciduous forests grow in one of the suitable seasons. During the shedding of leaves, the plants enter a dormant period.
- **RAINFORESTS:** They have the most plants and animals. Closed and continuous tree canopy, high humidity, the presence of moisture-dependent vegetation, a moist layer of leaf litter, the presence of epiphytes and lianas and absence of wildfire. The structure of rainforest is as follows:

- FOREST FLOOR: the bottom-most layer, receives only 2% of the sunlight. Only plants adapted to low light can grow in this region. The forest floor also contains decaying plant and animal matter, which disappears quickly, because the warm, humid conditions promote rapid decay
- UNDERSTORY LAYER: Home to a number of birds, small mammals, insects, reptiles, and predators. The vegetation at this layer generally consists of shade-tolerant shrubs, herbs, small trees, and large woody vines which climb into the trees to capture sunlight
- CANOPY LAYER: contains the majority of the largest trees, typically 30–45 m in height. Tall, broad-leaved evergreen trees are the dominant plants. Birds, monkey, arthropods, etc.
- EMERGENT LAYER: contains a small number of very large trees, called emergents, which grow above the general canopy, reaching heights of 45–55 m. These trees need to be able to withstand the hot temperatures and strong winds that occur above the canopy in some areas. Crown eagle, flying fox are found

- **CONIFEROUS FORESTS**: The greatest single band of the coniferous forest is the taiga (a Russian word for coniferous forest) in Siberia. Cold-tolerant evergreen conifers like Pine, Fir, Spruce and Larch are the major trees. Animals like wolf, Hyna, Bear, Red fox, Porcupine, squirrel are present

INDIAN FORESTS TYPES

- The first initiative to classify the forests of India was done by Champion in 1936 and revised by Seth in 1968.
- The **Champion and Seth** classification of forests includes**:** Tropical Wet evergreen forests, Tropical Semi-evergreen forests, Tropical Dry evergreen forest, Tropical Moist deciduous forests, Tropical Dry deciduous forest, Sub tropical Pine forests, Sub tropical Dry evergreen forests, Sub tropical Broad-leaved forests, Montane Wet temperate forests, Dry alpine scrub, Moist Alpine scrub, Sub alpine forest, Himalayan Dry temperate Forest, Himalayan Moist temperate Forest, Montane Wet temperate forests, Littoral and swamp

TROPICAL EVERGREEN FORESTS AND SEMI EVERGREEN FORESTS

- Western Ghats, the Nicobar and Andaman Islands and all along the north-eastern region
- Annual ppt 200cm and temp above 22^0C
- Semi evergreen forests are found in the less rainy parts of these regions. Such forests have a mixture of evergreen and moist deciduous trees.

TROPICAL DECIDUOUS FOREST

- Monsoon Forests
- Rainfall between 70-200 cm
- **Moist deciduous forests** are more pronounced in the regions which record rainfall between 100-200 cm. These forests are found in the northeastern states along the foothills of Himalayas, eastern slopes of the Western Ghats and Odisha.

- **Dry deciduous forest** covers vast areas of the country, where rainfall ranges between 70 -100 cm. Found in rainier areas of the Peninsula and the plains of Uttar Pradesh and Bihar.
- **Red Sanders** (*Pterocarpus santalinus*) occurs in the forest such as Southern Tropical Dry Deciduous Forests and falls in the eco-terrestrial regions of Deccan Thorn Scrub Forests as well as Central Deccan Plateau Dry Deciduous Forests. Red Sanders has a highly restrictive distribution in the South Eastern portion of Indian peninsula to which it is endemic. It grows almost exclusively in Karnataka, Tamil Nadu, Kerala and Andhra Pradesh.

TROPICAL THORN FORESTS

- Rainfall less than 70 cm
- Semi-arid areas of south west Punjab, Haryana, Rajasthan, Gujarat, Madhya Pradesh and Uttar Pradesh
- Variety of grasses and shrubs are found
- Important species found are babool, ber, and wild date palm, khair, , khejri, palas, tussocky grass, Acacias, euphorbias, spurge, caper, cactus, etc. Tussocky grass grows upto a height of 2 m as the under growth
- The common animals are rats, mice, rabbits, fox, wolf, tiger, lion, wild ass, horses and camels, leopard, caracal, chinkara, Chousingha, Blackbucks, etc

MONTANE FORESTS

- In the North, it is found in East of Nepal, higher hill ranges of north eastern India, hilly areas of West Bengal and Uttaranchal,
- In the South, it is found in three distinct areas of Peninsular India viz; the Western Ghats, the Vindhyas and the Nilgiris in parts of the Nilgiri Hills
- Oak, chestnut, pine, deodar, chinar, walnut, Silver firs, junipers, birch and rhododendrons, magnolia, laurel, cinchona and wattle etc are found

SHOLA FORESTS

- Shola forests are tropical Montane forests found in the valleys separated by rolling grasslands only in the higher elevations.
- They are found only in South India in the Southern Western Ghats
- Kurinji or Neelakurinji is a shrub that is found in the shola forests of the Western Ghats in South India blossoms once in 12 years
- The Shola forests and associated grasslands store large quantities of water on the mountain ranges, thus serving as huge water harvesting and storage structures. Shola forest are the source of water in rivers live Cauvery, Thamirabarani, Vaigai. Unlike other rivers in the peninsular region these rivers are perennial and they never go dry like the Ganges in the North India.

LITTORAL AND SWAMP

- Vegetation situated on the shore of the sea or a lake or an area of low-lying, uncultivated ground where water collects

- Plants in mangrove have roots that consist of soft tissue (aerenchyma) so that the plant can breathe in the water.
- Common trees of these forests are Rhizophora, Avicennia, Sundari, Palm, Coconut, Keora, Agar etc
- Estuarine crocodile, gharial, royal Bengal tiger, Water monitor lizard, Gangetic dolphin, and olive ridley turtle, Indian python
- Andaman and Nicobar Islands and the delta area of the Ganga and the Brahmaputra
- States having littoral and swamp forest are; West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Gujarat

ALPINE FOREST

- Height more than 3,600m above sea level
- The alpine and sub alpine forest are found in the states; Arunachal Pradesh, Sikkim, Uttarakhand, Himachal Pradesh and Jammu and Kashmir
- Kashmir stag, spotted dear, wild sheep, jack rabbit, Tibetan antelope, yak, snow leopard, squirrels, shaggy horn wild ibex, bear, rare red panda, sheep and goats with thick hair
- Silver fir, junipers, pines, birch, rhododendrons, etc. are the common trees of these forests

GRASSLAND ECOSYTEM

- Grassland biomes are large, lands of grasses, flowers, and herbs
- The rainfall is less here, that not enough to support a forest, but it is more than that of the desert
- Grassland biomes can be found in the interiors of continents.
- Due to the less precipitation, water limits and fire prevent large forests from growing.
- Rainfall is about 25-75 cm per year, not enough to support a forest, but more than that of a true desert
- Typical grasslands are vegetation formations that are generally found in temperate climates

GRASSLAND ECOSYTEM IN INDIA

- India's grasslands are mainly composed of steppes and savannas
- Steppe formations occupy large areas of sandy and saline soil; in western Rajasthan, where the climate is semi-arid average rainfall is less than 200 mm a year with a dry season of 10 to 11 months, and a large variation in rainfall
- **Impact of Grazing on Grasslands**: Due to heavy grazing pressure, the quality of grasslands deteriorates rapidly, microclimate becomes drier and is readily invaded by xerophytic plants. Intensive grazing results in increases areas of bare soil, which creates a new habitat for burrowing animals such as mice, jack rabbits, gophers, prairie dogs, locusts etc., which render large areas of forage lands sterile
- **Impact of Fire on Grasslands**: Generally, grasses can recover from fire, so long as the severity and intensity aren't too high, because their below-ground roots are still viable.

Boost Your Knowledge: Different Names of Grasslands in Different Parts of the world

- Steppes in Europe
- Savanna at Tropics
- Downs in Australia
- Veldt in South Africa
- Pustaz of Hungary
- Selvas of South America
- Prairies of North America
- Pampas in Argentina

DESERT ECOSYSTEM

- Less than 25 cm of annual rainfall or sometimes in hot regions where there is more rainfall but unevenly distributed in the annual cycle
- Deserts in temperate regions often lie in "**rain shadows**", that is, where high mountains block off moisture from the seas
- At high altitudes and at greater distance from the equator deserts are cold and hot near equator and tropics
- Ephemerals and rain perennials are witnessed
- Largest number of indigenous plants are capable of absorbing water from deep below the surface of the ground by means of a well-developed root system, the main part of which generally consists of a slender, woody tap root of extraordinary length

Plant Adaptation to Desert:

- Xerophytes are specialized plants found in arid/semi-arid or desert regions.
- Sometimes leaves are absent or reduced in size
- To prevent water loss through transpiration, the leaves of these plants get modified to spines
- The stems are modified to fleshy structures to carry out the process of photosynthesis
- Root system is well developed and spread over large area

Animal Adaptation to Desert:

- Nocturnal in habit to avoid the sun's heat during day time
- Conserve water by excreting concentrated urine
- Animals and birds usually have long legs to keep the body away from the hot ground
- Lizards are mostly insectivorous and can live without drinking water for several days
- Herbivorous animals get sufficient water from the seeds which they eat
- Camel is known as the ship of the desert as it can travel long distances without drinking water for several days

THAR DESERT:

- Excessive drought, the rainfall being scanty and irregular

- This season is characterized by extreme variations of temperature and the temperature is frequently below freezing point at night
- The relative humidity of the atmosphere· is always low
- Shrubs and perennial herbs, capable of great drought resistance
- Few trees and these are stunted and generally thorny or prickly, thus protecting themselves against plant feeding animals
- Great Indian Bustard, blackbuck, wild ass, chinkara, caracal, Sandgrouse and desert fox
- Flamingoes , Asiatic wild Ass etc lies in the Great Rann, Gujarat

COLD/TEMPERATE DESERT:

- Areas of Ladakh, Leh and Kargil of Kashmir and Spiti valley of Himachal Pradesh and some parts of northern Uttaranchal and Sikkim
- Lie in the rain shadow of Himalaya
- Characterized by extreme cold weather and denuded terrain they are not suitable for plant growth
- Isolated, scattered and over grazed herbaceous shrubs are found. Grazing period is less than 3-4 months
- Tibetan antelope, Asiatic Ibex, Wild yak, Tibetan wolf, Snow leopard, etc are the fauna
- Salix, Rhododendron, Birch etc. are the flora found

DESERTIFICATION:

- Destruction of the biological potential of the land which can ultimately lead to desert like condition
- Desertification is a main problem faced by desert adjoining areas, which stretches across parts of Rajasthan, Gujarat, Punjab and Haryana
- Causes of desertification includes: Population, Agriculture, Deforestation, Developmental activities

BIOGEOGRAPHIC REALMS/ ECOZONE

- Biogeographic realms are large spatial regions within which ecosystems share a broadly similar biological evolutionary history
- **Palaearctic Realm, Nearctic Realm, Africotropical Realm, Indo-Malayan Realm, Oceanian Realm, Australian Realm, Antarctic Realm and Neotropical Realm**
- India represents: **Two realms, Five Biomes, Ten Bio-geographic zones, Twenty-six bio-geographic provinces**

REALMS of INDIA:

- Palearctic Realm- Himalayan Region

- Indo- Malayan Realm- Rest of the India

BIOMES of INDIA:

- Tropical Humid Forests
- Tropical Dry or deciduous Forests
- Warm and semi deserts
- Coniferous forests
- Alpine meadows

BIOGEOGRAPHIC ZONES of INDIA: Trans-Himalayan, Himalayas, Desert, Semi-arid, Western Ghat, Deccan peninsula, Gangetic plain, North- East India, Islands and Coasts

BIOGEOGRAPHIC PROVINCES of INDIA:

S.No.	Biogeographic zones	Biotic provinces
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 Ghat mountains
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

AQUATIC ECOSYSTEM

- Aquatic ecosystems connect people, land and wildlife through water
- Wetlands, rivers, lakes, and coastal estuaries are all aquatic ecosystems—critical elements of Earth's dynamic processes and essential to human economies and health.

TYPES OF AQUATIC ECOSYSTEM

- **Fresh water ecosystem**: Salt content less than 5 ppt (parts per thousand)
- **Marine water ecosystem**: Salt content equal to or more than 35 ppt (parts per thousand)
- **Brackish water ecosystem**: Salt content between 5- 35 ppt (parts per thousand)

IMPORTANT AQUATIC ORGANISMS

- **PLANKTON:** Microscopic plants called **phytoplankton** and animals called **zooplanktons.** Distribution is controlled by ocean currents
- **PHYTOPLANKTON:** They are producers. Responsible for most of the transfer of carbon (carbon dioxide) from the atmosphere to the ocean. 10 gigatons of carbon are fixed from the atmosphere to the deep ocean each year-Biological Carbon Pump.

- **ZOOPLANKTON**: Comprises of organisms that are both microscopic and visible through the naked eye. Jellyfish, Portuguese Man o' War, crustaceans. Acts as disease reservoirs (Cholera)
- **BENTHOS**: Found in the bottom (water bed)- Benthic zone. Most organisms are detrivores

LAKE ECOLOGY

- Oligotrophic (young), Mesotrophic (medium) and Eutrophic Lake (ageing of lakes)
- Natural lakes mostly lie in the Himalayan region, the floodplains of Indus, Ganga and Brahmaputra
- **Sudarshan in Gujarat's Girnar area was perhaps the oldest man-made lake in India, dating back to 300 BC**
- Majority of lakes in India are either eutrophic or mesotrophic
- **Ameenpur lakes is the first Biodiversity Heritage Site in India. It is an ancient man-made lake in western part of Telangana (Sangareddy District)**

WET LAND ECOSYSTEM

- Intermediate between deepwater and terrestrial habitat
- Waterlogged soil
- Adapted plant life (hydrophytes/macrophytes)
- Hydric soils (not enough oxygen available for some plants)
- Most of the wetlands in India are directly or indirectly linked with major river systems such as the Ganges, Cauvery, Krishna, Godavari and Tapti
- India's 2022 Wetlands Change Atlas mapped 231,195 wetlands, covering **4.86 percent of the country's geographical area. It is published by the Space Application Center (SAC).**
- **The 2022 Atlas uses IRS Resourcesat-2/2A LISS III satellite data to map wetlands**
- Gujarat is at the top with 34,700 sq km (17.56 percent of total geographical area of the state), as wetlands
- **Peatland**: They contain a mixture of decomposed organic material, partially submerged in a layer of water, lacking oxygen. Peatlands are the largest natural terrestrial carbon store. Damaged peatlands are a major source of greenhouse gas emissions, annually releasing almost 6% of global anthropogenic CO2 emissions.
- Coastal wetlands are permanent shallow marine waters. Found in the areas between land and open sea, such as shorelines, beaches. Largely dominated by mangrove vegetation. It helps in climate change mitigation as Salt marshes, mangroves, and seagrass beds absorb large quantities of the greenhouse gas Carbon dioxide from the atmosphere. Coastal **blue carbon** is the carbon captured by living coastal and marine organisms and stored in coastal ecosystems

Functions of Wetlands:

- Habitat to aquatic flora and fauna, including numerous bird species
- Nutrient recycling
- Water purification

- Floods mitigation
- Ground water recharging
- Stabilization of local climate
- Source of livelihood to local people
- Supporting specific diversity

Depletion of Wetlands:

- Conversion of lands for agriculture
- Removal of sand from beds
- Aqua culture
- Pollution
- Climate change

Mitigation of Depletion of Wetlands:

- Protection of natural regeneration
- Artificial regeneration
- Weed control
- Eutrophication abatement
- Removal of encroachment

NATIONAL WETLANDS CONSERVATION PROGRAMME (NWCP)

- Implemented in the year 1985-86
- Criteria for identification of wetlands of national importance under NWCP are the same as those prescribed under the Ramsar Convention on Wetlands.
- The Central Government is responsible for the overall coordination of wetland conservation programmes.

RAMSAR CONVENTION ON WETLANDS

- Wetlands are indispensable for the countless benefits or "ecosystem services" that they provide ranging from freshwater supply, food and building materials, and biodiversity, flood control, groundwater recharge, and climate change mitigation.
- 64% of the world's wetlands have disappeared in the last century
- **Ramsar Convention on Wetlands is an international treaty for "the conservation and sustainable use of wetlands". It is also known as the Convention on Wetlands**.
- It is named after the **city of Ramsar in Iran**.
- The Convention was signed on 2nd of February 1971. The **2nd of February each year is**
- **World Wetlands Day.**
- The convention entered into force in India on February 1, 1982.
- The Convention uses a broad definition of wetlands. It includes all lakes and rivers, underground aquifers, swamps and marshes, wet grasslands, peatland, oases, estuaries, deltas

and tidal flats, mangroves and other coastal areas, coral reefs, and all human-made sites such as fish ponds, rice paddies, reservoirs and salt pans.

RAMSAR SITE

- At the time of joining the Convention, each Contracting Party undertakes to designate at least one wetland site for inclusion in the List of Wetlands of International Importance.
- The inclusion of a "Ramsar Site" in the List embodies the government's commitment to take the steps necessary to ensure that its ecological character is maintained.
- The countries with the most Sites are the United Kingdom with 170 and Mexico with 142.
- **In India Chilika Lake in Orissa and Keoladeo National Park in Rajasthan were the first two sites designated by the convention**
- **As of August 2022, there are 75 Ramsar sites in India (frequent updating is required)**

MONTREUX RECORD

- **The Montreux Record is a register of wetland sites on the List of Wetlands of International Importance where changes in ecological character have occurred, are occurring, or are likely to occur as a result of technological developments, pollution or other human interference**.
- It is **maintained as part of the Ramsar List.**
- Principle tool to register under the Ramsar convention for highlighting wetlands sites in need of priority conservation status
- It was established in the 4th meeting of Conference of Contracting Parties to Ramsar Convention at Montreux, Switzerland in 1990
- **Loktak lake and Keolado national park are the two Montreux Record sites in India**.

MANGROVES

- Usually littoral (a region lying along a shore)
- Found in tropical and sub-tropical coastlines
- Trees and bushes growing below high-water level
- Basically, evergreen land plants
- Best locations are where abundant silt is brought down by rivers
- Adaptation to salt and anaerobic mud is high
- **Pneumatophores** (blind roots) to overcome respiration problem. E.g., Avicennia
- Some species (e.g. *Rhizophora*) send arching prop roots down into the water. Adventitious roots called stilt roots emerged from the main trunk of a tree
- Most mangroves have **lenticels**
- **Viviparity and allelopathy is present as adaptive mechanism**
- Require high solar radiation and have the ability to absorb fresh water from saline/ brackish water

Mangroves in India:

- Sundarbans of West Bengal (Largest mangrove of India).

(Note: Son beel of Assam in Karimganj district is Assam's Largest wetland and Asia's 2nd Largest seasonal wetland)

- Bhitarkanika of Orissa
- Godavari- Krishna deltaic regions of Andhra Pradesh
- Coastal zone of Kerala
- North west coast of Gujarat
- Islands of Andaman & Nicobar
- Kori creek in Kutch

Role of Mangroves:

- Stabilize coastal shore
- Moderate monsoon tidal floods
- Protects from tsunamis, hurricanes
- Supplies important plants
- Livelihood of people

CORAL REEFS

- Corals consists of soft and hard or hermatypic. Hard corals are responsible for building reefs
- Majority of coral reefs are found in tropical and sub-tropical water
- Optimum water temperature of 68-degree F
- Shallow water less than 100 ft is ideal, but should not exceed 180ft
- Mostly found in Pacific Ocean and Indian ocean
- Cold-water corals inhabit in deep, cold (39-55 degrees F), water. There are only about 6 different coral species associated in building. **The largest cold-water coral reef is the Rost Reef of Norway**
  (Note: Largest Coral reef is Great Barrier reef)
- **Coral reefs are called as "Tropical Rainforests of Ocean". Invertebrates, vertebrates, plants live in close association with the corals with resource recycling**

Classification of Coral reefs based on their location:

- **Fringing-** Contiguous with the shore and the most common. Found in Andaman
- **Patch-** Isolated and discontinuous patches. Eg., Gulf of Mannar, Gulf of Katchchh
- **Barrier-** Linear structures that run parallel to coastlines. Body between reefs and the shore is termed as lagoon. Eg., Lakshadweep and Nicobar
- **Atoll-** Circular of semi-circular. Eg., Atolls of Nicobar and Lakshadweep

Functions of Coral Reefs

- Provide substrate for mangroves
- Natural protective barriers against erosion and storm surge

- Highly adapted for capturing plankton from the water
- Largest biogenic calcium carbonate producer
- Habitat for organisms

Boost Your Knowledge- Miyawaki Method

- Using the Miyawaki concept, **Seuj Axom Abhijan** plans to enhance green cover in Assam from 36% to 38% in 5 years (State Budget 2022-23)
- Miyawaki is a technique pioneered by Japanese botanist Akira Miyawaki, that helps build dense, native forests in a short time
- It has revolutionised the concept of urban afforestation by turning backyards into mini-forests.
- This method includes planting trees (only native species) as close as possible in the same area which not only saves space, but the planted saplings also support each other in growth and block sunlight reaching the ground, thereby preventing the growth of weed.
- The saplings become maintenance-free (self sustainable) after the first three years.
- The approach is supposed to ensure that plant growth is 10 times faster and the resulting plantation is 30 times denser than usual.
- Miyawaki method helps to create a forest in just 20 to 30 years, while through conventional methods it takes anywhere between 200 to 300 years.

Previous Year Questions

1. **Among the marine ecosystems, the most species-rich ecosystem is (2020)**
   a) Mangrove
   b) Coralreefs
   c) Openwater
   d) Noneoftheabove
2. **Which one of the following covers the highest percentage of forest area in the world? (2016)**
   a) Temperate coniferous forest
   b) Temperate decidous forest
   c) Tropical monsoon forest
   d) Tropical rain forest
3. **The Eastern Ghats and the Western Ghats meet at (2014)**
   a) Nilgiri Hills
   b) Cardamon Hills
   c) Annamalai Hills
   d) Palani Hills
4. **Pampas grassland are situated in parts of (2001)**
   a) Brazil
   b) Argentina
   c) Peru
   d) Canada
5. **The vast grassland of Australia is known as (2011)**
   a) Prairie
   b) Steppe
   c) Veld
   d) Down

Chapter 3: Environmental Problems

EUTROPHICATION

- **The process in which a water body becomes overly enriched with nutrients is called eutrophication**
- **Ageing of water bodies**
- Water bodies with very low nutrient levels are termed **oligotrophic** and those with moderate nutrient levels are termed **mesotrophic**
- **Stimulate algal and aquatic plant growth (phytoplankton)- Harmful Algal Blooms (HABs)**

Boost Your Knowledge:

- **BOD (Biological Oxygen Demand)**: BOD is the biological method used for the measurement of the total amount of dissolved oxygen (DO) used by microbes in the biological process of metabolizing (processing) organic molecules present in water. **More the BOD, more is the pollution**
- **DO (Dissolved Oxygen):** The total amount of oxygen gas present in the water is called the dissolved oxygen (DO)
- **Riparian buffer**: A vegetated area near a stream, usually forested, which helps shade and partially protect the stream from the impact of adjacent land uses
- **COD (Chemical oxygen Demand)**:Chemical oxygen demand (COD) is an indicative measure of the amount of oxygen that can be consumed by reactions in a measured solution

CORAL BLEACHING

- **Coral bleaching occurs when coral polyps expel zooxanthellae (algae) that live inside their tissues**
- **60-90% of zooxanthellae are lost and each zooxanthella may lose 50-80% of its photosynthetic activity**
- Normally, coral polyps live in an endosymbiotic relationship with these algae, which are crucial for the health of the coral and the reef.
- The algae provide up to 90% of the coral's energy. It also provides oxygen and colour to the coral
- The coral, in return, supplies the algae with carbon dioxide and other nutrients needed for the algae to survive
- **The leading cause of coral bleaching is rising water temperatures. A temperature about 1 °C (or 2 °F) above average can cause bleaching**
- **Biorock** is a cement-like engineering material formed when a small electric current is passed between underwater metal electrodes placed in seawater causing dissolved minerals to accrete onto the cathode to form a thick layer of limestone. This 'accretion process' can be used to

create building materials or to create artificial 'electrified reefs' for the benefit of corals and other sea-life.

- Discovered by Wolf Hilbertz in 1976, biorock was protected by patents and a trademark which have now expired.
- **Marine scientists from the Zoological Survey of India (ZSI) have installed the country's first solar-powered Biorock in the Gulf of Kutch off the Gujarat coast to regenerate endangered corals**

POLLUTION

- **Pollution is defined as 'an addition or excessive addition of certain materials to the physical environment (water, air and lands), making it less fit or unfit for life'**

CLASSIFICATION OF POLLUTANATS

- **Primary pollutants**: These persist in the form in which they are added to the environment e.g., DDT, plastic
- **Secondary Pollutants:** These are formed by interaction among the primary pollutants. For example, **peroxyacetyl nitrate (PAN) is formed by the interaction of nitrogen oxides and hydrocarbons**
- **Quantitative Pollutants**: These **occur in nature** and become pollutant when their concentration reaches beyond a threshold level. E.g., **carbon dioxide, nitrogen oxide**
- **Qualitative Pollutants**: These do not occur in nature and are **man-made**. E.g., fungicides, herbicides, DDT etc.
- **Biodegradable Pollutants**: Waste products, which are **degraded by microbial action**. E.g., sewage
- **Non-biodegradable Pollutants**: Pollutants, which are **not decomposed by microbial action**. E.g., plastics, glass, DDT, salts of heavy metals, radioactive substances etc.

AIR POLLUTION

- The presence in the atmosphere of one or more contaminants in such quality and for such duration as it is injurious, or tends to be injurious, to human health or welfare, animal or plant life

SIGNIFICANT AIR POLLUTANTS

- **PM10**: inhalable particles, with diameters that are generally 10 micrometers and smaller
- **PM2.5:** fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller. The average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle
- **Particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into the lungs, and some may even get into bloodstream. The impact of fine particulate matter (PM2.5) highlighted by the World Health Organization (WHO) study is felt through a broad spectrum of acute and chronic illnesses that cause premature death.**

SMOG

- Smog has been coined from a combination of the words **fog and smoke**. Smog is a condition of **fog that had soot or smoke in it**
- Photochemical smog (smog) is a term used to describe air pollution that is a result of the interaction of sunlight with certain chemicals in the atmosphere
- **Heavy smog results in the decrease of natural vitamin D production leading to a rise in the cases of rickets**
- A smog tower is a structure designed to work as a large-scale air purifier. This structure fitted with multiple layers of filters which trap fine dust particles suspended in the air as it passes through them**.**
- **India's first smog tower has been inaugurated at Cannaught Place, Delhi**

CLASSICAL SMOG VS PHOTOCHEMICAL SMOG

- **Classical smog** is a **mixture of smoke, fog, and sulfur dioxide** that forms as a result of a cool, humid climate. A classical smog tends to undergo a reduction in nature. We can find this type of natural smog in areas having a humid climate. Classical smog can act as a **reducing agent** in the presence of atmospheric pollution; therefore, we call it a reducing smog.
- **Photochemical smog or summer smog** is the chemical reaction of **sunlight, nitrogen oxides, and volatile organic compounds in the atmosphere**. This reaction leaves airborne particles and ground-level ozone. This type of smog depends on primary pollutants and the formation of secondary pollutants.

INDOOR AIR POLLUTION

- **It refers to the physical, chemical, and biological characteristics of air in the indoor environment within a home, or an institution or commercial facility**
- The main indoor sources are **perfumes, hair sprays, furniture polish, glues, air fresheners, moth repellents, wood preservatives, and other products**
- **Formaldehyde** mainly from carpets, particle boards, and insulation foam are indoor pollutants
- **Asbestos** is also a source of indoor air pollution

FLY ASH

- **Ash is produced whenever combustion of solid material takes place**
- Oxide rich and consist of silica, alumina, oxides of iron, calcium, and magnesium and toxic heavy metals like lead, arsenic, cobalt, and copper
- **Composition of Fly ash**: Aluminium silicate, silicon dioxide (SiO_2) and Calcium oxide (CaO) in major
- Fly ash is generally captured by **electrostatic precipitators** or other particle filtration equipment. **An electrostatic precipitator (ESP) is defined as a filtration device that is used to remove fine particles like smoke and fine dust from the flowing gas**
- The Ministry of Environment and Forests vide its notification in 2009, has made it mandatory to **use Fly Ash based products in all construction projects, road embankment works and low-lying land filling works within 100 kms radius of Thermal Power Station**

- A catalytic converter is an exhaust emission control device that converts toxic gases and pollutants in exhaust gas from an internal combustion engine into less-toxic pollutants by catalyzing a redox reaction. Catalytic converters are usually used with internal combustion engines fueled by gasoline or diesel, including lean-burn engines, and sometimes on kerosene heaters and stoves.

GOVERNMENT INITIATIVES FOR AIR POLLUTION

National Ambient Air Quality Standards (NAAQS):

- National Ambient Air Quality Standards (NAAQS) were notified in the year 1982, duly revised in 1994 based on health criteria and land uses.

The NAAQS have been revisited and revised in November 2009 for **12 pollutants, which include sulphur dioxide (SO_2), nitrogen dioxide (NO_2), PM2.5, PM10, ozone, lead, CO, arsenic, nickel, benzene, ammonia and benzopyrene**

National Air Quality Monitoring Programme:

- In India, the **Central Pollution Control Board (CPCB) has been executing a nationwide programme of ambient air quality monitoring known as National Air Quality Monitoring Programme (NAMP)**

National Air Quality Index (AQI):

- Launched by the Prime Minister of India in April 2015
- 6 categories, viz Good, Satisfactory, moderately polluted, Poor, very poor and Severe with distinct colour scheme
- **8 pollutants: SO_2, NO_2, PM2.5, PM10, CO, ozone, ammonia and lead**

COMMISSION FOR AIR QUALITY MANAGEMENT

- The Commission for Air Quality Management (CAQM) was established as a statutory body by the government in August 2021 as an overarching body to carry out air quality management in Delhi NCR
- It's formed under the Commission for Air Quality Management in National Capital Region and Adjoining Areas, Act 2021.
- The Commission basically aims at better coordination, research, identification, and resolution of problems related to air quality in NCR and adjoining areas. Adjoining areas refer to areas in the neighbouring states of NCR namely, Punjab, Haryana, Uttar Pradesh and Rajasthan.
- **Only the National Green Tribunal will have the power to hear cases involving the CAQM, and not the civil courts**

WATER POLLUTION

- **Mercury** compounds in waste water are converted by bacterial action into extremely toxic methyl mercury, which can cause numbness of limbs, lips and tongue, deafness, blurring of vision and mental derangement known as **Minamata disease**

- Water contaminated with **cadmium** can cause **itai itai** disease also called **ouch-ouch** disease. It is a painful disease of bones and joints and can cause cancer of lungs and liver
- The compounds of **lead** cause anaemia, headache, loss of muscle power and bluish line around the gum
- Presence of excess **nitrate** in drinking water is dangerous for human health and may be fatal for infants. Excess nitrate in drinking water reacts with haemoglobin to form non-functional methaemoglobin, and impairs oxygen transport. This condition is called **methemoglobinemia or blue baby syndrome**
- Excess **fluoride** in drinking water causes neuro muscular disorders, gastro-intestinal problems, teeth deformity (dental fluorosis) hardening of bones and stiff and painful joints (skeletal fluorosis). The maximum level of fluoride, which the human body can tolerate is 1.5 parts per million (mg/1 of water). Long term ingestion of fluoride ions causes **fluorosis**
- Over exploitation of ground water may lead to leaching of **arsenic** from soil and rock sources and contaminate ground water. Chronic exposure to arsenic causes **black foot disease**.

PLASTIC POLLUTION

- **Microplastics are tiny bits of plastics measuring less than 5mm in diameter**. **Microbeads and Microfibers** are the two types of microplastics. It is produced for using in cosmetics and toiletries, etc and is naturally produced by the photodegradation of plastics.
- Microbeads are used in soaps because exfoliating products need small, hard particles to rub debris from the skin.
- While microbeads are no better at scrubbing the skin than particles of shells or seeds, they're much cheaper to mass-produce. Due to this since the 1990s, manufacturers have increasingly replaced natural materials with plastic shards.
- They can be found in chewing gum, certain toothpastes, industrial cleaning products, synthetic clothing fibers and tires
- **Dioxin** (highly carcinogenic and toxic) by product of the manufacturing process is one of the chemicals believed to be passed on through breast milk to the nursing infant.
- Burning of plastics, especially PVC releases this dioxin and also **furan** into the atmosphere. Thus, conventional plastics, right from their manufacture to their disposal are a major problem to the environment
- The process of burning waste in large furnaces at high temperature is known as **incineration**. In - these plants the recyclable material is segregated - and the rest of the material is burnt and ash is produced

SOME IMPORTANT TERMS

- **Pyrolysis** is a process of combustion in absence of oxygen or the material burnt under controlled atmosphere of oxygen.
- **Composting** is a biological process in which micro-organisms, mainly fungi and bacteria, decompose degradable organic waste into humus like substance in the presence of oxygen

- **Vermicomposting i**s also known as earthworm farming. In this method, Earth worms are added to the compost. These worms break the waste and the added excreta of the worms makes the compost very rich in nutrients

E- WASTES

- E-waste is any electrical or electronic equipment that's been discarded.
- Contains heavy metals and other chemical harmful for the environment
- Electronic scrap components, such as CPUs, contain potentially harmful materials such as lead, cadmium, beryllium, or brominated flame retardants.
- Recycling and disposal of e-waste may involve significant risk to health of workers and their communities

NOISE POLLUTION

- Sound is measured in decibels (dB). An increase of about 10 dB is approximately double the increase in loudness.
- **A person's hearing can be damaged if exposed to noise levels over 75 dB over a prolonged period of time**.
- **The World Health Organization recommends that the sound level indoors should be less than 30 dB**.
- The Government of India on **Mar 2011 launched a Real time Ambient Noise Monitoring Network**. Under this network, Remote Noise Monitoring Terminals each have been installed in different noise zones in seven metros (Delhi, Hyderabad, Kolkata, Mumbai, Bangalore, Chennai and Lucknow).
- **Silence Zone** is an area comprising not less than 100 metres around hospitals, education alinstitutions, courts, religious places or any other area declared as such by a competent authority

NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000

- Union Government on 14 February 2000 enacted the Noise Pollution (Regulation and Control) Rules, 2000 in exercise of its power conferred under the Environment (Protection) Act, 1986 to control the increasing ambient noise level in public places from various sources.
- The **Rule 5** of the Noise Rules 2000 **restricts the use of loud speakers/public address system**. The Rule 5 was amended in 2010 to restrict the use of sound producing equipments as well

RADIATION AND RADIOACTIVE POLLUTION

- Alpha particles, can be blocked by a piece of paper and human skin.
- Beta particles can penetrate through skin, while can be blocked by some pieces of glass and metal.
- Gamma rays can penetrate easily to human skin, and damage cells on its way through, reaching far, and can only be blocked by a very thick, strong, massive piece of concrete

- **Half-life-** Each radioactive nuclide has a constant decay rate. Half-life is the time needed for half of its atoms to decay. Half-life of a radio nuclide refers to its period of radioactivity. The half-life may vary from a fraction of a second to thousands of years. Lesser is the half-life, faster will be the decay.

TYPES OF RADIATION

Ionising radiations

- They have high penetration power and cause breakage of macro molecules.
- They include X-rays, cosmic rays and atomic radiations {radiations emitted by radioactive. elements).

Non-ionising radiations

- They include short-wave radiations such as ultraviolet rays, which forms a part of solar radiation.
- They have low penetrating power and affect the cells and molecules which absorb them
- They damage eyes which may be caused by reflections from coastal sand, snow (snow blindness) directly looking towards sun during eclipse.
- They injure the cells of skin and blood capillaries producing blisters and reddening called sunburns

CASE STUDY

- **The Baghjan Tragedy**: The Assam gas and oil leak, also referred as the Baghjan gas leak in Tinsukia district, Assam, India on 27 May 2020. The blowout occurred at Well No. 5 in the Baghjan Oil Field, resulting in a leak of natural gas. The leaking well subsequently caught fire, and has resulted in three deaths (Officially), large-scale local evacuations, and environmental damage. The Assam gas and oil leak, also referred as the Baghjan gas leak in Tinsukia district, Assam, India on 27 May 2020. Wind conditions had carried the leaked gas towards the Dibru-Saikhowa National Park as well. The carcass of a Gangetic dolphin covered in condensate oil was found in the Maguri Motapung Beel, a local wetland, and sent for a post-mortem by the Tinsukia Wildlife Division, to establish the cause of death
- **The Chernobyl Disaster**: The Chernobyl disaster was a nuclear accident that occurred on **Saturday 26 April 1986**, at the No. 4 reactor in the Chernobyl Nuclear Power Plant, near the city of Pripyat in the north of **the Ukrainian SSR in the Soviet Union**. It is considered the worst nuclear disaster in history both in terms of cost and casualties. The accident started during a safety test on an **RBMK-type nuclear reactor.**
- **Fukushima Disaster**: The Fukushima Daiichi nuclear disaster was a **2011 nuclear accident at the Fukushima Daiichi Nuclear Power Plant in Ōkuma, Fukushima Prefecture, Japan**. It was the most severe nuclear accident since the Chernobyl disaster in 1986. It was classified as **Level 7** on the International Nuclear Event Scale (INES), after initially being classified as Level 5, joining Chernobyl as the only other accident to receive such classification. The **accident was triggered by the Tōhoku earthquake and tsunami on Friday, 11 March 2011**.

Boost Your Knowledge- Leaded Petrol

- Tetraethyl-lead (TEL) is a petro-fuel additive, first being mixed with petrol beginning in the 1920s as a patented octane rating booster that allowed engine compression to be raised substantially.
- This in turn caused increased vehicle performance and fuel economy.
- The practice of adding tetraethyl lead to petrol had spread widely to all countries soon after its anti-knock and octane-boosting properties were discovered.
- Lead is toxic, affects multiple body systems and is particularly harmful to young children. It affects the brain, liver, kidneys, and bones. Lead is measured in the blood to understand exposure.
- India was among those countries that took early action to phase out leaded petrol under UNEP. The process of phase down that had started in 1994, got completed in 2000.
- **Algeria was the last country to eradicate leaded petrol in July 2021**

BIOREMEDIATION

- Bioremediation is the **use of microorganisms (bacteria and fungi) to degrade the environmental contaminants into less toxic forms**.
- Using bioremediation techniques, **TERI** (The Energy and Resources Institute) has developed a **mixture of bacteria** called' **oilzapper**' which degrades the pollutants of oil-contaminated sites, leaving behind no harmful residues. It is environment friendly and highly cost-effective
- *Pseudomonas putida* is a useful organism for bioremediation

PHYTOREMEDIATION

- Phytoremediation is use of plants to remove contaminants from soil and water
- **Phytoextraction / phytoaccumulation** is the process by which plants accumulate contaminants into the roots and aboveground shoots or leaves.

MYCOREMEDIATION

- It is a form of bioremediation in which fungi are used to decontaminate the area
- Mycofiltration is a similar process, using fungal mycelia to filter toxic waste and microorganisms from water in soil.

Acid Rain

- Acid rain is made up of highly acidic water droplets due to air emissions, most specifically thedisproportionate levels **of sulphur and nitrogen** emitted by vehicles and manufacturing processes
- **It is rain with a pH of less than 5.6**
- **Flue Gas Desulphurization-** Flue-gas desulfurization (FGD) is a set of technologies used to remove sulfur dioxide (SO_2) from exhaust flue gases of fossil-fuel power plants, and from the emissions of other sulfur oxide emitting processes such as waste incineration

TYPES OF ACID DEPOSITION

- **Wet Deposition:** If the acid chemicals in the air are blown into areas where the weather is wet, the acids can fall to the ground in the form of rain, snow, fog or mist
- **Dry Deposition:** In the where the weather is dry, the acid chemicals may become incorporate into dust or smoke and fall to the ground through dry deposition, sticking to the ground, building, vegetation, cars, etc. Dry deposited gases and particles can be washed away by rainstorms, through runoff. About half of the acidity in the atmosphere falls back to the earth through dry deposition

OCEAN ACIDIFICATION

- Oceans normally have a pH 8, therefore is basic.
- 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
- When carbon dioxide dissolves into seawater, it forms carbonic acid (H_2CO_3). Some of the carbonic acid molecules dissociate into a bicarbonate ion and a hydrogen ion, thus increasing ocean acidity (H^+ ion concentration)
- Ocean acidification can lead to decreased production of the shells of shellfish and other aquatic life with calcium carbonate shells, as well as some other physiological challenges for marine organisms.
- The calcium carbonate- shelled organisms cannot reproduce under high saturated acidotic waters.
- **Ocean acidification impacts many species, especially organisms like oysters and corals.**

Previous Year Questions

1. **Vermi composting is done by (2018)**
   a) Fungus
   b) Bacteria
   c) Worms
   d) Animals

2. **Which among the following types is a non-material pollution? (2021)**
   a) Air pollution
   b) Water pollution
   c) Thermal pollution
   d) Soil pollution
3. **Presence of fluoride in drinking water is associated with**
   a) Mottling of teeth
   b) Dental fluorosis

c) Skeletal fluorosis
d) **All of these**

Chapter 4: Global Warming, Ozone Depletion and Climate Change Organisations

GLOBALWARMING

- Global warming is the phenomenon of a gradual increase in the temperature near the earth's surface.
- Major **sources** and **process** of **global warming** include **ozone depletion** and **green house effects**.

OZONEDEPLETION

- Ozone is defined as the **three-atom is otope of oxygen** (O_3).
- The **stratospherico zone layers** mostly concentrated between the altitudes of **12 km to 35km,** is considered as a **protective shield** because it **prevents** the **ultra violet solar rays** from reaching the earth's surface. Thus, the presence of ozone layer in the stratosphere is of vital significance for all biota including plants, animals and humans in the biosphere.
- The **thinning of this ozone layer** in stratosphere is termed as **ozone depletion**. It occurs when **the natural balance** between the production and destruction of ozone in the stratosphere is tipped in favor of destruction.

CREATIONOFOZONEHOLE

- **Ozone hole** is a region of marked thinning of the ozone layer in high latitudes, attributed to the chemical action of **chlorofluorocarbons (CFCs)** and do the **atmospheric halogenated pollutants**
- The **halogenated gases** are released into the atmosphere, during the maintenance or operation of devices which uses these **synthetic chemicals**.

GREENHOUSEGASEFFECT

- **Green house effect** is the trapping of the sun'swarmthin a planet' slower atmosphere, due to the greater transparency of the atmosphere to **incoming radiation** from the sun (**short wave length**) than to **infrared radiation** emitted from the planet's surface (**long wave length**)

MAJORSOURCESOFGREENHOUSEGASES

Gases	Major sources
CO_2	Fossil fuel combustion, deforestation, respiration
CH_4	Wetlands, anaerobic decomposition of organic wastes, agriculture
N_2O	Natural soils, fertilizers, fossil fuel combustion
HFC (Hydrofluorocarbon)	Refrigerant, aerosol propellant, fire extinguishers
PFC (Perfluorocarbon)	Manufacture of semi-conductors, refrigeration and the production of Aluminum

CARBON CAPTURE AND SEQUESTRATION

- Capturing CO_2 from a source such as a power plant or industrial facility
- Transport compressed CO_2 into deep injection site
- Injecting compressed CO_2 into a deep subsurface rock formation for permanent geological sequestration

GEOENGINEERING

- Geoengineering refers to a set of emerging technologies that could manipulate the environment and partially offset some of the impacts of climate change
- By removing CO_2 from the air
- Limiting the sunlight reaching the planet
- Solar geoengineering, or solar radiation modification (SRM) is a proposed type of climate engineering in which sunlight (solar radiation) would be reflected back to space to limit or reverse human-caused climate change.

GLOBAL WARMING POTENTIAL

- The Global Warming Potential (GWP) for a gas is a measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to carbon dioxide
- The larger the GWP, the more warming the gas causes
- Methane has GWP (over 100 years) of 27.9
- **GWP is 1 for CO_2**

UNFCCC

- United Nations Framework Convention on Climate Change (UNFCCC) was **held in Rio de Janeiro from 3 to 14 June 1992**
- Entered into force on 21 March 1994
- 197 countries that have ratified the Convention are called Parties to the Convention and have a near-universal membership as of 2020
- It is **Not Legally binding**, and sets the framework for limiting the emissions of Greenhouse Gases (GHGs) by individual member countries

CONFERENCE OF THE PARTIES (COP)

- Supreme decision-making body of UNFCCC for sustainable climate action
- All the representatives meet annually at different places to discuss about sustainable climate action
- **The first COP meeting was held in Berlin, Germany in March, 1995**
- **The COP8 in 2002 was held in New Delhi**

KYOTO PROTOCOL: COP3

- International agreement linked to the UNFCCC, which commits its Parties by setting internationally binding emission reduction targets
- **Adopted in Kyoto, Japan on 11 December 1997 and entered into force on 16 February 2005**
- **Legally binding**
- Protocol places a heavier burden on developed nations under the principle of "**common but differentiated responsibilities",** because it recognizes that they are largely responsible for the current high levels of GHG emissions in the atmosphere.
- India ratified Kyoto Protocol in 2002
- **Two phases of Kyoto Protocol:**
  - **2008-2012- 5% emission reduction compared to 1990 levels**
  - **2013-2020- 18% emission reduction compared to 1990 levels (Doha amendment)**

CLASSIFICATION OF PARTIES

- **Annex I:** The Parties are classified as industrialized (developed) countries + "economies in transition" (EITs)
- **Annex II**: Parties provide financial and technical support to the EITs and developing countries to assist them in reducing their greenhouse gas emissions (climate change mitigation) and manage the impacts of climate change (climate change adaptation)
- **Annex B**: Annex I Parties with first or second-round Kyoto greenhouse gas emissions targets
- **Least-developed countries (LDCs)**: 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**: mostly low-income developing countries

CARBON TRADING

- **Carbon trading is an exchange of credits between nations designed to reduce emissions of carbon dioxide. Carbon trading is also referred to as carbon emissions trading.**
- It includes:
  - **Cap and Trade/ Emission Trading**: Countries that have emission units to spare - emissions permitted them but not "used" - to sell this excess capacity to countries that are over their targets. Thus, a new commodity was created in the form of emission reductions or removal
  - **Offset/ Baseline and Credit Trading**: Carbon credit is to be earned by a country by investing some amount of money in such projects, known as carbon projects, which will emit lesser amount of greenhouse gas in the atmosphere.

KYOTO PROTOCOL TICK

- **Flexible Market Mechanism**:
- **Emission Trading**: Emissions trading, as set out in Article 17 of the Kyoto Protocol, allows countries that have emission units to spare - emissions permitted them but not "used" - to sell this excess capacity to countries that are over their targets. Thus, a new commodity was created

in the form of emission reductions or removals. Since carbon dioxide is the principal greenhouse gas, people speak simply of trading in carbon. Carbon is now tracked and traded like any other commodity. This is known as the "carbon market."

- **Joint Implementation**: The mechanism known as "joint implementation", defined in Article 6 of the Kyoto Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol **(Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party**, each equivalent to one tonne of CO2, which can be counted towards meeting its Kyoto target.
- **Clean Development Mechanism:** The Clean Development Mechanism (CDM), defined in Article 12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (**Annex B Party) to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits**, each equivalent to one tonne of CO2, which can be counted towards meeting Kyoto targets. A CDM project activity might involve, for example, a rural electrification project using solar panels or the installation of more energy-efficient boilers. The mechanism stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction or limitation targets

GREEN CLIMATE FUND (GCF)

- GCF is a unique global platform to respond to climate change by investing in low-emission and climate-resilient development.
- Mitigation and Adaptation mechanism for developing countries
- World Bank- Interim trustee to review after every 3 years

THE PARIS AGREEMENT- COP21

- The Paris Agreement is a **legally binding** international treaty on climate change.
- It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016.
- **Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.**
- The Paris Agreement works on a 5- year cycle of increasingly ambitious climate action carried out by countries. By 2020, countries submit their plans for climate action known as **nationally determined contributions (NDCs).**
- **20/20/20 target**: Reduce CO_2 by 20%, Increase renewable energy by 20%, increase energy efficiency by 20%
- **Article 28 of the Paris Agreement allows countries to leave the Paris Agreement and lays down the process for leaving.** A country can only give a notice for leaving at least three years after the Paris Agreement came into force.

THE INTERNATIONAL SOLAR ALLIANCE

- The ISA was conceived as a joint effort by India and France to mobilize efforts against climate change through deployment of solar energy solutions.
- It was conceptualized on the sidelines of the 21st Conference of Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Paris in 2015.
- The ISA is guided by its 'Towards 1000' strategy which aims to mobilise USD 1,000 billion of investments in solar energy solutions by 2030, while delivering energy access to 1,000

million people using clean energy solutions and resulting in installation of 1,000 GW of solar energy capacity. This would help mitigate global solar emissions to the tune of 1,000 million tonnes of CO2 every year

- **The ISA is headquartered in Gurugram, India. It is first ever International Body to be headquartered in India**

THE GLASGOW SUMMIT- COP26

- The 26th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) was **held between October 31, 2021 to 12th November 2021**
- Agreement to re-visit emission reduction plans in 2022 in order to try to keep the 1.5 °C Paris Agreement target achievable
- The first ever inclusion of a commitment to limit ("phase down") the use of unabated coal
- A commitment to climate finance for developing countries
- **Major initiatives announced at the Glasgow summit**
    - **Deforestation Pledge:**
        - In the COP26 climate summit's first major deal, leaders at the COP26 global climate conference have pledged to stop deforestation by 2030 to help slow climate change.
        - This agreement expands a commitment by 40 countries as part of the **2014 New York Declaration of Forests.**
    - **Global methane Pledge:**
        - The **US and the EU have announced a global partnership to cut emissions of the greenhouse gas methane by 2030.** The Global Methane Pledge aims to **slash methane emissions by 30% by 2030 compared with 2020 levels.**
        - While Brazil, one of the five biggest emitters of methane, has signed up, three other large emitter nations — **China, Russia and India — have not signed up.**
- **Infrastructure for Resilient Island States:**
    - **India has launched the Infrastructure for Resilient Island States (IRIS) initiative for developing the infrastructure of small island nations.**
    - **The IRIS is a part of the Coalition for Disaster Resilient Infrastructure (CDRI) initiative.**
    - CDRI is a multi-stakeholder global partnership of national governments, UN agencies and programmes, multilateral development banks and financing mechanisms, the private sector, and knowledge institutions, launched at the UN Climate Action Summit of 2019. It aims to promote the resilience of new and existing infrastructure systems to climate and disaster risks in support of sustainable development.
    - **The new initiative is the result of cooperation between India, the U.K. and Australia and included the participation of leaders of small island nations such as Fiji, Jamaica and Mauritius.**
    - India's space agency ISRO will build a special data window for the small island nations to provide them timely information about cyclones, coral-reef monitoring, coast-line monitoring through satellite.
- **One Sun, One World, One Grid**
    - The **Global Green Grids Initiative One Sun One World One Grid** (GGI-OSOWOG) has been announced at the COP26

- The new GGI-OSOWOG is an evolution of the International Solar Alliance's OSOWOG multilateral drive to foster interconnected solar energy infrastructure at a global scale
- This initiative aims to tap solar energy and have it travel seamlessly across borders. The initiative will work towards accelerating the making of large solar power stations and wind farms in the best locations, linked together by continental-scale grids crossing national borders.
- The project has proposed three phases:
- In the first phase, the grids of Middle East, South Asia and Southeast Asia would be integrated.
- In second phase, the Asian grid will be connected with African grid.
- In last phase, the grid will be the global grid

- **Joint declaration between the United States and China**

- China and the US have agreed to boost climate co-operation over the next decade, in a surprise announcement at the COP26 climate summit in Glasgow. The world's two biggest CO2 emitters pledged to act in a joint declaration

- **Panchamrit Strategies of India**

1. India will get its non-fossil energy capacity to 500 gigawatts by 2030
2. India will meet 50 per cent of its energy requirements till 2030 with renewable energy
3. India will reduce its projected carbon emission by one billion tonnes by 2030
4. India will reduce the carbon intensity of its economy by 45 per cent by 2030
5. India will achieve net zero by 2070

GREENHOUSE GAS PROTOCOL

- The mission of the Greenhouse Gas Protocol Initiative (GHG Protocol) is to develop and promote internationally accepted greenhouse gas (GHG) accounting and reporting standards through an open and inclusive process
- It is one of the multilateral REDD+ initiatives hosted by the World Bank

2014 UN CLIMATE SUMMIT

- Climate Summit 2014 (sometimes also referred to as the Leader's Climate Summit) was a meeting on climate change in New York on September 23, 2014
- It was also seen as a key step towards a new legal agreement on climate change, the Paris Agreement
- Direct product of the Climate Summit 2014 was the **New York Declaration on Forests** to which India did not ratify

New York Declaration on Forests

- Non-legally binding

- Declaration pledges to halve the rate of deforestation by 2020, to end it by 2030,
- To restore hundreds of millions of acres of degraded land.
- The proposed land restoration is described as covering "an area larger than India"

2019 UN CLIMATE ACTION SUMMIT

- 2019 UN Climate Action Summit was held at the headquarters of the United Nations in New York City on 23 September 2019
- Many countries and the European Union pledged to cut greenhouse gas emissions to zero by the year 2050
- India promised to bring their renewable energy capacity to 175 gigawatts by the 2022 and to 450 gigawatts
- Prime Minister of India, Narendra Modi, launched the Coalition for Disaster-Resilient Infrastructure (CDRI) on 25 September 2019

VIENNA CONVENTION FOR THE PROTECTION OF THE OZONE LAYER

- The Vienna Convention for the Protection of the Ozone Layer (Vienna Convention) was agreed in 1985 and came into force on 1988
- It established global monitoring and reporting on ozone depletion
- India became a party to the VC on 19 June 1991

UNDER2 COALITION (U2C)

- The Under2 Coalition, a Memorandum of Understanding by sub national governments to reduce their greenhouse gas (GHG) emissions towards net-zero by 2050
- **The Under2 Coalition is driven by a group of ambitious state and regional governments committed to keeping global temperature rises to well below 2°C.**
- **Currently, Chhattisgarh, Jammu and Kashmir (union territory), Maharashtra, Telangana and West Bengal are signatories to this pact from India**

MONTREAL PROTOCOL

- The Montreal Protocol on Substances that Deplete the Ozone Layer is an important Multilateral Agreement regulating the production, consumption, and emissions of ozone-depleting substances (ODSs)
- Signed in 1987 and came into force in 1989
- India ratified on 17th Sept 1992
- **In India, the implementation of the Montreal Protocol comes within the ambit of the Ministry of Environment, Forests, and Climate Change**.
- The Ministry has established an **Ozone Cell to implement the Protocol**.
- **As per the National Strategy for ODS Phaseout, the Ministry has notified the Ozone Depleting Substances (Regulation and Control) Rules 2000.**

KIGALI AGREEMENT

- Amendment to the Montreal Protocol

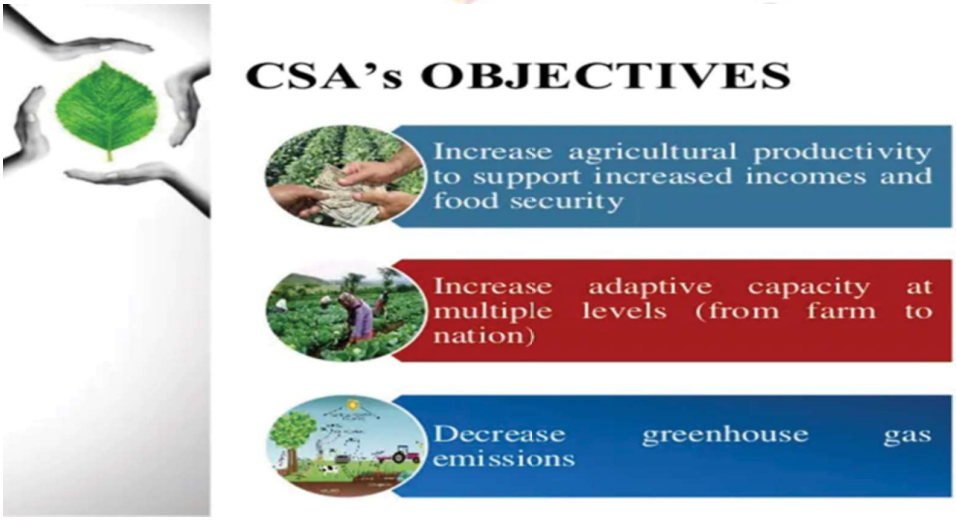
- Negotiated in October 2016
- **The agreement aims to phase down HFCs by reducing its manufacture and consumption**
- The first group consists of developed countries, led by the US and the European Union countries, that would have started the phase-down of HFCs by 2019, and reduce the level to 15% of 2012 level by the year 2036
- The second group consists of developing economies such as China, Brazil, and also some African States that will start the phase-down by 2024 and decrease it to 20% of 2021 levels by the year 2045
- **The third group (in which India is placed) consists of developing economies and also some of the hottest nations, that will start the phase-down by 2028 and reduce the level to 15% of 2024-26 levels by the year 2047.** Examples: India, Pakistan, Iran, Saudi Arabia
- **India ratified Kigali amendment on 18th August 2021**

INDIA COOLING ACTION PLAN

- The India Cooling Action Plan (ICAP) seeks to provide an integrated vision towards cooling across sectors encompassing inter alia reduction of cooling demand, refrigerant transition, enhancing energy efficiency and better technology options with a 20-year time horizon
- Released in 2019
- Aims to bring down refrigerant demand by 25-30% in next 20 years

CLIMATE SMART AGRICULTURE

- Climate-smart agriculture (CSA) is an approach that helps guide actions to transform agri-food systems towards green and climate resilient practices.
- **CSA supports the FAO Strategic Framework 2022-2031 based on the Four Betters: better production, better nutrition, a better environment and a better life for all, leaving no one behind**.



Boost Your Knowledge:

1. **REDD and REDD+**
   - The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD) is the UN knowledge and advisory platform on the forest solutions to the climate crisis.
   - **UN-REDD was launched in 2008 and builds on the technical expertise of the Food and Agriculture Organization (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP).**
   - At COP 13 under the Bali Action Plan, it was decided that REDD is to be included in a post-2012 framework and the details were to be decided during the COP 15 in Copenhagen.
   - Reducing emissions from deforestation and forest degradation (REDD+) is a mechanism developed by Parties to the United Nations Framework Convention on Climate Change (UNFCCC).
   - It creates a financial value for the carbon stored in forests by offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development.
   - **UN REDD+ goes beyond simply deforestation and forest degradation and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.**
2. **CDRI**
   - Coalition for Disaster-Resilient Infrastructure
   - **It aims to promote the resilience of new and existing infrastructure systems to climate and disaster risks in support of sustainable development**
   - **The fledgling partnership has a secretariat in Delhi, supported by the UN Office for Disaster Risk Reduction (UNDRR), to enable knowledge exchange, technical support and capacity building**

Previous Year Questions

1. The Paris Agreement of the Un Framework Convention on Climate change is to limit global warming well below (bench mark of pre-industrial level) (2020)

a) ^{O} C
b) 2.0^{O} C
c) 2.5 ^{o}C
d) 3^{o} C

2. If the Arctic Ice was somehow replaced with dense forest, which of the following situation may arise? (2013)

a) It will decelerate Global Warming.
b) It may or may not affect Global warming.
c) It will accelerate Global Warming.
d) It will have no effect on Global Warming.

3. Which one of the following reflects more sunlight as compared to other three? (2018)

a) Sand Desert
b) Paddy cropland
c) Land Covered with fresh snow
d) Prairie land

Chapter 5: Indian Environmental Acts and Organisations

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE (MOEFCC)

- The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency in the administrative structure of the Central Government for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programme

WILDLIFE PROTECTION ACT, 1972

- This Act provides for the protection of the country's wild animals, birds, and plant species, in order to ensure environmental and ecological security.
- **There are five types of protected areas as provided under the Act. They are Sanctuaries, National Parks, Conservation Reserves, Community Reserves and Tiger Reserves**
- There are six schedules provided in the Wildlife Protection Act
    - **Schedule I**: This Schedule covers **endangered species**.
    - **Schedule II**: Animals under this list are also accorded high protection
    - **Schedule III & IV**: This list is for species that are not endangered.
    - **Schedule VI:** This list contains plants that are forbidden from cultivation.

FOREST CONSERVATION ACT 1980

- **Check deforestation-** Prevent Forest lands being converted into agricultural, grazing or for any other commercial purposes and intentions
- **Conservation of forest-** Arrest the loss of forest biodiversity
- **Maintain ecological balance-** Protect the forest along with its flora, fauna and other diverse ecological components while preserving the integrity and territory of the forests

WATER (PREVENTION & CONTROL OF POLLUTION) ACT, 1974

- The Water (Prevention & Control of Pollution) Act, 1974 was adopted by the Indian parliament with the aim of prevention and control of Water Pollution in India
- One of the important provisions of the Water Act, 1974 is to maintain and restore the 'wholesomeness' of our aquatic resources
- **Under Water Act, 1974, pollution control boards (CPCB and SPCBs)** were created, who are responsible for implementation of its provisions

CENTRALPOLLUTIONCONTROLBOARD

- The Central Pollution Control Board (CPCB), **statutory organization**, was constituted inSeptember1974 under the Water (Prevention and Control of Pollution) Act,1974.
- It is responsible for planning and executing comprehensive nation wide programmes for the **prevention and control of water and air pollution**, **for advising the Central Government** on matters concerning prevention and control of water and air pollution

and **for coordinating activities** of state pollution control boards/pollution control committees besides **providing technical assistance** and guidance to them.

AIR (PREVENTION & CONTROL OF POLLUTION) ACT, 1981

- The Air Act was passed by the Parliament of India to prevent and control the harmful effects of air pollution in India.
- Section 2(a) defines an 'air pollutants' as any solid liquid or gaseous substance which may cause harm or damage the environment, humans, plants, animals or even damage property. A 1987 amendment to the act also added 'noise' in the list of harmful substances

ENVIRONMENT (PROTECTION) ACT, 1986

- **Came into force on 19 Nov, 1986 in the wake of the Bhopal Gas Tragedy, which occurred on Dec 2, 1984**
- Notification for protection of **ecologically sensitive areas** (ESA) are issued from time to time in accordance to the need under Environment Protection Act
- **Central Ground Water Authority is formed under EPA 1986**

BIOLOGICAL DIVERSITY ACT OF 2002

- The Biological Diversity Act, 2002 was passed by the parliament of India to protect biodiversity and facilitate the sustainable management of biological resources with the local communities.
- The Act was enacted to meet the requirements stipulated by the United Nations Convention on Biological Diversity (CBD), to which India is a party.
- **The Act's main objective is to ensure the conservation of biological diversity, sustainable use of its components and fair usage of its resources in order to prevent overuse or eventual destruction of biodiversity.**
- 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).
- **National Biodiversity Authority:** In order to carry out the provisions of the act, the National Biodiversity Authority (NBA) had been set up under the Ministry of Environments and Forest by the Government of India in 2003. The NBA is a statutory, autonomous body headquartered in Chennai. Under this act, the Central Government in consultation with the NBA shall notify threatened species and prohibit or regulate their collection, rehabilitation, and conservation and monitor and prevent actions that are prohibited under the Act.

FOREST RIGHTS ACT (FRA) 2006

- The **Forest Rights Act, India or the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act** is also known by other names like the **Tribal Rights Act or the Tribal Land Act.** It deals with the rights of the communities that dwell in the forests (including Scheduled Tribes), over land and other resources, which have been denied to them over the years because of the continuation of forest laws from the colonial era in the country.
- **Gram Sabha is the authority to initiate a process to vest rights on marginally and tribal communities after assessment of the extent of their needs from forest lands**
- **Ministry of Tribal Affairs (MoTA) is the nodal ministry for recognition and vesting of individual and community forest rights**

- The Critical Wildlife Habitats have been envisaged in Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.
- Critical Wildlife Habitats (CWH) are the "areas of national parks and sanctuaries where it has been specifically and clearly established, case by case, on the basis of scientific and objective criteria, that such areas are required to be kept as inviolate for the purposes of wildlife conservation".

COMPENSATORY AFFORESTATION FUND ACT, 2016

- The act provides for setting up Compensatory Afforestation Fund Management and Planning Authority (CAMPA) at both central and state level to ensure expeditious and transparent utilization of amounts realised in lieu of forest land diverted for non-forest purpose, i.e., Regenerate Forest and specific conservation activities
- If standing forests are diverted for "non-forest purposes", which include mining, dams, highways and other infrastructure, the entities involved have to pay the government so that the loss of forests can be compensated by afforestation elsewhere

SOLID WASTE MANAGEMENT RULES 2016

- The Rules are now applicable beyond Municipal areas and extend to urban agglomerations, census towns, notified industrial townships, areas under the control of Indian Railways, airports, airbase, Port and harbour, defence establishments, special economic zones, State and Central government organizations, places of pilgrims, religious & historical importance.
- Responsibilities of Generators have been introduced to segregate waste in to three streams, Wet (Biodegradable), Dry (Plastic, Paper, metal, wood, etc.) and domestic hazardous wastes (diapers, napkins, empty containers of cleaning agents, mosquito repellents, etc.) and handover segregated wastes to authorized rag-pickers or waste collectors or local bodies.
- Integration of waste pickers/ rag pickers and waste dealers/ Kabadiwalas in the formal system should be done by State Governments, and Self Help Group, or any other group to be formed.

CHEMICAL SAFETY

- The Ministry of Environment, Forest and Climate Change notified the Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989 and the Chemical Accidents (Emergency Planning, Preparedness and Response) (CAEPPR) Rules, 1996 for ensuring chemical safety in the Country. These rules delineate the criteria for identification of Major Accident Hazard (MAH) unit. As per the rules, Central Crisis Group, State Crisis Groups, District Crisis Groups and Local Crisis Groups at Central, State, District and Local level are required to be set up for the management of accidents due to handling of hazardous chemicals listed in the rules.

BIO-MEDICAL WASTE MANAGEMENT RULES 2016

- Phase-out the use of chlorinated plastic bags, gloves and blood bags within two years;

- Pre-treatment of the laboratory waste, microbiological waste, blood samples and blood bags through sterilization on-site

E-WASTE MANAGEMENT RULES 2016

- It includes CFLs or Compact Fluorescent Lamps as well as other lamps with mercury, and similar equipment.
- The Rules for the first time, bring producers under the ambit of the **Extended Producer Responsibility or EPR**, together with the targets.
- Producers have been made accountable for e-waste collection and e-waste exchange as well.
- **Extended Producers Responsibility** is essentially the use of financial incentives to encourage manufacturers to design environmentally friendly products by making producers accountable for their product management during end-stage consumption

PLASTIC WASTE MANAGEMENT RULES, 2016

- Rural areas have been brought in ambit of these Rules since plastic has reached to rural areas also. Responsibility for implementation of the rules is given to Gram Panchayat.
- Use of plastic sheet for packaging, wrapping the commodity except those plastic sheet's thickness, which will impair the functionality of the product are brought under the ambit of these rules.

Plastic Waste Management (Amendment) Rules 2018

- The Ministry of Environment, Forest and Climate Change has notified the Plastic Waste Management (Amendment) Rules 2018 on March 27, 2018.
- The amended Rules lay down that the phasing out of Multilayered Plastic (MLP) is now applicable to MLP, which are "non-recyclable, or non-energy recoverable, or with no alternate use."

Plastic Waste Management Amendment Rules, 2021

- The rules prohibit identified single use plastic items which have low utility and high littering potential by 2022.
- For effective implementation of Extended Producer Responsibility, the Guidelines for Extended Producer Responsibility being brought out have been given legal force through Plastic Waste Management Amendment Rules, 2021.

WETLAND CONSERVATION AND MANAGEMENT RULES, 2017

- Recommend measures for wetland conservation and for raising awareness among its stakeholders and local communities with respect to the importance of wetlands.
- **Setting up of National Wetland committee**

- Do not include river channels, paddy fields, man-made water bodies, etc

NATIONAL GREEN TRIBUNAL ACT, 2010

- India is the 3rd country in the world to have full fledge green tribunal followed by New Zealand and Australia
- NGT is a statutory body under this act
- An Act to provide for the establishment of a National Green Tribunal for the effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental thereto.

OZONE DEPLETING SUBSTANCES RULE, 2000

- Formed in July 2000 under Environment Protection Act, 1986
- Prohibit the use of CFCs beyond 1st Jan 2003
- Use of HFCs is allowed up to 2040
- Use of halons is prohibited after 1st Jan 2001

WESTERN GHATS ECOLOGY EXPERT PANEL

- Known as the **Gadgil Commission** after its chairman Madhav Gadgil, was an environmental research commission appointed by the Ministry of Environment and Forests of India
- Western Ghats Ecology Expert Panel (WGEEP) **designated the entire hill range as an Ecologically Sensitive Area (ESA).**

KASTURIRANGAN COMMITTEE ON THE WESTERN GHATS

- Kasturirangan committee was constituted to examine the WGEEP report. The committee is often called HLWG – it denotes the 10-member high-level working group (HLWG), headed by Kasturirangan
- Instead of the total area of Western Ghats, **only 37% (i.e. 60,000 sq. km.) of the total area be brought under ESA**

INTEGRATED WASTELAND DEVELOPMENT PROGRAMME (IWDP)

- Development of wastelands mainly in non-forest areas aimed at checking land degradation, putting such wastelands of the country to SUSTAINABLE use & increasing bio-mass availability especially that of fuel wood , fodder , fruits, fiber & small timber.
- Government of India taken up this colossal task through its INTEGRATED WASTELAND DEVELOPMENT PROJECT SCHEME (IWDP) by revitalizing & reviving village level institutions & enlisting people's participation.
- It was people's own programme which aims at giving them actual decision making powers in terms of project implementation & fund disbursal.

Previous Year Questions

The Integrated Wasteland Development Programme (IWDP) is sponsored by (2011)

a) NABARD
b) Government of India
c) Asian Development Bank
d) UNO

Chapter 6: International Environmental Conventions

STOCKHOLM CONFERENCE, 1972

- **First world conference to make the environment a major issue from 5th -16th June**
- United Nations Conference on the Human Environment
- **One of the major results of the Stockholm conference was the creation of the United Nations Environment Programme (UNEP)**
- **Stockholm Declaration of 1972: "Magna Carta" of environment protection and its development**

United Nations Environment Programme

- The United Nations Environment Programme (UNEP) is responsible for coordinating responses to environmental issues within the United Nations system.
- It was established by Maurice Strong, its first director
- UNEP hosts the secretariats of several multilateral environmental agreements and research bodies, including: **The Convention on Biological Diversity (CBD), The Minamata Convention on Mercury, The Convention on Migratory Species and The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)**
- In 1988, the World Meteorological Organization and UNEP established the Intergovernmental Panel on Climate Change (IPCC).
- UNEP is also one of several Implementing Agencies for the Global Environment Facility (GEF) and the Multilateral Fund for the Implementation of the Montreal Protocol

United Nations Conference On Environment And Development (UNCED)

- The United Nations Conference on Environment and Development (UNCED), also known as the **'Earth Summit',** was held in Rio de Janeiro, Brazil, from 3-14 June 1992
- **The 'Earth Summit' also led to the creation of the Commission on Sustainable Development, the holding of first world conference on the sustainable development of small island developing States in 1994, and negotiations for the establishment of the agreement on straddling stocks and highly migratory fish stocks**.
- The 'Earth Summit' had many great achievements:
    - **Rio Declaration on Environment and Development**: 27 principles intended to guide future sustainable development around the world
    - **Agenda 21-** The number 21 refers to an agenda for the 21st century. It is an action plan of how to do sustainable development
    - **Forest Principles**: Ways to do sustainable development in all forest types
    - **The Convention on Biological Diversity (CBD)**
    - **United Nations Framework Convention on Climate Change (UNFCCC)**
    - **United Nations Convention to Combat Desertification (UNCCD)**

Rio + 20 and SDG

- **Held on 13th June 2012 in Rio de Janeiro**
- 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.
- The **Sustainable Development Goals (SDGs) or Global Goals** are a collection of **17 interlinked global goals** designed to be a "blueprint to achieve a better and more sustainable future for all".
- The SDGs were set up in 2015 by the United Nations General Assembly (UN-GA) and is intended to be achieved by 2030. They are included in a UN-GA Resolution called the **2030 Agenda** or what is colloquially known as **Agenda 2030**.
- The SDGs were developed in the Post-2015 Development Agenda as the future global development framework to succeed the Millennium Development Goals which were ended in 2015.

The 17 SDGs are:

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. Reduced Inequality
11. Sustainable Cities and Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life Below Water
15. Life On Land
16. Peace, Justice, and Strong Institutions
17. Partnerships for the Goals.

UNCCD

- UNCCD stands for United Nations Convention to Combat Desertification.
- Established in 1994, UNCCC is a sole legally binding environment convention that links development and environment to sustainable land management.It became effective in 1996 after receiving 50 ratifications.
- The UN Convention to Combat Desertification aims to combat desertification and the ill effects of drought

- **India became a signatory in 1994, ratified it on 1996.**
- **In India MoEFCC is the nodal ministry**
- **The 14th Conference of Parties (COP) to the UNCCD was held in India in 2019. The conference which was held in Greater Noida had the theme, "Restore Land, Sustain Future".**
- **India was the COP president for 2019 – 2021.**
- **India is also a part of the Bonn Challenge, which is an international effort to bring 150 million hectares of the world's degraded and deforested land into restoration by 2020, and 350 million hectares by 2030.**

UNCCD COP 14

- The UNCCD COP 14 (14th edition of Conference of Parties) ended on 13 September 2019
- The theme of the Conference was 'Restore land, Sustain future'.
- The Conference **adopted the Delhi Declaration** and expressed a range of issues which includes gender and health, ecosystem restoration, taking action on climate change, private sector engagement, Peace Forest Initiative and recovery of 26 million hectares of degraded land in India.
- The country parties have agreed to make the **Sustainable Development Goal target of achieving land degradation neutrality by 2030,** a national target for action.
- Prime Minister Narendra Modi inaugurated the High-Level Segment (HLS) of UNCCD COP14.
- India to promote south-south cooperation and knowledge-sharing is establishing a center of excellence for forest research which will assist in addressing the issue of land degradation, climate change and biodiversity loss.

Convention on Biological Diversity (CBD)

- Informally known as the **Biodiversity Convention**, is a multilateral treaty opened for signature at the Earth Summit in Rio De Janeiro in 1992.
- It comes under the United Nations Environment Programme (UNEP).
- India is also a party to the Convention. India ratified it in 1994.
- The Biological Diversity Act, 2002 was enacted for giving effect to the provisions of the Convention. To implement the provisions of the Act, the government established the National Biodiversity Authority (NBA) in 2003. The NBA is a statutory body.
- **The goals of the Convention are:**
- Conservation of Biological Diversity
- Sustainable use of the components of the Biodiversity
- **Fair and equitable sharing of benefits arising from the genetic resources**

Cartagena Protocol

- **The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international agreement which aims to ensure the safe handling, transport and use of**

living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on biological diversity, taking also into account risks to human health.

- It was adopted on 29 January 2000 and entered into force on 11 September 2003.
- The Cartagena Protocol also sets up a **Biosafety Clearing-House (BCH)** to enable information exchange on LMOs between countries. The BCH is an information-sharing mechanism for relevant technical, scientific and legal information.

Nagoya Protocol

- The protocol was adopted in 2010 in Nagoya, Japan.
- It entered into force in October 2014.
- The Nagoya Protocol is significant in terms of conservation of biodiversity, and for having an equitable sharing of benefits of the genetic resources. This is also intended to help indigenous peoples everywhere to avoid being exploited for their **traditional knowledge** and expertise.

AICHI BIODIVERSITY TARGETS

- The Aichi Biodiversity Targets are **twenty actions** adopted under **'Strategic Plan for Biodiversity 2011-2020', which is a ten-year framework** for action by all countries and stakeholders to save biodiversity and enhance its benefits for people.

The Economics of Ecosystems and Biodiversity (TEEB)

- The Economics of Ecosystems and Biodiversity (TEEB) is a global initiative focused on "making nature's values visible". International initiative to draw attention to the global economic benefits of biodiversity
- Analysing the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation
- In response to TEEB, a global study was initiated in 2017 and was led by Pavan Sukhdev. Pavan Sukhdev is an Indian environmental economist whose field of studies include green economy and international finance

Kunming Declaration

- Adopted by over 100 countries October 13, 2021 in China
- CoP 15 to CBD
- **Theme of the declaration is "Ecological Civilization: Building a Shared Future for All Life on Earth."**
- Focuses on Post-pandemic recovery policies, programmes and plans contribute to the conservation and sustainable use of biodiversity, promoting sustainable and inclusive development

Global Environment Facility (GEF)

- In 1992 under Rio Summit, GEF was established as a separate, permanent institution
- The GEF is the **largest multilateral trust fund focused on enabling developing countries to invest in nature**, and supports the implementation of major international environmental conventions including on biodiversity, climate change, chemicals, and desertification.

INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE AND NATURAL RESOURCE

- IUCN is also known as the World Conservation Union
- This environmental organization established in 1948, is a worldwide conservation organization with its headquarters in Gland, Switzerland.
- The IUCN endorses captive breeding and habitat protection to maintain viable populations of wild flora and fauna.
- IUCN is an environmental organization with official Observer Status at the United Nations General Assembly. They prepare a list called IUCN Red List, which classify the plants and animals on the basis of their threat

WORLDWIDE FUND FOR NATURE (WWF)

- WWF, formerly named as World Wildlife Fund was formed as a charitable trust on 11th September 1961, in Morges, Switzerland
- It is now the world's largest independent conservation organization with over 5 million supporters worldwide.
- WWF is an international non-governmental organization that aims for conservation of the environment.
- The **Living Planet Report** has been published every two years by WWF since 1998; it is based on a Living Planet Index and ecological footprint calculation.
- In addition, WWF has launched several notable worldwide campaigns, including **Earth Hour** and **Debt-for-nature swap**, and its current work is organized around these six areas: food, climate, freshwater, wildlife, forests, and oceans

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

- CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is **also known as the Washington Convention** was adopted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN)
- CITES Secretariat is Administered by UNEP and is located in Geneva

TRAFFIC

- Trade Related Analysis of Fauna and Flora in Commerce (TRAFFIC)
- TRAFFIC is a leading non-governmental organisation working globally on trade in wild animals and plants in the context of both biodiversity conservation and sustainable development.

- A joint programme of World-Wide Fund for Nature (WWF) and IUCN
- TRAFFIC also works in close co-operation with the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Convention on the Conservation of Migratory Species of Wild Animals (CMS)

- As an environmental treaty of the United Nations, CMS provides a global platform for the conservation and sustainable use of **migratory animals and their habitats**. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.
- **Raptors**: Memorandum of Understanding on the **Conservation of Migratory Birds of Prey in Africa and Eurasia**

BIRDLIFE INTERNATIONAL

- Bird Life is widely recognized as the world leader in bird conservation.
- It is the **world's oldest international conservation organization**.
- **Include the Important Bird and Biodiversity Areas Programme, Marine Programme, Preventing Extinctions Programme, and Flyways Programme**

Global Tiger Forum

- Global Tiger Forum is an Inter-Governmental international body working exclusively for the conservation of Tigers
- Established in 1994, the Global Tiger Forum (GTF) has its **headquarters in New Delhi**.
- As per the Global Tiger Forum, it was set up to highlight the rationale for tiger preservation and provide leadership and a common approach throughout the world in order to safeguard the survival of the tiger, its prey, and its habitat.

Integrated Tiger Habitat Conservation Program

- ITHCP was launched in 2014.
- It is a strategic funding mechanism that aims to save tigers in the wild, their habitats and to support human populations in key locations throughout Asia.
- It has already facilitated 12 projects in six countries (Bangladesh, Bhutan, India, Indonesia, Nepal and Myanmar) to better manage Tiger Conservation Landscapes.

Global Tiger Recovery Programme (GTRP)

- Wild tigers are on the brink of extinction, scattered among **13 Asian Tiger Range Countries (TRCs): Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Russian Federation, Thailand, and Vietnam.**

- GTRP was developed, with the **shared goal of doubling the number of wild tigers globally by 2022** through actions

Globally Important Agricultural Heritage Systems (GIAHS)

- In 2002, during the World Summit on Sustainable Development (Johannesburg, South Africa), the Food and Agriculture Organization (FAO) of the United Nations launched a Global Partnership Initiative on conservation and adaptive management of "Globally Important Agricultural Heritage Systems".
- The overall goal of the GIAHS Programme is to identify and safeguard Globally Important Agricultural Heritage Systems and their associated landscapes, agricultural biodiversity, knowledge systems, and culture.
- **The three GIAHS in India are:**

1. Koraput Traditional Agriculture, Odisha
2. Kuttanad Below Sea Level Farming System, Kerala
3. Pampore Saffron Heritage, Jammu & Kashmir

Stockholm Convention on Persistent Organic Pollutants (POPs)

- Stockholm Convention is a global treaty that was adopted by the Conference of Plenipotentiaries in 2001 and came into force on 17th May 2004.
- It was **introduced to protect human health from harmful POPs suspended in the air for a long period of time.** The convention aims to reduce or eliminate the use of POPs through the active measures of the member states.
- The Stockholm Convention initially recognized 12 POPs causing adverse effects on the environment. In 2017, 16 additional POPs were added under the Stockholm Convention= Total 28
- Examples include DDT, Polychlorinated biphenyls (PCBs), etc.

Basel Convention

- Basel Convention on the **Control of Transboundary Movements of Hazardous Wastes and their Disposal** is a comprehensive treaty that was adopted in 1989 by the Conference of Plenipotentiaries.
- It aims to protect the human environment from the adverse effects of hazardous waste that is generated, managed and disposed of in the world community
- Adopted on 22 March 1989 in Basel, Switzerland. It came into force in 1992
- The Basel Convention secretariat is situated in Geneva, Switzerland
- Basel Convention also handles some topical issues like:
    - Electronic and electrical waste (e-waste) such as mobile phones and computers
    - Ships destined for dismantling
    - Mercury and asbestos wastes

- Illegal dumping of hazardous wastes

Rotterdam Convention

- Rotterdam Convention is a name for the Convention that was adopted by the Conference of Plenipotentiaries (COP) in 1998 in Rotterdam (Netherlands) that aims to **promote shared responsibilities in relation to the international trade of hazardous chemicals.**
- The secretariat of the convention is in Geneva, Switzerland

Minamata Convention

- The Minamata Convention on Mercury is an international environmental treaty that aims to protect human health and the environment from the harmful effects of mercury and its compounds.
- Adopted in 2013 in Kumamoto, Japan and entered into force on 16th August 2017
- India ratified in 2018. The Convention also excludes the use of mercury in Ayurvedic, Siddha and Unani medicines
- **It is the world's first legally binding treaty, to phase out this highly toxic substance**

Previous Year Questions

1. **Which among the following Protocols / Conventions is dedicated for protecting biodiversity from the potential risks caused by Living Modified Organisms (LMO) from modern technology? (2020)**
   a) **Cartagena Protocol**
   b) Nagoya Protocol.
   c) Bonn Convention.
   d) Vienna Convention

2. **Which of the following is not a component of sustainable development goals (SDG) being coordinated by the NITI Aayog?**
   a) No poverty
   b) Zero Hunger
   c) Life Below Water
   d) **Nuclear Non-Proliferation**

ACADEMY OF CIVIL SERVICES
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Chapter 7: Biodiversity and Protected Areas

- India is one of the 17 mega-diverse countries in the world

Levels of Biodiversity

- **Genetic:**Genetic diversity is defined as genetic variability present within species. Sexual reproduction is important in maintaining genetic diversity as it gives unique offspring by combining genes of parents
- **Species:** Species diversity is defined as the number of different species present in an ecosystem and relative abundance of each of those species
- **Species richness**: Number of different species present in an ecosystem. Tropical areas have greater species richness as the environment is conducive for a large number of species.
- Species richness can be measured as **alpha, beta** and **gamma**. The key difference between alpha, beta and gamma diversity is that alpha diversity measures the diversity of a particular area or an ecosystem, usually by expressing the species richness or the number of species, while beta diversity measures the diversity between ecosystems by measuring the species change between ecosystems and gamma diversity measures the overall diversity across a large geographic region.
- **Species evenness**: Relative abundance of individuals of each of those species. If the number of individuals within a species is fairly constant across communities, it is said to have a high evenness and if the number of individuals varies from species to species, it is said to have low evenness. High evenness leads to greater specific diversity
- **Ecosystem:** Ecosystem diversity refers to the variation in the ecosystem

Speciation

- **Speciation is the process of formation of new species from existing populations**
- **Allopatric Speciation**: Allopatric speciation is the type of speciation caused by geographical isolation. In this, the population is separated by a physical barrier
- **Parapatric Speciation**: This is a type of allopatric speciation in which the species are not formed by any physical barrier. Instead, they are beside each other. This occurs by an extreme change in the habitat. Though the individuals in these areas can interbreed, they develop different characteristics and lifestyles
- **Peripatric Speciation**: This is a type of allopatric speciation in which new species are formed from an isolated peripheral population. In this, the populations are prevented from exchanging genes Therefore, it is difficult to distinguish between them
- **Sympatric Speciation**: It refers to the evolution of new species from the surviving ancestral species in which both the species continue to live in the same geographical region.

Biodiversity and its Conservation Methods

- **In-situ Conservation**: In-situ conservation of biodiversity is the conservation of species within their natural habitat. In this method, the natural ecosystem is maintained and protected. Examples include **National Parks, Wildlife Sanctuaries, Biosphere Reserves are examples of in-situ conservation**
- **Ex-situ Conservation**: Ex-situ conservation of biodiversity involves the breeding and maintenance of endangered species in artificial ecosystems such as **zoos, nurseries, botanical gardens, gene banks**, etc. There is less competition for food, water and space among the organisms.

Biodiversity hot spots

- **Coined by Norman Myers**, the term "Biodiversity hotspots" can be defined as the regions which are known for their high species richness and endemism.
- There are **36 biodiversity hotspots in the world**
- There are **four hotspots in India: The Western Ghats, The Himalayas, Indo-Burma Region, Sundaland**

Table 1. Biodiversity Hotspots in the World

Sl. No.	Name of the Hotspot	Location
1.	Tropical Andes	South America
2.	Tumbes-Choco-Magdalena	South America
3.	Madrean Pine–Oak Woodlands	North and Central America
4.	Cerrado	South America
5.	Chilean Winter Rainfall and Valdivian Forests	South America
6.	Atlantic Forest	South America
7.	Mesoamerica	North and Central America
8.	Caribbean Islands	North and Central America
9.	California Floristic Province	North and Central America
10.	Guinean Forests of West Africa	Africa
11.	Cape Floristic Region	Africa
12.	Succulent Karoo	Africa
13.	Maputaland–Pondoland–Albany	Africa
14.	Coastal Forests of Eastern Africa	Africa
15.	Eastern Afromontane	Africa
16.	Horn of Africa	Africa
17.	Madagascar and the Indian Ocean Islands	Africa
18	Mediterranean Basin	Europe and Central Asia
19.	Caucasus	Europe and Central Asia
20.	Irano-Anatolian	Europe and Central Asia
21.	Mountains of Central Asia	Europe and Central Asia
22.	Western Ghats and Sri Lanka	South Asia
23.	Himalaya	South Asia
24.	Mountains of Southwest China	East Asia
25.	Indo-Burma	South Asia
26.	Sundaland	Southeast Asia and Asia-Pacific
27.	Wallacea	Southeast Asia and Asia-Pacific
28.	Philippines	Southeast Asia and Asia-Pacific
29.	Japan	East Asia
30.	Southwest Australia	Southeast Asia and Asia-Pacific
31.	East Melanesian Islands	Southeast Asia and Asia-Pacific
32.	New Zealand	Southeast Asia and Asia-Pacific
33.	New Caledonia	Southeast Asia and Asia-Pacific
34.	Polynesia–Micronesia	Southeast Asia and Asia-Pacific
35.	Forests of East Australia	Southeast Asia and Asia-Pacific
36.	North American Coastal Plain	North and Central America

Biodiversity Cold Spots

- Region with a limited number of living things, such as plants, animals, fungi, and bacteria. These are areas with a **low level of biological diversity but a high rate of habitat loss**.

Hottest Hotspot

- The eight hottest hot spots in terms of the factors:

1.Madagascar 2. Philippines 3. Sunderland 4. Brazil's Atlantic Forest 5. Caribbean 6. Indo-Burma

7. Western Ghats/Sri Lanka and 8. Eastern Arc and Coastal Forests of Tanzania/Kenya

THE RED DATA BOOK

- Information for endangered mammals and birds are more extensive than for other groups of animals and plants, coverage is also given to less prominent organisms facing extinction
- Black represents species that are confirmed to be extinct
- Red represents species that are endangered
- Amber for those species whose status is considered to be vulnerable
- White is assigned for species that are rare
- Pink pages in this publication include the critically endangered species
- Green pages are used for those species that were formerly endangered, but have now recovered to a point where they are no longer threatened
- Grey if sufficient information is not available to be properly classified

IUCN CLASSIFICATION OF CONSERVATION PRIORITY

- Extinct (EX) – No known individuals remaining.
- Extinct in the wild (EW) – Known only to survive in captivity, or as a naturalized population outside its historic range.
- Critically endangered (CR) – Extremely high risk of extinction in the wild.
- Endangered (EN) – High risk of extinction in the wild.
- Vulnerable (VU) – High risk of endangerment in the wild.
- Near threatened (NT) – Likely to become endangered soon.
- Least concern (LC) – Lowest risk. Does not qualify for a more at-risk category. Widespread and abundant taxa are included in this category.
- Data deficient (DD) – Not enough data to assess its risk of extinction.
- Not evaluated (NE) – Has not yet been evaluated against the criteria

National Parks

- National Parks are the areas that are set by the government to conserve the natural environment
- **Area established under section 35(4) of the Wildlife (Protection) Act, 1972**
- **IUCN Category II under protected areas**

National Parks as UNESCO World Heritage Site

- Kaziranga National Park, Assam
- Manas National Park, Assam
- Keoladeo National Park, Rajasthan
- Nanda Devi and Valley of Flowers National Park, Uttarakhand
- Sundarbans National Park, West Bengal
- Great Himalayan National Park, Himachal Pradesh
- Khangchendzonga National Park, Sikkim

Wildlife Sanctuaries

- Sanctuaries are naturally occurring areas that are meant to protect the species in their natural habitat from hunting, poaching and predation
- **IUCN Category IV under protected area**

Biosphere Reserves

- Biosphere reserves are the protected areas meant for the conservation of plants and animals. It also restores the traditional life of the tribals living in that vicinity. They conserve the biodiversity of that area.
- There are **18 Biosphere Reserves in India** established by the government that protect large areas of natural habitats.
- The Biosphere Reserves are identified by the Man and Biosphere Reserve Program to promote sustainable development. This program was initiated by UNESCO in 1971.

Name of Biosphere Reserves	States
Nilgiri Biosphere Reserve	Tamil Nadu, Kerala, Karnataka
Sundarbans Biosphere Reserve	West Bengal
Gulf of Mannar Biosphere Reserve	Tamil Nadu
Nanda Devi Biosphere Reserve	Uttarakhand
Simlipal Biosphere Reserve	Odisha
Pachmarhi Biosphere Reserve	Madhya Pradesh
Nokrek Biosphere Reserve	Meghalaya
Achanakmar-Amarkantak Biosphere Reserve	Chhattisgarh, Madhya Pradesh
Great Nicobar Biosphere Reserve	Great Nicobar

Agasthyamalai Biosphere Reserve	Kerala and Tamil Nadu
Khangchendzonga National Park	Sikkim
Manas	Assam
Dibru-Saikhowa	Assam
Dehang-Dibang	Siang and Dibang Valley in Arunachal Pradesh
Kachchh	Gujarat
Cold Desert	Himachal Pradesh
Seshachalam Hills	Andhra Pradesh
Panna	Madhya Pradesh

FACTS ABOUT NATIONAL PARKS & WILDLIFE SANCTUARIES IN INDIA

- First National Park- Hailey National Park (Jim Corbett) in Uttarakhand, 1936
- Largest National Park - Hemis National Park (Ladakh)- High altitude. Also, largest South Asia
- Smallest National Park - South Button Island NP (Andaman & Nicobar)
- First Marine National Park - Gulf of Kutch, Gujarat
- Floating National Park - Keibul Lamjao National Park, Manipur
- Jim Corbett National Park - First Tiger Project
- Madya Pradesh has the largest number of national parks
- Largest wildlife sanctuary by area- Kachchh desert wildlife sanctuary (Gujarat)
- Smallest wildlife sanctuary by area- Rowe Island wildlife sanctuary (Andaman & Nicobar) and Dr. Salim Ali Bird Sanctuary/ Pitti Bird Sanctuary (Lakshadweep)
- Oldest wildlife sanctuary - Vedanthangal Lake Bird wildlife sanctuary (TN): 1936

Bhitarkanika

- The area located in **Odisha** is designated as second Ramsar site of the State after the Chilika Lake.
- It is surrounded by Bhitarkanika Wildlife Sanctuary, which spread over 672 km2 (259 sq mi). Gahirmatha Beach and Marine Sanctuary are to the east, separating swamp region and mangroves from the Bay of Bengal
- It hosts many mangrove species, and is the second largest mangrove ecosystem in India.
- The national park is home to **Saltwater crocodile**, Indian python, king cobra, black ibis, darters, **olive ridley turtles** and many other species of flora and fauna

Keolado

- Keoladeo National Park or Keoladeo Ghana National Park (formerly known as the Bharatpur Bird Sanctuary) is a famous avifauna sanctuary in Bharatpur, Rajasthan, India, that hosts thousands of birds, especially during the winter season.
- It was declared a protected sanctuary in 1971 and established as a national park on 10 March 1982. It is also a World Heritage Site
- Keoladeo Ghana National Park is a man-made and man-managed wetland and one of the national parks of India.
- It is also the only regular wintering area in India for the Siberian crane.

Gir National Park

- Gir National Park and Wildlife Sanctuary, also known as Sasan Gir, is a forest, national park, and wildlife sanctuary near Talala Gir in Gujarat, India.
- It is part of the Khathiar-Gir dry deciduous forests ecoregion.
- The carnivores group mainly comprises the Asiatic lion, Indian leopard, jungle cat, striped hyena, golden jackal, Bengal fox,Indian gray mongoose and ruddy mongoose, and honey badger. Asiatic wildcat and rusty-spotted cat occur, but are rarely seen

Kuno National Park

- Kuno National Park is a national park in **Madhya Pradesh**, India, established in 1981 as a wildlife sanctuary
- **In 2009, Kuno Wildlife Sanctuary was also proposed as a possible site for Cheetah reintroduction in India.** ~~**In January 2022, environment minister Bhupender Yadav launched the action plan for reintroducing cheetahs in India, starting with Kuno national park. On 17 September 2022, eight cheetahs from Namibia arrived in Madhya Pradesh's Kuno National Park**~~
- **The Palpur – Kuno Wildlife Sanctuary (MP) followed by Sita Mata wildlife Sanctuary (Rajasthan) are two of the promising secondary habitats for the Asiatic lions in India according to the Asiatic lion reintroduction act, 1990**

Panna National Park

- Panna National Park is a national park located in Panna and Chhatarpur districts of Madhya Pradesh in India.
- Panna was given the Award of Excellence in 2007 as the best maintained national park of India by the Ministry of Tourism of India.
- It is notable that by 2009, the entire tiger population had been eliminated by poaching with the collusion of forest department officials.
- The Government of India along with Government of Madhya Pradesh and Government of Uttar Pradesh have planned to link the Ken River with Betwa River. This involves construction

of 283m long Daudhan Dam. The project aims to transfer excess water from Ken basin to Betwa basin thus provide water access to the drought prone region of Bundelkhand. This construction will cause inundation of 400 hectares of land of 4300 hectare Panna Tiger reserve. Environmentalist are afraid that this will adversely affect the population of tigers in the region.

Keibul Lamjao

- Only floating National Park in the world, which is located on the Loktak lake, and is the last natural habitat of sangai, the dancing deer of Manipur
- Sangai festival is an annual cultural festival organised by Manipur Tourism Department
- Brow-Antlered Deer (Sangai) faces threat from steadily degenerating habitat of phumdi as a result of continuous inundation and flooding caused due to artificial reservoir

Kutchh Desert Wildlife Sanctuary

- Kutch Desert Wildlife Sanctuary is situated in the Great Rann of Kutch, Kutch district, Gujarat, India. It was declared a sanctuary in February 1986.
- It is the largest Wildlife Sanctuary in India area wise
- It encompasses a true saline desert where thousands of greater flamingo (Phoenicopterus roseus) nest in the world-famous 'Flamingo City' located in the mud flats of the Rann, about 10 km from Nir outpost on Kala Dungar hill. It is the only area where flamingoes congregate to breed regularly.
- As per a television series, National Security by Rajya Sabha TV, the flamingo city is now a dead patch of land and flamingos do not come to breed here

National Chambal Sanctuary

- Tri-state protected area in northern India for the **protection of the Critically Endangered gharial, the red-crowned roof turtle and the Endangered Ganges River dolphin**
- Located on the **Chambal River** near the **tripoint of Rajasthan, Madhya Pradesh and Uttar Pradesh**

TX2

- TX2 is the global award which was set up in 2010 in St. Petersburg, Russia by international organizations working for tiger conservation like WWF, UNDP, IUCN, Global Tiger Fund (GTF), CATS and The Lion's Share.
- The event had participation from 13 tiger ranging countries as well, including India
- Pilibhit tiger reserve of Uttar Pradesh got the first International award TX2 for doubling tiger population within stipulated time

Previous Year Questions

1. **Biodiversity hotspots are among the richest and most important ecosystem in the world. How many such hotspots are presently there in the world? (2020)**
   a) 25
   b) 34
   c) 36
   d) 42
2. **Biodiversity forms the basis for human existence in which of the following ways? (2016)**
   a) Soil formation
   b) Prevention of soil erosion
   c) Recycling of waste
   d) Pollination of crops

3. **Kuno Palpur Wildlife Sanctuary, which is being proposed as a new home for some relocated Gir Lions from Gujarat is located in (2014)**

   a) Madhya Pradesh
   b) Maharashtra
   c) Rajasthan
   d) Odisha

Chapter 8: Important Species and Their Conservation

The Royal Bengal Tiger

- The Royal Bengal tiger has been listed as endangered by the IUCN Red list
- Mostly resides in the evergreen forests, dry deciduous forest, moist deciduous forest, alluvial grasslands, and mangrove forests
- "Tiger Conservation Units" in the foothills of the Himalayas. It includes Corbett National Park, Hazaribagh National Park, Bandipur Wildlife Sanctuary, Ratapani Tiger Reserve etc.
- **Royal Bengal Tigers found in Sunderbans constitute the only tiger population that reside in the mangrove forests.**

Project Tiger

- Project Tiger was launched by the Government of India in the year 1973 to save the endangered species of tiger in the country
- Till date 53 tiger reserves are present in India

Project Elephant

- Project Elephant was launched by the Government of India in the year 1992 as a Centrally Sponsored Scheme
- The Project is being mainly **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**.

Kashmir stag/ Hangul

- It is a subspecies of Elk which is native to India and is Critically Endangered
- Habitat distribution - in dense riverine forests, high valleys, and mountains of the Kashmir valley and northern Chamba in Himachal Pradesh
- **State animal of Jammu and Kashmir**

Project Hangul

- In the 1970s, the Jammu Kashmir Government with the support of IUCN and World Wildlife Fund (WWF) prepared a project for the protection of the hangul, particularly in Dachigam National Park
- Later the project was rechristened as "Save Kashmir's Red Deer Hangul" in 2009

Snow leopard

- The snow leopard inhabits the higher Himalayan and trans-Himalayan landscape in the five states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, and Arunachal Pradesh
- **State animal of Ladakh**

Salt water Crocodile

- Believed to be the **largest crocodile species living on Earth**
- Also known as a maneater or esturine crocodile
- A large population is present within the Bhitarkanika Wildlife Sanctuary of Odisha while smaller populations occur throughout the Sundarbans.

Great Indian Bustard

- Among the heaviest of the flying bird
- Common on the dry plains of the Indian subcontinent
- Listed as **Critically endangered under IUCN**
- **Found in Desert National Bark, Rajasthan**

Asiatic Lion

- Endangered species
- **India is the sole habitat for Asiatic Lions in the world**
- **Concentrated only in the Gir forest of the Junagadh district of the state of Gujarat**
- **The Asiatic lion Reintroduction Act has been proposed by the Indian Government in order to reintroduce the Asiatic lions in other parts of India**
- The Palpur – Kuno Wildlife Sanctuary (MP) followed by Sita Mata wildlife Sanctuary (Rajasthan) are two of the promising secondary habitats for the Asiatic lions in India

One- Horned Rhinoceros

- Confined to the tall grasslands and forests in the foothills of the Himalayas-Terai
- Commonly **found in Nepal, Bhutan and in Assam**
- **State animal of Assam**
- **The horn is a clump of hairy cartilage, a pure keratin believed to have carcinogenic and aphrodisiac properties**
- **INDIAN RHINO VISION 2020**: Designed by Rhino Task Force 2005 with a target to achieve rhino population to 3,000 by 2020 in seven protected areas in Assam. Indian Rhino Vision 2020 (IRV 2020) has officially come to a close with the translocation of two rhinos to Manas National Park from Pobitora Wildlife Sanctuary. Under IRV2020, a total of 22 rhinos have been translocated from Pobitora Wildlife Sanctuary (12) and Kaziranga National Park (10) to Manas National Park
- Kaziranga National Park, Assam on March 30, 2022, announced that the National Park has registered an increase in rhinos. **The National Park completed 14th Rhino Census conducted from March 25 to 28, 2022.** According to the Census, there has been an increase of 200 rhinos from 2018, making 2613

Wild Buffalo

- Wild water buffalo, also called Asian buffalo, Asiatic buffalo and wild Asian buffalo is an endangered species
- The global population has been estimated at 3,400 individuals, of which 3,100 (91%) live in India, mostly in Assam

Pygmy Hog

- **World's smallest wild pig**, with adults weighing only 8 kgs is Endangered
- Grasslands where the pygmy hog resides can make their own home/ nest along with a roof
- Habitat: Relatively undisturbed, tall 'terai' grasslands
- The population of pygmy hogs in the wild is confined to Manas Tiger Reserve in Assam, in the present. But in the past, they were widely distributed in the wet grasslands of the Himalayan foothills stretching from Uttar Pradesh to Assam, through Nepal terai and Bengal duars

Great Hornbill

- It is found in the Indian subcontinent and Southeast Asia
- Mostly found in Northeast India and Western Ghats and Andaman& Nicobar
- The great Indian hornbill is deemed as **the state bird of two Indian states, such as Kerala and Arunachal Pradesh**
- **Hornbill Festival**: Called the 'Festivals of Festivals', is a 10-day (**1-10th Dec**) annual **cultural fest of Nagaland at Kisama** that showcases the rich and diverse Naga ethnicity through folk dances, traditional music, local cuisine, handicraft, art workshops. The festival pays tribute to Hornbill

Black Necked Crane

- The Black-necked Crane is a medium-sized crane in Asia that breeds on the Tibetan Plateau and remote parts of India and Bhutan
- It is revered in Buddhist traditions and culturally protected across much of its range
- **Ladakh has designated it as the state bird**

Gharial

- The gharial (*Gavialis gangeticus*), also known as the gavial or the fish-eating crocodile
- Adult males have a distinct boss at the end of the snout, which resembles an earthenware pot known as a ghara, hence the name "gharial"
- It has been listed as **critically endangered on the IUCN Red List since 2007**.
- **National Chambal Sanctuary is the protected area in northern India for the protection of the Critically Endangered gharial**

Gangetic river dolphin

- **National Aquatic Animal of India**
- The declaration was made in 2009 in the National Ganga River Basin Authority's (NGRBA) first meeting
- Locally known as 'Sihu', is the **'City Animal' of Guwahati**
- **Guwahati became the first city in the country to have its own city animal in 2016**
- IUCN Red List of Threatened Species has given the status of '**Endangered' to the Ganges River Dolphin**

Olive Ridley Turtles

- Smallest sea turtles of all in India which is carnivorous in nature
- Three river mouths where the turtles come together for mass nesting: Dhamra River, Rushikulya River and Devi River near Bhitarkanika

Indian Vulture

- Old World vulture native to India, Pakistan and Nepal
- Indian vultures died of kidney failure caused by **diclofenac poisoning**

Sangai

- The sangai is an endemic and endangered subspecies of Eld's deer found only in Manipur, India. It is also the state animal of Manipur.
- Its common English name is Manipur brow-antlered deer or Eld's deer
- Its original natural habitat is the floating marshy grasslands of the **Keibul Lamjao National Park, located in the southern parts of the Loktak Lake, which is the largest freshwater lake in eastern India**.

Musk deer

- Despite being commonly called deer, they are not true deer belonging to the family Cervidae, but rather their family is closely related to Bovidae, the group that contains antelopes, bovines, sheep, and goats
- Musk deer live mainly in forested and alpine scrub habitats in the mountains of South Asia, notably the Himalayas.
- The musk gland is found only in adult males. It lies in a sac located between the genitals and the umbilicus, and its secretions are most likely used to attract mates.
- Musk deer are herbivores, living in hilly, forested environments, generally far from human habitation.
- Musk deer have been hunted for their scent glands, which are used in perfumes
- It is rumored that ancient royalty wore the scent of the musk deer, and that it is an aphrodisiac

Previous Year Questions

1. **Hornbill Festival of Nagaland is celebrated in which of the following venues? (2018)**
   a) Khonoma
   b) Kisama
   c) Barabasti
   d) Touphema
2. **In which of the following states 'Hornbill Festival' is held? (2015)**
   a) Arunachal Pradesh
   b) Meghalaya
   c) Sikkim
   d) **Nagaland**

Chapter 9: Biodiversity in Assam

The Bio-spectrum

- The array of floristic richness has prompted many a scholars to describe Assam as the "Biological Gateway" of North East.
- The eminent Plant Taxonomist and Plant Geographer Armen L. Takhtajan observed, **"Cradle of flowering plants lies in between Assam and Fiji".**

Diversity

- Forest in Assam can be described into following types/ sub types:
  - Tropical Wet Evergreen Forests
  - Tropical Semi Evergreen Forests
  - Tropical Moist Deciduous Forests
  - Sub-tropical Broadleaf Hill Forests
  - Sub-tropical Pine Forests
  - Littoral and Swamp Forests
  - Grassland and Savannahs
- **Hollong *(Dipterocarpus macrocarpus*), the tallest tree of Assam and also the "State Tree"**
- **Important grasses are *Apluda mutica, Phragmatis karka, Sclerostachya fusca, Saccharum species etc*.**

Floral diversity

- Orchids grow to their magnificent best in the Evergreen and Semi- Evergreen Forest and to some extent in Moist Deciduous forests.
- Bamboos have gained considerable importance in the socio-economic life of people in Assam for the variety of uses they cater to.
- **Altogether 38 naturally growing species of bamboo are recorded in Assam**
- *Bamboosua vulgaris* is the introduced species cultivated throughout Assam as ornamental plant
- **Bambusa jaintiana and Melocanna arundiana are the species reported only from Assam**.
- **Foxtail orchid is the state flower**

Wetlands and Aquatic Plant Diversity

- Assam has more fresh water wetlands than any other state in the North Eastern Region.
- The two major drainage systems of Assam**-the Brahmaputra and the Barak** and in the flood plains of these river systems exist patches of marshy depressions and swamps as well as perennial water bodies of varying shape, size and depth called locally as beels, haors, jalah, doloni, hola, pitoni etc.
- The wetlands in Assam cover an area of 1,400 sq km. District- wise 3513 numbers of wetlands are identified in Assam-by-Assam Remote Sensing Application Centre, Assam
- **Manmade tanks like Joysagar, Sibsagar, Dighalipukhuri, Jorpukhuri, Hazarapukhuri, Rajhuwa Borpukhuri etc**. were also dug by ancient Rulers of Assam.

- **Highest number of tanks are observed in Sibsagar district (20 number) followed by Kamrup (18 number) and Sonitpur (16 number).**
- But **area wise, the highest area under this category is observed in Sibsagar district (267.00 ha) followed by Sonitpur (83.50 ha) and Kamrup (80.00 ha) districts**
- There are an estimated 3513 beels and hoars, 1,85,623 ponds and tanks and one reservoir in Assam.
- **Deepor beel is a Ramsar site**.

Wetlands	**Location**
Deepor Beel	Guwahati
Pani Dihing	Sivasagar
Samaguri Beel	Nagaon
Son Beel	Karimganj
Batha Beel	Darrang
Kapla Beel	Barpeta
Dheer Beel & Diplai Beel	Chakrashila Wildlife Sanctuary under Kokrajhar and Dhubri districts respectively
Tamaranga beel	Bongaigaon
Khamrenga beel	Kamrup (M)
Mer beel	Nagaon
Chandubi	Kamrup (M)
Sohola beel	Kaziranga NP
Jamjing and Sengajan	Dhemaji
Maguri Motapung Beel	Near to Dibru saikhowa, Tinsukia
Gaurisagar Pukhuri, Sibsagar Pukhuri and Joysagar Pukhuri	Sibsagar

- **Free floating hydrophytes** is important with example of **Eichhornia cressipes (Water hyacinth or Meteka).** It is an **invasive species**, native to Brazil, used mostly as ornamental plants. Uptake of nitrogen and phosphate, and water purification capacity by water hyacinth is a benefit

The Rich Faunal Diversity

- Assam is part of the **transitional zone between the Indian, Indo- Malayan and Indo-Chinese Biographical regions.**
- Assam provides the gateway for spread of both oriental and Palaearctic fauna to other parts of the country.
- The distributional extent of several Indian species including **clawless otter, the spotted deer, the swamp deer, the stone marlin, the hispid hare, the great Indian one horned rhinoceros, the pigmy hog etc. have terminated in Assam plains**
- **White winged duck is the state of Assam**
- The distributional range of several **Indo-Chinese fauna** gets its sustenance from this region. Mention can be made of such species like **clouded leopard, the marbled cat, the golden cat, the spotted linsang, the large Indian civet, the binturong, the crab eating mongoose, the ferret badger, the hog badger, the hoary bamboo rat, the bay bamboo rat** etc
- Assam is home to all the primate species found in the North Eastern region. Besides, many of the relict mammalian fauna of peninsular India particularly those occurring in the Western Ghats have close relationship with Assam and N.E region
- Assam's mammalian diversity is represented by 193 species which are widely distributed in this region. But of late some of the species like **one horned rhinoceros, water buffalo, pigmy hog, swamp deer, golden langur, hoolock gibbon have their distribution limited to isolated pockets and protected areas.**
- The primate species are hoolock gibbon (only Indian ape), golden langur, capped monkey, rhesus macaque, pigtail macaque, stump tailed macaque, Assamese macaque, and slow Lorries.
- **Golden langur or "Sonali Bandar" as it is known locally is confined between Sankosh river in the west; Manas in the east; Brahmaputra in the south and mountains in Bhutan in the north**
- **Slow Lorries is the only prosimian found in Assam and the N.E. region. Locally known as "Lajuki Bandar" they are solitary animals and obligate canopy dwellers.**
- Assam is one of the "endemic bird areas" in the world. With 950 bird species the State is home to 53.5% of the bird species found in the Indian Sub-Continent
- Assam's varied physiography and habitant conditions support a rich variety of reptilian population. Gangetic gharial, 19 species of tortoises and 77 species of snakes and lizards are found in the state.
- Around 1500 species of butterflies are reported from India of which nearly half are reported from Assam and N.E. India. The Swallowtail butterflies occupy an important place and the **IUCN has identified the entire N.E. Region as Swallowtail rich zone under "Swallowtail Conservation Action Plan".**

Swallowtail Butterflies: An Action Plan for their Conservation

- This is **the first insect Action Plan prepared by the IUCN Species Survival Commission**, and was chosen because swallowtail butterflies are perhaps the most charismatic to non-entomologists.
- Some are the largest butterflies which exist, and the "birdwings" in particular have long excited wonder and comment among naturalists of all persuasions.
- Out of a total of 573 species, 170 are considered to need conservation action.
- This Action Plan exemplifies the wide-ranging conservation needs of swallowtails by selecting a geographically broad suite of faunas and individual taxa for priority conservation action.
- The **plan covers 34 regions throughout the world**, considering within each region the conservation status of particular species, action needed, and how projects could be undertaken, together with an indication of costs involved.

Previous Year Questions

1. **Which among the following is the State Tree Of Assam? (2020)**
   a) Titachapa
   b) Nahor
   c) Hollong
   d) Segum
2. **Find the odd pair out (2011)**
   a) Dheer beel: Dhubri district
   b) Khamrenga beel: Kamrup (M)
   c) Tamaranga beel: Bongaigaon district
   d) **Mer beel: Jorhat district**

Chapter 10: Protected Areas of Assam

Introduction

- Assam protected areas includes **Seven national parks** (2.51% of Assam's area), **18 wildlife sanctuaries** (1.88% of Assam's area), and **two proposed wildlife sanctuaries**

National parks

Sl. No.	Name	Location	Area (km^2)	Date/Year of announced as National Park
1	Kaziranga National Park	Golaghat, Nagaon district and Karbi Anglong	858.98	1974
2	Manas National Park	Kokrajhar, Chirang, Baksa, Bajali	950.00	1990
3	Nameri National Park	Sonitpur	200.00	1998
4	Dibru-Saikhowa National Park	Dibrugarh and Tinsukia	340.00	1999
5	Orang National Park	Darrang and Sonitpur	78.81	13 April 1999
6	Raimona National Park	Kokrajhar	422.00	8 June 2021
7	Dehing Patkai National Park	Dibrugarh and Tinsukia	234.26	9 June 2021

Kaziranga National Park

- Kaziranga National Park is a national park in the of the state of Assam, India.
- The park, which hosts two-thirds of the world's great one-horned rhinoceroses, is a **World Heritage Site.**
- **A four-day rhino census, conducted between 25 March and 28 March 2022 recorded a rise from 2,413 in 2018 to 2,613 in 2022**
- Kaziranga National Park was declared a Tiger Reserve in 2006. The park is home to large breeding populations of elephants, wild water buffalo, and swamp deer
- **Kaziranga is recognized as an Important Bird Area by BirdLife International for conservation of avifaunal species**.
- Located on the edge of the Eastern Himalaya biodiversity hotspot
- Kaziranga is a vast expanse of tall elephant grass, marshland, and dense tropical moist broadleaf forests, criss-crossed by four major rivers, including the Brahmaputra, and the park includes numerous small bodies of water.
- Although the etymology of the name Kaziranga is not certain, there exist a number of possible explanations derived from local legends and records. According to one legend, a girl named Rawnga, from a nearby village, and a youth named Kazi, from Karbi Anglong, fell in love. This match was not acceptable to their families, and the couple disappeared into the forest, never to be seen again, and the forest was named after them. According to another legend, Srimanta Sankardeva, the sixteenth-century Vaisnava saint-scholar, once blessed a childless couple, Kazi and Rangai, and asked them to dig a big pond in the region so that their name would live on

Boost Your Knowledge- Centre for Wildlife Rehabilitation and Conservation (CWRC)

- The Centre for Wildlife Rehabilitation and Conservation (CWRC) at Panbari near the Kaziranga National Park and Tiger Reserve has completed 20 years on (28th August 2022) of providing emergency care, treatment and rehabilitation to indigenous wild animals displaced due to various reasons.
- The centre was established on August 28, 2002 and is located in Borjuri village adjacent to the Panbari Reserve Forest near Kaziranga National Park in Assam
- It is a joint initiative of the Assam Forest Department, the Wildlife Trust of India (WTI) and the International Fund for Animal Welfare (IFAW)
- The CWRC continues to be the only facility of its kind in India to have successfully addressed the welfare where orphaned and/or injured wild animals of several species are hand-raised and/or treated and subsequently returned to the wild.
- It has records of conservation of 357 species including elephant, leopard, rhino, tiger, clouded leopard, black bear, wild buffalo, hog deer, muntjac, wild boar and monkeys.
- It has so far handled 7,397 animals out of which 4,490 (65%) could be sent back to the wild after proper care and treatment

Manas National Park

- Manas National Park is a n**ational park, Project Tiger reserve, biosphere reserve and an elephant reserve** in Assam, India which is a world heritage site
- Located in the Himalayan foothills, it is contiguous with **Royal Manas National Park in Bhutan**.
- The park is known for its rare and endangered endemic wildlife such as the Assam roofed turtle, hispid hare, golden langur and pygmy hog.
- **Manas is famous for its population of the wild water buffalo**
- **The name of the park is originated from the Manas River. The Manas River is a major tributary of Brahmaputra River, which passes through the heart of the national park**

Nameri National Park

- Nameri National Park is a national park in the foothills of the eastern Himalayas in the Sonitpur District of Assam, India, about 35 km from Tezpur
- Nameri shares its northern boundary with the Pakhui Wildlife Sanctuary of Arunachal Pradesh.
- Nameri National Park was declared as Tiger Reserve in the year 1999-2000, and is the second Tiger reserve of Assam after Manas Tiger Reserve.
- It has two core areas: Nameri National Park and **Sonai- Rupai Wildlife (Satellite Core of the Nameri Tiger Reserve).**
- The river Jia-Bhoroli is the lifeline of Nameri, which flows along the southern boundary of the park from northwest to southeast.
- In the east, the river Bor-Dikorai is a tributary of river Jia-Bhoroli, flowing along the southern boundary from northeast to southwest
- The Kameng River of Assam was famous since the time of British for the golden mahseer angling.
- **The white winged wood duck is currently the state bird of Assam which are found in Nameri NP**

Dibru-Saikhowa National Park

- Dibru-Saikhowa National Park is a national park located in Dibrugarh and Tinsukia districts, Assam, India. It was designated a Biosphere Reserve in July 1997
- It is located at about 12 km (7.5 mi) north of Tinsukia town at an average elevation of 118 m (387 ft), ranging from 110 to 126 m (361 to 413 ft).
- The park is bounded by the Brahmaputra and Lohit Rivers in the north and Dibru River in the south.
- It mainly consists of moist mixed semi-evergreen forests, moist mixed deciduous forests, canebrakes and grasslands.
- **It is the largest salix swamp forest in north-eastern India**, with a tropical monsoon climate with a hot and wet summer and cool and usually dry winter.
- It is a haven for many endangered species and rich in fish diversity.
- In December 2020, Gauhati high court stayed a permission given to Oil India Limited for hydrocarbon exploration at seven locations inside the protected area

Orang National Park

- Orang National Park is a national park in India located on the northern bank of the Brahmaputra River in the Darrang and Sonitpur districts of Assam.
- It was established as a sanctuary in 1985 and declared a national park on 13 April 1999.
- It has a rich flora and fauna, including great Indian rhinoceros, pygmy hog, Asian elephant, wild water buffalo and Bengal tiger.
- **It is the only stronghold of rhinoceros on the north bank of the Brahmaputra River**.

Raimona National Park

- Raimona National Park is located in extreme western part of Assam, India. It is spread across Gossaigaon and Kokrajhar subdivisions of Kokrajhar district of BTR.
- It was declared a National Park on 5 June 2021 by the announcement of Assam's Chief Minister Himanta Biswa Sarma on the occasion of World Environment Day at Gandhi Mandap, Guwahati.
- It is a part of a contiguous forest patch with an area of 422 km2 (163 sq mi) covering the northern part of the notified Ripu Reserve Forest (508.62 km2 (196.38 sq mi)), which forms the westernmost buffer to Manas Tiger Reserve in the foothills of Eastern Himalaya Biodiversity Hotspot.
- **Those were made owing to its significance for conservation of Asian elephants, gaur or Indian "bison" and golden langur, all of which have large populations in the area**.
- **It is also part of Chirang-Ripu Elephant Reserve**

Dehing Patkai National Park

- Dehing Patkai National Park is located in the Dibrugarh and Tinsukia districts of Assam and covers an area of 231.65 km2 (89.44 sq mi) rainforest.
- It is located in the Dehing Patkai Landscape which is a dipterocarp-dominated lowland rainforest. The rainforest stretches for more than 575 km2 (222 sq mi) in the districts of Dibrugarh, Tinsukia and Charaideo.
- The forest further spreads over in the Tirap and Changlang districts of Arunachal Pradesh.
- **Dehing Patkai National Park harbours the largest stretch of lowland rainforests in India**.
- Dehing Patkai Wildlife Sanctuary was declared as Dehing Patkai Elephant Reserve under Project Elephant.
- Dehing-Patkai as a potential wildlife sanctuary was identified in late 1980s during a primate survey as "Upper Dehing Wildlife Sanctuary".Subsequently during a study on **white-winged wood duck in early 1990s, it was discovered as a globally important site for this duck** and recommended to be upgraded to "Upper Dehing National Park

Wildlife sanctuaries

Sl. No.	Name	Location	Area (km²)	Specifications
1	Hoollongapar Gibbon Sanctuary	Jorhat	20.98	Isolated protected area of evergreen forest. Its forests used to extend to the foothills of the Patkai mountain range. The upper canopy of the forest is dominated by the Hollong tree (Dipterocarpus macrocarpus), while the Nahar (Mesua ferrea) dominates the middle canopy. The lower canopy consists of evergreen shrubs and herbs.
2	Garampani Wildlife Sanctuary	Karbi Anglong	6.05	It is one of the oldest sanctuaries containing hot water spring and waterfalls and surrounded by Nambor Sanctuary having 51 rare species of orchid.
3	Bura Chapori Wildlife Sanctuary	Sonitpur	44.06	It forms an integral part of the Laokhowa-Burachapori eco-system and is a notified buffer of the Kaziranga Tiger reserve. It is considered to be an ideal habitat for the Bengal florican.

Sl. No.	Name	Location	Area (km²)	Specifications
4	Bornadi Wildlife Sanctuary	Udalguri	26.22	The sanctuary was established in 1980 to protect the hispid hare and pigmy hog The sanctuary is home to many birds such as The White Capped Water Redstart and the Red Billed Blue Magpie.
5	Sonai Rupai Wildlife Sanctuary	Sonitpur	220	It is located along the foothills of the Great Himalayan Range. Four rivers flow through the sanctuary: Gabharu, Gelgeli, Sonai and Rupai.

Sl. No.	Name	Location	Area (km²)	Specifications
6	Pobitora Wildlife Sanctuary	Marigaon	38.80	Pobitora Wildlife Sanctuary holds one of the largest Indian rhinoceros populations in Assam. Pobitora Wildlife Sanctuary's grassland vegetation consists of at least 15 grass species The grasslands provide habitat and food resource for the Indian rhinoceros, hosting Assam's second largest population It is an Important Bird Area and home for more than 2000 migratory birds and various reptiles Under the Indian Rhino Vision 2020 (IRV 2020) which is a joint programme of the Department of Environment & Forests, Government of Assam, WWF-India, the International Rhino Foundation and the US fish & wildlife service, six rhinos were translocated from Pobitora and re-introduced into the

Sl. No.	Name	Location	Area (km²)	Specifications
				Manas National Park between December 2010 and January 2011. Earlier, under the same programme, two rhinos were similarly translocated from Pobitora to Manas National Park in 2008
7	Panidihing Bird Sanctuary	Sibsagar	33.93	Pani-Dihing is a complex of grassland and wetland. Some of the wetlands including channels or beels include Tokia, Jarjaria, Boloma, Dighali, Singorajan, Sagunpora, Kandhulijan, Fulai and Gaiguma. The first systematic ornithological surveys in the area was conducted by noted conservationist Dr Anwaruddin Choudhury in 1987-88

Sl. No.	Name	Location	Area (km²)	Specifications
8	Bherjan-Borajan-Padumoni Wildlife Sanctuary	Tinsukia	7.22	This wildlife sanctuary is spread across three blocks which consist of three separate forests, namely Bherjan, Borajan and Padumoni. It is a very important forest in terms of conservation and includes habitat for animals such as hoolock gibbon, capped langur, pig-tailed macaque, slow loris, rhesus macaque, leopard, etc
9	Nambor Wildlife Sanctuary	Karbi Anglong	37.00	Together with Garampani Wildlife Sanctuary of Karbi Anglong and Nambor-Doigrung Wildlife Sanctuary of Golaghat distrcit it forms a larger complex of wilderness
10	East Karbi-Anglong Wildlife Sanctuary	Karbi Anglong	222.81	

Sl. No.	Name	Location	Area (km²)	Specifications
11	Laokhowa Wildlife Sanctuary	Nagaon	70.13	It is situated 40 km downstream of the Kaziranga National Park and 30 km northwest of the Orang National Park on the other side of the river Brahmaputra It is a part of the Laokhowa-Burachapori eco-system. The sanctuary is an ideal habitat for Indian rhinoceros and Asiatic water buffaloes.
12	Chakrashila Wildlife Sanctuary	Dhubri and Kokrajhar	45.57	It is famous for the golden langur and is the second protected habitat for golden langur in India
13	Marat Longri Wildlife Sanctuary	Karbi Anglong	451.00	It is notified but under developed wildlife sanctuary It is an important component of Dhansiri-Lungding Elephant Reserve

Sl. No.	Name	Location	Area (km²)	Specifications
14	Nambor-Doigrung Wildlife Sanctuary	Golaghat	97.15	The forest type is tropical semi-evergreen with pockets of pure evergreen, interspersed with small forest marshes. The sanctuary along with Garampani Wildlife Sanctuary (6 km2) and Nambor Wildlife Sanctuary are a part of the Kaziranga-Karbi Anglong Elephant Reserve,
15	Borail Wildlife Sanctuary	Cachar and Dima Hasao	326.25	The Dima Hasao part of Barail is not part of this sanctuary

Sl. No.	Name	Location	Area (km²)	Specifications
16	Amchang Wildlife Sanctuary	Kamrup Metro	78.64	The sanctuary is known for hosting rare and endangered birds and animals. It is the presence of an isolated population of gaur or Indian "bison" that has added significance to Amchang.
17	~~Behali~~ Reserve~~d~~ ~~Forests~~ Deepor Beel	~~Bishwanath~~ Kamrup metro	~~140~~ 14.14	Behali is the only forest in Assam with three new… Staging site for migratory birds

Sl. No.	Name	Location	Area (km²)	Specifications
18	Barak Bhuban	Between Barak River and the Sonai River	320	Area has eight recording species of primates like slow loris, rhesus macaque, pig-tailed macaque, stump-tailed macaque, Assamese macaque, capped langur, hoolock gibbon and phayre's leaf monkey.

Boost Your Knowledge-

1. **Behali Reserved Forest**
   - Behali Reserved Forest, located in the Biswanath district of Assam is a patch of semi-evergreen forest in the foothills of Eastern Himalayas
   - This forest is a part of the greater Sonitpur Elephant Reserve and was declared as a reserved forest in 1917.
   - It lies between the two famous protected areas, the Nameri National Park on its west and Kaziranga National Park on its south
   - **On 4th May 2022, In The Assam Gazette, The Governor of Assam proposed to declare the Behali Reserved Forest as a Wildlife Sanctuary**.
   - It is also recognized as an Important Bird Area in 1994 and a Key Biodiversity Area in 2004
2. **Pobitora Wildlife Sanctuary**
   - Pobitora Wildlife Sanctuary is a wildlife sanctuary on the southern bank of the Brahmaputra in Morigaon district in Assam, India.
   - It was declared in 1987 and covers 38.85 km^2 (15.00 sq mi), providing grassland and wetland habitat for the Indian rhinoceros.
   - Pobitora Wildlife Sanctuary holds one of the largest Indian rhinoceros populations in Assam
   - Under the **Indian Rhino Vision 2020 (IRV 2020) which is a joint programme of the Department of Environment & Forests, Govt of Assam, WWF India, the International Rhino Foundation and the US fish & wildlife service**, six rhinos were translocated from Pobitora and re-introduced into the Manas National Park between December 2010 and January 2011. Earlier, under the same programme, two rhinos were similarly translocated from Pobitora to Manas National Park in 2008

Proposed Wildlife Sanctuaries

- North Karbi Anglong Wildlife Sanctuary
- Bordoibam Bilmukh Bird Wildlife Sanctuary

Biosphere reserve of Assam

- Manas
- Dibru-Saikhowa

Bird Sanctuary in Assam

Names	Location
Bordoibam Bilmukh Bird Sanctuary	Dhemaji and Lakhimpur districts
Satajaan Bird Sanctuary	Lakhimpur district
Pani dihing	Sivasagar District
Deepor Beel Bird Sanctuary	Kamrup (M)

Previous Year Questions

1. **Which of the following Wildlife Sanctuaries is located in Udalguri district? (2018)**
   a) Chakrashila
   b) Bornadi
   c) Amchang
   d) Bura Chapori
2. **Which of the following wildlife sanctuaries /National Parks is located in the Assam–Arunachal Pradesh boarder? (2020)**
   a) Sonai Rupai Wildlife sanctuary
   b) Bornadi Wildlife sanctuary
   c) Dibru-Saikhowa National Park
   d) Namdapha National Park
3. **The two UNESCO World Heritage Sites in Assam are (2020)**
   a) Nameri National Park and Dibru-Saikhowa National Park.
   b) Kaziranga National Park and Manas National Park.
   c) Rajiv Gandhi Orang Nationa lPark and Holongapar Gibbon Wildlife Sanctuary
   d) DeeporBeelWildlifeSanctuaryandDibru-SaikhowaNationalPark
4) **In which year, Kaziranga wildlife Sanctuary was elevated to a National Park? (2013)**
   a) 1974
   b) 1975
   c) 1976
   d) 1977

5) Panidihing Birds Sanctuary is located in which of the following districts of Assam? (2013)

   a) Jorhat
   b) Golaghat
   c) **Sibsagar**
   d) Dhemaji

6. **Arrange the National Parks of Assam correctly in the order of descending size (2013)**
   a) Kaziranga, Manas, Nameri, Dibru Saikhowa, Orang
   b) Manas, Kaziranga, Dibru Saikhowa, Nameri, Orang
   c) Kaziranga, Manas, Nameri, Orang, Dibru Saikhowa
   d) Manas, Dibru Saikhowa, Kaziranga, Orang, Nameri
7. **The National Park of Assam where the rare white-winged duck (Deohanh) is found is**
   a) Nameri
   b) Dibru Saikhowa
   c) Manas
   d) Orang

8. **Clouded leopard and capped langur are important animals of (2011)**
   - **a) Manas National Park**
   - b) Nameri Wildlife Sanctuary
   - c) Pobitora Wildlife Sanctuary
   - d) Boronodi Wildlife Sanctuary
9. **Nameri Wildlife Sanctuary which has recently been upgraded to a national park is located in the district of (1998)**
   - a) Tinsukia
   - b) Dhemaji
   - **c) Sonitpur**
   - d) North Cachar Hills
10. **Which one of the following wildlife sanctuaries of N.E. India is related with Project Tiger? (2001)**
   - a) Dibrugarh-Saikhowa Wildlife Sanctuary
   - b) Nameri Wildlife Sanctuary
   - c) Sonai-Rupai Wildlife Sanctuary.
   - **d) Manas Wildlife Sanctuary**
11. **The National Park of Assam where the rare white-winged duck (Deohanh) is found is (2009)**
   - **a) Nameri**
   - b) Dibru Saikhowa
   - c) Manas
   - d) Orang

Chapter 11: Miscellaneous

Burhi- Dihing

- Burhi Dihing is a large tributary of the Brahmaputra River in Upper Assam
- Burhi Dihing in Eastern Assam's Dibrugarh district witnessed fire in 2020 following the spillage of crude oil which was being transported to Digboi refinery.

The Khandong dam- Kopili Hydel Project

- Kopili Hydro Electric Project is 275 megawatts (369,000 hp), hydroelectric power project on the Kopili river and its tributary, Umrong stream.
- It is located in Dima Hasao district of Assam state in India.
- The project is developed and operated by North Eastern Electric Power Corporation Limited
- It is an important project since the indian State of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura benefit from this project
- **This hydroelectric project has suffered some serious damage due to contamination of Kopili river with acid mine discharge from open cast coal mines and rat hole mining in Meghalaya**

Lower Subansiri Hydel Project

- Built on the Subansiri River, a tributary of the Brahmaputra River, on the border of Assam and Arunachal Pradesh will be one of the biggest hydroelectric facilities in India
- 2,000MW hydroelectric power project
- Area in which dam is located – vulnerable to flood and earthquake- GLOF (Glacial lake outburst flood)
- Since the 1900s, it was noted that 34 earthquakes have occurred in Dibang Valley district.
- Internal displacement of indigenous tribes (Idu Mishmi) occured

RIVER INTER LINKING PROJECT

- The Indian Rivers Inter-link is a proposed large-scale civil engineering project that aims to effectively manage water resources in India by linking Indian rivers by a network of reservoirs and canals to enhance irrigation and groundwater recharge, reduce persistent floods in some parts and water shortages in other parts of India
- The Inter-link project has been split into three parts: a northern Himalayan rivers inter-link component, a southern Peninsular component and starting 2005, an intrastate rivers linking component
- Managed by India's National Water Development Agency Ministry of Jal Shakti

KEN-BETWA:

- First river interlinking project

- It was given the Union Cabinet's approval in July 2014 but was stalled because of protests from environmentalists and wildlife conservationists
- Project proposed to transfer excess water from the River Ken to the Betwa basin through the use of a concrete canal. The project aims to provide irrigation to the Bundelkhand region, which is one of the worst droughts
- Nearly 8,650 hectares of forest land including part of Panna National Park in Madhya Pradesh will be submerged
- It will also have an adverse impact on tiger reserves and wildlife sanctuaries in the region ght-affected areas in India.

Project BOLD

- The Khadi and Village Industries Commission (KVIC) introduced Project BOLD which is short for Bamboo Oasis on Lands from Nichla Mandwa, a small village in Udaipur, Rajasthan.
- This initiative was launched under KVIC's Khaki Bamboo Festival celebrating its 75 years of independence in the name of Azadi ka Amrit Mahotsav.
- As part of this, 5,000 saplings of *Bambusa tulda* and *Bambusa polymorpha* - special bamboo species, were brought in from Assam and were planted on the empty dry Gram panchayat land. KVIC set a world record by planting the most bamboo seedlings in one place on a given day.
- This project was created by KVIC and launched by the BSF in Jaisalmer to prevent desertification and support rural economies. Approximately 1000 bamboo seedlings have been planted under Project BOLD.
- The objective of Project BOLD is to create bamboo-based green spaces in dry and semi-arid lands, reducing desertification and providing livelihood and interdisciplinary support to rural industries.

National bamboo mission

- With a view to harness the potential of bamboo crop, Department of Agriculture & Cooperation (DAC), Ministry of Agriculture & Farmers Welfare is implementing a 100% Centrally Sponsored Scheme called Mission for Integrated Development of Horticulture (MIDH) in which National Bamboo Mission (NBM) is being implemented as a sub scheme in 2006-07
- The Mission envisages promoting holistic growth of bamboo sector by adopting area-based, regionally differentiated strategy and to increase the area under bamboo cultivation and marketing.
- Under the Mission, steps have been taken to increase the availability of quality planting material by supporting the setting up of new nurseries and strengthening of existing ones.
- To address forward integration, the Mission is taking steps to strengthen marketing of bamboo products, especially those of handicraft items.

Previous Years Questions

1. **Eco mark' is given to the Indian products that are (2006)**
   a) Pure and unadulterated
   b) Rich in proteins
   c) Environment friendly
   d) Economically viable
2. **The National Bamboo Mission strives to (2020)**
   1. Increase the area under bamboo plantation in non-forest areas.
   2. Rejuvenate the underdeveloped bamboo industry in India.
   3. Take over the sick paper mills in India.
   4. Explore the export market for Bamboo.

Choose the correct answer

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

3. **Match the following persons and their activities in the field of environmental conversation and development: (2021)**

List-I	List-II
a. Medha Patkar	1. Centre for Science and Environment.
b. M.S Swaminathan	2. Narmada Bachao Andolan
c. Anil Agarwal	3. Ornithology and conversation
d. Salim Ali	4. Rice Research and biodiversity conservation

a)

a	**b**	**c**	**d**
2	**4**	**1**	**3**

b)

a	b	c	d
2	1	3	4

c)

a	b	c	d
2	4	3	1

d)

a	b	c	d
3	1	4	2

4. **All species of lemur are endemic to (2020)**

(a) New Caledonia
(b) Seychelles Island
(c) Galapagos Islands
(d) Madagascar