

Environment Class 01

General Introduction of the Subject: (01:10:00 PM)

- There is an increasing importance of environment and ecology in the exam and for the health of the planet in general.
- It is a very dynamic subject and hence it is presumed to be difficult by the aspirants.
- **Syllabus**- Major topics to be covered:
- Ecology
- Environmental Degradation.
- Biodiversity.
- Conservation Efforts.
- Sustainable Development.
- Environmental Impact Assessment(EIA) & Environmental Ethics.
- **Weightage in the exam:**
- Prelims: On average 15-20 questions(30 to 40 Marks).
- Mains: 1 to 3 questions(30 to 50 Marks).
- (Showed PYQs in the PPTs)

Sources to be Referred: (01:48:00 PM)

- There is no one source available to prepare for this subject.
- Both static and current affairs are to be covered thoroughly.
- Current Affairs are a must.
- NCERTs: Biology & Chemistry of class 12th (Specific chapters)
- VisionIAS printed material as a reference book & Class notes.
- Current Affairs Magazines.

Ecology: (02:00:00 PM)

- (explained with PPTs)
- **Environment:**
- It is the sum total of all the conditions and influences that affect the development and life of all organisms on the Earth.
- It is one's surroundings.
- **Ecosystem:**
- It is a complex relationship between the living and non-living components.
- It is a community of life forms in concurrence with non-living components interacting with each other.
- **Ecology:**
- It is the scientific study of interactions in an ecosystem.
- Two branches of Ecology:
- **A. Autecology:**
- It is the study of the relationship of individual species with the environment.
- It is also known as population ecology.
- **B. Synecology:**
- It is the study of a group of organisms in their relationship with the environment.
- it is called Community Ecology.
- **The Gaia Hypothesis:**
- It was proposed by James Lovelock in 1972.
- According to this, the Earth's physical-chemical properties are tightly coupled to the activities of the living organisms it supports.

Levels of Organization: (02:55:00 PM)

- (explained with PPTs)
- **Organism/Individual:**
- It is the basic unit of study in ecology.
- It is the living individual of a species with the ability to function independently.
- **Population:**
- It is a group of individuals of the same species functioning as a unit of a biotic community.
- **Community:**
- It includes the populations of different species that live with each other in a habitat.
- **Ecosystem:**
- It is a part of a larger biome where living organisms interact with each other and with their physical environment.
- **Biome:**

- It is a large regional unit characterized by a major vegetation type and associated fauna found in specific climatic zones.
- For example, the Desert biome, Savannah biome, etc.
- **Biosphere:**
- It is the part of the Earth where life can exist.
- It is the interacting zone of the lithosphere, atmosphere, and hydrosphere.
- *(Difference between ecosystem and Biome explained by PPTs)*

Components of Ecosystems: (03:20:00 PM)

- *(explained with PPTs)*
- **1. Abiotic Components:**
- Nonliving components.
- Two types of abiotic components:
 - a. Climatic Factors: Rain, light, wind, temperature.
 - b. Edaphic Factors: Soil, PH, Mineral, Topography.
- **2. Biotic Factors:**
- All living organisms.
- Types:
 - **a. Producers (Autotrophs):**
 - They can produce food. For example, Plants.
 - Plants tap the sunlight using water, and carbon dioxide by the process of photosynthesis produces food.
 - **b. Consumers (Heterotrophs):**
 - Consumers can of the following sub-types:
 - Primary Consumers(Herbivores)- They eat plants.
 - Secondary Consumers(Small Carnivores)- Eat small herbivores.
 - Tertiary Consumers & Quaternary Consumers- They eat the secondary consumers.
 - **c. Decomposers (Saprophytes):**
 - They depend on dead plants and animals and decompose them.
 - Energy flows in the ecosystem from one organism to another organism.

Food Chain & Food Web: (03:34:00 PM)

- *(explained with PPTs)*
- Energy flow in the ecosystem from one organism to another organism.
- **Food Chain(FC):**
- It is the chain of organisms existing in any natural community through which energy is transferred.
- There are two types of FC:
 - **1. Grazing FC:**
 - It begins with the producers or autotrophs.
 - For example, FC in a grassland.
 - **2. Detritus FC:**
 - It Begins with dead organic matter.
 - For example, dead matter-> Micro organisms-> Moths-> Birds.
- **Food Web:**
- It is the network of interconnected food chains to form a number of feeding relationships among different organisms of a biotic community.
- It provides stability to the ecosystems.
- **Trophic Level:**
- It is a position an organism occupies in a food chain.
- It represents a functional level and not a species as such.

Ecological Pyramids: (03:52:00 PM)

- **1. Pyramid of Biomass:**
- *a. In Terrestrial Ecosystems:*
- It is generally upright in the
- It means in these ecosystems the biomass decreases with each topic level.
- *b. In Aquatic Ecosystem:*
- It is inverted in the aquatic ecosystem.
- It is inverted because the aquatic producers have a very high rate of production of biomass.
- **2. Pyramids of Numbers:**
- It is generally upright in all ecosystems.
- It can be inverted in some cases also:

- For example, the Tree ecosystem- one Tree> Many birds-> Many parasites on each bird.
- **3. Biomass of Energy:**
- It is always upright in all the ecosystems.
- It is upright because of the energy loss and not all energy can be transferred to the next trophic level.
- 10% Energy Loss Rule:
- From one trophic level to another trophic level there is only about 10% of the total energy is transferred and the rest is lost in respiration and heat loss.

Topics for the next class: Continuation of Ecology basic concepts.

Environment Class 02

A Brief Overview of the Previous Class:(01:12:00 PM)

Dictation for the last class:(01:27:00 PM)

- *Ecological Pyramid:*
- It is a graphical representation of the relationship between different organisms in an ecosystem.
- *a. Pyramid of Biomass:*
- It shows the amount of biomass present per unit area at each trophic level with producers at the base and the top carnivorous at the top.
- Biomass is measured by using the dry weight of an organism.
- The pyramid of biomass can be both upright as well as inverted.
- Examples: Upright- Grassland ecosystem.
- Inverted: Aquatic ecosystem.
- Each trophic level has a certain mass of biomass at a particular time called the Standing Crop.
- *b. Pyramids of Numbers:*
- It represents the number of individuals per unit area.
- An upright pyramid of numbers is found in grassland ecosystems.
- Inverted Pyramid of numbers in case of a tree ecosystem.
- *c. Pyramids of Energy:*
- It represents the flow of energy through each trophic level of an ecosystem.
- A pyramid of energy is always upright.
- It is due to the 10% Rule: The amount of energy decreases with successive trophic levels and only 10% of energy is transferred to each trophic level from the lower ones.

Ecological Productivity(EP):(01:42:00 PM)

- *(Explained with diagrams and PPTs)*
- EP refers to the primary fixation of solar energy by plants and the subsequent use of that fixed energy by plant-eating herbivores, carnivores, and detritivores.
- The productivity of producers(Green plants & phytoplanktons) is called Primary productivity.
- Secondary Productivity refers to the productivity at the levels of primary consumers.
- Tertiary Productivity is at the secondary consumers level.
- Gross Primary Productivity(GPP) is the total amount of energy that is fixed by plants or phytoplankton.
- Net Primary Productivity(NPP) is adjusted for energy losses due to respiration.
- $GPP = NPP + \text{Energy Loss}$.
- *Factors deciding Productivity:*
- a. Sunlight.
- b. Water.
- c. Nutrients.
- Regions with high ecological Productivity are Tropical Rainforests, Coral reefs, and Wetlands.
- Regions with Low Ecological Productivity: Deserts, Deep oceans, etc.

Ecological Succession:(02:02:00 PM)

- *(Explained with diagrams and PPTs)*
- It is the process by which the structure of the biological community evolves over time.
- The developmental stages of a community are known as Seral Stages.
- The series of communities that is characteristics of a given site is called a Sere.
- The species in the first seral stage is called a pioneer species.
- The community in the climax stage is called the Climax Community.
- Primary Succession: It occurs in a totally lifeless area.
- For example, in the regions of volcanic eruptions.
- Secondary Succession: It occurs in the areas with a community that previously existed and has been removed.

- For example, regions of forest fires.
- Autogenic Succession: It involves the succession of the community from itself as a result of its reaction to the environment causing its own replacement.
- Allogenic Succession: The replacement of the existing community caused largely by any external condition.

Ecological Niche:(02:29:00 PM)

- (Explained with diagrams and PPTs)
- Niche:
- It is a role played by an organism in an ecosystem, it encompasses both the physical and environmental conditions it requires and interactions it has with the other species.
- No two species can have the exact same niche, if it occurs one species will outcome the other and the other has to adapt and change or extinct.
- Species with a narrow niche are called specialist species. For example, the Koala bear, which feeds only on Eucalyptus, and Panda, which feed on bamboo.
- A species with a broader niche is called Generalist. It can eat and survive in a wild variety of conditions. For example, Goats, rats, etc.

Biotic Interactions:(03:10:00 PM)

- (Explained with diagrams and PPTs and a Video)
-

| S. No. | Interaction | Species A | Species B | Examples |
|--------|---|-----------|-----------|--|
| 01 | Mutualism Symbiosis: It is an intense mutualism in which both species can not survive without each other. For example, Corals. | + | + | Sea Anemone & Hermit Crab. Sea Anemone & Clown Fish. Horn Bill and Dwarf Mongoose In A |
| 02 | Commensalism | + | 0 | Cow dung & Dung beetles, Trees & Epiphytic Plants. Elephants & Frogs. |
| 03 | Proto-cooperation(Both the species are positively benefited) | + | + | Cattle Egret & cattle. |
| 04 | Ammensalism | 0 | - | A Large Tree shading small plants. |
| 05 | Parasitism | + | - | Leach, Worms, and parasitic plants like Cuscuta. |
| 06 | Predation | + | - | Lion and Deer. Predation happens between different levels. |
| 07 | Cannibalism(it is predating among members of the same species) | + | - | King Cobra, Head Hunters of Papua Guinea. |
| 08 | Competition | - | - | Between Similar species within the same trophic level. |

Types of Species:(03:45:00 PM)

- (Explained with diagrams and PPTs)
- *Herbivores*: Plant-eating organisms.
- *Nectarivores*: Survive on the nectar of the flowers. Example, Hummingbird, Purple Sunbird.
- *Frugivores*: Fruti eating. For example, Parrots.
- *Gramnivores*: Grass-eating birds.
- *Flagship Species*:
- These are the species selected to act as an ambassador, icons, or symbols for a defined habitat, issue, or campaign.
- They are relatively large and charismatic.
- For example, Cheetah, Lion, Tiger, Elephant, etc.

- *Keystone Species:*
- It is a species that plays an essential role in the function of ecosystems.
- Its appearance causes significant change.
- For example, Honey bees, Elephants(Engineers of the ecosystems)
- *Indicator Species:*
- It indicates the state of the ecosystem and of certain processes in the ecosystems.
- For example, Lichens indicate air pollution, Gangetic Dolphins indicate water pollution in Ganga, and Corals indicate siltation.
- *Umbrella Species:*
- These are the representatives of that ecosystem
- By protecting them the other species which are part of the same ecosystems are protected. For example, top predators, Lions, cheetahs, Tigers, etc.

Topics for the next class: Continuation of functions of ecosystems.

Environment Class 03

A Brief Overview of the Previous Class:(01:10:00 PM)

Ecosystem Services:(01:15:00 PM)

- (Explained with the PPTs and charts)
- **1. Provisioning Services:**
- This includes the products/raw materials or energy outputs like food, water, medicines, and other resources from ecosystems.
- Ecosystems are a source of food, water, medicines, wood, biofuels, etc. Also, they provide conditions for these resources to grow.
- **2. Regulating Services:**
- This includes the services which regulate the ecological balance.
- For example, terrestrial environs like forest purify and regulates air quality, prevent soil erosion, and control greenhouse gases.
- Biotic components such as birds, rats, and frogs, act as natural controllers and thus help in pest and disease control.
- Hence, ecosystems act as regulators.
- **3. Supporting Services:**
- Supporting services form the basis for other services.
- They provide habitat for different life forms, retain biodiversity, nutrient cycling, and other services for supporting life on the earth.
- **4. Cultural Services:**
- It includes tourism; provides recreational, aesthetic, cultural, and spiritual services, etc.
- Most natural elements such as landscaping pes, mountains, and caves, are used as a place for cultural and artistic purposes.
- Even a few of them are considered sacred.
- Moreover, ecosystems provide enormous economic benefits in the name of tourism.

Bio-Geo-Chemical Cycle(BGCCs):(01:32:00 PM)

- (Explained with the PPTs & Charts)
- The flow of chemical elements and compounds between organisms and the physical environment is called as Bio-Geo-Chemical Cycles.
- There are two types of BGCC:
- 1. Gaseous BGCC
- 2. Sedimentary BGCC.
- **Gaseous Cycle:**
- In this, the reservoir pool is the atmosphere.
- For example, Nitrogen, Carbon, Oxygen, and Water.
- **Sedimentary Cycle:**
- In this, the reservoir pool is the Earth's Crust of the Lithosphere.
- For example, Supfus and Phosphorous Cycle.
- **a. Water Cycle:**
- Water Bodies-> Evaporation-> Condensation-> Clouds->Precipitation/Rainfall->Water Bodies.
- **b. Carbon Cycle:**
- Atmosphere-> Photosynthesis absorbs CO₂->Biomass -> Through consumption to Herbivores-> Carnivores-> Through decomposition carbon is released by Decomposers and goes to soil and some part goes to air+ At all stages(Plants, herbivores, carnivores, decomposers) there is respiration leads to release of CO₂ to the atmosphere.

- Soil Carbon- Partially taken by the plant roots and part becomes fossil fuels-> mined and burnt by the process of Combustion- Atmosphere.
- Oceans directly absorb CO₂ from the atmosphere and store it.
- **c. Oxygen Cycle:**
- Oxygen from the atmosphere is taken by plants, animals, and other living organisms for Respiration-> Release Carbon Dioxide-> Taken by the Producers(Plants+ Phytoplanktons)-> Release Oxygen back into the atmosphere.
- Oxygen is taken by the Earth or Land, All the minerals get oxidized with oxygen to form their oxides.

Nitrogen Cycle:(02:01:00 PM)

- (Explained with the PPTs and charts)
- Nitrogen exists as Nitrogen(N₂), Ammonia, Nitrite, and Nitrate.
- 1. Nitrogen Fixation:
- Through Nitrogen fixation, Nitrogen is converted into Ammonia.
- This is done by two types of organisms:
- a. Free-living nitrogen fixing organisms: Azotobacter & Clostridium.
- b. Symbiotic Organisms: Rhizobium and Certain groups of Blue-Green Algae(Anabaena, Spirulina).
- Other methods: Lightning, Industrial Process of manufacturing fertilizers.
- 2. Ammonia-> Nitrite by Nitrosomonas and
- 3. Nitrites-> Nitrates by Nitrobacter.
- Nitrates can be taken by the plant's roots, and this intake is called Assimilation-> Consumption by animals->Decomposition and back to the soil.
- D. Denitrification: There are some bacteria(Pseudomonas) that convert Nitrites & Nitrates back to free Nitrogen by Denitrification-> Nitrogen in the atmosphere-> Again requires Nitrogen fixation.

Sedimentary Cycles:(02:54:00 PM)

- (Explained with the PPTs and charts)
- **1. Phosphorus Cycle:**
- The reservoir is the rocks-> Weathering, Breakdown, Erosion-> Phosphate in the soil-> Taken up by the producers (plants) through Assimilation-> Becomes part of their biomass-> Animals(Herbivores+ Carnivores) by Consumption-> Decomposition of all-> Soil in the form of the Phosphates.
- By Excretion also the Phosphates go to the soil.
- A part of the Phosphates from the soil is washed away and through the process of deposition, it becomes part of rocks or lithosphere.
- **2. Sulfur Cycle:**
- It is stored in two forms:
- a. Inorganic Forms: Sulphates & Sulphides.
- b. Organic Forms: Coal & Petroleum.
- Sulfur in the Lithosphere-> Taken by the plants(mainly Sulphates) by Assimilation-> Biomass->Animals(Herbivores+ Carnivores) by Consumption-> Decomposition of all-> Soil.
- Excretion also goes to the soil.
- From Coal & Petroleum-> By Combustion gets converted into Sulfur Dioxide(SO₂) or By volcanic eruptions also SO₂ is released into the atmosphere.
- Some of the decomposition forms H₂S(Hydrogen sulfide) and gets released into the atmosphere which is finally converted into SO₂.
- Then during precipitation SO₂+ H₂O-> H₂SO₄(Acid Rain)-> Sulphate in water and Soil.

Types of Ecosystem:(03:15:00 PM)

- (Explained with the PPTs and charts)
- Natural Ecosystems:
- 1. Terrestrial Ecosystems:
- Forest, Deserts, Grasslands, mountains, etc.
- 2. Aquatic Ecosystems:
- a. Marine
- b. Freshwater, River, Lakes/ Ponds, Wetlands, etc.

Aquatic Ecosystems

Water is abundant.

Light is limiting.

Oxygen is a limited factor mainly in the bottom layers.

Not too much of a temperature range- Moderate temperature.

Nutrients are limiting factors, especially in lower layers.

Terrestrial Ecosystems

Water is a limiting factor.

Light is abundant.

Enough Oxygen is available.

High-temperature range as land has lower specific heat- Too hot to too cold.

Enough nutrients are available.

Terrestrial Biomes:(03:24:00 PM)

- (Explained with the PPTs and charts and video)
- A Biome is a plant and animal community covering a large geographical area with specific geographical conditions.
- **1. Tundra Biome:**
- It means treeless or barren.
- It is found in the Polar regions or at very high altitudes.
- Two types of Tundra:
 - a. Alpine:
 - b. Arctic:
- One important characteristic of the tundra is the permafrost.
- The word permafrost is short-form for the permanently frozen soil, which starts within a meter of the soil surface. In the winter almost all of the soil is frozen.
- Due to permafrost soil, the roots won't be able to penetrate or sustain, and hence no trees are there.
- Vegetation is seasonal and short growing during summer such as Lichens, Mosses, etc.
- Fauna: Insects, Migratory birds, Reindeer(Seasonal, comes from the Taiga regions), Arctic Fox, Lion Seals, Polar Bear(Arctic, and Penguins in Antarctica).
- Adaptations in the animals living in these areas: Thick fur, large body size, small ears & small tail, hibernation(winter sleeping).

Taiga Biome:(03:54:00 PM)

- (Explained with the PPTs and charts)
- Soil is the Podzol soil also called the Boreal forests.
- Precipitation is more than in the Tundra.
- Productivity is higher than the Tundra.
- Vegetation is a Coniferous tree, leaves are needle-like, evergreen species.
- It is the largest type of biome by area and the most extensive biome has the longest and the continuous stretch.
- Very low biodiversity as only a few species can survive.
- Fauna: Yalk, Moose(largest deer species on the earth), Caribou or Reindeer, Snow leopards, Red Fox, owls, eagles, etc.

Topics for the next class: Continuation of biomes.

Environment Class 04

A Brief Overview of the Previous Session:(01:10:00 PM)

Temperate Grasslands Biomes:(01:18:00 PM)

- (Explained with PPTs)
- They are part of warm temperate zones.
- Higher precipitation than tropical grasslands due to frontal or temperate cyclones.
- During winter they can be covered by snow.
- The grass is small and green.
- Soils are very fertile and called Prairie soils as there is not much leaching and they have calcium carbonates.
- Animal diversity is very less.

Tropical Grasslands:(01:28:00 PM)

- (Explained with PPTs & Video)
- They are called a Big game country.
- Longer season of dryness.
- Summer precipitation through convection.
- **Vegetation:**
- Dominated by grass, Tall and yellow grass, the grass is drier than temperate grasslands.
- Drought and fire resistant.
- Have trees with broad trunks to store water.
- Controlling factors: Fire, water, and grazing.
- Animals run faster to escape from fire and predators.
- Animals: Zebra, Jerrafs, ostrich, elephants, kangaroo, lions, Cheetah, Hyna Leopards, etc.
- Richest wildlife.

Rainforest Biome:(01:45:00 PM)

- (Explained with PPTs & Video)
- 1. Temperate Rainforests:
- It is the region within the temperate latitudes with precipitation throughout the year.
- The vegetation is thick, and tall growing but not as diverse as tropical rainforest.

- 2. Tropical Rainforests:
- High temperature, and high rainfall throughout the year.
- Vegetation: evergreen, luxuriant, multi-layered, epiphytes, low undergrowth.
- Very high diversity.
- They cover only 6% of the earth's surface but contain more than 50% of plants and animal species.
- Fauna: Very high diversity of insects, reptiles, amphibians, mammals, birds, etc.

Desert Biome:(02:10:00 PM)

- (Explained with PPTs & Video)
- Dry climate.
- Thorny and waxy leaves, needle-like leaves, Green stem.
- Seeds are thick and tough coating.
- Nocturnal, burrowing animals, have long ears, capable of surviving with less water.
- Many insects, reptiles, birds, and other animals are found.

Aquatic Ecosystems:(02:15:00 PM)

- (Explained with PPTs & Video)
- Marine: Salinity more than 35 PPT.
- Brackish: 35 PPT
- Freshwater: Salinity less than 5 PPT.- Lotic and Lentic.
- Photic Zone: Where the sunlight is available.
- Where there is photosynthesis occurs.
- Aphotic Zone: Dark zone, no sunlight, only respiration no photosynthesis.
- It is also called the Profoundal zone.
- Littoral Zone: A zone near the land and water is shallow.
- Pelagic zone:
- Benthic Zone: It can be in any of the zones, it is the bottom zone.
- Aquatic Life:
- 1. Planktons:
- Free-floating micro-organisms.
- They are generally present in the photic zone.
- Two types:
- Phytoplanktons: Photosynthesis.
- Zooplankton: No photosynthesis.
- 2. Nectons: capable of swimming.
- 3. Benthos: They are bottom-dwelling organisms.
- 4. Neustones: They are capable of living or free floating on top of the water.
- Many floating plants and animals are there.
- 5. Periphytons: Small micro-organisms which live on the stems and leaves of submerged plants.

Wetlands:(02:52:00 PM)

- (Explained with PPTs & diagrams)
- Ecocline: The gradual change between two different ecosystems in terms of physical characteristics, nutrient availability, etc is called an ecocline.
- Ecotone: It refers to the transition zone between two different ecosystems where specific types of ecosystems develop. For example, wetlands.
- Edge Effect: Changes in the population or community structure that occurs at the boundary between two habitats are called the Edge effect.
- Edge Species: These are the species living in the ecotones.
- **Wetlands:**
- It is a transitional zone between terrestrial and aquatic ecosystems where the water depth does not exceed 6 meters.
- They are the zones of high primary productivity.
- The plants which are found in the wetlands are called hydrophytes(plants that are adapted to waterlogged conditions).
- The soils of wetlands are called Hydric soils which are saturated with water and have lesser oxygen.
- **Wetlands vs Lakes:**
-

Characteristics

Lakes

Wetlands

| | | |
|-------------------------|---|------------------------------------|
| Origin | Mainly due to the tectonic forces, fluvial. | Mostly fluvial and residual lakes. |
| Water turnover | Permanent | Permanent or temporary. |
| Change in water level | Relatively small | Relatively large |
| Thermal stratification | Yes | No |
| Vertical Mixing | Thermally regulated | Wind regulated |
| Dominant Producers | Phytoplanktons | Macrophytes |
| Food Chain | Grazing | Detritus |
| Productivity | Low | High |
| Trophic status | Oligotrophic | Mostly Eutrophic |
| Functions flood Control | Less significant | Significant |
| Waste treatment | No | Yes. |

Significance of Wetlands:(03:30:00 PM)

- (Explained with PPTs & Video)
- The wetlands are called the Kidneys of the environment as they help in filtering sediments and pollutants and purify the water.
- Nutrient recycling.
- Ground water recharge.
- It provides drinking water, food, and habitat.
- It supports large biodiversity.
- Helps in preventing flood control soil erosion.
- Cultural & tourism activities.
- Helps in climate mitigation.
- **Issues associated with the wetlands:**
- Conversion of wetlands for urban settlements and agriculture. For example, Bengaluru, Chennai, Hyderabad, etc.
- Increased water pollution due to urban sewage and industrial waste.
- Methane production contributes to global warming.
- Deforestation and land degradation.
- Excessive use of fertilizers in agriculture.
- Use of antibiotics in aquaculture.
- Sand extraction.
- Overfishing and Overgrazing.

Wildlife:(03:53:00 PM)

- (Explained with PPTs & Video)
- Things to be remembered: IUCN status, Region & Habitat, Characteristics, etc.
- **The International Union for Conservation of Nature (IUCN) List:**
- The IUCN Red List provides accurate data on the status of different species on the Earth. This information is used by various departments, institutes, and organizations.
- 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.
- Threatened:
 - a. Critically Endangered (CR) – Extremely high risk of extinction in the wild.
 - b. Endangered (EN) – High risk of extinction in the wild.
 - c. 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.

Topics for the next class: Environmental Degradation.
Environment Class 05

A Brief Overview of the Previous Class:(02:26:00 PM)

Environmental Degradation:(02:35:00 PM)

- (Explained with the diagrams & charts)
- A general discussion on environmental degradation.
- Environmental Degradation can be of the following types:
- Water Stress, Water pollution,
- Air Pollution.
- Land degradation & Desertification.
- Noise pollution, Radioactive pollution, Light Pollution, and Ozone Depletion.

Water Stress:(02:42:00 PM)

- (Explained with the diagrams & charts & PPTs)
- Water Resources: World & India Level.
- Water Stress: Demand > Supply.
- Water Conservation Methods:
- a. Traditional Conservation Methods:
- *Jhalara* - Jhalaras are typically rectangular-shaped step-wells that have tiered steps on three or four sides in the city of Jodhpur.
- *Bawari* - Bawaris are unique stepwells that were once a part of the ancient networks of water storage in the cities of Rajasthan.
- *Tanaka* - It is a cylindrical paved underground pit into which rainwater from rooftops, courtyards or artificially prepared catchments flows. It is indigenous to the Thar Desert region of Rajasthan.
- *Khadin* – It is a long earthen embankment that is built across the hill slopes of gravelly uplands. It is indigenous to the Jaisalmer region and similar to the irrigation methods of the Ur region (Present Iraq).
- *Kund* – It is a saucer-shaped catchment area that gently slopes towards the central circular underground well. It is found in the sandier tracts of western Rajasthan and Gujarat.
- *Eri* – It is a tank system, widely used in Tamil Nadu
- *Zing* – It is found in Ladakh, small tanks that collect melting glacier water. A network of guiding channels brings water from the glacier to the tank.
- *Ahar Pynes* – They are traditional floodwater harvesting systems indigenous to South Bihar. Etc.
- b. Modern methods: Check dams, reuse of water, recharge of structures, etc.
- watershed development.

Water Pollution:(03:00:00 PM)

- (Explained with the diagrams & charts & PPTs)
- Any undesirable change in physical, chemical, or biological characteristics of air, land, water, or soil is called pollution.
- The agents bringing the change are called Pollutants.
- *Water pollution:*
- It is an undesirable change in the quality of water through the addition of undesirable substances or undesirable levels of already existing compounds.
- *Types of Sources of Water Pollution:*
- Point Sources:
- It has a single identifiable source of pollution.
- The pollutants enter directly from the source to a water body.
- For example, industries.
- No-Point Sources:
- Where there is no single identifiable source and the pollutants originate from a very wide area.
- The pollutants enter the water body at multiple different locations, for example, agricultural runoff.
- It is easier to control the point sources than the non-point source.

Impacts of Water Pollution:(03:18:00 PM)

- (Explained with the diagrams & charts & PPTs)
- *Dissolved Oxygen(DO):*
- The amount of oxygen dissolved in the water is called as.
- It is measured in mg/liter.
- Potable water or healthy water should have the DO of at least 8 mg/ltr.
- *Biological Oxygen Demand(BOD):*
- It represents the amount of oxygen required by bacteria and other microorganisms while they decompose organic matter under aerobic conditions at a specified temperature.

- *Chemically Oxygen Demand(COD):*
- It is the chemical demand for Oxygen a source of water that has to break down organic substances chemically and convert them into carbon dioxide and water.
- COD measures the oxygen consumed for all organic material while BOD only measures the oxygen consumed for the biological degradation of organic material.
- Therefore, for a given water sample COD is always greater than the BOD.

Eutrophication:(03:36:00 PM)

- *(Explained with the diagrams & charts & PPTs)*
- *Oligotrophic:* When the amount of nutrients dissolved is low in any water body.
- *Eutrophication:*
- It is the enrichment of the water bodies with nutrients.
- It can be due to natural factors such as erosion, rainwater run-off, etc.
- However, the rapid increase in nutrient availability due to anthropogenic factors is different from natural aging and is called cultural eutrophication.
- *Sources of Eutrophication:*
- Agricultural runoff,
- Discharge of sewage water,
- Release of industrial effluents,
- Excessive use of chemical fertilizers.
- Cultural practices.
- *Impacts of Eutrophication:*
- Dissolved Oxygen decrease,
- BOD & COD Increases.
- Large-scale growth of algae, phytoplanktons, water hyacinth, duckweed, etc.
- They reduce sunlight availability so the number of species in water bodies decreases, as some of the species may not tolerate low levels of oxygen and sunlight.
- *Harmful Algal Blooms(HAB)-* Excessive growth of algae in a water body that is undergoing Eutrophication.
- HAB is caused due to various reasons:
- a. Excessive eutrophication mainly from agricultural fields and urban run-off.
- b. Thermal pollution,
- c. Climate Change.
- *Impacts of HAB:*
- Very low levels of DO due to the high consumption of oxygen during the decomposition of algae.
- Rapid decrease in other species.
- Discoloration of water.
- Release of foul smell due to decomposition.
- Making water unfit for use or consumption
- Release of certain toxins after decomposition.
- Large-scale fish kill.
- Creation of hypoxic conditions.
- Gradually it will result in the formation of dead zones- A condition where water can no more support life.
- Under anaerobic conditions, certain toxic bacteria grow which are deadly for aquatic organisms and birds. For example, Clostridium botulinum.
- *Measures to Control Eutrophication:*
- Stop the runoffs and divert rainwaters.
- Increase aeration and water movement.
- Removal of blooms manually.
- Spraying certain clay particles which bind with HAB or algal cells and sink to the bottom.

Wildlife:(04:10:00 PM)

- *(Explained with the diagrams & PPTs)*
- ***Tiger:***
- IUCN status - Endangered.
- At the world level, the number of tigers has drastically decreased.
- Tiger Range Countries(TRC): India, Bangladesh, Bhutan, Cambodia, Lao PDR (People's Democratic Republic), Malaysia, Myanmar, Nepal, Russia, Thailand, Vietnam, China, and Indonesia.
- Tigers are categorized as:

- *a. Continental Tigers:* Royal Bengal Tiger(India, Nepal, Bhutan, Bangladesh), Indo-Chinese Tiger(Myanmar, Thailand, Laos, Vietnam, Cambodia), Malayan Tiger(Malaysia).
- *South China Tiger:* It is functionally extinct.
- *Amur Tiger or Siberian Tiger:* Largely of all the tigers- Russia.
- *Caspian Tiger:* It is extinct in wild- Russia.
- *b. Island Tigers:* Sumatran Tiger & Javan Tigers(Indonesia). Bali Tiger is extinct.
- Tiger is a top carnivore.
- Tiger is Keystone, Umbrella, and Flagship species.
- Tiger always lives alone and it maintains their territory.
- Tiger was called a 'large-hearted Gentleman' by Jim Corbett.
- Tiger stripes are unique on each tiger.
- Total Tigers in India- 2967. Madhya Pradesh(526) leading, then Karnataka(524), Uttarakhand, Maharashtra, etc.
- M-stripes: (Monitoring System For Tigers-Intensive Protection and Ecological Status)
- This app was developed by the National Tiger Conservation Authority and the Wildlife Institute of India in 2010.
- M-STripES allows patrol teams to keep a better tab on suspicious activity while also mapping the patrolling, location, routes, and timings of forest officials.
- The App was also used in the All India-Tiger Estimation.
- CaTRAT (Camera Trap data Repository and Analysis Tool) is also used in tiger census.

Lion:(04:38:00 PM)

- (Explained with the diagrams & PPTs)
- IUCN Status- endangered.
- Second largest big cat.
- Clear sexual dimorphism.
- It is tropical grassland species.
- In Asia, it is present only in India. In India, it is in Gir National Park
- *Two subspecies:*
- African Lion: Its IUCN status is Vulnerable.
- It is bigger.
- It has a bigger Mane. So its ears are not visible.
- Asiatic Lion: It is Endangered.
- Slightly smaller in size.
- A belly fold of the skin is found only in Asiatic lions.
- Lion is Keystone, Umbrella, and Flagship species.

Topics for the next class: Continuation of environmental degradation.

Environment Class 06

A Brief Overview of the Previous Class& Answered Queries:(01:05:00 PM)

Bioaccumulation & Biomagnification:(01:27:00 PM)

- (Explained with diagrams, charts, and PPTs)
- *Bioaccumulation:*
- It is a process through which the concentration of certain chemical substances increases continuously in the body tissues of organisms within a trophic level due to absorption from food and the environment.
- *Biomagnification/Bioamplification:*
- It is the process by which certain chemical substances become more concentrated in the body tissues of organisms as one moves up the food chain.
- Properties of chemical which makes them suitable for biomagnification:
- a. Long-lived or have longer life term.
- b. Persistent - Can not be easily broken down by the environmental process.
- c. Water Insolubility: They are not excreted.
- Examples of such chemicals are heavy metals like mercury, copper, cadmium, Lead, Tin, etc.
- Polynuclear aromatic hydrocarbons.
- *Impacts:*
- Failure of eggs due to thinning of eggs in top predatory birds like Bald Eagles and Osprey.
- It impacts the immune system, child development, and fertility and increases the risk of cancers in Human beings.
- Impacts nervous system.

Some Important Water Pollutants:(02:01:00 PM)

- (Explained with diagrams, charts, and PPTs)
-

Pollutants

Mecury

Lead

Cadmium

Fluroid

Arsenic

Arsenic & Fluroid pollution is caused due to excessive groundwater extraction.

Nitrate

Iron

Uranium

Impacts

Minamata disease in humans.

In fish it causes dropsy- Build up of water in body tissues.

Dislexia in Children

Itai-Itai (Ouch -ouch) diseases, cause weakening of bones.

Causes fluorosis which involves teeth deformities, discoloration, and neuromuscular disorders.

Black foot disease.

Blue baby syndrome in children.

Skin problems.

Kidney diseases.

River Polltuion:(02:10:00 PM)

- It is a worldwide problem. All the major rivers are polluted in the world to some extent.
- In India- Ganga, Yamuna, Godavari, Cauvery, etc.
- *Reasons:*
- High population, Industries, sewage, and agricultural discharge in rivers, like the Yamuna.
- Excessive extraction of groundwater.
- Soil erosion, siltation, etc.
- There are a total of 351 river stretches in India that are highly polluted.

Air Pollution:(02:14:00 PM)

- (Explained with diagrams, charts, and PPTs)
- *Air pollution:* It refers to the release of pollutants into the air which is detrimental to human health and the ecosystems.
- It is the most immediate threat which must be resolved beacuse it has an immediate impact.
- *Types of pollutants:*
- a. Primary Pollutants:
- These are the air pollutants released directly from a source into the atmosphere and impact human beings or the ecosystem.
- Example, Sulfur dioxide, Nitrous oxide, etc.
- b. Secondary Pollutants:
- These are the pollutants not emitted directly from a source but are formed when other pollutants react in the atmosphere.
- For example, Smog, Acid rain, etc.
-

Pollutants

Source

Impacts

Carbon Monoxide(CO)

Incomplete combustion of hydrocarbons like coal, petroleum, wood, etc.

Highly poisonous gas.

Carbon Dioxide (CO₂)

Combustion of hydrocarbons, coals, petroleum, wood, etc even with the complete burning.

Global warming, greenhouse gas ef
High CO₂ can cause dizziness, nau
to a decrease in Oxygen levels.

| | | |
|--|---|---|
| <p>Oxides of Sulfurs: SO₂ & H₂S</p> | <p>Burning of fossil fuels, power plants, refineries.</p> | <p>Acid rains, asthma, bronchitis, and respiratory issues. It will reduce the chlorophyll content (Discoloration of leaves) or</p> |
| <p>Oxides of Nitrogen: NO, N₂O, and NO₂.</p> | <p>Burning of fossil fuels, automobile exhausts, fertilizers, etc.</p> | <p>Acid rain, respiratory issues like asthma, bronchitis. Reduces plant productivity.</p> |
| <p>Hydrocarbons like Benzene. Black carbon (Soot). Brown carbons Both are light and solid particles and remain suspended in the air.</p> <p>Suspended particulate matter.</p> | <p>Automobile exhausts. Incomplete combustion at high temperatures produces black carbon. Examples are Diesel engines and thermal power plants. Brown carbon is released by the burning of organic matter like wood, leaves, etc. See below</p> | <p>respiratory problems, lung diseases, cancer-causing (carcinogenic). Both are capable of Green House gas. Black carbon can settle on glaciers and increase global warming by reducing albedo and more GHG effects. See below.</p> |
| <p><u>Suspended Particulate Matter (SPM): (03:13:00 PM)</u></p> <ul style="list-style-type: none"> • (Explained with diagrams, charts, and PPTs) • These are particles less than 10 micrometers that float and move freely with the air current. • They are capable of entering the lungs easily. • PM_{2.5} & PM₁₀. • PM_{2.5} is more dangerous. • Sources: • Construction activities, spraying of chemicals in agricultural fields, exhausts from industries, vehicle exhausts, biomass burning, etc • Industrial processes, textile and carpet industries, sandblasting, etc. • Impacts: • Health impacts: respiratory disease, lung diseases, asthma, Bronchitis, carcinogenic, etc. • Occupational diseases like in Textile, mining, paint industries, etc. • Will impact the visibility and formation of smog. | | |
| <p><u>Fly Ash: (03:24:00 PM)</u></p> <ul style="list-style-type: none"> • (Explained with diagrams, charts, and PPTs) • It is produced through the burning of coals. • It is finer than cement with a size varying between 10-100 microns. • Fly Ash can be collected from thermal power plants using electrostatic precipitators (ESPs) from Flue Gas. • Composition of fly Ash- It is majorly made up of silicon dioxide, Aluminium oxide, ferric oxide, Calcium oxide, and many minor metals. • Impacts: • Respiratory diseases, cancers, stroke, etc. • Leaching of heavy metals into the soil causes soil pollution. • Water contamination. • Reduces photosynthesis activity. • Handling Methods: • a. Dry disposal- Through burial or covering with a soil layer. • b. Wet disposal by creating fly ash ponds. • c. Utilization in: • Bricks construction, cement manufacturing, landfilling, soil stabilization, etc. • Fly Ash Bricks: | | |

- *Advantages:*
- Cheaper, lighter in weight which makes the construction easier, and higher strength.
- Reduce the cost of construction as it requires less mortar.
- It is less heat absorbing which is good for indoor cooling, and saves electricity.
- Good sound insulator.
- *Disadvantages:*
- If it is poorly made, strengths will be less.
- Not good for winter as absorbs less heat.

Secondary Pollutants:(03:43:00 PM)

- (Explained with diagrams, charts, and PPTs)
- 1. Acid Rain:
- It is precipitation with a PH less than 5.6.
- It is majorly due to Sulfur and Nitrogen compounds released by vehicles, industries, thermal power plants, etc.
- Two different forms:
- *Wet Deposition:*
- When it falls with precipitation.
- Deposits on surfaces with the flow of water.
- *Dry Deposition:*
- When there is no precipitation it gets attached to dust or smoke particles and falls to the surface in powdered form.
- When it is washed by rain it results in the formation of an acidic runoff mixture.
- *Impacts:*
- It causes a bad odor.
- Reduces visibility.
- Eye and skin irritation,
- Respiratory issues in Human beings.
- Reduces fertility.
- Impacts buildings and monuments.
- Increases leaching of soil.

Smog:(03:54:00 PM)

- (Explained with diagrams, charts, and PPTs)
- Smog is a secondary pollutant formed in the atmosphere due to the reaction among various chemical compounds and gases released through the burning of hydrocarbons, oil refineries, and industrial processes.
- Smog = smoke + fog (smoky fog)
- Smog is a harmful mixture of fog, dust, and air pollutants such as nitrogen oxides, volatile organic compounds, etc. which combine with sunlight to form a dense layer of ground-level ozone.
- There are two types of Smogs:
-

Classical Smog

It was first formed in London in 1952.

It occurs in cool and humid climates(In winter)

It involves smoke and fog.

It is formed by sulfur dioxide and particulate matter from the combustion of fuels.

High concentration of SO₂, therefore reducing in nature.

It causes bronchitis, irritation, etc. problems in the lungs.

- *The Impacts of Smog:*
- Reduced visibility.
- Decreased temperature.
- Various health issues such as eye irritation, coughing, dryness of throat, breathing difficulty, headache, chest pain, etc.
- Damage to plant life, reduced photosynthesis, Corrosion of metals, etc.
- Components of Smog: Ozone, PAN(Peroxy Acetyl Nitrate), Formaldehyde, Acrylene, etc.

Delhi's Air Pollution:(04:08:00 PM)

- (Explained with diagrams, charts, and PPTs)

Photochemical Smog

It was first formed in Los Angeles in 1950.

It occurs in warm, dry, and sunny climates (In Summer)

It does not involve smoke & Fog.

Photochemical (summer smog) is formed when pollutants such as nitrogen oxides (primary pollutants) and organic compounds (secondary pollutants) react together in the presence of SUNLIGHT. A secondary pollutant called OZONE (Secondary pollutant) is formed.

High concentration of oxidizing agents, and hence Oxidizing agents.

It causes irritation of the eyes.

- *Reasons:*
- Sources of pollutants- Vehicular emissions, Construction dust because of limitation of space(urban renewal), Industrial pollution, thermal pollution, and burning of waste.
- *Time factor:*
- October end till December end.
- Air is very calm in this transition period between southeast to northeast winds.
- Temperature decreasing leading to Temperature inversion(Radiation inversion)- Further stable air.
- Stubble burning- The time gap between harvesting rice and sowing wheat is very less. So they have no option but to burn the stubble.
- (Punjab govt brought a law that says farmers can't sow rice before the first week of June to avoid soil salination)
- Green revolution- Mechanised harvesting - Leaves long stubble.
- Cracker burning.
- *Space factor:*
- Continentality- Very less winds and that too stable.
- Entire region is surrounded by mountains so this area holds the polluted air for a longer duration.

Topics for the next class: Land degradation, Ozone depletion, etc.

Environment Class 07

A brief overview of the previous class.

Land degradation (09:14 AM)

- **IPCC**- defines land as the terrestrial portion of the biosphere that comprises the natural resources, ecological processes, topography, human settlements, and infrastructure that operated within that system.
- **Land degradation**: reduction in the quality of land (based on its fertility)
- It is defined as a negative trend in land conditions caused by direct or indirect human-induced processes expressed as long-term reduction or loss of biological productivity, ecological integrity, or value to humans.
- On the basis of the loss of productive capacity, we have **three types of land degradation**-
- **Slight** degradation with loss of crop yield potential (up to 10%)
- **Moderate** degradation (up to 50% loss)
- **Severe** degradation (more than 50% loss)
- **Causes:**
- **Natural**: variation in precipitation, El-Nino, negative Indian ocean dipole, excessive evaporation, natural climate change.
- **Anthropogenic causes**: Deforestation (water holding capacity decreases, the soil becomes loose and susceptible to erosion, organic content in soil reduces, nutrients and water in the soil decrease); soil erosion (removal of the top layer of soil resulting in loss of fertility and its capacity to support vegetation).

Causes of soil erosion:

- **Wind erosion** through deflation (lifting action of wind)
- **Water erosion** (movement of water on soil)
- **Splash erosion**: impact of raindrops on the soil, makes it loosen up.
- **Sheet erosion**: removal of the top thin layer due to flowing water.
- **Rill erosion**: due to the continuous flow of water small finger-like rills are developed.
- **Gully erosion**: e.g Chambal badlands, continued soil erosion results in the development of large-scale gullies.
- **Slip erosion**: entire top layer gets removed.
- Water logging and faulty irrigation practices.
- Water-intensive agriculture
- Salinisation due to excessive evaporation and saltwater intrusion in coastal areas.
- Excessive use of fertilizers.
- **Unsustainable agricultural practices**: monoculture, water-intensive crops, stubble burning, shifting cultivation, mass movements (landslide, mudslide, overgrazing), disposal of wastes (any waste).

The extent of land degradation in India (10:05 AM)

- Himalayan region: soil erosion, steep topography, deforestation, overgrazing, mass movements, and developmental activities.
- Northern plains: unsustainable agriculture, deforestation, water logging, and high population density.
- Western India: low precipitation, high evaporation, wind erosion, water erosion.
- Eastern parts: mining, deforestation, water erosion.
- Northeast region: shifting cultivation, land subsidence, water erosion.

- Peninsular India: water-intensive agriculture, deforestation, urbanization salinization along coastal regions.
- **Impacts of land degradation:**
- Impacts ecosystem services-> provisioning services, regulation services, supporting services.
- On Climate -> carbon sink, the release of non-CO2 GHG, Albedo change.
- On food and security poverty -> agricultural productivity, GDP.
- On Gender and education
- On human health -> indirect impact and direct impact.
- **Methods of conservation:**
- **Active** restoration methods:
- Involves the active participation of human beings to reclaim degraded land.
- It is faster and costlier.
- 1. **Reforestation and afforestation:** through large-scale plantations e.g National afforestation program.
- 2. **Agroforestry:** targets growing trees in agricultural lands.
- Combination of agriculture with the practice of growing trees. It involves growing trees along peripheral areas of agricultural land, uncultivated agricultural fields, and in combination with crops.
- **Benefits:**
- **Economical-** to generate extra income e.g teak, Sangwan, Khair generates extra income through timber products, etc. It reduces crop failure.
- **Ecological:** reduce soil erosion, increases water availability through percolation, and increases nutrient recycling and it will change the microclimate.
- **Social benefits:** reduce pressure on forests, an alternative source of income for the farmers, decrease poverty, and unemployment, reduction in forest-related crimes, and reduce migration of farmers.
- Agrisilviculture- (silvi is trees)
- **Allelopathy-** the release of chemicals and hormones by one plant which affects the growth of another is called allelopathy. It is used in agriculture through the careful selection of trees in agroforestry in order to suppress weeds, pests, and insects.
- **Shelter belts:** the trees are planted parallel to the direction of winds in a linear manner in order to protect the cropland.
- **Windbreaks:** trees are planted in thick belts perpendicular to the direction of the winds.
- **Passive** restoration methods:
- Involves no human participation and the land is left to regenerate naturally.
- It is difficult to implement since it involves the livelihood of the local community.

Social forestry (10:53 AM)

- Involves growing trees outside the conventional forests along the village common lands, roadside bus stops schools, etc.
- **Urban forestry-** growing trees in urban areas.
- Urban areas have less soil available for trees, and low percolation of water, infrastructure activities, and powerlines.
- **Joint forest management (JFM):**
- It is the management of the forest adjacent to the village community jointly by the community and the forest department. It is introduced in the National forest policy 1988.
- The village community maintains the forest and is allowed to use NTFP (non-timber forest produce) through the establishment of a village forest committee.
- **Terrace cultivation/ step cultivation:**
- Agriculture in hilly and mountainous areas as per the slope through graduated terraces to minimize soil erosion and water loss.
- **Contour bunding:** it involves the rising of bunds and the raising of bunds along the contour lines in order to reduce soil erosion.
- **Mulching:** material applied on the soil surface to check soil moisture evaporation, and increase soil water and nutrient availability.
- **Mixed cropping:** growing different crops together at the same time. It involves strip cropping i.e planting different crops in alternative strips.
- **Sand dune fixation:** it involves planting an indigenous variety of vegetation and grass species in order to stop the shifting of the sand dunes in desert areas.
- **Miyawaki forest conservation method** (discussed in class)
- **Sustainable agriculture** (discussed in class)
- **Zero-budget natural farming** (discussed in class)

Land degradation neutrality (LDN) (11:46 AM)

- According to UNCCD, LDN is a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales.
- SDG 15, aims to achieve LDN by 2030.

Cheetah (11:55 AM)

- Fastest land mammal.
- Grassland species.
- Oldest big cat species
- Keystone species of the grassland ecosystem.
- African cheetah- vulnerable.
- Asiatic cheetah- critically endangered.
- Cheetah vs Leopard:
- The cheetah has two distinct lines on the face.
- The Asiatic cheetah in India was last killed in 1952.
- Habitat destruction, lack of prey, poaching, trafficking, and human-animal conflict.
- **Issues in relocation:**
- First-time intercontinental wildlife transfer is happening.
- Adjustment to a new grassland is an issue.
- Competition from other animals e.g leopards.
- It may become invasive species.

The topic for the next class is -> climate change.

Environment Class 08

A brief overview of the previous class.

Climate change and global warming (09:19 AM)

- As per UNFCCC, it defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
- **Causes:**
- **Natural:**
- Variation/ change in solar radiation, movement of crustal plates, El-Nino southern oscillation, orbital changes, volcanic eruption.
- **Anthropogenic:**
- GHG (greenhouse gas) emissions, Changes in land use patterns, deforestation, increasing livestock farming, and increasing livestock farming, fertilizers containing nitrogen, and fluorinated gases.
- **Radiative forcings-** causes of changes/disturbance in heat budget.
- Global energy balance is affected by various changes or forces which can be natural or anthropogenic. Such changes are called radiative forcing or climate forcing.
- **Positive forcing-** increase in temperature/ warming effect. e.g release of GHG
- **Negative forcing-** decrease in temperature/ cooling effect e.g increase in aerosol in the atmosphere.

Effects of Climate change (10:00 AM)

- *(a video on climate change by National Geographic was shown)
- The greenhouse effect is a situation in which the outgoing terrestrial radiation is trapped in the atmosphere for a longer period of time due to the presence of greenhouse gases.
- The greenhouse effect is natural to the earth's atmosphere however the excessive release of Greenhouse gases has increased the impact of Greenhouse resulting in global warming.
- **Important greenhouse gases:**
- Carbon dioxide
- Methane
- Nitrous oxide
- HFC (hydrofluoro carbon)
- PFC (perfluorocarbon)
- SF6 (sulfur hexafluoride)
- Chourofluorocarbon (CFC)
- Black carbon
- Water vapor.
- **Global warming potential:** It is a measure of how much energy the emissions of 1 tonne of a gas will absorb over a given period of time relative to the emissions of 1 tonne of carbon dioxide.

Greenhouse gas (GHG)

Atmospheric lifetime (yrs)

Global Warming Potential (GWP)

| | | |
|----------------------------|----------------|---------------|
| Carbon dioxide | 50-200 | 1 |
| Methane | 12-3 | 21 |
| Nitrous dioxide | 120 | 310 |
| Hydrocarbons | 1.5 to 209 | 150 to 11,700 |
| Perfluorocarbons | 2600 to 50,000 | 6500 to 9200 |
| Sulfur hexafluoride | 3200 | 23900 |

- **Atmospheric lifetime:** It is a time period up to which a gas stays in the atmosphere.
- Methane short-lived gas and carbon dioxide are next, then nitrous oxide.
- The highest source of carbon dioxide is energy consumption. Burning of the forest.
- Agriculture forest and land use.

Emissions of gases (10:40 AM)

- **Carbon dioxide** emission, current concentration 2021 average (414.7 ppm)
- Primary sources of **Methane**- wetlands, ruminant emissions, biomass burning, landfills
- **Nitrous oxide** emission- agricultural soil management, wastewater treatment, stationary combustion, chemical production, and other products, manure management.
- **Fluorinated gas** emissions- substitute of ozone-depleting substances, electronics industry, electrical transmission, and distribution

Evidence of climate change (11:12 AM)

- **Global warming:** According to the latest assessment report 6 of IPCC, the average temperature of the earth's surface has increased by 1.09 degrees Celcius since the late 19th century.
- The warmest years on record are 2016 and 2020.
- Each of the last four decades has been successively warmer than any preceding decade since 1850.
- **Ocean warming:** the top 100 meters of oceans have shown warming of more than 0.33 degrees Celcius since 1969.
- The global sea level rise in the last century is 20 cm.
- Melting of ice sheets and glaciers: melting across the globe and retreating in the Himalayas, Alps, Andes, and Rockies.
- **The Arctic sea** area has decreased by 40% in Sept and 10% in march.
- The extent of ice in the Arctic region is the smallest in the last 1000 years.
- Increase in **extreme events**- heat waves, cold waves, tropical cyclones, floods, droughts, in its frequency.
- Since the beginning of the industrial revolution, the acidity of oceans has increased by 30%.
- Carbon dioxide levels are highest compared to the last 8 lac years. from 80ppm to 414ppm in the last 151 years.
- **Impact on the hydrological cycle:**
- Reduces the availability of water resources, increasing water demand.
- The water supply to agricultural crops decreases and crops become more water-intensive.
- Intensity and frequency of rainfall changes. Increases occurrence of floods due to faster melting of glaciers.
- Increased occurrence of droughts due to irregular rainfall.
- Hydropower generation capacity increases in the short run and decreases in the long period of time.
- **Ocean warming:**
- It results in the formation of a more stable and stratified upper layer.
- It leads to less mixing of the deeper and colder nutrient-rich layer with a surface reducing the supply of nutrients to upper layers.
- The oxygen supply to lower layers will be decreased creating oxygen minimum zones.
- At higher temperatures, the dissolved oxygen in water decreases.
- Higher temperature impacts the metabolic activity of marine organisms causing an increase in some species and a decrease in some others.
- High temperature is harmful to some sensitive marine species e.g coral reefs.
- **Ocean acidification:**
- Ocean observes higher carbon dioxide which decreases the ocean's pH by forming carbonic acid.
- Marine species that are dependent on calcium carbonate such as corals and oysters, shellfish
- **Ocean deoxygenation:** At higher temperatures water holds less oxygen. Due to reduced mixing the oxygen supply to the bottom layer decreases. Higher temperature increases oxygen demand through metabolic rates.
- Increased algal blooms at higher temperature cause depletion of oxygen. Higher occurrence of hypoxic conditions and dead zones.
- Ocean warming, ocean acidification, and oxygen deoxygenation are referred to as the deadly trio.
- **Impact on food security:**

- An increase in droughts reduces water availability.
- Agriculture crops become more water-intensive at higher temperatures.
- Increased incidences of pests and insects.
- Soil fertility decreases due to excessive evaporation and increased land degradation.
- Cost of production increases in agriculture.
- Increased storage and processing costs.
- Increased extreme events such as floods cyclones and unseasonal rainfall.
- Impacts fishery production.
- It Impacts livestock through less water availability, and fodder.
- Higher carbon dioxide concentration reduces the nutritional quality of food.
- Increases the growing period of certain crops.
- Increases the sowing area due to the melting of ice
- **Impact on human beings:**
- *(as discussed in the class)

The topic for the next class is ->Biodiversity.

Environment Class 09

A Brief Overview of the Previous Class:(01:13:00 PM)

Ozone:(01:18:00 PM)

- (Explained with PPTs)
- *Ultra Violet(UV Rays) Radiations:*
- Ultraviolet rays are part of the Electromagnetic Spectrum ranging from the end of the visible light range to the X-ray region.
- It is harmful rays as a continuous effect on humans can cause skin and eye disorders.
- A large amount of UV rays coming from the sun is absorbed by the ozone layer in the atmosphere.
- On the interaction of UV ray wavelength with biological materials, is divided into three divisions -
- *UVC (100 nm-280nm):*
- These are completely absorbed by the stratosphere.
- It is the most damaging.
- *UVB (280 nm- 315 nm):*
- It is slightly damaging and hence it is called Biologically Active.
- It is damaging when long-term exposure occurs.
- It can cause skin tanning, skin cancer, etc.
- It helps in Vitamin D synthesis.
- 90% of it is blocked in the Stratosphere.
- *UVA (315 - 400 nm):*
- It is the least damaging.
- 95% of it reaches the Earth's surface.
- *Ozone:*
- Ozone absorbs the UV rays.
- It is O₃. It is an allotrope of Oxygen.
- Its name is derived from the Greek term 'Ozeine', meaning "to smell".
- It has a pungent smell and pale blue in color.
- Ozone is found in both:
- *Troposphere: 10%.*
- It is not naturally available. It is the result of pollution.
- It is a major part of the smog.
- It is harmful to living beings and results in various health issues and hence called 'Bad Ozone'.
- *Stratospheric Ozone:*
- 90% of the total.
- It is called 'Good Ozone'.
- Ozone in the atmosphere is concentrated between 15 and 30 kilometers above the earth's surface, with a maximum thickness present at around 25 Km.
- The overall proportion of ozone in the atmosphere is 0.000004%.
- It is measured in Dobson Unit. It is a layer of 0.001 mm at 0 degrees Celcius at 1 Atmospheric Pressure.
- Total amount of Ozone in atmospheres is 300 to 500 Dobson Units.

Ozone Cycle:(01:42:00 PM)

- (Explained with PPTs)

- It is a mechanism through which Ozone absorbs UV radiations.
- It is the cycle through which Ozone is formed from molecular oxygen by absorbing the UV radiation and Ozone gets converted back into molecular oxygen by absorbing UV radiation again.
- A Oxygen molecule splits into two atoms of oxygens when exposed to UV rays.
- O₂ Molecule reacts with the Atomic oxygen and forms O₃(Ozone).
- When UV rays fall on an O₃ molecule and it splits into O₂ and atomic oxygen.
- In both states it absorbs UV radiation and that is how it protects us from the UV rays.
- *Uses of Ozone:*
- It absorbs UV radiations in Stratosphere.
- It protects oxygen in the Troposphere.

Ozone Depletion:(01:52:00 PM)

- *(Explained with PPTs & charts)*
- Ozone layer depletion is the gradual thinning of the earth's ozone layer in the upper atmosphere caused due to the release of chemical compounds containing gaseous bromine or chlorine from industries or other human activities.
- Some compounds release chlorine or bromine when they are exposed to intense UV light in the stratosphere.
- These compounds contribute to ozone depletion and are called ozone-depleting substances (ODS).
- These include:
- Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs), Carbon Tetrachloride(CCL₄), Methyl Chloroform, Nitric Oxide(NO), Methyl Bromide, etc.
- They were used in refrigerators, propellents, fire extinguishers, dry cleaning agents, etc.
- They are Non-Corrosive, Non-inflammable, Low toxicity, chemically stable, long lifetime, and non-oxidized(Can't be removed from the atmosphere easily).
- These compounds relieve a Chlorine atom in Stratosphere and this is highly reactive and interferes in the Ozone cycle and thus leads to the depletion of O₃.
- Each Cl/Bromine atom converts thousands of Ozone molecules into Oxygen and causes ozone depletion.

Ozone Depletion Over Antarctica:(02:12:00 PM)

- *(Explained with PPTs & charts)*
- *The conditions favoring large-scale Ozone depletion over Antarctica:*
- a. Antarctica is a huge land mass.
- b. Very low temperatures during winter.
- c. Formation of Polar Stratospheric Clouds(PSCs) in the polar regions at low altitudes.
- d. PSCs are formed to a greater extent at colder temperatures.
- e. The Ice particles of PSCs provide a substrate for chemical reactions and release Ozone Depleting agents causing large-scale ozone Depletion.
- f. Very cold temperatures during winter result in the formation of a polar vortex, which is a ring of rapidly circulating air confining Ozone Depletion to Antarctica.
- *Timeline:*
- June- Very low temperatures and Vortex is formed.
- July-August- Free Chlorine, Bromine, and Nitric Oxide are trapped in PSCs.
- September- Spring begins.
- First sunlight reaches Antarctica, PSCs clouds disappear, catalytic Chlorine and Bromine are released on a large scale destroying Ozone.
- October- lowest levels of Ozone over Antarctica.
- November- Vortex breaks and fresh Ozone comes in reducing the ozone Hole.
- *Why not the Arctic?*
- a. Temperature is not as low as in Antarctica.
- b. Not much large continental area.
- c. PSCs are not formed usually.
- d. The vortex is not strong, therefore Ozone levels in winters over the Arctic are much higher than in Antarctica.

Effects of Ozone Depletion:(02:36:00 PM)

- *(Explained with PPTs & charts)*
- *On Humans:* Damage DNA, genetic mutation, Skin disease, Reduced immunity, etc.
- *On Plants & Ecosystems:* May harm crop productivity, plant metabolism, reproductive capacities, bio-geo-chemical cycles, etc.
- *Air Quality:* Chemical reactivity of gases increases, and Concentration changes in gases like O₃, H₂O₂, etc.

- Changes the lifetime of GHGs like Methane, etc.

Biodiversity:(03:10:00 PM)

- (Explained with PPTs & charts)
- It means the variations in the life forms.
- Classification:
- We have a 5 kingdom classification of all life forms: Monera, Protista, Fungi, Plantae, and Animalia.
- Kingdom is the highest level and Species is the lowest level of classification.
- Species: It is the largest group of organisms in which individuals can interbreed.
- Total species are estimated to be 15 to 30 million.
- The 1992 Earth Summit defined Biodiversity as the variability among living organisms from all sources such as terrestrial, marine, and other aquatic ecosystems, and ecological complexes of which they are a part.
- This includes diversity within the species, between species, and of ecosystems.

Types of Biodiversity:(03:32:00 PM)

- (Explained with PPTs & charts)
- *Genetic Biodiversity:*
- It is the total number of genetic characteristics in the genetic makeup of a species and the naturally occurring genetic differences among individuals of the same species.
- For example, Homo Sapiens of Africa, Asia, and America.
- *Species Biodiversity:*
- It is the number of species found in an ecosystem.
- For example, an ecosystem in the tropical rainforest has a high number of species than the ecosystems of the coniferous forests.
- *Ecosystem Biodiversity:*
- It is the variations in ecosystems within a geographical location or habitat.
- For example, different types of ecosystems are found in the equatorial rainforest biome.
- Species diversity:
- It considers two main factors while measuring diversity:
- Richness: Number of different species present.
- Evenness: Number of individuals per species and their relative abundance.
- Species Richness can be measured in three different ways:
- a. Alpha Diversity: It refers to the diversity within a particular area or ecosystem and is measured by counting the number of species within the ecosystem.
- b. Beta Diversity: It is the species diversity between ecosystems and it involves comparing the number of species that are unique to each of the ecosystems.
- c. Gamma Diversity: It is the measurement of the overall diversity of different ecosystems within a region.
- Gamma diversity= Alpha+ Beta diversity.
- Shannon-Weiner Index: It is an index to measure species diversity.
- It is used by the 'State of the Forest Report' in India to measure species diversity in Indian forests.

Topics for the next class: Continuation of Biodiversity.

Environment Class 10

A Brief Overview of the Previous Class & Resolved Queries:(01:08:00 PM)

Distribution of Biodiversity:(01:34:00 PM)

- (Explained with PPTs & Charts)
- Mega-Diverse Countries:
- It is used to raise awareness for the protection of natural biodiversity and particularly in countries where this is more abundant and threatened.
- The criteria used for considering a country as Mega Diverse Country:
- a. It must have 5000 endemic plants.
- b. It Must have marine ecosystems within its border.
- c. There are a total of 17 mega-diverse countries with at least 70% of the planet's terrestrial biodiversity.
- United States of America, Mexico, Colombia, Ecuador, Peru, Venezuela, Brazil, Democratic Republic of Congo, South Africa, Madagascar, India, Malaysia, Indonesia, Philippines, Papua New Guinea, China, and Australia.
- There is no megadiverse country in Europe.
- *Various Regions of Biodiversity/ Biogeographic Realms:*

- A Biogeographic realm is any of the large spatial regions of the Earth's land surface with ecosystems sharing a similar biological evolutionary history and distributional patterns of the terrestrial organisms.
- A biogeographical realm shares similar processes and major vegetation types.
- There are 8 biogeographical realms recognized corresponding roughly to continents:
- Nearctic Realm- Greenland and most of North America.
- Palearctic Realm- Most of Eurasia and North Africa, the Himalayas of India.
- Afrotropical Realm- Trans-Saharan Africa, Madagascar, and Arabia.
- Indomalayan Realm- Rest of the Indian subcontinent, Southeast Asia, southern China, and the majority of the Greater Sunda Islands
- Oceania Realm- Polynesia (except New Zealand), Micronesia, and the Fijian Islands.
- Australian Realm- Australia, Melanesia, New Zealand, the Lesser Sunda Islands, Sulawesi, and the surrounding islands. The Wallace Line is the zone's northern boundary.
- Antarctic Realm- Antarctica, Alexander Island, South Georgia, and the South Sandwich Islands.
- Neotropical Realm- South America, Central America, the Caribbean, South Florida, and the Falkland Islands.

Biogeographical Regions of India:(02:06:00 PM)

- (Explained with PPTs & Map)
- Biogeography is the study of the distribution of species(Biology), organisms, and ecosystems in geographic space and through geological time.
- India is divided into 10 biogeographic regions:
- 1. Trans-Himalayas:
- There are present in the immediate north of the Great Himalayan range.
- It has high-altitude Alpine vegetation.
- Low diversity of fauna like Snow leopards, Ibex, Yark, and Tibetan Antelope(those which are found in Ladakh are called Chiru), Black Necked Crane(The breeding ground is Tso Moriri).
- National Parks- Hemis National Park, Pin Valley National Park.
- 2. Himalayas. 3. Gangetic Plains. 4. Semi-Arid. 5. Desert.
- 6. Western Ghats, 7. Deccan Plateau.
- 8. North-East, 9. Coastal, 10. Islands.

Snow Leopard:(02:21:00 PM)

- (Explained with PPTs & Map)
- It is found in the Himalayan states.
- It is found in 12 countries:
- India, Nepal, Bhutan, China, Mongolia, Russia, Pakistan, Afghanistan, Tajikistan, Kyrgyzstan, Uzbekistan, and Kazakhstan.
- Its IUCN status is vulnerable.
- It is found normally above 3000 meters.
- Its habitat is extremely fragmented and it lives in very difficult & steep terrain.
- It has a very thick & heavy tail which helps in balancing and climbing.
- They are 'ghosts of mountains'.
- They have excellent camouflage capabilities.
- They are very very elusive animals.
- They are hunted in China for traditional medicines.
- There is an issue of the Man-animal conflict in India.
- Reasons for their decrease in the population are- a decrease in snow cover area and Man-animal conflict.
- Project Snow Leopard is launched in 2009, as a centrally sponsored scheme.
- Save Our Snow Leopard is a programme started by WWF-India.

Himalayan Biogeographical Region:(02:42:00 PM)

- Diverse topography.
- Precipitation both rainfall and snowfall.
- Vegetation- Deciduous, mixed forests, coniferous, Bughals(grasslands), and Alpines.
- Fauna: Kashmir Stag(Hangul)- Critically Endangered species.
- Mishmi Takin, Snow leopard, Himalayan Bear.
- Himalayan Tahr.
- National Parks: Rajaji National Parks, Nanda Devi, Dhanu Chini, Jim Corbett, etc.

Gangetic Plains:(03:13:00 PM)

- Made up of alluvial soils.
- Temperature is too extreme(Too hot and too cold)

- Precipitation 50 to 200 cm.
- Vegetation is moist and dry deciduous.
- However, the natural vegetation is almost lost to agriculture and animal diversity is also less.
- Fauna- Nilgai(Blue Cow), Swamp deer(BarahSingha), Hawk deer,
- Gangetic dolphins(River Dolphin, which is the national aquatic animal of India)- It is found only in freshwater. It is an indicator of the pollution of rivers.
- Ghariyal- Found mostly in Chambal River. It is critically endangered.
- Spotted Deer(Chinkara), etc.

Semi-Arid Region:(03:22:00 PM)

- It is found in the western part of MP, the eastern part of Rajasthan, the Southern part of Gujarat, etc.
- It is majorly a grassland ecosystem.
- It has thorn forests also.
- A natural ecosystem is almost lost.
- These are the areas of the big cats- Lion, tiger, Cheetah, and leopards.
- Black Buck, there is a Velavadar National Park in Gujarat, which has the highest number of blackbucks.
- Great Indian Bustard- Critically endangered.
- There are many national parks like Gir National Park, Nalsoravar, etc.

Desert Biogeographic Region:(03:29:00 PM)

- Precipitation is less than 25 cm.
- Vegetation is xerophytic.
- Western Rajasthan(Sandy Desert) and Northern Gujarat(Salty desert).
- The Kharai camels are a unique breed of camel found in the Kutch of Gujarat.
- Indian Wild Ass- found in the little Rann, the northern part of Gujarat.
- Banni Grassland is situated near the Great Rann of Kutch in Gujarat.
- Chirbatti is the magical light found in the Banni grasslands.
- Flamingoes, black bucks, Great Indian Bustard, etc.
- National Parks- Desert National Park(Rajasthan)- Dinosaur fossils are found here.

The Western Ghats:(03:37:00 PM)

- The terrain is hilly and mountainous.
- It extends from Tapi to Kanya Kumari covering.
- It is one of the Biodiversity hotspots.
- Temperature & precipitation is high to very high.
- Vegetation- Wet Evergreen, Semi-evergreen, Moist deciduous.
- Fauna- Great hornbill(Also found in North East), Malabar Civet(Critically endangered), Nilgiri Tahr, Lion Tailed Macaque(Silent Vally Nationa Park)
- Malabar giant squirell, Flying lizzard, etc.
- National Parks- Periyar, Agstyamalia, Nilgiri, Bandipur, Kudremukh, etc.

Deccan Plateau & Deccan Peninsular Region:(03:45:00 PM)

- Overall a higher region.
- Temperature is higher mostly.
- Huge variation in rainfall.
- Moist deciduous, dry deciduous, and tropical thorn forests.
- Fauna- Black Buck, Gaur, Sloth Bear(Wildlife SOS is an NGO working for their rescue and conservation), barking deer(Also found in Western ghats),
- Great Indian Bustard is also found in a few locations, Monitor Lizzard. etc.
- National Parks- Kanha, Satpura, Pench, Simlipal,Palamu, Achanakamar, Nagrjuna Sagar(largest tiger reserve), etc.

North East:(03:57:00 PM)

- The entire NE except for Arunachal.
- Precipitation 200 cm per annum.
- Temperature moderate to high.
- Very good coverage of forests, one of the richest in diversity and known for endemism, but very less explored.
- Fauna- One-Horned Rhinos, Red Panda, Hornbill, Dancing Deer(Sangai Deer, in Manipur, Loktak Lake- It has Phumdis), Bengal Florican(Plains of Assam) It is critically endangered,
- Golden Langur(Endemic to NE, most common in Assam), Hoolock Gibbon, Pigmy Hog.
- Carnivorous plants(Meghalaya is known for it) - Pitcher Plant, Venus fly trap- These are prohibited from cultivation.
- National Parks- Kaibul Lamjao, Kaziranga, Manas, Orang, Pobitora(Highest density of Rhino), etc.

Coastal & Island Regions:(04:06:00 PM)

- Coastal are plain regions, are kind of an ecotone.
- Vegetation- Dry evergreen(Coromondal coast), Dry deciduous to Moist deciduous, Mangroves in Deltas, Islands have Corals.
Andaman & Nicobar have active volcanic activities, and Lakshadweep is a coral island made on volcanic bases only.
- Precipitation & temperature are high.
- Fauna- Dugong- Mammal herbivore, Saltwater crocodile, leatherback turtle, Olive ridley turtle, Irrawaddy Dolphins, Fishing cats(In Sundarbans).
- National Parks- Sundarbans, Gulf of Mannar, Bhitar Kanika, Gahirmatha, Guindy National Park, Chennai(Crocodile breeding center), Kolleru Lake, etc.

Topics for the next class: Biodiversity laws.

Environment Class 11

Biodiversity loss:(1:16:10 PM):

- **Habitat loss:**
- Deforestation.
- Land clearing.
- Land degradation.
- Fragmentation of forests.
- **Forest fires:**
- Wildfire if the forest fire goes in an uncontrollable manner.
- **Natural causes:**
- Lightning.
- Swaying of bamboo.
- Rolling of stones.
- **Anthropogenic causes:**
- **Intentional cause:**
- Shifting cultivation.
- Stubble burning.
- Poaching, hunting.
- Regeneration of grasses etc.
- **Unintentional causes;**
- Negligence by tourists.
- Tribals etc.
- **Overexploitation:**
- Overgrazing.
- Logging or cutting of trees for timber.
- Shifting cultivation.
- Monoculture.
- **Pollution:**
- **Water pollution:**
- Example-Coral bleaching, reduction in Gangetic dolphin, and air pollution.
- Lichens will not be there in polluted waters.
- The photosynthetic capacity of plants will also be impacted.
- algal blooms.
- **Soil pollution:**
- Destroy the microorganisms.
- Impact the biogeochemical cycles.
- **Thermal pollution;**
- Coral bleaching.
- Hypoxic conditions.
- **Radiation pollution:**
- House sparrow.
- **light pollution:**
- Fish, bird migration, etc.
- Impacts the olive ridley turtles.
- **Climate change:**
- Global warming.

- Causes disturbance in the migration pattern of birds.
- Disturbs the oceanic circulation.
- affects the plankton growth.
- Increases in extreme events.
- biodiversity of polar regions.

Poaching and hunting:(2:00:30 PM):

- Illegal trade and money.
- Medicine purpose.
- Food purpose.
- Trophy.
- Tourism.
- Amur falcon is being hunted for food in Nagaland.
- Excessive poaching and hunting>> wildlife being extinct>>wooly Mammoth, Dodo bird, Tasmanian tiger, the passenger pigeon.

Invasive Alien Species:(2:50:19 PM):

- Second largest cause.
- Native and Alien species.
- Rapidly increasing species>> Invasive species.
- Native species are naturally found in a habitat.
- Alien species or exotic species are not naturally found and are introduced by humans intentionally or otherwise through human agency or accidentally.
- IUCN defines invasive alien species as an alien species that become established in natural or semi-natural ecosystems, is an agent of change, and threatens native biodiversity.
- **Characteristics of invasive species:**
- Their pioneer species is in a varied landscape.
- Tolerant of a wide range of soil and weather conditions.
- Generalist in distribution.
- Produce large amounts of seeds that disperse easily with a higher dispersal rate.
- Grows aggressive root system.
- Short gestation period.
- Long flowering and fruiting period.
- Broad native range.
- Examples-Prosopis Juliflora, Parthenium plant, lantana camera, water hyacinth, common myna, etc.

Man-animal conflict:(3:20:02 PM):

- It is when encounters between humans and wildlife lead to negative results such as loss of property, livelihood, and even life.
- It often leads to people killing animals in self-defense or as retaliatory killings which can drive species to extinction.
- **Causes:**
- Habitat destruction, deforestation, fragmentation.
- Lack of prey.
- Expansion of agricultural lands.
- urbanization.
- Conversion of forest for nonforest purposes.
- Infrastructure projects like roads, railways, etc.
- Increasing human population.
- Mostly conflicts>>western ghats and northeast.
- Assam>> man-elephant conflict.
- **Solutions:**
- Coexistence through developing alternative sources of income.
- eco tourism> example>>Nagaland.
- Relocate to other forests if numbers have increased.
- Habitat conservation.
- Increase the prey.
- Provide insurance coverage to agriculture.
- Wherever there is the issue of road accidents>> killing of animals>> giving passage>> underbridge and overbridge.
- Bee fencing>> natural barriers.

Next class-Biodiversity Hotspots.

Environment Class 12

Conservation of biodiversity:(1:51:27 PM):

- **Biodiversity hotspot:**
- Conservation International identifies the different regions across the world with high biodiversity and is under constant threat.
- To qualify as a biodiversity hotspot, a region must have 1500 vascular plants as endemic.
- Lost at least 70 percent of its natural vegetation.
- A total of 36 biodiversity hotspots are recognized across the world.
- **India>> 4 biodiversity hotspots:**
- **1) the Himalayas>> J and K, Ladakh, Himachal, UK, Sikkim, Arunachal Pradesh.**
- **2)Indo-Burma hotspot>> North East and Indo-China.**
- **3)Western Ghats and Sri Lanka.**
- **4)Sundaland.>> Nicobar group of islands along with the islands of Southeast Asia.**

Conservation strategies:(2:18:36 PM):

- **Ex situ conservation:**
- It involves conservation by removing it from an unsafe or threatened habitat and placing it under the care of humans.
- Examples>> Botanical gardens, zoos, breeding centers, gene banks, cryopreservation, and Seed vaults.
- **In situ Conservation:**
- Protecting endangered plant or animal species in their natural habitat.
- Examples>> National parks, Wildlife sanctuaries, Biosphere reserves, etc.
- **Ex situ vs In situ conservation:**
- **Ex situ-** Adaptation problem >>**In situ-** No such problem.
- **Ex situ-**Lower chances of survival. >>**In situ-** Higher chances.
- **Ex situ-** Higher cost >>**In situ-**Lower cost
- **Ex situ-**No effect>> **In situ-** local community affected.
- **Ex situ-**Chances of infection, mutation, or changes in behavior are more>> **In situ-** less.
- **Ex situ-**Lower genetic diversity>> **In situ-**Higher.

In situ conservation methods:

- **Area-based Approach:**
- National parks, Wildlife sanctuaries.
- The entire habitat is protected.
- **Species-based Approach:**
- A particular species are targeted.
- Tiger reserves, Elephant reserves, etc.
- **Forest are classified into;**
- **Public forests and Private forests.**
- **Public forest:**
- **Divided into Reserved, protected, and village forests.**
- **Reserve forests** are totally reserved for the government.
- **Protected forests>>** Some of the rights are allowed to people.
- Most of the rights are with the government.
- **Village forests;**
- Assigned to the village for maintenance.
- **Private forests>>** Cannot change the nature of the forests.
- Some of the reserved or protected forests are the status of National parks and some are given the status of wildlife sanctuaries.

Biosphere reserves:(3:18:26 PM):

- May include nonforest areas also.
- Sites established to promote sustainable development based on local community efforts and sound science.
- Include terrestrial, marine, and coastal ecosystems.
- **Integrate the following 3 functions;**
- 1)Conservation of biodiversity and cultural diversity.
- 2)Economic development that is sustainable.
- 3)providing logistic support, development, research, monitoring, education, and training.
- **BR is divided into 3 zones:**
- **Core Area:**

- Strictly protected zone with endemic plant and animal species.
- Kept free from human interference.
- Contains a protected area like a National park or wildlife sanctuary.
- **Buffer zone:**
- Surrounds core area.
- managed in ways that help in the protection of the core zone in its natural condition.
- Involves education, limited tourism, training, monitoring, limited fishing, and grazing.
- **Transition area;**
- Human activities are in harmony with nature.
- Socio-culturally and ecologically sustainable economic activities are allowed.
- Includes settlements, croplands, intensive recreation, etc.
- National governments declare their own BRs.

Man and Biosphere Reserve Program:(MAB):

- The BRs are declared by national governments and remain under the sovereign jurisdiction of the states where they are located.
- UNESCO's MAB recognizes BRs across the world.
- Also provides a framework to help national governments in the planning and implementation of research and training programs.
- India has declared a total of 18 BRs out of which 12 BRs are declared by UNESCO as well.
- **Explained with help of a map:**
- Great Nicobar BR.
- Gulf of Mannar BR.
- Agasthyamalai BR in the Cardamom hills.
- Nilgiri BR.
- Pachmarhi BR>> satpuras.
- Panna BR>> Ken Betwa river link issue.
- Achanakmar-Amarkantak BR.
- Simlipal BR.>> Samool trees.
- Sundarbans BR.>> Also a NP, WS,etc.
- Nokrek BR>>Garo hills.
- Khangchendzonga BR.>> second highest peak.
- Nanda Devi BR>> Valley of flowers.
- **These 12 are UNESCO recognized.**
- Manas BR>> UNESCO Heritage site.
- Dibru-Saikhowa BR.
- Dihang-Dibang BR>>Brahmaputra called as Dihang.
- Seshachalam BR.
- Rann of Kutch BR.
- Cold desert BR.

Sacred Groves;(3:52:53 PM):

- Tracks of virgin forests are left untouched by the local inhabitants and are protected by the local people due to their cultural and religious beliefs.
- **Examples>>**
- Pavitravana(Andhra Pradesh).
- Gompa(Arunachal Pradesh).
- Maharashtra-Davrai.
- UK- Deobhumi.
- Tamil Nadu- Kovil Kadu.
- Kerala- Kavu.
- Karanataka- Deverakadu.

Environmental Conservation:(3:59:42 PM):

- **International level:**
- **International Organization:** eg- IUCN.
- Any organization working at the international level.
- Includes both state and non-state actors.
- **Intergovernmental body.>>WMO.**
- Body involving only state actors.
- **NGOs:**
- Includes nonstate actors or nongovernmental organizations.

- Example>>WWF.
- **Program:**
- Established with a specific objective.
- ex-UNEP.
- **Fund:**
- Example>>GEF.
- Provides funding
- **Convention;**
- Broader grouping with a common objective.
- example>> Vienna convention for the protection of Ozone layer.
- **Treaty:**
- The outcome of a convention with a specific target to be achieved by the deadline.
- example>. Paris agreement under UNFCCC.
- **Protocol:**
- involves detailed guidelines to be followed and is more specific than an agreement.
- **Timeline of events at the national level:**
- 1864-Imperial forest department.
- 1865-Indian forest act.
- 1867-Imperial forest service was established.
- 1927-Indian Forest Act.
- 1972-Wildlife protection act.
- 1974-Water Act.
- 1980-Forest conservation act.
- 1981-Air act.
- 1986-Environment Protection act.
- 1988-National Forest Policy.
- 2002-Biodiversity act.
- 2006-Forest rights act.
- 2010-National Green tribunal act.
- 2016-Compensatory afforestation fund act.

Next class:-Projects for wildlife, acts, etc.

Environment Class 13

A Brief Overview of the Previous Class:(01:15:00 PM)

Legislations related to the Environment:(01:28:00 PM)

- (Explained with the PPTs & charts)
- **Article 48A(DPSP):**
- The State shall endeavor to protect and improve the environment and safeguard the forests and wildlife of the country.
- This Article was added by the 42nd Amendment.
- **Article 51A(Fundamental Duty):**
- To protect and improve the natural environment including forests, lakes, rivers, and wildlife, and to have compassion for living creatures.
- **1864- Imperial Forest Department** was established:
- Its main aim was to exploit the natural forests of India.
- **1865- Indian Forest Act:**
- Its main intention was to have government(colonial powers) monopoly and control over the forests & forest resources.
- It provided for the protection of the trees and the prevention of forest fires.
- It prohibited cultivation and grazing in forest areas.
- It classified the forests into:
- **Reserved Forests:**
- Totally belongs to the government.
- All other's rights were extinguished.
- No other than the government had any rights or claims on forests.
- **Protected Forests:**
- Here the rights continued.
- **1867-Imperial Forest Service:**
- It aimed to develop and train a cadre of professionals in forest management.

- **1927- Indian Forest Act:**
- 1. It defines a forest- as " It is an area occupied by the government for conservation and management of biological and ecological resources."
- 2. It classified forests into:
- **Private forests:**
- These are those which are not occupied by the government but the government regulates timber cutting and cultivation
- **Public Forests:**
- They are further classified into:
- **a. Reserved Forests:**
- Totally belongs to the government.
- All other's rights were extinguished.
- No other than the government had any rights or claims on forests.
- Government can declare any forest as a reserved forest, and once declared so, the rights inside this forest are extinguished.
- **b. Protected Forests:**
- These are the forests not reserved under the government but protected by the government for some time.
- Not all rights are extinguished in a protected forest.
- **c. Village Forests:**
- These are the forests that states governments can assign to any village community the rights of reserved forest in some parts.
- 3. The government is empowered to regulate the activities inside any forest and also punish any violations.
- 4. The state government controls the movement of forest produce through the system of transit permits.

Wildlife Protection Act, 1972: (02:02:00 PM)

- 1. Authorities established under the Act:
- **At Central Government:**
- The Director of Wildlife Preservation and assistant directors and other officers subordinate to the Director.
- **At the State Governments:**
- The Chief Wildlife Warden (CWLW) heads the Wildlife Wing of the department and exercises complete administrative control over Protected Areas (PAs) within a state.
- The state governments are also entitled to appoint Wildlife Wardens in each district.
- [Note: In 1935 forestry was made a provincial subject. In 1966- the Indian Forest Service was constituted.
- In 1976, through the 42nd CAA forestry was transferred to the Concurrent List.]
- **National Board for Wildlife (NBWL):**
- It serves as an apex body for the review of all wildlife-related matters and the approval of projects in and around national parks and sanctuaries.
- The NBWL is chaired by the Prime Minister and is responsible for the promotion of conservation and development of wildlife and forests.
- The Minister of Environment, Forest and Climate Change is the Vice-Chairperson of the board.
- **State Board for Wildlife (SBWL):**
- The state governments are responsible for the constitution of the state board of wildlife.
- The Chief Minister of the state/UT is the chairperson of the board.
- The board advises the state government in:
- The selection and management of areas to be declared as protected areas.
- The formulation of the policy for the protection and conservation of the wildlife
- Any matter relating to the amendment of any Schedule.
- **National Tiger Conservation Authority:**
- It is a statutory body established under the Act.
- It aims to strengthen tiger protection in India.

Schedules of WPA, 1972: (02:24:00 PM)

- The Act Prohibits the hunting of wild animals in India.
- It provides for a total of Six Schedules.
- **Schedule 1:**
- All important endangered and critically endangered species.
- **Schedule 2:**

- Himalayan Black bear.
- Flying Squirrel,
- Giant Squirrel.
- Indian Cobra, King Cobra, etc.
- **Schedule 3:**
- Chital(Spotted Deer)
- Barking deer, Hawk deer, Sambar, Hyena, etc.
- **Schedule 4:**
- Flamingos, Hares, Falcons, Kingfishers, Horseshoes Crabs, etc.
- **Schedule 5:**
- It contains animals that are declared as vermin.
- There are no punishments for killing vermins.
- It includes Common Crows, Rats, Mice, etc.
- Centre government can declare any species as vermin in any region if needed.
- **Schedule 6:**
- It includes the plant species which shall not be cultivated or collected or removed.
- Examples, Pitcher plant, Ladies Slipper, Blue Vanda (Blue Orchid), Red Vanda (Red Orchid), etc.
- The animals in these Schedules shall not be killed except:
- In self-defense,
- If the animal is dangerous to human life or the animal is disabled or diseased beyond the recovery stage,
- Chief Wildlife Warden can permit hunting in such cases.

Protected Areas:(03:11:00 PM)

- National Park Vs Wildlife Sanctuary:
-

National Park

It is hitched to the habitat of particular animals like tigers, lions, hangul, etc.
Declared by both state and center.
Generally bigger in size.
Boundaries are circumscribed by legislation.
Except for the buffer zone, no biotic interference.
Tourism is permissible. etc.

Wildlife Sanctuary

It is generally species oriented.
Declared by both state and center.
Generally smaller than the NP.
Boundaries are not sacrosanct.
Limited biotic interference.
Tourism is permissible. etc.

- **Conservation Reserves & Community Reserves:**
- The government may declare any area adjoining a national park or sanctuary as a conservation reserve if the land is owned by the government.
- If the land is held privately or by a community, it is used for the conservation of wildlife and its habitat, it can be declared as a community reserve.
- No change in land use pattern is allowed in conservation or community reserves.

Wildlife Protection(Amendment), Bill, 2021: (03:32:00 PM)

- 1. Rationalization of Schedules:
- Schedule 1 to 4 are merged into Schedules 1 & 2.
- Schedule 3 includes Protected plant species.
- Schedule 4 includes the species under the CITES.
- The schedule for vermin is removed, and the central government shall declare any animal as vermin by notification.
- 2. Control of invasive alien species by empowering the central government to regulate trade.
- 3. A person possessing live specimens of scheduled animals shall obtain registration certificates.
- 4. It allows for the transfer of captive elephants by a person having ownership certificates as per the conditions prescribed by the central government.

Water(Prevention and Control of Pollution), Act, 1974:(03:48:00 PM)

- 1. The Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB) are statutory bodies to control water pollution were constituted.
- CPCB advises the government and coordinates the actions.
- SPCB prevention, controls pollution and prescribes standards.
- It can inspect any of the establishments and can also impose penalties
- **Air(Prevention and Control of Pollution), Act, 1981:**
- It expanded the authority of CPCB and SPCB to include pollution control of the air.

- Rest all functions of both bodies are same as they perform for the water pollution.

Leopard:(03:57:00 PM)

- (Explained with PPTs)
- It is one of the most widespread of all big cats.
- Also, it has the highest number.
- It has Vulnerable status.
- Has a very wide range of habitats and can live in varying conditions.
- It is generally the apex carnivorous.
- It is also known as a panther. Black Panthers are also leopards with a genetic defect that make them black.
- A black panther was seen recently in the Kabini forest reserve in Karnataka.
- **Clouded Leopard:**
- It has Vulnerable Status.
- It is very small in size.
- It is found in dense forests or tropical rainforests and very shy animals.
- It is a state animal of Meghalaya.
- Usually found on trees.
- **Fishing Cat:**
- It preys on fish.
- It is found usually in wetlands, deltas, and inside the forest near water bodies.
- In India found in West Bengal, Orissa, the foothills of the Himalayas, and some parts of western ghats.
- It is nocturnal- Mialny is active at night.
- **Elephants:**
- Three Species:
- Savanna Elephant (Loxodonta africana)- Endangered.
- It is the tallest.
- Both males and females have tusks.
- The highest point of these is at their neck.
- Asian (Elephas maximus) elephants- Endangered.
- The highest point of these is at their back.
- Only males have tusks.
- Forest elephants(Loxodonta cyclotis.- Critically Endangered.
- Elephants have one of the longest gestation periods.
- Elephants follow matriarchy and live in herds.

Topics for the next class: Continuation of Legislations related to the environment.

Environment Class 14

Discussion on Previous Class (09:09 AM)

Water (Prevention and Control of Pollution), Cess Act of 1977 (09:19 AM)

- To provide for the levy of a cess on water consumed by persons operating certain types of **industrial activities**.

Forest Conservation Act 1980

- It aims to prevent and regulate the diversion of forest land for non-forestry purposes.
- Prior approval of the **central government** is essential for converting forests into non-forest land.
- The government may constitute an advisory committee to grant approval.
- The project developer shall provide for **compensatory afforestation** in non-forest land, equal to the area of forest land being diverted or doubled in case of degraded land.
- The project developer shall pay the net present value (NPV) of the diverted forest for **50 years**.

TN Godavarman Case 1995 (09:50 AM)

- The Supreme Court defined forest as per the **dictionary meaning** of forest irrespective of ownership.
- All forests are subjected to the Forest Conservation Act.
- The **state government** shall constitute an **expert committee** to identify and demarcate the forest.
- The Supreme Court stopped tree felling and non-forest activities inside forests across India.

Compensatory Afforestation Fund Act of 2016

- The funds are received for compensatory afforestation, NPV, and other project-specific transfers.
- It provided for **National Compensatory Afforestation Fund (NCAF)** with a 10 percent share, **State Compensatory Afforestation Fund** with a 90 percent share.
- These funds are created under the Public Account of India.

- It provides for the establishment of the NCAF Management and Planning Authority and SCAF Management and Planning Authority.
- The funds can be used for **afforestation, forest regeneration, and wildlife protection, infrastructure development** inside the forest.
- The NPV shall be determined by an expert committee appointed by Central Government.

Environmental Protection Act, 1986 (10:13 AM)

- It is an umbrella legislation designed to provide a framework for the **central government** and coordination of activities of various authorities.
- The environment is defined to include **water, air, land, and the interrelationships** which exist among themselves and human beings and other living creatures and properties.
- The presence of a pollutant is defined as any solid liquid or gaseous substance present in such concentration as may be injurious to the environment.
- Hazardous substances include any substance or preparation which may cause harm to human beings or living creatures in the environment.
- The act empowers the center to **"take all such measures as it deems necessary"**.
- The center can coordinate action and implement nationwide programs, restrict or close any industry and impose penalties and punishment.

Biodiversity Act, 2002 (10:52 AM)

- It aims to protect India's rich biodiversity and associated knowledge and check **biopiracy**.
- It provides for the setting up of the National Biodiversity Authority (NBA); State Biodiversity Board (SBB) and Biodiversity Management Committee in Local Bodies.
- NBA and SBB are required to consult BMC in decisions w.r.t. biological resources.
- All foreign nationals and MNCs require prior approval from NBA for obtaining biological resources from India.
- Indian citizens and entities have free access to use biological resources within the country.

Biodiversity Amendment Bill, 2021

- Registered **AYUSH medical practitioners** and other people practicing indigenous medicines and cultivated medicinal plants are exempted from giving prior intimation to SBB.
- To **simplify the patenting** process for foreign-controlled companies.
- Allowing foreign investment in research in biodiversity through Indian Companies.

Forests Rights Act, 2006 (11:15 AM)

- It is referred to as The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.
- It recognizes the **forest rights of families** who primarily reside in the forest and depend on the forest for livelihood.
- The family must be residing in the forest for **75 years**.
- **It recognizes the following rights:**
- Right to Live inside the forest.
- Right to hold forest land for self-cultivation for up to a maximum of **4 hectares**.
- The title rights are recognized only for land that is actually being cultivated and no new lands are granted.
- Usage Rights on **minor forest produce** from the forest.
- Community rights to protect or conserve forest resources for sustainable use.
- **The Process of Recognition of Rights:**
- The **Gram Sabha** will pass a resolution recommending eligible rights holders.
- This resolution is screened and approved at the sub-division followed by the district level.
- For this purpose, a **screening committee** is established.
- This act defines **critical wildlife habitat** as an area of National Parks and Sanctuaries, where it has been established on the basis of scientific criteria.
- That such areas are required to be **kept inviolate** for the purpose of conservation.
- Critical wildlife habitat inside a tiger reserve is called as a **critical tiger habitat**.

National Green Tribunal Act (NGT), 2010 (11:55 AM)

- It was established for **expeditious disposal of cases** related to environmental protection.
- The NGT has the power to enforce any legal rights related to the environment and provide relief and compensation.
- The tribunal is not bound by the procedure of CrPC and is guided by **principles of natural justice**.
- There is no need for an advocate in NGT.
- The cases filed in front of NGT shall be disposed of within **6 months**.
- NGT deals with all the environmental legislations except the Indian Forest Act, of 1927, the Wildlife Protection Act, of 1972, and the Forests Rights Act, of 2006.

(Next Class: Initiatives for Environment Conservation at National and International Levels, Waste Management Rules)
Environment Class 15

A brief overview of the last class (1:20:00 PM)

Class Plan: (01:22:00 PM)

- Waste management rules
- Coastal regulation rules
- Groundwater management rules
- Wetland management rules
- Ecosensitive zone rules
- Waste management rules
- Solid waste rules
- e-waste Management rules
- Biowaste management rules
- Plastic waste management rules
- Hazardous waste
- Construction waste

Laws and Rules (01:22:00 PM)

- Laws are the legislations done by the parliament or state government however rules and regulations are kind of delegated legislations created by the executives
- *Plastic Waste Management Rules:*
- *Dictation:*
- The thickness of plastic carry bags has been increased to 120 microns.
- The street vendors and retailers shall not provide carry bags. Only registered shopkeepers on a charge basis are allowed to give out plastic bags.
- The government banned single-use plastic with effect from 1 July 2022.
- The government has given a comprehensive list of single-use plastic products.
- The plastic waste which is not covered under the identified list shall be managed through Extended Producer Responsibility(EPR) mechanism.
- The rules are applicable throughout India including rural areas.
- Extended producer responsibility (EPR) is a mechanism set up for the products which are out of the comprehensive list of single-use plastic products
- Registered Producer responsibility organizations are set up to implement this EPR mechanism.

E-waste (01:47:00 PM)

- *Dictation:*
- Extended Producer Responsibility (EPR) is made compulsory for all e-waste.
- The targets for EPR were fixed in a phased manner, starting from 10% in 2017 to 70% after 2023.
- Registered producer responsibility organizations can undertake EPR activities on behalf of brand owners.
- A deposit refund scheme has been introduced as an additional economic instrument where producers can charge additional deposits at the time of sale.
- EPR applies to manufacturers, producers, importers, transporter, and recyclers.

Solid Waste (02:01:00 PM)

- *Dictation:*
- Waste segregation at source- It is the responsibility of generators to segregate waste into:
 - 1) Wet biodegradable waste.
 - 2) Dry waste such as plastic metal, wood, etc
 - 3) Domestic hazardous waste such as diapers, napkins, containers of cleaning agents, mosquito repellent, etc.
- EPR is applicable for sanitary napkins and packaging waste.
- The biodegradable waste should be processed through composting or bio-methanation within the premises as far as possible.
- Burning of solid waste openly is prohibited.
- Solid waste based Refused derived fuel (RDF) plants are encouraged to be set up.
- Landfill sites should be located 100 meters away from a river, 200 meters from a pond 500 meters from highways and human habitats including public parks, and a minimum of 20 kilometres from airports.
- Generators have to pay a user fee to waste collectors and spot fines can be imposed for littering.

Biomedical Waste (02:20:00PM)

- *Dictation:*

- Biomedical waste is classified into four categories:
- 1) *Red colour* bin for plastic waste like syringes, plastic bottles, etc
- 2) *Yellow colour* bin for infectious waste like cotton, bandages, etc
- 3) *Blue colour* bin for discarded Glass bottles
- 4) *Black colour* bin for used needles etc.
- The rules apply to hospitals, labs, clinics, vaccination camps, blood donation camps, and other healthcare facilities.
- The pre-treatment of biomedical waste is to be done on-site as per WHO guidelines.
- The complete treatment is to be done at a common biomedical waste treatment facility.
- No onsite treatment within 75 km of the common biomedical waste facility.
- Establishing a Bar code system for disposal is compulsory.
- *Construction and Demolition Waste:*
- The large construction and demolition waste needs to be handled as per the guidelines.

Wetland management rules, 2017 (02:35:00 PM)

- *Dictation:*
- National wetland authority plays an advisory and monitory role.
- State wetland authority in every state or Union territory headed by the Minister of Environment is the nodal authority for wetlands
- State wetland authority shall prepare a list of all wetlands to be covered under the rules.
- All wetlands irrespective of ownership can be classified as wetlands except river channels, paddy fields, water bodies for aquaculture, drinking water projects, and water bodies within the Indian forest act, Wildlife protection act, coastal regulation zones, and Forest Conservation Act.
- The state wetland authority shall develop a comprehensive list of activities to be permitted and regulated.
- The prohibited activities as per the guidelines are setting up new industries, dumping solid waste, and discharging untreated water.

Groundwater Rules, 2020 (02:47:00 PM)

- *Dictation:*
- It is mandatory to obtain NOC for groundwater extraction except for Domestic consumers, Agricultural activities, rural drinking water supply schemes, armed forces establishments, and small MSMEs.
- It is compulsory for new and existing industries, group housing societies, and private water supply tankers.
- No NOC for over-exploited areas.
- NOC holders need to pay groundwater charges based on the quantum of extraction.

Coastal Regulation Zone, 2018 (03:18:00 PM)

- *Dictation:*
- The coastal regulation zone extends up to 500 meters from the High tide line (HTL).
- *CRZ I A* is Eco-sensitive areas
- *CRZ I B* is the entire Intertidal area.
- *CRZ II* is areas developed near the coast (Urban areas)
- *CRZ III A* is rural areas with higher population density area
- *CRZ III B* is a Rural area with a bit lower population density.
- *CRZ IV A* is an area upto 12 nautical miles from the low tide line (LTL)
- *CRZ IV B* is a tidal-influenced water body area.
- No development zone up to 50 meters from HTL.
- Tourism infrastructure on beaches is permitted within no development zone but beyond a 10-meter distance from HTL.
- CRZ clearance for CRZ I and CRZ IV is provided by the central government and for CRZ II and CRZ III by the state government.
- All defence and strategic purpose projects are exempted from the rules.

National Forest Policy, 1988 (03:40:00 PM)

- *Dictation:*
- The overall objective is the conservation of natural heritage, biodiversity, and genetic resources.
- It sets a target of 33% of forest cover in India.
- It envisages a symbiotic relationship between tribals and forest departments.
- It discourages shifting cultivation and promotes massive afforestation programs to increase forest cover.

Project Tiger (03:47:00 PM)

- *Dictation:*

- It is a centrally sponsored scheme initiated in 1973.
- The National Tiger Conservation Authority administers it.
- A Tiger protection force was set up to reduce the factors that lead to the depletion of the tiger and to ensure a viable tiger population.
- For this purpose, the government declares tiger reserves.
- Jim Corbett national park is considered a first national park and Tiger reserve as well.
- Union Minister of Environment is chairman of NTCA.
- Presently there are 54 tiger reserves in India (the 54th is Ranipur wildlife sanctuary in Uttar Pradesh)
- 53rd is Guru Ghasidas national park also called Sanjay national park.
- The 52nd tiger reserve is the Ramgarh Vishdhari tiger reserve in Rajasthan.
- According to the recent NTCA tiger census, there are 2967 tigers in India.
- The Tiger census started in 2006 after every four-year tiger census is carried out.
- All the states have seen a rise in tiger populations except Odisha, Mizoram, and Chattisgarh.
- There were three tiger reserves where the tiger was not sited. These sites were Mizoram Dampa tiger reserve, Buxa tiger West Bengal and Palamau tiger reserve, Jharkhand.
- Various tools like M Strips, CATRAT, ExtractCompare, and Hotspotter, SECR, cytochrome-b marker, Maximum Entropy Model (MaxEnt) are used for tiger census.
- A few international efforts to save tigers are as follows:
- The global tiger Forum The first meeting of tiger range countries happened in Delhi in 1993
- In 2010, st. Petersburg Tiger Summit, Russia was held. The 2022 year was decided as a doubling population year for tigers and a program called GTRP was launched. TX2 program was also discussed.
- Conservation assured tiger standards were set up by the TX2 Programme.

Topics for next Class: Continuation of various projects related to animal conservation.

Environment Class 16

Project Elephant (01:14 PM)

- **Karnataka** has the highest number of elephants followed by Assam and Kerala.
- India accounts for more than **60 percent** of Asiatic elephants.
- Project Elephant was launched in **1992**.
- The elephant is also the National Heritage Animal of India.
- **Objectives of Project Elephant:**
- To ensure a viable population of elephants in their natural habitat.
- To decrease the man-elephant conflict.
- To protect elephants from illegal ivory trade and poaching.
- Notification of Elephant Reserves.
- At the International level, CITES has the **Monitoring the Illegal Killing of Elephants (MIKE)** Programme is a site-based system designed to monitor trends in the illegal killing of elephants.

Indian Rhino Vision (IRV) 2020

- In India, Great one-horned rhinos are found.
- Status: **Vulnerable**
- Indian rhinos are highly located in Assam.
- In Assam, **Kaziranga National Park** has the largest concentration of one-horned Rhinos. It is also found in **Pobitora Wildlife Sanctuary**.
- IRV started in **2005**.
- Relocation of Rhinos to Manas National Park from Kaziranga National Park.
- The project is jointly launched by **International Rhino Foundation, WWF-India, and Assam Forest Department**.

Project Snow-Leopard (01:38 PM)

- Started in the year **2009**.
- Objective:
- To promote an inclusive and participative approach to conserving snow leopards and their habitat.
- Based on a rough estimate, **China** has the largest number of snow leopards followed by Mongolia and India.
- This project was started by **Bishkek Declaration**.
- Other Programs: **Save Our Snow Leopard, SECURE Himalayas, Global Snow-Leopard, and Ecosystem Program**.

Great Indian Bustard (GIB)

- Status: **Critically Endangered**.
- It is the heaviest flying bird.

- Less than 150 left.
- **Schedule 1** of the Wildlife Protection Act, 1972
- The majority of GIB are found in Rajasthan and Gujarat.
- It is an indicator species of the grassland ecosystem.
- It shares the same ecosystem as Blackbuck and Cheetah.
- **Threat:** Collision with power lines.

Conservation of GIB

- Integrated development of wildlife habitat.
- SC has also appointed a high-powered committee to develop an emergency response plan.
- A GIB protection zone is being established. One such zone was established in Karnataka.

Sea-turtles (01:53 PM)

- **1. Leatherback turtle:** It is the largest of all species of turtles.
- It is found near the Nicobar Group of Islands.
- **2. Loggerhead turtle**
- **3. Hawksbill turtle**
- **4. Green Turtle**
- **5. Olive Ridley Turtle:**
- Above mentioned 5 are found in and around India.
- Two other species are **Kemps-ridley and flatback sea turtles.**
- **Olive Ridley Turtles:**
- It is the most abundant.
- They are found in tropical waters of the Indian, Atlantic, and Pacific oceans.
- They are carnivores.
- They migrate thousands of kilometers and lay eggs in a particular area.
- **Operation Oliva:** It is implemented by Indian Coast Guard.
- Providing safe passage to olive ridley turtles.
- **Operation Save Kurma:** It covers all the turtles.
- It is being implemented by Wildlife Crime Control Bureau.
- **Sea Turtle Project:**
- Implemented by the Wildlife Institute of India (WII) in ten coastal states.

1971 Ramsar Convention

- Convention on conservation and wise use of wetlands.
- 2nd February is International Wetlands Day.
- To cooperate internationally on transboundary wetlands.
- Designation of wetlands as Ramsar sites.
- **172 members** in Ramsar Convention.

Partners of Ramsar Convention (02:25 PM)

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

1972: Stockholm Conference

- It is also called as UN Conference on Human Environment.
- It was held on 5th June 1972.
- It resulted in Stockholm's declaration on the protection of the environment.
- Establishment of UNEP.

1973: Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

- It aims to ensure that the International Trade of wildlife does not threaten their survival.
- CITES is administered by UNEP.

1979: Convention on Migratory Species (03:11 PM)

- It is also called as Bonn Convention.
- Conservation and management of terrestrial, aquatic, and avian migratory species.
- **131 members** including India.
- The last COP of CMS happened in Gandhinagar.

1982: Nairobi Conference

- The tenth anniversary of the Stockholm conference.
- It resulted in Nairobi Declaration.

1985: Vienna Convention

- Protection of the **Ozone Layer**.
- Entered into force in 1988.
- 197 countries have signed and ratified the convention.
- To promote cooperation.
- To adopt measures against ozone depletion.
- As a result of this **Montreal Protocol** was finalized.
- Reduction of all Ozone-depleting substances (ODS).
- It implemented legally bounding control.
- Most of the ozone-depleting substances are phased out except for critical uses like:
 - **Metered doses inhalers for asthma and COPD.**
 - **Fire suppression system in submarines and aircraft.**
- CFCs were replaced with HCFCs and with HFCs.
- HFC is not an ODS, but it is a greenhouse gas.
- To reduce HFCs through the Montreal protocol **Kigali agreement** was agreed upon in 2016.
- According to it, HFC should be phased by 85 percent by developed countries from 2019 and by developing countries from 2024 and 2028.
- **Reasons behind the successful implementation of the Montreal Protocol**
- Acceptance of Common but differentiated Relationships (CBDR).
- Establishment of a multilateral fund for the implementation of the Montreal protocol
- Implemented by **UNEP, UNDP, and World Bank**.
- An alternative to HFCs is **HFO: Hydrofluoroolefins**.

1987: Our Common Future by Brundtland Commission

1988: Montreal Protocol

1988: IPCC

1989: BASEL Convention on Transboundary Movement of Hazardous Waste.

- To reduce the **movement of hazardous waste** between nations.
- It aims to minimize the amount of Hazardous waste and assist LDC in environmentally sound management.
- It provides for prior consent to approve and procedures to regulate the transboundary movement of hazardous waste.
- **It does not cover radioactive waste.**

1992: Rio Earth Summit: UNFCCC, UNCBD, UNCCD

1997: Kyoto Protocol

1998: Rotterdam Convention

- It is about **hazardous chemicals**.
- It aims to promote shared responsibility in the International trade of certain hazardous chemicals.
- It facilitates information exchange through Prior Informed Consent.
- It creates legally binding obligations.

2000: Cartagena Protocol

2001: Stockholm Convention

- It is a convention on **Persistent Organic Pollutants**.
- POPs are resistant to environmental degradation.
- They accumulate and biomagnify in the ecosystem.
- The members agree to eliminate the listed POPs under the convention.
- Examples: Endrin, DDT, etc.

2010 Nagoya Protocol

2013: Minamata Convention

- It is a convention to protect human health and the environment from **mercury pollution**.
- It aims to reduce mercury pollution from selected activities.

2015: Paris Agreement

Next class: UNFCCC, UNCBD, and UNCCD

Environment Class 17

Brief Review of the Previous Class (01:10 PM)

Rio Earth Summit-1992 (01:18 PM)

- **2000-** Millenium Summit
- **2002-** Johannesburg **Rio+10** Summit.
- **2012-** **Rio+20** Summit in Rio De Janeiro
- **Outcomes of Rio Earth Summit:**
- UNFCCC

- UNCBD
- UNCCD

Intergovernmental Panel on Climate Change (IPCC)

- IPCC was established as a scientific body in 1988.
- UNEP and WMO established it.
- It is an intergovernmental body.
- It is a research body to provide scientific information to develop climatic policies.
- There are 195 members including India.
- It releases three types of reports:
 - 1. The **First Assessment Report (AR1)** was released in 1990.
 - AR5 was released in 2015.
 - The **sixth assessment report (AR6)** is the latest one (2021).
- Other reports include Special Reports and Methodology Reports.

United Nations Framework Convention on Climate Change (UNFCCC)

- It entered into force in the year 1994.
- **Parties to UNFCCC are classified as:**
- **Annex 1** includes industrialized and developed countries and economies in transition (EIT).
- **Annex 2** Countries: These are members of the OECD, which is required to provide financial and technical support to EIT and developing countries and LDCs.
- **Non-Annex 1:** These are not listed in Annex 1 and are low-income developing countries.
- **LDCs:** Least Developed Countries.
- COP1 was held in Berlin in 1995.
- COP 3 was held in Kyoto in 1997.

Kyoto Protocol (01:53 PM)

- It was agreed upon in **1997**.
- It aims to reduce global warming through targeted emission reduction.
- It targeted to reduce the emission of six greenhouse gases: **CO₂, CH₄, N₂O, HFC, PFC, and SF₆**.
- Annex 1 countries were given specific targets and deadlines.
- For Non-Annex-1 and LDCs there were no fixed targets.
- It entered into force in 2005 and the target period was between 2008 to 2012.
- Mechanisms under Kyoto Protocol:
 - **Joint Implementation**
 - Through this, an Annex 1 country can invest in emission reduction projects in another Annex 1 country.
 - **Clean Development Mechanism**
 - When Annex 1 countries can implement emission reduction projects in non-annex 1 countries and meet their targets.
 - **Carbon Credit and Emission Trading**
 - It allows the parties to buy Kyoto Units which are carbon credits from other countries to meet their targets.

REDD and REDD+ (02:10 PM)

- It stands for **Reducing emissions from deforestation and forest degradation**.
- Deforestation involves the permanent removal of forests and forest degradation is negative changes in the forest area.
- REDD aims to use financial incentives to reduce the emissions of greenhouse gases from deforestation and forest degradation.
- It can be used as an offset scheme of carbon markets to produce carbon credits by the national governments or the private sector or NGOs.
- It was strongly supported by the World Bank and the UN.
- **REDD+:** It goes beyond deforestation and forest degradation and includes the role of conservation, sustainable management of forests, and enhancement of forest carbon stock.

COP 7 in Marrakesh in 2001 (02:21 PM)

- Marrakesh resulted in the formation of **the Adaptation Fund**.

COP 8 in Delhi in 2002

- **Delhi Ministerial Declaration** called the developed countries to transfer technologies and minimize the impact of climate change.

COP 15 in Copenhagen in 2009

- It resulted in a rift between developed and developing countries and showed the reluctance of Annex 1 countries to fulfill targets under Kyoto.

COP 16 in Cancun in 2010

- It was agreed on a **Green fund for climate change** to help developing countries and developed countries.
- It was agreed that **\$100 billion per year** be mobilized by 2020.

COP 17 in Durban in 2011

- Agreed to start the negotiations for a new legally binding treaty after Kyoto.
- The fund agreed upon at Cancun was named as **Green Climate Fund and a committee was established to oversee the fund.**

COP 18 in Doha in 2012

- Kyoto protocol was amended and a second commitment period was agreed upon between 2012 to 2020.

COP 21 in Paris in 2015 (03:03 PM)

- It resulted in Paris Agreement.
- It commits to limiting global warming to below **1.5 degrees celsius** or to a **maximum of 2 degrees Celsius** above pre-industrial levels.
- Countries were expected to commit voluntarily to emission reductions through **Intended Nationally Determined Contributions (INDCs).**
- It is not a treaty and INDCs are **not binding.**
- It is legally binding for the members to participate in **Global Stocktake Mechanism.**
- The agreement is guided by the principles of CBDR.
- It entered into force in **2017.**

COP 22 in Marrakesh in 2016

- It adopted the Marrakesh Action Proclamation for Climate and Sustainable Development.

COP 23 in Bonn in 2017

- The USA withdrew from Paris Agreement.
- **Talanoa Dialogue:** Inclusive and Participative Dialogue for Climate Change.
- **The transport decarbonization alliance** was announced to facilitate a shift towards sustainable fuels.

COP 24 in Katowice in 2018

- The first meeting of parties after the Paris agreement came into force.
- It was agreed to record the pledges in the public registry.
- The future pledges should cover a common time frame from 2031.

COP 25 Madrid in 2019

- No major outcomes.

COP 26 in Glasgow in 2021 (03:30 PM)

- The present pledges if fulfilled will result in limiting global warming to 2.4 degrees Celsius.
- Members were asked to increase the pledges to limit global warming to 1.5 degrees Celsius.
- Net-Zero targets were announced in Glasgow.
- More than 140 countries announced the net zero targets including India (2070).
- **Glasgow Breakthrough Agenda** was finalized to accelerate the development and deployment of clean technologies.
- More than 100 countries promised to stop deforestation by 2030 (Except India).
- More than 100 countries except for India, Russia, and China agreed to cut thirty percent of Methane emissions by 2030.

COP 27 in Sharm El-Sheikh (To be covered in Current Affairs)

United Nations Convention on Biological Diversity (03:38 PM)

- It was adopted during **Rio Earth Summit in 1992.**
- It is under **UNEP.**
- **It has three main goals:**
- Conservation of biological diversity
- Sustainable use of its components
- Fair and Equitable sharing of benefits arising from genetic resources.
- The convention is **legally binding** and the members are obliged to implement its provisions.

Cartagena Protocol on Biosafety (adopted in 2000).

- It is part of UNCBD.
- It aims to ensure the safe handling, transport, and use of **Living Modified organisms** resulting from modern biotechnology that may adversely impact biodiversity.
- It establishes **Advanced Informed Agreement** Procedures for Ensuring that countries are provided with the information necessary to make informed decisions.
- It establishes a **Bio-Safety Clearing House.**

Nagoya Protocol (2010)

- COP 10 of UNCBD was held in Nagoya in 2010.

- It aims at sharing the benefits arising from the utilization of genetic resources in a fair and equitable manner.
- A strategic plan of 20 biodiversity targets to be achieved by 2020 was finalized which was called **Aichi Targets**.

2012 COP 11 in Hyderabad: No major outcome

2021 and 2022 in Kunming China (To be covered in Current Affairs)

Crocodiles (03:59 PM)

- There are three types of crocodiles in India:
- **1. Gharial:**
- Status: **Critically endangered**
- It is found majorly in the **Chambal river** and also found in the Ganga tributaries.
- **2. Magar Crocodile:**
- It lives in **freshwater**.
- Status: **Vulnerable**
- It is found throughout India
- **2. Salt-water crocodile:**
- Status: **Least Concern**
- Famous Places: Chilika Lake and Andaman Nicobar
- Indian Crocodile Conservation Project:
- To conserve crocodiles and promote captive breeding.
- It started with help of UNDP and FAO.
- **Crocodile breeding centers:** Guindy National Park, Chennai

Gangetic Dolphins (04:05 PM)

- It is a **freshwater dolphin** found only in rivers and lakes. of India.
- It is found in Ganga and its tributaries, Brahmaputra, and its tributaries in India, Nepal, and Bangladesh.
- It is a **Schedule 1** animal.
- It is an indicator species of River Ganga, indicating pollution levels.
- Threats: Poaching for oil, low water levels in Rivers, fishing nets.
- Status: **Endangered**.
- It is the national aquatic animal of India.
- These are not only dolphins found in India.
- Another one is **Irrawaddy Dolphin**.

Next Class: UNCCD, Vultures and Mahasheer