

Springboard
ACADEMY

AN INSTITUTE FOR IAS & RAS

RAS PRELIMS
2024 - 2025

ECOLOGY
PRELIMS EXAM



Sunil Sir

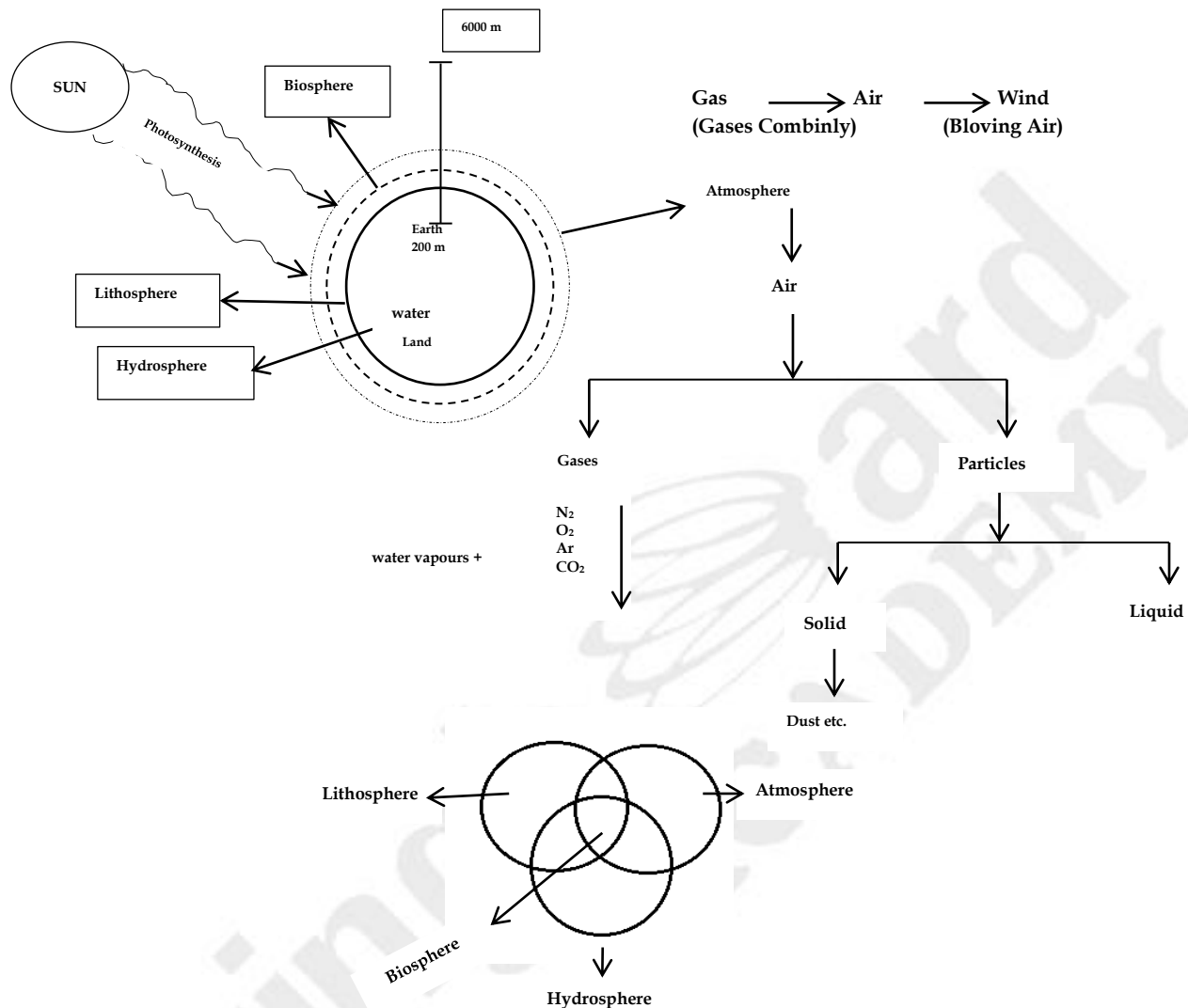
SYLLABUS

Geography of World & India	Environmental Issues : <ul style="list-style-type: none">✧ Desertification✧ Deforestation✧ Climate Change✧ Global Warming✧ Ozone Layer Depletion
Science & Technology	<ul style="list-style-type: none">✧ Environmental & Ecological Changes and their Impact.✧ Biodiversity, Conservation of Natural Resources and Sustainable Development.
Geography of Rajasthan	<ul style="list-style-type: none">✧ Biodiversity & its Conservation.

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ENVIRONMENT



Environment :-

- All the natural Structure Surroundings on the Earth.
- The group of Natural influences which by their physical & biological powers influences the origin development (Work of environment) & death of an organism.

Pollution :-

- Pollution is the undesirable change in physical, chemical & biological composition of environment.
- Pollution is such change in the purity of Natural resources (Air, Water, Soil) that destroy their utility.
- Pollution may be natural or Manmade.

Pollutants :-

- Any material or act on the part of human/anthropogenic or natural which leads to pollutant called pollutants & they may be solid, liquid or gas in nature.
- The chemicals & other substances produced due to human activities, when their concentration increases in environment & ecosystem could not recycling them, so they disturb the balance of ecosystem are known as pollutants.

Classification of Pollutants

I. On the Basis of Degradation :

A. Bio Degradable:-

- The substance which are usually degraded by macro-organism in environment. But if these materials enter the environment in such large quantities, they can't be degraded completely then addition of these materials causes pollution in environment.

Example : Domestic waste, Paper, Cloth, Sewage etc.

O – Oxygen in atom form

O₂ – Oxygen in Molecule form

O₃ – Ozone

B. Non-Biodegradable Pollutant :

- The substances which are usually not degraded or degraded partially by the micro-organisms so they remain in environment for long time & cause pollution.

Example : Plastic, Metals, Radio active substance, Insecticides, Detergent, Glass etc.

II. On The Basis of Formation/Production :

A. Primary Pollutants:

- A Primary pollutant is a pollutant emitted directly from source.
- These persist in the form in which they are added to the environment.
- Example : Sulfur dioxide(SO₂) , Carbon Monoxide (CO), Nitrogen Oxide [(NO₂) (Nitrogen oxide, N₂O etc.)] mercury(Hg), Particulate Matter (PM), Volatile Organic Compound (VOC), Plastic etc.

B. Secondary Pollutants:

- Pollutants which form in the atmosphere are known as secondary pollutants.
- Two or more primary pollutant react chemically in the environment & produce secondary pollutant.
- Secondary pollutants are more toxic than primary pollutants.

- Example : Smoke + Fog = Smog, Acid Rain,
 $\text{NO}_x + \text{VOC} = \text{O}_3$ (Ozone)
 Peroxy - acetyl nitrate (PAN)
 SO_3 - Sulphur tri-oxide.

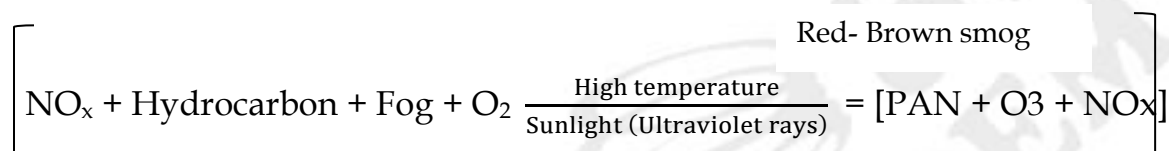
❖ Smog :

Type of Smog:

1. Photochemical Smog/ Los Angeles Smog/ Summer Smog/ Red Brown Smog :

- ✓ This process requires smoke, fog, nitrogen oxide, hydrocarbons, oxygen, high temperature & UV-rays (Sunlight).
- ✓ These react & make red-brown smog
- ✓ It is a mixture of - (PAN + O_3 + Nitrogen Oxides)

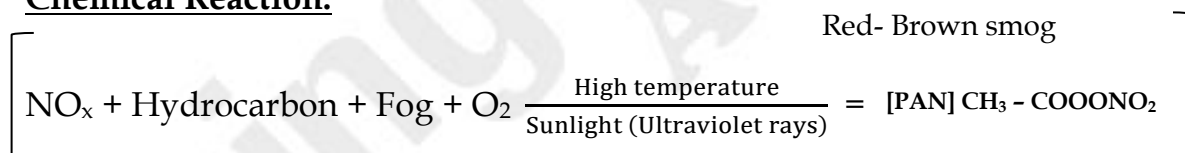
Chemical Reaction:



➤ PAN: (Peroxy Acetyl Nitrate) :

- It is a secondary pollutant that is formed when Nitrogen Oxide & Hydrocarbons chemically react in the presence of UV rays & high temperature.
- Its colour is Red-Brown.

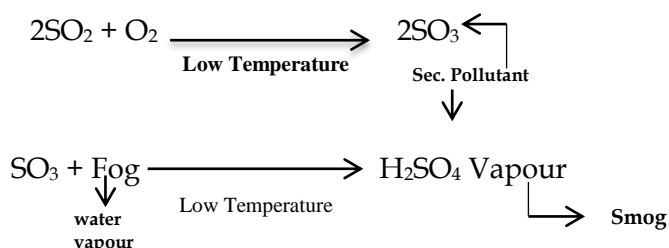
Chemical Reaction:



2. Winter Smog/London Smog/Classical Smog -

- This process requires coal, smoke, Sulphur dioxide (SO_2) low temperature & fog.
- These react & make vapour of Sulphuric acid (H_2SO_4)
- Due to inhalation of ' H_2SO_4 Vapour' about 4000 people died in London in 1952.

Chemical Reaction:



❖ Acid Rain :

- Acid rain is the rainfall that has been acidified.
- It is formed when oxides of sulphur & nitrogen react with the moisture in the atmosphere.
- It is rain with a pH of less than '5.6'

☑ Types of Acid Deposition :

Wet Deposition :

- It acid comes down on earth with rain, fog & smog, it is known as wet deposition.

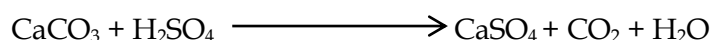
Dry Deposition :

- If acid settled on earth surface through solid dust particles with nitrate or Sulphate this is called dry deposition.
- In acid rain the ratio of H_2SO_4 [7 : 3] & HNO_3 [7:3]
- small amount of carbonic acid ' $(\text{C}_6\text{H}_5\text{OH})$ ' is also produced & carbonic Acid ' (H_2CO_3) '
- Acid rain containing ions of sulphate (SO_2), Nitrate (NO_2^-), ammonium (NH_4^+) & Hydrogen falls as wet deposition.

☑ Effects of Acidic Rain :

1. Acid rain increases the acidity of soil, which decreases fertility of soil. (Desertification)
2. Water of Acid rain reaches to River, Pond, Lake etc. It increases its acidity which adversely affects the Aquatic animals.
3. Acid rain causes black spots on historical monuments.
Like : Tajmahal , Made of Marble.

Chemical Reaction:

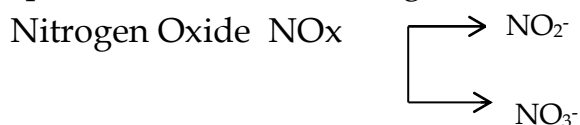


4. Acid Rain Causes Skin diseases.

III. On the Basis of Quality & Quantity :

A. Quantitative Pollutants :

- The Substance which are already present in environment but become pollutant when their concentration reaches beyond a threshold value in the environment.
- Example : CO_2 Global warming due to CO_2



B. Qualitative Pollutants :

- The Substance which are usually not present in environment & are added by human being & their small amount can cause pollution.
- Example : Insecticide, Fungicides, Herbicides etc.

❖ Air Pollution :-

- The Undesirable change in physical, chemical & Biological composition of air is known as Air pollution.
- According to WHO, Air pollution is a condition in which concentration of such type of substance increase in air which are harmful to the organism & the environment.

☑ Major Air pollutants & their effects :

1. $PM_{2.5}$:- Suspended Particulate Matter (SPM)

- SPM of size less than 2.5 micro meter (10^{-6})
- According to 'CPCB (Central Pollution Control Board)' particulate matter of size less than 2.5 micro meter are very harmful for human health.

2. PM_{10} : SPM_{10}

- SPM of size less than 10 micro meter.
- these particulate matter cause silicosis, allergy, cancer & other respiratory problems.

3. Carbon monoxide : (CO)

- It is most toxic air pollutant & present in industrial & vehicle smoke.
- It makes 'carboxy-hemoglobin (Hb-CO)' when reacts with hemoglobin in our body which destroy RBC.
- It causes death due to asphyxiation when inhaled in large amount.

4. Sulphur Di-oxide : (SO_2)

- It is a gas produced from burning coal, mainly in thermal power plants. Some industrial process such as production of paper, smelting of metals etc. produce sulphur dioxide.
- It can lead to diseases related to respiratory tract.
- Sulfur oxide cause chlorophyll destruction. (Example: yellow leaves)
- Sulfur oxide is responsible for formation of smog & acid rain.

5. (NO_2) : Nitrogen Dioxide :

- It is produced from burning fuels including petrol, diesel, coal.
- It causes photochemical smog, acid rain & respiratory problems.

6. Lead : (Pb)

- It is present in petrol, Diesel, lead batteries, paints, hair dry product & beauty products.
- It can cause nervous system damage digestive problems & in some cases cause cancer.
- lead poisoning also called "Plumbism" (A type of Paralysis)

7. Volatile Organic Compound : VOC's

- VOC's are organic chemicals whose are found at room temperature in vapour form.
- There sources are perfumes, hair spray, furniture polish, glues, air freshener, replents wood preservatives.

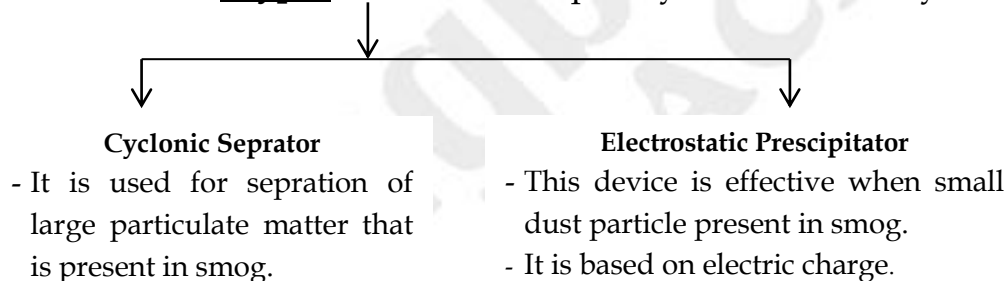
☑ Air Pollution Control :

⊗ Industry :

- Particulate & gaseous pollutants are present in smoke of industry.
- Following two devices are used to remove particulate pollutant from the industrial smoke:

▪ Arresters :

- ⇒ These are used to separate particulate matters from contaminated air.
- ⇒ There are **2 types** of arresters frequently used in industry.

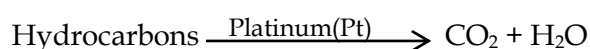
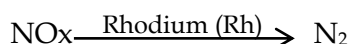
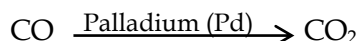


▪ Scrubber :

- Control Measures of gases those are emitted from Industries.
- The gaseous Pollutants can be controlled through the technique of combustion, absorption (Suitable Liquid Absorbent) & Adsorption (Solid Surface.)
- This device control air pollution in Industry, It can remove solid particles as well as some gases (i.e SO₂) from smoke.
- Control measures of gases those are emitted from industries.
- The gaseous pollutants can be controlled through the technique of combustion, absorption (Suitable liquid absorbent) & adsorption (Solid surface)

☑ **Control pollution from auto mobiles /vehicles :**

- **BS(Bharat Stages):** Bharat stages are being adopted to reduce pollutant emitted from vehicles. Bharat stage four Implemented through out the country since '1st April, 2017'.
- **BS-VI** Standard have been implemented from '1st April, 2020.
- **'Catalytic Converter'** : It is used in vehicles to reduce the pollutants present in smoke.
- These Convert :



☑ **Other Measures:**

- Effective Traffic management system & advance public transportation should be developed in urban areas.
- Government should adopt renewable energy sources.
- Sustainable agricultural practices should adopted.
- Population should be control.

☑ **National Air Quality Index : (NAQI)**

- National Air Quality Index is launched by "Ministry of Environment forest & Climate change of Indian" Government under Swachha Bharat Abhiyan from 2014 with outline : " One Number - One Colour- One Description".
- It is monitored by 'Central Pollution Control Board (CPCB)' & State Pollution Control Boar(SPCB)'.
- It has been developed by the CPCB in consultation with 'IIT Kanpur' & other service.

➤ **Main Objective:**

- Information on air quality is put up in public domain in simple linguistic terms that is easily understood by common person.
- It has been launched for monitoring the quality of air in major 'urban centers' across the country.
- The measurement of air (Pollution) quality is based on '8 Pollutants.

1. PM _{2.5}	5. NO ₂
2. PM ₁₀	6. NH ₃
3. CO	7. O ₃
4. SO ₂	8. Pb

• **This Index has 6 Categories :**

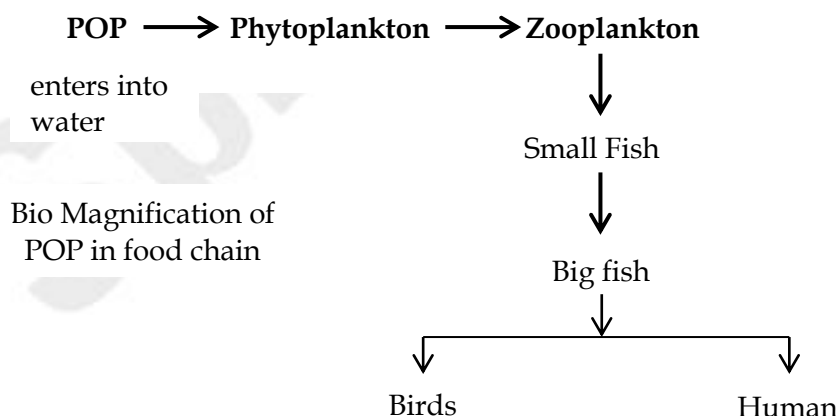
S.No.	Category	Scale	Colour	Impact
1.	Good	0-50	Dark Green	Minimum Impact
2.	Satisfactory	51-100	Light Green	May cause minor breathing discomfort to sensitive people.
3.	Moderately polluted	101-200	Yellow	May cause breathing discomfort to the people with lung, heart disease.
4.	Poor	201-300	Saffron	May cause breathing discomfort to most people on prolonged inhaling.
5.	Very poor	301-400	Light Red	May cause respiratory illness to people on prolonging inhaling
6.	Severe	401	Dark red	May cause respiratory impact even on healthy people & serious health impact on people with lung/heart disease.

❖ **Water Pollution :**

• **Bio Magnification :**

1. **Persistent Organic Pollutant :** (POP) & other pollutants that do not decompose, if they enter the food chain progressively increase their concentrate along the food chain, condition is known as bio magnification.
2. The Highest Concentration occurs in top consumer.

⇒ **Food chain & POP :**



☑ **Characterstics of POP:**

- these pollutants are not decomposed by micro organism.
- They are Insoluble in water & soluble in fat.

- Most of pollutants are biologically active, so they affect the body in various manners.

Example : DDT, Endosulphan, Alderin, mercury (Hg), Aluminium, Iron, Phenolic compound, ABS (Alkyl Benzene Sulphonate/Detergent)

☑ **Effects of Bio Magnification:**

- High concentration of POPs disturb calcium metabolism in birds. Which cause thinning of egg, shell & their premature breaking, eventually causing decline in bird populations.
- Main cause of decreasing population of 'vulture' is 'Diclofanic Sodium' it's an analgesic drug/Pain Killer.
- Accumulation of metals in body causes allergy cancer & reduces Immune power in human being.
- "Minamata disease" is cause in humans in Japan by biomagnification of mercury (Hg).

⇒ **Eutrophication :**

- 'Eutrophia' : Greek word means 'adequate & healthy nutrition'.
- The process of nutrient enrichment (N,P,K) of water & consequent loss of species diversity (or death of aquatic animals) is referred to as eutrophication.

⇒ **Water Pollution :-**

- The water pollution is caused by the addition of organic & inorganic chemicals as well as the biological materials. which change the physical & chemical properties of water. this harmful process is called water pollution.
- Only 0.1% impurities make domestic water unfit for human use.
- Water pollution is measured by the presence of dissolved oxygen in water.
- If concentration of dissolved oxygen is less then '8mg/liter' may be considered as "highly contaminated".
- 'Daphna' , ' Trout Fish' & 'Larva of Stone Fly' are the Indicators of Fresh water.
- 'E.colai', 'Sewage Fungus', sludge worms, 'blood worms' are the indicators of polluted water.

☑ **Methods of Measurnment of Water Pollution :**

⇒ **Biochemical Oxygen Demand : (BOD)**

- It is the amount of dissolved oxygen needed by Arobic Bacteria for decomposition of Biodegradable/organic substance present in water.
- it is expressed in "milligrams of oxygen per liter of water".

- The water pollution by organic wastes is measured in terms of biochemical oxygen demand.

⇒ **Chemical Oxygen Demand : (COD)**

- The amount of dissolved oxygen required by chemical like 'potassium dichromate' ($K_2Cr_2O_7$) for oxidation/Degradation of biodegradable & non-biodegradable pollutants present in water.
- While measuring BOD & COD of water from same source then COD will always be higher because potassium dichromate oxidizes both biodegradable & non-biodegradable pollutants.
- Chemical oxygen demand is a slightly better mode used to measure pollution load in water.
- If we take water from 2 different sources & perform BOD & COD then we can't certainly determine that which water has higher value of BOD or COD.
- It means we can't determine in that case.

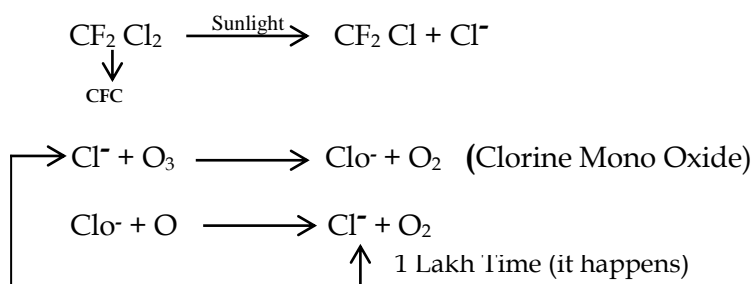
☑ **Effects of Polluted Water :**

1. Toxicity of Hg (Mercury) – Minamata Disease
2. Toxicity of cadmium (Cd) Itai - Itai (Ouch-Ouch) Disease.
3. Toxicity of Arsenic – Black foot disease
4. Long term ingestion of Fluoride Ions causes fluorosis (Knock - knee syndrome).
5. Blue Baby syndrome from toxicity of Nitrate (Methemoglobinemia).
6. Viral diseases hepatitis A & E, Polio, Rota Virus.
7. Bacterial diseases – Typhoid, Cholera.
8. Protozoal diseases – Amoebiasis, Giardiasis.
9. Polluted water decreases fertility of soil.
10. Polluted water reduces dissolved oxygen content.
11. Biological magnification.
12. Eutrophication.

Ozone Layer Depletion

- Ozone (O₃) is a natural toxic gas consisting three atoms of oxygen.
- It is found in two different layers of the atmosphere.
- Ozone in the troposphere is "bad" because it dirties the air & helps to form smog, which is not good to breathe.
- Ozone in the stratosphere is "good" because it protects life on Earth by absorbing some of the sun's harmful ultra violet rays, thus acting like a sun screen.
- At the height of 16 km to 25 km on Earth concentration of ozone is maximum in stratosphere. This region of stratosphere is also known as 'Ozonosphere'.
- Thickness of Ozone layer is measured in 'Dobson Unit' (DU).
- $1\text{DU} = 2.69 \times 10^{20} \text{ O}_3 \text{ Molecule / M}^3$
 $1\text{DU} = 1 \text{ ppb}$
- **The thickness of ozone is measured by objects.**
 - Dobson spectrophotometer.
 - The filter ozohometer.
 - Total ozone mapping spectrometer. (Nimbus -7 Satellite) NASA.
- If the thickness of Ozone layer is less than 220 D.U. in stratosphere then, its called as, Ozone layer hole.
- The Ozone hole over Antractica (South Pole) develop each year between the late August & early October.
- The Ozone concentration in north pole reduce during March & April month.
- Ozone concentration increases in day time & reduce in night.(In Trophosphere)
- "Polar Stratosphiric Clouds" '(PSCs)' are responsible for reduction in ozone reduction over polar regions.
- The formation & destruction of ozone in stratosphere is a natural phenomena. It does'nt affect ozone layer.
- The equilibrium between the formation & destruction of ozone, has been upset by the influx of several substances (CFC Specially Chlorine & Bromine) into the atmosphere which react with ozone & destroy it.

Chemical Reaction:



☑ Effects on Ozone Layer Depletion:

1. Decrease in the quantity of total-column/ thickness ozone tend to cause increased penetration of solar 'UV-B' radiation to the earth's surface.
2. It has profound effects on human health, animals, plants micro-organisms, materials & on air quality. (smog)

☑ Control of Ozone Layer Depletion:

1. Vienna Convention : 1985

- It acts as framework for the international efforts to protect the ozone layer.
- However it does not include legally binding reduction goals for the use of CFCs.

2. Montreal Protocol : 1987

- The montreal protocol (on substances that deplete the ozone layer) was designed to reduce the production & consumption of ozone depleting substances in order to reduce their abundance in the atmosphere, & thereby protect the earth's fragile ozone layer.
 - The treaty was opened for signature on September 16, 1987 so 'world ozone day' is celebrated on 16th September every year.
 - It entered into force on Jan 1, 1989.
- ⇒ **Provisions of Montreal Protocol :**
- All member countries have to maintain the production & use of CFC at the level of 1986. In which any increase is prohibited.
 - Member countries will reduce 50% use of CFC till 1998.

3. Copenhagen Amendment : 1992

- In this conference, time limit was decided to restrict the use of CFCs.
- Developed Countries – till 2000.
- Developing Countries- 2010.
- India restricted use of CFCs from 2008.

4. Kigali Agreement : 2016

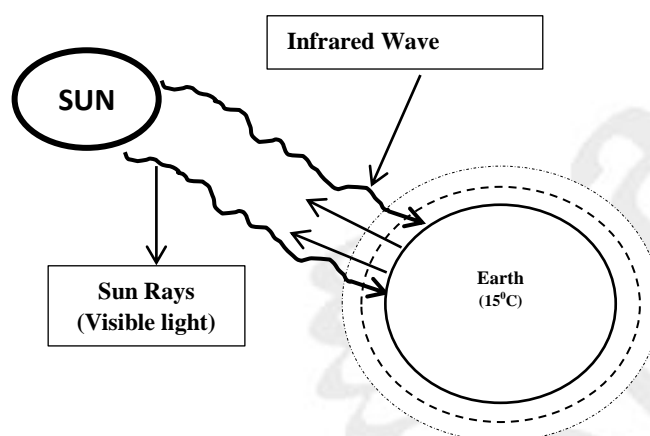
- Twenty-Eight meeting of the parties to the monetreal protocol on substances that deplete the ozone layer held in Kigali, (Rwanda) amended the 1987 monetreal protocol to phase out hydroflorocarbons (HFCs).
- HFCs were introduced in the 1990s as alternative to replace chemicals that had been found to erode the ozone layer, but turned out to be catastrophic for global warming.

- The elimination of HFCs could reduce global warming by 0.5 degrees by year '2100'.
- The Kigali agreement for HFCs reduction will be binding on countries from "1 Jan 2019"
- India is member of this agreement.

Climate Change

⇒ Climate Change :

- The phrase 'Climate Change' represents a change in the long term weather patterns.
- Climate change is not a change of weather in a particular day, It is the cumulative change of long term weather pattern.
- Climate change means the changes in climate over the last 100 years which is caused predominantly by human activity.



⇒ Green House Effect :

- The green house effect is a naturally occurring phenomenon that blankets the earth lower atmosphere & warms it.
- It maintaining the temperature suitable for living things to survive.
- The higher concentration of CO₂ & other gases present in environment forms a thick layer above earth's surface.
- It allows light waves (low wavelength) from the sun to enter in atmosphere but does not allow the heat/terrestrial/infrared waves (high wavelength) emitting from the earth surface to go out.
- Because of this, temperature of the earth's surface increase , this is called "green house effect".
- Green house effect is a natural phenomenon. According to one estimate, in the absence of naturally occurring green house effect, the average temperature of the earth surface would be.
- 19°C instead of present value of 15°C & the earth would be a frozen lifeless planet.
- But currently with increase in concentration of carbon dioxide & other green house gases the average temperature also increases.
- For Eg. : CO₂ is 90% on atmosphere of venus so it's average temperature of venus is 447°C .

Global Warming

- Global warming is an average increase in the temperature of the atmosphere near the Earth's surface & in the troposphere, which can contribute to changes in global climate patterns.
- Global warming can occur from a variety of cause, both natural & human induced.

⇒ Major Green House Gases:

Natural

1. Water vapour
2. Carbon Dioxide (CO₂)
3. Methane (CH₄)
4. Ozone (O₃)

Man Made

1. CO₂ 76%
2. CH₄ 16%
3. N₂O (Nitrous Oxide) 6%
4. Fluorinated Gases 2%
 - a) Hydro Florocarbons (HFC)
 - b) Per Fluorocarbons (PFC)
 - c) Sulfur Hexafluouride (SFs)

⇒ Other Green House Gases:

1. CFC – Cloro Floro Carban .
2. HCFC – Hydro Cloro Floro Carban.
3. Black Carbon
4. Brown Carbon

⇒ Decreasing order of countries on the basis of Emission of CO₂.

1. China 30%
2. USA 15%
3. European Union 9%
4. India 7%
5. Russia 5%

⇒ **Residence time of Green House Gases in Environment.**

- | | |
|-------------------------------------|------------------|
| 1. Methane (CH ₄) | - 12 Years |
| 2. CO ₂ | - 100 Years |
| 3. N ₂ O (Nitrous Oxide) | - 115 Years |
| 4. HFCs | - 1-270 Years |
| 5. PFCs | - 800-5000 Years |
| 6. SF ₆ | - 3200 Years |

⇒ **Global warming potential of these gases (100 years).**

- | | |
|------------------|--|
| CO ₂ | - 1 |
| CH ₄ | - 21 Times more than CO ₂ |
| N ₂ O | - 310 Times more than CO ₂ |
| HFCs | - 140 -11700 Times more than CO ₂ |
| PFCs | - 6500-9200 Times more than CO ₂ |
| SF ₆ | - 23900 Times more than CO ₂ |

⇒ **Important Convention related to climate change :**

➤ **Stockholm Convention : 1972**

- **Official Name :-** "United Nations Conference on Human Environment (UNCHE)".
- "United Nation Environment Programme (UNEP)" was created as a result of this conference.
- The UNEP is the leading global environmental authority that sets the global environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development within the UNDP.
- 'Stockholm Declaration' was released in this conference that is known as the 'Magna Carta of Environmental Conservation'.
- This convention start on 5 June 1972, hence this day is celebrated as 'world environment Day'.
- Indian PM Indira Gandhi Participated in this conference.

➤ **Rio Summit / Earth Summit : 1992**

- **Official Name : United Nation Conference on Environment & Development (UNCED).**
- Representatives of 172 Countries took part in this summit.
- **"One Earth Theory"** was adopted, according to which the political boundaries of all countries may be different but in terms of environment, the whole earth is one, so if one country harms the climate then it also affects other countries.
- **The Earth Summit resulted in the following documents:-**
 1. "Rio Declaration on Environment & Development"
 2. "Agenda 21" [**Agenda of sustainable development of 21st century**]
 3. "Forest Principles".
- Important legally binding agreements were opened for signature :-
 1. "Convention on Biological Diversity" (CBD).
 2. "UN Framework Convention on Climate Change" (UNFCCC).
 3. "United Nations Convention to Combat Desertification" (UNCCD).

➤ **Rio + 20 Conference 2012 :**

- **Official Name :- "United Nation Conference on Sustainable Development (UNCSD)**

Rio Summit - 1998

Document issued (Legal Bound Agreement)		
UNFCCC	UNCCD	CBD
Effective : 1994	1996	1993
HQ - Bonn (Germany)	Bonn (Germany)	Montreal
COP (Conference of Party)	2 years	2 Years
Ist COP : 1995 (Berlin Germany)	COP-15 : 2022 Abid Jan (Coted Iveise) COP-16 : 2024 Riyat (Saudi Arab)	Ist Part : 2021 (China) Kunming 2 nd Part : 2022 Montreal (Canada)
Note: Kunming - Montreal Declaration (30/30 Target) - According to this by 2030 member country of CBP will declared 30% of their geographical area as protected for Bio-Diversity.		

⇒ Important COP's of UNFCCC :

3 rd COP : 1997	Kyoto (Japan)	Kyoto Protocol
COP-13 : 2007	Bali (Indonasia)	Bali Action Plan
COP-21 : 2015	Paris	Paris Climate Change Agreement
COP-26 : 2021	Glasgow (U.K)	
COP-27 : 2022	Sharm-El-Sheikh (Egypt)	
COP-28 : 2023	Dubai (UAE)	
COP-29 : 2024	Baku (Azerbaijan)	

⇒ Important COP in India :

UNFCCC : 20	2002	COP - 8	New Delhi
UNCCD	2019	COP - 14	New Delhi
CBD	2012	COP - 11	Hydrabad

Bio Diversity

- Biodiversity is a variation/diversity that include within species diversity between species diversity & diversity of organism those are found in different natural habitats (desert forest etc.)
- Bio diversity includes both terrestrial & Aquatic organisms:
 - 'Raymond F. Desman' used the word : " Biological Diversity" very 1st time in 1968.
 - "Walter G. Rosen" used the word " Biodiversity in 1985.
 - As a concept, the "term Biodiversity" was 1st used by the famous insect scientist "E.O. Written" in 1986.
- Since then the term was adopted by Bio-Scientist, environmentalists, politisians etc. as a concepts.

⇒ Levels of Bio Diversity :-

- **Genetic** - **Biodiversity (With in Species)**
- **Specis** - **Biodiversity (Between Species)**
- **Ecological** - **Biodiversity (Between Ecosystem) (Natural Habitat)**

1. Genetic Level :-

- It is concerned with the variation in genes within a particular species.
- Genetic diversity allows species to adopt to changing environment.
- All living organisms are identified on the basis of their 'Genetic structure' & this genetic structure gives specificity to organisms.
- The variation in living organisms of same species is considered as 'genetic level diversity'.
- Eg. diversity among human species, dog species, cat species, mango species etc.

2. Species Level :

- It is a broad scale expressing biodiversity.
- It refers to the variety of living organisms on earth. Species differ from each another, markedly in their genetic make-up do not inter-breed in nature.
- Variation in different species is the diversity of species level.
- Eg.: Human & tiger, elephant & dog etc, difference between wheat & mustard species.

3. Ecological Level :

- This refers to the different types of habitats. There are several Kinds of habitats around the world Coral reefs, grasslands wetlands, desert, mangroves & tropical rain forests are of ecosystem.
- The diversity found among the organism living in different geographical area is the biodiversity of ecological level.

Like: Diversity among plant species found in desert & grasslands.

⇒ Measurement of Biodiversity :

- Measurement of Biodiversity refers to the number of species & it's richness.
- Under this measurement, the data is to compile the number of species in a particular region & their median similarities.

⇒ Measurement of Biodiversity :

- Alpha Biodiversity (α)
- Beta Biodiversity (β)
- Gamma Biodiversity (γ)

1. Alpha Biodiversity :

- The total number of species found in a particular is called alpha biodiversity.
- Biodiversity is measured at very small level in this method.
- It is helpful in comparative study of biodiversity in different region.
Like : If total species of forest ecosystem = 105
- Alpha Biodiversity = 105

2. Beta Biodiversity :

- It includes :-
 - (i) Comparison of biodiversity between 2 ecosystem.
 - (ii) It also include difference of biodiversity between 2 ecosystem
(Migration of species is an important factor that influence that difference.
 - (iii) It is ratio between regional & local biodiversity.

3. Gamma Biodiversity :

- It is measure of the averall biodiversity for the different ecosystems within a region.
- It is the total number of species found in various community of large Geographical area or globally is called gamma biodiversity.
- It is the largest level for measurement of biodiversity.

$$\gamma \text{ Biodiversity} = [S_1 + S_2 + S_3 + S_4] - C$$

- S = No. of Species
- C = No. of common species

⇒ **Pattern of Biodiversity on Earth :**

- the diversity of planets & animals is not uniform throughout of the world.
- In general 'species diversity' decreases as we move away from the equator towards the poles.
- Species richness decrease with increasing altitude.
- within a region species richness increased with increasing explored area, but only up to a limit.
- The largely "Tropical Amazonian rain forest" in 'South America' has the 'greatest biodiversity on earth'.
- It is called the :
 - ✓ "Lungs of the planet"- "Tropical Amazonian rain forest"
 - ✓ 'Kindney of Planet' - 'Wetland'.
- Other regions with high biodiversity are coral reefs, wetlands, temprate forests.
- where as desert, sub polar regions, polar regions consits of Least Biodiversity.

⇒ **Biodiversity in India:**

- India is rich in biodiversity terms.
- India has only 2.4% of the world's land area,
- Its share of the global species diversity.
- is an impressive 8.1 %
- These are about 45000 plant species & 90000 animal species known in India.
- Many species are still not identified. (1 Lakh plant species & 3 Lakh Animal species)

⇒ **India is among the 17 Mega diverse countries :**

➤ **These countries are as follows:**

(A) Countries of Asia Continent :

- (i) India
- (ii) China
- (iii) Indonesia
- (iv) Malaysia
- (v) Phillipines

(B) Africa Continent :

- (i) Zaire
- (ii) South Africa
- (iii) Madagascar

(C) South America Continent :

- (i) Brazil
- (ii) Colombia
- (iii) Venezuela
- (iv) Ecuador
- (v) Peru

(D) North America Continent :

- (i) U.S.A
- (ii) Mexico

(E) Australia Continent:

- (i) Papua new Guinea
- (ii) Australia

⇒ Cause of Biodiversity losses:

- Habitatloss & Fragmentation
- Over Exploitation
- Invasive Alien Species
- Co-extinction

⇒ Conservation of Biodiversity :

- Biodiversity is essential for human life, co-existence & ecological balance.
- As biodiversity consists of great significance so, it is our responsibility to protect it.

❖ Conservation of Biodiversity :

	In-Situ Conservation		Ex-Situ Conservation
1.	National Park	1.	Seed Bank
2.	Wildlife Sanctuaries	2.	Gene Bank
3.	Community & Conservation Reserves	3.	Cryopreservation (Preserving : Umbilical Cord (gene) nitrogen oxide) - 196
4.	Marine Protected areas	4.	Botanical Garden
5.	Sacred Groves	5.	Zoo
6.	Biosphere Reserves	6.	Zoological Gardens
7.	Hot Spot of Biodiversity	7.	Tree Gardens
		8.	Aquarium

⇒ **Hot-Spot :**

- Concept by: "Norman Mayer"
- Declaration by : "Conservation International" (U.S. Based NGO)

☑ **Hot-Spot in India : 4**

- 'The Himalayas' 44.4% (it's part in India)
- 'Western ghats & Shri Lanka' 64.9% (in India)
- 'Indo-Burma Region' 5% (Part in India)
- 'Sunda Land' 1.28% (Part in India)

• **Hottest Hot - Spot : 8**

- Some hot spots are much richer than other in terms of their numbers of edemics/Biodiversity
- These are – 8
 - (i) 'Western Ghat' }
 - (ii) 'Indo - Burma' } In India
 - (iii) 'Sundaland' }
 - (iv) 'Phillippines'
 - (v) 'Medagascar'
 - (vi) Eastern Arc & Coastal Forests of Tanzania & Kenya'.
 - (vii) Brazil's Atlantic Forest'
 - (viii) Caribbean Region'

⇒ **Biosphere Reserves :**

- In 1971 UNESCO Started "**Man & Biosphere Programme**".
- The objective of this programme was to make 'balance between economic development & environment protection', therefore UNESCO declare biosphere reserve through out the world.
- 18 Biosphere reserves are declared in India in which 12 are included in 'UNESCO List'.
- '1st Biosphere Reserve' of India (Nilgiri in 2000- Tamilnadu, Karnataka & Kerala).
- last biosphere of India Included in UNESCO List (Panna - Madhyapradesh in 2020).

⇒ **National Park :**

- The state government can declare a national park under the 'wildlife protection act, 1972' to provide protection to the animal plant species & the entire ecosystem.
- To declare any wildland as a national park or a sanctuary, prior permission of the 'Wildlife Board' (Chairman-PM) is required.

- It does not allow human activities other than education, research & tourism.
- "Jim Corbett" (Uttarakhand) - India's 1st national park, was declared in 1936.
- **Currently these are 106 National Parks.**
- **There are 3 National Park in Rajasthan.**
 - (i) 'Keoladeo, National Park' (1982)
 - (ii) 'Ranthambhore, National Park' (1980)
 - (iii) 'Mukundra Hills, National Park'

⇒ **Wildlife Sanctuary :**

- Sanctuaries are declared by the state government to provide protection to a particular or few specific wild species.
- Human activities such as collecting dry wood, collecting fruits, controlled transport, Limited Grazing & Limited Mining are allowed but the safety of wildlife is not compromised.
- In India, there are about 551 wildlife sanctuaries .
- In Rajasthan there are 27 wildlife sanctuaries.

⇒ **Wet Lands:**

- Wetlands are areas intermediate in character between deep water & terrestrial habitats, also transitional in nature & often located between them.
- They are permanently or temporary saturated by water.
- Availability of water & nutrients is more in these areas, so different types of species grow here.
- "mangrove Vegetation" Develops which have "Pneumatophore roots".
- mangrove vegetation has a special feature called 'vivipari' (Seed germinate on plant it self).
- Wetlands are specially adopted for birds, therefore they are known as 'Shelter place for migratory birds'.

⇒ **Conservation of wetland :**

- Ramsar Convention 1971
- It is a International treaty for conservation of wetland which took place on '2 Feb, 1971' at Ramsar (Iran).
- So, 'world wetland day' is celebrated on 2 Feb.
- Secretariat : ' Gland', Switzerland.
- The Ramsar Convention entered into force in India on 1 Feb 1982 & Chilka Lake(Odisha) was designated the ' 1st Ramsar Site'.

- There are more than 2500 Ramsar Sites in the world, including 85 Ramsar Sites in India.
- Higher Ramsar Sites State is Tamil Nadu (18).
- Second Higher Ramsar Site State is Uttarpradesh (10).
- Rajasthan had 2 Ramsar sites :
 - (i) Keoladeo - Bharatpur
 - (ii) Sambhar Lake - Jaipur Rural

⇒ **Coral Reef :**

- The coral reef is formed by adjustment of the exoskeleton of coral polyps.
- The coral polyp is an organism of ' Cnidaria Invertibrate Phylum'. It develops in tropical oceans & used calcium carbonate.
- Coral polyps live in group & form 'calcium carbonate' or 'lime shell' around them.
- When a coral polyp dies, Another coral polyp builds its shell on it. In the long term there is a huge reef develops called 'coral reefs'.
- Coral reefs found only in 1% area of oceans & they have only 25% of marine species therefore they are known as "Rain Forests of the ocean".

Desertification

- Desertification - "**Degradation of fertile land**"
- Desertification is the degradation process by which a fertile land changes it self into a desert by losing its flora and fauna.
- This can be caused by drought, deforestation, climate change, human activities or improper agriculture.

☑ Causes of desertification :-

1. Overgrazing
2. Deforestation
3. Farming practices
4. Urbanisation and other types of land development
5. Climate change
6. Stripping the land resources. (Overmining)
7. Natural Disasters.
8. Acid Rain.

☑ Impacts of Desertification :-

1. Because of desertification farmer will become poor.
2. Agriculture production reduce.
3. Increased problem of Hunger.
4. Bad Impact on economy.
5. Loss of Biodiversity.
6. Imbalance in environmental activities like -
 - Rain pattern
 - Wind pattern
 - Situation like climate change
 - Land sliding and flood.

Desertification in India :-

- According to the Government's data recently presented to the " United Nations Convention to Combat Desertification" (UNCCD) India lost 31 % or 5.65 Million Hectares, of grassland area in a decade.
- As per reports, over 105 Million hectares or about 32 % of India's area is undergoing degradation.
- Between 2003-2005 and 2011-2013, 26 states witnessed an increase in the level of desertification in India.

- More than 80 % of the country's degraded land lies in first nine states (North India)

☑ **Control of Desertification :-**

1. At local Level :-

- Try to Stop overgrazing
- Promote environment friendly agriculture practices.
- Increased plantation can stop desertification.
- Proper harvesting and management of rain water.
- Increased used of Mulching process.

2. At Government Level :-

- A Command area development programme was launched in 1974.
- Which is coordinated by the ministry of water resources for its implementation in various states of the country.
- Its aim is at improving the irrigational potential through water management.
- In 1989-90, Integrated watershed management programme was launched which was later renamed as "Haryali Guidelines in 2003, and then subsumed under pradhan mantri krishi sinchai yojana.(PMKSY)
- The desert development programme implemented by the ministry of rural development was launched in 1995 to minimize the effects of drought in areas across the country.
- India also became a signatory to the United Nations Convention to Combat Desertification (UNCCD) in 1994.
- National Deforestation programme was implemented by the ministry of Environment, forest and climate change in the year 2000.
- In 2001, the national action programme to combat desertification was implemented by the ministry of Environment forest and climate change.
- Desertification and land degradation atlas of India was released by "ISRO".

3. At International Level :-

- UNCCD- United Nations Convention to Combat Desertification was established on 17 June, 1994 in Paris. (France)
- So, Every year, June 17 is Celebrated as the world day to combat desertification and drought.
- UNCCD entered into force in December, 1996.
- To help publicise the convention, 2006 was declared "International year of desert and desertification" by UN.

Conference of Parties on UNCCD :-

- First five sessions of the COP were held annually from 1997 to 2001, there after the meeting is held every 2 yeras.
- COP - 14 On UNCCD 2019 - New Delhi.
- The theme of the conference was " Restore land, Sustain Futur's".
- Headquaters : Bonn, Germany.
- COP - 15 2022 - Abidjan (Cote d'Ivoire)
- COP - 16 2024 - Riyadh (Saudi Arabia)
- SDG - No. 15 that's title is **Life on Land** is related to fertility of earth surface.
- **Bonn Challenge** - According to this challenge world's 350 million hectare desertified land restored into fertile land by 2030.

Deforestation

- Deforestation can be defined as the large-scale resources of trees from forest (or other lands) for the facilitation of human activities.
- It is a serious environmental concern since it can result in the loss of biodiversity, drainage to natural habitats, disturbances in the water cycle, and soil erosion.
- Deforestation is also a contributor to climate change and global warming.

☑ Causes of Deforestation :-

1. Natural Causes :-

- Volcanic eruption can burn away the forest lands surrounding the volcano.
- Deforestation of forests due to hurricanes flood, and other natural calamities.
- Invasion of the forest ecosystem by parasites that destroy trees.
- Forest fires that are sparked by lightning and other natural phenomena.
- It is important to note that natural factors have a very small share in the overall deforestation.

2. Anthropogenic Causes :-

- The Primary anthropogenic activities (Human Activities) that contribute to deforestation include :-
 1. Agriculture :- Small scale and large scale farming.
 2. Logging :- Cutting of trees for use as raw material.
 3. Mining and urban expansion- Clearing of forest area for the construction of infrastructure.
- According to the secretariat of the UNFCCC :- Agriculture is the root cause of deforestation that is 80 %.
- Logging accounts for another 14 % deforestation.
- Cutting of trees for use as wood fuel account for 5 % deforestation.

☑ Control of deforestation :-

1. Role of Individuals :-

- An individual can contribute to the prevention of deforestation by implementing the **3R (Reduce, Reuse, Recycle)** principle in these daily lines.
- Individual can also combat deforestation by spreading awareness about its negative consequences and participating in tree planting campaigns.

2. Role of Governments :-

- The following strategies can be implemented by governments to combat deforestation.
- Implementation of security measures and strict causes to present illegal logging.
- Increasing the count and range of forests under government protection.
- Carefully planning the construction of Infrastructure (Roads, dams etc.) in order to minimize the loss of forest area.
- Investing in new technologies in the agricultural industry (Such as Hydroponics) and helping farmers implement eco-friendly agricultural practices (Such as cyclic agriculture).
- Optimizing the management of forests by banning inefficient agricultural practices (Such as Slash-and burn agriculture).
- Facilitating the production and use of wood alternatives to reduce the demand for timber. for example- Bamboo can serve as an alternative to wood fuel.
- Launching new reforestation campaigns to restore deforested lands. campaign like -'एक पेड़ मां के नाम' should be promoted.

3. Efforts those are made on International level :-

1. UNREDD – United nations programme on reducing emission from Deforestation.

- In COP- 13 (in 2007) of UNFCCC member countries agreed on this programme
- This Programme starts functioning/Effective 2008
- Headquarter :- Geneva, Switzerland.
- **Objective :-**
 1. Stop the deforestation and forest degradation in developing countries.
 2. Increase the forest cover in developing nation to reduce level of CO₂
 3. Promote the Sustainable development practices through the investment in the environment friendly technology.

☑ Global deforestation pledge :-

- In COP-26 of UNFCCC (Glasgow-2021) 100 member countries signed this pledge to stop deforestation by 2030.
- This pledge is expansion of 2014's New York declaration of forest.