

## Environment Class 13

12th March, 2024 at 9:00 AM

### OZONE LAYER DEPLETION (09:11 AM)

- Tropospheric ozone is an air pollutant, a key ingredient of photochemical smog, and a greenhouse gas.
- However, stratospheric ozone (ozone layer) is beneficial as it filters out dangerous high-energy UVs.
- UV can be further divided into **UV-A, UV-B and UV-C** with increasing frequency.
- The ozone layers filter out dangerous UV-C and a large part of UV-B.
- The ozone layer is in the stratosphere because there is plenty of oxygen and UV light, which leads to an equilibrium between the formation and destruction of ozone.
- If this equilibrium gets disturbed because of anthropogenic factors more towards ozone destruction, it will lead to ozone depletion.
- More exposure to UV light can cause skin cancer, cataracts, genetic defects, and damage to a lot of materials.
- **Dobson Unit:**
- It is a unit of measurement of the ozone layer.
- 1 dobson unit is several ozone molecules, that would be required to **create a layer of pure ozone 0.01 mm thick at zero degrees Celsius at 1 ATM.**
- In terms of dobson units, the ozone layer's average thickness is about 300 dobson units (3mm thick).
- The term ozone hole signifies the reduction of the ozone layer to less than 100 dobson unit

## **MECHANISM OF OZONE DESTRUCTION (09:37 AM)**

- **Ozone Depleting Substances:**
- Human activities add substances to the atmosphere, that can potentially reduce ozone concentration in the ozone layer.
- E.g. Oxides of Nitrogen (Mostly due to Jet Engine Exhaust), and CFCs.
- Originally thought to be an ideal industrial chemical, because of stability, non-toxicity, very less reactivity and longer atmospheric lifetime.
- But it became a leading cause of ozone destruction.
- The chlorine of CFC can go on to destroy more than 100,000 ozone molecules before being removed from the air.
- Interference Reactions: There are reactions which mitigate the destructive impact of Chlorine.
- Nitrogen oxide can act as a catalyst in ozone destruction and at the same time, they can produce the destructive capacity of chlorine.
- **Polar Stratospheric Clouds:** These clouds are formed in the higher stratosphere at less than minus 80 degrees Celsius.
- They provide a surface which converts, benign forms of Chlorine into ozone-destroying forms.
- It also interferes with interference reactions.
- Chlorinated molecules accumulate in the stratosphere and when the first sunlight of the season reaches all of this chlorine becomes available for ozone destruction.
- **Role of Polar Vortex:**
- The polar vortex is a large area of low pressure and cold air surrounding both the earth's poles.
- It exists throughout the year but strengthens in winter.
- This vortex creates some sort of barrier isolating the upper atmosphere from the rest of the atmosphere for some time.
- Thus, Chlorine can remain in the stratosphere for a longer duration.

## **OZONE-DEPLETING SUBSTANCES AND THE SOURCES (10:07 AM)**

- It is a measure of how much damage chemicals can cause to the ozone layer compared to similar mass Trichlorofluoro methane.
- We assign an Ozone destruction potential of 1 to this molecule.
- **CFCs:** Used in refrigeration, air conditioning, foam blowing, cleaning of electronic components, solvents, and insulation.
- **Halons:** Used in fire extinguishers,
- **Bromochloromethane:** ODP of 6
- **Carbontetra Chloride:** Used as raw material in the production of CFC and HCFCs. ODP is 1.1.
- **Methyl bromide:** Used in fumigation of soil and food production facilities. ODP is 0.7.
- **Methyl Chloroform:** Used as a solvent in cleaners, and adhesives. ODP is 0.1.

## **GLOBAL INITIATIVES TO TACKLE OZONE DEPLETION (10:17 AM)**

- **Vienna Convention (1985):**
- For the protection of the ozone layer.
- It paved the way for the Montreal Protocol.
- **Montreal Protocol (1987):**
- It became a legally binding agreement to reduce the production and consumption of ozone-depleting substances.
- It is considered one of the most successful environmental agreements.
- Recent studies suggest that the ozone layer is being repaired and in a few decades will be restored.
- The protocol has become successful because of many reasons:
  1. There were trade restrictions which limited signatories to trade only with other signatories for CFCs and other substances.
- Thus many countries ratified the protocol, there was an approach of cooperation, and a multilateral fund was set up to support developing countries.
- New scientific information was accommodated and incentives were given to the industry to find alternatives to ODS.
- **Kigali Agreement 2016:**
- Montreal Protocol was amended under Kigali Agreement and signatories have to phase out HFCs which were not ozone-depleting but have very high Global Warming potential.
- India is a signatory to all of the above. Under EPA-1986, govt. notified the Ozone-depleting substances (Regulation and Control) Rules, 2000.
- As of now, India has phased out CFCs and is phasing out HCFCs.
- India will start phasing down HFCs in four steps from 2032 onwards:
  - 10 percent reduction by 2032.
  - 20 percent by 2037
  - 30 percent by 2042
  - 85 percent by 2047
- The main replacement of HFCs is a group of refrigerants known as Olefines which has much lower GWP.
- Some companies are also exploring Ammonia, CO<sub>2</sub>, and Hydrocarbon as refrigerants.

## **LAND DEGRADATION AND DESERTIFICATION (10:56 AM)**

- Land degradation can be defined as a negative trend in land conditions which leads to the reduction or loss of at least one of the following:
  1. Biological Productivity
  2. Ecological Integrity
  3. Value to Humans
- Land degradation within dry land regions such as arid, semi-arid areas is termed as desertification which can turn fertile land into desert-like conditions.
- There can be both natural and anthropogenic factors.
- Natural factors wind erosion, Water Erosion, Water logging and Wildfire.
- Anthropogenic factors: Agriculture and related activities, excessive agricultural inputs, Use of pesticides, intensive livestock farming.
- **Land Use Changes:**
- Mining, Industrial Development, Deforestation, Municipal Solid and Plastic Waste.

### **IMPACT OF LAND DEGRADATION (11:28 AM)**

- The environmental impact includes biodiversity loss, extreme weather events, further contribution to climate change, and disruption of ecosystem services.
- Socio-economic impact includes Food Security Issues, Water Scarcity, Environmental Migration, and Zoonotic diseases.

### **GLOBAL INITIATIVES**

- **United Nations Convention to Combat Desertification (UNCCD)**
- Rio Summit: Entered in Force in 1994. It is the only legally binding agreement at the International level which looks into the issue of sustainable land management.
- The convention is working towards **land degradation neutrality (LDN)**.
- This includes the restoration of productivity of degraded land.
- Enhancing the livelihood of people, and mitigating the impact of droughts on vulnerable populations.
- The convention can support countries with the LDN Fund.
- **LDN will be measured by:**
  1. Land Cover and Land Cover Change
  2. Land Productivity
  3. Soil Organic Carbon
- India is a signatory to UNCCD.
- **Bonn Challenge:**
- Launched by govt. of **Germany and IUCN**.
- It is a non-binding challenge to restore 350 million hectares of land by 2030.
- India is part of this challenge and has pledged to restore **21 million hectares**.
- United Nations has declared the current decade as a decade for ecosystem restoration.
- 'Namami Gange' was one of the projects selected for this purpose.

### **Topic for the Next Class: Pollution and Waste Management**