**COURSE N 09**

**ENVIRONMENTAL PROBLEMS**

**6- Climate Change**

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**Definition of climate change and global warming**

**Climate Change** refers to long-term changes in the Earth's climate patterns, particularly in terms of temperature, precipitation, and other atmospheric conditions.

In recent history, human activities have been the primary driver of rapid climate change, particularly through the release of greenhouse gases like carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). These gases trap heat in the atmosphere, altering weather patterns, sea levels, ecosystems, and biodiversity.

Global Warming is a subset of climate change and specifically refers to the long-term increase in Earth's average surface temperature due to the accumulation of greenhouse gases in the atmosphere.

It is one of the most visible manifestations of climate change. Global warming is driven mainly by human activities such as the burning of fossil fuels, deforestation, and industrial processes that release carbon dioxide and other heat-trapping gases into the atmosphere.

**weather and climate**

**Weather refers to the short-term atmospheric conditions in a specific place at a particular time, typically over hours to days. It includes factors like temperature, humidity, precipitation, wind speed, and cloud cover.**

**Climate, on the other hand, refers to the long-term patterns and average conditions of weather in a particular region over a longer period, typically 30 years or more.**

**Causes of Climate Change**

**1. Natural Causes of Climate Change**

* **Volcanic Eruptions:**
  + **When volcanoes erupt, they release large quantities of gases like carbon dioxide (CO₂), sulfur dioxide (SO₂), and ash into the atmosphere.**
  + **Volcanic ash can block sunlight, leading to a temporary cooling effect (known as a "volcanic winter"). However, the CO₂ released by volcanoes contributes to the long-term warming of the Earth.**
* **Solar Radiation Variations:**
  + **The amount of solar energy reaching the Earth can fluctuate due to changes in the Sun's activity.**

**2. Human Activities Contributing to Climate Change**

**Human activities have accelerated climate change in recent decades, primarily through the release of greenhouse gases. Some of the major activities contributing to climate change are:**

* **Burning Fossil Fuels:**
  + **The burning of coal, oil, and natural gas for energy production, transportation, and industry releases large amounts of carbon dioxide (CO₂) into the atmosphere. This is the leading cause of the greenhouse effect, which traps heat and causes the Earth to warm.**
  + **Fossil fuel consumption is the biggest human contribution to climate change, responsible for about 70% of global CO₂ emissions.**
* **Deforestation:**
  + **The clearing of forests for agriculture, urban development, and logging reduces the number of trees that can absorb CO₂ from the atmosphere through photosynthesis.**
* **Industrial Processes:**
  + **Industrial activities, such as cement production, chemical manufacturing, and agriculture, release greenhouse gases like methane (CH₄), nitrous oxide (N₂O),. These gases are potent greenhouse gases that trap more heat in the atmosphere than CO₂.**
  + **Agriculture is a significant source of methane and nitrous oxide emissions, especially through livestock (e.g., cows producing methane) and the use of synthetic fertilizers.**
* **Waste Management:**
  + **Decomposing organic waste in landfills produces methane, a potent greenhouse gas. Improper waste management can exacerbate methane emissions.**

**The Carbon Cycle and Its Role in Regulating Earth's Climate**

**The carbon cycle is a natural process through which carbon is exchanged between the atmosphere, oceans, land, and living organisms. It plays a crucial role in regulating Earth's climate by maintaining the balance of carbon dioxide in the atmosphere.**

* **Carbon Sinks:**
  + **Forests, oceans, and soils act as carbon sinks, absorbing more CO₂ from the atmosphere than they release. This helps regulate atmospheric CO₂ levels.**
  + **Plants absorb CO₂ during photosynthesis, and some of this carbon is stored in vegetation or soils for long periods.**
* **Carbon Sources:**
  + **Respiration, decomposition, and burning fossil fuels release CO₂ back into the atmosphere. Human activities, such as burning fossil fuels and deforestation, have disrupted the natural balance by increasing the amount of CO₂ released, overwhelming the carbon sinks' ability to absorb it.**
* **Human Impact on the Carbon Cycle:**
  + **The burning of fossil fuels and deforestation are causing more CO₂ to be released than can be absorbed by natural carbon sinks, increasing the concentration of CO₂ in the atmosphere. This disrupts the carbon cycle and contributes to global warming and climate change.**

**Carbon sinks are closely related to green carbon.**

**Carbon Sinks and Green Carbon**

**Carbon sinks are natural environments that absorb more carbon dioxide (CO₂) from the atmosphere than they release, helping to reduce the overall concentration of CO₂ in the air. These carbon sinks include:**

1. **Forests: Forests act as a significant carbon sink, absorbing CO₂ through photosynthesis. Trees store the carbon in their biomass (trunks, branches, leaves) and in the soil as organic matter.**
2. **Oceans: Oceans also absorb large amounts of CO₂. Phytoplankton in the ocean take in CO₂ during photosynthesis, and marine plants like seagrasses and mangroves store carbon in their biomass and sediments.**
3. **Soils: Soils store carbon in the form of organic matter, especially in the form of decaying plants and microorganisms. Soil can store carbon for extended periods, making it an important long-term carbon sink.**

**Green Carbon and Its Relation to Carbon Sinks**

* **Green carbon refers specifically to carbon stored in terrestrial ecosystems, particularly forests, vegetation, and soils. This carbon is absorbed through the process of photosynthesis and is stored in the living biomass of plants (trees, grasses, etc.) and in the soil as organic matter.**
* **Forests are the primary source of green carbon. When trees absorb CO₂ during photosynthesis, they convert it into plant matter (e.g., wood, leaves, and roots). This carbon can be stored in the plants for many years, and some of it eventually moves into the soil as organic carbon after the plants die and decompose.**
* **Soils are also a critical component of green carbon because they store a significant portion of the carbon absorbed by plants. Soil carbon storage helps to regulate atmospheric CO₂ levels by acting as a long-term carbon reservoir.**

**In Conclusion:**

**Carbon sinks like forests, oceans, and soils play a significant role in green carbon because they absorb and store carbon through natural processes like photosynthesis and soil organic matter accumulation.**

**This carbon storage process helps regulate atmospheric CO₂ levels and mitigates the effects of climate change.**