

Carbon Sequestration, Types, Importance, Benefits & India

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Carbon sequestration is one of the most important solutions to fight climate change. As the level of **carbon dioxide (CO₂)** in the atmosphere increases, it leads to global warming and environmental imbalance. Carbon sequestration helps in capturing and storing this excess carbon, making our planet healthier and more sustainable.

Studying carbon sequestration is closely linked to **Sustainable Development Goal 13 (SDG 13: Climate Action)**, which focuses on taking urgent action to combat climate change and reduce its impacts.

Carbon Sequestration Types

Carbon Sequestration can be classified into different types based on how and where carbon dioxide (CO₂) is captured and stored. Each type plays an important role in reducing atmospheric carbon and maintaining environmental balance.

1. Biological Carbon Sequestration

Biological carbon sequestration is a natural process where living organisms like plants, trees, and soil absorb and store carbon dioxide through photosynthesis.

- Trees and forests act as major carbon sinks by storing carbon in their trunks, branches, leaves, and roots
- Soil stores carbon in the form of organic matter such as dead plants and microorganisms
- Grasslands and agricultural lands also capture and store carbon effectively
- Wetlands and mangroves are highly efficient in storing “blue carbon” for long periods
- Helps improve soil fertility and supports biodiversity
- It is cost-effective and environmentally friendly

2. Geological Carbon Sequestration

Geological carbon sequestration involves capturing carbon dioxide from industrial sources and storing it deep underground in rock formations.

- CO₂ is captured from power plants, factories, and industrial processes
- The gas is compressed into liquid form and transported through pipelines
- Injected into deep underground reservoirs such as depleted oil and gas fields
- Stored in saline aquifers and porous rock layers
- Can trap carbon for thousands to millions of years
- Requires advanced technology and careful monitoring to prevent leakage

3. Ocean Carbon Sequestration

Ocean carbon sequestration refers to the process by which oceans absorb and store carbon dioxide from the atmosphere.

- Oceans absorb nearly 25-30% of global CO₂ emissions
- Phytoplankton use CO₂ for **photosynthesis**, forming the base of the marine food chain
- Carbon is stored in deep ocean layers through biological and chemical processes
- Marine ecosystems like seagrasses and mangroves store large amounts of carbon
- Helps regulate global climate and temperature
- Excess CO₂ can lead to ocean acidification, affecting marine life

4. Technological (Artificial) Carbon Sequestration

This type uses human-made technologies to capture and store carbon dioxide efficiently.

Includes Carbon Capture and Storage (CCS) and Direct Air Capture (DAC)

- CO₂ is captured directly from industrial emissions or the atmosphere
- Stored underground or reused in products like fuels and building materials
- Helps reduce large-scale industrial carbon emissions
- Still expensive and requires high energy input
- Important for achieving long-term climate goals

Carbon Sequestration in India

India aims to create an additional carbon sink of 2.5 to 3 billion tonnes of CO₂ equivalent through increased forest and tree cover under the **Paris Agreement** commitments

- Forests are the largest carbon sinks in India, with programs like the Green India Mission focusing on afforestation and reforestation
- Agroforestry practices (growing trees along with crops) are widely promoted to increase carbon storage while supporting farmers' income
- Soil carbon sequestration is being improved through sustainable farming methods like organic farming, crop rotation, and reduced tillage
- Mangroves and coastal ecosystems, especially in regions like Sundarbans, act as powerful "**blue carbon**" sinks storing large amounts of carbon
- India is encouraging Carbon Capture and Storage (CCS) technologies in industries to reduce emissions from power plants and factories
- Government schemes like National Afforestation Programme and CAMPA (Compensatory Afforestation Fund) support increasing green cover
- Restoration of degraded lands and wastelands is being carried out to improve carbon absorption capacity

Carbon Sequestration Importance

Carbon sequestration is essential for maintaining environmental balance and reducing the harmful effects of climate change. The importance are:

- Helps reduce **global warming** by lowering the concentration of greenhouse gases in the atmosphere
- Controls climate change by capturing and storing carbon released from human activities
- Improves air quality, leading to a healthier environment and reduced pollution
- Supports biodiversity by protecting forests, wetlands, and marine ecosystems
- Enhances soil fertility by increasing organic carbon content, improving crop productivity
- Helps countries achieve climate targets like carbon neutrality and emission reduction goals
- Protects natural ecosystems such as forests and mangroves, which act as major carbon sinks
- Reduces pressure on oceans by limiting excess CO₂ absorption, thereby lowering the risk of ocean acidification

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