

Carbon Sequestration

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Introduction

Carbon is the basic building block of life and is found in all the living beings on earth. Carbon is a fundamental component of bio molecules and is a chemical element like hydrogen or nitrogen. On Earth, it can be found as a solid, dissolved substance, or as a gas. For instance, carbon may react with oxygen molecules to create gaseous carbon dioxide, which is also found in graphite and diamond. There are several different types of carbon, mostly dissolved in ocean as plant biomass, soil organic matter, and gaseous carbon dioxide (CO₂) in the atmosphere. CO₂ is also one of the main greenhouse gases which is potentially causing global warming leading to climate change. From about 280 parts per million (ppm) by volume before 1850 (the start of the industrial period) to 421 ppm in May 2022, the atmospheric concentration of carbon dioxide (CO₂) has grown by almost 50% (NOAA, 2022). The burning of fossil fuels and deforestation are two examples of human activities that are thought to exacerbate the ongoing increase in CO₂ content in the atmosphere. One of the approaches to reduce the concentration of CO₂ in atmosphere is Carbon sequestration.

Carbon sequestration is the procedure of removing and storing carbon dioxide from the atmosphere. It is one strategy for lowering atmospheric carbon dioxide levels in an effort to slow down the rate of global climate change. This transfer of carbon, also known as "sequestering," improves soil quality and long-term agronomic production while helping to offset emissions from burning fossil fuels and other carbon-emitting activities. It is the long-term preservation of carbon in the earth's soils, forests, vegetation, and other plant and animal life.

Carbon source and carbon sink

The processes that release carbon into the atmosphere are known as carbon sources. Any operation that involves the burning of fossil fuels, like the production of electricity from coal, emits a lot of carbon into the atmosphere. A forest is considered to be a carbon source

It releases more carbon than it absorbs. Other anthropogenic activities such as the burning of fossil fuels have released carbon from its long-term geologic storage as coal, petroleum and natural gas releases lots of carbon to the atmosphere as carbon dioxide gas. Any entity, including plants, the ocean, and soil, that removes more carbon from the atmosphere than it absorbs is known as a carbon sink. Plants grab carbon dioxide from the atmosphere to use in photosynthesis; some of this carbon is transferred to soil as plants die and decompose. The oceans also represent a significant carbon dioxide storage system. While some carbon dioxide merely dissolves in saltwater, marine creatures also absorb the gas for photosynthesis.

Methods of carbon sequestration

1. Geologic sequestration

Geological carbon sequestration refers to the injection of CO₂ into porous geological rock formations. After being injected down below (usually over 800 metres), CO₂ is captured in tiny pores or crevices in the rock structure. The CO₂ storage areas are sealed off by impermeable cap rocks that serve as seals. Current industrial manufacturing practises include this kind of carbon sequestration. Industries that produce steel, energy, and natural gas send carbon dioxide runoff down into the soil, where it is trapped and keeps carbon dioxide from escaping into the atmosphere.

2. Ocean sequestration

Oceans absorb carbon from the atmosphere as a result of the CO₂ gradient since the concentration of CO₂ in atmosphere is higher than in the oceans. The majority of the carbon on Earth is stored in the oceans, but soils hold three times as much carbon as is found in living plants and animals and account for around 75% of all terrestrial carbon reserves. Carbon is naturally stored in the ocean via two pumps, solubility and biological and there are analogous man-made methods, direct injection and ocean fertilization, respectively. The ocean has more potential in absorbing carbon in colder climates, which makes the rise in temperature in polar regions more concerning. Currently, it is believed that a third of human-generated emissions are making their way into the ocean.

3. Terrestrial sequestration

The process by which carbon dioxide (CO₂) from the atmosphere is naturally taken up through photosynthesis and stored as carbon in biomass and soils.

Forest as sink



Plants and Trees are natural sequestrers of carbon, they take carbon from atmosphere; utilize it within the process of photosynthesis as well as they store it within the form of biomass or wood. Large amounts of carbon are stored in both the roots and the leafy growth of plants and trees, which are good at sequestering carbon. The absence of carbon emissions from burning is crucial for the success of this carbon sequestration process.

As forests expand, they store carbon in the organic matter of the soil and the woody tissues of the trees. The net rate of carbon uptake is highest when forests are young and decreases with time. While old woods may sequester carbon for a very long period, they effectively offer no net uptake.

Major strategies for using forests for carbon sequestration are:

- Active forest management
- Avoided deforestation
- Forest preservation
- Afforestation

Wetland restoration

One important natural carbon sink or pool is the soil found in wetlands. Soil carbon can be increased more effectively through wetland restoration.

Benefits of carbon sequestration

- The carbon sequestration slows down the climate change by absorbing extra carbon dioxide from the atmosphere.
- The deep injection of carbon dioxide is very feasible since the CO₂ gas can be easily liquefied and transmitted easily through pipelines.
- Deep injection of CO₂ improves the extraction of fuels like oil and methane from their reserves in addition to removing excess pollutants from the air.
- It also helps in maintaining a healthier ecology in an area.

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