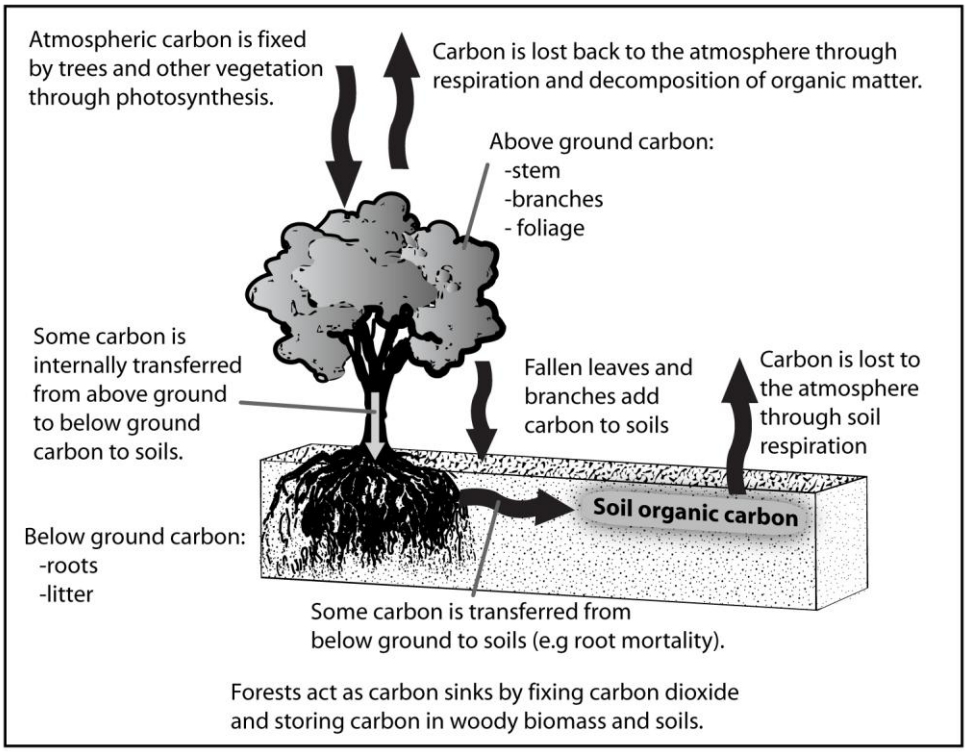
Carbon Sequestration

Forests

Forests are well known sinks for atmospheric carbon. Globally, the carbon content of forests (woody biomass, litter, deadwood, and soil organic carbon) is equivalent to about one half of the carbon in the atmosphere.



The net sum of all carbon inputs and outputs from a system -- like a forest, grassland, city park, or farm field -- is called the "carbon balance." Inputs include woody biomass, and fallen leaves and branches, and outputs include tree respiration and decomposition of soil organic matter. These concepts are the key to evaluating the amount of carbon storage in a given area. The following illustration shows how trees capture carbon dioxide and sequester carbon as an effective method of reducing atmospheric concentrations of the greenhouse gas carbon dioxide:

Carbon Cycle of Forests

Trees, like all other plants, fix atmospheric carbon dioxide through photosynthesis and convert it to biomass and other materials necessary for metabolism. Nearly all of the long-term carbon storage occurs as woody biomass. Only a very small fraction of the carbon fixed becomes soil organic carbon through additions of fallen branches, leaf litter and dead roots. Some carbon is released back to the atmosphere from tree respiration and decomposition of soil organic matter.

Storing carbon in woody biomass is a good choice because it is a stable, long-term carbon pool. Even if a forest is no longer sequestering additional carbon or is sequestering at low rates, the

carbon previously sequestered in biomass is preserved for a long time because wood decomposes very slowly.

Carbon Sequestration: Forests

Dynamic Carbon Cycle over Time

In young trees, respiration and losses of carbon to the atmosphere are low; therefore, most of the carbon fixed through photosynthesis is converted to biomass and sequestered. As trees age, respiration increases because energy is needed to replace dying tissues and a lower proportion of carbon fixed through photosynthesis is converted to biomass and sequestered. At a certain point in time trees no longer sequester additional carbon but instead maintain a constant quantity of carbon. This steady state condition occurs when the carbon gained from photosynthesis and the carbon lost through respiration is equal. Different tree species reach steady state at different times, somewhere between 90 and 120 years.[1,2]

Methods to Sequester Carbon:

- Afforestation - Is the planting of trees where trees have not grown (in the last 100 years). A common type of afforestation is the planting of short rotation woody crops like hybrid poplar. These species grow very quickly and as a result sequester large amounts of carbon in a short time. They are planted and harvested within a short time frame -- 10 to 15 years, and the biomass is sold for paper and other processed wood products.
- Reforestation – Reestablishment of trees on land that had been forested in the last 100 years.
- Forest Management – forests can be managed to maximize their carbon storage. Lengthening time between harvests, selective thinning for increased stocking and planting fast growing species are techniques used to enhance carbon sequestration.

Threats to Carbon Sequestration:

Deforestation is caused by a complete harvest of a forested area, or by prolonged degradation that leads to the destruction of a forest. About 25% of all anthropogenic (human caused) carbon dioxide emissions are due to deforestation. Avoiding deforestation altogether maintains the carbon stores in tree biomass and reduces soil organic carbon losses from soil respiration as a result of disturbance.

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[1] Birdsey, R.A. 1996 “Regional Estimates of Timber Volume and Forest Carbon for Fully Stocked Timberland, Average Management After Final Clearcut Harvest.” In: Forests and Global Change: Vol. 2

[2] Sampson, R.N. and D. Hair. Forest Management Opportunities for Mitigating Carbon Emissions, pp. 309-334, American Forests, Washington, DC.