Info

Working Trees

How can agroforestry increase carbon sequestration?

🔺 *This multiple row windbreak in South Dakota is sequestering carbon and protecting a hay field.* Photo by Nathan Kafer, South Dakota Conservation and Forestry.

People who manage forests, farms, and other lands provide a wide range of public benefits, such as supplying clean water, supporting wildlife habitat, and adapting to climate change, as well as sequestering carbon. Like trees in forests, trees planted in agroforestry practices also sequester carbon and play an important role in reducing greenhouse gas concentrations.

Agroforestry is the intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits. Most agroforestry practices are designed to be multifunctional. This means that they will sequester carbon as an additional benefit while enhancing and/or protecting crop or livestock production, or providing other benefits. Carbon sequestration also can improve soil health and help with adapting to climate change. Given the large amount of land under agricultural production in the United States, the potential for carbon sequestration through agroforestry systems is significant.

> Two key characteristics of agroforestry practices that help increase carbon sequestration are that they include perennial plants and they include a diversity of plants.
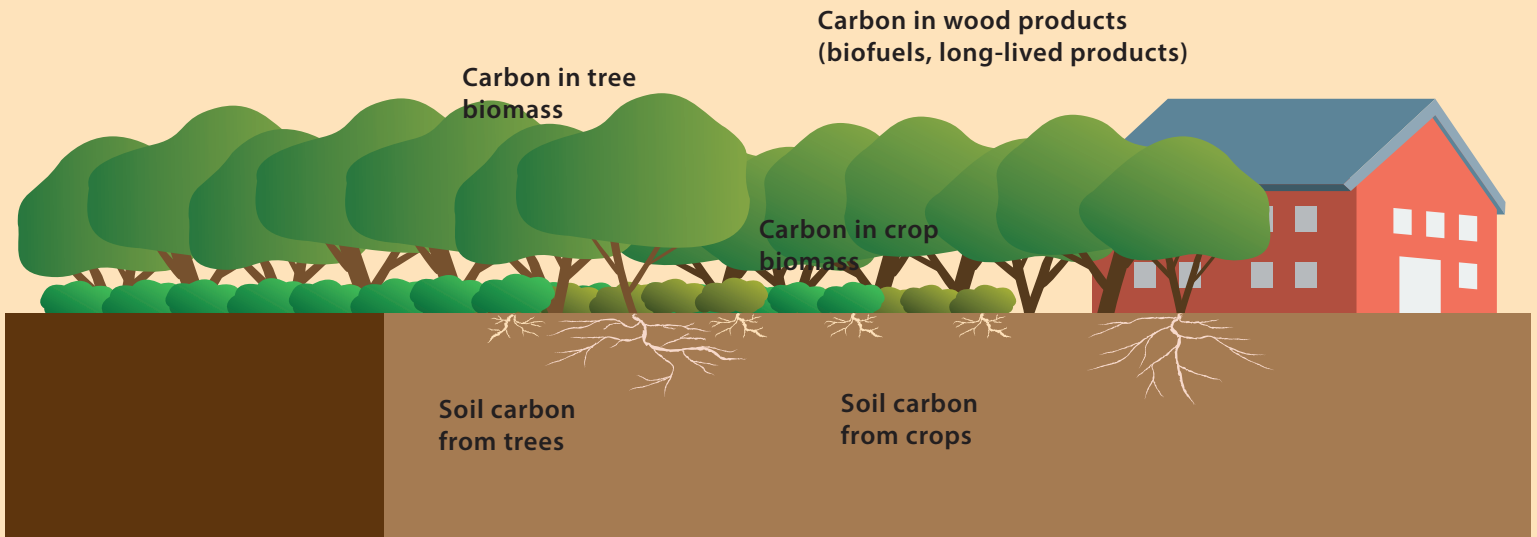

Perennial systems, like agroforestry, generally sequester more carbon than annual vegetation because they grow for more days of the year than annual crops. Also, perennial plants generally store more carbon each year, while annual plants slowly release carbon after they die off each year and decompose. In particular, trees sequester carbon in their trunks and branches, increasing the amount stored as they grow.

Agricultural systems with multiple types of plants tend to use resources efficiently. These systems take up carbon dioxide, reduce production of other greenhouse gases, and store carbon in the soil at different depths. Adding trees to an agricultural system tends to store more carbon than is stored in a similar agricultural system without trees. For example, silvopastures often sequester more carbon than pastures without trees.

The tree and shrub components of agroforestry practices contribute to carbon sequestration by using carbon dioxide for photosynthesis and storing carbon above ground in tree trunks and branches, as well as below ground in roots and the soil. This carbon can stay in the tree or soil for a long time. If the tree is harvested for wood products, this carbon remains sequestered for the life of the product created, such as in buildings or furniture. Additionally, agroforestry systems can also produce food, unlike timber plantations and woodlot plantings.

Carbon in wood products (biofuels, long-lived products)

Carbon in tree biomass

Carbon in crop biomass

Soil carbon from trees

Soil carbon from crops

⬆ Carbon is stored in many parts of agroforestry systems, including in the soil, tree biomass, crop biomass, and wood products.

Here are some examples of how these temperate agroforestry practices can be designed to maximize carbon sequestration on agricultural lands:

Alley cropping

In addition to rows of trees, other perennial crops can be selected to plant in the alleys, increasing the system's total above and below ground sequestration capacity.

Silvopasture

Choosing silvopasture systems that add trees to pastures generally sequesters more carbon than cutting trees to create silvopastures.

Windbreaks

Adding additional rows to a windbreak design, selecting species that grow biomass quickly, or selecting species that are used in wood products can increase the sequestration potential of a windbreak system.

To estimate carbon sequestration potential of current or future management practices, land managers and technical assistance providers can use modeling tools. These tools include COMET-Farm and COMET-Planner, which allow the user to generate reports that estimate carbon changes and greenhouse gas emissions from different management choices for a field or farm. Agroforestry practices provide important ways to increase carbon sequestration while also providing other production and conservation benefits. This makes agroforestry a good option for farmers and land managers interested in increasing carbon sequestration while diversifying their operations.

For more information on climate change, visit: **www.fs.usda.gov/nac/topics/climate change.php**

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