SOIL CARBON & BIOCHAR

WHAT IS SOIL CARBON?

Soil carbon sequestration, also known as "carbon farming" or "regenerative agriculture," includes various ways of managing land, especially farmland, so that soils absorb and hold more carbon. Increasing soil carbon is accomplished in three key ways: (1) switching to low-till or no-till practices; (2) using cover crops and leaving crop residues to decay; and (3) using species or varieties with greater root mass. Double-cropping systems, where a second crop is grown after a food or feed crop, also keep more carbon in the soil.

WHAT IS BIOCHAR?

Biochar is another way of getting carbon into soils. Biochar is a kind of charcoal created when biomass from crop residues, grass, trees, or other plants is combusted at temperatures of 300–600°C without oxygen. This process, known as pyrolysis, enables the carbon in the biomass to resist decay. The biochar is then introduced into soils, where, under certain conditions, it might sequester carbon for many hundreds of years.

CO-BENEFITS AND CONCERNS

+ **Improved soil quality**: soil carbon sequestration and biochar help restore degraded soils, which can improve agricultural productivity and help soils retain water.
− **Saturation**: soils can only hold a finite amount of carbon; once they are saturated, societies will no longer be able to sequester more carbon using soil carbon sequestration.
− **Reversibility**: the carbon captured via soil carbon sequestration and biochar can be released if the soils are disturbed; societies would need to maintain appropriate soil management practices indefinitely.
− **Difficulty of measurement**: monitoring and verifying carbon removal, especially via soil carbon sequestration is currently difficult and costly.

GOVERNANCE CONSIDERATIONS

- ☐ **Encouraging adoption**: good agricultural extension efforts and incentives would be needed to encourage widespread adoption, especially on small farms.
- ☐ **Monitoring, verification, and reporting**: processes, standards, and technologies need to be developed to reliably measure carbon sequestration.
- ☐ **Sustainable biochar production**: policies would be needed to promote and ensure that biomass is sourced and processed sustainabily for biochar.
- ☐ For **cross-cutting considerations**, see the What Is Carbon Removal? fact sheet on our web site.

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TECHNOLOGICAL READINESS

Both soil carbon sequestration and biochar are mature technologies. Soil carbon sequestration techniques are already in widespread use. Biochar is already produced and used in relatively small quantities. Both would need to be scaled up substantially to achieve significant climate benefits.

POTENTIAL SCALE AND COSTS

Soils hold three times the amount of carbon dioxide (CO_2) currently in the atmosphere or almost four times the amount held in living matter. But over the last 10,000 years, agriculture and land conversion has decreased soil carbon globally by 840 $GtCO_2$, and many cultivated soils have lost 50–70% of their original organic carbon. Because soils have such a large storage capacity, enhancing soil storage by even a few percentage points makes a big difference. The amount of carbon sequestered beneath particular parcels of land depends upon many variables, such as the soil type, the climate, and the prior land use. Moreover, sequestration follows a curve: the new practices sequester a lot of carbon at first, for the first two decades or so, but this diminishes through time towards a new plateau as soils become saturated with carbon. A recent expert assessment estimates that **soil carbon sequestration** could be scaled up to **sequester 2–5 billion metrics tons of CO_2 ($GtCO_2$) per year by 2050**, with a **cumulative potential of 104–130 $GtCO_2$ by the end of the century** at a cost of **between $0 and $100 per ton of CO_2**.

The potential and cost of using biochar at large scales are less clear. A recent expert assessment estimates that **biochar** could **sequester 0.5–2 $GtCO_2$ per year by 2050** at a **cost of $30–120 per ton of CO_2**. The broader academic literature envisions sequestration rates between 1 and 35 $GtCO_2$ per year with estimates of the **cumulative potential ranging from 78–477 $GtCO_2$ this century**. Further research is needed to refine estimates of biochar's cost and potential.

FURTHER READING

Sabine Fuss et al., "Negative emissions—Part 2: Costs, Potentials and Side Effects," *Environmental Research Letters* 13, no. 6 (2018): 063002, https://doi.org/10.1088/1748-9326/aabf9f.

Pete Smith, "Soil carbon sequestration and biochar as negative emission technologies." *Global Change Biology* 22, no. 3 (2016):1315–24. https://doi.org/10.1111/gcb.13178

For more fact sheets on carbon removal,
visit www.american.edu/sis/carbonremoval/factsheets

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