

Land Carbon Sequestration and Soil Health

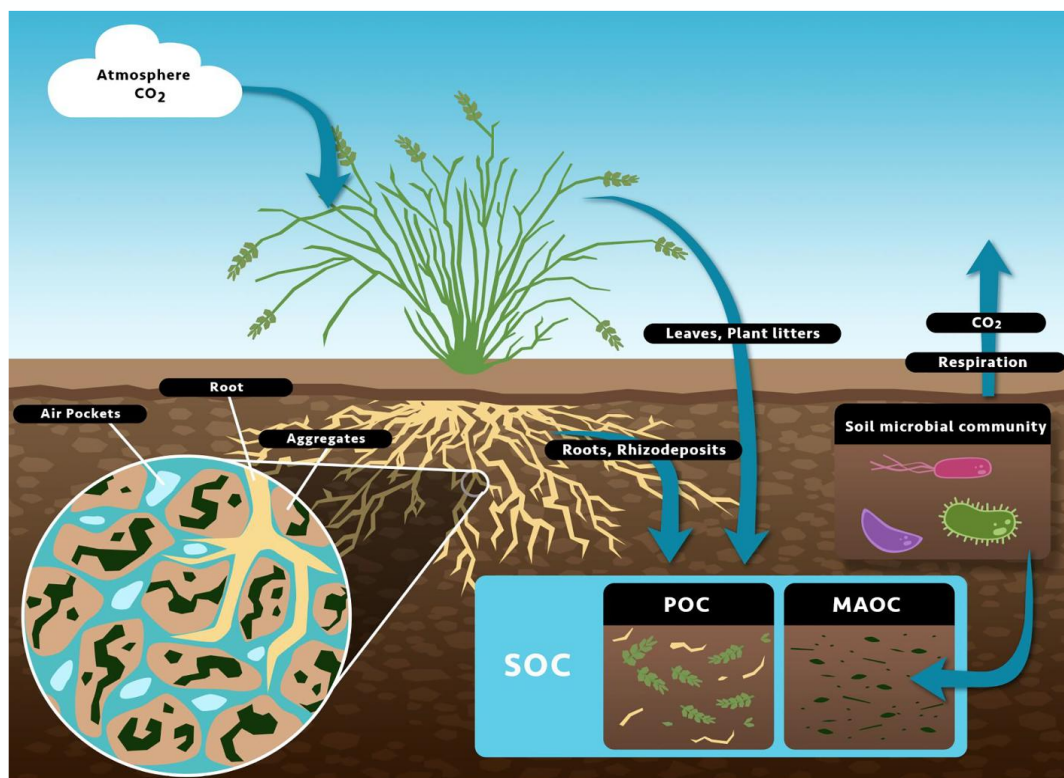


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Key points

- Soil carbon sequestration and greenhouse gas mitigation are possible in arid and semiarid lands.
- Soil organic carbon sequestration increases with improved agricultural practices.
- Besides, adding basalt rock dust to agricultural, rangeland, and forest soils is increasingly considered an emerging method to sequester carbon.
- Optimal economic incentives to farmers and landowners can drive success in carbon sequestration.

Carbon sequestration involves capturing atmospheric carbon and storing it in a solid or liquid form. Carbon sequestration and mitigation of greenhouse gas emissions on agricultural, forest, urban lands can occur through various means. Identifying, verifying, and disseminating cost-effective practices to sequester carbon while optimizing resource use could provide climate change solutions and additional revenue to farmers and ranchers.



Why soil carbon sequestration is important?

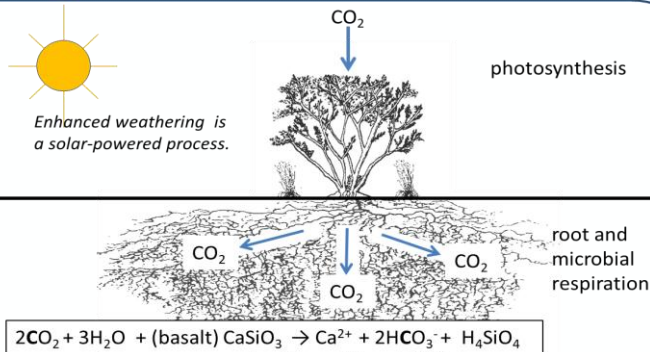
Soil carbon—as both organic carbon (1500 Pg) and inorganic carbon (940 Pg)—is the largest global terrestrial carbon pool, exceeding four times the amount of carbon contained in plants (560 Pg). Since a large amount of soil carbon has been lost from soil in the last 100 years due to anthropogenic activities (farming, urbanization, etc.), soil carbon sequestration could be a pathway to mitigate climate change.

Agricultural management for soil carbon sequestration

- **Reducing soil disturbance:** reduced and no-tillage management protects carbon from oxidation. They also increase soil aggregation and protect carbon in soil aggregates.
- **Intensifying and diversifying cropping systems:** cover cropping, crop rotation, intercropping of deep and shallow-rooted crops, and perennial cropping add biomass carbon to soil and increase carbon sequestration.
- **Soil amendments:** amendments like compost and biochar applications add carbon to the soil. Microbially processed carbon in compost can be stored for years. Well-prepared plant biochar, a charcoal-like material produced from pyrolysis, has a half-life of more than 100 years.
- **Improved nutrient management:** Adopting 4R nutrient strategies (right source, rate, method, and time) and precision nutrient management increases soil carbon sequestration and improves soil health.

Enhanced weathering for sequestering carbon

Enhanced weathering of basalt rock dust added to soil is an emerging method for sequestering carbon. The CO_2 plants pull from the air during photosynthesis are pumped into the soil during root respiration, which reacts with basalt particles to create calcium carbonate and bicarbonates. Basalt has been mined and crushed across New Mexico to produce coarse aggregates used in concrete and road construction. Spreading crushed basalt on soil, selecting salt-tolerant species to grow, and using techniques for dust control will provide next-generation solutions for soil carbon sequestration.



- Plants pull CO_2 from the air by photosynthesis and “pump” it into soil by respiration. In the soil, carbon is sequestered as 2HCO_3^- after CO_2 reacts with basalt particles.
- In regions with high rainfall and in irrigated agriculture, the 2HCO_3^- is carried downward into groundwater aquifers. From aquifers, 2HCO_3^- slowly flows with water to streams, then to rivers, and eventually to the oceans. In the oceans, C remains sequestered as 2HCO_3^- until it crystallizes as marine limestone CaCO_3 where it is stored at geological time scales.



Why New Mexico? New Mexico is the 5th-largest state, covering an area of 121,590 mi^2 , of which approximately 50% is grassland and savanna, 20% is forests, and 19% is shrubland, with the remaining areas being agriculture, urban, and other lands. New Mexico’s biomes are similar to other dryland biomes in 1/3 of Earth’s land surface.

New Mexico State University College of ACES has 12 Agricultural Science Centers across the state, which could serve as a test-bed for carbon sequestration technology applicable to half of the world. The state also has many Historically Underserved Farmers and Ranchers who can generate revenue through carbon credit programs.

System approach in carbon management and soil health: A systems research approach is needed to make effective long-term decisions about needs and solutions for carbon sequestration in the land use sector and link that with soil health and human wellbeing.

Policy and socioeconomic interventions: Linking carbon sequestration with soil health and optimizing economic incentives to farmers and landowners can drive the success in carbon sequestration efforts. Dramatic changes to current agricultural land use will require the consent of landowners. By providing incentives, farmers and landowners will be motivated to adopt carbon sequestration practices on a large scale, transforming agricultural production, soil health, and environmental quality. Tools must be developed by evaluating region specific opportunities and challenges and estimating arid and semi-arid land’s carbon sequestration and climate mitigation potential.

