Building soil carbon for environmental & human wellbeing

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SOIL IS A CRITICAL CARBON STOCK

Soil keeps carbon out of the atmosphere and contributes to agricultural productivity.
HOW MUCH SOIL ORGANIC MATTER IS NEEDED FOR SUSTAINABLE AGRICULTURE?
HOW MUCH SOIL ORGANIC MATTER IS NEEDED FOR SUSTAINABLE AGRICULTURE?
2% SOIL ORGANIC CARBON IS CITED AS A CRITICAL THRESHOLD FOR SUSTAINABLE AGRICULTURE

Kemper and Koch (USDA ARS 1966)
CROPS GROWN ON SOILS WITH LESS THAN 2% SOIL CARBON ARE LESS PRODUCTIVE
77% OF MAIZE CULTIVATION IS ON SOILS WITH <2% SOIL ORGANIC CARBON
TYPES OF SOIL CARBON
Different forms of soil carbon impact different ecosystem services

<table>
<thead>
<tr>
<th>STABLE SOIL CARBON</th>
<th>ACTIVE SOIL CARBON</th>
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<tbody>
<tr>
<td>Locked onto minerals for years; increases water holding capacity</td>
<td>Readily usable by microbes. Sometimes correlated with crop productivity</td>
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Fast-cycling organic matter
Provides nutrients for plants

Belowground/root inputs

DECOMPOSITION

FORMATION

Slow-cycling organic matter
Stores water and nutrients

Aboveground inputs

THE NATURE CONSERVANCY

Lehmann and Kleber (Nature 2015)
SOIL ORGANIC MATTER SCIENCE

Key knowledge gaps

<table>
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<th>SEQUESTRATION</th>
<th>CROP YIELD</th>
<th>IS TNC HAVING AN IMPACT?</th>
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<tbody>
<tr>
<td>How can land management increase stable soil carbon?</td>
<td>How does organic matter impact yield and water availability?</td>
<td>How much and what types of soil carbon are being built by TNC?</td>
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SAMPLING TNC SOIL

15 sites globally

THE NATURE CONSERVANCY
DOES SOIL ORGANIC MATTER IMPACT YIELD?

- **Active cycling organic matter**
- **Partially decomposed plant material**
- **Stable organic matter**

**Fast cycling** → **Slow cycling**
DOES SOIL ORGANIC MATTER IMPACT YIELD?

Yield

- Fertilizer

Active C

Control Manure Manure stover

Particulate C

Control Manure Manure stover

Stable C

Control Manure Manure stover
CAN LAND MANAGEMENT INCREASE STABLE SOIL CARBON?

Stable C (g C g soil⁻¹)
PRIORITIZE PRACTICES FOR SOIL CARBON
Management impacts different types of carbon at different time scales
Soil minerals determine carbon sequestration

**PRIORITY AREAS FOR SOIL CARBON**

![Graph showing the relationship between soil texture and stable carbon concentration. The R² value is 0.53732.](image)
SOIL SOLUTIONS
Three approaches to managing soil for climate and agriculture

<table>
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<tr>
<th>Restore Stable and Active Carbon</th>
<th>Protect Existing Stable Carbon</th>
<th>Consider Local Benefits</th>
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<td>Use priority practices in priority areas to build carbon</td>
<td>Reducing land conversion will keep carbon in the soil</td>
<td>The greatest benefits of soil carbon may be to local ecosystems</td>
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