Biochar Systems as a Tool for Climate Change Mitigation

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Biochar Systems

Carbon-negative bioenergy

Systems Benefits

- Mitigation of Climate Change
- Waste Management
- Energy Production
- Soil Improvement
- Social, Financial Benefits
Terra Preta de Indio

500-8,000 years old!
(Amazon, Brazil)
Biochar Soil Improvement

![Graph showing the correlation between Organic Carbon (mg g⁻¹) and Cation Exchange Capacity (mmolc kg⁻¹). The graph is divided into two sections: Biochar-rich soils and Biochar-poor soils. The equations for the lines are:

- Biochar-rich soils: \( r^2 = 0.909 \)
  \[ \text{CEC} = 2.81C + 9.1 \]

- Biochar-poor soils: \( r^2 = 0.784 \)
  \[ \text{CEC} = 8.60C - 18.6 \]

References:

Soil Biology

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Biochar Stability

About 1.5 to 2 orders of magnitude greater than uncharred biomass

Bruun et al., 2008, *Organic Geochemistry* 39, 839-845
Lehmann et al., 2008, *Nature Geoscience* 1, 832 - 835
Kuzyakov et al., 2009, *Soil Biology and Biochemistry* 41, 210-219
Major et al., 2010, *Global Change Biology*, 16, 1366-1379
Zimmerman, 2010, *Environmental Science and Technology* 44, 1295-1301
Biochar Stability and Stabilization

Ordinary organic matter (plant residues, manures, compost)
Biochar Carbon Sequestration

Systems Analysis: Life Cycle Assessment

Greenhouse gases (kg CO$_2$e t$^{-1}$ dry feedstock)

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Switch grass A
emit.        reduct.        Net = - 442
Switch grass B
emit.        reduct.        Net = + 36
Yard waste
emit.        reduct.        Net = - 885

Biochar Stability – Life Cycle Relevance

Biochar Production with Energy Generation
Biochar Production without Energy Generation

[Image of biochar production equipment]
Large Global Interest

- U.S. Biochar Initiative – second national conference in Iowa, 2010, with over 300 attendees from all areas of industry

- UNFCCC/UNCCD interest, biochar centers in UK and NZ

- International Biochar Initiative Conference, September 2010, Rio de Janeiro, Brazil (www.biochar-international.org)
The way forward

- Biochar system analysis at scale of implementation (sustainability, unintended consequences, economics, emission budgets, etc) through targeted R&D programs

- Inform quality control of biochar for soil carbon sequestration

- Development of sustainability recommendations for farmers and land managers