

Biochar and Sustainability

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International
Biochar Initiative

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Biochar and Sustainability

Presentation Overview

- What is biochar?
- What makes biochar carbon-negative?
- How can biochar promote sustainability?
- The International Biochar Initiative



Biochar and Sustainability

Q: What is *biochar*?

A: *Biochar* is a charcoal-like substance produced from the controlled, incomplete combustion of biomass with limited oxygen. Used as a soil amendment, *biochar* creates a stable organic carbon reservoir that is virtually permanent (hundreds to thousands of years).



Biochar and Sustainability

- During the conversion of biomass to **biochar**, about 50% of the biomass C is retained in the crystalline biochar structure (*Lehmann, 2007*)
- Energy co-product (oil, gas form)
 - Thermal energy (cooking, heating)
 - Oil or gas for on-farm electricity generation
 - Oil or gas for refining, fuel production



What makes BIOCHAR "*Carbon-negative*"?

CO₂ Cycle (simplified): "Carbon-neutral"

- CO₂ is captured by photosynthesis, and fixed into biomass
- Biomass decays into CO₂

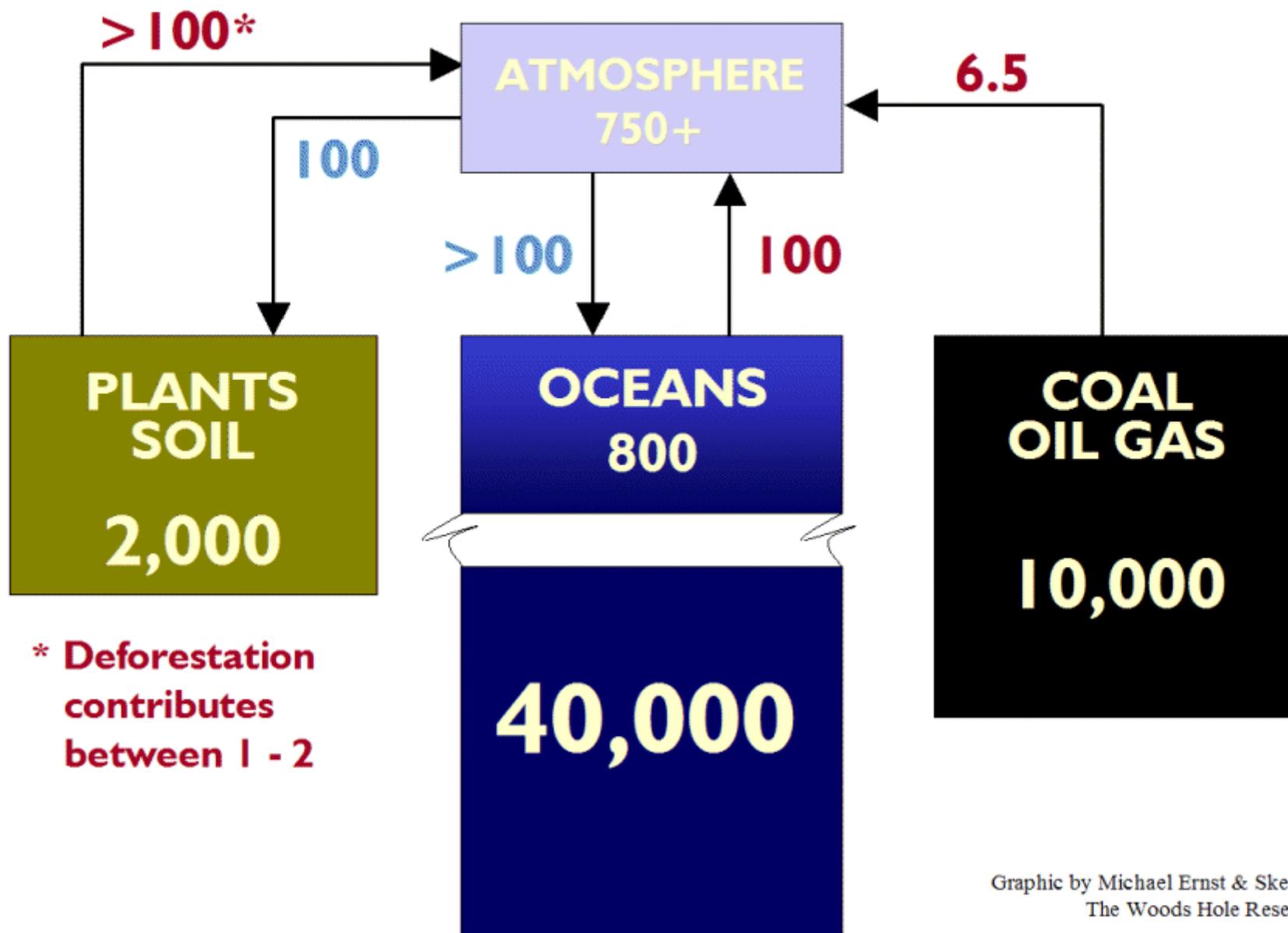
BIOCHAR halts the decay process, and captures the C in a virtually permanent carbon stock, *preventing re-release to the atmosphere.*

- **Bury it!** As a soil amendment, biochar also has beneficial agronomic and water quality impacts.



Global Flows of Carbon

(Petagrams of Carbon/Year)



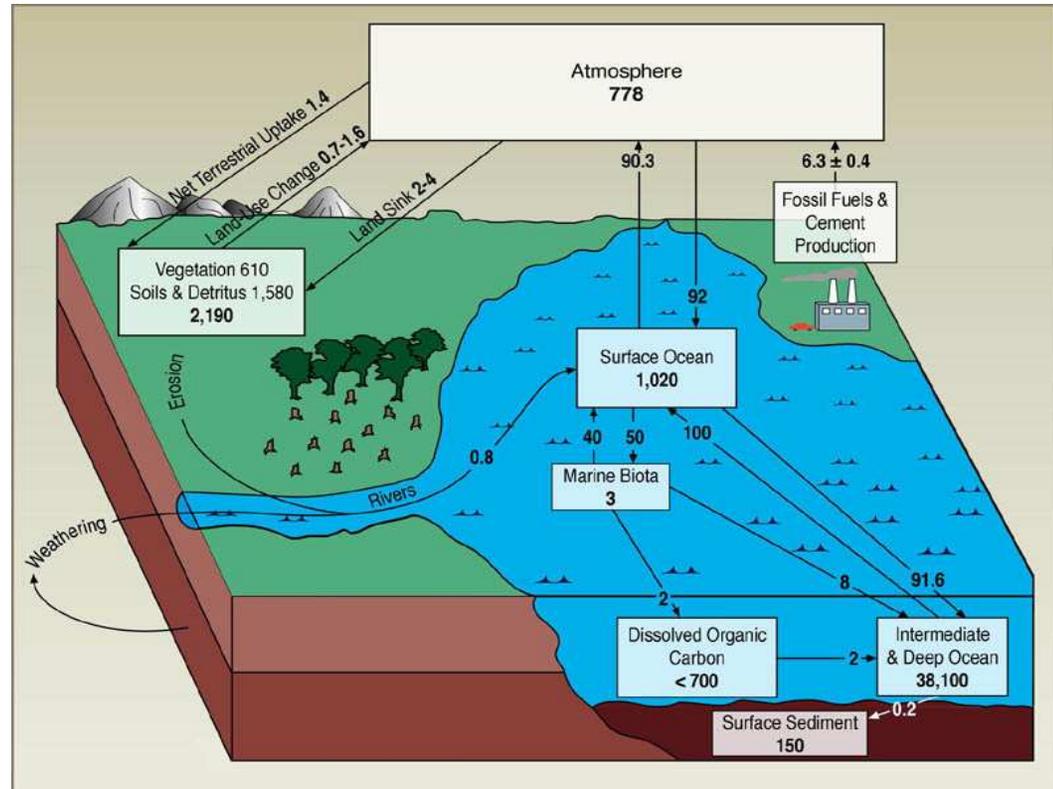
Graphic by Michael Ernst & Skee Houghton
The Woods Hole Research Center

Biochar & Climate Change



Since all atmospheric CO₂ passes through biomass every seven years, the production and utilization of *biochar* on a large enough scale would lead to significant negative trends in global CO₂.

C Cycle Graphic:
www.climate-science.gov



Biochar and Sustainability

*Q: How can **biochar** promote sustainability?*

- Agriculture can itself create sustainably fertile soils: agricultural waste biomass to **biochar**
- Concept: “Terra Preta de Indio” soils
- Terra Preta soils of Amazon basin contain up to 70x more black carbon than surrounding soils, and high levels of nitrogen, phosphorus, potassium, and calcium



Biochar and Sustainability: Terra Preta de Indio Soils

Terra Preta de Indio Soil



Nearby Oxisol Soil



Photos: Julie Majors, Cornell University

Biochar and Sustainability: Improving the Earth's Soils

- Impact of ***biochar*** on soils, crops:
 - Enhances nutrient retention and plant bio-availability, enhances moisture retention, inhibits nutrient leaching into ground and surface waters
 - Improves soil quality, fertility, productivity (Terra Preta timescales?)

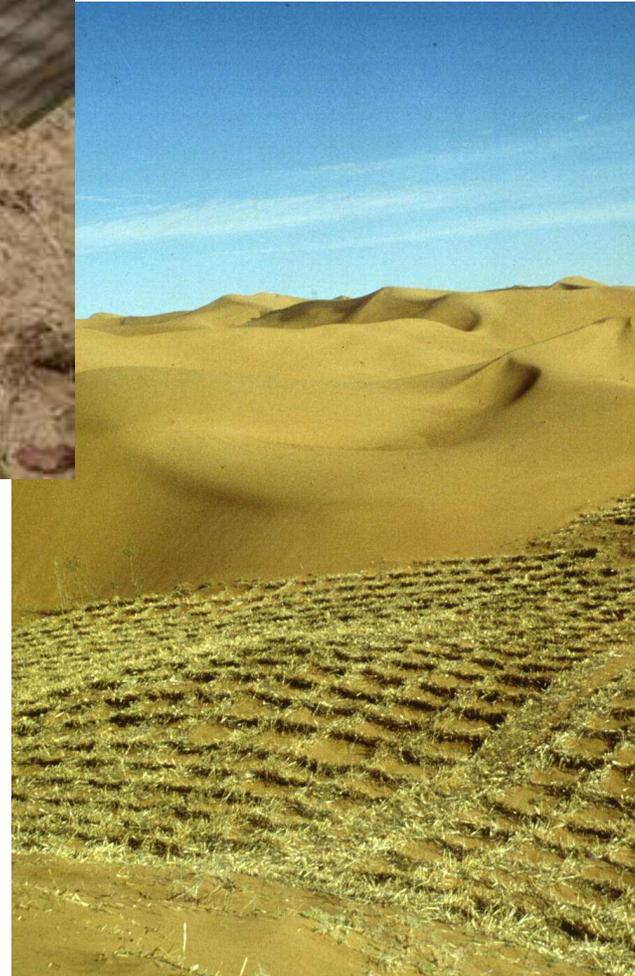


Biochar and Sustainability

- ***Biochar*** in a developing country context:
 - Household-level ***biochar*** systems can combine cooking function with biochar production for crops (gardens, farms), biomass for fuels
 - Enhance food & energy security, reduce desertification



Biochar and Sustainability: Avoiding Desertification



Photos: International Development Research Center
(www.idrc)

Avoiding Tropical Deforestation: Use "Slash-&-Char" to replace "Slash-&-Burn"



Photos: Christoph Steiner (www.biochar.org)



Biochar and Sustainability

- **Biochar** in rural, agricultural settings:
 - Utilization of waste biomass (e.g. peanut or rice hulls, tree bark/waste, animal manure) to produce **biochar**
 - **Biochar** can replace part of chemical fertilizer inputs, enhance crop productivity, soil quality
 - **Biochar** can improve water quality impacts of agriculture



What Makes Biochar Work?

- Considerable R&D efforts underway
- Highly porous, has a very high surface area
- Supports soil microbial communities
- Stimulates mycorrhizal fungi in soil, which promotes plant growth
- Higher soil nutrient retention and nutrient bio-availability (related to higher cation-exchange capacity and high surface area of the charcoal)
- **Biochar** in soils increases above- and below-ground biomass production



Biochar Pot Trials:

Biochar from rice husks (500°C); sterilized subsoil



Control



Biochar



Biochar + fungi

Photos: Robert Flanagan, SAFFE, China (2008)



The International Biochar Initiative

- A *consortium* of research, commercial, and policy-oriented institutions and people devoted to sustainability of world's soils, and sustainable bioenergy production
- Formed at 2006 World Congress on Soil Science
- 1st international conference Spring, 2007 in Australia (www.iaiconference.org)
- 2nd international conference Sept. 8-10, 2008 in Newcastle, UK (www.biochar-international.org)



The International Biochar Initiative

- IBI is a platform for the international exchange of information and activities in support of **biochar** research, development, demonstration and commercialization.
- IBI advocates **biochar** as a strategy to:
 - improve the Earth's soils;
 - help mitigate the anthropogenic greenhouse effect by reducing greenhouse gas emissions and sequestering atmospheric carbon in a stable soil carbon pool; and
 - improve water quality by retaining agrochemicals.
- IBI also promotes:
 - sustainable co-production of clean energy and other bio-based products as part of the **biochar** process;
 - efficient biomass utilization in developing country agriculture; and
 - cost-effective utilization of urban, agricultural and forest co products.



The International Biochar Initiative



International
Biochar Initiative

www.biochar-international.org

2nd International IBI Conference:

8-10 September, 2008 in Newcastle, UK