# Biochar from Agricultural Wastes:
# Soil Restoration, Enhanced Sequestration and On-Farm Energy Production

Debbie Reed[1], Johannes Lehmann[2]

[1]International Agrichar Initiative, Renew the Earth, USA, [2]Department Of Crop and Soil Sciences, Cornell University, USA

## Introduction

The discovery of islands of rich, dark soils with high organic matter content in the Amazon basin has generated global interest in replicating their existence. These ***terra preta*** ("dark earth") soils, as they are known, are highly prized by local farmers for their fertility and productivity, despite being located in an area notorious for poor, highly acidic, low organic matter oxisol soils. The ***terra preta*** soils were produced by indigenous populations thousands of years ago, and still exhibit far greater carbon and organic matter content than surrounding soils. Scientists have linked the soil properties to additions of charcoal from smoldering fires, nutrients from human wastes, and high microbial content, among other things. By understanding how the soils were created and what sustains their carbon retention, fertility and productivity, replication of the soils can enhance a stable soil carbon sink, promote agricultural sustainability, and aid non-agricultural land restoration.

Pyrolysis of agricultural or forest biomass to create a fine-pored char product (aka "biochar" or "agrichar") for use as a soil amendment is a promising technology under investigation. When applied to tropical, poor, or depleted soils, charcoal has been shown to increase soil nutrient retention capacity and enhance microbial diversity of the soil beyond what is possible by adding conventional inorganic or organic fertilizers alone. The specific surface properties and the high surface area of the char captures otherwise leachable or volatile nutrients, thus providing additional fertilizing benefits for plant growth. As a soil amendment, char can also be enriched with nitrogen in the form of ammonium bicarbonate (ABC). Initial studies of the process in China have found that ABC is significantly more beneficial and effective when applied with charcoal. The pyrolysis process also yields bioenergy in the form of hydrogen gas, oils, electricity and/or heat.

Size-appropriate pyrolysis units could establish contained, localized production systems to utilize waste biomass, sustain the soil resource, create stable, enhanced carbon sinks, and produce energy for on-farm or on-site utilization. Mobile units could optimize seasonal or shared ownership among farmers or cooperatives.

In addition to its agronomic value, the char remains in the soils for centuries, thus offering the potential to sequester carbon for long periods of time. Char's combined benefits -- carbon storage and the preservation of soil retention and quality -- will be increasingly important as policies are enacted to increase renewable fuel production from agricultural biomass, and to combat global climate change.

An international consortium of research, commercial and policy-oriented people and organizations devoted to the sustainability of the world's soils, and to sustainable bio-energy production, have joined together to further develop and promote the research, technical and policy applications of this promising area. As the ***International Agrichar Initiative***, this coalition is prioritizing key research and management questions to commercialize the technology and identify and promote key policy applications.

## IAI 2007 Conference

The **2007 Conference of the International Agrichar Initiative (IAI),** on char science, production and utilization, is being held April 29-May 2, 2007 in New South Wales, Australia. Associated conference field trips will visit: (1) a pyrolysis and agrichar production unit operated by BEST Energies Inc, and (2) the New South Wales Department of Primary Industries, where agrichar is being tested in agricultural field trials.

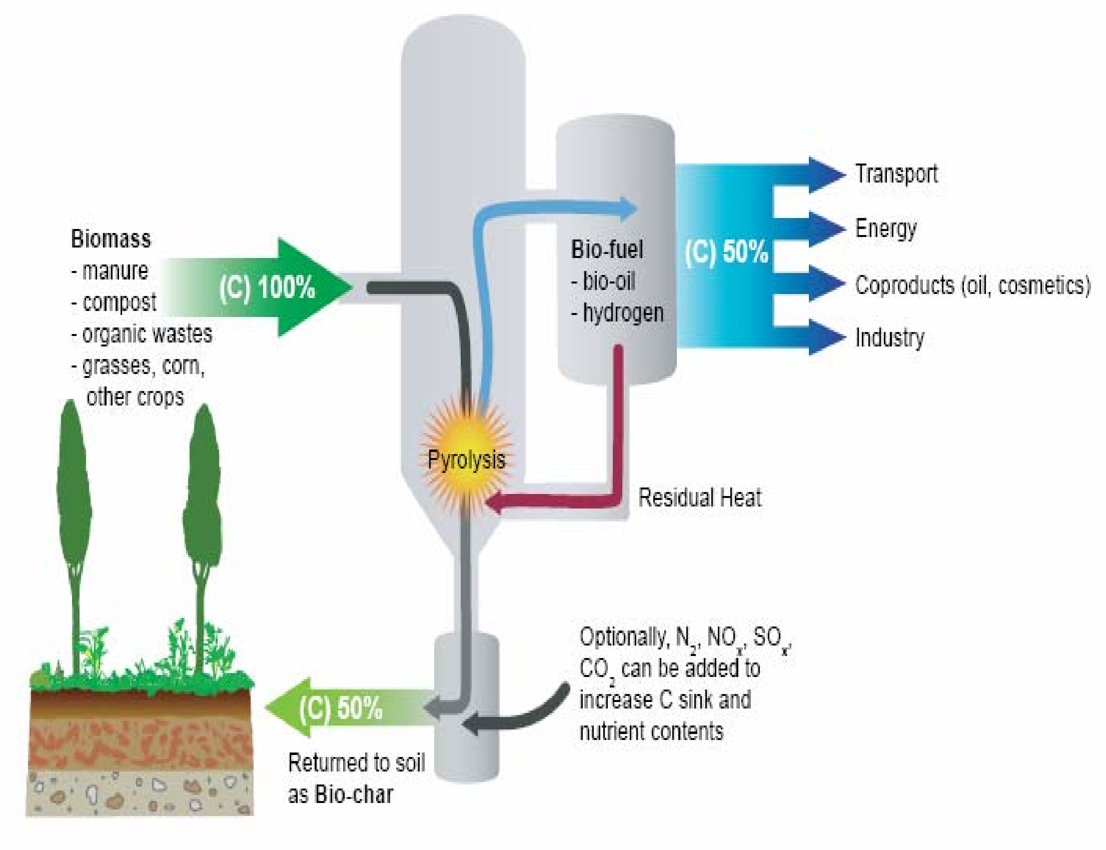
For more information on the IAI 2007 Conference, including the conference agenda, go to:
**www.iaiconference.org**

## Critical Next Steps

A number of critical agronomic, technological, and carbon accounting research questions remain to fully achieve the promise of biochar/agrichar. For example:
- Is it possible to produce a consistent, hi-quality char with desired nutrient levels (e.g., N, P, K)?
- Is it possible to predetermine the char profile and crop-dependent impacts, including nutrient release, based on feedstock and pyrolysis factors?
- Can char be pelletized or otherwise packaged for delivery into soils via conservation tillage methods?
- Can the system address on/off-farm waste management and enhance profitability and environmental impacts?

## Schematic: Pyrolysis of Agricultural Biomass to Biochar and Energy

Agricultural biomass (e.g., corn stover, livestock manure, peanut hulls, forest biomass) is pyrolyzed at low temperatures (350-500°C) to produce a fine-grained, porous char material. The char (aka "biochar" or "agrichar") retains up to 50% of the biomass carbon content. As a soil amendment, biochar can sequester carbon, improve soil fertility and productivity, and enhance crop yields. Co-produced energy can fuel the pyrolysis unit and on-farm energy needs. Unlike "carbon neutral" processes, the biochar process is "carbon-negative": it removes atmospheric carbon. The biochar system can resolve waste management on-site, contribute to mitigation of global climate change, and enhance profitability.

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