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Progressing from Terra Preta de Índios to the Whole World

# Climate Change Mitigation Value and Potential

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## Introduction

There are increasing calls to mirror and enhance this process by the concerted use of 'biochar', a form of charcoal produced with the simultaneous production and capture of bio-energy which is then applied to the soil. A measure of the need and interest for a concerted effort in this area has been the evolution of an organised consortium, known as the International Biochar Initiative (IBI) (<www.biochar-international.org>).

The inspiration for the supplementation of soil with charcoal stems from observations made in the ancient agricultural management practices that created terra preta, deep black soils. These soils, found throughout the Brazilian Amazon, are characterised by high levels of soil fertility compared with soils where no organic C addition occurred (Harder, 2006; Marris, 2006; Lehmann, 2007a; Renner, 2007). The evident value of the terra preta led to the suggestion that investment into biochar and application to agricultural soil may be both economically viable and beneficial. Rising fossil fuel prices, the need to raise yields in light of the global food crisis, and the emergence of a significant global market for trading carbon appear to promise added economic incentives in the future.

At the same time the need to protect soils under an increasingly uncertain climate makes the apparent ability of biochar to increase the capacity for soil to absorb and store water vitally important. It also appears that adding biochar to soil may be one of the only ways by which the fundamental capacity of soils to store and sequester organic matter could be increased.

There are a number of detailed reviews describing charcoal formation (Knicker, 2007) and associated C dynamics (Preston et al., 2006; Czimczik et al., 2007), including its role in the global carbon cycle (Schmidt et al., 2000). Forthcoming is a compendium of review articles ("Biochar for Environmental Management: Science and Technology"), which will place existing studies in the context of pyrolysis bioenergy (Lehmann and Joseph, 2009b ).

Current studies are in many cases conceptually or geographically limited, and are often constrained by limited experimental data. In particular, mechanistic descriptions of the characteristics of biochar and its function in the soil and experimentation relevant to wide-scale applications of biochar are currently limited. In this report we examine existing published research within a framework constrained by a policy context. Thereby, we aim to identify gaps where new research should be focused in a way that will enable biochar to engage with climate change mitigation and to maintain soil productivity.

## Results

The summary of guidelines can be found in the Table 1.

| Crop Name | Results |
|---|---|
| Tomato | 0.5 $Mgha^{-1}$ char increased biomass 140% |
| carrot | 0.5 $Mgha^{-1}$ char increased biomass 102% |
| Maize on volcanic soil | 0.5 $Mgha^{-1}$ char increased yield 131% |
| ‘’ | 5 $Mgha^{-1}$ char decreased yield to 53% |
| ‘’ | 5 $Mgha^{-1}$ char decreased yield to 19% |
| Onion on clay loam soil | 0.5 $Mgha^{-1}$ wood charcoal increased biomass by 240% |
| ‘’ | 0.5 $Mgha^{-1}$ bark charcoal increased biomass 224% |
| ‘’ | 0.5 $Mgha^{-1}$ activated charcoal increased biomass 200% |
| Maize | 91% yield higher and biomass yield 40% higher on charcoal site than control |
| Maize, garden peas and Squash in area of low soil fertility | Water Hyacinth charcoal plus urine and manure increased maize and garden peas yields but not squash |
| Beans | Beans yield increased by 50% and Manure production by 43% over the control at 90 and 60$gkg^{-1}$ biochar respectively |

## Conclusions

Based on the results of this review, the following research priorities have been identified:

1) Determine a predictive relationship for properties and qualities of biochar and its manufacture such that it can be optimized for use in soil.

2) Examine how the possibility of adverse impacts on the soil and atmosphere can be eliminated with certainty.

3) Model the impact of alternate bioenergy systems on the carbon cycle at the global scale, and in the context of national targets, in order to support policy decisions and devise suitable market instruments.

Since the underlying context for biochar-based strategies is that of global climate change, research needs to provide answers that are applicable under diverse combinations of climate, agriculture and energy production systems. This requires a fundamental, mechanistic understanding of how biochar provides its unique functional characteristics, probably embodied in models, and would include its interactions with other living and nonliving components of soil.

## Field Trial in Western Kenya

In Picture one and two Salim Mayeki Shaban determining the height of Crops in the Biochar Test Plots.In Picture three and four Mayende observing squash and maize in his biochar test plot

Rob Lavoie helping my staff and community prepare biochar test plots in Musamba Village in Mumias District in Western Kenya