*New Agriculturist*

# Biochar - putting carbon back

If burning fossil fuels has caused global warming, trapping atmospheric carbon dioxide in a stable, solid form and putting it back in the ground could be part of the solution. Made from organic wastes such as crop residues, rather than cut timber, 'green charcoal' is more eco-friendly than traditional charcoal. Moreover, when a finely chopped form of green charcoal known as 'biochar' is used as a soil improver, it not only sequesters carbon dioxide, but retains water, nutrients and growth-promoting microorganisms in the root zone, resulting in much improved crop yields.

## Pyro technique

The making of green charcoal for fuel gained international recognition in 2002, with the development of the 'Pyro' kiln. Pioneered by a Paris-based NGO, Pro-Natura, the charcoal-making machine has been used in Senegal since late 2007, producing fuel briquettes from flakes of green charcoal mixed with a binding agent such as starch, molasses or clay.

The Pyro-6F machine makes biochar through pyrolysis (low-temperature burning without oxygen)
*credit: Pro-Natura*

Unlike an ordinary kiln, organic matter can be continuously fed into the French-made Pyro, and charcoal extracted, with no need for repeated cooling and reheating. Its efficient design means that it requires little external fuelling, and can produce up to five tons of charcoal each day. Gases released by the heating process are burned in a second, post-combustion chamber, maintaining the temperature of the oxygen-free kiln at 550°C. Excess gas may also be put to other uses, such as drying the organic feedstock, or heating greenhouses.

## Soil improver

Recently, Pro-Natura has been trialling an agronomic use of biochar, incorporating it as a soil improver and replicating a farming method used for millennia in the Amazon rainforests of Brazil. *Terra Preta*, literally 'black land', is the name given to the dark-coloured soils farmed by Amazonian Indians up to 7,000 years ago. For generations these farmers increased their yields by adding charcoal and manure to their soil; research suggests that carbon particles improve the uptake of nutrients and water by plants, and support a rich population of fungi and bacteria, which contribute to improved growth and disease resistance.

Farmers in Niamey, Niger, have trialled the use of biochar in 'Super vegetable gardens'
*credit: Pro-Natura*

The method is now under trial in some arid parts of West Africa. In 2008 a pilot project was launched at Ross Bethio in north-west Senegal, Pro-Natura's main green charcoal and biochar production site. Local farmers have been given biochar, together with training and financial incentives to encourage adoption and facilitate research on the impact of biochar on yields of vegetables, maize and rice. Results suggest that adding one kilogramme of biochar to a square metre of soil can double yields; beyond that, the porous material holds water and nutrients in the root zone, thereby increasing the benefits from other inputs, such as irrigation and composting.

## Carbon credits

As a domestic fuel, the use of green charcoal briquettes has been approved as a source of carbon credits, available on the voluntary market. Pro-Natura is now working to get a carbon credit rating for the $CO_2$ sequestered in soil through the use of biochar as a soil improver. Preliminary calculations estimate that at least 30 tons of $CO_2$ per hectare are sequestered given a 1 kg/$m^2$ rate of biochar application. If validated, voluntary purchase of such carbon credits could help to fund the scaling up of the technology. Laurens Rademakers, who promoted biochar in the UK's Manchester Report for 2009, argues that biochar could ultimately have a global role in reducing atmospheric $CO_2$ whilst increasing food production.

That suggestion has fuelled a heated debate in the UK press, with environmental columnist George Monbiot particularly sceptical that biochar could be a silver bullet to fight global warming and food insecurity. He attacks the concept of vast plantations being created to grow feedstock for biochar, given the ecological damage this would cause. However, biochar advocates have responded by dismissing this as useful to Monbiot in creating a debate, but not a part of mainstream biochar thinking.

## Local technology

Maintaining the green credentials of biochar is vital to its future

success, not least in attracting carbon credit payments. This is likely to mean that the use of green charcoal, whether as a fuel or soil improver, remains a locally-focussed activity. Biochar feedstock, such as maize stalks, cotton plants or wood shavings, tends to be low density, so transporting it large distances to a centralised production unit would soon offset its value as a renewable energy.

Adding 1 kg of biochar to a square metre of soil can double yields
*credit: Pro-Natura*

Family-based production of biochar is also possible, although current designs of domestic kiln do not recycle gases and are therefore less environmentally friendly than the Pyro kiln. And, while home-made green charcoal could help families increase their crop yields and potentially reduce their energy or fertiliser bills, organising a system for households to earn carbon credit payments would be challenging.

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