Il biochar: una matrice Carbon Negative

Dr. Lorenzo Genesio

Istituto di Biometeorologia – Consiglio Nazionale delle Ricerche
Vice Presidente ICHAR
Una storia che parte da lontano: la Terra Preta
La Terra Preta (ADE) è sicuramente frutto di una azione dell’uomo (volontaria) volta ad aumentare la fertilità dei suoli.

Civiltà indigene pre-colombiane tra 2400 - 600 anni fa

L’ingrediente base è Carbone vegetale

Sombroek WG (1966) Amazonian Soils. CAPD, Wageningen, NL
Dalio studio della Terra Preta:

1. Il carbone vegetale aumenta la fertilità dei suoli
2. Il carbonio rimane nel suolo per centinaia di anni senza degradarsi e senza perdere le sue proprietà ammendanti
La voce Terramare deriva da terra marna (dal dialetto emiliano = terra grassa) con riferimento alla terra, generalmente di colore scuro, tipica dei depositi archeologici, formatisi, attraverso i secoli, con il succedersi delle abitazioni che venivano ricostruite una sull’altra.

Nel corso dell’Ottocento queste collinette furono per la massima parte distrutte dalla attività di cava volta al recupero del terriccio, che veniva venduto come concime.
• Stabilità del carbone vegetale nel suolo

• Il processo di pirolisi
Verso un’agricoltura carbon negative

**The Carbon cycle**
*(CO$_2$ neutral)*

- Photosynthesis
- Respiration
- Decomposition

**The Biochar cycle**
*(CO$_2$ negative)*

- Photosynthesis
- Respiration
- Soil respiration (5%)
- Pyrolysis
- Bioenergy from syngas

25% - avoided emissions

**SOIL CARBON**

25%
To meet the challenges of global climate change, greenhouse-gas emissions must be reduced. Emissions from fossil fuels are the largest contributor to the anthropogenic greenhouse effect, so a reduction in fossil-energy use is a clear priority. Yet, because some emissions will be unavoidable, a responsible strategy also means actively withdrawing carbon dioxide from the atmosphere. Such carbon sequestration faces multi-faceted challenges: the net withdrawal of carbon dioxide must be long term and substantial, the process must be accountable and must have a low risk of rapid or large-scale leakage. One near-term technology that can meet these requirements is biochar sequestration. When combined with bioenergy production, it is a clean energy technology that reduces emissions as well as sequesters carbon. In my view, it is therefore an attractive target for energy subsidies and for inclusion in the global carbon market.

An existing approach to removing carbon from the atmosphere is to grow plants that sequester carbon dioxide in their biomass or in soil organic matter (see graphic, overleaf). Indeed, methods for sequestering carbon dioxide through afforestation have already been accepted as tradable 'carbon offsets' under the Kyoto Protocol. But this sequestration can be taken a step further by heating the plant biomass without oxygen (a process known as low-temperature pyrolysis). Pyrolysis converts trees, grasses or crop residues into biochar, with twofold higher carbon content than ordinary biomass. Moreover, biochar locks up rapidly decomposing carbon in plant biomass in a much more durable form.

The precise duration of biochar's storage time is under debate, with opinions ranging from millennial (as some dating of naturally occurring biochar suggests) to centennial timescales (as indicated by some field and laboratory trials). Whether biochar remains in soils for hundreds or thousands of years, it would be considered a long-term sink for the purposes of reducing carbon dioxide emissions. Moreover, the storage capacity of biochar is not limited in the same way as biomass sequestration through afforestation, conversion to grassland or no-tillage agriculture. Agricultural lands converted to no-tillage, for example, may cease to capture additional carbon after 15–20 years, and even forests eventually mature over decadal and centennial timescales and start to release as much carbon dioxide as they take up. Biochar is a lower-risk strategy than other sequestration options, in which stored carbon can be released, say, by forest fires, by converting no-tillage back to conventional tillage, or by leaks from geological carbon storage. Once biochar is incorporated into soil, it is difficult to imagine any incident or change in practice that would cause a sudden loss of stored carbon. The bottom line is that plant biomass decomposes in a relatively short period of time, whereas biochar is orders of magnitudes more stable. So given a certain amount of carbon that cycles annually through plants, half of it can be taken out of its natural cycle and sequestered in a much slower biochar cycle (see graphic). By withdrawing organic carbon from the cycle of photosynthesis and decomposition, biochar sequestration directly removes carbon dioxide from the atmosphere. Pyrolysis does have costs associated with the machinery and heating (around US$4 per gigajoule) and is dependent on a supply of cheap biomass. But the bigger question is whether this approach can be scaled up to national and regional, or even global, scales. At the local or field scale, biochar can usefully enhance existing sequestration approaches. It can be mixed with manures or fertilizers and included in no-tillage methods, without the need for additional equipment. Biochar has been shown to improve the structure and fertility of soils, thereby improving biomass production.

Biochar not only enhances the retention and therefore efficiency of fertilizers but may, by the same mechanism, also decrease fertilizer run-off.

For biochar sequestration to work on a much larger scale, an important factor is combining low-temperature pyrolysis with simultaneous capture of the exhaust gases and converting them to energy, either through combustion or gasification. This would not only reduce the amount of carbon dioxide released but also provide a source of renewable energy. At the national and regional levels, biochar can be produced from agricultural by-products and used as a soil amendment to increase crop yields and improve soil health. At a global scale, biochar could become a significant contributor to the mitigation of climate change by sequestering carbon dioxide in soils.

Bio-energy in the black

Johannes Lehmann

A handful of carbon

Locking carbon up in soil makes more sense than storing it in plants and trees that eventually decompose, argues Johannes Lehmann. Can this idea work on a large scale?
Biochar is a solid material obtained from the carbonisation of biomass. Biochar may be added to soils with the intention to improve soil functions and to reduce emissions from biomass that would otherwise naturally degrade to greenhouse gases. Biochar also has appreciable carbon sequestration value. These properties are measurable and verifiable in a characterisation scheme, or in a carbon emission offset protocol.
Despite 20 years of effort to curb emissions, greenhouse gas (GHG) emissions grew faster during the 2000s than in the 1990s, which presents a major challenge for meeting the international goal of limiting warming to the preindustrial era. Most recent scenarios from integrated assessment models require large-scale deployment of negative emission technologies (NETs) to reach the 2°C target. A recent analysis of NETs, including direct air capture of CO2 from ambient air by engineered chemical reactions (DAC; Keith, 2009; Socolow et al., 2015) recently reviewed and analysed natural weathering to remove CO2 from the atmosphere (Edmonds et al., 2004; Joos et al., 2013) and the products stored in soils, while coal is the fuel being offset.

...
“....lo scopo generale di promuovere soluzioni, tecnologie, studi avanzati, attività dimostrative e progetti educativi finalizzati alla riduzione delle emissioni di gas climatici in atmosfera attraverso l’uso di BIOCHAR....”
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Produzione di energia rinnovabile in modo efficiente, grazie alle tecnologie che utilizzano la pirolisi.

Riduce le emissioni di metano e protossido di azoto provenienti dai suoli.

Rappresenta una soluzione sostenibile ed ecocompatibile per gestire i residui delle coltivazioni agricole.

Riduce l’impiego di fertilizzanti chimici, migliorando la qualità del suolo e aumentando le rese agricole.

Diminuisce l’inquinamento da nitrati delle falde acquifere.

Accresce la capacità di ritenzione idrica del terreno, contrastando la desertificazione.
Grazie per l'attenzione