BIOCHAR – BUILDING SYNERGIES BETWEEN AGRICULTURE, RENEWABLE ENERGY PRODUCTION, AND CARBON SEQUESTRATION

Goodspeed Kopolo (President of Zambia Biochar Trust and Biochar Europe)
Christoph Steiner (Founder BIOCHAR.org)

AFOLU – Agriculture, forestry and other land use has a unique potential to sequester carbon. Living plants are very effective in capturing CO_2 and storing the carbon in their tissues. Every year, this process (photosynthesis) takes about 100 to 120 billion tons of carbon from the atmosphere. Approximately the same amount is released by plant respiration and decay of dead plant material. The 60 billion tons released from decomposing biomass is almost 10 times more carbon than released by fossil fuel burning.

Humans currently appropriate more than a third of the production of terrestrial ecosystems. This is a lot of carbon is in our hands! However forestry and agriculture are currently responsible for more than 30% of all greenhouse gas emissions. This is mainly caused (17.4% of the total emissions) by deforestation and decay of biomass. Soils are another important contributor as they contain 3 times more carbon than the atmosphere and 4.5 times more than the plants and animals on earth. However, most soils have lost 30% to 75% of their original carbon pool, or 30 to 40 tons of carbon per hectare. This has to change and it is challenging to convert a source of greenhouse gases into a sink. Such a transformation needs to consider:

- Not to compete with food production (biofuels)
- Not to compromise soil fertility
- To be persistent in a changing climate
- To be quantifiable

Proposals for agricultural and forestry biomass utilization typically focus on only carbon sequestration or bioenergy production – but not both. Some suggest maximizing carbon sequestration by the burial of crop residues in the deep ocean or the storage of trees underground. On the other hand, maximizing renewable energy production from crops and crop residues can substitute for fossil fuels (an option currently eligible for carbon trading). However both these options neglect the removal of nutrients and carbon and its beneficial effects on soil fertility. It is imperative that carbon management does not compete with food production and/or compromise soil fertility.

The drawback of conventional carbon enrichment in soils (such as reduced tillage intensity) is that this carbon sink option depends on climate, soil type and site specific management. The issues of permanence, leakage and additionality are the greatest obstacles for land use and forestry (LULUCF and REDD) carbon projects. Furthermore, the permanence and vulnerability of these sinks is likely to change in a warming climate. Therefore carbon sequestered by LULUCF projects is generally considered only temporarily sequestered. The CDM board and Gold Standard deals with these challenges by either excluding or strictly limiting LULUCF projects.

Biochar Carbon Sequestration

Biochar may offer a tool to deal with these issues. Biochar is carbonized plant material produced by pyrolysis. Pyrolysis facilitates renewable energy production, and the remaining carbon (biochar) can be redistributed to agricultural fields to improve soil fertility. This facilitates crop residue utilization, soil carbon sequestration and enhancement of soil fertility in a synergistic way.

Carbonization of biomass increases the half-life time of the remaining carbon (50%) by order of magnitudes and can be considered a manipulation of the carbon cycle. While fire accelerates the carbon cycle the formation of biochar (= carbonized plant material, charcoal, black carbon) decelerates the carbon cycle. Biochar production transforms carbon from the active (crop residues or trees) to the inactive carbon pool. Therefore issues of permanence, land tenure, leakage, and additionality are less significant for biochar projects.

Biochar C sequestration might avoid difficulties such as accurate monitoring of soil carbon which is another main barrier to include agricultural soil management in emission trading. Independently from its use as soil amendment the turnover rate and the quantity of carbon could be used to assess the carbon sequestration potential.

LULUCF issues in more detail:

Permanence and vulnerability

The drawback of soil carbon enrichment with conventional methods is that this carbon-sink option is of limited duration (permanence). The new carbon level drops rapidly again, as soon as the required careful management is no longer sustained. Soil carbon of cropland increases only if either carbon additions are enhanced or decomposition rates reduced.

Reduced decomposition is an advantage of charcoal as soil amendment (biochar). Carbon dating of charcoal has shown some to be over 1500 years old, fairly stable, and a long-lasting form of carbon sequestration. German researchers assessed a half-life of 1400 years for carbonized plant materials.

Leakage

The production of biofuels frequently competes with food production. E.g. producing biofuels from corn, soy or palm oil may increase food prices. As a consequence land is converted to agriculture somewhere else and thus causing greenhouse gas emissions outside the project boundary (=induced land use change).

Using crop residues for bioenergy would avoid this problem. However the removal of crop residues is reducing soil organic carbon and soil fertility.

Pyrolysis with biochar carbon sequestration avoids this problem. While producing renewable energy from biomass, SOC sequestration, agricultural productivity, and environmental quality can be sustained and improved if biochar is redistributed to agricultural fields. The uses of crop residues as potential energy source or to sequester carbon and improve soil quality can be complementary, not competing uses.

Land tenure

The exclusiveness of rights to the land is one fundamental precondition for REDD and payments for environmental services. This poses another obstacle in particular for small farmers. Insecure tenure reduces the incentive for long-term fertility improvements and those receiving the payments cannot exclude other people who could use forest and land resources in ways that are incompatible with providing the contracted service.

This does not apply for biochar carbon sequestration because the carbon once sequestered in the soil is nearly permanent. There is no risk that altered management practices would reduce the carbon stock. Terra Preta soils in the Amazon Basin proves that.

Additionality

Additionality in certain REDD projects and some CCX offsets, in particular those involving no-till agriculture is an issue of particular concern in LULUCF projects.

Biochar will always compete with charcoal. In other words the non-fuel use of charcoal competes with charcoal used as a fuel. There is an opportunity cost attached to biochar. This is the value of energy still contained in the biochar. In fact, the use of charcoal to substitute fossil energy would already qualify for emissions trading.

Therefore biochar projects will always be additional.

Other obstacles

Implementation costs

Ex-ante credits, such as those issued by the Plan Vivo System can provide the necessary capital. Ex-ante refers to reductions that are planned or forecasted but have not yet been achieved. In this case buyers donate toward intended emission reductions. If waste biomass is available the production of biochar can be rather quick and the exact quantity relatively certain (in comparison to accumulation in growing biomass). Therefore guaranteed forward deliveries (reductions in the near future) are feasible.

Acceptance:

Most carbon offset schemes do not accept the avoidance of CO_2 emissions from decomposing plant material. The definition of a carbon sink should be revised to include the difference between a sink to the inactive carbon pool, such as biochar, and a sink that remains in the active carbon pool, such as reforestation.

Nevertheless, article 3.3 of the Kyoto Protocol counts carbon stock change in soil, as well as biomass. Article 3.4 allows parties to include sequestration in plants and soil through management of cropland, grazing and land and existing forests. The Millennium Development Goals (MDG) Carbon Facility's mission is to improve access to carbon finance be enabling a wider range of developing countries and project types to participate in the carbon market. They promote projects that generate additional sustainable development and poverty reduction benefits, thereby contributing to all MDGs.

Biochar a fair adjustment

Biochar is different from trade reductions in current emissions. Because biochar is an effective and permanent carbon sink, it has the potential to recapture historic emissions, thus providing an important path for industrialized nations to reduce their historic carbon dept. Therefore on top of all its other attractions, biochar may present a pathway for negotiating reductions in GHG emissions with fast-growing economies such as China and India.