Biofuelwatch Comments on draft methodology "General Methodology for Quantifying the Greenhouse Gas Emission Reductions from the Production and Incorporation into Soil of Biochar in Agricultural and Forest Management Systems", submitted by Carbon Gold

28th August 2009

Summary:

We believe that there are several serious flaws in the draft methodology and that overall, biochar impacts on soil carbon are currently highly uncertain and not measurable and verifiable. Our main concerns relate to:
- a lack of references to evidence about soil organic carbon losses caused by biochar additions;
- an omission of greenhouse gas emissions resulting from the removal of deadwood, diseased trees and crop residues covered by the draft methodology;
- an omission of potential carbon dioxide emissions resulting from tillage in order to incorporate biochar into soil, as well as a lack of any discussion about biochar losses during application and possible erosion;
- the omission of any references to the labile carbon fraction in biochar as well as the significant uncertainty over the scale of black carbon losses from biochar;
- a very vague statement under 'leakage' which we feel does not properly address the indirect impacts of crop residue removal for biochar in terms of soil erosion and depletion resulting in a potentially greater need for synthetic fertilisers and possibly even further land use change.

Reference to CDM methodologies AMS-III.L, AMS-III.E and AM0025:

The three CDM methodologies quoted by Carbon Gold (AMS-III.L, AMS-III.E, AM0025) all relate to biomass in landfill or biomass which would have gone into landfill in the absence of the project. They do not relate to crop residues left or incorporated into soil, composting in aerobic conditions (something which in methodology AM0025 specifically supports), nor do they relate to deadwood diseased trees and other forest 'residues'. The CDM methodologies are therefore not relevant to a large number of scenarios which would fall under Carbon Gold's proposed methodology.

The 'CDM Tool for estimation of Carbon Stocks, Removals and Emissions for the Dead Organic Matter Pools due to Implementation of a CDM A/R Project Activity' looks at emissions from land clearance carried out in order to set up an afforestation or reforestation project. Land clearance has not been proposed in relation to Carbon Gold's submission.

Project activity emissions:

+ Substantial soil organic carbon losses following charcoal/biochar additions have been documented.[i] There is ongoing research into such carbon losses [ii] and pending the outcome of this research it is not possible to predict any carbon dioxide emissions from SOC losses – it also seems likely that carbon losses may be shown to differ so significantly according to soil type, charring conditions, biochar feedstock and over time, that predictions may be nearly impossible.

+ The draft methodology covers biochar made from deadwood and diseased trees. Emissions from the reduction of carbon stock due to the removal of deadwood, including dead trees have been omitted. The IPCC Greenhouse Gas Inventory Guidelines 2006 make it clear that deadwood as well as 'litter' such as leaves, needles, twigs, etc are part of the forest carbon pool .It says: "*it is assumed that the average transfer rate into dead organic matter (dead wood and litter) is equal to the average transfer rate out of dead organic matter, so that the net stock change is zero.*"[iii] The removal of dead organic matter from forests thus reduces the overall carbon pool. According to one study, high levels of deadwood removal in managed forests have reduced carbon held in deadwood from an average of 8.9 tonnes per hectare to an average of 2.1 tonnes per hectare.[iv] Deadwood removal also results in significant biodiversity losses.[v]

+ The draft methodology also covers "crop residues, such as straw, husks, shells and pips". The IPCC Greenhouse Gas Inventory Guidelines 2006 make it clear that crop residue removal results in a reduction of soil organic carbon whereas high levels of crop residue inputs into soil increases soil carbon levels.[vi] As with biomass from deadwood, the draft methodology ignores reductions in carbon stock caused by crop residue removal. It treats all of the carbon in biochar as being 'additional', despite the fact that a considerable proportion of it was derived from previous reductions in carbon stocks. In both cases (crop residues and deadwood), this goes against IPCC guidelines.

+ The application of biochar to soil will almost certainly require tilling which can result in substantial losses of soil carbon and disruption to soil structures.[vii]

+ Even with tillage, biochar losses from the project area can be substantial during biochar application – a preliminary report from a recent study in Canada reported that about 30% of the biochar blew away during application..[viii] Erosion is another way in which biochar is likely to be lost. Although the biochar carbon lost from the project area will initially be moved elsewhere rather than turning into carbon dioxide, airborne black carbon has a highly positive radiative forcing because it absorbs solar radiation and reduces albedo. How strong this effect will be depends on the size of biochar particles which are blown away – the smaller they are, the longer they remain airborne. Soot has the smallest particle size and thus the greatest impact of global warming amongst different types of black carbon. Biochar is charcoal used for a specific purpose and the lower end of the particle size of charcoal extends into the same range as that of soot, the submicron range.[ix] A report by CSIRO states: The size of biochar particles is relatively rapidly decreased, concentrating in size fractions <5µm diameter."[x] Although the global warming impact of black carbon was not included under the Kyoto Protocol, we nonetheless believe that it should be taken into account when considering the draft methodology, particularly since most of the evidence of the impact of airborne black carbon was not available at the time the Kyoto Protocol was agreed.[xi]

<u>Project Activity ghg removals:</u>

The draft methodology appears to be based on an assumption that all of the carbon in biochar, unless it is 'volatile matter', will remain stable over long periods of the time. There is clear evidence, however, that this is not the case and that all biochar contains a 'labile carbon fraction' which varies in its proportion. This 'labile fraction' is different from the 'volatile matter' covered by the "Standard Method for Chemical Analysis of Charcoal" quoted by Carbon Gold. 'Volatile matter' is the proportion of coal or charcoal lost when exposed to high temperatures in the absence of oxygen. The 'labile carbon fraction' in biochar/charcoal, on the other hand, is the fraction which can be turned into carbon dioxide. Johannes Lehmann et al suggest that this fraction is between 1 and 20%, and relates to the loss of aliphatic carbon in biochar as well as surface oxidation.[xii] The draft methodology entirely ignores the labile carbon fraction.

In this context it is important to note that there is further evidence that a proportion of biochar carbon greater than 20% could be lost. Firstly, an assessment by Masiello[xiii] looked at the 'global black carbon budget' and found that considerably more black carbon is being created through wildfires every year than can be found in soils and marine and coastal sediments combined. Masiello states: "Even a labile black carbon loss process with a timescale of thousands of years is too slow to account for environmental observations." Secondly, several studies show lower levels of black carbon from wildfires after a period of time than would be expected. A study of boreal forest fires looked at black carbon following wildfires in an area of Siberia. The fires had occurred every 25-40 years yet, over a 200 year period, the amount of black carbon did not significantly increase. Another study of black carbon remains from swidden agriculture in Western Kenya showed that 72% of that black carbon was lost in the first 20-30 years.[xiv] An unpublished study in Costa Rica[xv] explored the hypothesis that soils in old forests which have burnt repeatedly over centuries hold more black carbon than soils in young forests which have not experienced repeated burns. This hypothesis was not confirmed by the findings. In all three cases, the authors could not tell whether black carbon losses were due to translocation, to degradation (resulting in carbon being emitted as CO_2) or a combination of both. These studies indicate that it is impossible to predict how much of the carbon in biochar will be stable, or for how long.

<u>Leakage:</u>

Large-scale removal of crop residues (included in the draft methodology for biochar production) results in both soil depletion and erosion. According to a letter by David Pimentel and Rattan Lal published in *Science*, the removal of crop residues can increase the rate of erosion one hundred fold.[xvi] Crop residues provide nutrients essential for plant growth and are thus important for soil quality.[xvii] Biochar, on the other hand, is not a fertiliser and does not contain nutrients (except for fresh biochar which still contains ash residues, which are rapidly depleted). Even if it was shown that biochar can make the uptake of nutrients from organic or synthetic fertilisers more efficient, those nutrients still have to come from a different source. Crop residues supply nutrient hence their removal would increase the requirement for synthetic fertilisers. When charcoal was used as a soil amendment in Central Amazonia (terra preta), it was very slowly built up together with the addition of significant amounts of varied residues,[xviii] a very different situation from one where residues are removed on a large scale to create biochar. Furthermore, soil erosion can

also be expected to result in a greater need for synthetic fertilisers as nutrient-rich topsoil is blown or washed again, both more likely with large-scale crop residue removal.
The potential for indirect increases in emissions resulting from excessive crop residue removal leading to soil depletion and erosion does not appear to have been considered in the draft methodology.

If crop residues, deadwood or diseased trees were obtained from outside the project area, the greenhouse gas emissions described above would nonetheless occur as a result of the project.

There is a general statement under 'leakage' which indicates biomass should not be utilized that would otherwise have been used for different purposes such as fuel, however this statement appears to us too vague to give any assurances against the use of crop residues which would otherwise have remained on or have been incorporated into the soil.

Other comments:

The IPCC did not take a position on biochar either in their most recent Fourth Assessment Report or in their greenhouse gas inventory guidelines and we have been advised that this is due to the fact that by the time the Fourth Assessment Report was finalised, insufficient evidence was available for them to reach any conclusion.

This year, the United Nations Environment Programme has described biochar as "a new and poorly understood technology' and has warned: The impacts of large-scale biochar production on biodiversity and long-term agricultural sustainability (e.g. nutrient depletion) are unknown.[xix]

[i] Fire-Derived Charcoal Causes Loss of Forest Humus, David A. Wardle et al, Science 2 May 2008: Vol. 320. no. 5876, p. 629; Rogovska et al. (2008): Greenhouse gas emissions from soils
as affected by addition of biochar

[ii] Wilson Bruun et al. (2008): Biochar in fertile clay soil: impact on carbon mineralization, microbial biomass and GHG emissions. http://www.fluxfarm.com/reviews/biochar-fertile-clay-soil-impact-carbon-mineralization-microbial-biomass-and-ghg-emissions.h

[iii] Chapter 2, www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_02_Ch2_Generic.pdf

[iv] Dynamik der Kohlenstoffvorräte in den Wäldern Thüringens. Abschlussbericht zur 1. Phase des BMBF-Projektes "Modelluntersuchung zur Umsetzung des Kyoto-Protokolls", C Wirth et al, Thüringer
Landesanstalt für Wald, Jagd und Fischerei. Mitteilungen 23⁄2004, 308 S.

[v] “Totholz - Bedeutung, Situation, Dynamik”, Steffen Herrmann und Prof. Dr. Jürgen Bauhus Waldbau-Institut, Albert Ludwigs Universität Freiburg, March 2007, www.waldundklima.net/wald/totholz_bauhus_herrmann_01.php

[vi] Chapter 4, Table 5.5, www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_05_Ch5_Cropland.pdf

[vii] For figures regarding likely soil carbon losses due to tillage also see footnote V.

[viii] Preliminary Evaluation of Biochar in a Commercial Farming Operation in Canada, BlueLeaf Inc, 2009, www.dynamotive.com/wp-content/themes/dynamotive/pdf/BlueLeaf_Biochar_Field_Trial_2008.pdf

[ix] New Directions in Black Carbon Organic Chemistry, C.A. Masiello, Marine Chemistry 92 (2004), 201-213

[x] Biochar, climate change and soil: A review to guide future research, CSIRO, Saran Sohi et al, February 2009, www.csiro.au/files/files/poei.pdf

[xi] See for example: Koch, D., and J. Hansen 2005. Distant origins of Arctic black carbon: A Goddard Institute for Space Studies ModelE experiment. *J. Geophys. Res.* 110, D04204, doi:10.1029/2004JD005296.

[xii] Stability of Black Carbon/Biochar, Johannes Lehmann et al, presentation at SSSA Conference 2008, www.biochar-international.org/images/Lehmann_Biochar_ASA2008.pdf

[xiii] see footnote viii

[xiv] Long-term black carbon dynamics in cultivated soil, Binh Tanh Nguyen et al, Biogeochemistry, Volume 89, Number 3 / July, 2008

[xv] Black carbon in seasonally dry forests of Costa Rica, Lorenz et al, presentation at SSSA Conference 2008, www.biochar-international.org/images/Lorenz_SSSA_Black_C_Costa_Rica.pdf

[xvi] David Pimentel and Rattan Lal, 17th August 2007. Letter: Biofuels and the Environment. Science

[xvii] Crop Residues and Soil Carbon, Rattan Lal, 2008, www.fao.org/ag/ca/Carbon%20Offset%20Consultation/CARBONMEETING/3FULLPAPERSBYCONSULTATIONSPEAKERS/PAPERLAL.pdf

[xviii] See: www.fao.org/nr/giahs/other-systems/other/america/terra-preta/detailed-information2/en/

[xix] The Natural Fix? The role of ecosystems in climate mitigation, UNEP, June 20099, www.unep.org/publications/search/pub_details_s.asp?ID=4027