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Char-up & Decarbonize!

The potential multi-role of biochar - reducing climate change and increasing resilience of soils

Introduction

Organic waste and plant residues can be turned into charcoal and energy with the help of the pyrolysis process. The most fertile and robust soils on earth contain charcoal – either from naturally ignited grassland-fires (Tschoronozem, Ukraine) or even man-made many thousand years ago (Terra Preta, Brasil and Peru). The worldwide soils in general contain more than twice the carbon content of the atmosphere – about 11 kg C /m^2 land-surface. Soil degradation contributes to climate change. Much more than a billion tons of not-used biomass residues every year is being piled up for uncontrolled decomposing or burned in open fires creating vast output of smoke, CH_4-, CO_2-, particulate- and N_2O emissions, soot and acids. Rural regions worldwide are lacking of economic access to energy. Biochar or charcoal can take up and store more than 2 kg water and fertilizer per kg dry substance. It has a high pH-value (10.1) and can even aspirate gases. Soils enhanced with biochar are more tolerant against drought and heavy precipitation, store water and fertilizer better and reduce odors and gaseous emissions such as N_2O and CH_4. Thus, yields are increasing and the fertilizer demand is being reduced. With this knowledge, the above mentioned problems could be turned into a global and local solution.

Climate positive energy – potentially implemented for all hydrocarbons?

A novel concept has been developed at Ökozentrum that drastically reduces the demand for high grade steel and specific costs of the pyrolysis plants – while creating lowest emissions (pm < 5 mg/m3n, CO <10 mg/m^3_n [@13%O_2]) and being able to process all biomass substrates with up to 50% water content. Approximately 50% of the heat value of the input is stored in the biochar, 50% is turned into climate positive energy. The energy output has "negative carbon footprint" of -500 g CO_2 / kWh only with the carbon sequestration – without additional effects such as N_2O-emission reduction. The process allows to control the oxygen content of the reactor, which opens the perspective to even co-process other hydro-carbons such as chlorine-free plastic waste.

The only exergetic de-carbonisation strategy

To separate the oxygen from the CO_2, nature needs solar energy. The only other solution to stabilize carbon to not turn back into CO_2 is pyrolysis. Biochar in agriculture could increase hygiene in the barn and dry toilet, decrease the fertilizer demand (with the mineral content + a certain percentage of the nitrogen requirement + the lime by the alkaline effect) and make soils and crops more robust against water logging and drought, reducing watering demand and losses caused by rot.
The first field testing and studies lead to estimations, that the value of biochar will be at least at the level of today's prices of charcoal which is between 500 and 1'000 CHF/t worldwide. Together with the generated energy, the benefit of biochar will be between 300 and 500 CHF per ton CO_2 sequestrated. This is so much more than any emission-reduction-certificate price, that the global benefit of de-carbonisation and reducing N_2O- and CH_4-emissions will be free of costs.

Research demand

There is a huge demand to coordinate the already created knowledge from biochar research worldwide. Additionally there will be the demand to systematically determine the above mentioned effects, especially in tropical farming and in regions with a strong impact of weather changing due to global change. Some first field testing has been started in spring 2016, focusing on the watering demand of coffee plantations in Vietnam, where the weather seems to be changing to be "too dry for coffee". However this and other projects need international help and coordination to create a greater view. On the pyro-technical side, applied R&D has to ensure, that the decentralized production of biochar does not create new pollution and meets the regulation of the European Biochar Certificate EBC.

Contact us at CharNet.ch

CharNet is a network of professionals in Switzerland to support biochar and coordinate the research demand. Among the more than 70 private members, companies, farmers and institutions there are research teams of EAWAG, ZHAW, FiBL, Agroscope, Ithaka-Institute and Ökozentrum.

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