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Biochar effects on soils: overview and knowledge gaps

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One of the cornerstones of the sustainable biochar concept is to improve, or at least to not deteriorate, soil quality and functioning. The idea of global sustainable biochar systems, with biochar applied to global cropland and grassland soils, has highlighted limitations in: i) current scientific understanding of biochar interactions with soil components, ii) the capacity to assess ecosystem services provided by soils, and iii) the uncertainty in spatio-temporal representation of both (i) and (ii).

Pyrolysis conditions and feedstock characteristics largely control the physico-chemical properties of the resulting biochar, which in turn determine the suitability for a given application. Soils are highly heterogeneous systems at a range of scales. Combinations of land use, soil management and changing climatic conditions further enhance this heterogeneity. While this leads to difficulties in identifying the underlying mechanisms behind reported effects in the scientific literature, it also provides an opportunity for 'critical matching' of biochar properties that are best suited to a particular site (depending on soil type, hydrology, climate, land use, soil contaminants, etc.).

Biochar's relatively long mean residence times in soils (100s of years) make it a potential instrument for sequestering carbon (if done sustainably). However, that same long mean residence time sets biochar apart from conventional soil amendments (such as manures and other organic fertilizers) that are considered as transient in the soil (1-10s of years). The functional life time of biochar in soils essentially moves biochar from a soil management tool to a geo-engineering technique. One of the consequences is that desired ecosystem services that are provided by soils, have to be projected for the same time period.

This presentation aims to discuss critical knowledge gaps in biochar-soil-ecosystem interactions against a background of ecosystem services.