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Can the application of biochar during arable and forestry plantation create an ongoing carbon sink and increase plant productivity?

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This study is based at the National Trust Wallington estate in Northumberland, NE England, an agricultural estate where land-management options are being considered in an attempt to enhance current land carbon stocks. The aim of this research is to identify if biochar (charcoal produced from biomass) can provide an opportunity to create a perpetual carbon sink as apposed to a transitionary sink associated with other land-use changes currently under consideration?

The main issues under investigation are: can biochar be ploughed into arable soils to create a long term carbon sink? Can biochar be ploughed into organic rich forest soils to create a long term carbon sink? Will the application of biochar increase crop productivity, increasing photosynthesis and carbon sequestration further still?

In order for the estate to become carbon neutral through biochar application alone it was calculated that 3312 Kg/ha/year of biochar would need to be applied to the current area of arable land. This however is based on the assumption that all of the biochar added is stable and will remain in the soil, and assumes that addition does not lead to increased CO_2 emissions from the organic matter already present. This study presents the results of weekly soil respiration measurements currently being made on 24 lysimeters filled with arable and forestry soils and 4 levels of charcoal treatment. Levels of treatment were chosen to assess the impact of applying biochar on a yearly basis and any negative impacts which may result from very high eventual concentrations. The following levels of charcoal were applied: 0 Kg/hectare, 6250 Kg/hectare, 62500 Kg/hectare, 87 500 Kg/hectare. The lysimeters containing 0 Kg/ha act as a control, the lysimeters containing 6250 Kg/hectare allow assessment of the impacts of 2 years of addition, 62 500Kg/ha the impact of 18 years of addition, and 87 500kg/ha the impact of 26 years of addition.

The study will also present the results of plant productivity, and leachate properties including pH, conductivity, nutrient concentrations and dissolved organic carbon concentrations. This will allow clarification that the positive impacts of biochar addition in terms of an increased C sink will not be offset by any negative affects associated with water quality or nutrient leaching.