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Biochar technologies at the Water Energy Food nexus in African smallholder farming systems: a unique window for climate-smart agriculture and low carbon futures .

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Production of biochar from non-competed organic residues by high-efficiency gasifier systems, and it's incorporation into agricultural soils are implementable solutions to sustainably intensify crop productivity while mitigating agriculture's impact on climate change. Studies provide evidence that amending biochar to soils causes intrinsic changes of soil nutrient and water cycles whereby boosting crop production, especially for tropical soils because they tend to be highly susceptible to degradation processes.
An estimated 2.5 billion people in developing countries rely on biomass to meet their energy needs for cooking, which accounts for over 90% of current household energy consumption. Organic residues, like rice or coffee husks, maize cobs and many others, are available but not suitable for open combustion systems. Existing gasifier systems can substantially reduce wood fuel use and emissions of harmful gasses while producing a useful biochar product. Small scale pilot projects in Uganda and Kenya have illustrated that smallholder farming households hugely appreciate the benefits of gasifier cook stoves. Safety and emissions test were carried out and were fed into global scenario models for determining their potential in combating climate change. Next to that, we investigated the effects of biochar on the fertilizer efficiency as well as resilience of crops.
Trials in Kenya and Uganda have demonstrated that inputs of biochar at rates as low as 0.5 kg m-2 increased the maize grain yields under NPK input by 1.5 times for more than 3 years. Stable isotope analysis of maize ear leaf samples from trials in Uganda found that water stress in maize was significantly reduced by input of biochar. Standard boiling tests with two-chamber gasifier stoves using residues of rice husks, maize cobs and coconut shells showed that firewood consumption was reduced between 40 and 60% as compared to a traditional three stone open wood fire. Laboratory and field measurements of carbon dioxide, carbon monoxide, NO_x and fine particulate matter revealed tremendous decreases in emissions.