

China can make staple crops carbon-negative by adding biochar to soil

Researchers calculate that alternative farming practices could turn staple crop production into a carbon sink and boost crop yields in China if adopted en masse

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Farmers harvesting straw in Anhui province, China TPG/Getty Images

China's production of staple food crops such as wheat and corn could become a net carbon sink if farmers start widely applying biochar to soil.

Instead of returning raw biomass, like straw, to the soil at the end of the growing season, farmers could take it to pyrolysis plants, where the material is heated at a very high temperature in an oxygen-free chamber to create biochar, a charcoal-like solid rich in carbon.

Studies have shown that applying it to soils not only locks the carbon away, but also improves the health of soil and its ability to retain water. Creating biochar also produces bio-oil – a possible substitute for petrol – and syngas – a mixture of hydrogen and carbon monoxide that can be used to generate electricity.

Pete Smith at the University of Aberdeen in the UK and his colleagues assessed the potential impact of the mass application of biochar in the farming of staple crops in China.

As part of the process, they tried to design the most climate-friendly system of farming possible, combining straightforward actions like a reduction in fertiliser use with more innovative technologies like biochar.

“We’ve looked at all the traditional mitigation methods, the things that we would expect farmers to do, like improving their nitrogen use efficiency, reducing over-fertilisation and all those things,” he says. “We’ve said, we already know farmers can do that. But what additional things can we ask farmers to do, to get to even a lower-carbon, even to a net negative way of staple food production?”

In other words, how low could emissions from China’s crop production go if “everything and the kitchen sink” was thrown at it?

The answer is very low indeed, the study suggests. Under an “ideal” system described in the paper, farmers producing staple crops would apply biochar rather than biomass to their soils and take other steps to reduce methane and nitrogen pollution. Meanwhile, the electricity generated from burning syngas could be fed into power grids, displacing power generated by fossil fuels.

Taken together, these measures could turn staple crop production in China into a net carbon sink, soaking up the equivalent of 38 megatonnes of carbon dioxide every year, according to the study. It would also boost crop yields by 8 per cent and improve air quality.

“If the government of China threw its weight behind it, this could certainly make a significant contribution [to tackling climate change],” says Smith.

However, this wouldn’t be a simple system to roll out. It would require building expensive pyrolysis plants in thousands of farming communities around China, which would probably require funding from the government. Farmers may also need to be subsidised to buy biochar for their land, at least for a few years until the price drops.

Meanwhile, some provinces, such as Guangdong, Guangxi, Fujian and Hainan, will still be net emitters of greenhouse gases because of high methane emissions from rice paddies in those regions. Finally, the carbon storage and crop yield benefits of using biochar might depend on soil type, a factor not assessed in this study.

“They are on the right track,” says Robin Matthews at The James Hutton Institute in Aberdeen, UK. But he cautioned that extensive fieldwork would be necessary across a range of soil types and climatic conditions to verify the carbon sequestration benefits. “It just needs testing across a wider range of environments,” he says.

For Smith, the major barrier to rolling this system out would be the high upfront cost of building thousands of pyrolysis plants. “Just getting started is the critical thing – that’s the make or break as to whether it will work or not,” he says. But China’s centralised governance structure means a mass shift in farming practices may be possible. “If there’s one country where it could work, I think it’s China,” says Smith.

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