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Can zero tillage sequester more carbon? A study of agricultural soils across the East Midlands, UK

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Approximately 40% of the world's agricultural land, and up to 68% of UK agriculture, is managed by ploughing to provide optimal conditions for crop establishment and growth. Ploughing can increase soil carbon losses through oxidation, resulting in significant carbon dioxide emissions. These concerns have driven the adoption of conservation agriculture, including zero tillage, a practice defined as planting into unprepared soil whilst disturbing less than a third of the soil surface. Zero tillage presents many benefits, including greater aggregate stability, reduced soil erosion and water conservation. However, no consistent and conclusive trend in total soil carbon has been demonstrated, although studies have indicated that in zero tilled soils carbon is generally stored in the soil surface, and in ploughed soils it is distributed deeper in the soil profile.

Trends in soil carbon under contrasting agricultural practises remains a significant knowledge gap. Few studies have considered carbon storage at depths greater than 30 cm despite many crop roots extending deeper than this, or accounted for the role of bulk density notwithstanding its importance is obtaining accurate carbon concentrations. Moreover, there has been limited assessment of the large scale spatial variation between fields.

We report results from an extensive study that assessed and predicted how zero tillage altered soil biophysical properties and associated carbon storage in 80 paired ploughed and zero tilled fields across the East Midlands. We recorded a significantly higher total carbon under zero tilled surface soils (0 – 10 cm) (12.3% higher than ploughed systems), but no significant difference in the amount of carbon between zero tilled and ploughed soils at 40 – 50 cm. After accounting for bulk density, carbon stocks were significantly higher under zero tilled systems, in 0 – 10 cm and 40 – 50 cm (15.0% and 16.4% respectively).

Future analysis will model the spatial dependence of carbon stocks across the East Midlands and include other assessed biophysical properties, to elucidate relationships at a regional scale and to evaluate the stability of the carbon stored. These initial results are especially important in the context of climate change mitigation as they demonstrate that zero tillage can increase the sequestration of atmospheric carbon dioxide in agricultural soils.