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# Effects of a raised water table on greenhouse gas emissions and celery yield from agricultural peat under climate warming conditions

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Peatlands are globally important areas for carbon preservation: covering only 3% of world's land, they store 30% of total soil carbon. At the same time, peat soils are widely utilised in agriculture: in Europe 14% of peatland area is under cultivation, 40% of UK peatlands have been drained for agricultural use and 24% of deep peat area in England is being farmed.
One of the most important regions for crop production on lowland peats in the UK are the East Anglian Fenlands (the Fens): an area of drained peatlands in East England. 88% of the Fenland area is cultivated, sustaining around 4000 farms and supplying 37% of total vegetable production in England. The soils of the area are fertile (89% of agricultural land being classified as grade 1 or 2) and so crops with high nutritional demands tend to dominate. It is estimated that Fenland peats store 41 Tg of Carbon, which is lost from the ecosystem at a rate of 0.4 Tg C/yr. The Fens are at risk due to continued drainage-induced volume loss of the peat layer via shrinkage, compaction and oxidation, which are estimated to result in wastage rate of 2.1 cm/yr.
Cultivation of peat soil requires drainage as most crops are intolerant of root-zone anoxia: this leads to creation of oxic conditions in which organic matter becomes vulnerable to mineralisation by aerobic microorganisms. It is, therefore, crucial to find a water table level which would minimise peat loss and at the same time allow for economically viable crop growth. Despite the importance of preservation of agricultural peats, there is a lack of studies which attempt to find water table level that strikes a balance between crop yield and greenhouse gas production.
The future of the Fens is overshadowed by another uncertainty: increases in temperature brought by the climate change. It is estimated that average global temperature increase expected by the end of this century (relative to 1986-2005) would be within the range of 0.3-4.8°C, depending on the scenario. Rising temperatures should accelerate the rate of organic matter mineralisation, which will lead to higher emissions of greenhouse gases as well as enhanced plant growth due to better availability of nutrients. The effects of higher temperatures on crop growth and greenhouse gas emission have not been properly investigated in the context of agriculturally-utilised peatlands.
This study was conducted on peat cores excavated from a field in the Fens and focused on the following objectives:
1. To examine effects of climate change-induced temperature rises on celery productivity and peat $CO_2$ and CH4 emissions.
2. To find the field water table level that reduces peat emissions of $CO_2$ and CH4 while maintaining celery productivity.
The research found higher $CO_2$ emissions from the elevated (+5°C) temperature treatment and lower $CO_2$ emissions from the higher (-30cm) water table level, however, noted no effect on CH4 emissions of any of the treatments. The higher water table decreased aboveground celery biomass. There was no effect of increased temperature on aboveground celery yield.