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Carbon dioxide emissions from peat soils under potato cultivation in Uganda

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Organic wetland soils in south western Uganda are found in valley bottom wetlands, surrounded by steep, mineral soil hill slopes. Land use change in these papyrus dominated wetlands has taken place over the past forty years, seeing wetland areas cleared of papyrus, rudimentary drainage channel systems dug, and soil cultivated and planted with crops, predominantly potatoes. There has been little research into the cultivation of organic wetlands soils in Uganda, or the impacts on soil carbon dynamics and associated carbon dioxide (CO_2) emissions. This study used two rounds of farmer interviews to capture the land management practices on these soils and how they vary over the period of a year. Three potato fields were also randomly selected and sampled for CO_2 emissions at four points in time during the year; 1) just after the potato beds had been dug, 2) during the potato growing period, 3) after the potato harvest, and 4) at the end of the fallow season. Carbon dioxide emissions, soil and air temperatures, water table depth, vegetation cover and land use were all recorded in situ in each field on each sampling occasion, from both the raised potato beds and the trenches in between them. There appeared to be a delay in the disturbance effect of digging the peat, with heterotrophic CO_2 emissions from the raised beds not immediately increasing after being exposed to the air. Excluding these results, there was a significant linear relationship between mean emissions and water table depth from the raised beds and trenches in each field over time ($p<0.001$, $r2=0.85$), as well as between emissions and soil moisture content ($p<0.001$, $r2=0.85$). Temporal variability was observed, with significant differences in the means of emissions measured at the different sampling times ($p<0.001$, one-way ANOVA); this was the case in both raised beds and trenches in all fields studied, except for the trenches in one field which showed no significant difference between sampling times ($p=0.55$). Mean emissions from the raised beds were highest during the potato growing season (1.74 $\pm$ 0.07 g m-2 hr-1 ($\pm$ shows standard error)) and lowest at the time when the beds had been freshly dug (0.67 $\pm$ 0.17 g m-2 hr-1). Mean emissions from the trenches were highest at the end of the fallow period (0.37 $\pm$ 0.02 g m-2 hr-1) and lowest at the time when the beds had been freshly dug (0.20 $\pm$ 0.05 g m-2 hr-1). As the first of its kind on Uganda's peat soils, this study has provided some insight into the use of these soils and impacts on CO_2 emissions which can be used to inform Uganda's national emissions scenarios, whilst highlighting some of the fundamental data gaps which need to be addressed with future studies.