



Investigation of the carbon sequestration potential of soils and woodlands at university farms

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Reducing carbon footprint has increasingly become an important topic regarding the management of industries and universities from different fields. Newcastle University promised to achieve the goal of net-zero carbon dioxide emissions by 2040, and the first process from this ambitious target is to produce a 43% reduction by July 2020, against a 2005/06 baseline. According to the report from Carbon Management Plan 2019 of Newcastle University, there are still 1,720 tons of carbon that should be reduced or offset during this year.

Two farms were investigated in this project: Nafferton Farm (NF) and Cockle Park Farm (CP). Soil sampling was conducted within each field at three depth increments (0-30 cm, 30-60 cm and 60-90 cm) separately. Except for soil analysis, this study also chooses some plots in the woodlands around two farms to estimate the carbon storage by various vegetation species, and these two sections will offer comprehensive information about the quality and quantity of carbon in two farms.

On average, the percentage of total carbon (TC) from all soil profiles was higher under woodland than crop fields in CP. Because the hectare of crop fields is greater than woodland, the sum of total carbon in individual soil layers from the areas is comparatively larger in crop lands, where C stock is 14,122 tons, 6,017 tons, 5,437 tons for the 0-30 cm layers, 30-60 cm layers and 60-90 cm layers, respectively. Meanwhile, the data is 1,905 tons, 822 tons, and 648 tons for three soil depth layers in the woodland of CP. In Nafferton Farm, the value of TC from the corresponding soil layers is 17,841 tons, 6,844 tons, 6,177 tons separately.

The results attained so far represent that TC and soil organic carbon (SOC) in each farm are all statistically significantly different ($p < 0.001$) with respect to soil depth, but differences were not significant with respect to crop and tree species grown in a single area. Moreover, TC in surface soil of NF is statistically higher ($p < 0.01$) than that in CP. In Cockle Park Farm, C contents from woodland were considerably higher than those in crop fields ($p < 0.001$) and the difference of TC and SOC at individual depth layer cannot be ignored. Gross carbon sequestration of plants in woodland is 150.64 tons' annually, which was calculated by i-Tree Ecosystem Analysis. Simultaneously, the total carbon of trees, including leaf biomass and tree trunks, is in a range of 3,198- 4,096 tons in the woodland of CP. Consequently, the current quantity of carbon in topsoil from the whole fields of two farms and the woodland of CP is 35,610 tons which is over four times

as high as the estimated carbon emission produced by University in 2019/20 (8, 181 tons).

Overall, it is recommended that the management team of university should attach importance to the operation of two farms. The expectation of mitigating 1,720 ton's carbon in the short term can be fulfilled if the management department considers converting 58.79 ha crop fields to mixed-species woodland.