# Differences in soil carbon among farmland types

Wing Ng[1], Adrian Crew[2], Day Teixeira[1], Pete Maxfield[2], Matt Bell[1]

[1] Department of Animal and Agriculture, Hartpury University, Gloucester, GL19 3BE

[2] Department of Health and Applied Sciences, UWE, Bristol, BS16 1QY

## INTRODUCTION

Previous research promoted carbon assessment and flow of human and natural capital to remediate atmospheric carbon emissions on farms. However, differences among land use types (**FIG. 1**) is often not included as part of accounting methods. This study compared levels of soil organic carbon (SOC) among different land use types using real-time analysis on farms.

**FIG. 1:** (a) left: Field sampling in an arable field; (b) right: Field sampling woodland area.

## METHODS

**Field sampling**

There were 5 soil and 5 plant samples taken per location over a 'W' pattern of each field. A total of 350 samples across 70 fields at Hartpury University were collected.

**Data analysis**

Near-infrared reflectance spectroscopy (NIRS) scanners were used to obtain soil and plant nutrient concentrations (**FIG 2**). A plate meter measured plant height and herbage covers were obtained using cut and weigh methods.

**Data process**

Soil and plant nutrient variables were analysed using a linear mixed model in SPSS to compare land use types. Significance difference was attributed at $P < 0.05$ (**TABLE 2**).

**Other techniques**

Future work will compare ground measurements with other methods to quantify carbon stocks (e.g. remote-sensing and laboratory analysis).


**FIG. 2:** (a) left: Agrocares soil scanner for soil analysis, and (b) right: NIR4 scanner for forage analysis.

## RESULTS AND DISCUSSION

**TABLE 1:** % of sites above, below and between soil organic carbon (SOC)/ Clay thresholds of 1/8, 1/10 and 1/13 for each land-use

| Land use | n | Percentage (%) of sites with indicated SOC/Clay ratio | | | |
|---|---|---|---|---|---|
| | | Very good (>1/8) | Good (≤1/8 > 1/10) | Suggest improvement (≤1/10 > 1/13) | Poor (≤ 1/13) |
| Arable crops | 110 | 44% | 35% | 20% | 1% |
| Temporary ley | 50 | 26% | 38% | 30% | 6% |
| Permanent grass | 165 | 70% | 18% | 12% | 0% |
| Woodland | 25 | 68% | 24% | 8% | 0% |
| All land use | 350 | | | | |

**TABLE 2:** Predicted mean (s.e.) soil and plant herbage nutrients

| Variables | Units | Arable | Temporary leys | Permanent grass | Woodland |
|---|---|---|---|---|---|
| **[1]Soil variables** | | | | | |
| Organic Carbon | g/kg | 23.9 (1.7)$^a$ | 23.3 (2.3)$^a$ | 31.7 (1.4)$^b$ | 36.5 (3.5)$^b$ |
| Total Nitrogen | g/kg | 2.3 (0.1)$^a$ | 2.3 (0.2)$^a$ | 3.0 (0.1)$^b$ | 3.3 (0.3)$^b$ |
| SOC/Clay ratio | | 0.14 (0.01)$^a$ | 0.11 (0.02)$^a$ | 0.18 (0.01)$^b$ | 0.22 (0.03)$^b$ |
| **[1]Plant variables** | | | | | |
| Height | cm | 6.6 (0.5)$^a$ | 6.6 (0.7)$^a$ | 4.0 (0.4)$^b$ | - |
| Fresh cover | kg FW/ha | 7358 (653)$^a$ | 7567 (880)$^a$ | 5444 (516)$^b$ | - |
| Dry matter cover | kg DM/ha | 1318 (119)$^{ab}$ | 1619 (161)$^a$ | 1178 (94)$^b$ | - |

[1] Means within a row for the variables and with different superscript letters (i.e., a,b,c) differ significantly and attributed at P value <0.05.

- Soil samples of arable and temporary ley fields had a higher % of SOC/Clay ratio within poor or suggest improvement thresholds compared to permanent and woodland areas with a higher % of good or very good SOC/Clay ratio after NIRS analysis (**TABLE 1**). The latter areas also had higher mean SOC, total nitrogen and SOC/clay ratio after SPSS analysis (**TABLE 2)**.
- Although arable and temporary ley fields were more productive with a greater herbage height and cover than permanent grass (PG) fields, PG fields had significantly better SOC and nitrogen levels (**TABLE 2**).

## CONCLUSION AND FUTURE WORK

This study shows that NIRS can serve as a user-friendly and practical alternative for initial and effective real-time field measurements to indicate critical soil and plant variability among land use types. Further work is needed to evaluate confidence levels among different techniques to support monitoring among different land uses and to improve on-farm carbon assessment.

**Acknowledgement and references**

This work is funded by Hartpury, John Oldacre Trust and The Douglas Bomford Trust. For references, please scan the QR code.

SCAN ME

**Wing KP Ng**

PhD student, MRSB, MSc, Pcert

wing.ng@hartpury.ac.uk

paulinewkng