North Wyke Farm Platform

Case study no. 39

Soil Organic Carbon

A single proxy measure of sustainability for pastoral systems?

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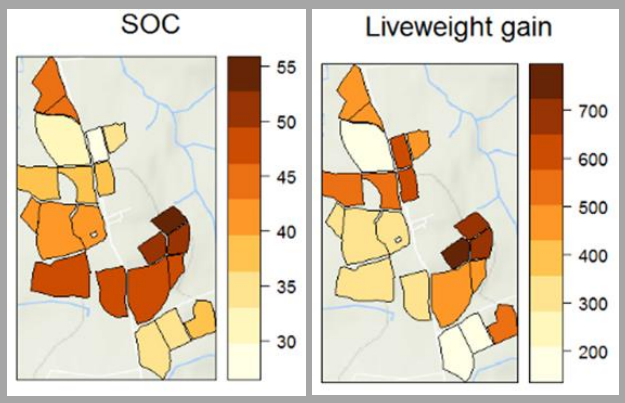
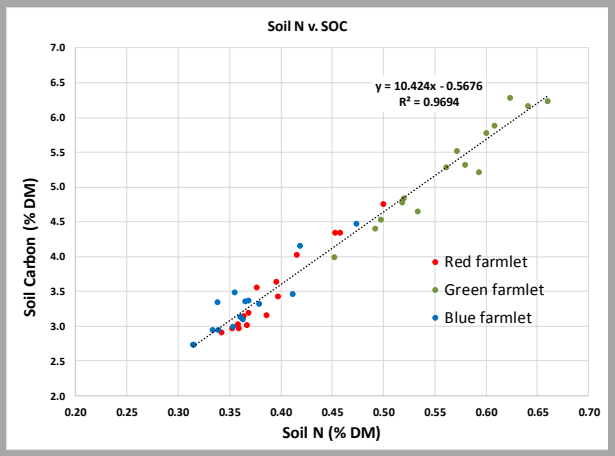
Facing increasingly unpredictable weather conditions, soil erosion, pest and disease damages and economic uncertainty, agricultural producers need concise information that can help improve productivity and minimise fluctuations in product quality. Ideally, such information takes the form of 'customer-friendly' measures — inexpensive to obtain yet explicitly connected to scientific understanding of agriculture — so that adequate support can be given to producers who are not currently achieving economic, environmental and social sustainability.

A holistic evaluation of farming systems, however, is a challenging exercise. Agricultural activities undertaken by humans interfere with the already complex physical, chemical and biological interactions between crops, pastures, animals and the surrounding environment (soil, water and atmosphere), yet neither can these interactions be completely observed nor can their consequences on the long-term productivity be accurately foreseen. Perhaps for this reason, previous attempts to find a single proxy measure of sustainability have not been always successful.

At North Wyke Farm Platform, we have identified soil organic carbon (SOC) as a potential candidate to play this crucial role under pastoral systems. While the positive impact of SOC on long-term soil fertility has long been known, evidence was lacking to link this measure to economic performance of the farm — by far the most important prerequisite to convince commercial producers to make an operational change. For the first time in the literature, we have successfully established the direct relationship that animal grow more efficiently under elevated SOC (*below*).



Relationship between SOC (t/ha) and Livestock performance (kg/ha/yr) at North Wyke



Relationship between soil N and soil C at North Wyke

Additional analyses have also revealed that a higher level of SOC is associated with less nutrient losses into watercourses due to carbon's water holding capacity. Conversely, a higher stocking density was shown to facilitate accumulation of SOC in the soil as well. Combined together, these findings demonstrate the relative merit of livestock grazing over alternative land use, for example arable farming for food and feed production.

In order to better understand the mechanism regulating these relationships, a new campaign was launched in 2017 to investigate the translational pathway of nutrients — initially from soil to pasture. Fifteen pairs of soil and forage samples were collected from each of the 15 fields (subcatchments) that differ in topographical conditions. At each sampling point, forage was first cut to the ground level within a 25 x 25 cm quadrat, and then soil cores beneath were taken with a spade. These samples were subsequently analysed for various parameters of interest at the North Wyke laboratories, including SOC content, soil structure, microbial diversity and abundance, forage productivity, and forage quality. Data analysis to date has identified multiple interdependencies between different parameters including SOC (*above*), and this knowledge will subsequently be used to determine the minimum set of information (samples, analysis and sampling frequency) that should be collected on commercial grazing farms to assist their informed decision-making.

Through the Global Farm Platform initiative (http://www.globalfarmplatform.org), a global network of livestock research farms led Rothamsted, we will compare the results of this study with those by our network partners, initially from Colombia, Kenya, Malawi and Uruguay. This component of the research is supported by UK Research and Innovation Global Challenges Research Fund.

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