An introduction to soil carbon, agriculture & future payments

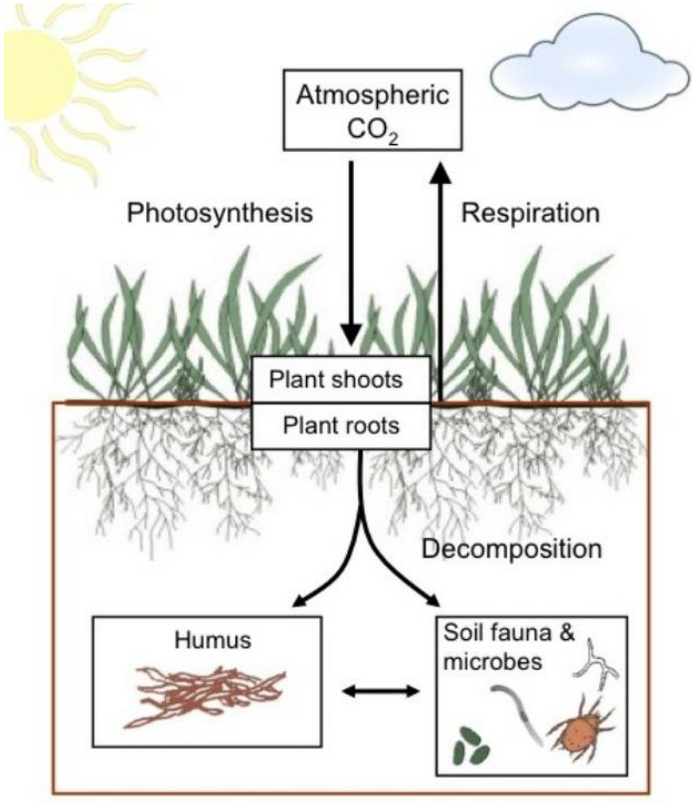
Scientific background and income opportunities

What is soil carbon?

Soil carbon refers to the carbon that is in soil in inorganic and organic forms, soil organic carbon (SOC) is a proportion of the organic matter that is found within soils. SOC is made up of predominantly dead and decaying organic matter, this can take the form of leaf litter, root remnants decaying soil organisms etc. A small proportion of SOC includes living organic matter but this is usually less than 10%. SOC can also include organic matter that is somewhat resistant to decay, the most widely known of these is Biochar. Soil Inorganic carbon (SIC) is the solid carbonate formed through the weathering of stones and rocks that are found in soil, usually derived from the soils parent material. Most soil carbon in Scotland will be predominantly made up of soil organic carbon however sandy soils will likely have a greater proportion of Soil inorganic carbon.

The soil carbon cycle

Soils play a vital role in the global carbon cycle, soils are continually transferring carbon dioxide with the atmosphere. Plants take in CO2 from the atmosphere and some of this gets stored in the soil from plant roots. Much of this CO2 is then emitted from the soil when organic matter such as leaf litter and plant matter decompose. In an undisturbed natural system this cycle is usually at equilibrium, however human management of soils can influence the carbon cycle and make soils a net emitter or sequester of carbon depending on management. Most long-term grassland soils as well as forests are likely at equilibrium or in some cases may sequester carbon annually while almost all arable land that is ploughed will be a net emitter of carbon. This is due to the addition of



organic material (animal deposition, slurry, manure) to grassland and the continual growth and regrowth of the grazed land, for modern arable farms there is usually a lack of organic manure and regular exposure of the soil surface to the atmosphere during tillage practices which results in faster degradation of organic matter resulting in CO2 emissions. This is a generalised assumption, and each farm and field may have different factors which contribute to its soils ability to sequester or emit carbon. It must also be noted that soils also emit nitrous oxide, which is an extremely potent greenhouse gas, when additional nitrogen is added which can negate any positive impact from carbon sequestration.

How can farm soils increase SOC?

There are a wide variety of activities that can be done on farms to improve soil carbon, particularly soil organic carbon. Arable farms can do the most, things like moving towards a minimum or reduced tillage system, using nitrogen fixing cover crops and incorporating livestock can all increase soil organic carbon stocks. These shifts in management will require additional time, labour and capital initially but if they can be incorporated into systems appropriately studies have shown there are significant long term cost benefits. On livestock grassland farms things are quite a bit more limited, the main system change that would improve soil organic carbon is the move to a multi species grass sward and beginning to rotationally graze. The multi species sward can create a variation in rooting depths encouraging healthier soil structure which in turn encourages soil microbes, rotational grazing can stimulate root growth, both of which can increase soil organic carbon. There are again significant system changes and capital costs associated with these grassland options, but long-term business sustainability has also been shown to increase.

Additional to these management changes that can increase soil carbon there is also emerging interest in the application of biochar to land which can help to store carbon in soils. Biochar is created through the a method of heating known as pyrolysis where organic matter is heated in the absence of oxygen to produce a charcoal like substance that is extremely resistant to decay by microorganisms. This can then be spread to land to add to the soil carbon sink. Enhanced rock weathering is another method of enhancing soil carbon which increasingly gaining attention, this is the process whereby rock fines of particular silicate rocks, usually basalt are spread to land. These rock fines are react with rainfall and soil carbon (pulled into soil through plant roots) to form bicarbonates in the soil, which increases the soil inorganic carbon.

Can farmers benefit?

The science around the impact of agricultural practices on soil carbon levels varies considerably depending on soil type, climate, previous management, and crop type. However, there is increasing interest from government and private sector into regenerative agriculture, the principles of which focus on preserving agricultural soils. A key element of regenerative agriculture is increasing soil organic carbon. Although there is yet to be clear pathways for the majority of farmers to benefit from increasing soil carbon on their farms there are 3 possible ways that farms could benefit.

1. The sale of carbon credits from increased soil carbon
2. Increased government funding for increasing soil carbon and farming 'regeneratively'
3. Market advantage from producing a more environmentally sustainable/lower carbon product

The sale of carbon credits from increased soil carbon

There is already a market for the sale of soil carbon credits delivered from the changing of agricultural management assuming an increase in soil organic carbon levels. However, these current frameworks are based on international frameworks such as VERRA soil carbon quantification methodology which can be extremely broad. The new soil carbon code is likely to make the mechanism of selling carbon credits from soil management far more robust for farmers in the UK while increasing confidence in buyers. The soil carbon code will, like the peatland and woodland carbon code, set out the minimum requirements for the creation of a high quality, high integrity agricultural soil carbon market in the UK. The code is being developed by the Sustainable Soils Alliance researchers from SRUC, the James Hutton Institute and the University of Leeds amongst some of the contributors. It is likely to be published in 2023.

Increased government funding for increasing soil carbon and farming 'regeneratively'

The government support that agriculture receives is going to change, in Scotland this is going to come into effect in 2025. Scottish government have set out some of the measures that will be a part of this new payment reform in 2025, a significant amount of these measures are linked to increasing soil organic carbon, some of the measure are displayed below:

Arable

- Continuous Soil Cover
- Minimum/No Tillage

Grassland

- Diverse sward species content (legumes-herb-grass mixtures) and use of herbal leys
- Regenerative grazing (mob, strip, adaptive multi-paddock grazing) on improved grassland

This highlights an opportunity for farmers looking to move towards increasing soil organic carbon that these actions will reflect positively on the business as 2025 draws near. The Preparing for

Sustainable farming programme can support the first step on this journey through funding for carbon audits and soil sampling.

Market advantage from producing a more environmentally sustainable/lower carbon product

As companies are pressured by consumers to reduce the environmental impact of their products, food producers and retailers are beginning to look at how they can engage with their agricultural supply chains to reduce emissions. At the heart of this engagement is increasing soil health and by default soil organic carbon, for example Nestle have committed to pumping £1.35 billion to support regenerative agriculture across their supply chains by 2025. This highlights the opportunities that may be available from the market for increasing soil organic carbon and translating this to the production of a lower carbon or environmentally sustainable product.

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