

Soil Management

Practical Guide

Scottish soils are a valuable store of carbon, particularly the peat soils of the uplands and islands.

In Scotland, more than 60x more carbon is stored in our soils than vegetation and between them, these carbon stores hold about 125x the total amount of CO₂ emitted each year in Scotland. It is essential that we protect soil carbon reserves and play our part in meeting Scotland's greenhouse gas (GHG) reduction targets.

Soil carbon can be lost in a variety of ways including :

- Ploughing and other cultivations expose soil organic matter to oxygen - this breaks the soil carbon down to carbon dioxide - a greenhouse gas.

Top tips for EVERY farm

- **Keep off wet soils** - working wet soils causes compaction and reduces yields.
- **Dig to assess soil structures** - structure will change over time.
- **Soil test** regularly - particularly for pH and P.
- Maintain **soil organic matter**.
- Take steps to **prevent erosion**.
- **Irrigate** to the crop's requirements and not more.
- Maintain field **drains**.

- Water-logging of plant material can cause it to rot in the absence of air causing the release of methane, another powerful greenhouse gas.
- Higher overall temperatures speed up the various soil carbon breakdown processes.

Soil carbon increases when the soil organic matter (SOM) accumulates faster than it is being lost. And SOM is one of the keys to soil health and fertility and is worth maximising to **boost the soils' productive capacity and crop yields**.

Soil management for carbon, therefore, matters to all farmers, whether organic or conventional.



This Practical Guide highlights tips for managing farm soils to preserve and boost soil carbon, reduce GHG emissions and benefit the farm business.



There are five sets of Practical Guides covering :

Use energy and fuels efficiently

Develop renewable energy

Lock carbon into soils and vegetation

Optimise the application of fertilisers and manures

Optimise livestock management and the storage of manure and slurry

Find further information, including links to other Practical Guides and Case Studies, at

www.farmingforabetterclimate.org



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Websites

www.farmingforabetterclimate.org
www.soilassociation.org
www.scotland.gov.uk
www.ipcc.ch
www.carbontrust.co.uk
www.sorp.org
www.sruc.ac.uk/info/120062/crop_and_soils_systems/412/visual_evaluation_of_soil_structure
www.agrecalc.com



2015
International
Year of Soils



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Key Facts:

- Soil and soil organic matter is being lost much faster than it can be made. Minimise soil erosion and keep soils in the field where they can work for you and reduce carbon emissions too.
- It can take up to 500 years to create 1cm of topsoil - and only moments to lose it in erosion.
- More than half the world's known species live in the soil - there can be up to 5 tonnes of animal life in one hectare's soil.
- Worldwide, soils may have lost 60% of their original soil organic matter since settled agriculture began.
- Healthy soil is 25% water and 25% air - both air and water need pore spaces.

Designing a rotation

When designing a crop rotation think about :

- varying rooting depths
- maintaining soil cover
- grass leys
- nitrogen fixing crops
- weed suppression
- cover crops, green manures
- shared pests and diseases
- spring or autumn sowing
- speed of establishment
- forage vs cash crops
- irrigation requirements

Managing Soils to boost Soil Carbon

- **Reduced tillage** drastically cuts down on soil carbon losses. It won't work for every farm in every year. Note it can also reduce on-farm fuel use, cutting costs.
- **Minimising soil erosion** keeps soil in the field.
- **Incorporating crop residues** after harvest returns much of their carbon to the soil. This boosts soil fertility directly through the residue's nutrients as well as providing better water holding capacity and boosting activity of soil biota.
- Where straw is required for bedding, returning it later as **manure** helps to maintain SOM.
- Growing **cover crops**, particularly legumes, on otherwise bare ground can benefit soil carbon as well as perhaps "soaking up" excess nutrients
- Good **irrigation practice** helps avoid waterlogging and boosts SOM.
- Nutrient management using long-term **manure applications** boosts soil carbon whilst making good

Carbon Storage is long-term

Accumulating carbon in the soil is a long-term process. The life-time of stable soil organic matter is 250-1900 years but it can be lost in a moment, for instance through erosion.

To speed up sequestration either :

- **INCREASE** the rate at which you apply organic matter particularly from off-farm (e.g. composts) **or**
- **DECREASE** the rate of oxidation of soil carbon and decomposition of soil organic matter, for instance by using reduced tillage systems

use of resources

- **Crop rotations** with a variety of plant families helps SOM through a variation in rooting depths and styles from year to year. In particular, including **grass** in the rotation is helpful.
- **Improving grazed pasture** through drainage, soil aeration, compaction reduction and improved diversity of forage species can all help SOM.
- **Afforesting** highly degraded or marginal soils will significantly improve carbon sequestration compared to sub-optimal grazing or arable use of those soils.

The **hidden carbon** in the manufacture, transport and application of pesticides and fertilisers and the employment of tillage and irrigation must be taken into account when determining the case for land use change.

Soil Quality Improvement

In a trial comparing soils that had a diverse rotation including grass, or had significant manure additions or were in continuous wheat, after five years the soils in diverse rotation and the manure-amended soils had :

- increased levels of organic matter
- more fungal activity
- better porosity
- greater compaction resistance

Higher soil carbon and better soil structure will be critical for soils to be able to cope with increased climate variability with, for instance better drainage and drought resistance.

See the other Practical Guides in this series including **Assessing Soil Structure, Improving Soil Quality** and **Field Drainage**.