Improving Soil Quality

Practical Guide

Predictions suggest that our climate will get wetter and warmer. Rainfall is increasing in autumn and winter making soils wetter. Heavy rainstorms are also becoming more frequent resulting in farm runoff and increased losses of soil by erosion. Soil and runoff leaving the field carry large amounts of soil carbon, nitrogen and other nutrients and represent a large loss to the farm. A single serious erosion event can remove more calcium, magnesium and potassium than the crop takes off in one year. Wet soil in the autumn also delays harvest and subsequent drilling of winter crops.

As the soil gets wetter, oxygen has difficulty getting into the soil so it becomes poorly aerated. This results in the production of greater volumes of the greenhouse gases nitrous oxide and methane. This also represents a loss of fertility in farm soils. Wet soil can also damage crop roots and increase winter kill.

Roughly 5% of the soil volume is organic matter, which is a valuable store of carbon from the atmosphere. As the soil becomes warmer, more of this carbon is lost by the increased activity of soil bugs. Soil erosion also breaks up soil aggregates to expose carbon so that large volumes of gas are emitted to the atmosphere and carbon and plant nutrients are washed away. The break down and release of stored carbon to the atmosphere as carbon dioxide is a 'feedback mechanism', which results in more climate change.

Warmer springs and summers are also lengthening the growing season. In the long term, more people may migrate to Scotland as other areas become less hospitable and productive. This will put more pressure on bringing our marginal soils into production.

This Practical Guide concentrates on how we can improve soil quality to help us to adapt to climate change.

Which soils are most vulnerable to climate change?

- Soils low in organic matter such as those under continuous arable cultivation. Soils, which are prone to instability such as loamy sands and fine sandy loams and soils with high peat content, which are prone to erosion. These soils are best left unploughed over winter.
- Silty and clay soils are prone to smearing and compaction, which can decrease water infiltration and increase the chances of runoff. Tillage increases air spaces within the soils (macroporosity) so these soils can be ploughed before or during the winter.
- Bare soils (see Practical Guide on cover crops)
- All soils on slopes but especially those listed above.

Farming for a Better Climate

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

Funded by the Scottish Government as part of their Climate Change Advisory Activity

Websites

www.farmingforabetterclimate.org

www.sac.ac.uk/climatechange

www.adaptationscotland.org.uk

www.soilassociation.org

www.agrecalc.com

www.sruc.ac.uk/info/120062/crop_and_soils_systems/412/visual_evaluation_of_soil_structure

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The Scottish Government Riaghaltas na h-Alba

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Adjust cropping patterns

Water and wind gather speed and power over long distances where there are no interruptions. This increases the likelihood of erosion in exposed areas.

Consider splitting long, sloping fields with fences, hedges or buffer strips. Arrange susceptible fields so that any runoff is channelled into low lying rough or boggy areas or into ponds on the farm.

Top tips for EVERY farm:

- ✓ Keep seedbeds coarse
- ✓ Keep the soil covered
- ✓ Preserve and improve soil structure
- ✓ Consider minimum tillage
- ✓ Avoid soil compaction
- ✓ Maintain or increase soil organic matter
- ✓ Add organic manure
- ✓ Work across slopes where safe to do so
- ✓ Consider delaying ploughing
- ✓ Maintain drainage

Maintain drainage

Well-drained soils dispose of surface water quickly and decrease the chances of runoff occurring. Rough or boggy patches in areas where drainage water is received can be left undrained. Consider managing runoff; this can help you to reduce diffuse pollution risks and keep valuable soils and nutrients on the farm. Well -drained soils usually have good aeration and better soil quality than soils where drainage is restricted.

Preserve and improve soil structure

Regularly dig up and look at the soil and take photographs to monitor quality (see the *Assess your Soil Structure Practical Guide*). If there are compact or grey-blue layers in the top 20 cm of soil, loosen to just below these layers to create aggregates and porosity. Compacted soil have closed-up pores, which hold up water and reduce aeration. On slopes compacted areas can channel water flow. Loosen compacted zones with tines or a subsoiler just enough to displace aggregates and so re-open pores and let the water into the soil. Displacement should be sufficient to prevent the aggregates squeezing back together when the soil is wheeled again. When preparing seedbeds, avoid over-tillage and keep the seedbed as coarse as possible to keep the aggregates large enough to retain gases and carbon.

Keep the soil covered

Crops help to protect the soil from run-off, erosion and compaction. Keep the soil covered with crops as much as possible. The leaves and stalks protect the soil from raindrop impact and shelter it from the wind. The roots aid soil aggregation, contribute soil organic matter, improve localised drainage and provide the 'glues' which stick the soil together. Crop or manure residues on the surface may look untidy but do help protect the soil. Delay incorporation as long as possible on sloping land to gain the benefit of the soil protection from the residues. Increase the surface area of sown seedbeds by using indented rollers or aerators, which reduce erosion by providing temporary water storage and by reducing particle movement. The longer growing seasons may enable winter cover crops to be grown, such as clover, vetch or rye.

Maintain or increase soil organic matter

Any addition of organic material helps improve soil quality. Organic material adds carbon to the soil and helps to keep soil aggregates separate and intact. When ploughing-in straw, try to avoid burying it all at plough depth. Instead, aim to spread the straw throughout the plough layer by adjusting the plough or by using non-ploughing. This also helps to break down the straw more quickly and increase soil benefits from the release of beneficial products. The addition of organic matter also aids in promoting earthworm activity, which improves soil drainage and aeration. Organic matter also makes soil aggregates more resistant to break-up by erosion and during compaction. Organic matter levels can be maintained by regularly including grass breaks in the rotation.