Soil Carbon

Soil organic matter represents a major store of world carbon and is therefore important in the fight against climate change. All agricultural soils in Wales store large quantities of carbon, typically 10-50 times more than is held in the overlying vegetation. Preserving and building this soil carbon store is important for locking up carbon dioxide from the atmosphere and for helping to protect against future climate change.

What is soil carbon?

It is part of the soil organic matter, which includes other important elements such as phosphorus, hydrogen, oxygen, and nitrogen. It enters soil largely as a result of the death of plant roots and the breakdown of organisms that live in the soil (e.g. bacteria, fungi, earthworms etc). For example, all the roots in a grassland soil are continually born and die providing a continual input of carbon into soil. Carbon is also added when wastes are added to soil (e.g. crop residues, faeces, manure, compost, biosolids). Consequently, soil organic matter is made up of plant and animal materials in various stages of decay.

How is soil carbon distributed across Wales

All our soils in Wales are approximately 10,000 years and started forming when the glaciers melted and retreated after the last ice age. All of the soil carbon we see today has slowly accrued since then. As it builds up so slowly, most people will never notice a change in the organic matter content of their soil. By analogy, carbon entering soil from organic inputs is like rivers trickling into an ocean. Current evidence suggests that mineral grassland soils in Wales are still building their soil carbon reserves; however, in the uplands it is a different story as there seems to be some evidence that we are losing soil carbon from peats and shallow soils in the mountainous areas. The maps below show that most soil carbon is stored in the upland areas of Wales and that most vegetation carbon is stored in woodlands which are scattered throughout Wales.

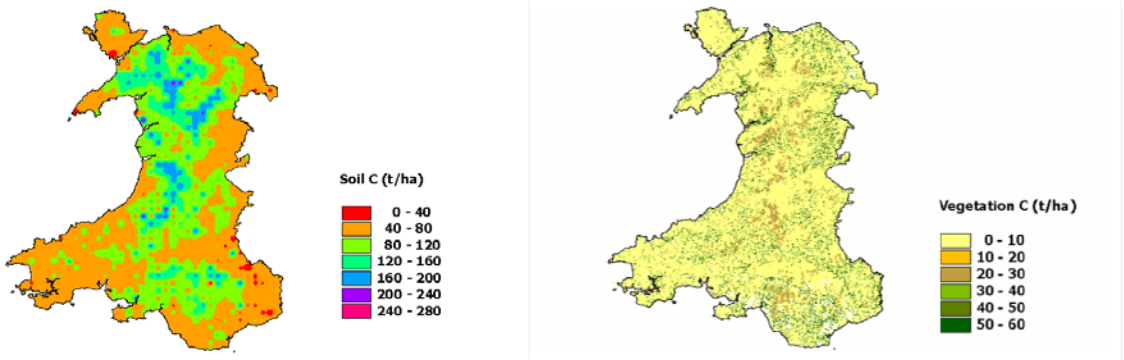

Figure showing the amount of carbon stored in soils (left hand panel) and vegetation (right hand panel) in the Welsh landscape.

Preserving soil carbon: what is it worth?

Although it is difficult to put a precise economic value on soil organic carbon, across Wales it has been estimated to be worth an incredible £10 billion or about £1 million per square mile of countryside based on current carbon trading prices. Unfortunately, soil carbon trading schemes are not currently in operation in the UK so farmers cannot be paid for sequestering carbon, however, this does not mean that it should be overlooked. In many respects, soil organic matter provides so many benefits to farmers that there are too many to list here and they all add value by stimulating grass and crop growth and maintaining yields. Of most benefit is the fact that organic matter promotes soil structural stability making the soil more resistant to compaction from farm machinery and trampling by animals. It also provides food for the billions of organisms in soil which in turn promotes nutrient recycling and stimulates the proliferation of beneficial microorganisms which help crops to grow. Organic matter also opens up the soil allowing roots to grow deeper and also allowing water to enter the soil faster reducing the risk of surface runoff, flooding and loss of soil by erosion into rivers. In a climate change context, it important that we keep as much carbon locked up in soil organic matter as we can. When soils are not maintained optimally, organic matter can be lost as carbon dioxide to the atmosphere which in turn could lead to an acceleration of global warming. It is easy to see how this can occur when one considers that the soils of Wales contain over 10 times the amount of carbon as that held in the atmosphere above Wales (i.e. a small loss of soil carbon has a major effect on atmospheric CO_2 levels).

How can we manage soils in Wales to preserve soil carbon?

At the moment we are not directly paying farmers to lock up carbon, however, many of the Agri-Environment schemes operating in Wales work in a similar way by promoting measures which help carbon storage (e.g. lowering grazing intensity, better use of fertilisers, tree/hedge planting etc). However, is there more we could do to manage our soils and plants to reduce greenhouse gas emissions in Wales? Well the answer is yes!

Firstly, in terms of big gains, it appears that planting more woodland will have a major positive effect. Similarly, preserving our peatlands in the uplands is also vital as well as better managing fertilisers and organic wastes in the lowlands and protecting soil against erosion. Drainage also appears to be key. In the uplands we can preserve carbon stored in peat by blocking drainage channels to reflood the peatland. In the lowland mineral soils it appears that maintaining good drainage is the best option to reduce greenhouse gas emissions and preserve soil organic matter.

There are also technological solutions which are still in their infancy. While the jury is still out on growing biofuel crops in Wales (many suggest that overall they are more detrimental to the environment than fossil fuels), the incorporation of charcoal (biochar) and rock dust into soil have been proposed as new ways to lock up carbon in soil. These proposed technologies remain unproven and for the foreseeable future we will have to rely on the farming community to preserve our natural carbon resource.