

The soil plays a vital role in both the emission of carbon dioxide and the sequestration of carbon. The global soils and vegetation are thought to hold 2,500 billion and 600 billion tonnes of carbon respectively. The management of these resources can therefore considerably affect the rate at which CO₂ is released and the amount of carbon that is held in the soil. Careful and effective management of the soil and the crops it supports can minimise the release of CO₂ and optimise carbon sequestration rates.

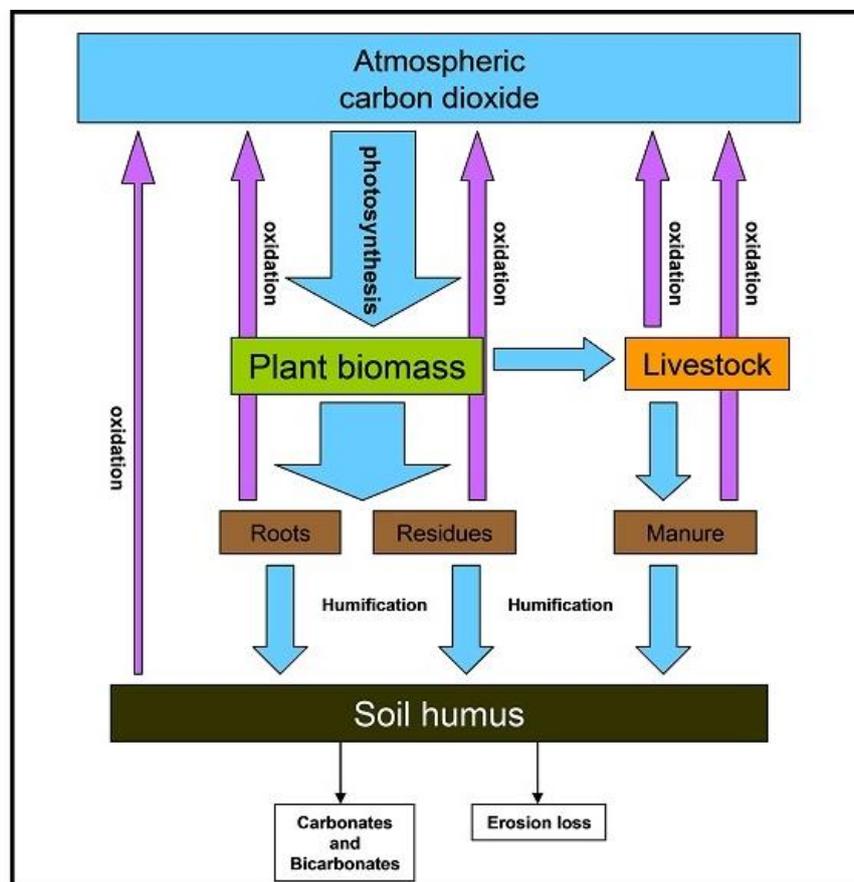
Grassland is potentially the best plant for building soil carbon levels because of its continual supply of organic matter both above and below the ground; and its ability to promote soil aggregation and good soil structure. Effective grassland management therefore plays an important role in building soil carbon.

Carbon dioxide release

Carbon dioxide is released by the soil's biological population as it breaks down vegetation and organic matter held in the soil. The rate of respiration and therefore the amount of CO₂ released is increased when the soil is disturbed and oxygen levels in the soil increase resulting in increased microbial activity. A flux in the release of CO₂ is therefore seen for example, when soils are ploughed, when temporary grassland leys are incorporated and when land use changes from a state of permanent vegetation (i.e. woodland or permanent pasture) to rotational cropping.

Carbon sequestration

The diagram below shows the flow of carbon from the atmosphere through living biomass to the soil.



Carbon is held in the soil as soil organic matter and is present in several forms – fresh organic matter (dead plant roots, leaves, animal manures); temporary materials resulting from decomposition; humus (stable soil carbon); and living organisms. The amount of carbon held in soil organic matter depends on the balance between carbon added to the soil in organic matter and that lost from the soil when organic matter is broken down by microorganisms and oxidised. The most stable form of carbon within the soil is humus which forms over time as organic matter undergoes the process of humification. In order to increase the level of carbon sequestered in the soil, management of the soil needs to be focused on increasing soil organic matter levels and creating conditions which favour the accumulation of more resistant forms of organic matter which remain in the soil longer and resist microbial decay.

Soil biology

The soil's living organisms play a crucial role in carbon storage – they decompose and convert organic matter into humus; re-synthesis root exudates into stable humic substances; incorporate organic matter into the soil; protect carbon within aggregates; and mediate the cycling of carbon. These actions are all governed by biological processes which are substantially affected by biological, chemical and physical conditions within the soil and wider environment. Soil management is key in optimising soil biology and therefore managing carbon sequestration.

Soil conditions need to be managed to provide the best environment for soil organisms to function in harmony to maintain a fertile and productive soil as well as a potentially vast carbon store.

Economic Benefits of Soil and Grassland Management

We have researched five of the most popular soil and grassland management options and assessed their relative benefits based on:

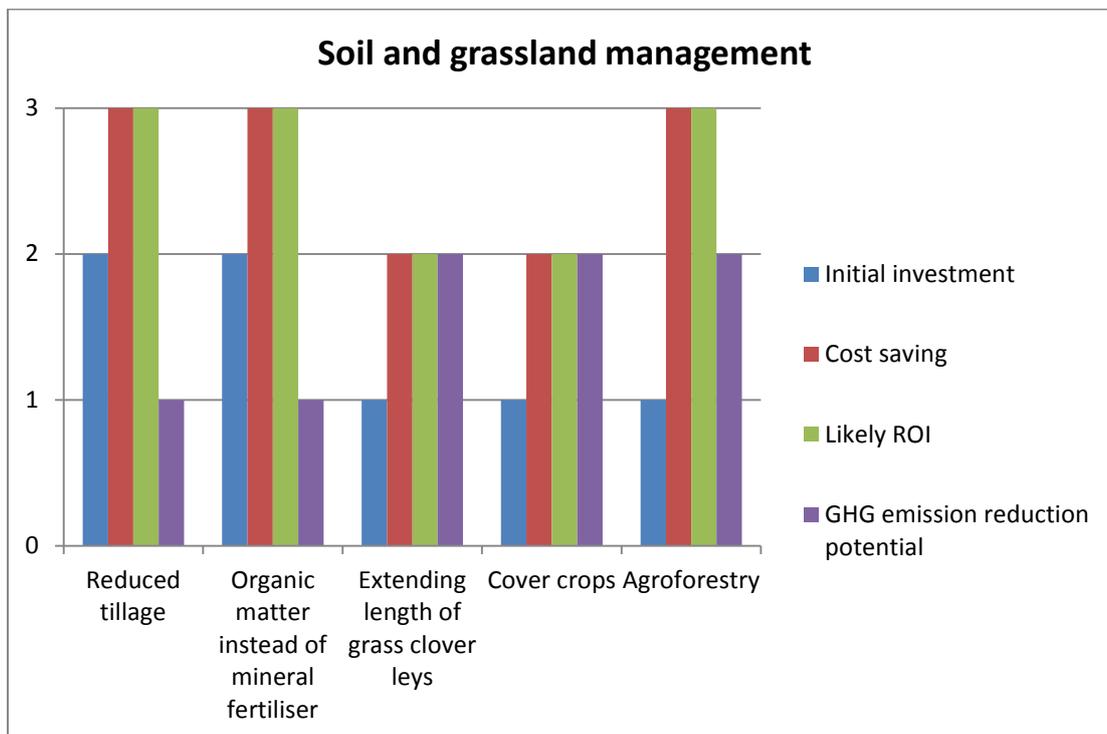
1. Initial investment
2. Cost saving
3. Likely ROI
4. GHG emission reduction potential

The graph on the next page shows the results of the research.

Results: The three areas in this section have been divided into five to give a more accurate analysis. We can see that reducing tillage, using organic matter, and agroforestry have excellent cost saving and ROI prospects. Of these three, the first two have reasonably good investment costs, but agroforestry has the best GHG emission reduction potential.

Extending the length of leys and using cover crops have identical results, with high investment costs but scoring well in the other three areas.

Economic verdict: a blend of these practices makes the most sense – particularly reducing the amount of tillage, applying organic matter instead of mineral fertiliser, and giving some of the farm over to agroforestry.



Management to reduce carbon impact

There are a number of soil and grassland management practices which reduce CO₂ losses and promote carbon sequestration, these include:

- Reducing **ploughing** frequency and intensity
- Avoiding **compaction** and **erosion**
- Reducing the occurrence of **bare** soil
- Increasing the lifespan of temporary **leys** and increased **permanent pasture**
- Using **mixed species** leys
- Including a range of **legumes** within leys
- Regular additions of a range of **manures**, **composts** and other organic matter
- Maintaining a healthy and diverse soil **biological population**
- Careful **grazing** management

The following factsheets in this series focus in more detail on the management practices that can be implemented to take steps towards improving a farm's impact on greenhouse gas emissions with particular reference to carbon sequestration and release.

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