

Assessing greenhouse gas emissions from farming systems: a review of the tools available and how they can help your business

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Making producer-led innovation a reality

Two approaches to assessing a farm's greenhouse gas emissions:

1. Whole-farm approach
2. Life Cycle Assessment

There are two components of all calculators:

- A database with standard figures for emissions (or sequestration rates) associated with an individual item or process;
- Farm specific information

Agriculture differs from other sectors in that the primary contribution towards global warming is from non-CO₂ greenhouse gases.

Over half of all agricultural emissions are from N₂O; 40% are due to methane and only about 8% are due to CO₂.

Source	Millions of tonnes CO ₂ equivalent (2010)
Methane (CH ₄)	18
Nitrous oxide (N ₂ O)	28.6
Carbon dioxide (CO ₂)	4.1
TOTAL:	50.7

In addition farming systems have considerable potential to absorb CO₂ from the atmosphere through soil carbon sequestration, potential to offset up to 4% of global GHGs

Carbon sequestration

Some calculators attempt to take this into account, others leave it out. Effects of land use change less controversial than C sequestration from grassland.

Studies report significant gains in soil C within grassland e.g. Bellamy *et al.* (2003) found gains of 0.1 tonnes of C/ha/year between 1978 and 2003 and Soussana *et al.* (2004) increases of 0.2-0.5 tonnes of C/ha/yr (included permanent and temporary grassland).

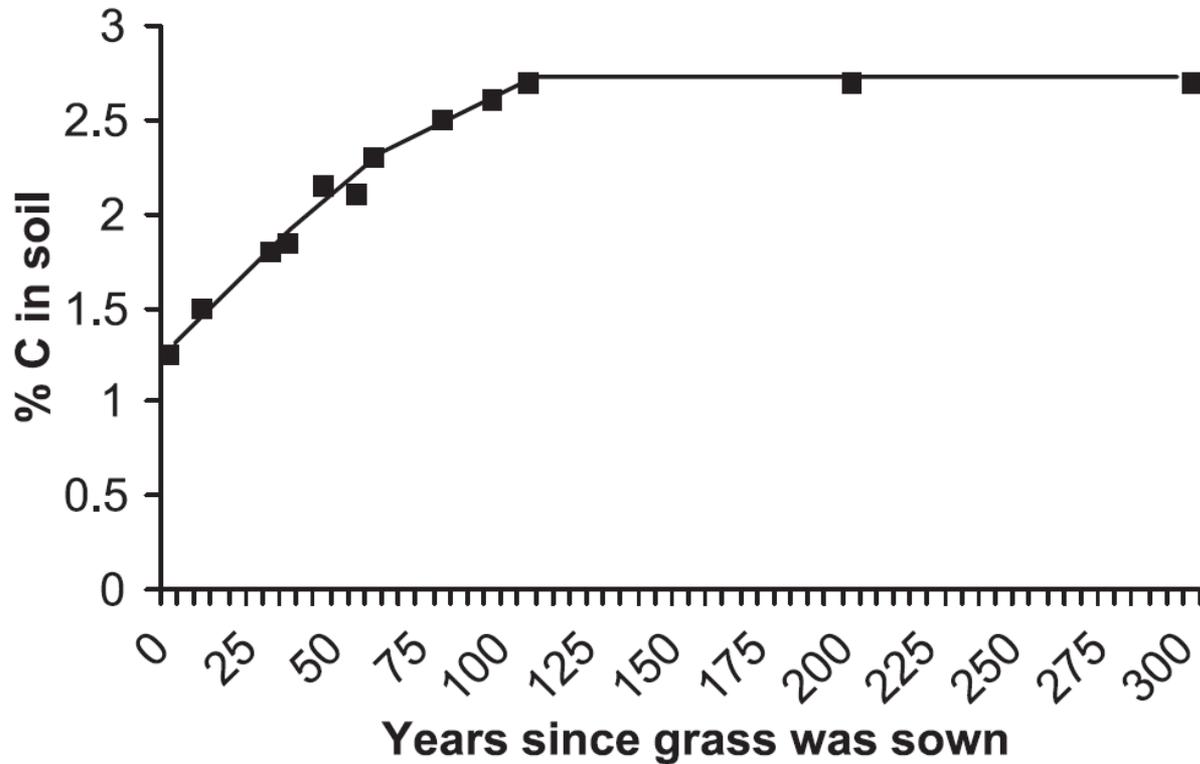
There are still considerable uncertainties partly as a result of disparity in soil sampling depths. Some grassland management/conditions can also result in losses (e.g. drought in 2003 and intensification of nutrient-poor grasslands on organic soils). The non-linear effects of previous land use change have also been left out of many studies.

Require combination of long-term measurements and C-flux measurements taking account of C-transfers to allow for more accurate estimates

Carbon sequestration

Non-linear relationship between land-use change and soil carbon stocks – difficult to capture within models and a lack of long term trials.

The accumulation of total soil carbon in silty clay loam soils at Rothamsted, UK, when old arable land is sown to permanent grass. Adapted from nitrogen content in Figure 18.10 of Jenkinson (1988).



Source: Freibauer *et al.* 2004

Choosing the right tool for your farm

Range of tools available: Important to consider a range of factors when choosing a tool, this can include:

1. Ease of use
2. Simplicity versus accuracy
3. Scope of the assessment
4. Ease of interpretation

Some examples of tools currently 'on the market'

CALM tool (Carbon Accounting for Land Managers)

- Web based tool – assesses whole farm
- Easy to use (based on drop-down menus)
- Takes 30-45 minutes to complete
- Only includes on-farm emissions and emissions associated with imports of electricity. Optional inclusion of manufacture of fertiliser
- Includes estimates of sequestration
- Easy to understand report

C-Plan (version 0 and version 2)

- Web based tool (version 0) or paid consultancy (version 2)
- Easy to use (based on drop-down menus)
- Version 0 takes about 15 minutes to use, version 2 about 30 minutes provided the information is to hand
- Version 0 only includes on-farm emissions, version 2 offers a complete LCA incorporating all inputs to the farm
- Version 2 offers specific mitigation advice with reports detailing the reduction from specific actions, as part of a paid service
- Includes sequestration for woodland and Land Use Changes

Farm Carbon Cutting Toolkit

- Web based tool (version 3 about to be launched)
- Easy to use (based on drop-down menus)
- Includes energy/emissions associated with all imports and transport from the farm
- Latest version takes about 30 minutes to use,
- Includes soil carbon sequestration estimate based on soil organic matter % and bulk density
- Results are presented as a summary for the farm
- Factsheets and advice available online at

www.farmcarbontoolkit.org.uk

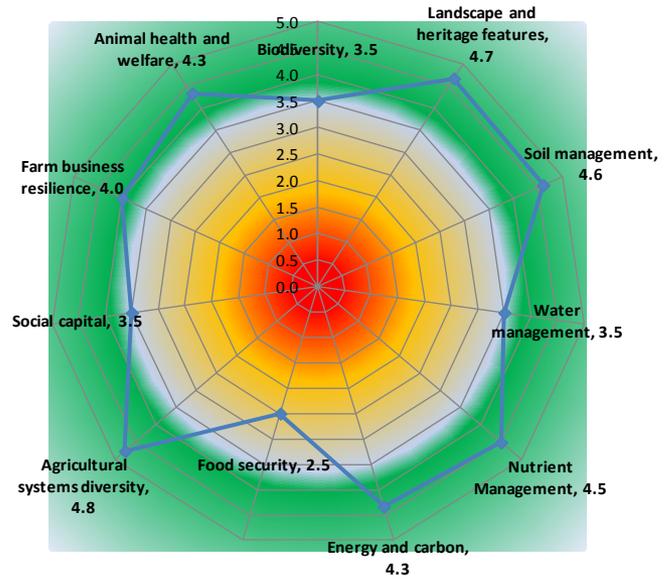
Cool Farm Tool:

- LCA tool developed by the University of Aberdeen, commissioned by Unilever and being used in a multi-company project on climate change mitigation
- Footprint calculation can be carried out on a 'product' or 'enterprise' basis
- A 'what if' approach can allow farmers to see the impact of changing certain practices
- Soil carbon sequestration included for land use change, shift in cultivation practices and woodland
- Straightforward process for one enterprise although a 'whole-farm' calculation can be time consuming

Other tools:

FAST: Farm Sustainability Tool (ORC)

Assesses performance against 11 spurs, covering a range of environmental economic and social criteria



FARMSCOOPER (ADAS)

Presents magnitude of effect for a range of mitigation measures factoring in effect of soil type, rainfall, N, P, K application

Cost saving and % effect for range of environmental indicators considered

Does not address many livestock relevant GHG mitigation measures

	Fixed Cost	Variable Cost	Total Cost	Nitrate	Phosphorus	Sediment	Ammonia	Methane	Nitrous Oxide	Pesticides	Biodiversity	Water Use	Energy Use
	£	£	£	Kg	Kg	Kg	Kg	Kg	Kg	Units	-	-	-
Baseline Value	0	0	0	3,836	191	27,706	4,264	12,076	1,773	5.3	-	-	-
Prior Implementation Value	2,022	-6,273	-4,252	3,436	173	27,564	3,858	11,983	1,651	4.7	-0.3	-4.0	0.9
Impact (Change from prior situation)	£	£	£	%	%	%	%	%	%	%	-	-	-
4 - Establish cover crops in the autumn	0	1,134	1,134	9.0	4.0	19.5	0.0	0.0	0.7	0.6	0.2	0.0	-2.3
5 - Early harvesting and establishment of crops in the autumn	0	1,378	1,378	0.7	0.4	1.8	0.0	0.0	0.1	0.0	0.0	0.0	0.0
6 - Cultivate land for crops in spring rather than autumn	0	1,890	1,890	1.8	1.3	2.4	0.0	0.0	0.1	0.1	2.3	0.0	0.0
7 - Adopt reduced cultivation systems	0	-1,620	-1,620	4.3	0.2	1.3	0.0	0.0	0.9	1.3	0.2	0.0	3.8
8 - Cultivate compacted tillage soils	0	194	194	0.4	0.3	0.7	0.0	0.0	0.4	1.0	0.0	0.0	-4.5
9 - Cultivate and drill across the slope	0	547	547	0.3	0.1	0.5	0.0	0.0	0.0	0.8	0.0	0.0	0.0
10 - Leave autumn seedbeds rough	0	450	450	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	2.3
11 - Manage over-winter tramlines	0	306	306	0.1	0.0	0.1	0.0	0.0	0.0	0.5	0.0	0.0	-0.2

In Summary:

Choice of tool depends on what you want to achieve: if trying to assess whole farm performance and get a quick overview, a CALM or C-Plan approach is more appropriate

A more detailed, LCA assessment requires more time (and money) but can identify savings throughout the supply chain in GHG and financial terms

Important to not view greenhouse gas emissions in isolation; only one aspect of sustainability

Carbon sequestration from grassland and management changes is a developing area BUT will be possible to include product LCAs if scientific consensus can be achieved...

A summary of the tools currently available is presented in a report produced as part of the Better Organic Business Links project, see:

www.organiccentrewales.org.uk/publications.php