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A farmers guide to carbon footprint calculators

Tony Little, Organic Centre Wales
Laurence Smith, Organic Research Centre, Elm Farm

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What is a footprint?

As we have become more aware of the impact that our domestic and business activities have on the environment, it has become more important that we are able to measure and monitor that impact. Footprint calculators have been developed to enable us to do this. A few calculators include several environmental resources (soil, water and biodiversity etc). Others focus on the balance of greenhouse gases (GHG) emitted and sequestered by the farm, .known as the **carbon footprint**.

What is special about farming?

In terms of their carbon footprints, farms are different from other industries in two important respects:

- In most industries, the main greenhouse gas emitted is carbon dioxide (CO_2). In agriculture methane (CH_4) and nitrous oxide (N_2O) are much more important
- Farms can sequester as well as emit carbon.

How do carbon footprint calculators work?

Fundamentally all calculators work in the same very simple way. They are made up of two parts; a) a **database with standard figures** for emission and sequestration rates for individual items or processes and b) **farm specific information**. The calculator multiplies these two components together to give a total for each item, as illustrated in the table below. It then adds all the individual items together to estimate the total emissions and total carbon sequestered for the farm, and subtracts one from the other.

As mentioned above, the main greenhouse gases in agriculture N_2O and CH_4 rather than CO_2. This gives us a problem because the warming potential of each gas is different. We solve it by using units called **CO_2, equivalents.** A kilogramme of CH_4 has the same effect as 23Kg of CO_2, and therefore has 23 CO_2, equivalents. A kilogramme of N_2O has 296 CO_2 equivalents.

How a carbon calculator works

Parameter	**No. Units (Farm data)**	**Emissions per unit (Kg CO_2 Eqv/ Unit)**	**Total emissions (Kg CO_2 Eqv)**
Diesel	3,000 litres	2.31	6,930
Electricity	1,500 Units	0.53	795
Dairy cows including manure (CH_4)	100 Head	2,944	294,400
Beef cattle including manure (CH_4)	15 Head	1,167	17,505
Sheep including manure (CH_4)	150 Head	188	28,200
Grass clover, ha (N_2O)	10 ha	555	5,550
Etc, etc			
TOTAL Emissions			353,380
Sequestration – Natural woodland regeneration on arable land	10 ha	12,517	125,170
Bioenergy crop production	10 ha	4,520	45,200
TOTAL Carbon Sequestration			**170,370**
Net Global Warming Potential			**183,010**

Why are there so many calculators?

There several reasons why you might want to calculate your carbon footprint, for example:

- As a management tool to measure, monitor and reduce the carbon footprint of the farm and improve the efficiency and performance of the business;
- As a marketing tool to help environmentally conscious consumers choose the products they buy;

Different calculators are suited for different purposes. Generally speaking there are two types; those that measure the footprint of a farm or system and those that can measure the footprint of a particular product. As a farmer you are likely to be more interested in the former, but product footprints can be a very useful tool for example if you want to quote the carbon footprint on packaging and use this as a marketing tool.

Within these broad categories there are wide variations on a theme; for instance some have a particular focus on dairy or horticulture, for example. For product footprinting, the BSi and the Carbon Trust UK have developed the PAS 2050 methodology, which is rapidly establishing itself as a UK standard. This uses a so called **Life Cycle Asessment (LCA),** which means it includes all the environmental impacts from primary production right through to disposal.

How are they different from one another?

There are three main issues to be aware of here:

The Scope of the data

This refers to what is, and is not, included when the standard figure for the emissions per unit (e.g. per ha of crop or per head of livestock) are worked out. The World Business Council for Sustainable Development (WBCSD) has defined three scopes, which are now internationally accepted.

Scope 1 refers to direct emissions from sources that are owned or controlled by you. This includes emissions from diesel used by tractors; propane used for propagation; kerosene for boilers etc. It also includes direct emissions from soils and livestock.

Scope 2 is a separate category for the emissions associated with the generation of the (purchased) electricity used on the farm.

Scope 3 refers to indirect emissions including those associated with the production, processing and distribution of inputs in to the farming system. These would include seed, bought-in grain and compound feed, fertilisers, pesticides etc .

Obviously, calculators whose databases only use scope 1 and 2 data will give you a very different answer to one that also takes account of scope 3 emissions, particularly when you consider that the latter can account for up to 40% of a farm's total footprint. Some systems allow you to pick and choose the type and scope of data used, but most do not. In either case it is important to make sure you know what scope of data your calculator uses and how this affects the outcome.

The raw data

To complicate matters further, there is no formal agreement on some of the raw data, especially for scope 3 data - the emissions associated with producing a tonne of N fertiliser or mining rock phosphate, for instance. This introduces the potential for developers of the calculator to be selective with the data in the interests of promoting one product or farming system over another.

Carbon sequestration.

All farms sequester carbon as well as emit greenhouse gasses, and different calculators tackle this in different ways. Some leave it out altogether, arguing that most producers are really only interested in energy saving and resource management issues and that there have been insufficient studies to generate accurate data on sequestration rates. While the latter is certainly true, many producers will want to look at the impact of the whole system and that includes the potential for sequestration. Many calculators, therefore, do take this area into account, while acknowledging the current limitations.

How do I choose the most suitable calculator?

As with all these things, there is no 'one size fits all' calculator. The most important things is that you are very clear about what you want to use the calculator for. If on-farm emissions are your focus, then you could use one with just Scope 1 and 2 emissions data. If it's the wider global warming potential of the farm you are interested in, then you need something that includes scope 3 emission and sequestration data. If you are footprinting products, especially if you want to use it to market your produce, you probably want something that is PAS 2050 compliant.

There are also practical considerations as well: How easy it is to enter data? Does the system take you through the calculation process in short, logical steps; is it easy on the eye? Are the results easy to understand, and do they give sufficient detail to be useful?

We have summarised the key characteristics some of the main calculators that are in widespread use or that we have judged to be of particular relevance to organic farmers. If you want to find out more, you can read the detailed report on which this summary is based at http://www.organiccentrewales.org.uk/business-home.php, or contact Tony Little, jll@aber.ac.uk, 01970 621632.

Notes

Sources of data in the Table: Standard emissions figures are from National Atmospheric Emissions Inventory and Carbon Trust energy and carbon conversion factors. Carbon sequestration figures taken from: P. Falloon D. Powlson, P. Smith (2004): 'Managing field margins for biodiversity and carbon sequestration: a Great Britain case study' Soil Use and Management (2004) 20, 240 - 247

Abbreviations

CALU	Centre for Alternative Technology	**ORC - EF**	Organic Research Centre – Elm Farm
CFF	Climate Friendly Food	**PAS**	Publically Available Specification
CLA	Country, Land & Business Association	**SAC**	Scottish Agricultural College
IPCC	Intergovernmental Panel on Climate Change		

Key characteristics of calculators reviewed

	CALM	CPLAN	Man. Energy & Carbon
Developed by	CLA	D & J Coulter	CALU
Format	Web	Web & Spreadsheet	Paper
Availability	Free	1) Free (simple) 2) Pay-click-calculate (more complex) 3) Consultancy (spreadsheet not publically available)	Free
Purpose	Farm management.	Farm Management; policy development	Farm management
Ease of use	High	High	Medium
Complexity	Medium	Medium	Low
Methodology	IPCC	IPCC plus UK National	ADAS
Scope	1, 2, some 3	1 & 2 on web; 3 consultancy only	1, 2
Emissions from fuel & electricity	✓	✓	✓
Emissions from Livestock	✓	✓	✓
Emissions from soil/ crops	✓	✓	✓
Focus on organic systems	x	x	x
Sequestration	✓ (Outline)	✓ (Outline)	x
Website/ Contact Details	*www.cla.org.uk/Policy_Work/CALM_Calculator/*	*www.cplan.org.uk*	*k.buckler@bangor.ac.uk*

Key characteristics of calculators reviewed (continued)

	SAVEFuel/ REFuel	EASI	Carbon Friendly Food (CFF)
Developed by	SAC	ORC – EF	CFF
Format	Spreadsheet	Spreadsheet	Web
Availability	Consultancy	Consultancy	Free
Purpose	Farm management	Farm management	Farm management; certification; marketing
Ease of use	Consultant operated	Consultant operated	High
Complexity	Medium	High	High
Methodology	SAC	Organic Research Centre	Climate friendly Food
Scope	1, 2	1, 2, some 3	1, 2, some 3
Emissions from fuel & electricity	✓	✓	✓
Emissions from Livestock	✓	✓	✓
Emissions from soil/ crops	✓	Limited	✓
Focus on organic systems	x	✓	✓
Sequestration	x	✓ (Detailed)	✓(Detailed)
Website/ Contact Details	*rod.mcgovern@sac.co.uk*	*laurence.s@organicresearchcente.com*	*http://www.climatefriendlyfood.org.uk/carboncalc*

Key characteristics of calculators reviewed (continued)

	LCA analysis of Blaencamel farm	Bangor Farm Model	Agri assist emissions footprint tool
Developed by	Peter Segger	Bangor University	Dairy Crest Direct Ltd and Agri assist Ltd
Format	Spreadsheet	Spreadsheet	Web
Availability	Free	Not publicly available	Fee payable for use of tool
Purpose	Farm management	Farm management	Farm management tool
Ease of use	Medium	Research tool	Medium
Complexity	Medium	High	Medium
Methodology	Own methodology	LCA – PAS 2050	LCA – PAS 2050
Scope	1, 2, some 3	1, 2, 3	1,2,3
Emissions from fuel & electricity	✓	✓	✓
Emissions from Livestock	✓	✓	✓
Emissions from soil/ crops	✓	Limited	✓
Focus on organic systems	✓	x	x
Sequestration	✓ (Detailed)	✓ (Detailed)	✓
Website/ Contact Details	*peter@blaencamel.com*	*www.senr.bangor.ac.uk*	*mmasters@edgarley.fsworld.co.uk*