Farm Carbon Toolkit

Case study: Hill Top Farm

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Farm Details

A 445ha farm with 80% of the area above the moorland line. The majority of the farm is over limestone, meaning that the farm is quite dry and is at risk of burning off in the summer from lack of moisture, limiting forage availability.

Transition of the farming system

The farm has undergone a significant transition in terms of the farming methods that are used. Traditionally a large number of sheep were kept; in 2008 the farm was lambing 800 sheep, with no cattle and feeding a lot of concentrates and purchased feed. In 2012 the sheep numbers were reduced to 400 and the numbers have continued to decline as the cattle numbers have built up with the farm now lambing 100 sheep and moving to a herd of Belted Galloway cattle to manage the landscape. The cattle are used to help maintain the biodiversity across the multitude of habitats which exist on the farm including areas of SSSIs as well as upland hay meadows. The majority of the farm is in Higher Level Stewardship. As well as maintaining existing habitats on the farm, new areas have been created including the planting of 500m of new hedge and 3ha of woodland.

The project

Aim: to demonstrate the impact on the farm's carbon performance from the transition that has taken place at Hill Top Farm.

What we did: The Farm Carbon Calculator was used to model the carbon performance of the previous farming system and the current stock and farm set up. The aim of this approach was to assess whether the transition; as well as providing multiple benefits for conservation and biodiversity, has resulted in a reduction in greenhouse gas emissions and improvements in sequestration.

Previous farming system modelling

Headline figures:

Figure 1 depicts the overall carbon balance from the previous farming system (based on 800 lambing ewes), and the sequestration taking place from the upland permanent pasture, to provide the overall carbon balance for the farm of 270 tonnes CO2e. The figures are all reported in CO2e which translates the emissions that are coming from nitrous oxide and methane into their carbon dioxide equivalents for reporting purposes.

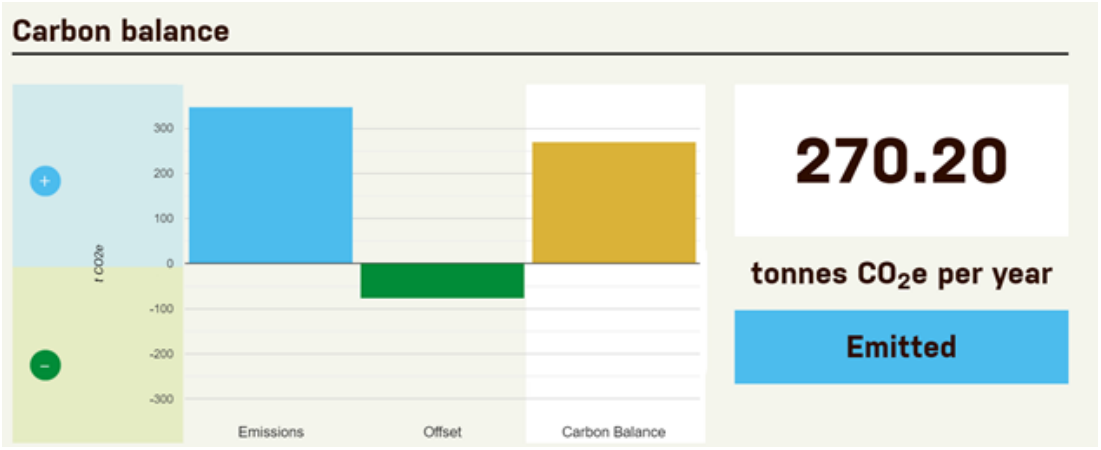

Figure 1 Carbon balance for Hill Top Farm's previous farming system

Although overall carbon balance is a useful starting point, understanding its relevance across multiple farming systems or enterprises requires a metric that can be compared. As such, the overall carbon balance can be split into carbon balance per ha and balance per tonne of output (in this case 1000 lambs at 40kg LW). Figure 2 below shows these metrics. Upland beef and sheep systems generally have a lower carbon footprint than some of the lowland systems due to the lower amounts of inputs used that often have a high carbon cost (including fertiliser).

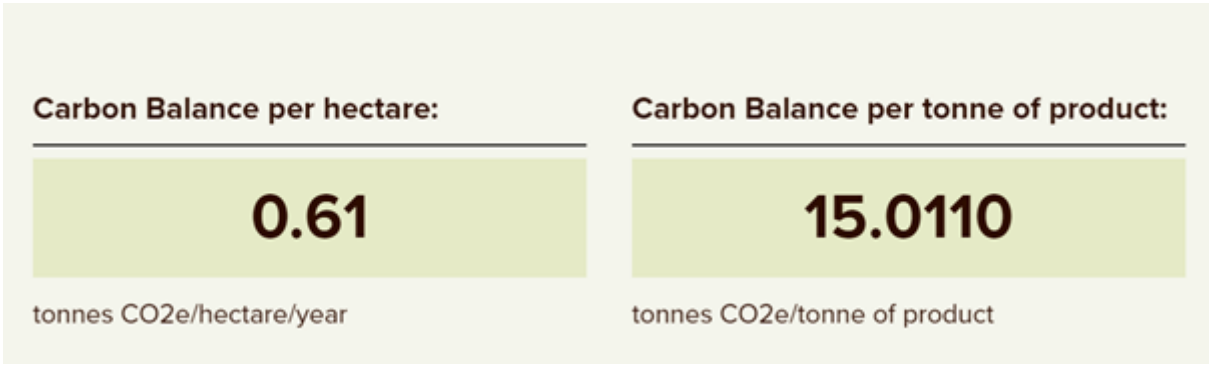

Figure 2 Carbon footprinting from Hill Top Farm's original farming system reported as carbon balance per hectare and per tonne of product

Emissions breakdown

Emissions	tonnes CO_2e	%
Fuels	31.30	9.02%
Materials	0.98	0.28%
Inputs	0.27	0.08%
Livestock	314.30	90.62%
Total	**346.84**	**100%**

The table shows that the vast majority of emissions at Hill Top farm were originating from the sheep enterprise, both from the livestock themselves (contributing 280t CO2e of the total) and the purchased feed that was being used (contributing 34 tonnes of emissions). Fuel use was originating from

red diesel use on-farm, petrol for the quad bike, electricity use and also the use of contractors for silage making. Material emissions are taking account of a small amount of fencing that was completed and the plastic used for silage making and the input emissions arises from some spot on weed control that was undertaken on nettles and thistles.

Sequestration

Sequestration was accounted for on the original footprint report by assigning a small sequestration value to the permanent pasture areas. The 426 ha of the farm are shown to be providing a sequestration value of 76t, recognising the importance of pastureland as a carbon store.

Current system:

The carbon footprint was then remodelled to take into account current farming practices. Main changes that were modelled include the reduction in sheep numbers and the development of the cattle enterprise.

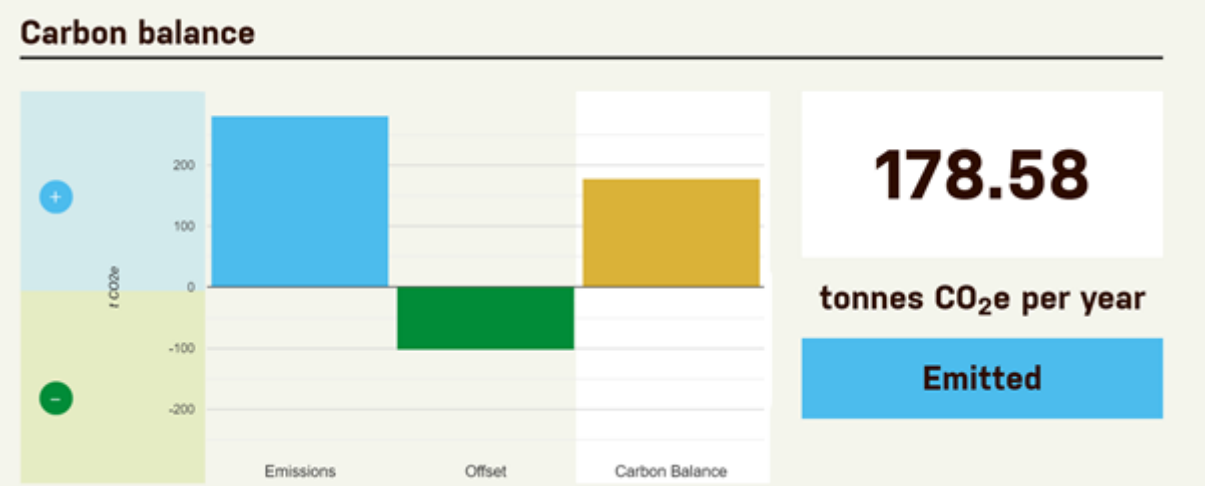

Figure 4: The Carbon balance of the current farming system at Hill Top Farm

As figure 4 shows the carbon balance is reduced to 178 t CO2e providing a reduction in total carbon balance of 91.62t CO2e. This is arising from the elimination of concentrate feed across the livestock enterprises, a reduction in sheep numbers, and the planting of new woodland and hedgerows. It is noteworthy that the carbon balance has reduced despite the cattle producing a higher volume of methane per head than sheep.

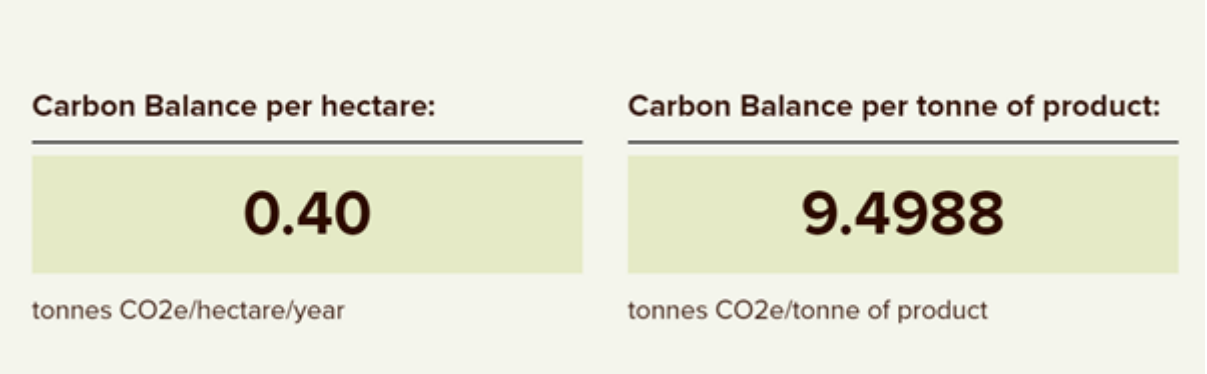

Figure 5: Carbon balance per hectare and per tonne of product from the current farming system at Hill Top Farm

As well as the overall reduction in carbon balance, when comparing by area or per tonne of product – the numbers are also lower, with the carbon balance per tonne of product reducing by almost 6 tonnes.

Emissions categories

Emissions	tonnes CO_2e	%
Fuels	30.66	10.90%
Materials	0.98	0.35%
Livestock	249.64	88.75%
Total	**281.27**	**100%**

The reduction in emissions has originated from two distinct areas. There is no spraying that takes place on the farm any more which provides a modest reduction (emission associated with herbicides are minimal), but the majority of emissions reductions has come from the livestock enterprise. The lower number of stock (160 cattle ranging from 0-4 and 100 ewes plus lambs) has reduced the emissions generated from the livestock enterprise from 314t previously to 249 t CO2e currently, a reduction of 65 t CO2e despite the development of the cattle enterprise. The transition to a pasture-based system has also eliminated the emissions associated with the purchased feed (38 tonnes in the previous footprint).

Sequestration categories

Offset	tonnes CO_2e	%
Habitats	-76.64	74.63%
Hedgerows	-1.35	1.31%
Woodland	-24.70	24.06%
Total	**-102.70**	**100%**

The creation of the woodland has generated an additional sequestration value of 24t CO2e. Planting hedgerows has provided a carbon sequestration benefit as well as the wider habitat and biodiversity benefits that will be generated. When comparing this model with the previous farming system the same

sequestration value for permanent pasture has been used, generating 76.64 t CO2e..

Future opportunities

The metrics that have been used to calculate the carbon balance thus far have been generated using GWP100. However there is an alternative way to calculate the impact of short lived greenhouse gas emissions such as methane which is termed GWP*. This metric allows an understanding of the cyclical nature of methane and is determined by assessing livestock numbers and how those livestock are managed. If the GWP* metric is applied to Hill Top Farm it has a significant impact on the overall carbon balance of the farm taking it from being a net emitter to being very close to net zero.

Alongside the alternative metric for methane, a third footprint was modelled which explored the potential for enhanced soil carbon sequestration through adaptive management. By grazing the cattle across the farm in a manner which maximises biodiversity (providing a period of rest and recovery) the farm will be providing soil health and carbon sequestration benefits. A conservative increase in soil organic matter of 0.01% was modelled across the farm to highlight the ability of the soils to provide not just a climate solution but also improved water infiltration, and habitat creation. The 0.01% increase would sequester an additional **163 tonnes**. In order to be able to accurately assess the carbon levels, regular soil sampling is required.

Figure 8 below shows the carbon balance when the GWP* metric and a small amount of soil carbon sequestration is included within the model. These actions take the farm from being a net emitter of 178t CO2e to being a net sequesterer (or carbon positive), sequestering 95t more than the farm emits.

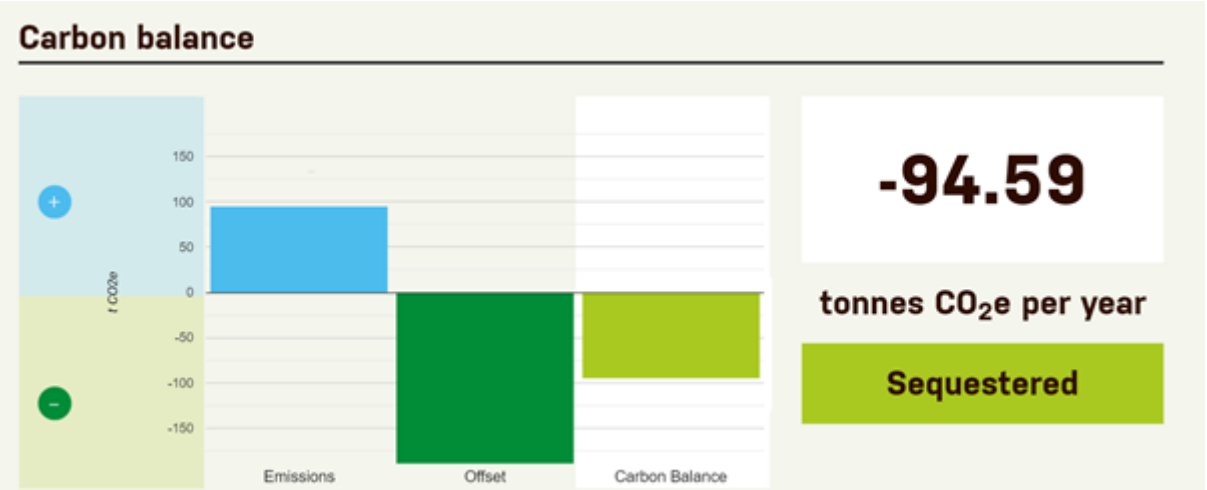

Figure 8: The impact of modelling soil carbon sequestration alongside the use of GWP* at Hill Top Farm

Figure 9: The carbon performance per hectare and per tonne of product utilising the projected modelling

Future plans

There are however no plans to stop at this point! There are still emissions reductions to be had on the farm, focussing on fuel use efficiency and the potential to continue to improve pasture quality and soil health through grazing management.

Although carbon footprinting can be a bit of a daunting topic, he found the experience a useful one! *"The whole process was extremely practical; Becky was extremely helpful in interpreting the activities on the farm, and extremely knowledgeable in terms of how the different farming activities contributed to sequestration and current emissions.*

We were enthused by the results that we got, but going forward we want to work with Becky to understand what more we can do to improve our environmental impact and where the synergies are between climate and biodiversity."