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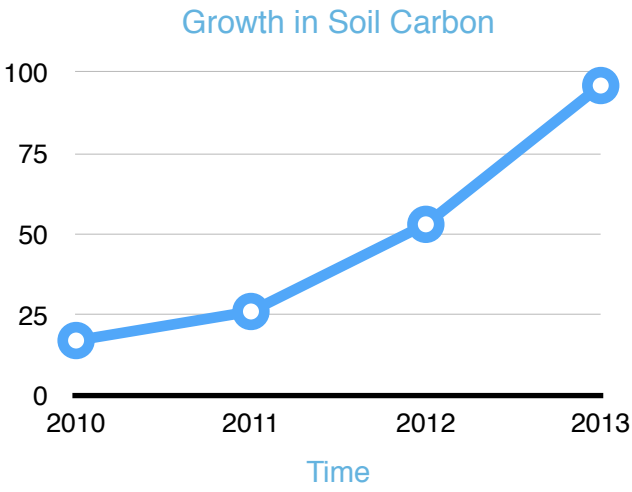
The financial case for investing time and effort into carbon sequestration

In March 2014 I was invited to join one of the FCCT's 'Building Soil Carbon' master classes, run by Adam Twine and Jonathan Smith and held at Martin Howard's, Northcott Farm in the lovely Tamar Valley. I was not there to give a presentation but as payments for soil carbon sequestration were going to be discussed it seemed sensible to mention my project 'Carbon Prophet' www.arcarbon.co.uk .

It was clear that there was a great deal of interest and not a little confusion, about how such a scheme could work, the science behind it and the significant income that may be achieved by increasing soil sequestered carbon. This blog post therefore is my attempt to cover some of the ground that time constraints meant we missed on the day.

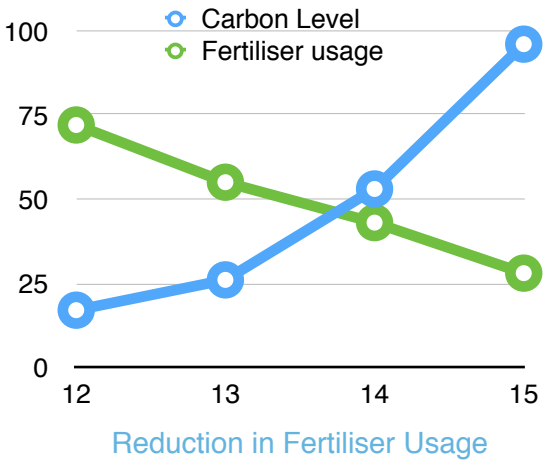
Lets start with the science. It would make life so much easier if determining the elemental content of a soil sample was as easy a counting the horses in the picture opposite. After all it does not matter what language you speak or even if you have ever seen a horse before; as long as you can count you will know how many horses there are and it does not matter if you use a pen and paper, a calculator or your fingers to record the total, any recording system will do. Most people would probably do a head count but you could complicate things by counting the number of legs and dividing by 4 however, whichever system you chose the answer (assuming your maths is good), would be the same. Unfortunately, determining the amount of any element is not so straight forward. If you want to know how much Phosphorus for example is in the soil of the field in the picture; what method do you use? In calcareous soils the Olsen test may be used most often but there is also the Morgans test using sodium acetate extraction and the modified Morgans using ammonium acetate extraction. For base saturation you have Mehlich 111, then there's Reams and Bray 1. Each of these tests will give you a result but it is likely that you will get a different figure for each type of test. The trouble is that although all the results might be different, they are all correct. Unfortunately, they are all equally incorrect as well. The fact is that your test may tell you that you have 950 ppm of Phosphorus but does that mean that if you take 1 metric tonne of soil you could liberate 950 grams of P? Well, you might, but you may also achieve 876 grams, 903 grams, 1032 grams or some other number. This is because determining the actual amount of an element is subject to a huge number of variables, not least of which is the relative strengths of the extracting agent used. Luckily for me Dr Jenni Dungait (one of the speakers on the day), along with other distinguished scientists got together to define a standard test for carbon that includes a determination of the bulk density of the sample. This standard test allows us to determine a standardised result and it is this methodology that our laboratory, NRM, uses to calculate the amount of carbon in a sample. We then apply a bit of maths to achieve our determination of the amount of carbon sequestered in the soil and



how this builds up over time.

So, we have an acceptable, scientifically robust way of measuring the amount of carbon sequestered in the soil and from there it is a reasonably easy step to determine the equivalent amount of atmospheric carbon dioxide this equates to. We use relative atomic weights of C and CO_2 to achieve this.

What then does all this mean to you the farmer? Well, firstly, it means that we can measure how much carbon exists in your soil and whether your actions such as fertilising, ploughing or weed killing increases or decreases these levels. There is plenty of evidence that all these operations have a detrimental effect on soil carbon levels; often due to the damaging effect that synthetic chemistry can have on soil microbiological populations but also by releasing carbon back into the atmosphere or by damaging soil structure. It is also apparent that managing your soil to increase its natural fertility has a very positive impact on your costs. We have seen fertiliser requirements fall by significant percentages per annum and in some crops, the complete removal of the need to use hugely expensive fungicides.



Secondly, we can show you ways to increase that carbon through alterations to your management regimes that promote sensible microbial management and the increased use of composts and other natural amendments that work to increase natural soil fertility. This does not mean that we encourage you to turn to an organic system, far from it. What we are trying to promote is the use of microbial management as an extra weapon in your armoury-one that works to maintain and increase yield, reduce cost and create a new revenue stream.

Thirdly, should you chose to build soil carbon, we can help you pay for this work by creating an income for you from the trading of the increase.

Financial benefits of soil carbon sequestration. Dr Christine Jones (Jones et al. 2007) estimates that between 50 and 80% of organic carbon that was once in the worlds topsoil has been lost to the atmosphere over the last 150 years. These depleted soils can be restored. As Dr Jones states, “By inference degraded soils have the potential to store up to 5 times more organic carbon than they currently do.” The problem is how do we incentivise farmers to make the changes to their land management practices that will ensure wide scale sequestration of carbon? AR Carbon’s answer to this is to create a carbon trading scheme for farmers and growers called Carbon Prophet that gives them an income proportional to the amount of carbon they sequester.

How it works is relatively simple. By measuring the carbon content of the soil, along with the soils bulk density, you can generate a figure for the amount of carbon sequestered within that soil. We chose to ignore the top 10 cms of soil and concentrate on the next 30 cms and applying a bit of maths, we come up with a figure for the amount of carbon there is in a one hectare plot to a depth of 30 cms.

Using Northcott Farm for illustrative purposes only and assuming a bulk density of the soil as 1000g/l with a 1% carbon content, it is possible to put a few figures together that highlight the potential income that could be derived from managing and increasing the amount of carbon sequestered within the soil:

Potential income from Carbon Trading

Bulk Density: 1000g/l = 1000kg/M^3

1% C/M^3 would therefore weigh (1000 kg x 0.01%) = 10 kg C/M^3

Therefore at 1% C per hectare = 30 Tonnes of carbon per hectare

Applying a conversion rate of 3.67 give a CO_2e equivalent of **110.1 Tonnes per hectare**

Carbon offsets have been traded for some time and they have ranged in price from under £5 each to over £13. For our purposes I have assumed a value of just £3 per tonne. Applying this figure to Northcote Farm we can estimate a value for the carbon already in the soil.

Area of Farm: 146 ha

CO_2e amount for the whole farm = 110t/ha x 146 hectares = 16060T/CO_2e

Value as a carbon offset at £3 per Tonne = 16060 x £3 = **£48,180.00**

As mentioned earlier, Dr Jones estimates that depleted soils could hold up to 5 more carbon than they currently do. Applying this to Northcott would give a potential holding of 150 tonnes per hectare. Carbon build up is a relatively slow process but assuming Martin works at restoring these levels and achieves an increase equal to just 5 tonnes per hectare per year he could realise an annual income for the next 30 years of over £8000 per year. This is illustrated below:

5 tonnes increase per year = 18.35T/CO_2e per annum

18.35 x £3 = £55.05 per hectare per year

£55.05 X 146 hectares = **£8037.30 per annum**

£8037 per year is not a kings ransom but when nearly 60% of all farms in the UK make either no money, or just break even from their farming operations, it is definitely a significant, potential income. If you then factor in the savings that accrue from reduced requirements for synthetic chemicals such as fertilisers and fungicides, project 'Carbon Prophet' from AR Carbon has the potential to revolutionise farm incomes.

One of the regular questions I get is what happens if in one year there is an increase in soil carbon but this is then lost in following years? The simple answer is that this is very unlikely to happen for two very simple reasons. Firstly our sampling methodology ignores the top 10 cms of soil and secondly, where areas are regularly ploughed we would test below plough depth to mitigate for the loss of carbon to the atmosphere from this operation. What we are attempting to measure is the amount of carbon that is sequestered for the long term within the soil. Certainly, in the top most layer of the soil carbon is readily lost to the atmosphere but there is plenty of evidence from around the world that shows the very effective sink that agricultural soils can become for carbon and that these pools can persist in the soil for hundreds or even thousands of years. This makes soil the most important potential sink for carbon that humans have any real management control over.

That said, any potential or actual sink has the ability to lose its carbon. Draining peat bogs is an obvious example of this and it is happening to an alarming extent. Land managers in some areas are draining peat bogs in order to turn the land over to growing heather, as a cover for grouse and other game birds. Carbon Prophet has the potential to reverse this trend as payments for

sequestration can be more lucrative and are certainly more environmentally friendly. Woodland projects currently have the lead in farm based carbon reduction schemes but these too regularly lose some of their sequestered carbon. This picture was taken two weeks ago and shows a logging operation that was harvesting 15 to 25 year old trees. On inquiring, I was told that most of this production will eventually end up in a biomass burner.

Before anyone gets the wrong impression, I am not saying that using woodland as a method of sequestering atmospheric carbon is worthless. Quite the contrary in fact but is this system the only answer? In my opinion it is not. The pressures of feeding an ever growing population means that, until such time as we start to feed ourselves on Oak, Beech, Larch or any other tree, there remains a need to farm the land to produce the food that we require. Modern synthetic chemistry can have a detrimental effect on the natural balance of the soil, making it ever harder to produce sufficient quantities of food and locking farmers into ever larger applications of expensive fertilisers.

I have spoken to farmers not only in the UK but in America, Asia and Africa and I am yet to find a farmer who simply does not care about the environment. However, they all also worry about the economics of their operations and whether their farms will still be going concerns that provide an income for future generations. Farmers want to be more environmentally friendly but they also need to be sure that they stay afloat. These farmers have a vital role to play in mitigating the worse effect of man made climate change but they have to be supported to do so. Unfortunately the current economic situation means that there is little money and even less enthusiasm from our politicians for subsidy based incentives and this is where Carbon Prophet from AR Carbon can fill the funding gap.