GREEN
EUROPEAN
JOURNAL

Back in the Ground: Capturing Carbon through Farming

Article by Frédérique Hupin
December 14, 2020

While the merits of natural solutions to climate change, like planting trees or restoring peatland, are hotly debated, one such idea currently part of a major European research project is still little used around the world: carbon sequestration by agricultural soil. Agriculture could become a solution to climate change, rather than being part of the problem. This would involve spreading the principles of agroecology while building resilience to climate variations and crop disease.

Claire Chenu, a professor at France's National Research Institute for Agriculture, Food and Environment (INRAE), was a spokesperson for the "4 per 1000" initiative launched by the French at COP21 held at the end of 2015 in Paris. As she explains: "The main idea behind the "4 per 1000″ initiative is to manage soils sustainably so that they can fulfil the many functions that we expect of them. This is above all to support food production and security, but to also to mitigate climate change and help agriculture to adapt to it." So, increasing the amount of carbon stored in the soil through photosynthesis could also help reduce atmospheric CO_2. She continues: "There is so much carbon in the world's soils that, if we increased the amount of carbon in agricultural soils by 4 per 1000 – or 0.4 % – each year, we would capture the equivalent of what is emitted by our planet into the atmosphere annually from all sources."

It's an incredible figure, and represents the total carbon emissions that could theoretically be offset. The key to this phenomenon is photosynthesis, which means farmers have a vital role to play in storing carbon because they have billions of factories working for them for free: chloroplasts, the organelles in which photosynthesis takes place. Photosynthesis is the unique process that enables plants to synthesise their tissues (organic matter) using light energy and carbon dioxide (CO_2) absorbed from the air. The parts of crops that we use are turned back into CO_2 without storing any carbon, but what is left in the field (stems, roots, soil cover) helps to increase the organic matter in the soil and capture carbon. Furthermore, as they grow, plants inject sugars (containing carbon) through their roots into the soil, nourishing microfauna and fungi that benefit them (nutrition, resistance to diseases).

The seed of an idea

This may sound like a sustainable solution but to better understand the process and challenges of rolling it out on the ground, we need to hear from farmers themselves. Luc Joris is farmer in Chastre, Belgium, where he has a 225-hectare growing beat, chicory, endives, potatoes, peas, cereals, maize and pastures. He has long been thinking, talking to fellow farmers and reading specialist agricultural journals about reducing tillage, pesticides and synthetic fertilisers. His initial goal was to improve profitability. He is monitored by independent agronomists who calculate his net carbon account. These calculations are made using the Cool Farm Tool, an American model that has been adapted for European conditions. In calculating the carbon footprint of his land, a range of factors are taken into consideration, including use of fertilisers and plant protection products, crop management (types of tillage), yields obtained, vegetation, and trees planted. The carbon account is regularly updated to factor in improvements in farming practices. The net carbon account for Joris's farm is positive: in 2020 it captured 80 more tonnes of

CO_2 than it produced. But Joris believes there's still room for improvement in sequestration: "Storing carbon means doing two things: first, stopping the degradation of soil humus content, because that's where the carbon is; and second, nourishing the soil with a variety of high-quality cover and crops without injecting too many chemicals, because the production of chemicals adds carbon from elsewhere".

The secrets to carbon capture

Joris already knew that his soil should never be left bare and always needed cover to inject carbon into it through plant photosynthesis. Permanent soil cover using a variety of plant species, including legumes, which fix nitrogen in the soil through their symbiotic relationship with soil-dwelling bacteria.

But he could do better: he had to stop tilling the soil, which releases hard-earned carbon stores. Three years ago, he took the plunge and stopped deep ploughing. This change in practice also brought him significant diesel savings: turning the soil to a depth of 30 cm uses a lot of fuel on a farm. Moreover, using compost and manure reduces the need for mineral fertilisers made in oil-guzzling factories. This all adds up to a net gain for the farm's overall carbon account. Joris has also planted hedgerows to improve this further. He previously had one large 45-hectare plot that he has now split into three with multi-species hedgerows bordered by strips of mixed grasses. These provide shelter and cover for auxiliary insects, which reduce disease pressure.

Through all of these actions, Joris has improved his revenues while adopting practices that are positive for the environment. Indeed, by cutting back on inputs, (diesel, synthetic fertilisers), he reduces the CO_2 emissions created by their manufacture and use. What's more, he increases the organic matter (carbon) in his soil, which makes his land more fertile and more resilient to drought, floods and disease.

Making it all add up

There's a reason why Joris became a farmer. He enjoys working hard and seeing the fruits of his labour. He is practically minded and enjoys engineering and working outdoors with living things. But explaining his job to people who know nothing about it beyond a few misconceptions is a challenge. So, as is the case for many farmers, selling direct from the farm isn't something he's thinking about doing. The amounts he would need to sell are huge and, in any case, apart from potatoes and peas, everything he produces must be processed first. You can't dip a beetroot in your tea.

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Like most farmers, Joris sells his products through traders or direct to industry. For cereals, the price is set by the exchanges in Chicago or Paris. For potatoes, peas, beet and chicory, he signs contracts with processing plants. "They offer you a price, and it's take it or leave it; there's no room for negotiation. And they insist on large, perfectly uniform batches to ensure that every product leaving the factory is identical. Since they centralised collection, processing and distribution in the 1950s, artisans and small-scale local industry have been in decline. But it's their know-how that allows small businesses to adapt to the harvest's characteristics and get the most out of the product." Capturing carbon in the soil and obtaining a "low carbon" certificate for agricultural produce is also a way of persuading traders and processors to pay a better price for a differentiated product that improves the environment. Locally, we are starting to see these types of initiative but, to succeed, they need farmers to work with local processors (such as bakeries, breweries) who can promote the added value of their products. Carbon

certification is a way of doing this.

Obstacles to change

Joris smiles when asked why more farmers don't farm like him: "It's force of habit: ploughing is so engrained. Stopping ploughing for cereals isn't a problem, but for root crops like beet, chicory or potatoes it's more complicated. They need soil that is very crumbly. To manage this without ploughing, you need to know the technique inside out. And if your crop fails, you'll say: 'it's because I didn't plough'. It's a common mental shortcut. But you won't succeed unless you first want to and then learn how, and it's futile to do what others have tried and failed. Talking to other farmers and listening to their advice is important. Experimenting is fine but, at the end of the day, you have to earn a living. You have to take reasonable risks. Most farmers don't want to take risks anymore, which I can understand. They would like a formula for everything that guarantees results. But in reality you need a plan B. And even plans C, D, E, F, G. For example, when you change a rotation, if the crop fails, you should always have something else ready to re-sow without relying on your seed supplier. So, I produce my own seeds. As long as I just sow them on my farm, I'm not breaking any seed patent laws. I don't disinfect my seeds, which is one more saving and better for the environment too. It's only once you are earning a living that you can take risks. "

"Today, being 'low carbon' certified is an opportunity. We have the chance to jump on the bandwagon and earn income from it. In future, it may well be made mandatory and become an obligation. That would be very good for the environment but it might be harder for certified farmers to make money from it."

Joris sums it up well: the two solutions for encouraging carbon sequestration are either certification or European regulation through the CAP. As far as the first is concerned, many initiatives are emerging in Europe. Some are based on specifications, others on soil analyses or carbon accounts. But lots of questions must first be resolved before carbon sequestration through agriculture can become widespread at a European level.

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Chenu is the coordinator of EJP SOIL, a new European research programme launched in February 2020. Its 24 member countries aim to pool their research into agricultural soils, to promote a better understanding of the role of farming in carbon capture through soil. Chenu explains the idea behind the project: "Europe has a very ambitious climate policy. Member states need to know how management of agricultural soils can play a part in this. What's more, the EU plans to update the CAP to take better account of soil." While policy-makers at the Commission may be open to bringing in additional legislation to support carbon sequestration through funding and incentives, there remains a lack of a clarity about the science for measuring carbon in the soil, raising questions around the feasibility of a results-based policy. "For soils, it isn't clear," explains Chenu. "How do you measure changes in soil quality? Could we put in place CAP systems based on measuring soil quality, rather than on practices? (…) We're going to take an inventory of climate-smart practices that maintain soil quality and biodiversity in different countries. Then we'll prioritise research into systems in which soils are multi-functional. The options being examined involve practices from agroecology, regenerative agriculture, conservation agriculture, agroforestry, and organic agriculture."

Frédérique Hupin is a trained agronomist with over 15 years of hands-on experience of sustainable farming practices. She is an independent agricultural consultant and journalist and writes for the Belgian daily *L'Avenir* and for the French magazine *Techniques Culturales Simplifiées*.

Published December 14, 2020
Article in English
Published in the *Green European Journal*
Downloaded from https://www.greeneuropeanjournal.eu/back-in-the-ground-capturing-carbon-through-farming/