BLUE NORTH

EXPLAINING CARBON SEQUESTRATION IN AGRICULTURE

CLIMATE CHANGE: CAUSE FOR CONCERN

Around the world, there has been a massive increase in actions to try to slow down the rate of climate change. We know what is needed: rapid cuts in greenhouse gas emissions until we reach a point where no more emissions are accumulating in the atmosphere. This point is called 'net zero', where any greenhouse gases emitted are balanced out by what is absorbed or removed again. The sooner we get there, the better! The agricultural industry is already experiencing a taste of the negative effects of climate change through increased extreme weather events, heatwaves, droughts, and unusual rainfall patterns. On top of risky environmental changes, rising fossil fuel-based input costs, expected carbon border adjustment mechanisms, and increased pressure from markets to measure and reduce the carbon footprint of food products are putting producers in a very tight spot. The pressure cooker will only get worse as global concern grows and more organisations and countries (many of which are legally bound to halting climate change[1]) set targets to reach net zero. This was one of the reasons behind starting the Confronting Climate Change (CCC) initiative, to assist producers in determining their emissions, identifying hotspots, and proactively responding to the carbon reduction demands. Organisations are urged to go beyond measuring emissions and aim for sharp reductions (see figure 1).

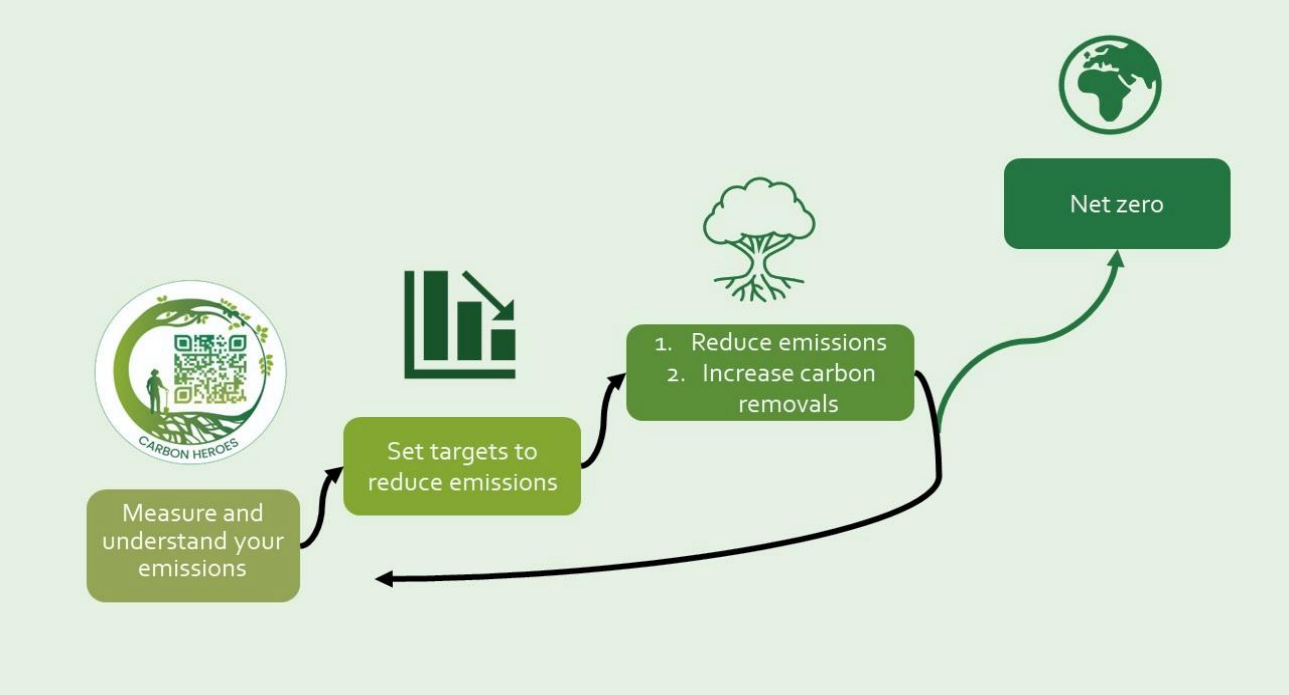

Figure 1: The steps organisations can take on a carbon journey to achieving net zero (the point in time where we are no longer emitting more greenhouse gases than we are removing from the atmosphere).

[1]The 2015 Paris Climate Agreement adopted by 196 Parties at the UN Climate Change Conference to limit the increase in global average temperatures to well below 2°C, preferably to 1.5°C above pre-industrial levels. Currently, we are at 1.1°C and if nothing changes, we will reach 2.8°C 2100. Read more

CAN WE REALLY FARM WITH CARBON?

Some greenhouse gas emissions will be hard or even impossible to avoid (for example from livestock and aviation). For this reason, we will need to go one step further and reabsorb or remove greenhouse gases out of the atmosphere to reach net zero. Fortunately, nature does this already. Thinking back to school biology class, plants absorb carbon dioxide (CO_2) during photosynthesis (see figure 2) which is how they "eat" and becomes embedded in new growth.

Carbon dioxide, although not the only greenhouse gas, is the main climate change driver. Of all industries, agriculture is one of the best positioned to take advantage of plant-driven, or nature-based carbon dioxide removals. This also means the agricultural sector is a critical role player needed in the strategy to mitigate climate change. So, growing plants pull out greenhouse gas emissions – but it's not so simple at all.

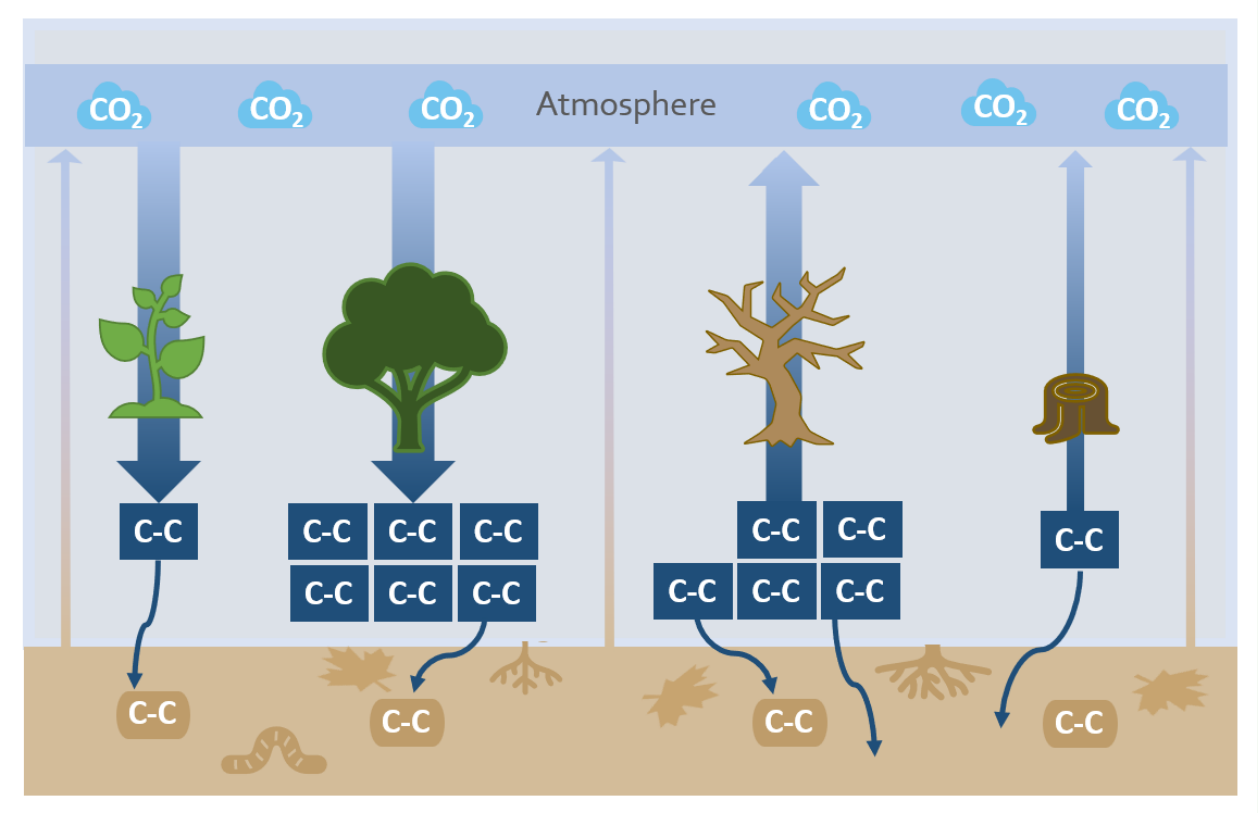

Figure 2: As plants grow, they absorb CO_2 out of the atmosphere. This carbon is held in the plant material with some passing down into the soil through root exudates, litter, and organic matter additions. Once the plant completes its lifecycle or is pulled out, the carbon bound in the material begins decomposing and releases the CO_2 back into the atmosphere. Over time, the biomass breaks down and all the carbon sequestered by the plants returns to the atmosphere again, with only the fraction of carbon held by the soil remaining.

Agriculture produces billions of tonnes of plant biomass every year, yet it is still a major greenhouse gas emitter, responsible for a quarter of human caused emissions. The most obvious problem with removing carbon to biomass is permanence: it all breaks down again. When using diesel, the CO_2 that is released comes out the fossil fuel pool, an ancient form of stored carbon millions of years old, that once emitted, can never go back again. This extra carbon is left to cycle between the atmosphere, ocean, and land almost indefinitely. Due to the amount that had been emitted (the current rate is around 35 billion tons of CO_2 per year[2]) the carbon cycle is tipping out of balance. At the start of the industrial revolution in 1750, the concentration of carbon dioxide in the atmosphere was about 280 parts per million (ppm), and today the

2 This is the net loading of gases in the atmosphere. Approximately half of what we've emitted in the last decade has been pulled out of the atmosphere by the ocean and natural land sinks.

concentration is about 420 ppm (read more here). When carbon is removed to natural systems, there is only a benefit as long as the carbon is held. Removing carbon for a few years to decades only for it to be released back again does little in the long run to prevent global warming – and ends up adding more emissions when its cultivation requires electricity, fuel, and synthetic fertiliser inputs. Croplands, unlike natural ecosystems which tend to reach maturity and permanently hold a level of carbon, are unstable and require human intervention to keep them producing volumes high enough to be profitable. Products like fruit or grain are quickly consumed, annuals become decomposing residues within a season and even orchard blocks are replaced when they start getting old and unproductive. So yes, although all growing plants are absorbing CO_2, when taking a long-term view, they are more likely borrowing it than removing. That being said – there is a benefit to even temporary carbon removals as it gives us a bit more time to act and find more permanent solutions to climate change.

The longer the carbon dioxide is kept out of the atmosphere the better as then it can't contribute to warming. Although biomass removal tends to be temporary, the kind of material it is influences how long before it breaks down. "Breaking down" or decomposition is an active process and occurs is when organic carbon is eaten by an organism (animals, insects, microbes, etc) and converted back to CO_2, releasing the energy for the organism to use. This is the reason why eating food gives us energy, and where the carbon in CO_2 comes from when we exhale. Food that is rotting is also being eaten – only by bacteria, fungi, and insects instead. Depending on the type of material, the moisture, and nutrients it contains, and how easy it is for something to break up the molecules (sugar, starches, proteins, carbohydrates, fibres), it will take a different amount of time to break down. This is why lettuce goes off in a week and a wooden bench can last decades –though both are plant captured carbon.

According to the GHG Protocol's recent draft guidance[3] on how to account for removals, any carbon stored in living or dead biomass can be counted, but the catch is that the removal must be reversed as soon as it is released to the atmosphere again. So, when it comes to figuring out how much carbon a farm has sequestered, the biomass in perennial woody plants are the only ones worth the effort of counting and monitoring. Several hectares of orchard can quickly add up to a lot of carbon, but two things are important to remember:

1) A maximum amount of carbon will be reached where no more carbon can be removed as all the orchards are at their largest. The amount will fluctuate up and down as blocks are replaced, and plants increase in size. At the same time, every year of production and input usage will continue to release emissions.
2) Trees are not free. All farms occupy land, which was originally natural vegetation. Furthermore, irrigated crops and orchards are significant users of water, a scarce resource in this country. Alien invasive species are a good example where the overall ecological damage far outweighs the "carbon removal" they provide leading to their removal and repurposing as firewood.

Another even more important carbon removal pool is soils. Carbon sequestration into soils can be semi-permanent and held for far longer. Carbon in soils is a balance between two processes, carbon flowing into soils (through plant roots, and organic inputs) and carbon decomposing as soil life relies on it as a food source (this is also called mineralisation and makes the nutrients available for plants too). Farming practices can have significant impacts on soils through affecting either one of these processes: they can increase carbon flow into soils by increasing active roots in the soil or adding inputs and they can slow down the breakdown of carbon through soil protection and minimising shocks.

Like biomass carbon – there is also a limit to the maximum amount of carbon soils can stability hold on to, determined by the soil texture (clay and silt can hold and protect organic carbon). Secondly, increases in carbon can also be washed out of the soil and leached into groundwater. In most areas, croplands are known for degraded soil carbon levels, so there is still potential for significant amounts of carbon to be stored. Other factors like topography (how a piece fits into its landscape), climate, and moisture availability all impact the amount of carbon in the soil. In dryland systems, it's good to aim to get the soil organic carbon levels up to the nearby natural areas. However, in irrigated systems – by providing additional moisture you are increasing the ability of the system to produce biomass and feeding even more carbon into the soils than it could naturally. In this case it's possible to build up enough to overtake the "natural amount" of soil organic carbon (as seen in irrigated dairy pastures in the Western Cape).

3 The GHG Protocol's Land Sector and Removals Guidance is a still in draft form and outlines how removals can be incorporated into organisational carbon footprints. The final version is expected to be released in 2024.

So yes, farm management activities can be used to remove carbon from the atmosphere, and this is an important way to help mitigate climate change and give us some extra time to cut out emissions. However, a set amount of carbon cannot be predictably removed each year in the same way that fruits are harvested, they are finite pools that eventually fill up. We're still far from the limit so not to be discouraged – but removals cannot be used as a replacement for decreasing emissions. It's more important that greenhouse gas emissions are rapidly cut down, and the natural removals pool used to buffer against that last bit we can't reduce.

CARBON FOOTPRINTING AND CARBON CREDITS

Carbon removals on farms are starting to be recognised within carbon footprinting, although is it not as simple as subtracting the removals off your emissions as they have different levels of permanence. More and more food brands and retailers are starting to focus and set targets for removals on the farms of their suppliers. A farm that removes carbon can either choose to report it in its own footprint or they can choose to sell it as a carbon credit – but they cannot do both. Carbon removal measurement differs from carbon credits. Carbon removal activities at an organisational level (e.g., on a farm) can be used to positively contribute towards that organisation's own emission measurements and targets. A carbon credit, on the other hand, is a valuable, tradable asset that signifies the removal of carbon from the atmosphere or the prevention of its release into the atmosphere. Essentially, a credit represents a unit of carbon that has been either sequestered or avoided through activities considered beyond the usual business requirements.

A carbon credit can:

- be sold to another business or individual to allow that entity to reduce its net carbon emissions *or*
- be bought by a business or individual to offset one's own net carbon emissions.

It is important to note that if a carbon removal is accounted for in the emission measurements by the farm on which the carbon removal took place, that carbon removal can no longer be used by the farm to generate carbon credits as doing so will result in "double counting". This is when the same emission removal is counted twice (making it sound like double the emissions have been mitigated), both for the company doing the removal and for the company buying the carbon credit and using it to offset their own emissions.

WHAT SHOULD THE AGRICULTURAL SECTOR BE DOING?

Step 1: Start measuring and managing your carbon footprint. This will enable organisations to identify where they should focus their attention to reduce emissions.

Step 2: Find ways to change the way you do things! Reduce emissions as much as possible, cutting emissions is more beneficial than carbon removal, and some greenhouse gas types cannot be removed once emitted.

Step 3: Increase carbon removals to neutralise emissions that cannot be reduced.

Step 4: Repeat steps 1 – 3. Set an ambitious science-based emission reduction target: Aim to reduce your own emissions by 42% (from a baseline) in 10 years' time, and eventually to reach net zero.

If you would like to know more about any of the topics discussed in this article, please contact the CCC team at support@bluenorth.co.za or 063 688 5593.

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