Is tracking carbon on farm good for business?

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In submitting this report, the Scholar has agreed to Nuffield Australia publishing this material in its edited form.

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Executive Summary

"Respond – don't react."

- Eddie Vedder, Pearl Jam, Gold Coast 2024

Farmers are seeing a need to build resilience into their businesses so they can adapt and thrive into the future. It is important that farmers adopt practices and technologies that result in efficiencies, improve profitability and give farmers the ability to 'weather the storm' of increasingly volatile seasonal variations.

More than 140 countries, including Australia, have set, or are considering setting, a net-zero target. The Australian government has set a Net Zero 2050 Plan, which will guide our transition to the legislated target of net zero greenhouse gas emissions by 2050.

Adoption of practices and technologies to reduce emissions and remove carbon from the atmosphere is one of the biggest barriers to achieving a lower emissions agricultural future. In order for farmers to engage, it needs to make good business sense. Linking such practices and technologies to farm efficiencies, productivity and profitability is key. It is also very achievable.

Farmers can engage via two main pathways – 1) measuring, monitoring and managing your own carbon footprint, and 2) engaging in carbon markets to trade in carbon credits like ACCUs. There are huge opportunities for farmers to not only reduce emissions and remove carbon from the atmosphere, but also to grow productivity and build social, environmental and economic resilience.

When carbon market agreements are done properly - when farmers are informed and engaged in the process, when the service provider approaches the projects with integrity and rigour, and follow the correct process of the 'methods', farmers can financially benefit from carbon projects in a number of ways. This includes provision of an alternative income stream and through improvements in productivity when additional activities required under a project agreement (such as time-controlled or rotational grazing) are implemented.

Measuring and monitoring a farm's carbon footprint can identify opportunities to make improvements and efficiencies on farm. This is particularly possible when data is collected and monitored over several years. For example, having year-on-year data on diesel, fertilizer and energy use can assist in making decisions for future purposes.

A major benefit of baselining your carbon footprint to identify your emissions intensity number is that it will also identify the areas a farm business is already doing well. A business can use this information to supply to suppliers, financial institutions or in funding applications as evidence of how they are already undertaking sustainable practices. The data is evidence of their sustainability credentials.

Often, farmers will find that they are already doing activities that reduce emissions or sequester carbon, purely because those activities are best practice and make good business sense. In baselining and understanding carbon footprint on-farm, farmers have the opportunity to prove that they are already being sustainable in their business, as well as identify areas for improvement.

Undertaking activities to sequester carbon or reduce emissions can have tradeoffs, in terms of time, productivity and cost. These trade-offs exist where the benefit gained

from reducing emissions / storing carbon does not outweigh the cost, and need to be carefully considered. Carbon agreements do not fit every business and every farm, so it is vital that farmers do their research before entering into an agreement.

> *"This journey is about knowledge, not about being dictated at."*
>
> - Prof. John Gilliland, OBE

Despite over 145 countries around the world having targets to meet net zero, and nearly 200 countries signing up the Paris Agreement, engagement of farmers globally and within countries varies widely. Examples include formal training (free and paid), research projects implementation and extension, incentives-based schemes, formal carbon project agreements, one-on-one consultations and informal farmer-to-farmer learning. There are pros and cons to each.

The audience for this report is the average, family-owned farm business and its advisors. It is intended to inform those who have average to good business skills but are not yet engaged in carbon farming or carbon markets.

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Foreword

I am a farmer and advisory officer who has worked with farmers for 17 years to improve condition of natural resources and build drought resilience. When I first heard about carbon farming, carbon credits and emissions reductions, I was really interested, but I was also a bit skeptical. Carbon had become the buzz word over the past few years, and the more I looked into it, the more I realised it was confusing, complex and contentious. Initially I was interested in finding out whether we could enter into formal agreements under the Australian ACCU Scheme to earn and trade carbon credits, or Australian Carbon Credit Units (ACCUs) as part of our own business. It made sense - an alternative income stream would come in very handy and help drought-proof our business, and we would financially be recognised for the work we were doing to improve groundcover and soil health.

Figure 1: Pippa Jones, Auhtor (Source: Author)

But over time the conversation shifted to needing to know my farm's own carbon footprint in case I needed this information to help inform the supply chain (ie supermarkets, meat processors) of my Scope 1 and 2 emissions. My Scope 1 and 2 emissions were my supply chain's Scope 3 emissions. The supply chain need to know their Scope 3 emissions to show how they were progressing to their ambitious net zero targets.

So I decided to look into what was happening around the world in both carbon markets and carbon footprinting in order to better understand the complexities but, more crucially, whether paying attention to carbon made good business sense. I also wanted to see which models were being used to help farmers know what to do and what decisions to make.

Both here and abroad I have met with government officials on how they are managing international expectations for a net zero future. I've met with organisations who are working directly with farmers to improve soil health and build soil carbon through government grants. I visited farms where farmers are doing 'additional' activities to improve soil health and, in turn, trade in carbon credits. I've met with farmers who are reporting their emissions to their supply chain in order to have access to markets and trade as a price premium.

Along the way I discovered that context is everything. What works on one farm won't necessarily work on the neighbouring farm. Every farm is different, and farmer's motivations, risk appetite, priorities, business model, succession plan, history, soil type and climate impact decision-making. We make decisions on farm with the best information we have in front of us at any given time, so it is important that we, as

farmers, are informed and engaged so that we can respond appropriately, rather than react.

Along my travels and during my extensive research, I discovered that, despite countries around the world signing up to net zero targets, they are poles apart in terms of measuring and regulating both emissions and carbon (and regulating agriculture in general). There is also a large variation in the way farmers are engaged in carbon farming. There is a huge range on which countries and individuals are managing and monitoring carbon, and massive variations in understanding, acceptance and adoption of these practices.

At the end of the day, farmers will continue to be engaged if the concept of carbon, whether through abatement or sequestration, when it links to good business. Profitability and productivity drive many good business decisions, and tracking your carbon is no different.

My report will focus on the two main options for farmers right now: a) entering into carbon markets and b) measuring, monitoring and managing your carbon footprint on farm. I will also identify successful models, programs and organisations that support farmers to build knowledge of carbon, whether through support to enter carbon markets, support to measure and monitor a carbon footprint or support in understanding of how tracking carbon can improve your business and farm resilience.

I am neither a scientist nor an economist, nor am I a futurist. I am, however, a communicator and a pragmatist. Hopefully this report provides some clarity and, if nothing else, promotes curiosity.

Table 1. Travel itinerary

Travel date	Location	Visits/contacts
21-23 November, 2023	Canberra, Australia	Agrifutures Australia event: Carbon Conversatons
8-20 March, 2024	Brazil – Campo Grande, Bonito and Pantanal wetlands	Contemporay Scholars Conference, post-CSC tour
22-29 March, 2024	Uruguay	Meetings – Ministry of Livestock, Agriculture and Forestry Meeting – INAC Farm visits – Joao Antonio
14-21 June, 2024	Montana, USA	Meeting – Matador Ranch and Cattle (Lora Sodaquist) Field day – Gabe Brown Meeting – Meagan Lannard Meeting – Matt Skoglund (North Bridger Bison) Meeting – Western Sustainability Exchange

		Meeting – Producer Partnership
22 June – 5th July	Alberta and Prince Edward Island, Canada	Meeting and farm visits – Steve LaRocque, Alberta Meeting and farm visit – Christy Hoy, RDAR Alberta Farm visit – Kettleridge Organics Meeting – Kim Cornish, Olds, Alberta Meeting and farm visits – Scott Holtman, Lethbridge Meeting and farm visit – Harold Perry, Perry Farms, Lethbridge Meeting – Maggie McCormick, Prince Edward Island Federation of Agriculture Farm visits – Sally Bernard, Barnyard Organics Meeting – Matt Ramsay, PEI farmer
29th July – 5th August	Can Tho, Vietnam	Various meetings - Can Tho University staff and ACIAR staff for Carbon In FOCUS program Meeting – Thoa from Abavina
19th – 25th September	Borneo (GFP)	Various meetings
26th – 30th September	Taiwan (GFP)	Various meetings
1st – 10th October	Japan (GFP)	Various meetings
11th – 17th October	Poland (GFP)	Various meetings
18th – 26th October	Italy (GFP)	Various meetings
29th October – 4th November	United Kingdom	Meeting – Hattie Mcfadyen Meeting – Sophie Gregory Farm visit – JM Stratton and Co Meeting – Tom Vagner, Sustainable Farmer group Meeting – Ben Hunt, Wessex Water
19th -24th January, 2025	Tasmania, Australia	Meeting – Matthew Harrison, University of Tasmania Farm visits – Richard Gardiner, Rob Bradley, Dave Robert-Thompson Meeting – Rayne van der Berg, Nat Cap Plus
17th -19th February, 2025	Brisbane, Australia	EvokeAg Conference

Acknowledgments

Never in a thousand years would I think I could be a successful Nuffield Scholar, but after chatting with my sister Victoria Ballantyne, a 2022 UK Nuffield Scholar, about her experiences, I thought I should have a go.

Little did I realise the incredible learnings I'd have, friendships I'd make and journeys I would go on over the next few years. I am incredibly grateful to Nuffield Australia and my sponsor, PSP Investments, for giving me the opportunity to take part. I am extremely grateful to my employer, NSW Local Land Services, for giving me the flexibility to undertake the scholarship.

To the numerous scholars who hosted me, provided advice, acted as sounding boards and gave me tips and ideas throughout, who opened their homes and provided valuable contacts – thank you. To all those people who agreed to speak with me about my topic, even when I didn't fully grasp the science or the depth of the topic – thank you.

I am always grateful for the unwavering support of my amazing husband, Dion. He managed to keep the wheels turning whilst I was away and encouraged me to continue learning when I was home. I know that my children thrived whilst I travelled, and I appreciate all that Dion did to make this experience the best it could be for me. I am also indebted to numerous extended family and friends who supported us throughout that time. I couldn't have done it all without them.

Objectives

This report aims to:

- Identify and discuss examples where tracking carbon on farm can lead to improved productivity and profitability.
- Identify and discuss opportunities and risks for adoption of carbon farming in Australia and globally.
- Compare and contrast ways that farmers are engaged in carbon farming, including through sequestration and reduced emissions.

Introduction

Changes in climate have, and will continue to, impact primary production productivity and profitability. According to the Australian Government's Agriculture and Land Sector Summary (2024), the impacts of climate change are expected to increase into the future.

Consequently, farmers are seeing a need to build resilience into their businesses so they can adapt and thrive into the future. It is important that farmers adopt practices and technologies that result in efficiencies, improve profitability and give farmers the ability to 'weather the storm' of increasingly volatile seasonal variations.

Changes in climate are being felt globally, and in response, over 190 countries have pledged to the Paris Agreement of a global goal of holding global temperature rise to below 2 degrees C (Australian Government Net Zero, 2024)

In order to meet these ambitious goals, economies around the world are investing in new ways to reduce emissions and store carbon. The agriculture and land sector is at the forefront of this challenge, and is well placed to continue to underpin Australia's food security whilst also contributing to the transition to a low emissions future.

Adoption of practices and technologies to reduce emissions and remove carbon (aka sequester carbon) from the atmosphere is one of the biggest barriers to achieving a lower emissions agricultural future. There are, however, huge opportunities for farmers to not only reduce emissions and sequester carbon, but also to grow productivity and build social, environmental and economic resilience. Make resilience and profitability the outcome – have carbon as the consequence.

Farmers can, and in fact are already, undertaking practices to reduce emissions and sequester carbon, purely because it makes good business sense. This seems to be via two main pathways – 1) measuring, monitoring and managing your own carbon footprint, and 2) engaging in carbon markets to trade in carbon credits like ACCUs. The first relies on farmers knowing their own carbon footprint so they can identify areas for improvement and potentially use that data to inset their own emissions or demonstrate business sustainability goals. The second offers income and supports offsetting another business's footprint. By implementing practices that enable trading in carbon credits or measurement of a carbon footprint to sequester carbon or reduce emissions on farm, farmers are able to implement practices that improve productivity and profitability – a 'win-win' situation.

This report will provide examples of how measuring, monitoring and managing carbon on-farm through activities that either reduce emissions or sequester carbon can lead to improved profitability. Involvement in carbon markets is not exclusive of carbon footprinting - one can be achieved at the same time as the other. The biggest challenge for farmers is knowing which activities to implement without negatively impacting the profitability of the enterprise. Key to this is knowing who to talk to for trusted and accurate information to make informed decisions. Current limited research or economic analysis makes decision-making difficult when long-term impacts aren't yet clear.

Farmers are part of the solution, and Australia is doing a pretty good job at providing farmers with opportunities to engage. It isn't about working against one another, but together, to achieve change. Getting to Net Zero is about the industry as a whole getting there, not each individual farmer.

Chapter 1: Why does it matter? National and global trends, influences and agreements

International trends

As of 2024, 194 countries, including Australia, had signed the Paris Agreement. This agreement is a legally binding international treaty that commits to the global goal of holding the increase in global average temperatures to well below 2 °C of warming and pursuing efforts to keep warming to less than 1.5 °C. (Australian Government Net Zero website, 2024).

More than 140 countries, including Australia, have set, or are considering setting, a net-zero target, covering about 88% of global emissions. More than 9,000 companies, over 1000 cities, more than 1000 educational institutions, and over 600 financial institutions have joined the Race to Zero, pledging to take action to halve global emissions by 2030. (United Nations Climate Action, 2024)

Similarly,159 countries have committed to the voluntary Global Methane Pledge, including Australia. The Pledge aim to accelerate efforts to reduce methane emissions as rapidly as possible (Global Methane Pledge, 2024) through a range of actions. The pledge does not require Australia to focus only on agriculture, or to reduce livestock numbers.

With this target-setting and voluntary commitments comes the requirement to record emissions data. There are increasing examples around the world where these large companies are requesting Scope 1 and 2 data from producers. These companies follow the Science-based targets initiative (SBTi) Net-Zero Standard as it is one of the world's only recognised framework for corporate net-zero target setting. Companies like Amazon, Toyota, BP, Apple and Cargill all have emissions reductions and, in most cases, net zero targets by 2050 (https://zerotracker.net/). According to the OECD report on product carbon footprints (2024), amongst the 500 largest firms listed in the US stocks exchanges, 77% disclosed their Scope 3 emissions in 2023, an increase from previous years.

In saying this, there is a gap between what the large companies *want* to achieve and *how* they will achieve it. Despite global goals to reduce emissions and increasing public pressure for companies to be more sustainable, a large portion of the global population cannot afford to pay a premium for food that is grown under conditions that result in a lower carbon footprint.

"We have two types of people in our country – consumers and citizens. They are the same group of people but how they buy is different from how they vote."

- Lotte Van Den Der Hollander, October 2024

On top of this, recent years have seen a global cost-of-living crisis, which is impacting people's purchasing choices.

"They (consumers) are making food-selections on price first and sustainability second."

- Prof. John Gilliland OBE, May 2024

The Australian Context

Australian agriculture contributes 16.9% of Australia's national emissions (Zero Net Emissions Ag CRC, 2024). Of these, almost two thirds are attributed to methane produced by livestock. The land sector, encompassing agriculture, currently acts as a net carbon sink, sequestering more carbon than it emits. (Land and Ag Sector Plan, 2024).

Table 2: Emissions and sinks in the agriculture and land sector (Source: Climate Change Authority, 2024)

	Mt CO_2-e	Subsector share (%)
Agriculture		
Enteric fermentation[a]	55	64%
Agricultural soils (including fertiliser and urea application)	13	16%
Manure management	7	8%
Fuel use and other	10	11%
Net total – Agriculture	85	
Land		
Deforestation[b]	8	8%
Existing forests	-15	-14%
Reforestation	-50	-48%
Croplands	-12	-11%
Grasslands	-17	-16%
Other land use, land-use change and forestry (LULUCF)	-3	-3%
Net total – Land	-88	
Net total – Agriculture and land	-3	

The Australian government has set a Net Zero 2050 Plan, which will guide our transition to the legislated target of net zero greenhouse gas emissions by 2050. (Australian Government Net Zero, 2024). Six sectoral plans will support this work, including one for agriculture and the land sector.

In Australia, the federal government introduced the Safeguard Mechanism, which requires Australia's highest greenhouse gas emitting facilities to reduce their emissions in line with Australia's emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050. If a safeguard facility exceeds their baseline, they must manage any excess emissions by purchasing credits to offset emissions (Australian Government Clean Energy Regulator website, 2024). The Safeguard Mechanism relies on the trading of Safeguard Mechanism Credits (SMCs). These SMCs are similar to ACCUs as they are a tradeable unit, however differ in the fact that they are not subject to the same additionality standards as ACCUs (Carbon Market Institute, 2023).

Mandatory reporting for climate-related financial disclosures came into effect in Australia on January 1st, 2025. Many very large Australian businesses and financial institutions now need to prepare annual sustainability reports that include information about an entity's climate-related risks and opportunities, as required by Australian climate disclosure standards. This reporting includes reporting Scope 1 and 2 in the first year of reporting and Scope 3 emissions in the second year of reporting. It is worth noting that Scope 3 disclosures would represent information that is available at the reporting date without undue cost or effort. (Australian Government, 2024).

Chapter 2: Engaging in Carbon markets

Carbon markets exist globally to allow carbon credits to be bought and sold, allowing large polluters to offset their own greenhouse gas emissions, with one tradable carbon credit equals one tonne of carbon dioxide. Carbon markets provide farmers with alternative revenue when they follow a specific set of rules (a method) to either sequester carbon or reduce emissions on farm, resulting in the issuance of tradeable carbon credits.

Australia's ACCU Scheme is one of the most rigorous carbon markets in the world and is managed by the Australian Government's Clean Energy Regulator (Australian Government Clean Energy Regulator, 2024). ACCUs generated under some (but not all) methods are generally recognised to have more integrity than those developed under less-rigorous schemes globally. For example, the 2021 Soil Carbon Method has gone through four iterations and updates, making sure it is reviewed and fit-for-purpose as scientific advancements are made (pers. comms Orgill, 2024). Other methods have been discontinued or temporarily suspended due to questions around abatement claims and continue to go through periodic reviews.

In 2022, the ACCUS Scheme was reviewed by Professor Chubb and other experts. The recommendations of the 2022 Chubb Review was accepted in principle. Reviews of approved methods is ongoing to ensure the methods remain valid, that the Scheme is transparent and that abatement is real (Chubb et al, 2022). The Chubb review panel of 2022 made several recommendations, although the review and recommendations continue to be discussed and debated.

Other international trading programs exist, such as the VERRA or GOLD Standard markets. Both have approved methods that are widely used by service providers and farmers across the globe to earn carbon credits for on-ground practices that sequester carbon or reduce emissions.

There are examples such as the Alberta (Canada) Carbon Market being one of the earlier markets that farmers could engage in. It was developed in 2008 as a way the Province's oil and gas companies could offset their emissions. Methods were developed and service providers worked with farmers to register projects and earn carbon credits. Outcomes were mixed - some methods under the Alberta Carbon Market have not led to good outcomes for farmers, or have led to incorrect issuance of carbon credits when they may not have met the requirements under permanence and additionality, or when issues like leakage have occurred. (*pers comms, La Rocque, 2024)*

However, when done properly - when farmers are informed and engaged in the process, when due diligence is carried out, when rigour and process of the method is followed, farmers can financially benefit from carbon projects in a number of ways. Firstly, through the generation of alternate income stream through the sale of some or all of their carbon credits. Secondly, through improvements in productivity when additional activities required under a project agreement (such as time-controlled or rotational grazing) are implemented. Thirdly, if the farmer decides to inset some or all of credits to reduce emissions in their own supply chain.

Figure 2: Time-controlled grazing in Montana, USA (Source: Author)

Some argue that the public purse (the government) should pay for the monitoring, the reporting and the verification (MRV) of carbon (ie the baselining and auditing on farm), given there is public good that comes from sequestering carbon in soils and vegetation (pers. comms Gilliland, 2025). This could and should only be the case when reliable, robust MRV systems are in place to ensure validity of the data.

Others argue that carbon credits should not be sold by farmers to sectors outside the agricultural industry (the 'family'). It is said that the agricultural industry will need all the sequestration and emissions reductions to achieve its own emissions reductions targets (Eckhart, pers comms 2025).

However, once something becomes a tradable commodity, and without rules prohibiting it, the seller is free to trade these in whatever way they see fit. The existence of the Safeguard Mechanism ensures that demand for carbon credits across all industries in Australia will continue.

There will be a market for carbon credits for the foreseeable future. Globally, whilst big business has set ambitious net zero targets, the path to practically reaching those targets is not clear. So, whilst there is a gap between the ambition and the actual, there is and will continue to be demand and a place for offsetting and insetting (and alternative income) supplied through carbon credits. And whilst historically carbon markets have not been perfect, there is a process of ongoing improvement – in the methods themselves, the measurement, the verification and the reporting.

Case Study – Matador Ranch and Cattle, Montana, USA

Matador Ranch and Cattle (the Ranch) is a 380 000 acre ranch in the Beaverhead Valley near Dillon in Montana, USA. The Ranch is a fusion of the former Beaverhead and Selkirk ranches, which have a long history of cattle ranching in Montana. The property cares for 12,000 head of cattle, largely black Angus breeding cows and re-stockers, and employs over 30 staff members. Their mission statement is "To create the best beef business in America by delivering economic, ecological and social value."

The Ranch has implemented some new initiatives in recent years to improve ecology, measure and manage carbon and improve the business gross margins. Like all

farmers, they want to leave the landscape in a better condition than they found it whilst still being productive and profitable.

Figure 3: Matador Ranch and Cattle – Selkirk Division (Source: Author)

The Ranch registered two carbon projects in July 2023 that involve high density, high frequency rotational grazing of cattle to improve soil health, ensure continued daily weight gains in the cattle and increase soil organic carbon (SOC). Increased SOC consequently increased water holding capacity of the soil (amongst other benefits), which improves the resilience of the landscape, acting as a buffer during dry times.

Matador Cattle and Ranch want to ensure that their carbon projects have integrity and scientific rigour behind them. Both soil carbon projects are registered with Climate Action Reserve, and involved 280 soil samples being taken to baseline soil carbon levels and inform where on the property the soil carbon projects should occur. Re-sampling of soil is done every five years under the protocol requirements with Climate Action Reserve.

The Ranch's carbon projects will result them being able to trade in premium carbon credits under a voluntary carbon market. The Ranch sees the carbon projects as an opportunity to be a leader amongst beef producers in Montana, and the wider USA. The Ranch are in a position to navigate the challenges of the carbon market and are supportive of developing resources to make entering carbon markets accessible to smaller operations.

Figure 4: Visiting Selkirk Ranch, June 2024 (Source: Author)

Matador Ranch and Cattle are also aware of the opportunities to reduce methane emissions in their herd. They undertook the world's first trial of using Asparagopsis as a feed additive in grazing cattle as a means to reduce emissions. The trial fed 25 cattle in an open-grazing situation. The trial saw a 30% reduction in methane emissions and no overall effect on cattle performance. The Ranch acknowledges that there are challenges in adopting feed additives like Asparagopsis in open grazing environments, but can also see potential long term benefits.

The team at Matador Ranch and Cattle will continue to implement management practices that store carbon in the soil whilst also focussing on ecological function and profitability in their business.

Case Study – Carbon in FOCUS, Mekong Delta Vietnam

Vietnam has similar net zero goals to Australia – to be net zero by 2050. But unlike Australia, carbon markets don't exist in Vietnam (as at January 2025), meaning that farmers and government staff do not have a good understanding of the processes, methods, risks and rewards of carbon projects.

Average farm sizes of 1ha and low literacy rates amongst farmers means there is a risk that farmers will be taken advantage of by large corporations wishing to engage rice farmers in carbon projects that don't benefit the farmer. In order to avoid this, Australian researchers from the Australian Centre for International Agricultural research (ACIAR) including Dr Susan Orgill and Dr Davis Rowlings are working closely with Vietnamese researchers on the Carbon in FOCUS project, which is supported by Select Carbon.

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Carbon in FOCUS is a project being run to support rice farmers in the Mekong Delta prepare for being involved in carbon markets in the future. It is based on science and is looking into opportunities for farmers to engage in carbon markets that benefit the farmers and their farms.

Figure 5 and Figure 6: Dr Orgill and Dr Rowlands presenting to Vietnamese Department of Agriculture and Rural Development staff at a Carbon forum at Can Tho University. (Source: Author)

In Vietnam, the largest source of emissions in agriculture come from methane emissions in rice fields, so opportunities to lower these emissions whilst improving productivity of the rice farms is a priority of the project. Key to success of the project is education of both farmers and the government extension staff who work with them, and implementation of practices that will reduce emissions, such as water management, residue management and fertiliser use whilst maintaining profitability.

Chapter 3: Measuring and managing a farm's carbon footprint

Increasingly, large corporations are setting ambitious goals to have a carbon-neutral, nature-positive future. These organisations rely on knowing their Scope 3 emissions (which are their supply chain's Scope 1 and 2 emissions) to inform these goals. For example, Woolworth in Australia, Tesco in the United Kingdom and Walmart in North America have all set goals that rely on knowing some of their Scope 3 emissions (Deconinck, OECD report, 2024), even if the path to achieving these goals is not yet clear. It is worth noting that the goals set by large companies are based on emissions intensity.

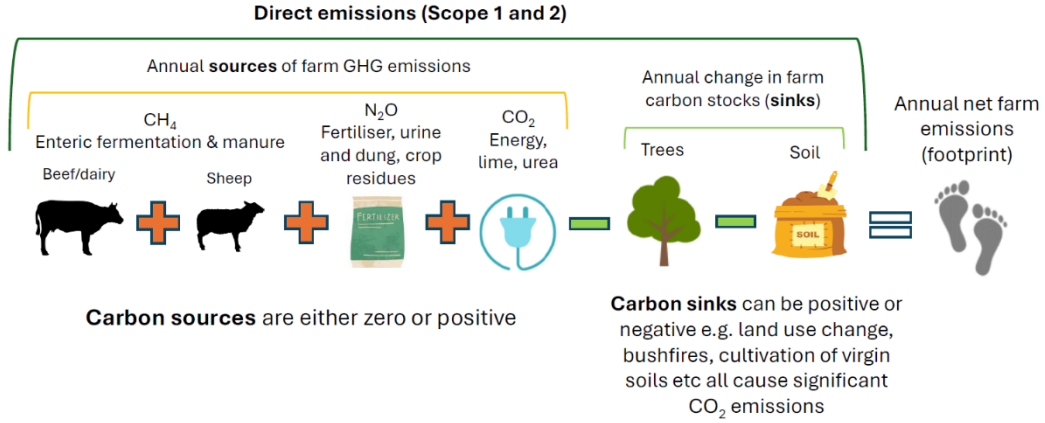

Figure 7: Farm-level GHG sources and sinks (Source: Agriculture Victoria)

Farmers are part of the supply chain so it is likely they will be required to provide some data to these organisations in the future, if not already being required already. Observations have been made that the benefits of supplying this data to the supply chain is focused not on the farmer receiving a price premium for supplying the data, but rather on them having market access or an avoided discount *(pers comms, Cosgrove, 2024).*

Eckart (pers comms January 2025) does, however, believe that the concept of a Virtual Cooperative might be a way that farmers can be rewarded by the supply chain by having a lower emissions intensity number than their competitors. The virtual cooperative concept is still being trialed at time of writing with a very large Australian agriculturalproducer. It is yet to be seen whether the concept is applicable on a smaller scale. This concept is discussed further in the 'Opportunities" section of the report.

One way that farmers are able to provide data to their supply chain is through developing a carbon footprint (emissions intensity number) for the farm, enterprise or commodity. Farmers are able to use any of a range of carbon calculators that exist in the market - some free and some user-pays. According to the UK Department for Environment, Food and Rural Affairs, there are 81 different farm level calculation tools worldwide (Deconinck, OECD, 2024). These farm-level calculators allow farmers to input data on farm activities and management practices to calculate carbon footprints, however they vary greatly in scope, process, methods, alignment with international standards, cost and user-friendliness. They also vary in what emissions and removals they include, beyond the main sources and sinks. Table 2 summarises emissions

accounting metrics that are included in some of the more popular farm level calculators.

Table 3: Emission accounting metrics included in selected global farm level calculator tools. (Source: OECD paper (2024) measuring and communicating environmental impacts in food systems)

	Agrecalc	COMET-Farm	Cool Farm Tool	Farm Carbon Calculator	FarmGAS	Holos	OverseerFM
Non-land emissions							
On-site energy use GHG emissions	Maybe	No (separate tool available)	Yes	Yes	Maybe	Yes	Yes
Land management: non-CO_2 emissions							
Enteric fermentation CH4 emissions	Maybe	Yes	Yes	Yes	Yes	Yes	Yes
Manure management CH4 and N2O emissions	Maybe	Yes	Yes	Yes	Yes	Yes	Yes
Managed soils N2O emissions	Maybe	Yes	Yes	Yes	Yes	Yes	Yes
Biomass burning CH4 and N2O emissions	Maybe	Yes	No	No	Yes	Yes	Yes
Rice cultivation or flooded land CH4 emissions	Maybe	Yes	Yes	No	Maybe	No	Maybe
Land management: CO2 emissions and removals							
Biomass carbon stocks	Maybe	Yes	Yes	Yes	Maybe	Yes	Yes
Dead organic matter carbon stocks	Maybe	Yes	Yes	Maybe	Maybe	Yes	Maybe
Soil carbon stocks	Maybe	Yes	Yes	Yes	Maybe	Yes	Maybe
Biomass carbon stock changes	Maybe	Yes	Yes	Maybe	Maybe	Yes	No
Dead organic matter carbon stock changes	Maybe	Yes	Yes	Maybe	Maybe	Yes	No
Soil carbon stock changes	Maybe	Yes	Yes	Yes	Maybe	Yes	No
Land use change: emissions and removals							
Direct land use change emissions (dLUC)	Maybe	Yes	Maybe	Yes	No	Yes	No
Statistical land use change emissions (sLUC)	Maybe	No	No	No	No	Yes	No
Gross biogenic land CO2 emissions and removals							
Gross biogenic land CO2 removals	Maybe	Yes	Maybe	No	Maybe	Maybe	No
Gross biogenic land CO2 emissions	Maybe	Yes	Maybe	No	Maybe	Maybe	No
Land tracking metrics							
Indirect land use change emissions (iLUC)	Maybe	No	No	No	No	No	No
Land occupation (LO)	Maybe	No	Maybe	No	No	No	No
Carbon opportunity cost (COC)	Maybe	No	No	No	No	No	No

The OECD paper by Deconinck (2024) recommends that calculators should align with the latest global standards and guidelines, that they should be regularly reviewed and updated and that they should have third party verification.

Tools available to Australian farmers include the MLA Carbon Calculator, the AIA Environmental Accounting Platform (EAP) and Ruminati. Whilst these all link to the University of Melbourne's Greenhouse Accounting Framework tools, they (like all calculators globally) all vary in the methods they use to draw data and the assumptions made (when relying on secondary data and research), consequently resulting in variations in results generated (OECD, 2024). To help overcome the issues around consistency and to allow regular updating of carbon footprinting tools, the Australian Government's Department of Agriculture, Fisheries and Forestry (DAFF) announced a call for Expressions of Interest in November 2024 to "provide consistent application of standards … ensuring robust GHG estimates for producers and their advisors." (DAFF, 2025). At the time of writing, this nationally-agreed standard was in development. It will align to international standards such as the GHG Protocol, the

International Panel on Climate Change and the Science Based targets initiative (Eckart, pers comms, January 2025).

It has been acknowledged that one of the barriers to widespread up-scale of individual farm carbon footprinting is time and cost constraints of farmers to undertake the activity (OECD product footprint report, 2024). To try and overcome this and make supplying data to suppliers more achievable for the Canadian cattle industry, the Canadian Cattle Association have used robust data to create figures that reflect emissions in the cattle sector for supermarkets and processors to access to report on their Scope 3 emissions. This data, which is regional-specific, avoids the need for farmers to supply the businesses in the supply chain with farm-specific data – a costly and time-consuming activity that is subject to human error (*pers comms, Grant, 2024*).

Other options to support farmers engage include private sector engagement with suppliers, embedding carbon footprint calculators in existing schemes and providing technical assistance to farmers (OECD, 2024). Several Australian banks and businesses have begun working with some of their customers to input data in Australian-based carbon calculators.

Measuring and monitoring a farm's carbon footprint can identify opportunities to make improvements and efficiencies on farm. This is particularly possible when data is collected and monitored over several years. For example, having year-on-year data on diesel, fertiliser and energy use can assist in making decisions for future purposes. A discussion with a beef farmer from the United Kingdom highlighted this in her comment.

"I keep doing my carbon audit because it keeps me on top of my figures and means I can compare figures year on year. We haven't bought fertiliser for the last three years because we realised it didn't make financial sense to use it and we weren't getting the return on investment due to the super high prices driven up by international volatility. It makes good business sense when feed, fert and fuel fluctuate so much, and because we can grow clover to fix nitrogen without fertiliser. We would use fertiliser if we needed to but at the moment we don't need to."

- *Victoria Ballantyne, Scottish beef and lamb producer, 2024*

In recent years there has also been an increase in consultants offering services in assisting industries, including agriculture, in navigating the carbon industry / and estimating carbon footprints and outputs. Consultants from Promar International in the United Kingdom work directly with farmers supplying to a major British beef supplier to calculate their farm's carbon footprint.

The consultants deliver results across eight practice areas including emission reduction, net zero and sustainable land management. The practice of calculating a carbon footprint can assist the farmers to identify areas where efficiencies can be made (ie feed efficiencies, reducing electricity usage). Promar International consultants can support them to work out a plan on how to make changes to their farm business's for improved productivity and increased resilience. (pers.comms McFadyen, 2024)

A major benefit of baselining your carbon footprint is that it will also identify the areas a farm business is already doing well. A business can use this information to supply to

suppliers, financial institutions or in funding applications as evidence of how they are already undertaking sustainable practices. It can also be used in the Virtual Cooperative concept, as described earlier.

Case Study – Perry farms, Alberta, Canada

Perry Farms in southern Alberta, Canada, is a diverse operation comprising ~5000 acres of irrigated land producing a variety of crops for numerous clients. Perry Family Farms supply both McCains and Fritolays with potatoes for potato chips. Owners Harold and Chris Perry uses the Cool Farm Tool to provide McCains with Scope 1 and 2 emissions data. This is mandatory however at the time of my visit (July 2024) there was no financial incentive / price premium for doing it. Harold believes that in the future, those who have low emissions data will be looked upon more favorably.

Figure 8 and Figure 9: Scott Holtman and Harold Perry at Perry Farms & Harold Perry in a cover crop (Source: Author)

Perry Farms is using cover crops, biological fertilisers, solar energy plans, a biogas plant, farming and agtech tools to improve soil health and improve the management of the farm. By integrating aerial image remote sensing and geographic information systems with controlled variable rate irrigation systems, water and fertiliser use can be managed more efficiently, and land productivity can be increased by an estimated 20%.

They test both crop and soil for nutrition regularly, and as a result have avoided using synthetic fertilisers on several occasions, replacing them with biological fertilisers. Not only are the biological fertilisers good for the soil, they also reduce the amount of N2O emissions that are emitted from synthetic fertiliser application. Soil health is a passion of Harold's, and he has developed a thorough soil testing regime to inform his farm decisions, including monitoring Soil Organic matter and Soil Organic Carbon. This knowledge and data has seen Perry Farms' reduce their insecticide, fungicide and seed treatment programs to nil in most cases, however Harold admits he is still working on figuring out how to reduce herbicides.

Perry Farms founded the Grow the Energy Circle Ltd (GrowTEC), a multi-faceted bioenergy plant that is a model of sustainable industry and innovative synergy. It converts manure and organic waste into biogas and heat which both generate electricity and biological soil amendments which are used on farm to reduce the reliance on synthetic fertilisers. GrowTEC also creates carbon credits which are sold annually.

Case Study – Lands of Dowth trial and Arc Zero project

In 2016 year, livestock nutrition company, Devenish, from Northern Ireland created a replicated trial on 32ha on their Living Lab research farm at Dowth, County Meath, Ireland, in partnership with Wageningen University and Research, and University College Dublin, led by Professor John Gilliland.

The concept behind the trial was that by reintroducing diversity of plants into grazing sward and reducing reliance on synthetic fertilisers they could reduce emissions, increase earth worms, infiltrate more water, store more carbon and be more profitable. To achieve this would require key behavioural changes on farm, so to put the science behind the trial they engaged 5 PhD students to gather data and analyse the results. The trial involved aerial LiDAR surveying of the carbon in the hedges and trees, and deep soil sampling. As a result of having this data, in one year the farm was able to make changes that realised:

- a 65% reduction in nitrogen fertiliser,
- a 20% improvement in average daily weight gain in grazing animals;
- 14 times faster water infiltration of soil
- a 26% reduction in GHG emissions intensity, without recognising increases in soil carbon, and
- increased profits.

This trial was on a single property, so to scale-up the results, several farmers across Northern Ireland joined forces, applied for and received funding and managed to upscale the trial to 7 farms across Ireland involving several different commodities including beef, dairy, sheep, arable with beef and willows with dry cows .

They achieved this by defining the goal, baselining the emissions and the carbon in the trees, hedges and soil then comparing that against the area's benchmark. This provided 'granular evidence' that gave them knowledge, and the farmers used that knowledge to make informed practice changes on farm. This 'granular evidence' (or data) also allowed the farmers to answer their critics, and used carbon as a currency to explain the circularity that occurs in the farming landscape. But the added benefit of having this data is this - in knowing and understanding how to respond appropriately, farmers are building resilience in themselves, their businesses, the environment and their local communities (Gilliland, ArcZero, 2024). This has further been developed and is noe being replicated across 170 farms covering 36,000 ha in England, Scotland and Wales (AHDB, 2024).

Chapter 4: Opportunities and risks

Opportunities

Often, farmers will find that they are already doing activities that reduce emissions or sequester carbon, purely because those activities are best practice and make good business sense. In baselining and understanding carbon footprint on farm, farmers have the opportunity to prove that they are already being sustainable in their business, as well as identify areas for improvement.

When trying to identify which practices to adopt (or to keep doing) for improved productivity and reduced emissions / sequestration, it is important to consider those that offer a win-win situation. For example, in Northern Ireland, Professor John Gilliland grows willows and uses cattle to graze those willows. Studies have shown that when cattle eat willow, there is a reduction in methane production in the rumen *(pers.comms John Gilliland, 2025).* By grazing cattle on his willows, John found that he had a 28% reduction in methane produced in those cattle and he doubled the amount of soil organic carbon in the soil under the willows, due to the complex root systems they create *(pers.comms John Gilliland, 2025).* This is an example of a win-win situation – reduced emissions, improved carbon sequestration, healthy cattle.

Harrison et al (2024) also promotes the importance of identifying the win-win situations on farm. His research is aimed at navigating trade-offs between GHG emissions mitigation and profit. His team identified numerous win-win, win-lose, lose-win and lose-lose scenarios that he and his colleagues have observed in the implementation of carbon farming practices in Australia (pers.comms Harrison, 2024).

Productivity and profitability gains – on-farm activities

The following list is an example of some of the activities that farmers around the world are undertaking to sequester carbon or reduce emissions in order to improve productivity or profitability. It is not exhaustive.

- Improved groundcover and soil health leads to increase in water holding capacity and reduced soil loss.
- Reducing chemical applications to crops will reduce emissions, whilst at the same time reducing other associated costs (labour, diesel, chemical)
- Use of slow-release and nitrification inhibiting fertilisers (commercially available but expensive)
- The use of biological fertilisers
- Using solar panels on shed roofs will reduce electricity bills and consequently reduce Scope 2 emissions
- Planting trees will provide ecosystem services such as shade for stock, habitat for beneficial insects and wind breaks whilst also sequestering carbon when those trees are growing.
- Planting trees for agroforestry.
- Using feed additives (ie 3NOP, Asparagopsis) to reduce enteric methane in cattle herd.
- Preg-testing in order to cull empty cattle
- Joining heifers at an earlier age

- turning off steers at a younger age (increased ADG).
- Management practices such as rotational and time-controlled grazing rather than set stocking
- Using EiD tags in sheep to monitor individual animals productivity and profitability, and thus cull or keep based on this data.
- Producing super-fine merino sheep where the wool gets a price premium over other wool products.

What's your biggest deficit?

Harrison (2024) presented that the biggest opportunity often comes from identifying and overcoming the biggest deficit on farm. In other words, if a farmer can identify what is the biggest risk / issue on farm, by overcoming that issue they will likely have the biggest impact on sequestration or emissions on farm.

For example, if grazing impacts of pest animals are having the biggest impact on pasture productivity, managing those pest animals through population control or exclusion fencing can result in more pasture growth. More growth and seasonal groundcover not only improves soil organic matter (SOM) and SOC, it can also lead to better weight gains and improved animal productivity.

Similarly, if soil erosion is prominent, and is resulting in loss of groundcover and topsoil, by managing the erosion through activities like well-designed water ponding and water spreading, you are able to improve groundcover, improved SOM and SOC, and improve livestock productivity.

According to Harrison et al (2024), recognising and managing the biggest deficits will have the biggest impact on your ability to sequester carbon or reduce emissions whilst also improving profitability. Measuring and monitoring plays an important part in a) recognising and b) addressing a deficit.

The Virtual Co-operative Concept

Eckart (pers comms 2025) outlines the concept of the Virtual Co-operative as one option for farmers to have financial gain from having a lower emissions intensity number (lower carbon footprint) than competitors and other producers.

If a farmer has an emissions intensity number (carbon footprint) that the supply chain would like to claim in their own reporting requirements, they can do so by rewarding the farmer through financial / other means. For example, if a supermarket would like to buy from one beef producer over another because the first has a lower emissions intensity number, the supermarket can do so by providing the first farmer with benefits (ie price premium) that would not exist to other beef producer. Similarly, a bank could offer the first producer a discounted loan in return for being able to use data for reporting requirements.

The supermarket and bank are two of several members of the supply chain that could participate in the 'virtual co-operative' for a single producer. This concept of a virtual co-operative gives the farmer more control of land use for insetting as there is a direct link between practices that lower emissions intensity number and financial reward. At time of writing, it had not been proven on a large scale so it wasn't clear if this concept would work on smaller scale farm businesses. There was confusion from farmers around whether multiple members of the supply chain can report using a single emissions intensity number.

Risks

Trade-offs

Undertaking activities to sequester carbon, reduce emissions or enter into and maintain a registered carbon project can have tradeoffs. These trade-offs exist where the benefit gained from reducing emissions / storing carbon does not outweigh the cost. Like every business decisions, there are wins and loses to consider for the farm business. These trade-offs need to be considered on an individual basis to find those that deliver win-win situations, instead of win-lose.

Table 4: Examples of tradeoffs in carbon farming

Time	- Completing baseline emissions, including time to upskill to do it correctly - Building / improving / upgrading infrastructure - Regular moving of stock in rotational grazing systems
Upfront costs	- undertaking soil samples - planting trees - install fencing and water for improved grazing management - purchase of feed additives - payment to a service provider to enter into a formal carbon project (ie baselining) - costs to measure herd productivity (preg-testing, feed supplements) - investment in genetics for herd improvement
Productivity / profitability	- Reduced fertiliser and chemical application may impact crop yield in the short term - Improved groundcover may mean that you are sequestering more carbon in the soil, however, it could also result in increased carrying capacity and larger methane emissions. These increased emissions will cancel out any benefits made from having improved groundcover and higher SOC.

Risks with generating carbon credits in a carbon market

Whilst the benefits of alternative income from selling carbon credits are attractive, entering into formal carbon agreements is complex and not without risks. Carbon agreements do not fit every business and every farm, so it is vital that farmers do their research before entering into an agreement. Historically, risks have existed around:

- the permanence of carbon storage in vegetation and soils
- lack of evidence of actual abatement occurring under *some* methods
- impact on land value when a formal carbon agreement exists over a property.
- impact of seasonal conditions (ie drought and bushfire) on carbon sequestration or abatement.
- The length of the agreements (25 or 100 years) and effects this may have on saleability of land in the future
- Selling carbon credits outside the supply chain, resulting in the farmer no longer being able to inset those credits within their own supply chain / enterprise

Internationally and nationally, some carbon markets and programs delivered less-than-ideal outcomes for the broader rural communities where they have been adopted. This includes projects in western Queensland where farmers signed up for agreements without fully understanding the consequences. The local communities suffered too, with 18 properties bought by a single company, resulting in 18 properties without families and a diminished community. These experiences left a negative sentiment around involvement in carbon farming in the area and more widely, even though many elements of carbon contracts have changed since then (Currey et al, 2022).

The biggest risk of all is that with the stroke of a pen, government can change legislation and sign pledges and agreements that will impact the generation, issuance, supply and demand of carbon credits and the markets they are traded in. This risk is extremely difficult to mitigate or predict.

Case Study – Challenges and opportunities - Uruguayan cattle

Uruguay does not have any net zero ambitions and the agricultural sector contributing only 0.03% of global emissions, however the industry is still maneuvering itself to play a part in a global economy that is increasingly focused on decarbonization.

In Uruguay, cattle are the second largest export commodity. Set stocking is common, and farmers don't traditionally invest in on-farm infrastructure (water and wire) to improve grazing management as costs are too high. The Uruguayan meat industry group, INAC, is trying to work with farmers to improve grazing management to sequester soil carbon.

Figure 9: Inspecting rotational grazing on a cattle property, Uruguay. (Source: Author)

By improving groundcover through grazing management, farmers are able to build SOM and consequently SOC. With this comes improved water holding capacity, healthier soils and better grass growth. This is a challenge as it requires farmers to change the way they value and manage their grass, and requires practice change.

INAC is also trying to improve herd productivity and herd management techniques amongst farmers. If farmers can begin to preg-test cows, cull empty cows and have a higher weaning rate, they will increase productivity of the herd and decrease emissions intensity in the cattle herd.

The Uruguayan Ministry for Livestock, Agriculture and Fisheries (the Ministry) is developing a project that aims to reduce emissions, increase productivity and increase biodiversity through provision of technical advice and funding for farmers. Despite Uruguay not having any Net Zero targets, there is recognition that there is global pressure for a low emissions future, as well as demand from supply chains for lower emissions products.

The Ministry recognises that, although technology will play an important role in the future, the biggest impact in Uruguay for reducing emissions will be through improved grazing management. At the time of my visit (March 2024), the new program was likely going to involve a combination of extension and grants for practice change and farmer capacity building.

The Ministry recognises the future role and opportunities that will likely exist for farmers in environmental markets, not just carbon markets. It is hoped these markets will provide opportunities to build sustainable and profitable businesses whilst looking after biodiversity and the environment at the same time.

Chapter 5: Considerations for registering a soil carbon project (and what to think about to make sure it is good for business)

Like all good business decisions, being informed of the topic and the implications of those decisions is key to adoption. There are many factors to consider when entering into a carbon market with a registered carbon project. These factors have come from personal observations and communications over the last two years, and from the Carbon Farming Foundations (2023) website. A few important considerations when deciding how to approach carbon farming are listed below:

- What is the starting point of your soil carbon? If you are starting from a high base (relative to your region and climate) then it is unlikely that you will increase SOC through practice change (additionality) alone. The lower the SOC, the greater the gain. This knowledge will impact whether you enter into a soil carbon agreement under the ACCU Scheme.
- How have you been engaged with carbon projects and service providers under the ACCU Scheme in the past? If someone has contacted you, then consider why that is the case.
- If considering a project with a service provider, understand the business model of the service provider. Who pays for the upfront costs of baselining (you or them)? Additionally, understand what percentage of your carbon credits they will hold when credits are issued.
- Understand who the project proponent is. Who is responsible for carrying out the project?
- Consider the tax implications of registering a soil carbon project and entering into an agreement.
- Discuss with your interested financial institution. Do they support and agree to you entering into a formal carbon project agreement?
- Consider the implications on land value.
- Surround yourself with advice – discuss all options with your accountant, financial advisor and legal counsel.

Chapter 6: Support for farmers to engage in carbon farming

Despite over 145 countries around the world having targets to meet net zero, and nearly 200 countries signing up the Paris Agreement, engagement of farmers globally and within countries varies widely. Examples include:

- The NSW Department of Primary Industries and Regional Development On-Farm Carbon Advice Initiative is a free program that is building awareness and understanding of the productivity and farm business benefits of carbon farming. It increased understanding of:
  - Climate change and global responses
  - Agricultural emissions and emission reduction and sequestration strategies and delivers a farm carbon planning service
  - The pros and cons of carbon farming, including improving market access.
  - Current agriculture industry research and development around carbon

- Canadian farmers are being incentivised to reduce emissions on farm. The Canadian government invested CAD $700 million from 2021-2024 in On Farm Carbon Action Fund (OFCAF) program. Under this program, farmers can apply to be paid up to 85% of the cost of a project to sequester carbon or reduce emissions through funding for 3 beneficial management practices. These practices are:
    - rotational grazing (fencing and water infrastructure)
    - improved efficiencies in nitrogen fertiliser use, and
    - implementing cover cropping.

- The Zero Net Emissions Ag CRC is an Australian multi-stakeholder approach to transitioning Australian agriculture to net-zero, healthy, resilient and profitable food systems by 2040 (ZNEAgCRC, 2025). The CRC received funding for ten years from the Australian government in 2023. It focuses on high quality research to solve industry identified programs and is independent of government. The four ZNE-Ag CRC research programs are:
    - Low emissions plant solutions
    - Towards methane-free cattle and beef
    - Whole farm and mixed enterprise systems analysis
    - Delivering value from net zero

- In 2024, the AHDB in Great Britain invested over £2.5 million and launched an initiative called the Environment Baselining Pilot. After receiving over 500 Expressions of Interest, 170 farms from across Great Britain were chosen to take part in the 5 year program. Participants will be supported to establish a baseline for net carbon on farm, taking into account carbon stored in soils, hedges and vegetation, as well as greenhouse gas emissions and sequestration. The baselining provides a starting point for tracking changes in greenhouse gas emissions and carbon sequestration over time, and farmers will be supported to create and implement an action plan to drive improvements

(AHDB 2024). One beef producer who was successful in his expression of interest to be one of the pilot farms is Jock Gibson of northern Scotland.

"*UK agriculture is under the spotlight right now. We operate under a social licence so it is really important that we get quality, impartial data to help make meaningful improvements on farm. It is a privilege to be able to contribute to the project"*
– Jock Gibson, Scottish beef farmer, January 2025.

There are many more ways that farmers are engaged in carbon farming. The table below summarises some of the methods and the observed pros and cons of each method. It is not exhaustive but provides a snapshot of the available options for farmers to engage in carbon literacy around the globe.

Table 5: Summary of Methods to Engage Farmers in Carbon Farming

Engagement Model	**Pros**	**Cons**	**Examples**
Incentives-based	- Enables through funding - Allows farmers to prioritise carbon storage or emissions reduction	- Engagement may be for the wrong reasons - Public funds for private gain	- OFCAF – Canada - Sustainable Farming Incentive – UK
Education / Training - Free	- Targeted - Structured - Planned	- No financial input, so less participant ownership - Time commitment required	- NSW DPI On-Farm Carbon Advice Initiative – Australia - DCCEEW Carbon Farming Outreach Program – Australia -NSW Local Land Services natural capital resources
Education / Training - Paid	- Targeted - Structured - Likely higher participant investment due to cost involved	- Time commitment required - Cost commitment	- MLA CarbonEdge – Australia - Soil C-Quest – Australia - Carbon Market institute
Informal (Farmer-to-Farmer Engagement)	- Voluntary uptake - Informal info exchange - Relies on trust	- Misinformation may occur	- Looking 'over the fence'

Engagement Model	Pros	Cons	Examples
Research	- Science-based - Trusted (if done by a research organisation)	- Long-term process - Expensive	- Carbon in FOCUS (ACIAR and Can Tho University) – Vietnam - ZNEAgCRC - ArcZero – Northern Ireland
Registered Soil Carbon Projects Through Service Provider or other provider	- Targeted/1-on-1 engagement - Meets method requirements (when done well) - Access to ACCU/VERA/GOLD or other schemes	- Many providers, creating confusion - Financial costs in baselining - Lack of ownership / understanding by farmers (when not done well)	- ACCU Soil Carbon Method – Australia - VERRA Method – Global - GOLD Standard – Global - Montana Grasslands Carbon Initiative – USA - Carbon Farming Foundation
One-on-One with Consultant	- Can be free for farmer (supplier pays the consultant) - Tailored carbon footprint assessment - Areas for improvement provided	- Labour-intensive - Time-consuming - Limited resources/capacity - Expensive	- Origin Green – Ireland - Promar International – UK

Conclusions

Reducing emissions and sequestering carbon does not have to be bad for business. In fact, there are many examples where it is good for business, as it can lead to improved efficiencies and profitability.

However, not every scenario will be profitable in every farming situation. Context is key, so always consider your individual situation and seek advice before undertaking significant business changes or decisions. Always consider the easiest options that you can achieve on farm to reduce emissions or sequester carbon – go for the low hanging fruit first.

If reducing emissions and sequestering carbon means we have more productive, more profitable farms, and if new technologies and scientific advances enable this, then we should definitely engage. Likewise, it makes sense to engage if understanding our carbon footprint (our emissions intensity number) can help us find financial reward and gain through the supply chain.

In Australia, whether this be through entering into a formal agreement under a Carbon Project under the ACCU Scheme, or through baselining, monitoring and managing your carbon footprint (or by doing both), chances are that farm businesses will be more productive and more profitable, whilst also meeting supply chain requirements.

And in being more profitable and more productive, farmers can be more resilient – economically, socially, environmentally. Australia is a land of extremes – of drought, floods and bushfires. If the agriculture industry can listen, learn, ask questions and engage appropriately, and consequently build more resilient businesses, then that is a good thing.

Recommendations

For farmers

- Pay attention and do your homework. Make sure decisions made are relevant, fit your business, align with your business's values, goals and risk appetite.
- Baseline your farm's carbon footprint to get your emissions intensity number. Then identify if there are any areas where you can improve on this (particularly the low hanging fruit!).
- Identify the activities you are already undertaking to lower your emissions intensity number so you can share those activities with your bank, supply chain and consultants.
- Surround yourself with advice.
- Form a peer-to-peer learning group to share ideas and learn from one another. Ask questions – there is no such thing as a silly question.

For government and industry

- That government invest in developing regional emissions datasets for livestock and potentially cropping (per crop type) based on co-efficients. This will provide farmers with easily accessible, robust data to provide to their supply chain (ie supermarkets and meat processors). These datasets can be developed by research organisations such as NSW DPIRD or CSIRO, or by industry groups. This will save farmers from having to develop farm-specific 'carbon footprinting' by being able to access robust figures that are relevant to their region and enterprise.
- That emissions data be developed and publicly available per region and sector. Farmers can aim for an emissions intensity number for their sector / region and not be expected to be productive / profitable below that number. This will limit the pressure on farmers who are already doing best practice to implement practises that will have a negative impact on the farm business.
- That soil carbon sequestration / sinks be recognised on farm footprint calculators, not just emissions. Note; This may require more research or support to enable.
- That farmers be recognised, incentivised and possibly renumerated for the time and cost involved in baselining emissions on farm and providing this to supply chain.

Glossary

Abatement Reduction in the amount or degree of something, particularly when it is harmful

The Australian Carbon Credit Unit (ACCU) Scheme encourages people and businesses to run projects that reduce emissions or store carbon.

Australian Carbon Credit Units (ACCUs) are a tradable financial product. They incentivise carbon abatement activities through projects ranging from reforestation to energy efficiency.

Carbon farming means a carbon removal activity related to land management that results in the increase of carbon storage in living biomass, dead organic matter and soils by enhancing carbon capture and / or reducing the release of carbon to the atmosphere. (Council of the European Union 2022)

Carbon neutral: balancing the amount of greenhouse gases (also known as carbon emissions) it puts into the atmosphere with the amount it takes away through storage or sinks (Swinburne University of Technology)

Carbon markets are a mechanism that puts a price or value on carbon emission reductions, or carbon removals from the atmosphere. If designed well, carbon markets can incentivise demand for emissions reduction, drive decarbonisation at lowest cost, attract large amounts of private sector capital to emissions reduction and ultimately scale up high integrity climate solutions that will address climate change faster (Carbon Market Institute, 2024).

Carbon footprint is a term used to describe the total amount of greenhouse gas emissions caused by individuals, organisations or products (City of West Torrens, SA, 2024).

Emissions: an amount of a substance that is produced and sent out into the air that is harmful to the environment, especially carbon dioxide, methane and nitrous oxide.

Emissions Intensity Emissions intensity for a production variable means the emissions released, in tCO2-e, per unit of the production.

Greenhouse gas (GHG) are gases that trap heat in the atmosphere, most commonly being carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O).

Insetting is when companies, including farm businesses, invest in carbon reduction projects within their own supply chain.

Net Zero refers to achieving an overall balance between greenhouse gas emissions produced and greenhouse gas emissions taken out of the atmosphere (Climate Council of Australia, 2024).

The **Safeguard Mechanism** is designed to reduce greenhouse gas emissions from Australia's largest facilities. It requires the facilities to keep their emissions below a set baseline.

Scope 1 emissions are emissions released into the atmosphere as a direct result of the activities at your farm (Clean Energy Regulator, 2024).

Scope 2 emissions represent the emissions that were released outside your facility boundary to produce the electricity that you imported into the farm and used (Clean Energy Regulator, 2024).

Scope 3 emissions are indirect emissions other than Scope 2 emissions. They occur outside of the boundary of your farm as a result of your actions. Scope 3 emissions may occur:

- upstream, such as the emissions generated in the extraction and production of fossil fuels
- downstream, such as the emissions from transport of your products.

(Clean Energy Regulator, 2024)

Carbon Sequestration is the process of capturing, securing and storing carbon dioxide from the atmosphere.

Sustainable Development Goals are a suite of 17 goals determined by the United Nations that were developed to end poverty, reduce inequalities and tackle climate change. See https://sdgs.un.org/goals.

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