Project Update
P1d: Carbon on NSW Dairy Farms

December 2023

What's driving the carbon balance?

Understanding the environmental impact of dairy farming is essential to develop ways to reduce greenhouse gas emissions and a path to carbon neutrality.

Some elements about emissions on dairy farms, are well understood, for example some sources and sinks, some mitigation strategies, and the carbon balance of some production systems.

But the path to carbon neutrality – including other sources of emissions and other carbon sinks – aren't understood in detail, nor has information been tested in all types of farming systems with a range of management practices.

That's why this Dairy UP project, with support from the NSW Environmental Protection Authority (EPA), is investigating the sources of dairy production greenhouse gas emissions, how to mitigate and accurately measure some of these emissions and move towards carbon neutrality.

This research will fill industry knowledge gaps with local studies applicable for the NSW dairy industry. This project initially focussed on Kikuyu pastures but additional funding from EPA enabled it to be expanded to also include intensive dairy production systems.

A path to carbon-neutral dairy

The Dairy UP team is working with the NSW Environmental Protection Authority (EPA) to identify and evaluate options for carbon neutral dairy production.

This work comes under the Dairy UP program called "Unlocking the potential of Kikuyu-based systems" and is one of five projects.

This project, known as P1d, focuses on the environmental impact, especially carbon.

Other programs include:

P1a: Remote pasture management

P1b: Anti-nutritional factors (toxicity)

P1c: Genetic variability

P1d: Carbon on NSW dairy farms

P1e: Modelling/quality

For more information visit www.dairyup.com.au

Why carbon research?

The Australian dairy industry is facing mounting pressure from many stakeholders to reduce its greenhouse gas emissions.

Customers want dairy to reduce its impact on the environment, while the Australian Government has committed the nation to net zero emissions through The Paris Agreement, an international treaty on climate change.

In line with these market, consumer and regulatory expectations, Dairy Australia has pledged to reduce the emissions intensity of the Australian dairy industry to 30 per cent less than 2015 levels by 2030.

To reduce emissions, the industry needs to accurately understand its existing emissions and how different management practices and farming systems affect output and carbon sequestration (capture and storage).

Potential benefits

This Dairy UP project will help the NSW Dairy industry to meet the industry's emissions reduction targets.

It will also fill knowledge gaps within the industry to enable dairy farmers to estimate their farm's emissions with increased accuracy, while providing practical ways to decrease emissions.

This project is using the Australian Dairy Carbon Calculator and the Dairy Greenhouse Gas Accounting Framework which means the work could also be used by the wider industry, beyond NSW.

There's also potential for this research to assist other Australian livestock industries.

The data collection method is aligned with the Australian Government requirements for carbon trading which means participating farms will be able to use the soil information if they want to embark on soil organic carbon sequestration (capture and storage).

Multipronged approach

This Dairy UP project includes many areas of research to gauge the best understanding of carbon on NSW dairy farms.

Information collected will be combined and used to model the greenhouse gas balance for commercial intensive and pasture-based dairy farms in NSW.

The research includes a literature review, analysis of pasture and the carbon cycle, measurements of soil organic carbon on NSW dairy farms and examination of the impact of cattle nutrition and productivity on emissions.

Literature review

This work examined research and studies from across the globe to understand what's been achieved.

Progress (December 2023)

The literature review has been completed. It established a baseline situation and modelling for carbon neutral scenarios.

The review highlighted the need for data on soil carbon stocks and sequestration, cycling of greenhouse gases from the land, impacts of nutrition under Australian conditions, and inclusion of intensive dairy systems.

Pasture and the carbon cycle

Using eight chambers and a greenhouse gas analyser on pastures, researchers are measuring the fluxes – the kilograms of greenhouse gas emitted or taken up per hectare per day – from different pasture types and management practices.

This work included a calculation of the carbon dioxide equivalent of different pastures.

These measurements will be used to better understand the carbon cycle and enable more accurate measurements.

Progress (December 2023)

Early results indicate that every hectare of pasture, on average, was capturing about 8kg of carbon dioxide equivalent per day with a minimum pasture uptake of -765 and a maximum emission of 445 CO_2e kg/ha/day.

Researchers are now testing the idea that of carbon dioxide emitted from each cow each day –

11 kg CO_2e cow/day – potentially 8kg CO_2/ha/day comes CO_2 taken from the pastures.

This information will be fed into greenhouse gas calculators to help calculate an accurate greenhouse gas balance for farms.

Soil organic carbon measurements

Up to 120 soil samples per farm from 10 participant farms are being analysed for soil organic carbon. This data will tell dairy farmers and researchers about the "carbon capital" stored in the soil. This measurement will establish a greenhouse gas emission baseline and provide insight into how different pastures, crops, and management practices affect soil carbon.

Progress (December 2023)

Soil tests from two farms have been analysed.

Initial findings from the University of Sydney Camden farm showed native pasture has the highest soil organic carbon at 4.8 per cent. This was contrary to the findings from the soil and landscape grid of Australia maps – used for initial reference – which estimated the native pastures would have the lowest soil organic carbon.

The lowest soil organic carbon area at the Camden property, according to the analysis, was the cropping paddocks at 1.2 per cent with Ryegrass and Kikuyu pastures at about 3 per cent.

Cattle nutrition and productivity

The diets of dairy cattle, including diet composition, concentrate feeding rates and pasture quality, are being examined to better understand how this affects emissions.

Progress (December 2023)

NSW Dairy Farm Monitor Project data was used for the first part of this project to examine the effect of concentrate feeding on productivity, greenhouse gas emissions and economics.

This analysis found that farms with the highest Earnings Before Interest and Tax (EBIT) fed the lowest concentrate (1 tonne or less per cow per year). But they had the greatest CO_2 emissions intensity per kg of fat and protein corrected milk including emissions from concentrate fed.

Farms with the next highest EBIT fed 2-3 tonnes of concentrate/cow/year and had the lowest emissions intensity. However, this study did not yet consider soil carbon and pasture cycling of greenhouse gases amongst others.

More research questions

The research has generated lots of questions and new considerations when it comes to calculating the greenhouse gas balance on dairy farms.

For example, researchers want to further explore if there are options to gain carbon credits for a farm through feeding, pasture management and soil organic carbon.

There are also questions now about management practices and how variations could be accounted for in an overall farm emissions calculator.

And when it comes to soil organic carbon, researchers want to learn more about converting cropping areas to permanent pastures, the time it would take, and the effect of conversion on carbon sequestration.

Next steps

On-farm measurement of soil organic carbon will continue until all 10 farms have been analysed. Data collection of sources and sinks from these farms will then allow the calculation of a more holistic greenhouse gas balance.

Researchers will also further investigate pasture management practices and productivity to determine the effect this has on the carbon cycle.

Additional research will look at the effect of different ingredients in a cow's diet and the role these ingredients play in emissions.

PhD student

Mulisa Faji, University of Sydney

Collaborators

The scope of this Dairy UP project has been expanded thanks to additional funding from the NSW Environmental Protection Authority (EPA).

DairyUP
Unlocking potential

Journal article

Dida M. F., et al (2024), Dietary Concentrate Supplementation Increases Milk Production and Reduces Predicted Greenhouse Gas Emissions Intensity in Pasture-based Commercial Dairy Farms. Journal of Dairy Science March 22, 2024

More info

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Carbon terminology

Carbon calculator: a tool for farmers to measure their farm's carbon footprint and understand the sources of emissions and explore options for reducing emissions.

Carbon credit (carbon offset): permits the owner to emit a certain amount of carbon dioxide or other greenhouse gases.

Carbon dioxide equivalents: a measure used to compare emissions from various greenhouse gasses on the basis of their global warming potential by converting amounts of other gasses to the equivalent amount of carbon dioxide with the same global warming potential.

Carbon sequestration: the process of capturing and storing carbon dioxide from the atmosphere.

Fat and protein corrected milk emissions intensity: kilograms of carbon dioxide equivalents per kilogram of fat and protein corrected milk.

Fluxes: the kilograms of greenhouse gas emissions or uptake per hectare per day.

Delivery organisations

The University of Sydney Dairy Research Foundation | NSW Department of Primary Industries | Scibus | Dairy Australia

Partner organisations

NSW Farmers Growing the best | eastAUSmilk | Dairy NSW | Dairy Australia | AFMH | Leppington Pastoral Company Pty Ltd | NSW Local Land Services | Norco

Additional program supporters, collaborations or partnerships

Charles Sturt University | DairyBio | DataGene | Eagle Direct | Entegra
Macquarie University | NSW EPA | smaXtec | UC Davis | University of Technology Sydney