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Tasmanian Institute of Agriculture

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TIA is a joint venture of the University of Tasmania and the Tasmanian Government

Methane yield & intensity in pasture-based dairy systems

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Farm overview

Project: ZNE-Ag CRC Producer Demonstration Site Host Agreement TIA Dairy Research Facility

Funding source: Zero-Net Emissions Agriculture CRC

Lead organisation: Tasmanian Institute of Agriculture

Research team: Richard Rawnsley, Pieter Raedts, Andrew Marshall, James Hills, Ben Noble

Project duration: 2025-2026

The challenge

Agriculture is a major contributor to Australia's greenhouse gas emissions and enteric methane from ruminant livestock represents one of the largest sources of agricultural emissions (72% in 2022-23[1]).

In Australia, emissions reporting for dairy systems is largely based on the National Greenhouse Gas Inventory (NGGI), which applies fixed methane yield assumptions for forage-fed cattle.

However, increasing evidence suggests that these default factors may not accurately reflect emissions from contemporary, high-performing pasture-based systems.

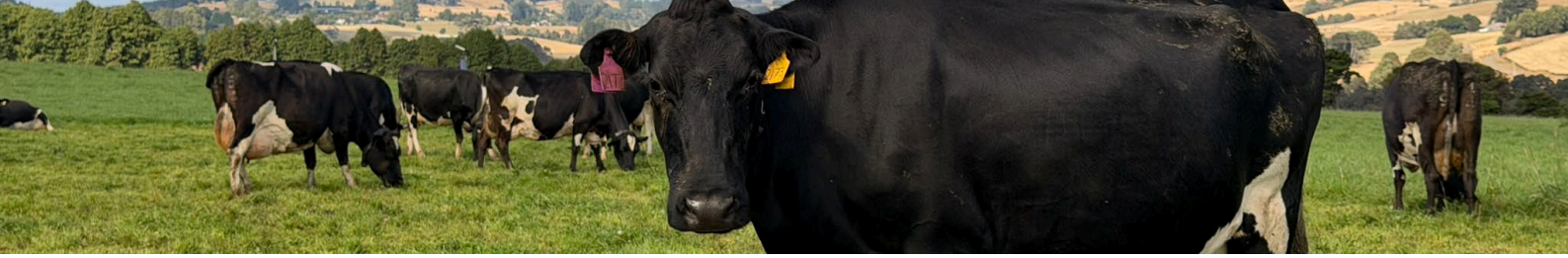
In temperate regions such as Tasmania, irrigated perennial ryegrass-white clover pastures can provide consistently high-quality feed with high digestibility and metabolisable energy throughout the year.

Understanding how these pasture characteristics influence methane production can help strengthen the evidence base for emissions estimations and support future improvements in emissions reporting for modern pasture-based dairy systems.

KEY POINTS

- GreenFeed units were deployed at TIA's Dairy Research Facility to measure methane production and intensity in a pasture-based dairy system.
- The study was conducted alongside the Dairy HIGH2 farmlet trial, which evaluated innovative pasture mixes and reduced synthetic nitrogen fertiliser inputs while maintaining high levels of milk production.
- This trial generated new data on methane emissions from irrigated temperate pasture systems.
- Findings will contribute to an improved understanding of emissions performance in pasture-based dairy systems and help inform future emissions accounting approaches.

Image caption: *Discussing the GreenFeed research trial with attendees at a TIA Field Day.*



Our response

To improve understanding of methane emissions in contemporary, high-performing pasture-based systems, TIA undertook methane measurements within the Dairy HIGH2 farmlet trial using GreenFeed units. Dairy HIGH2 is a nationally-significant program funded by Dairy Australia that compared four irrigated farmlet systems featuring innovative pasture mixes and varying amounts of synthetic nitrogen fertiliser, including a farmlet that received no synthetic nitrogen fertiliser. The trial had a goal to halve synthetic nitrogen use while maintaining high levels of pasture and milk production.

Using GreenFeed units, TIA researchers quantified enteric methane emissions in irrigated dairy farmlet systems and compared measured values with estimates derived from NGGI methodology. This is a unique opportunity to examine how feed quality and management practices influence emissions outcomes.

What we achieved

Across all four farmlets, average daily enteric methane production ranged from 387g to 481g CH_4 per cow per day. While variation existed between cows and systems, clear differences were observed between management periods.

During the first deployment, methane emissions were consistently lower than NGGI predictions based on estimated feed intake, averaging approximately 13% below expected levels. During the second deployment, when pasture silage was introduced to fill a feed deficit, methane emissions aligned closely with NGGI estimates.

Methane intensity ranged from 11.0g to 15.3g CH_4 per kg energy-corrected milk. Farmlet systems with higher milk production consistently recorded lower methane intensity, demonstrating the dilution effect of production on emissions per unit of product.

At the whole-farm level, emission intensity ranged from 0.61kg to 0.66kg CO_2e per kg fat- and protein-corrected milk. The lowest emissions intensity was observed in the system without nitrogen fertiliser input and a lower stocking rate, highlighting the combined influence of feed inputs and management intensity.

Image caption: *GreenFeed unit at the TIA Dairy Research Facility.*

Image caption: *Associate Professor Richard Rawnsley and Mr Ben Noble.*

Industry implications

The study provides valuable new data on methane emissions from irrigated temperate dairy systems and highlights the important role of diet quality in influencing methane production.

The results suggest that current NGGI emission factors may overestimate methane production in high-quality irrigated pasture systems, particularly where diets are highly digestible and low in structural fibre.

The divergence between measured and predicted emissions was most evident when high quality pasture and grain concentrate was the total diet, while inclusion of supplementary silage resulted in emissions aligning more closely with national inventory assumptions. This indicates that diet composition and rumen fermentation dynamics play a critical role in determining methane output, and that these effects are not fully captured in static emissions factors.

From a systems perspective, improvements in milk production efficiency consistently reduced methane intensity, supporting the role of productivity gains as a key mitigation pathway. However, whole-farm emissions intensity was also strongly influenced by fertiliser use and imported feed requirements, demonstrating that mitigation outcomes depend on both biological efficiency and external input dependence.

Overall, these findings highlight the importance of refining emissions accounting frameworks to better reflect modern pasture-based dairy systems, particularly in irrigated environments where feed quality is consistently high.

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