# Final Project Summary

## P6c: Future Systems – Digital Feeding

May 2026

Feed costs are one of the biggest expenses on Australian dairy farms, so improving the efficiency of supplementary feeding has a direct impact on farm profitability. Accurate individual grain allocation offers the opportunity for many pasture-based herds to improve milk response to supplementation.

This project investigated how existing on-farm data and climate data could be used to support more precise, individualised grain allocation decisions for pasture-based herds with automatic feeders. It built on earlier work by the University of Sydney that identified the potential to increase milk production by 10% through improved concentrate allocation to individual cows.

**Digital feeding systems**

The project explored how artificial intelligence (AI), machine learning and optimisation algorithms could be used to predict milk yield from routinely collected farm data and adjust grain allocation accordingly.

The work focused on developing a "digital feeding" approach that could operate within practical farm constraints and existing in-parlour feeding systems. The models tested whether overall milk production could be improved through more advanced individualised feeding based on each cow's predicted response to different feeding levels.

### Data, Advanced Technology and Automation (DATA)

Dairy UP's P6 project explored ways to use existing farm, climate and industry data to develop ways to monitor cows and systems. Reports and tools based on this data could be used by farmers to make better decisions, for example about heat management, health and feeding.

The Australian dairy industry collects large amounts of farm and production data. Until now this has been stored in numerous, separate databases.

This project aimed to utilise data, advanced technologies and automation to integrate information from multiple sources to enable the creation of tools that support on-farm decisions.

P6 was a suite of three projects that combined animal science and data science. Each project was undertaken by a PhD student.

- P6a: Resilient Cattle (heat tolerance).
- P6b: Resilient Cattle (health): early intervention for improved animal health, enabled by advanced sensing.
- P6c: Digital Feeding – data-driven feeding to optimise grain allocation in pasture-based herds.

This document provides a final update on P6c Digital Feeding.

## Key findings

Our modelling predicted that herd-level milk production could increase by 6.6–8.8% when grain allocation was optimised using AI-predicted individual cow response to feeding.

Cows differed widely in how efficiently they converted grain into milk. One kg of grain has energy for up to about 2.4 L of milk. However, due to variations in the intake and composition of other feeds, as well as differences in feed conversion efficiency, the 'apparent' total conversion efficiency varies widely. In our studies, some cows produced only 0.17 L/kg, while others produced up to 15.8 L/kg.

This highlights the importance of accounting for cow-to-cow variability when making feeding decisions.

Machine learning models reliably predicted milk yield using routinely collected farm data, without requiring liveweight measurements or additional climate-monitoring equipment.

## Implications for farmers

The findings suggest there are opportunities to improve feed efficiency by directing more grain towards cows that respond most effectively.

Artificial intelligence has the potential to enhance existing individualised feeding systems by predicting how individual cows are likely to respond to different feeding levels.

## More info

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P6 final report

# Research and results

## Research approach

The project used existing commercial farm data to test whether artificial intelligence and optimisation tools could improve grain allocation decisions in pasture-based dairy herds.

Researchers analysed large datasets from two commercial pasture-based dairy farms, including milk yield, concentrate intake, days in milk, lactation number, breed and weather conditions.

Study 1 used 32,504 records from 130 cows to develop machine learning models for predicting milk yield. Digital feeding strategies were tested using 7,371 of these records from 81 cows.

Study 2 used 456,078 daily records from 1,053 cows to investigate variation in cow response to grain feeding and evaluate digital feeding optimisation strategies using the developed machine learning models.

Optimisation algorithms were then used to test whether redistributing the same total amount of grain across the herd could improve overall milk production while remaining within practical farm feeding limits, such as minimum and maximum concentrate levels and restrictions on day-to-day changes in feeding.

## Results

The project demonstrated that redistributing grain according to predicted individual cow response could improve feed-use efficiency and herd-level milk production without increasing overall grain use.

The research highlighted major differences between cows in how efficiently they converted grain into milk. Without considering other diet components, milk produced per kilogram of concentrate ranged from 0.17 to 15.8 litres, highlighting the importance of accounting for cow-to-cow variability when making feeding decisions.

Modelling predicted herd-level milk production could increase by 6.6–8.8% when grain allocation was based on AI-predicted individual cow response to feeding. The best-performing optimisation approach consistently predicted increases of around 8.6%.

The optimisation models redistributed grain from lower-responding cows to cows predicted to respond more efficiently to concentrate feeding, while remaining within practical farm feeding limits.

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Unlocking potential

Machine learning models reliably predicted milk yield using routinely collected farm data, including milk yield, concentrate intake, days in milk, lactation number and weather conditions. Days in milk and concentrate intake were identified as the strongest predictors of milk production. The models explained about 61% of the variation in daily milk yield when tested on separate farm records not used to develop the models.

Environmental variables such as temperature and humidity added only small improvements to prediction accuracy compared with cow-level production and feeding data. This suggests digital feeding systems may be able to be implemented using data already collected on many commercial farms, without requiring additional climate-monitoring equipment or liveweight measurements.

## Further research

The project was a modelling and simulation study using commercial herd datasets. The next step would be to validate the performance of digital feeding systems under real-time farm conditions.

## PhD Student

Blessing Azubuike, University of Sydney

## Collaborators

Participating dairy farms: Ryan Apps, Bega NSW; University of Sydney Corstorphine farm.

## Journal articles

Azubuike et al. (2026) Leveraging artificial intelligence and evolutionary algorithms for optimising cow supplementation and milk production. Artificial Intelligence in Agriculture,Volume 16, Issue 2, Pages 926-939.

Azubuike et al. (2025) A data-driven approach for optimising supplement allocation to individual lactating dairy cows in pasture-based systems, Smart Agricultural Technology, Volume 12,101669

**Delivery organisations**

The University of Sydney – Dairy Research Foundation
NSW Government Department of Primary Industries and Regional Development
Scibus
Dairy Australia

**Partner organisations**

NSW Farmers Growing the best
eastAUSmilk Advocacy-Unity-Service
Dairy NSW | Dairy Australia
AFMH
Leppington Pastoral Company Pty Ltd
NSW Government Local Land Services
Norco

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