



# Mapping Pasture Quality: Using Remote Sensing to Address Northern Australia's Fodder Gap

## From Research to Rangeland Management

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NORTHERN BEEF RESEARCH UPDATE CONFERENCE – March 2026

# Why Pasture Quality Matters

## For Graziers:

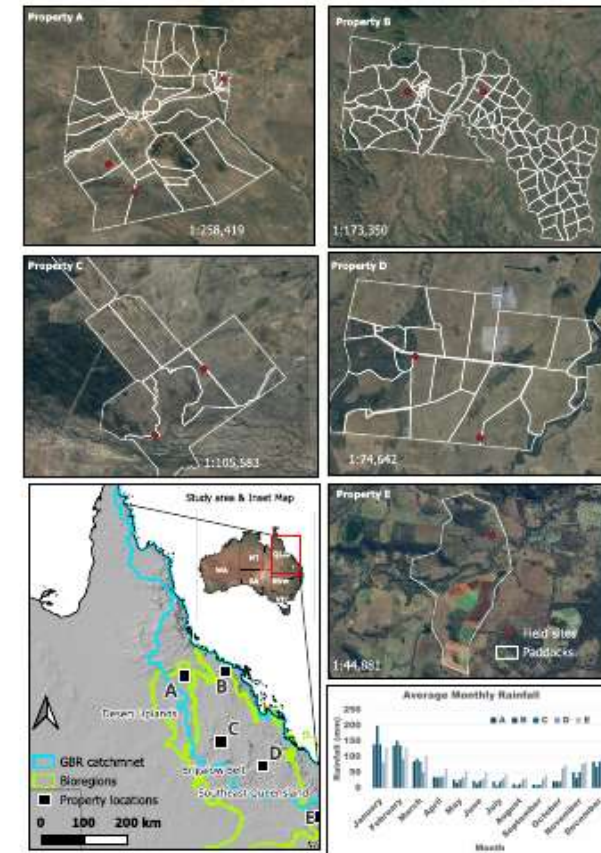
- When to move cattle to better paddocks
- When supplementation is needed
- Optimal stocking decisions

## For the Environment:

- Sustainable grazing pressure
- Reduced overgrazing and erosion

## Our Study:

- **9 sites** across GBR catchment
- Grassland and woodland pastures
- Ground truth → UAV → Satellite



Study sites across the Great Barrier Reef Catchment

# The Challenge: Scaling the Gold Standard

## Laboratory Wet Chemistry

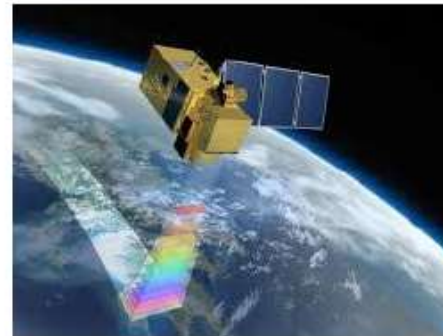
- The **gold standard** for accuracy
- Precise chemical composition
- Required for model calibration
- *Limitation:* Spatially limited, expensive

## Satellite Extension

- **Extends** lab results spatially
- Free Sentinel-2 imagery
- Whole-property coverage
- *Enables:* Continuous monitoring

**Key Insight:** Satellite predictions calibrated against lab chemistry

Lab samples remain essential – we scale their value across the landscape



# What We Measure: The Numbers That Matter

## Crude Protein (CP)

- Essential for muscle and milk production
- **Maintenance:** 7% minimum
- **Growth:** 10–12% ideal
- Drops rapidly as pasture dries off

>7% Good    5–7% Monitor    <5% Poor

## Dry Matter Digestibility (DMD)

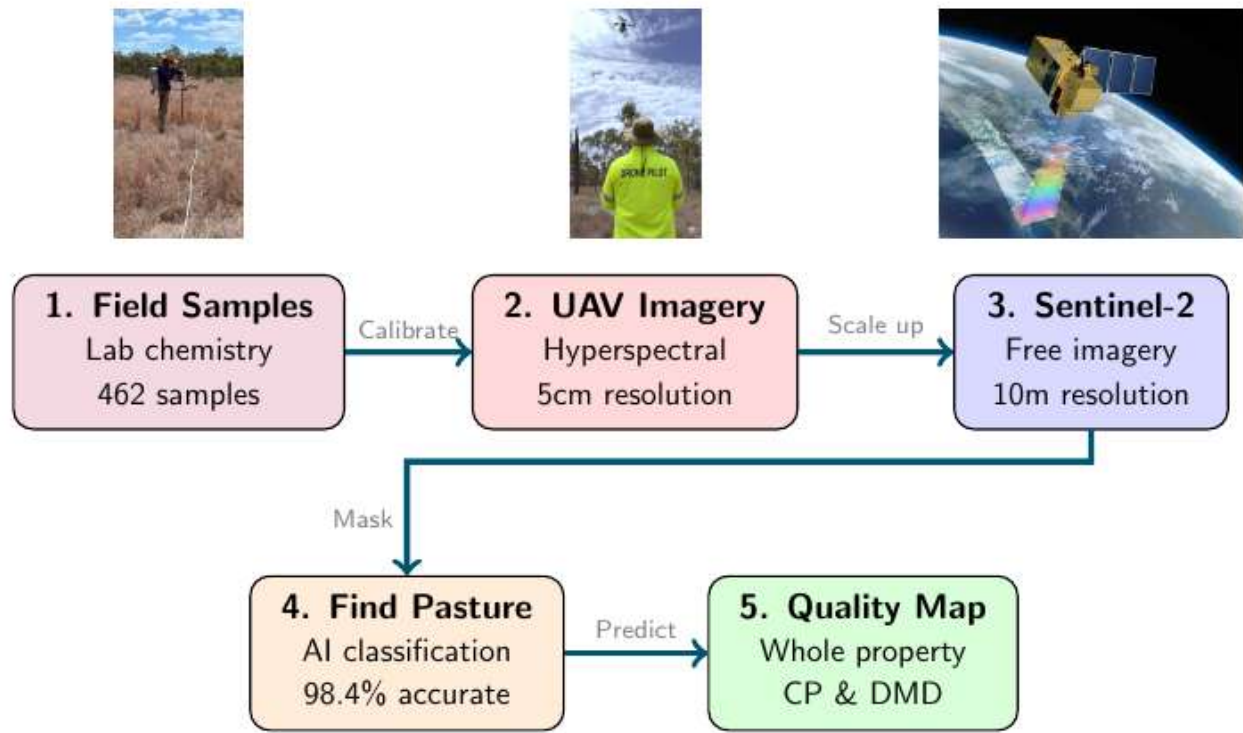
- How much energy cattle can extract
- **Good:** >55%
- **Maintenance:** 50–55%
- **Poor:** <50% (weight loss likely)

>55% Good    50–55% Marginal

<50% Poor

*These thresholds guide management decisions (MLA 2022; CSIRO 2007)*

# How It Works: From Lab to Paddock Map



## Why UAV?

Bridges scale gap: 1m<sup>2</sup> samples → 100m<sup>2</sup> pixels

## Why Classification?

Trees and soil confuse predictions — mask them out

## Why Sentinel-2?

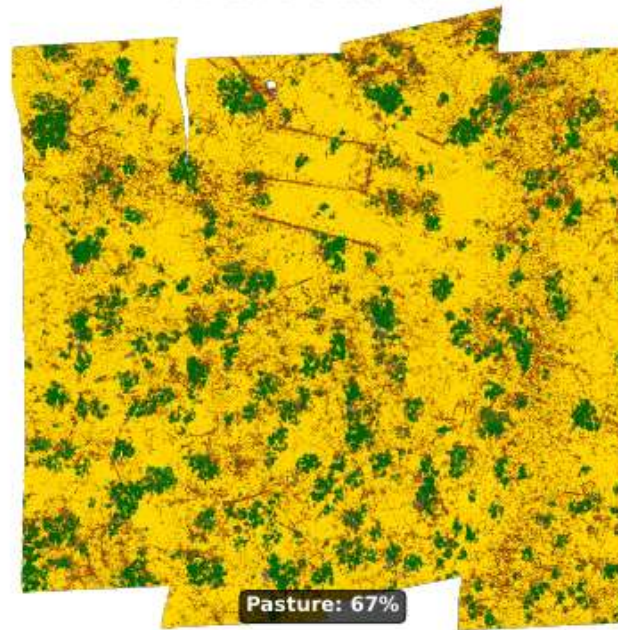
Free, global, 10m resolution, 5-day revisit

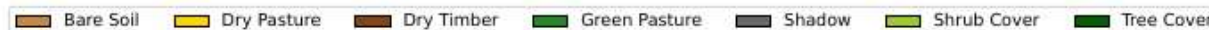
# Finding the Pasture

UAV RGB (5 cm pixels)



Land Cover Classification



 Bare Soil   Dry Pasture   Dry Timber   Green Pasture   Shadow   Shrub Cover   Tree Cover

## Why Classification Matters:

- Rangeland = mix of pasture, trees, bare soil
- Trees have high “apparent” protein (leaves)
- Bare soil has no nutritional value
- **Must isolate productive pasture**

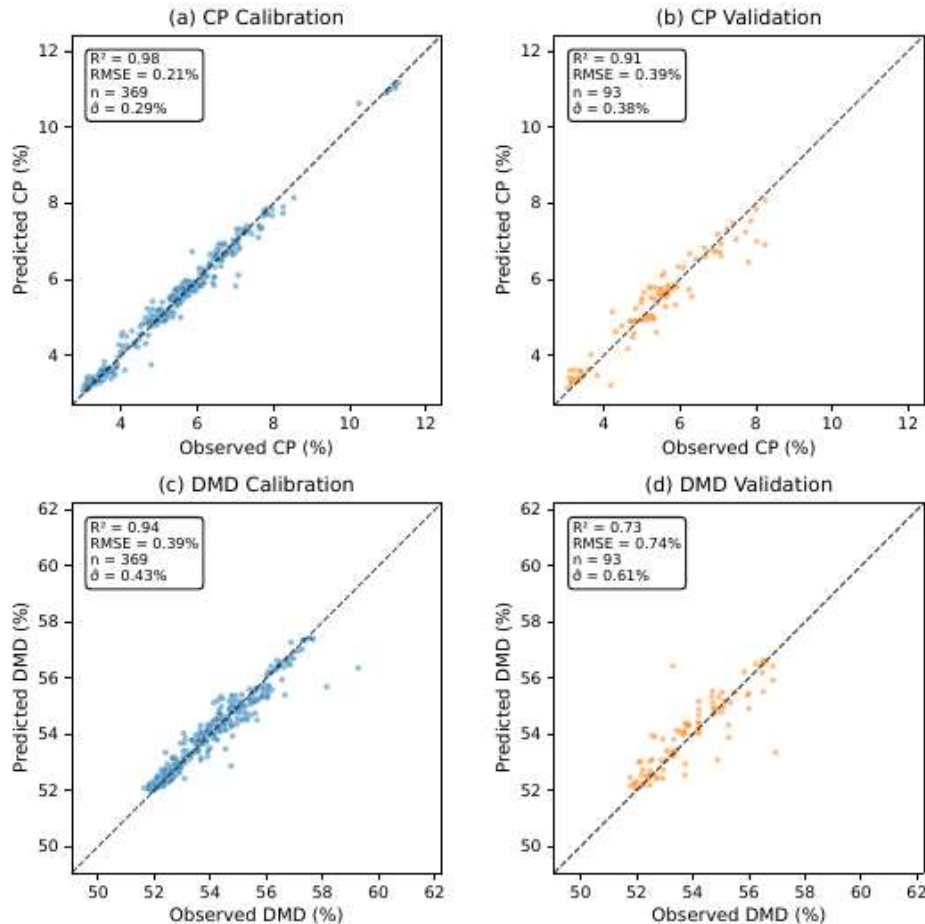
## Our Approach:

- Deep Neural Network (4 layers)
- 7 land cover classes
- **98.4% overall accuracy**

## Mt Pleasant Example:

Only ~30% is pasture — the rest is trees, shrubs, and soil that must be masked out.

# Model Accuracy



$\delta$  = mean model uncertainty (derived from 80% prediction interval)

Scale	Metric	$R^2$ Val	RMSE
Leaf	CP	0.76	1.38%
	DMD	0.47	2.57%
UAV	CP	0.95	0.79%
	DMD	0.88	1.05%
<b>Sentinel-2</b>	<b>CP</b>	<b>0.92</b>	<b>0.39%</b>
	<b>DMD</b>	<b>0.73</b>	<b>0.95%</b>

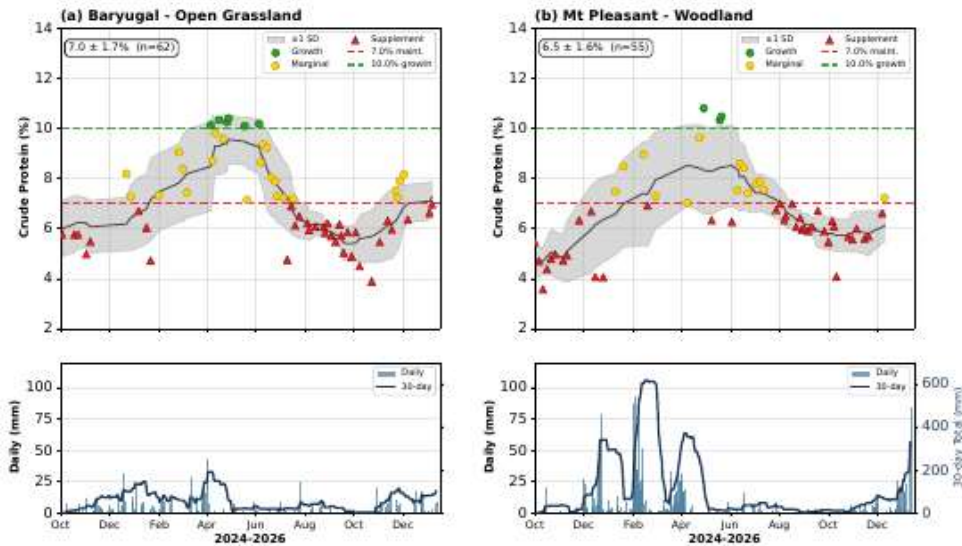
## UAV: The Critical Bridge

- Connects 1m<sup>2</sup> samples to 100m<sup>2</sup> pixels
- Validates spatial patterns
- Enables transfer learning

**Result: Sentinel-2 CP:  $R^2 = 0.92$**

# Tracking Pasture Quality Through the Seasons

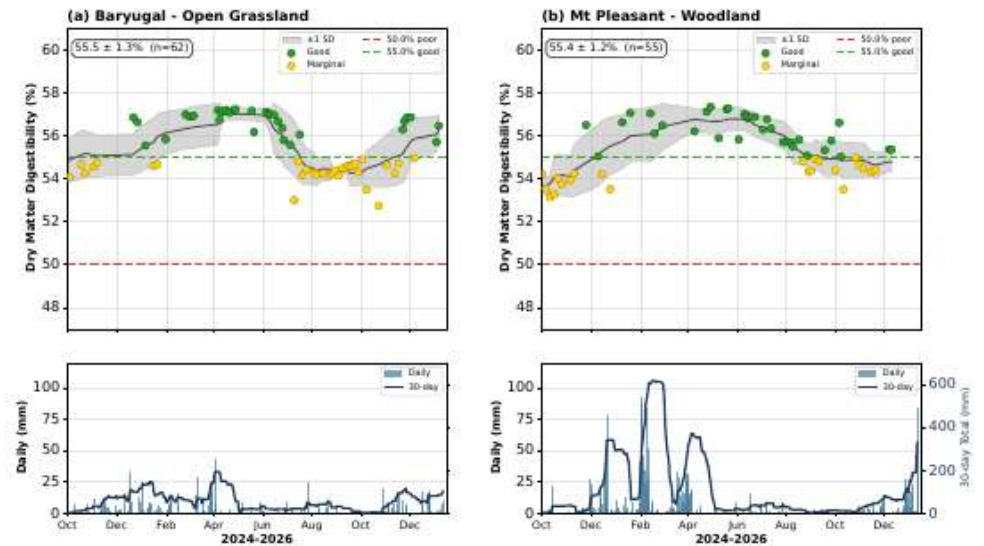
## Crude Protein



**Crude Protein:**  
 CP peaks wet: 10–12%  
 CP drops dry: 4–6%

Response: 2–3 weeks post-rain

## Dry Matter Digestibility



**Digestibility:**  
 DMD peaks wet: 55–57%  
 DMD drops dry: 52–54%

More stable than CP

### When to Act:

CP > 7% Good

CP 5–7% Monitor

CP < 5% Supplement

# How to Use This Information

## Paddock Selection

- Identify best-quality paddocks
- Move cattle to high-protein areas
- Strategic rest and rotation

## Supplement Planning

- Know when CP drops below 7%
- Target supplements where needed
- Avoid unnecessary costs



## Stocking Decisions

- Match numbers to feed quality
- Early warning of dry conditions
- Evidence-based destocking

## Historical Analysis

- Compare years back to 2018
- Track response to management
- Benchmark paddock performance

# Conclusions and Next Steps

## What We've Achieved:

- ✓ Accurate satellite-based CP predictions ( $R^2 = 0.91$ )
- ✓ Validated across multiple sites and seasons
- ✓ Operational pipeline using free Sentinel-2 data
- ✓ 98.4% accurate pasture classification
- ✓ Archive available from 2018

## Potential Future Developments:

- Improved DMD predictions
- Web mapping and reporting tools
- Expand beyond GBR catchment

## Key Takeaway

Free satellite data + modern AI  
= **whole-property pasture quality mapping**

## Cost Comparison

Traditional lab: \$50–100/sample  
Satellite imagery: **Free**  
Updates: Every 5 days

## Applications

Grazing management  
Drought response planning

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## **References:**

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