

Towards a complete nitrogen budget from subtropical dairy farms: three years of pasture nitrogen losses in surface runoff

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Introduction

Dairy represents one of the most intensive and nitrogen (N) loaded production systems in the high rainfall regions of Queensland, with application rates up to 300 kg N ha⁻¹ year⁻¹. However the fate of much of the applied N is uncertain and the high (>1200 mm year⁻¹) and intensive rainfall and the proximity to environmentally sensitive areas such as the Great Barrier Reef make losses in surface water run-off of particular interest to the industry.

Experimental setup

- The study was located on a dairy farm 10km due east of Gympie, 180 km north of Brisbane, Queensland (Latitude: 26.19° S; Longitude: 152.74° E) on a 6° slope
- Surface runoff volume and rates, together with nutrient and sediment loads were investigated from two replicate tipping bucket run-off collectors from June 2012 to July 2015.



Results

- Highest runoff and N loss occurred from late Jan-March 2013 when >1000 mm of rain fell following an extended dry period.
- N losses were only elevated after the initial 440 mm Jan 2013 event when NO₃⁻ concentrations peaked at 39 mg L⁻¹, totalling 16.5 kg N ha⁻¹ for the event.
- N losses from subsequent events were minimal (<4 kg N ha⁻¹ yr⁻¹) despite very high rainfall events (>280 mm)
- NO₃⁻ was the dominant loss form though organic N accounted for 20% of losses

Table 1. Total rainfall, surface runoff and nutrient concentrations and load measured at Gympie, Queensland.

Year	Rain (mm)	Number of events (>1mm)	Total runoff (mm m ²)	% rain as runoff	NO ₃ ⁻ (kg N ha ⁻¹)	NH ₄ ⁺ (kg N ha ⁻¹)	Organic N (kg N ha ⁻¹)	Total N lost (kg N ha ⁻¹)
2012/13	1318	5	412	31.3	15.0 ± 3.0	0.6 ± 0.4	2.8 ± 0.8	18.5 ± 4.2
2013/14	1008	3	59	5.8	2.4 ± 0.2	0.1 ± 0.0	1.4 ± 0.6	4.0 ± 0.8
2014/15	1222	1	26.6	2.2	0.02 ± 0.01	0.19 ± 0.02	0.31 ± 0.1	0.52 ± 0.1
Average	1211	3	166 ± 124	13.1 ± 9.2	4.3 ± 3.1	0.3 ± 0.2	1.5 ± 0.7	7.7 ± 5.5

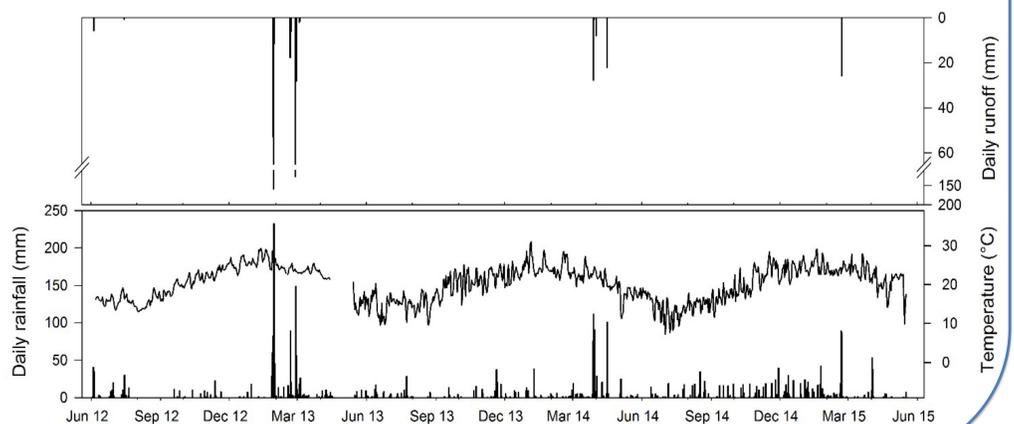


Figure 1. Daily rainfall and mean air temperature for the experimental period June 2012 to June 2015 at Gympie, Queensland.

Conclusions and Outlook

Despite the high annual N application rates and intense rainfall of subtropical dairy pastures, N losses from surface runoff are generally low and are not a major N loss mechanism. This is largely due to these events occurring during summer, outside the traditional fertiliser application window when excess N in the profile is limited by high pasture uptake. However large losses can still occur after intense rain following unseasonable summer dry periods, an occurrence predicted to increase with increasing climate variability associated with climate change.