

Estimating N excretion and deposition for improved nutrient management on Australian dairy farms

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Background

Australian dairy industry

- Important economically
 - Third largest rural industry
 - AUD 14 billion (AUD 4 billion, farmgate)
 - Located most states and territories
 - Typically higher rainfall and greater access to water
- Year round access to pasture to support grazing base
 - Grazing & pasture management – feeding systems



Background

Australian dairy industry

- Historic feeding systems
 - Perennial pasture (grass + legumes)
 - Forages (typically conserved silage and hay)
 - Grain/concentrate (fed at milking)



➤ Intensification of dairy industry

- More recent changes
 - Altered feeding systems
 - Increased pasture and fodder production

Background

Australian dairy industry

- 5 main feeding systems

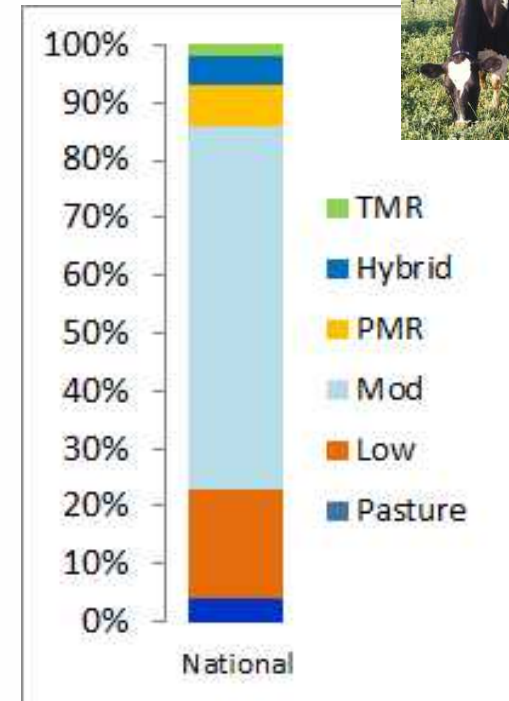
Grazed pasture + other forages + up to 1.0 tonne grain/concentrates ➤ **Low**

Grazed pasture + other forages + more than 1.0 tonne grain/concentrates ➤ **Mod**

Pasture grazed for most or all of year + partial mixed ration on feed pad ± grain/concentrates ➤ **PMR**




Pasture grazed for <9 months/year + partial mixed ration on feed pad ± grain/concentrates ➤ **Hybrid**

Zero grazing, cows housed & fed total mixed ration ➤ **TMR**



Background

Australian dairy industry

- Locations cows spend time on grazing system farms
 - Grazed pasture 
 - Laneways
 - Dairyshed and yards (concreted)
 - Feedpads (concreted and not concreted) 
 - Holding areas (not concreted) 
- Variable nationally

Background



Australian dairy industry

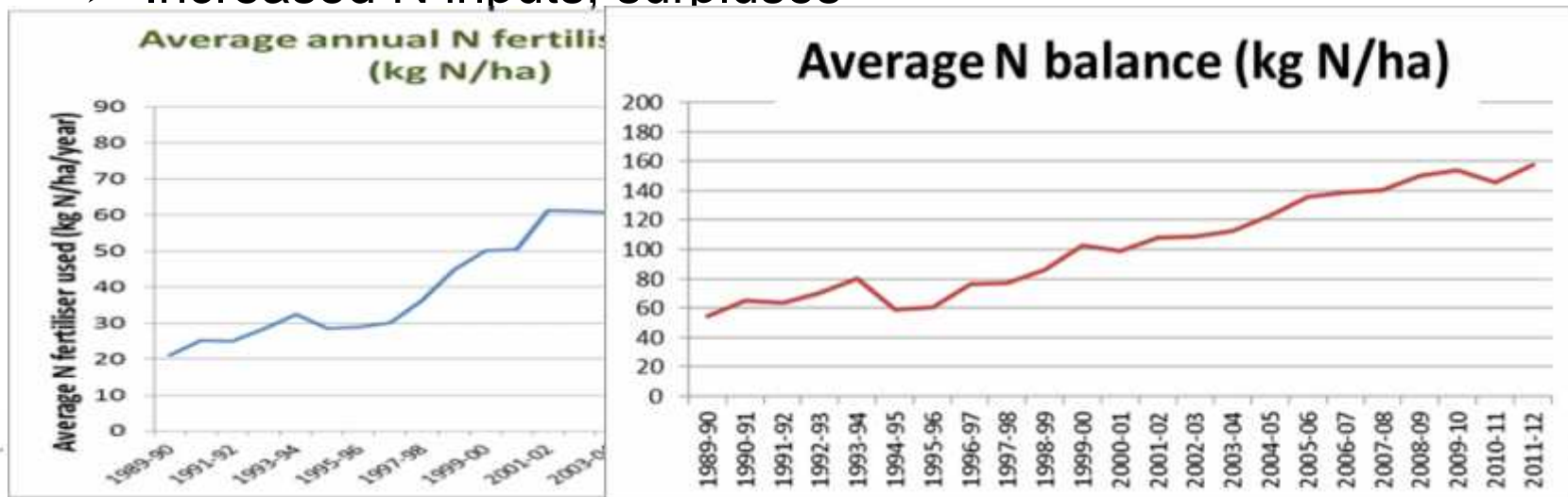
- Intensification of dairy industry
 - Feeding systems
 - Altered feeding systems
 - Greater N fertiliser use
 - Increased pasture and fodder production



Background

Australian dairy industry

- Intensification of dairy industry
 - Average annual per farm data and metrics sourced from the Australian Bureau of Statistics (Stott and Gourley, 2016)
- Increased N inputs, surpluses



Why quantify N excretion and deposition?

Intensification of dairy industry

- Greater N inputs (feed and fertiliser)
- Changes in animal time on grazed pasture
 - Less N deposited to pasture
- Manure capture for re-use
 - Direct and indirect

Quantification of N excretion and deposition

Intensification of dairy industry

- Greater N inputs (feed and fertiliser)
- Changes in animal time on grazed pasture
 - Less N deposited to pasture
- Manure capture for re-use
 - Direct and indirect

Individual dairy farms

- 43 case study grazing systems
Farm data and samples collected
- 5 times over a year



N Excretion



1. Animal metabolic energy requirement
 - Milk production, Pregnancy, Grazing, Activity, Maintenance
2. Energy supplied by supplements fed
 - Grain, concentrate, by-products, fodder
(Supplements provide 52% of cow's energy requirements)
3. Calculated energy from pasture
 - Pasture sample ME
 - Pasture DM Intake

	Dry matter intake (kg/cow/day)	
	Supplement	Pasture
Minimum	1.0	0
Mean	9.2	9
Maximum	25.4	22

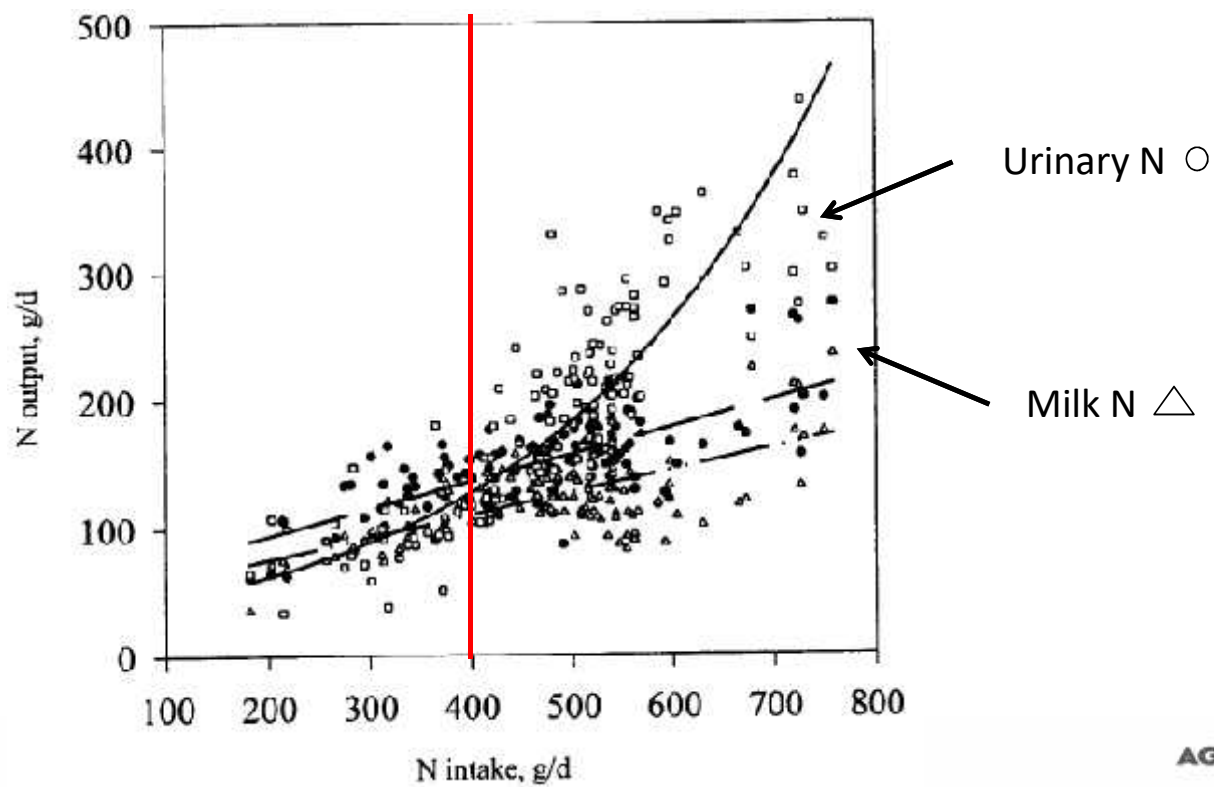
N Excretion



4. $N \text{ excreted} = \text{Total } N \text{ intake} - N_{\text{milk}}$

	Intake	Secretion	Excretion	NUE
	(gN/cow/day)			(%)
Minimum	268	48	199	11
Mean	545	112	433	21
Maximum	983	190	793	39
SD	129.4	29.0	110.3	4.3

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Castillo et al, 2000

N Excretion

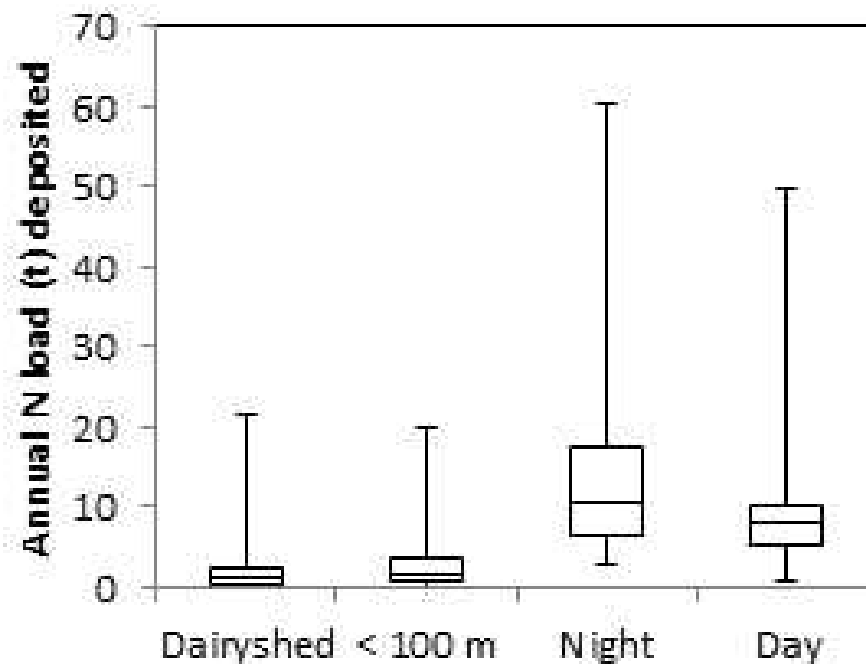


- N excreted over a lactation on the 43 dairy farms
 - compared with total N imports
(Feed, fertiliser, livestock, N fixation, irrigation water)
- 60% of total N imported - excreted

	Excreted N load	Total N imports
	(t/year)	
Minimum	6.8	8.8
Mean	34.4	55.1
Maximum	154.9	245.2
SD	29.6	49.0

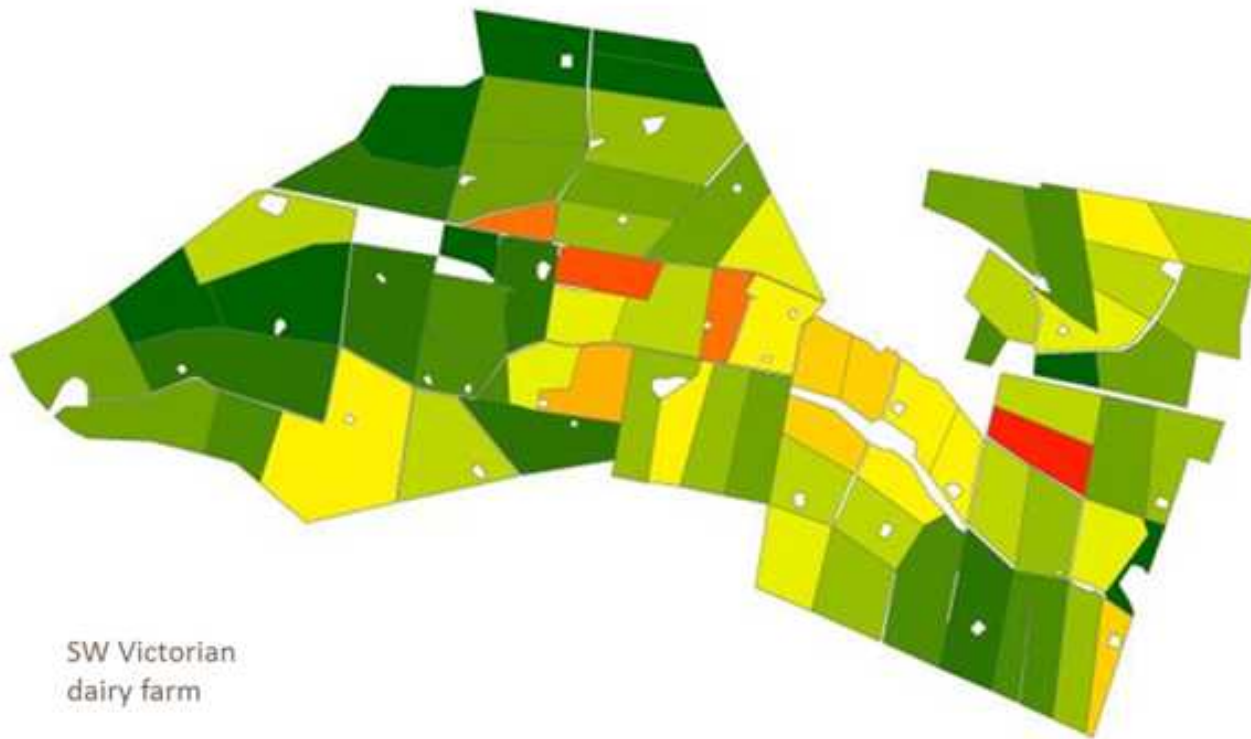
Annual N deposition around grazing system farms

Apportioned for each farm according to the places cows visited and time spent there



- Loads deposited to feedpads & holding areas (<100m from dairyshed)
 - Similar to that in dairysheds and yards
- N deposited in feedpads & holding areas
 - Not always collectable
- More N deposited in paddocks close to dairyshed
 - Cows kept overnight

Animal N Loading (kg N/ha/yr)



kg N/ha/yr

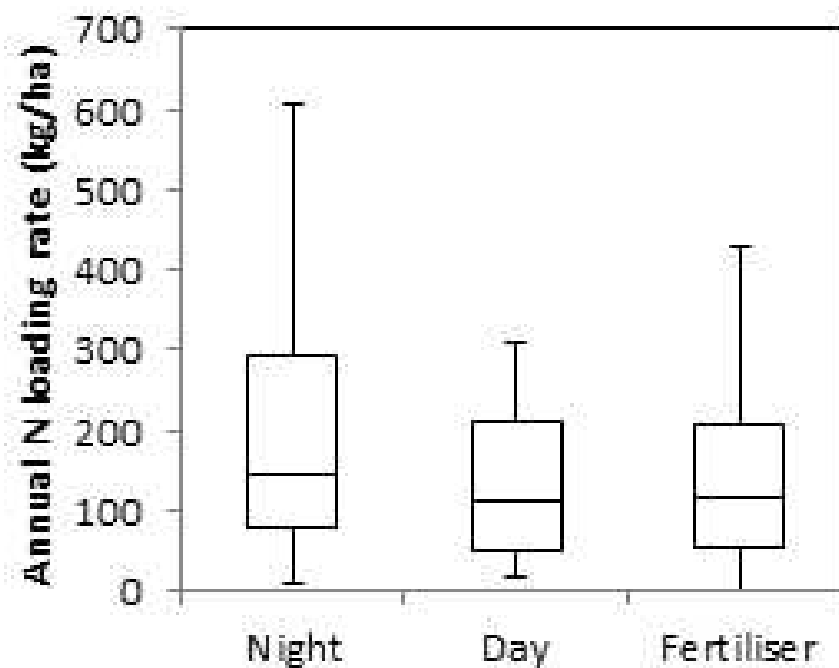
0 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 120
121 - 140
141 - 160
161 - 180
181 - 200
201 - 220
221 - 240
241 - 260
261 - 280

SW Victorian
dairy farm

- 540 cows
- 460 ha
- 1.2 cows/ha
- 42% reliant
imported feed

Annual N loading rate to paddocks

Based on the areas of paddocks cows visited on each farm



Does not include effluent (dairyshed manure) applied to paddocks

Solutions



N management on Australian dairy farms

- Calculation of N recycled through lactating animals
 - major pool of on-farm nutrients
- Estimation of N deposition in excreta
 - considered in calculation of nitrogen applications
 - Spatially non-uniform returns (based on locations animals visit most frequently)
 - potential point source losses
- N deposition on to concreted (collectable) and non-concreted (non-collectable) surfaces can be equivalent
 - Non-collectable deposited N needs specific management





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