Does variable rate irrigation decrease the loss of water quality contaminants from grazed dairy farming?

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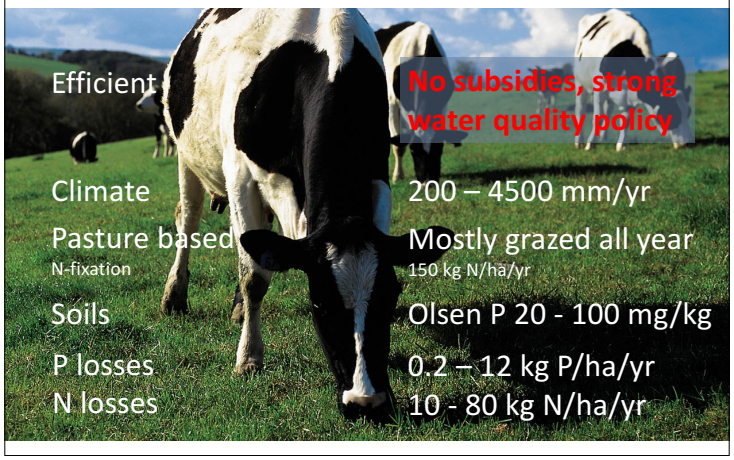
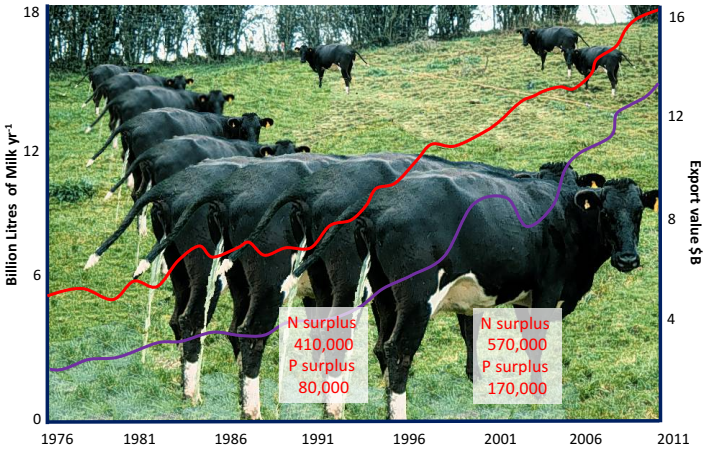
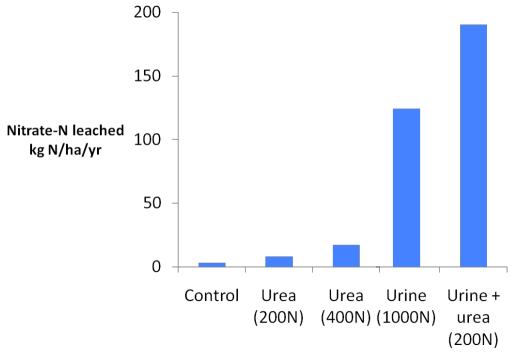
Grazed Pasture Systems



Sources: Intensification

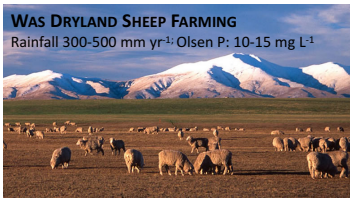


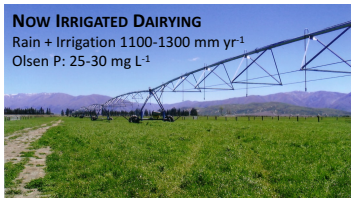
Urine vs. Fertiliser (N)



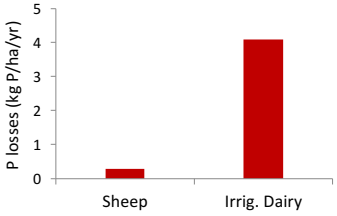
Silva et al. (1999) Aust. J Soil Res. 37: 357-369

Land Use Change and Irrigation (P)





And
Poor P retention (10%)
Sandy texture



Timeline

2009 Converted to dairy
- 235 ha
- Mixed ryegrass – white clover
- Capital P fertiliser & lime (Olsen P 15 to 30 mg/kg; pH 5.4 to 5.7).

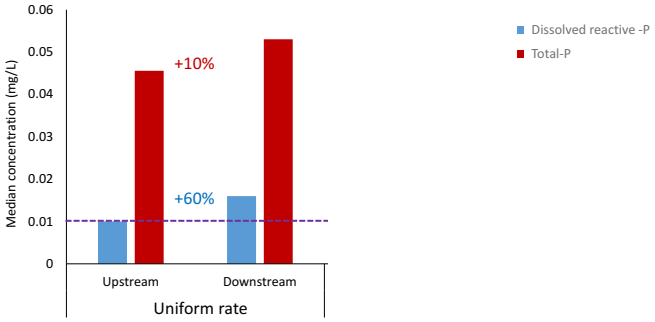
2009-2012 Uniform rate
- Centre pivot & static low rate irrigation.
- 900 mm irrigation on 3-day rotation over 3 soil types (Oct – Apr)

2013-2016 Variable rate
- Available soil moisture 40-160 mm.
- 500-800 mm irrigation over 2-day rotation depending on daily soil water deficit (Oct – Apr).

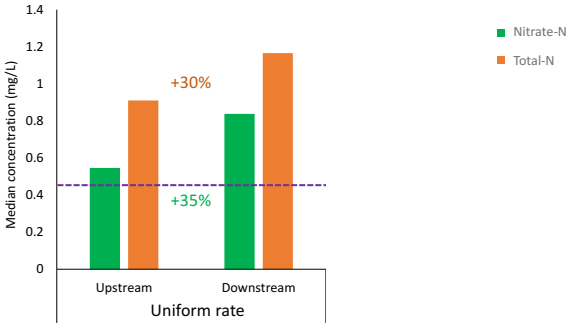
Monitoring

- Flow (15-min intervals) at 2 sites.
- Weekly baseflow and 6-storm events (p.a.) analysed for N and P forms, sediment and *E. coli*.
- Soil moisture and meteorological data

Changes in Phosphorus Forms



Changes in Nitrogen Forms

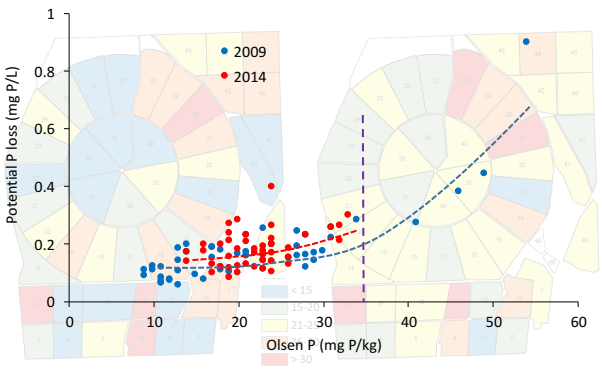


Overall Losses

Analyte	Irrigation	Measured loss (kg/ha/yr)	NZ mean loss (irig + dry)
Nitrate	Uniform rate	20	27
	Variable rate	8	
Total P	Uniform rate	3	1.9
	Variable rate	0.5	

Why the Difference?

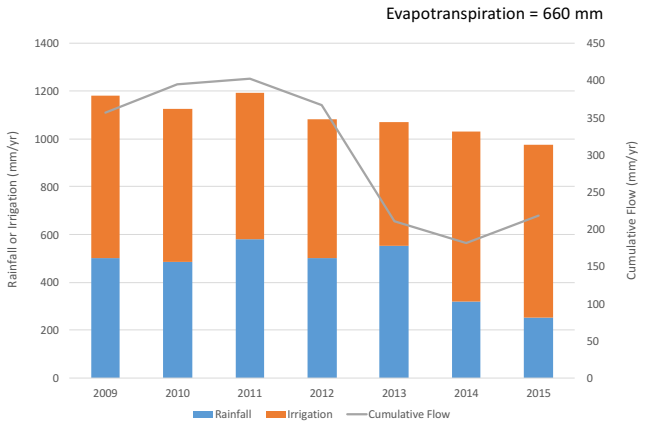
Soil Olsen P concentration 2009 | Soil Olsen P concentration 2014



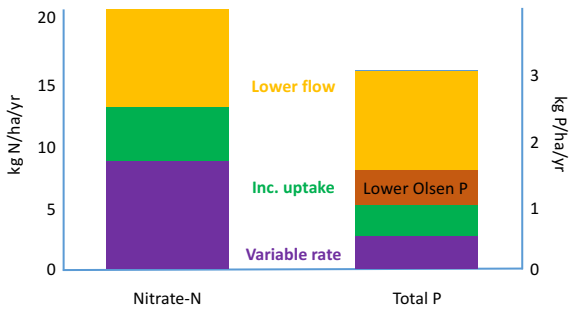
Why the Difference?

	2009	2010	2011	2012	2013	2014	2015
N-fert (kg N/ha)	156	150	140	145	140	140	140
P fert (kg P/ha)	40	26	25	25	25	25	25
Stocking rate (cows/ha)	3.2	3.4	3.3	3.1	3.1	3.0	3.0
Production (kg MS/ha)	1394	1423	1450	1432	1495	1464	1512

WHY THE DIFFERENCE?



CAUSES



CONCLUSIONS

- Profit increased > $9,000/ha under irrigation
- Regular dairy system could be viewed as “leaky”
- Concentrations of N and P forms breaching water quality regulation
- Better timing and placement of irrigation (variable rate) resulted:
  - less drainage
  - Less N and P loss
  - Increased N and P uptake
  - 6% improvement in profitability