Principles from the P21 research programme into lower N input dairy systems

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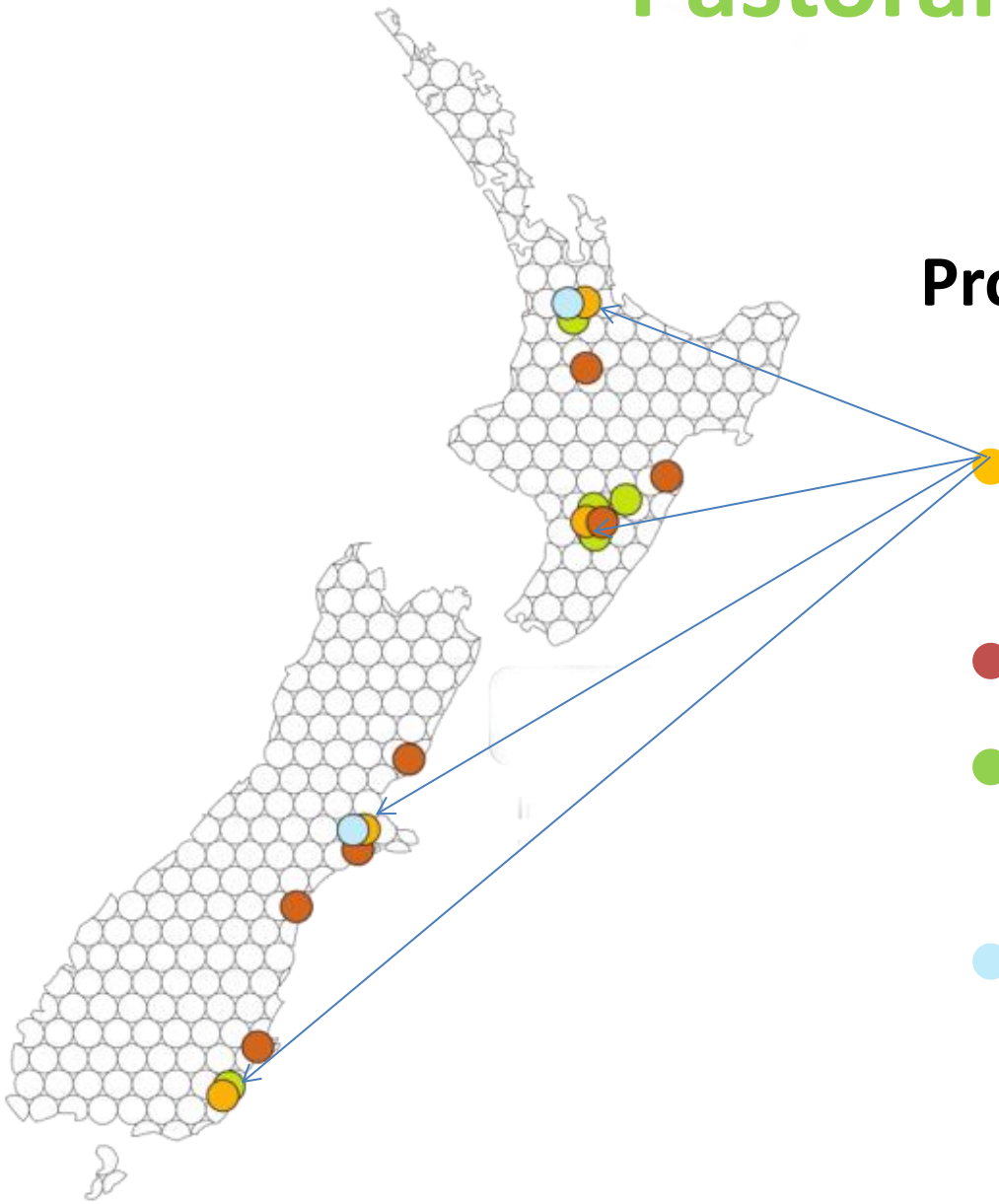
What the investors wanted from P21

Ministry of Business, Innovation & Employment

*"Industry accessible, **adoptable, systems-level** solutions for profitably **increasing production** while reducing **environmental footprint**, that have been **field tested** for demonstrable efficacy and value."*

Pastoral 21



Projects throughout NZ

- Next generation dairy systems
- Mixed livestock systems
- Breakthrough technologies - feed
- Breakthrough technologies - environment

Common features of farmlets

- Comparison of farm systems:
  - **'Current'**
  - **'Future'**
- Pre-experimental modelling to design systems and set hypotheses
- Only 5 years in the future
- Not major changes – have to be adoptable
- Common data collection
- Farmer Reference Groups
- Separately funded co-development programme to drive uptake of findings

Proposed solutions

Common themes:

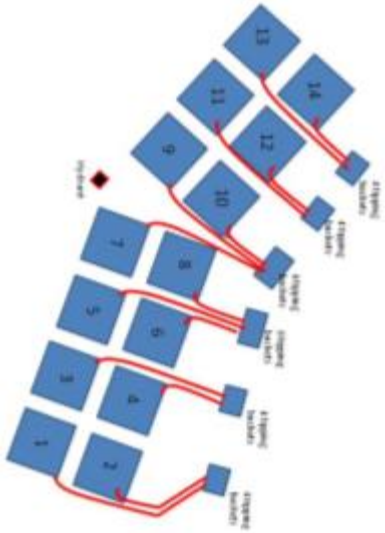
- Decrease in N fertiliser inputs compared with the regional norm Adjusted stocking rate in line with reduced N input
- Managing urine deposition during the autumn/winter period.

Measuring N leaching

Porous cups

Soil sampling

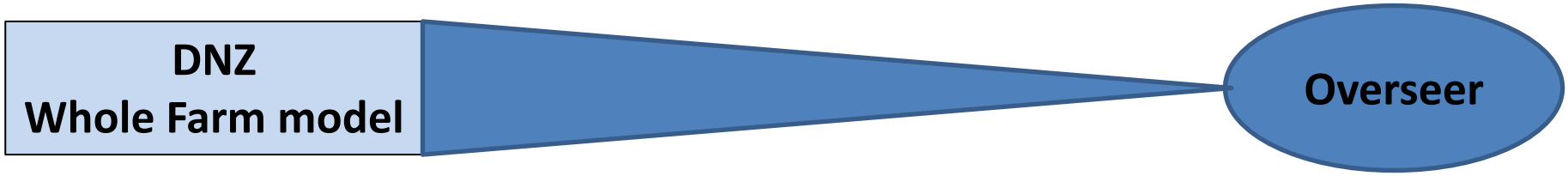
Hydrologically isolated plots



Lysimeters

- No simple answer
- All have pros and cons
- Many are soil-type specific
- A mixture of measurements and modelling is likely to provide the most robust assessment

Modelling in P21



- **Framework of process based models**
- Including economics
- Used for
  - Detailed pre-experimental modelling
  - Setting hypotheses
  - Systems evaluations as the experimental programme progresses

- **Simpler representation of the systems**
- And simpler to use
- Does not include economics
- Used for:
  - Assessing N leaching for the systems
- P21 provides new experiments for evaluating Overseer

Farmax **Models feed supplies**

Waikato: testing the concept

on two - 13 ha farmlets

	Current	Future
Stocking rate (cows/ha)	3.2	2.6
Cow genetic merit (BW)	156	225
Replacement rate (%)	22	18
N fertiliser (kg N/ha)	Up to 150	Up to 50
Nitrification inhibitors	No	Yes (now No)
Standoff- urine collected	No	Yes
Grain feeding (kg/cow)	0	Up to 400
Effluent applied (% of farm)	23	50

Canterbury: testing the concept at LURDF

	Milking Platform	Wintering system
1. Low Stocking Efficient (LSE)	• High BW cows • 3.5 cows/ha • 150 kg N fertiliser/ha/year • 100 kg grain/cow • Diverse pastures →	• Kale sown early December • Fed with green chop oats • Followed by oats crop
		
2. High Stocking Efficient (HSE)	• High BW cows • 5.0 cows/ha • up to 400 kg N/ha/year • up to 800 kg grain/cow →	• Fodder beet sown October • Fed with grass silage

What have we learnt?

- The systems work
- Nothing radical about them
- Our models capture the principles

1. Production and profit were maintained with fewer inputs

- More production per kg of liveweight
  - More per cow per day,
  - More days in milk
  - Used N fertiliser to fill deficits, not boost surpluses
  - Applied well-known principles of pasture management and grazing

- By cutting costs: fewer cows, fewer inputs
  - Lower replacement rate
  - Gains from saved inputs offset extra Standoff costs

2. Large reductions in N leaching were achieved

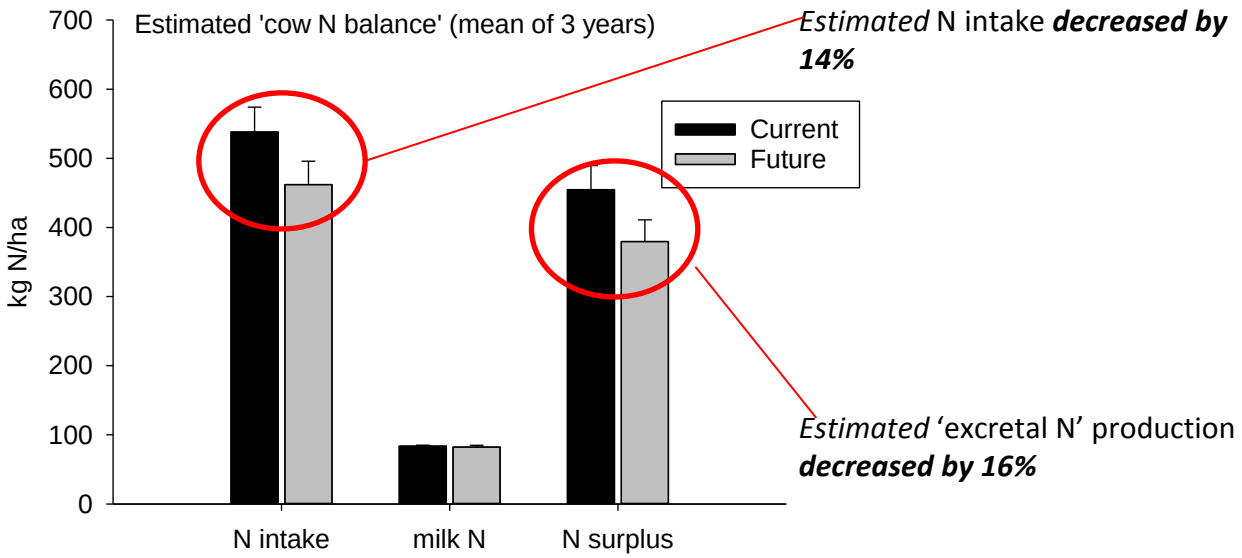
- Demonstrated through measurement and modelling
- Generally, results matched with pre-experimental modelling

Year	NO_3-N leached (kg N/ha)		P value
	Current	Future	
2012	50	22	<0.01
2013	67	38	<0.01
2014	63	42	<0.05
Mean	60	34	

3. Reductions in N losses were achieved by:

1. Decreasing fertiliser and purchased supplement inputs

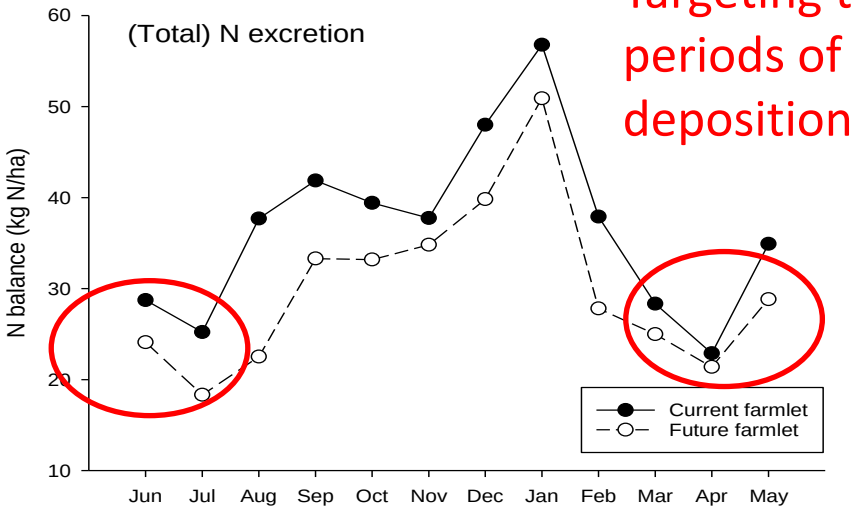
2. Adjusting stocking rate to match feed demand and the change in feed supply



3. Reductions in N losses were achieved by:

3. Standing cows off paddock for periods of the day and year

4. Safe and effective recycling of the resultant effluent

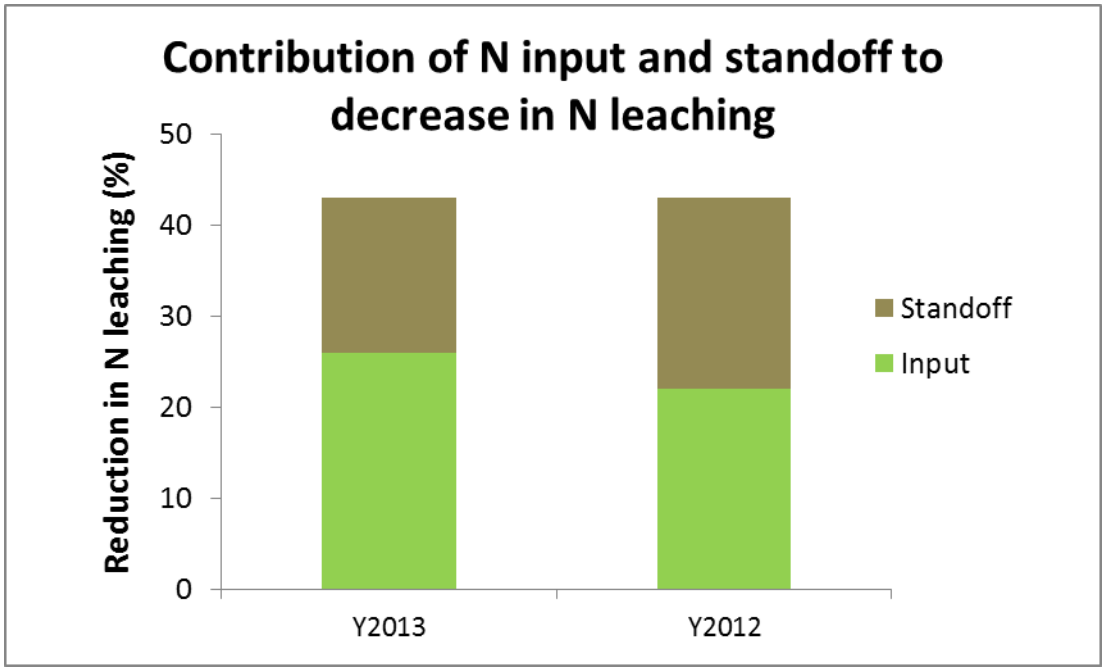


Targeting these periods of urine deposition

	'Current'	'Future'
N fertiliser on pasture (kg N/ha/yr)	137	46
Effluent applied (% of farm)	23	50
Effluent applied (kg N/ha/yr)	9	19

4. Standoff plays a role

- For N, by decreasing urine N load on paddocks – less to leach
  - Modelling (Waikato) suggested a 50-50 split between lower N inputs and stand-off
  - May vary with season



- For P and sediment, to protect wet soils from damage and runoff

Conclusions

- Modified farm systems work
- More success with footprint than with $
- Based on known scientific principles
- Many of the tools for managing these systems are available
- Changes are based on incremental advances in science
- BUT (a) a good level of management is needed and (b) still some refinement in some aspects of management to tease out/develop

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What is ‘low N’?

Parameter	Baseline 50 kg N	90 kg N	120 kg N
Pasture yield t DM/ha/yr	15.3	15.6	16.1
Silage fed kg/cow/yr	468	600	708
Grain fed kg/cow/yr	161	111	102
Days in milk	248	251	253
MS kg/ha	1069	1105	1133
N leaching (% of base)	100%	102%	108%