A novel, comprehensive genetic and management initiative to reduce the environmental impact of New Zealand dairy cattle.

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2018 Interbull Meeting, Auckland New Zealand

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New Zealand Animal Evaluation Limited

Government Industry Partnership

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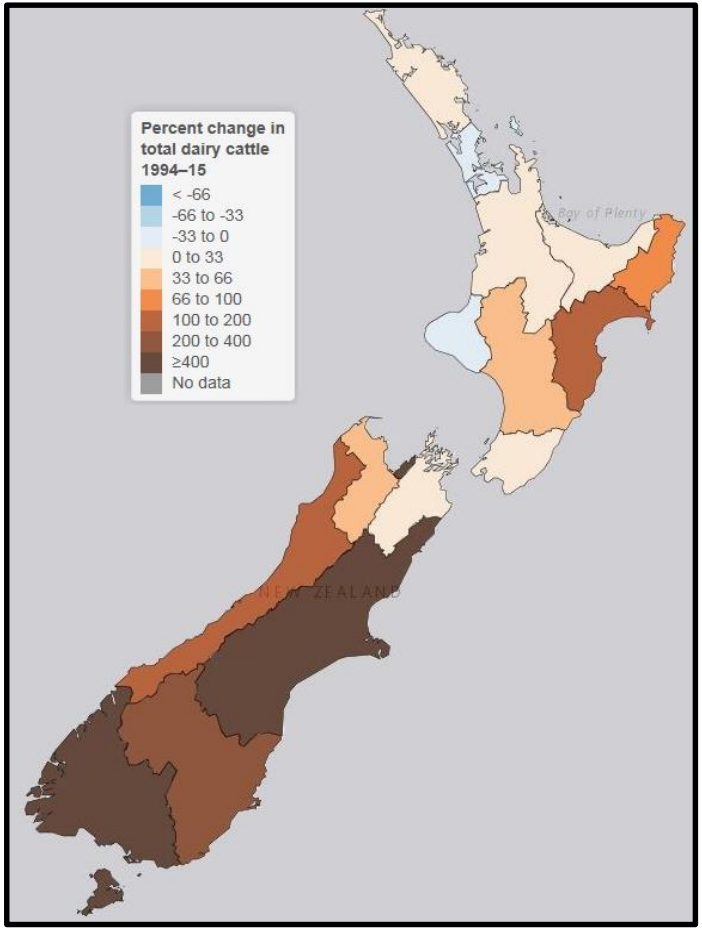
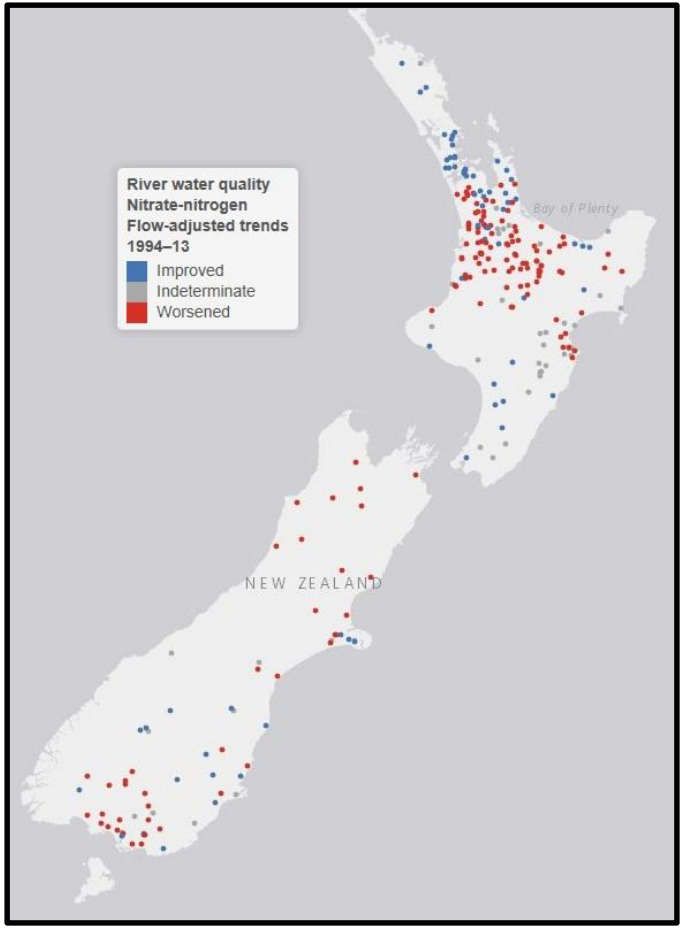
Ministry of Business Innovation & Employment wants impact

This programme will deliver transformational options for dairy and beef farmers to meet environmental targets by:

1. *Developing genetically low nitrogen excreting animals*
2. *Implementing genetic and management strategies to reduce nitrogen leaching*
3. Ultimately, this research partnership will reduce sector-wide nitrate leaching by 20%

Industry growth and water quality





http://archive.stats.govt.nz/browse_for_stats/environment/environmental-reporting-series/environmental-indicators/Home/Fresh%20water/river-water-quality-nitrogen.aspx

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Intense public pressure

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Cows and seep

Dairy farming is polluting New Zealand's water

Government data suggests that 60% of rivers and lakes are unswimmable

Central Government Response

Freshwater National Policy Statement (2014)

- Informs **local governments** about their responsibilities under Resource Management Act
- Directs **regional councils to set objectives** for the state of fresh water bodies and set limits to meet them
- Emphasizes **catchment-level targets** rather than specific on-farm practices
- Full implementation by **31 December 2025**

Regionally variable nitrogen limits

- **Auckland:** N input limits:150kg N/ha/yr on sandy soils, 200kg N/ha/yr other soils
- **Bay of Plenty:** Limits on N and P that can leave a farm property based on a 3 year “benchmark” period (mid-2001 to mid-2004).
- **Horizons:** N limits based on farm’s land use capability (LUC) classification

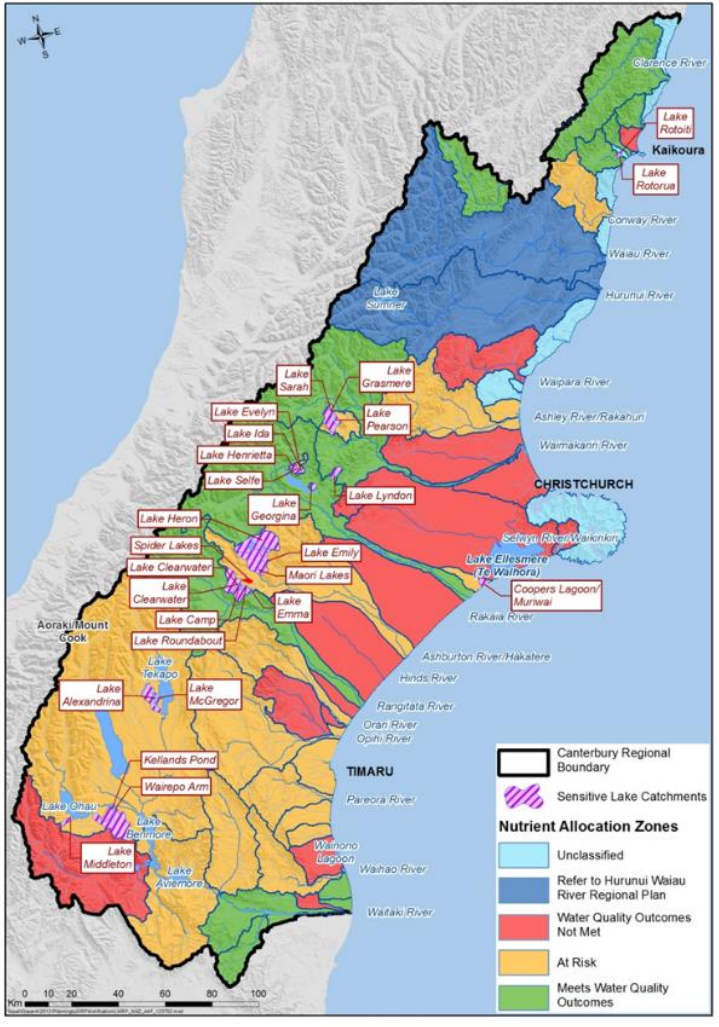
Variation within regions: Canterbury

Nitrogen Baseline 2009-2013 averaged N Loss.

Red - from 2017 need consent and must be at baseline (if over 20kg N/ha/yr).

Orange - Baseline + 5kg N - consent required 2016 (if over 20kg N/ha/yr).

Blue and **Green** – Consent required if increase greater than 5kg N/ha/yr.



Enforcement largely model-based

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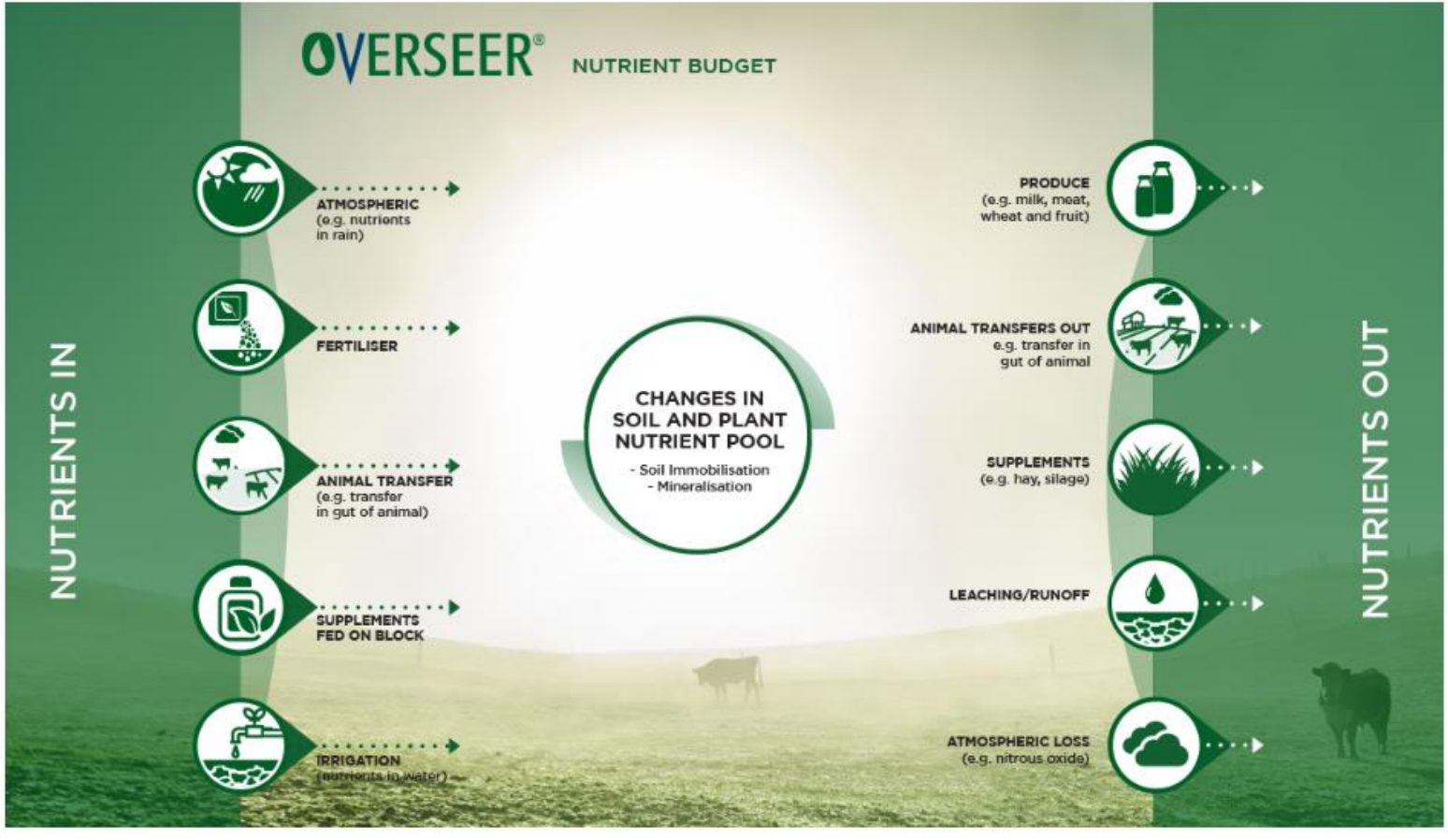
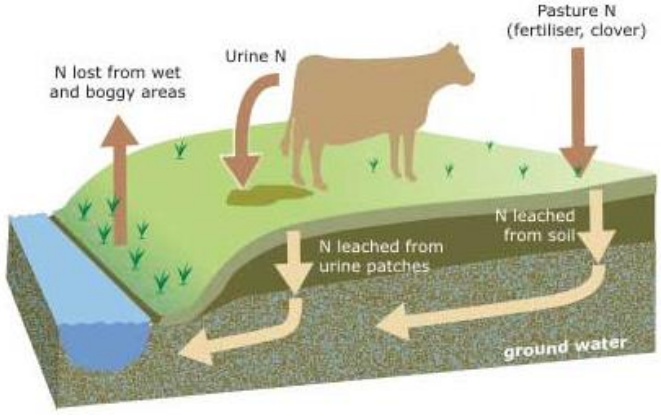
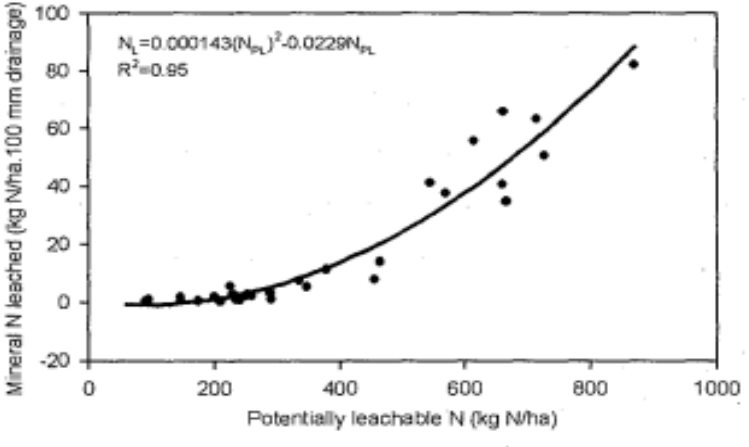


Cow urine important for nitrogen leaching

Urine patches can have1200 kg N per hectare, and plants can't process it all.
(Haynes and Williams, 1993)





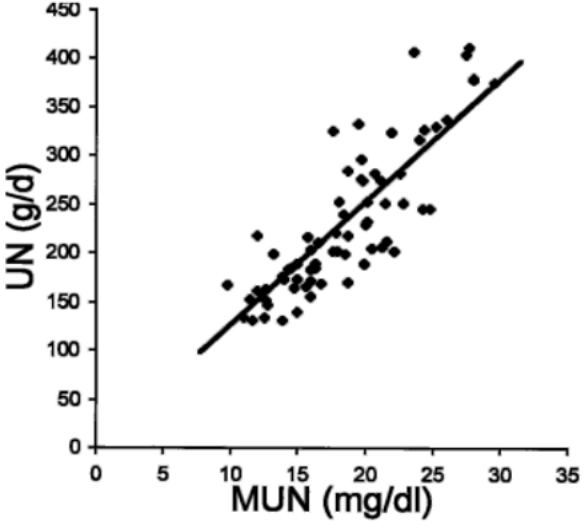
Di HJ, Cameron KC (2000) New Zealand Journal of Agricultural Research 43, 139-147.

Advantages of genetic solutions

- Cumulative and permanent
- Universally applicable (assuming low GxE)
- Infinitely scalable
- No changes to infrastructure or farming practices
- Low cost to farmers once implemented
- Can be “stacked” with management solutions (e.g. alternative pasture plants)

Can milk urea nitrogen (MUN) predict urinary nitrogen (UN)?

1. Ammonia in rumen → b
   passive diffusion to milk
   al., 1993).
2. MUN routinely measure
3. MUN and UN are phenc
   response to dietary [N].
4. MUN is heritable (Beats



Jonker JS, Kohn RA and Erdman RA 1998. Using milk urea nitrogen to predict nitrogen excretion and utilization efficiency in lactating dairy cows. Journal of Dairy Science 81(10), 2681-2692.

Key technology: automated urine sensors

Developed by AgResearch

Continuously-recorded individual-level data for UN, urine volume, and urination frequency in feed stalls or while grazing

M.Shepherd, P.Shorten, D.Costall, K.A.Macdonald (2017) Agriculture, Ecosystems & Environment 236: 285-294

Research Aims

'Knowing is not enough; we must apply. Willing is not enough; we must do.'

- Johann Wolfgang von Goethe

1. **Genetics, genomics, physiology, and omics to enable selective breeding**
   - Quantitative genetic and genomic analyses in representative "Development Herds"
   - Physiological and -omic comparisons of phenotypically divergent animals
   - Develop new animal evaluation models
2. **Validation, demonstration, and adoption to achieve national water quality outcomes**
   - Develop practical breeding strategies & economic values
   - Validate mitigation strategies at the whole-farm and catchment levels
   - Develop enhanced models for sensible regulation

7-year Programme

Questions?

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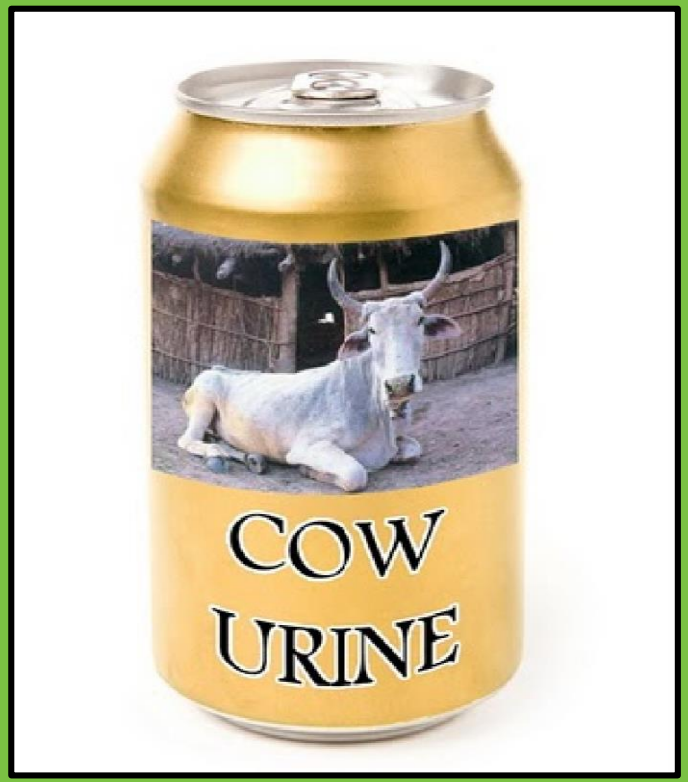

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