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Reflections of a scientist

Derrick Moot

New Zealand's specialist land-based university

Changes over 20 years in research

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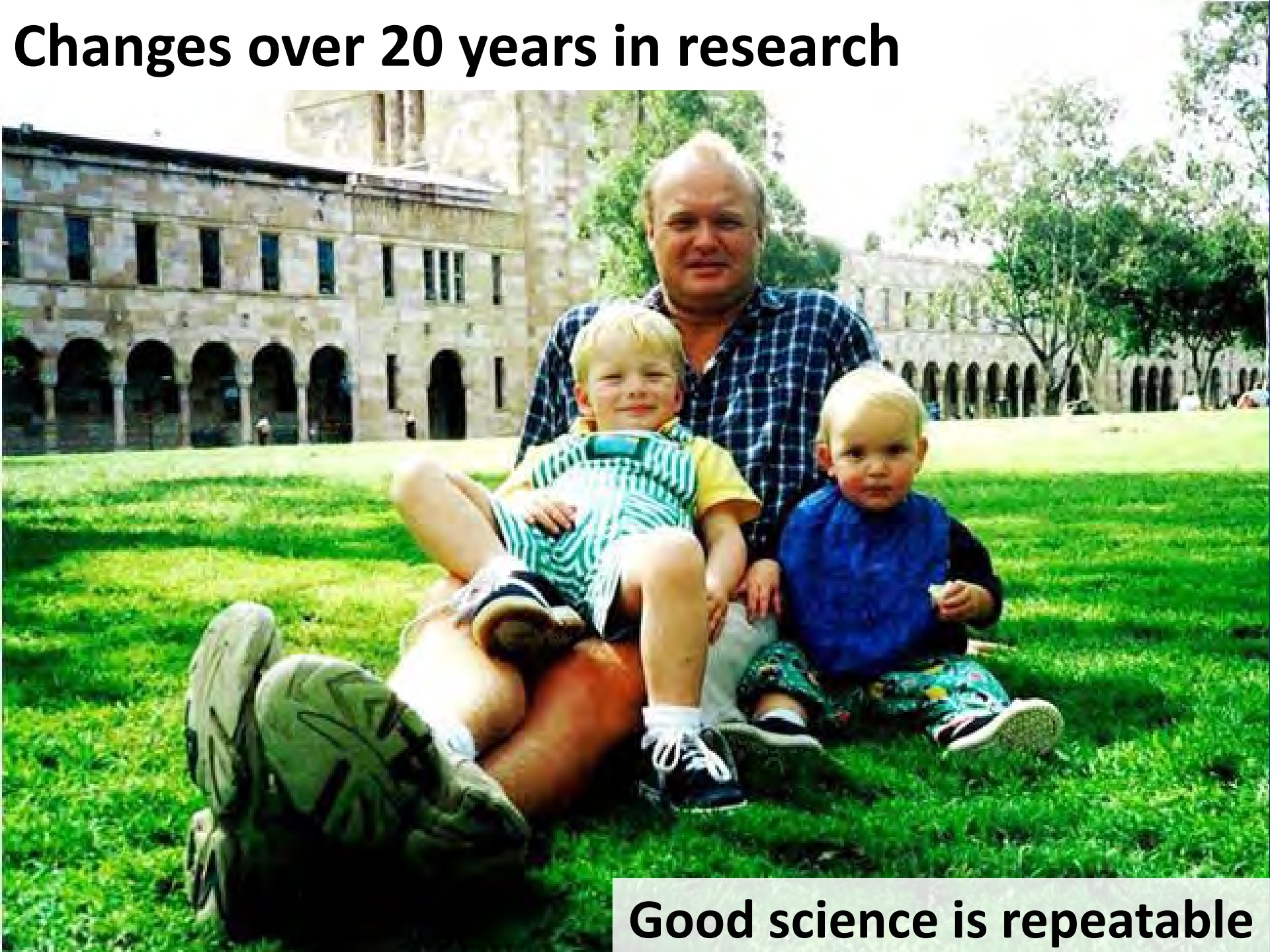
Farmers no longer trusted as guardians of our land

- Dairy dominates the conversation
- Industry leaders = wrong side of science debates
- Scientists silenced by CRI reforms
- Minimal funds for 'public good' applied research
- Market failure for sheep and beef farmers
- Biotechnology – yet to deliver in the field
- Forestry – the saviour?

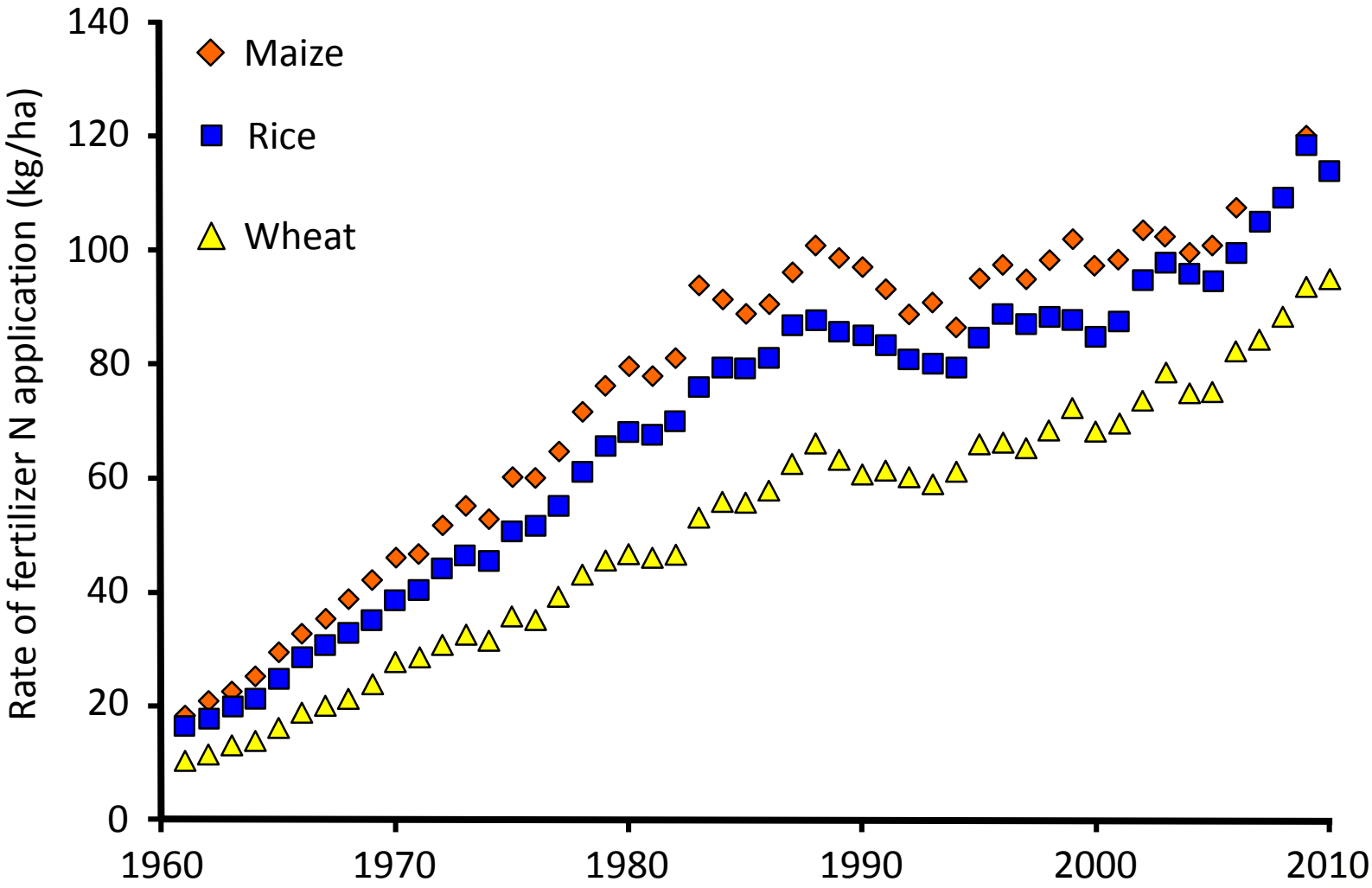
Changes over 20 years in research



Good science is repeatable

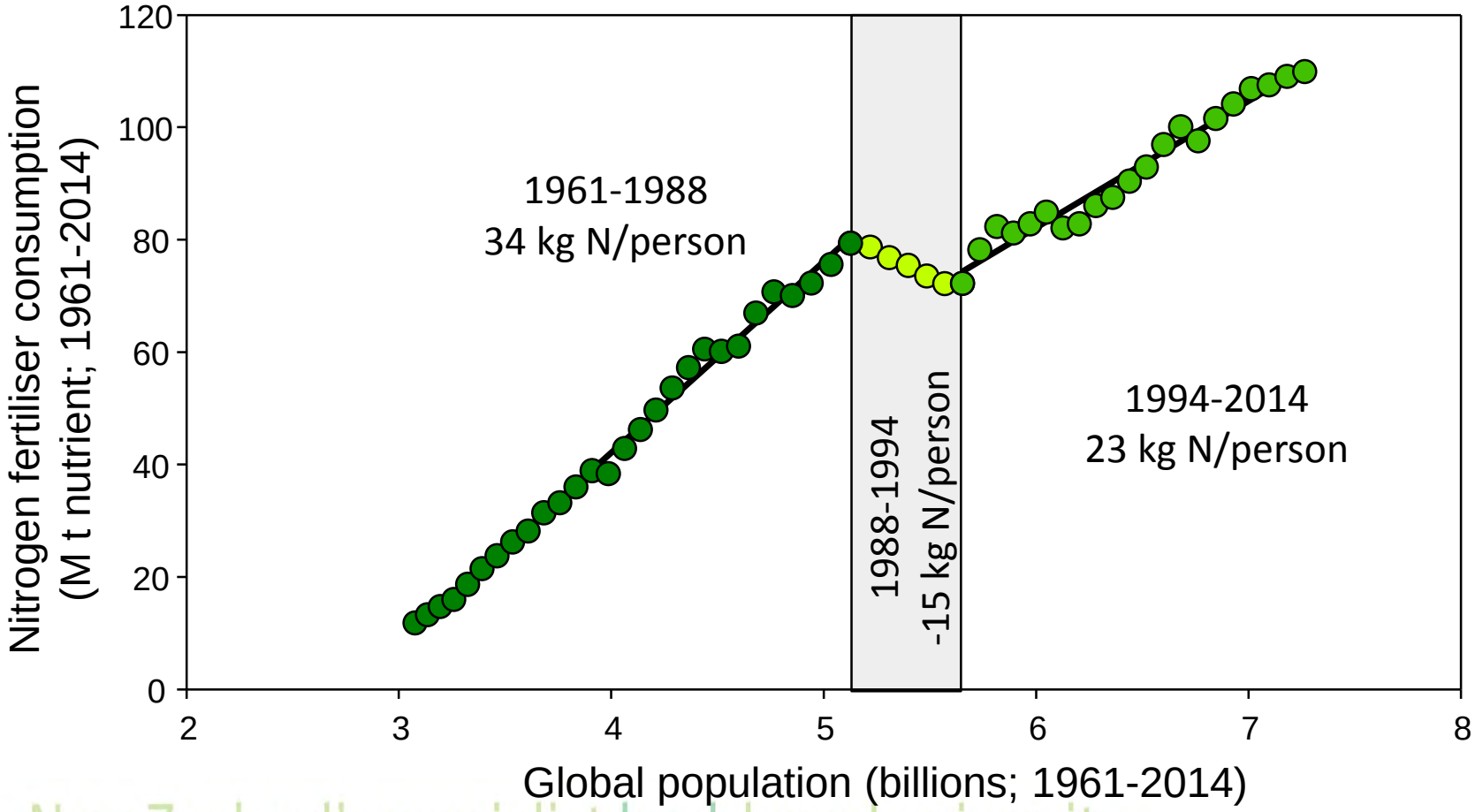
Reflections

Average global N fertilizer application rates in maize, rice, & wheat



Ladha *et al*. 2016

Global N fertiliser use



This graph contains data sourced from FAOStat (global population) and IFAData (International Fertilizer Association; Total N consumption)

Dryland lessons for Canterbury dairy ?

Water and nitrogen = ryegrass

(230,000 ha irrigated dairy)

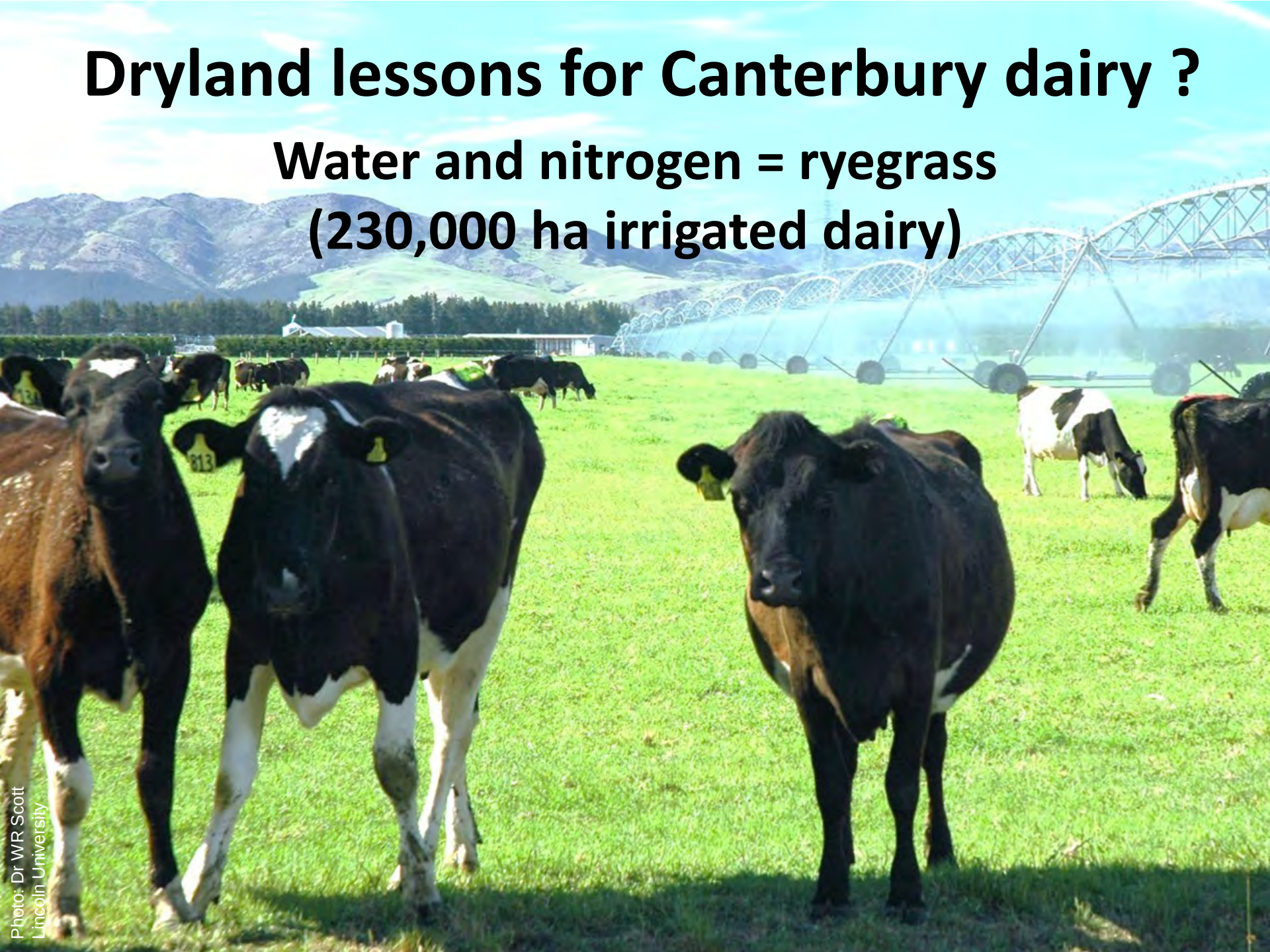
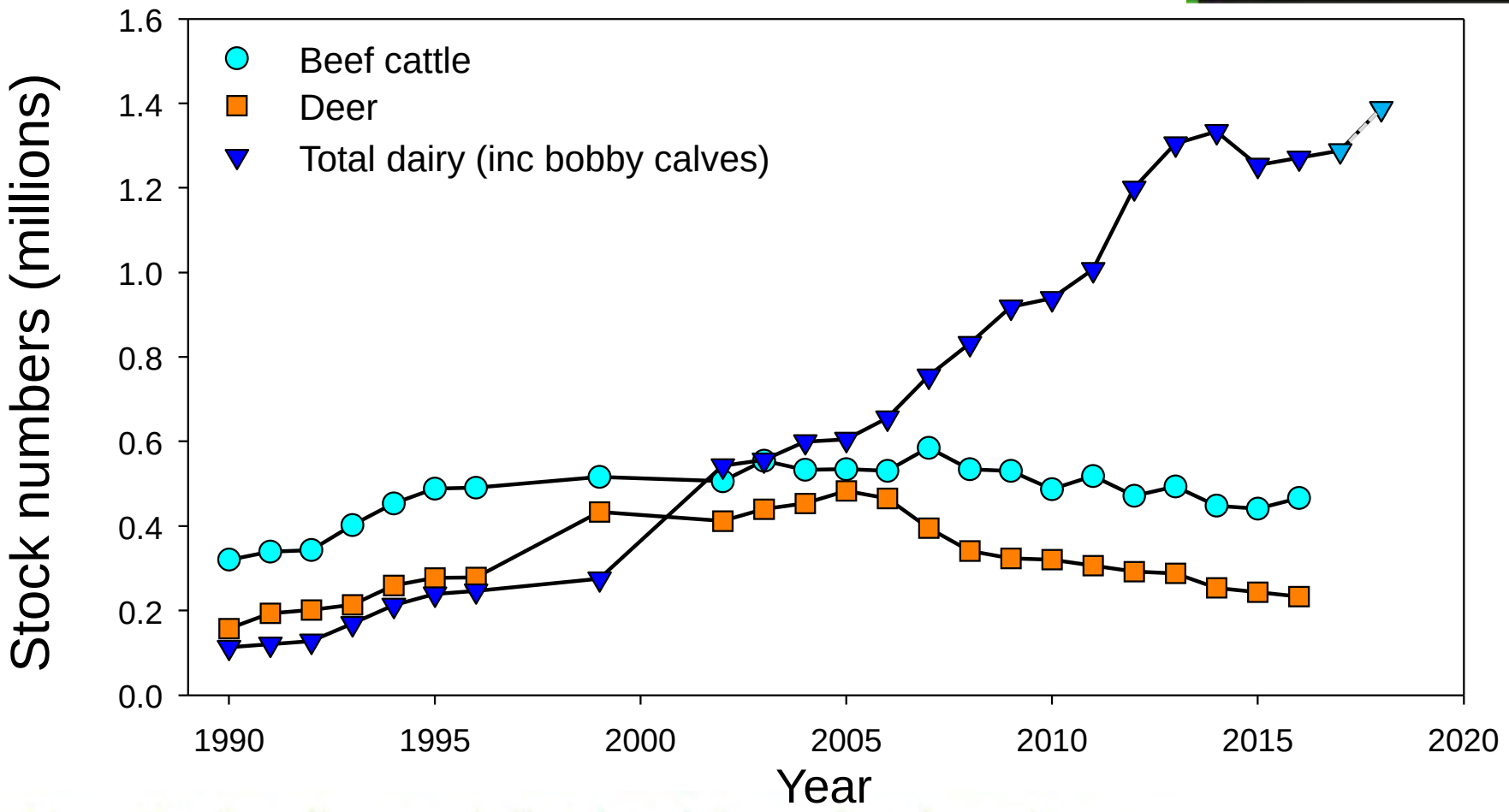


Photo: Dr WR Scott
Lincoln University

Current Canterbury Dairy Pastures

- Ryegrass based
- Stony shallow soils
- Urine into ground water
- CPW limits on N leaving
- Stocking rates 3.5 cows/ha

Deer & cattle numbers in Canterbury



Moot *et al.* 2010: Department of Statistics 2016

Photo: DJ Moot
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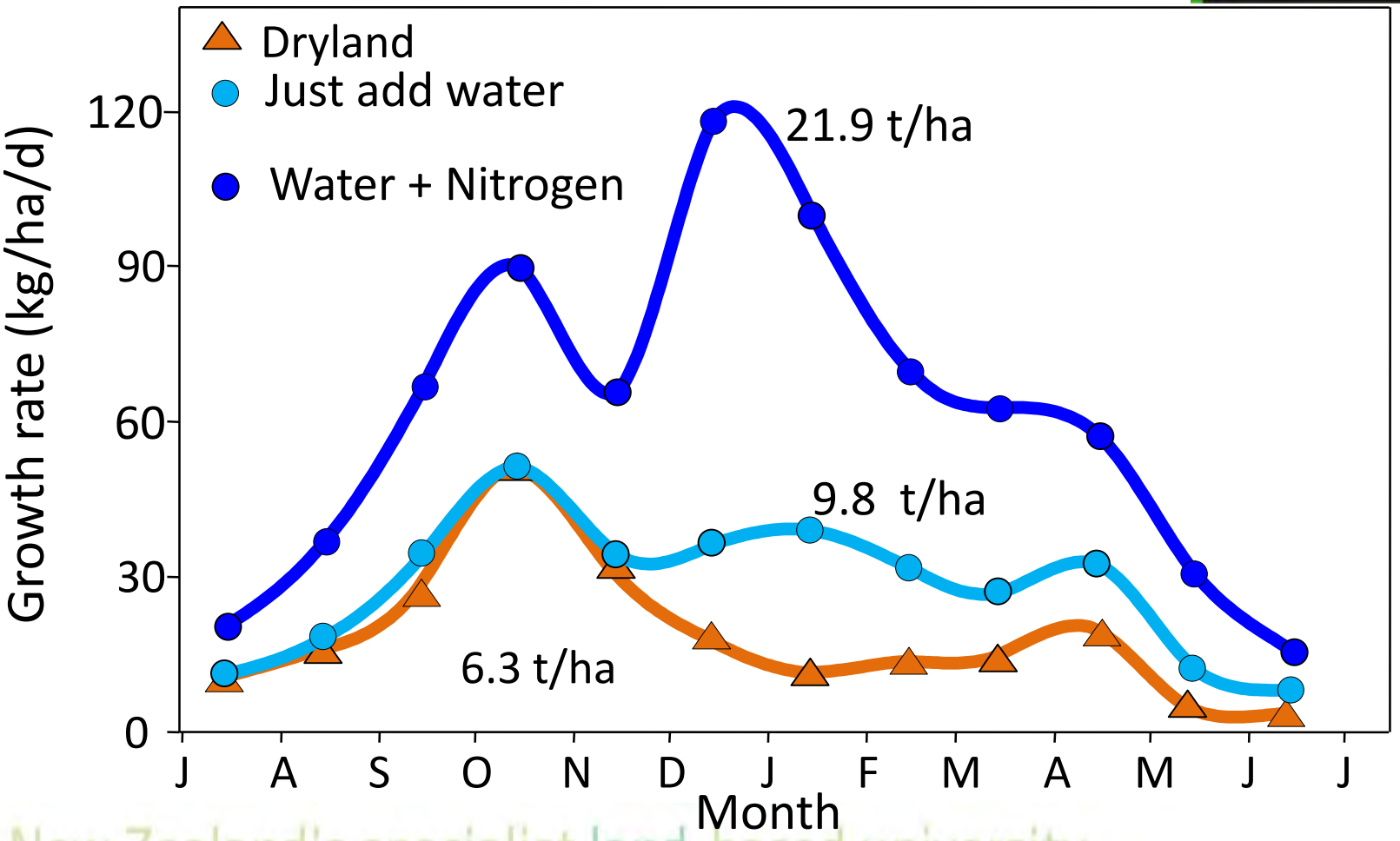
Growth rates (2 year means)



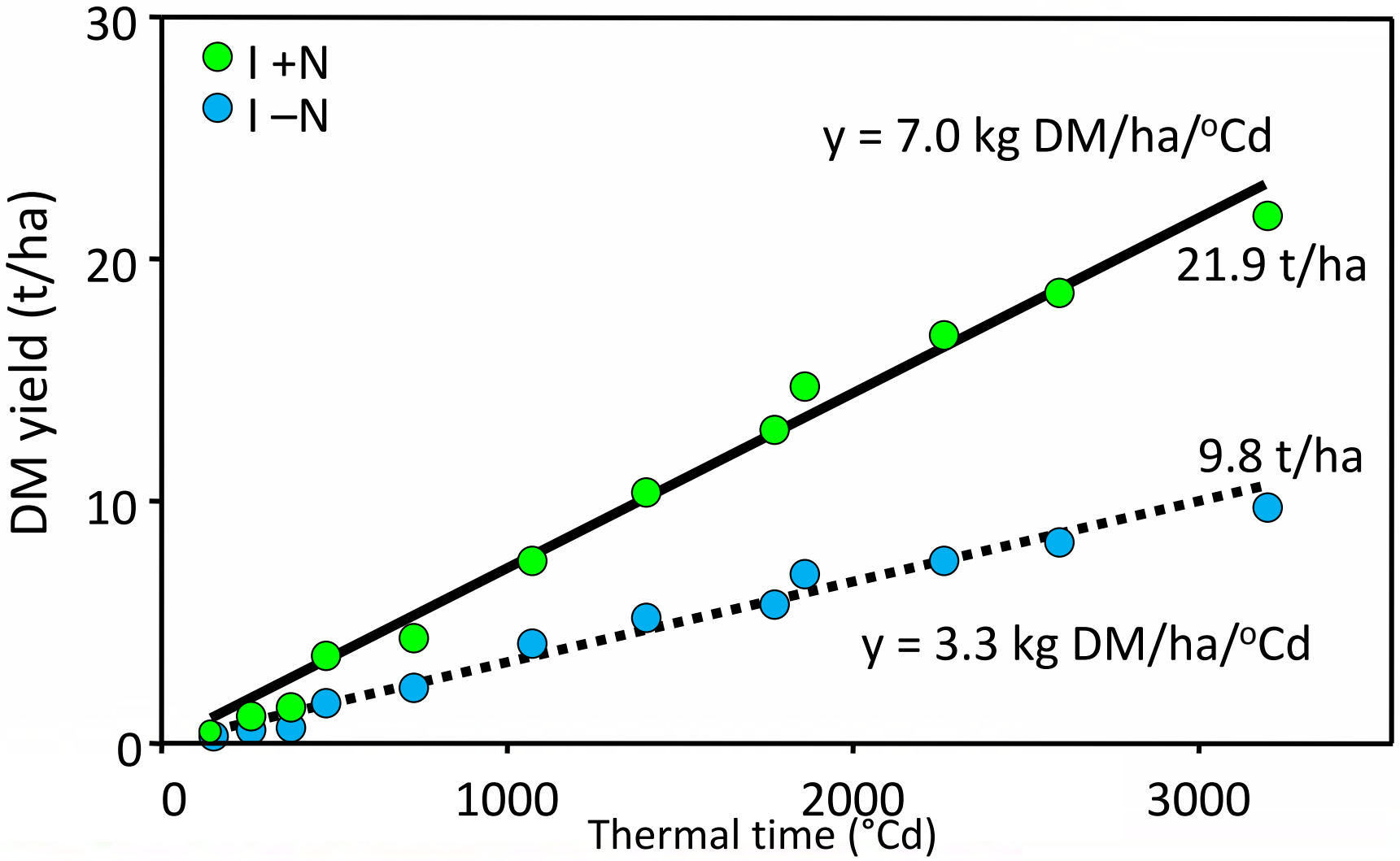
Mills *et al*. 2006, 2009

Winter

⇒ temperature response

Photo: KM Pollock
Lincoln University

The Nitrogen gap



Mills *et al*. 2006; 2009

Nitrogen dilution curve

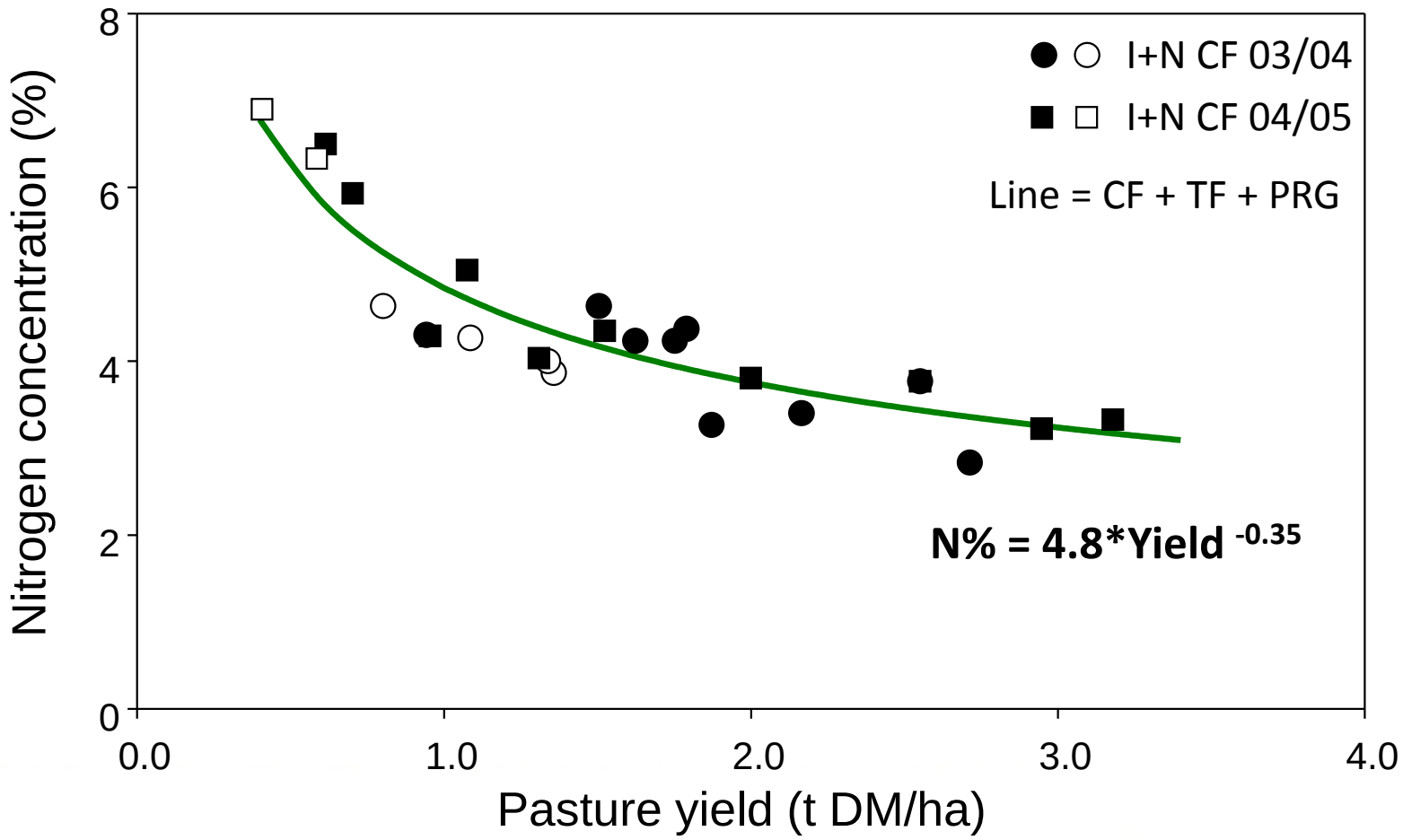
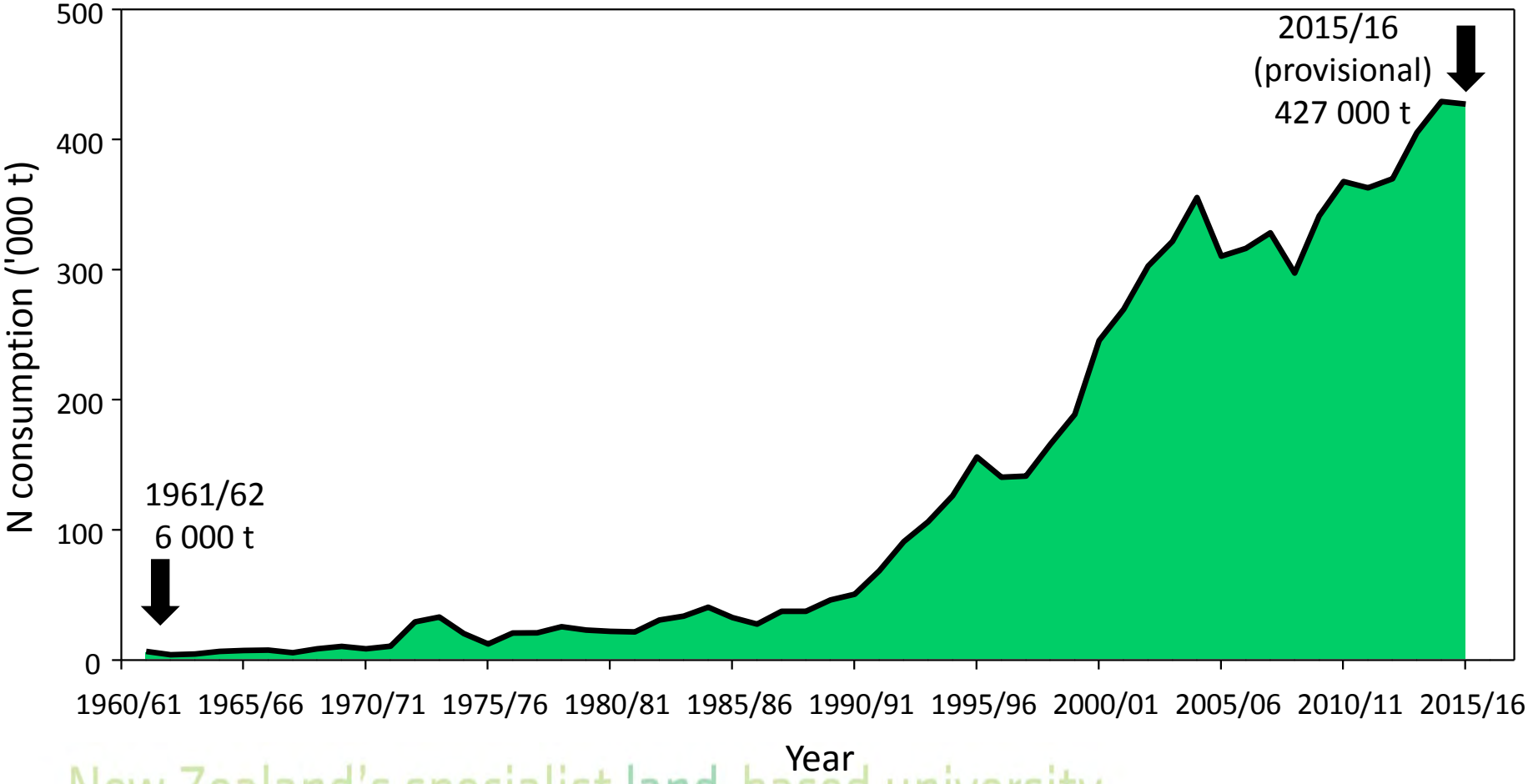
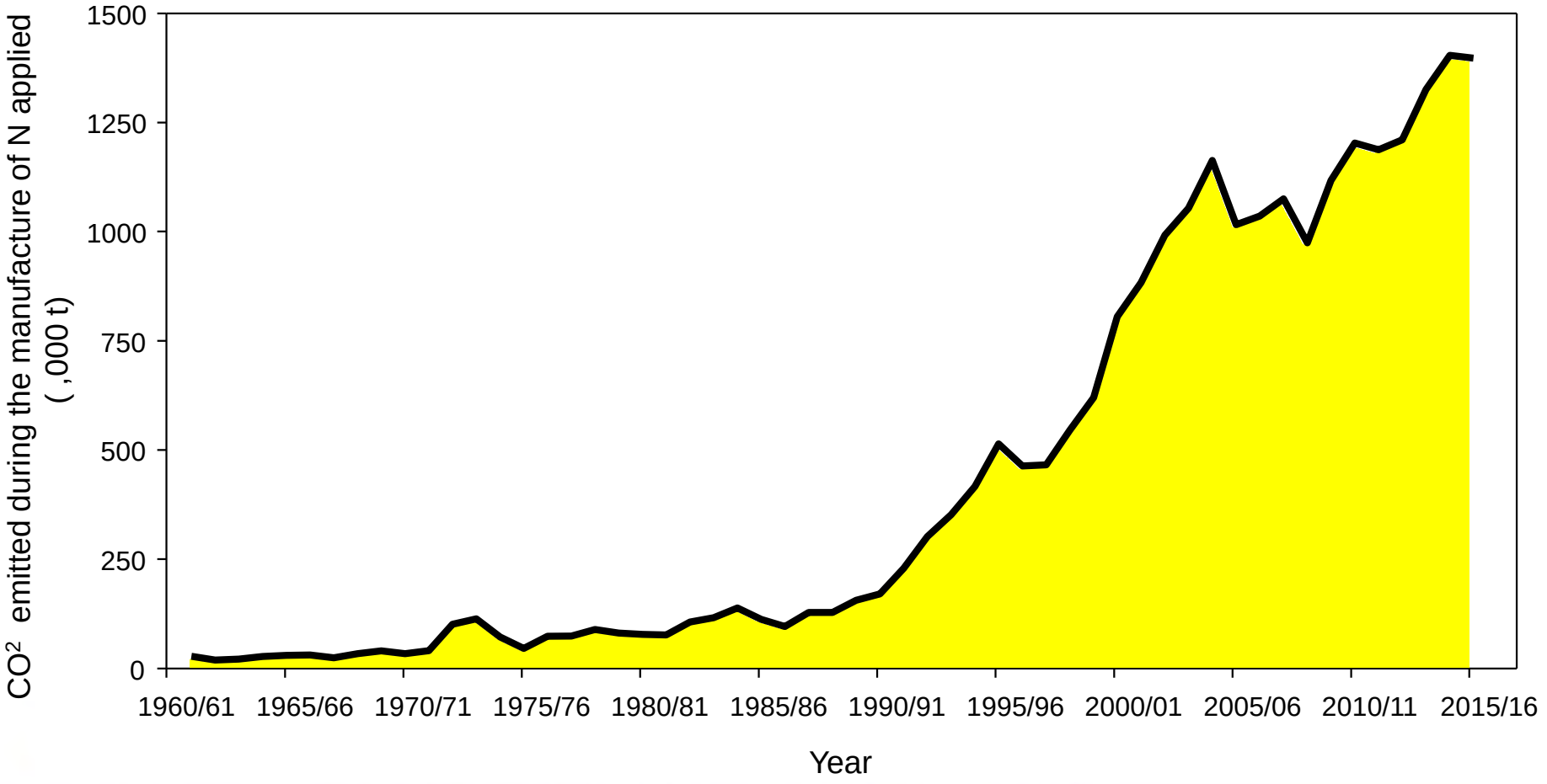


Figure incorporates data from Mills 2007, Lemaire & Salette 1982, Soussana *et al*. 1996

Nitrogen applied in NZ

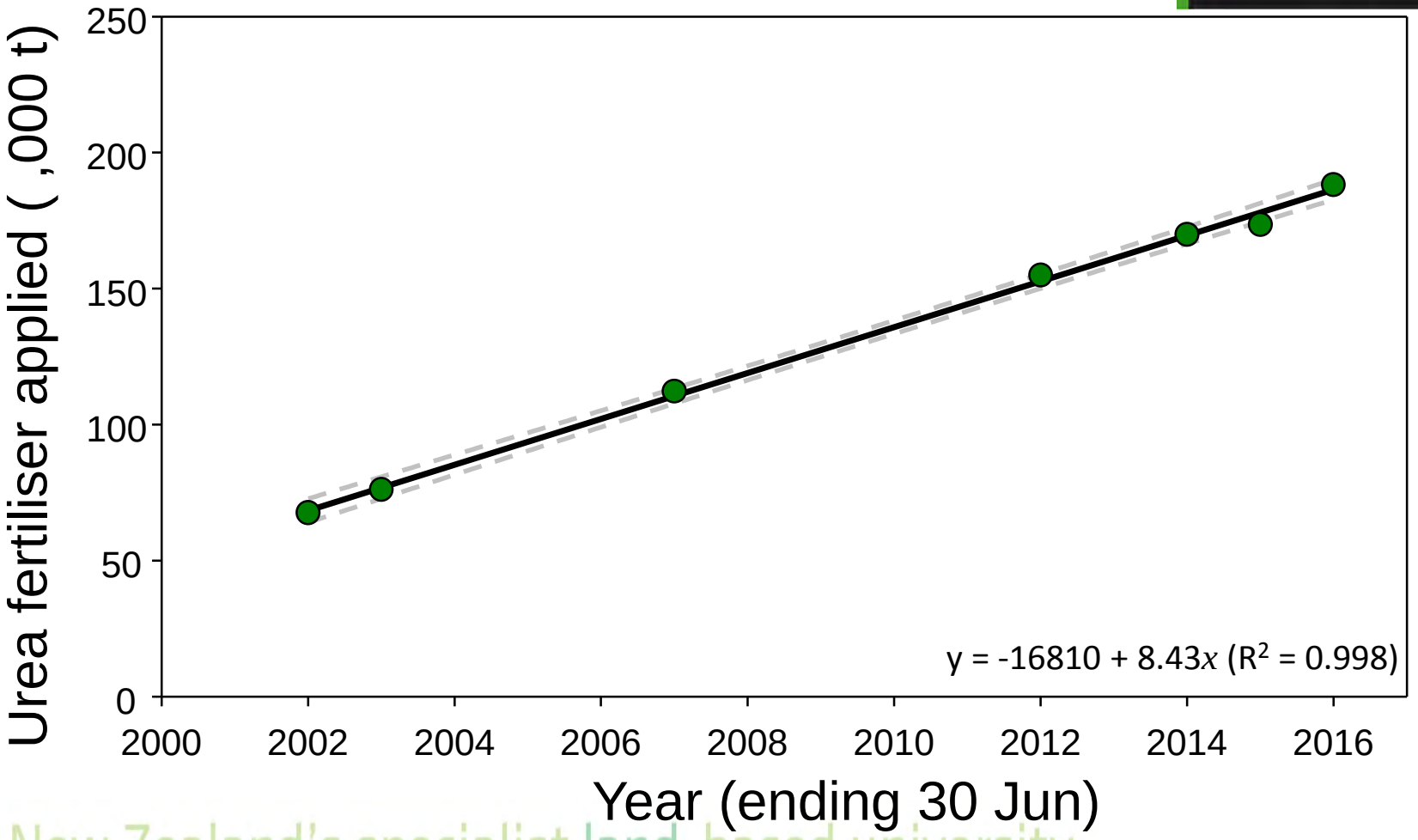


CO_2 emissions generated in the production of N fertiliser

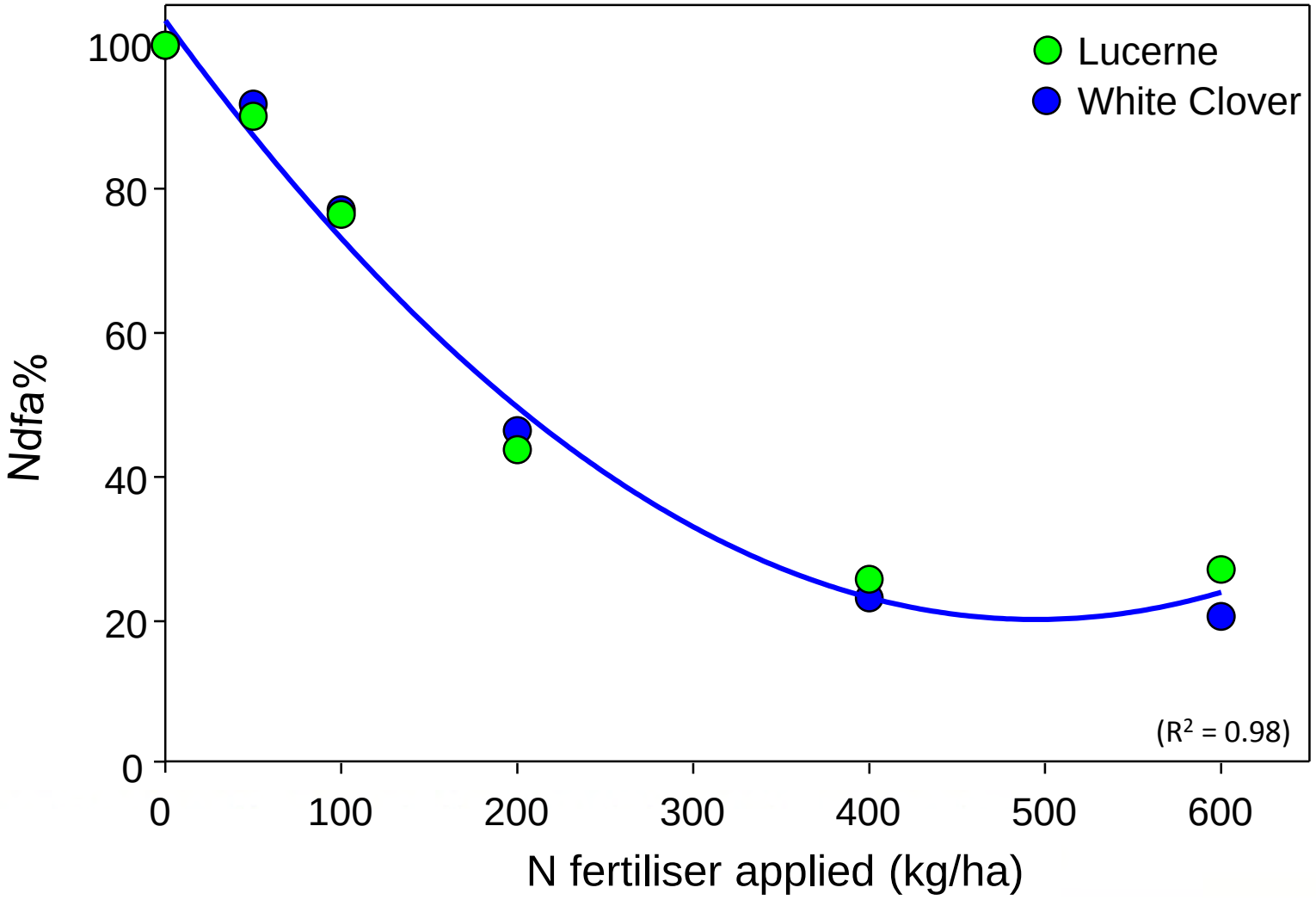


Based on Saunders *et al*., 2006 & Wells 2001 assuming all N consumed in NZ was manufactured using natural gas (including imported N fert)

Urea use in Canterbury



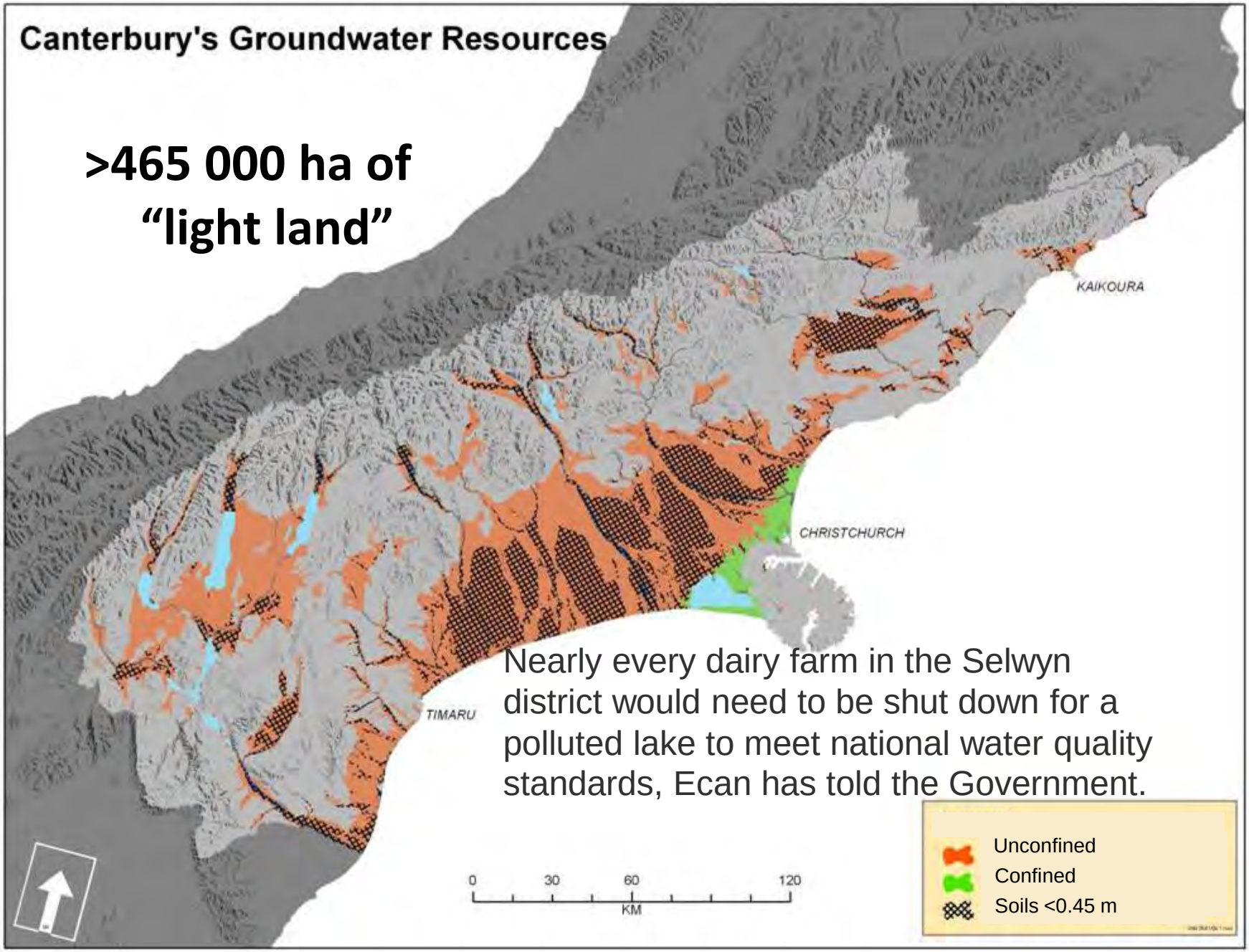
Contributions from BNF



Ryan-Salter unpublished

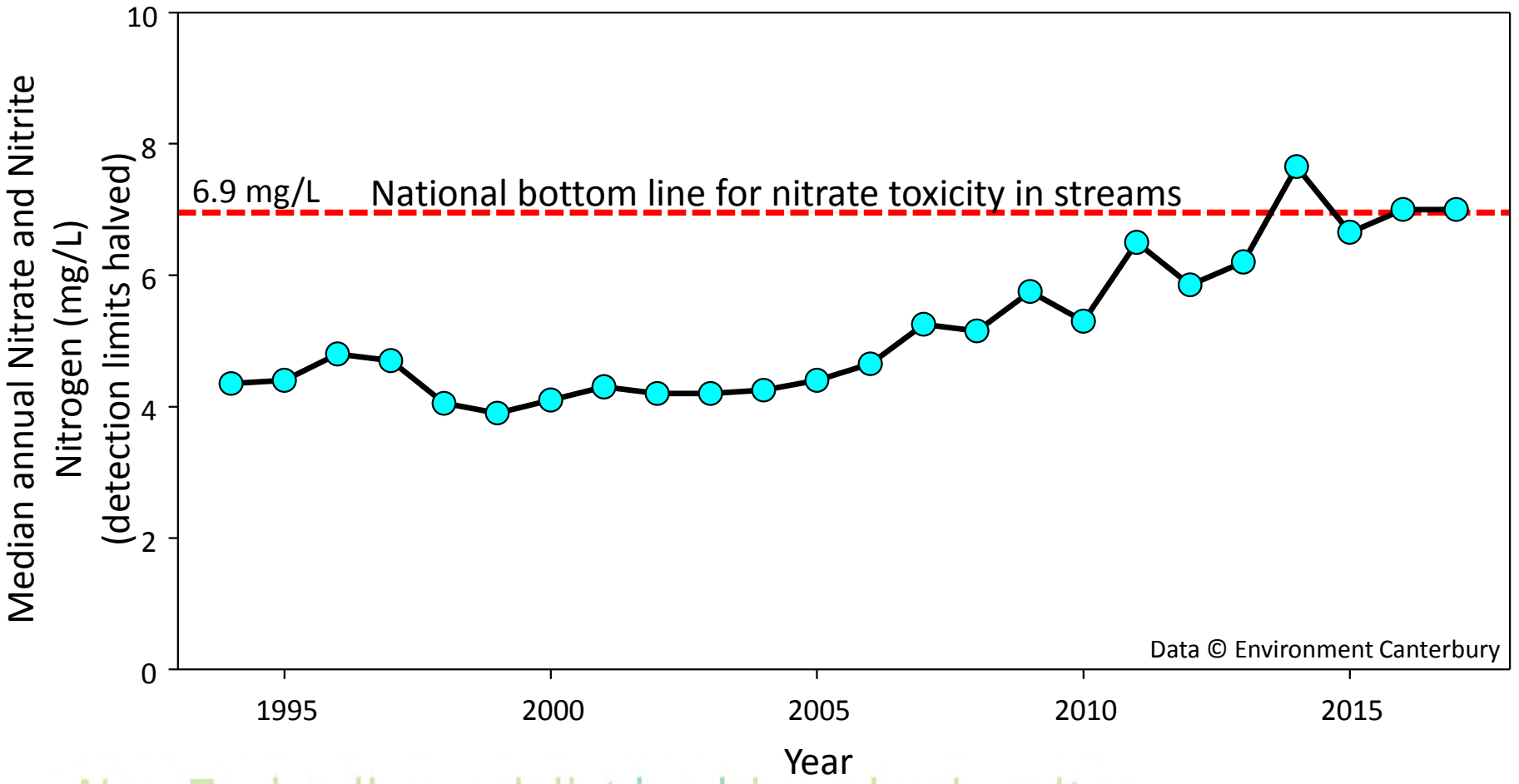
Fenced water ways, large herds – N deficient pastures

Photo: DJ Moot
Lincoln University

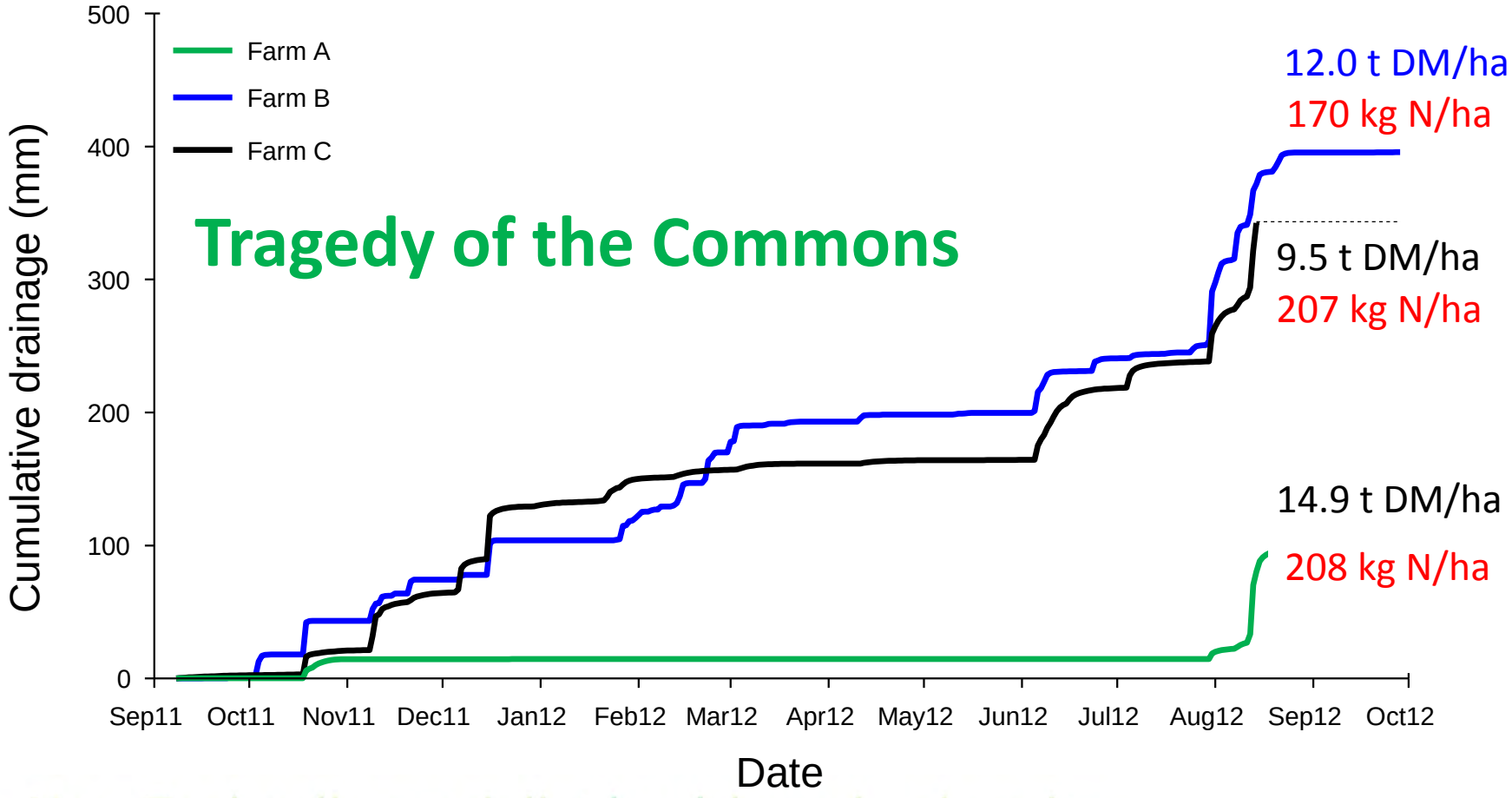


Source: Ken Taylor ECan

Nitrate + Nitrite measured at Harts Creek, Canterbury

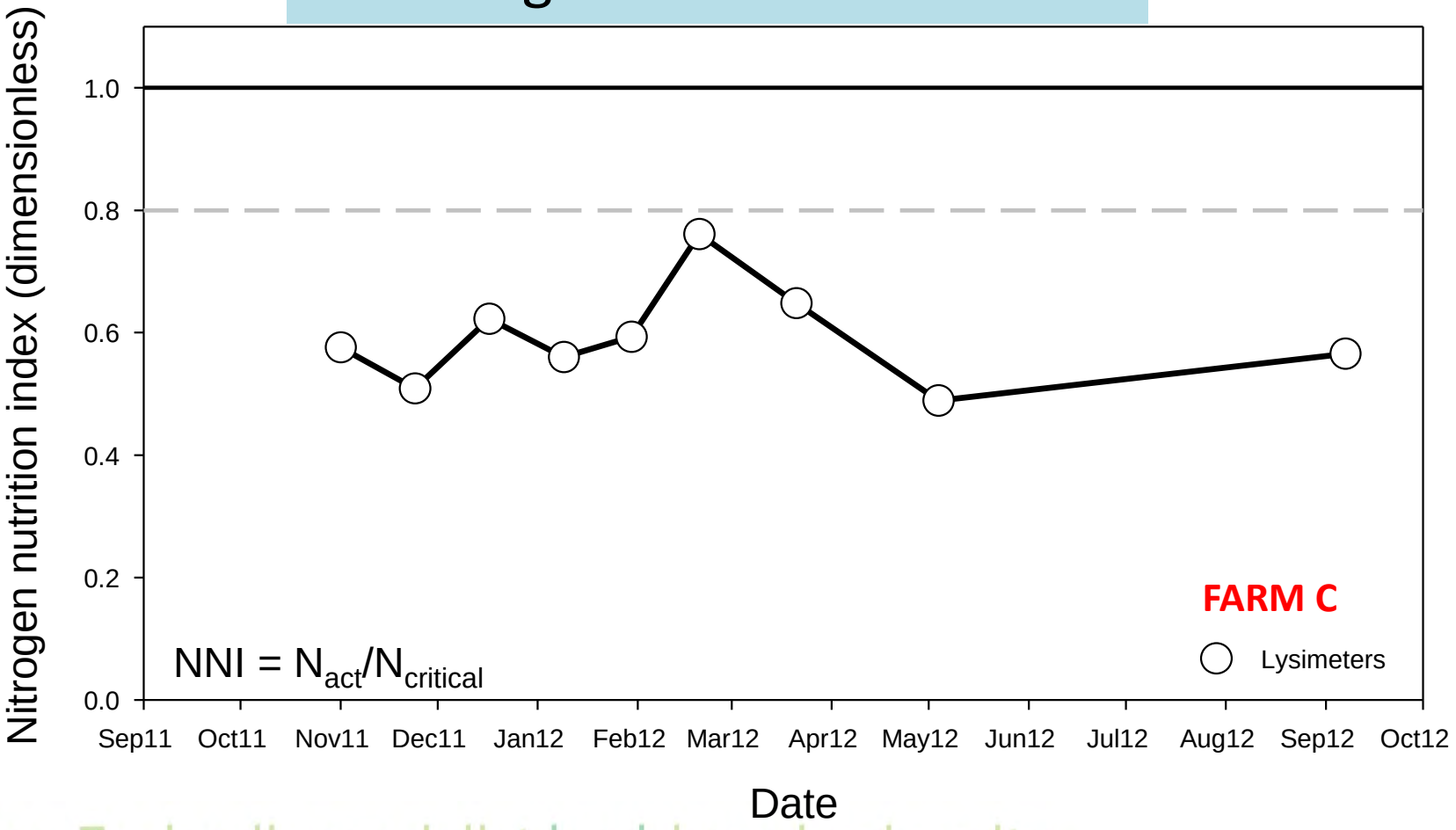


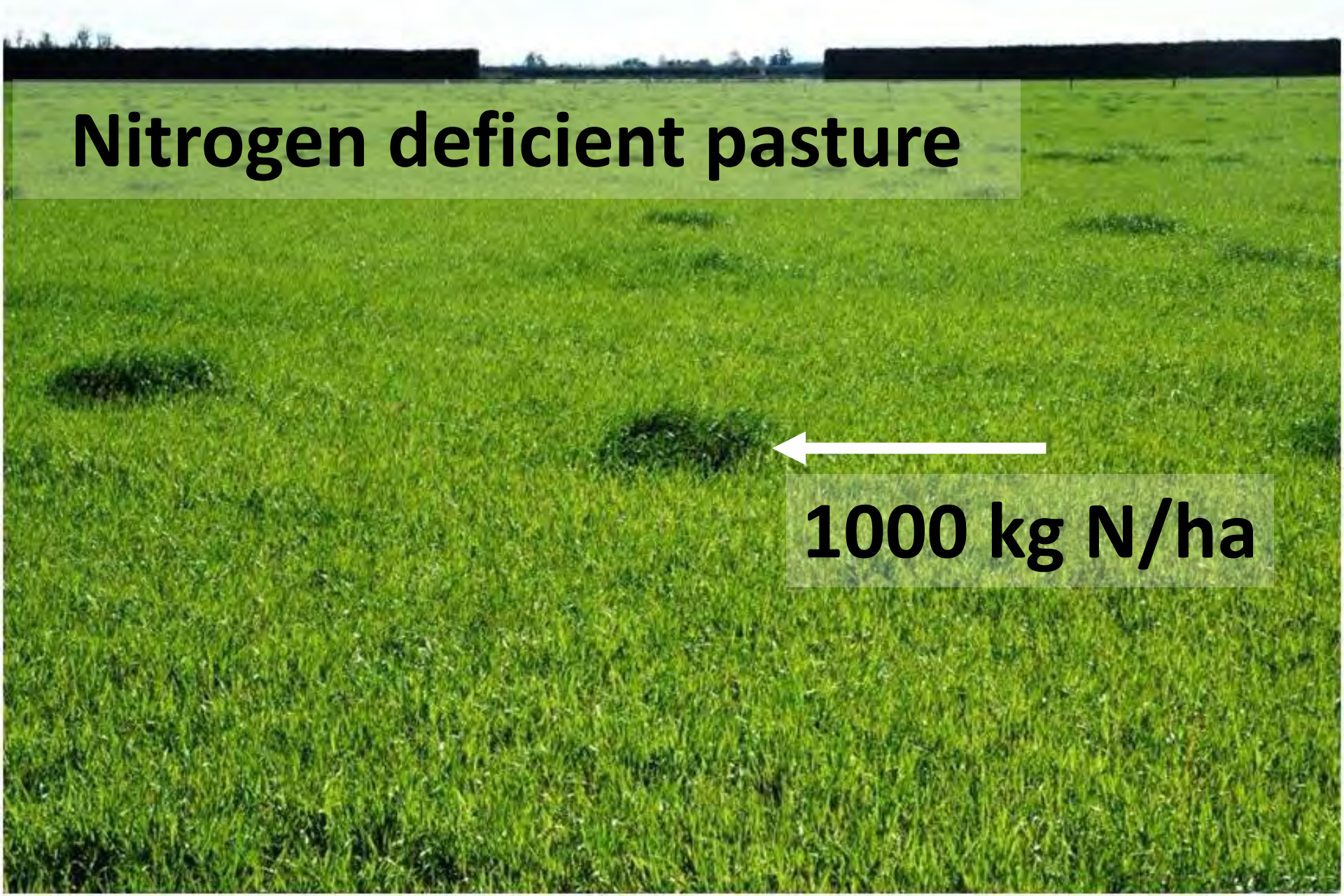
Cumulative drainage (mm)



Nitrogen nutrition index

Over irrigated under fertilized




Nitrogen deficient pasture
1000 kg N/ha

Future dairy pastures

- Farm environment plans
- Levy on irrigation water used
- Mandatory soil water budget for irrigation events
- Levy on nitrogen fertilizer – ETS
- Levy on methane emissions – ETS
- CPW (200 kg N/ha)
- Divergent systems – low (≤3.0 cows) vs high (4+ cows)/ha

System 1 – high legume low SR pasture fed cows

Tall fescue, red and white clovers 29 August 2017
“keeps growing under water restrictions”

Irrigated red clover

Photo: DJ Moot
Lincoln University

Dryland dairy grazing lucerne

October 2016 ***"once on lucerne - 2000 litres extra milk overnight"***

Changed irrigation management

Photo: DJ Moot
Lincoln University

Mandatory catch-crop?

Photo: DJ Moot
Lincoln University

System 2 = Higher SR, heavier cows

Nutrients carried on and off farm = US indoor systems

Cereals – total mixed ration

System 2 – High SR – housing or partial housing

Photo: DJ Moot
Lincoln University

Requirement = Overseer for lucerne

Photo: DJ Moot
Lincoln University

Photos: Richard Cookson

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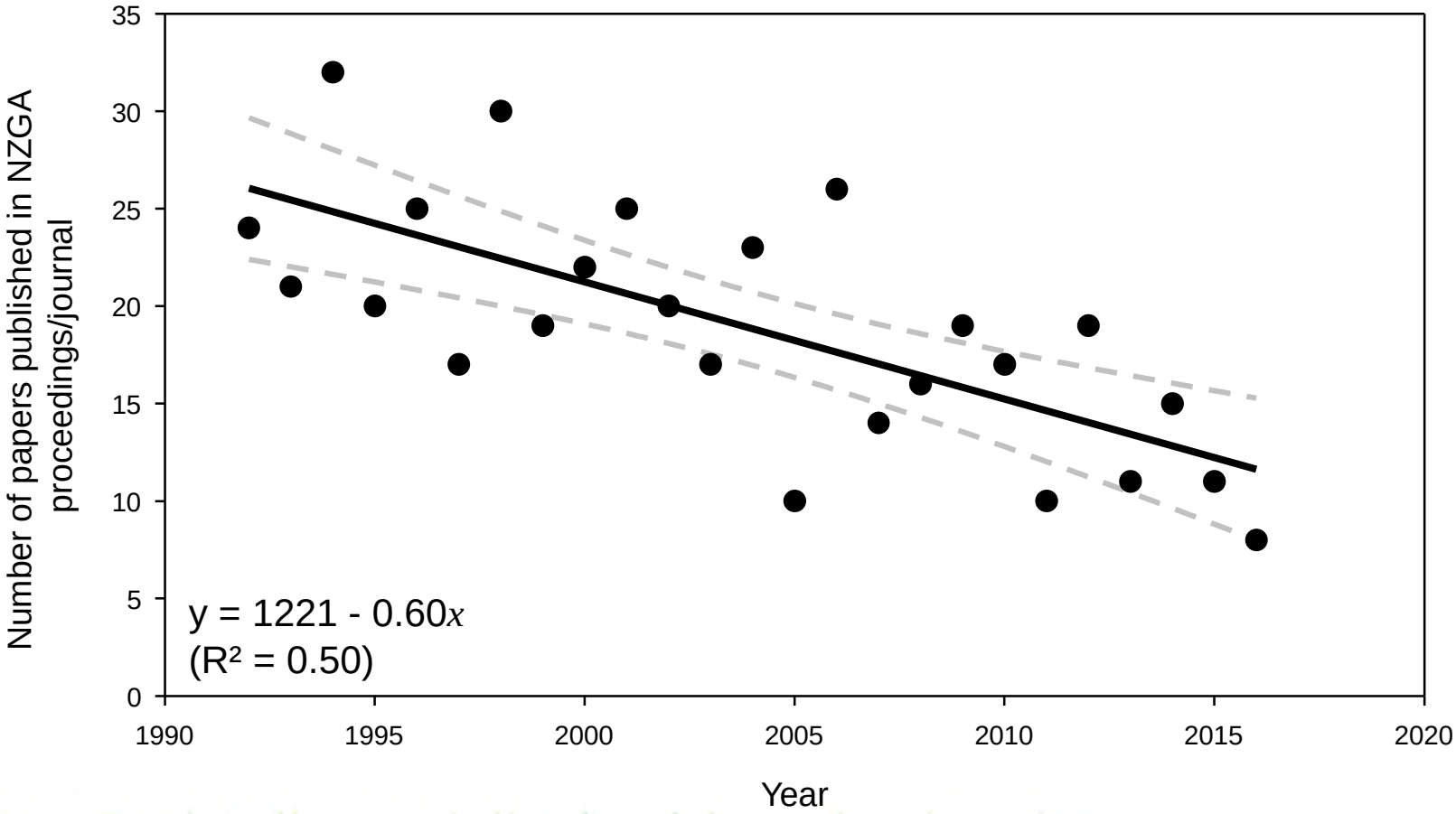
Science or “fake news” to lead the 21st Century?

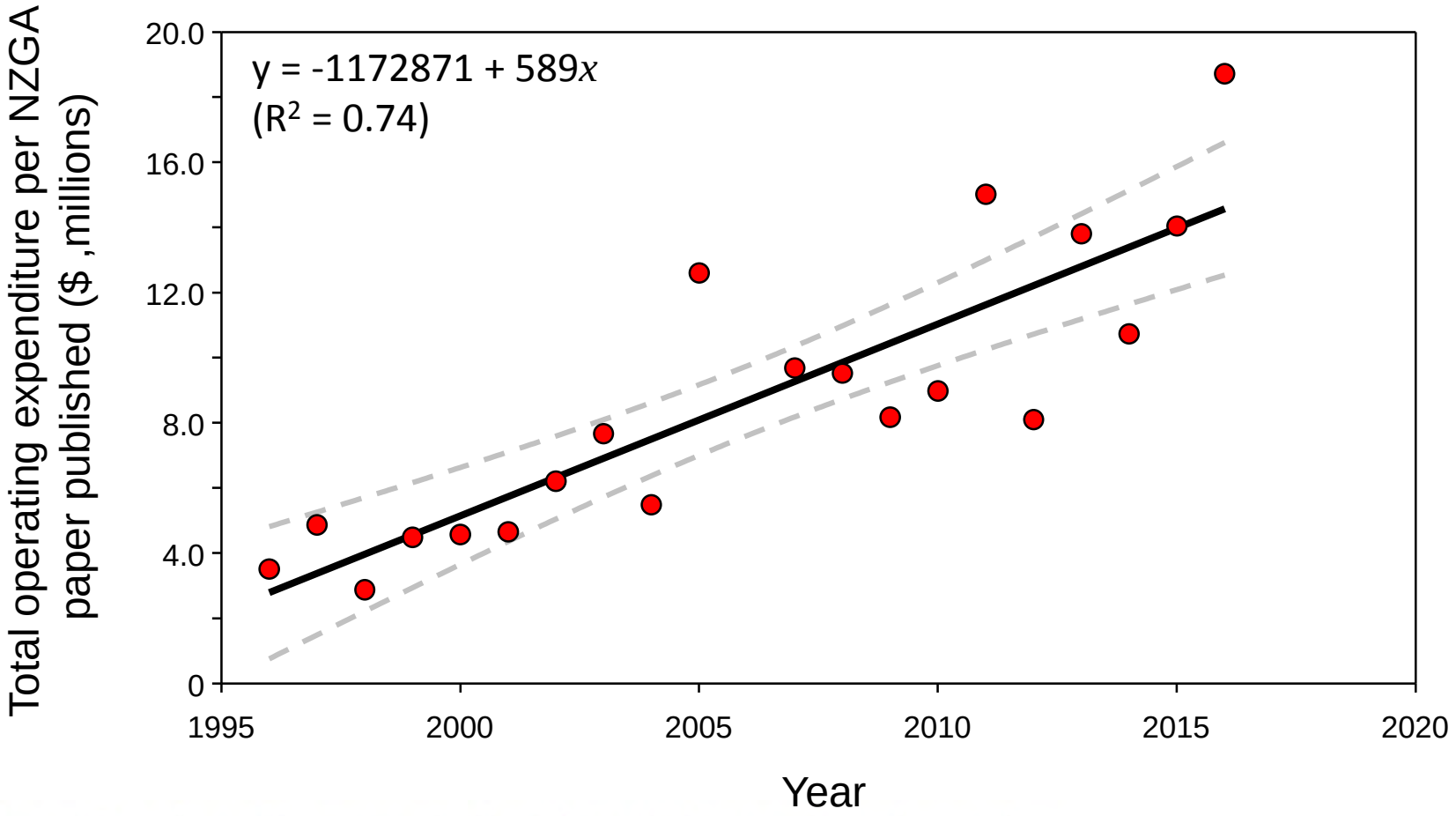
Photo source: http://clearthinking.co/the-teleconference-before-the-challenger-disaster-how-the-thinking-shifted/

The people who know how things really operate are always at the bottom of these organizations

AgR lead author NZGA publications



AgR expenditure per NZGA paper



Drought tolerant cisgenic® ryegrass in the Biotron

Biotechnology has failed to deliver

Photo: Pastoral Genomics

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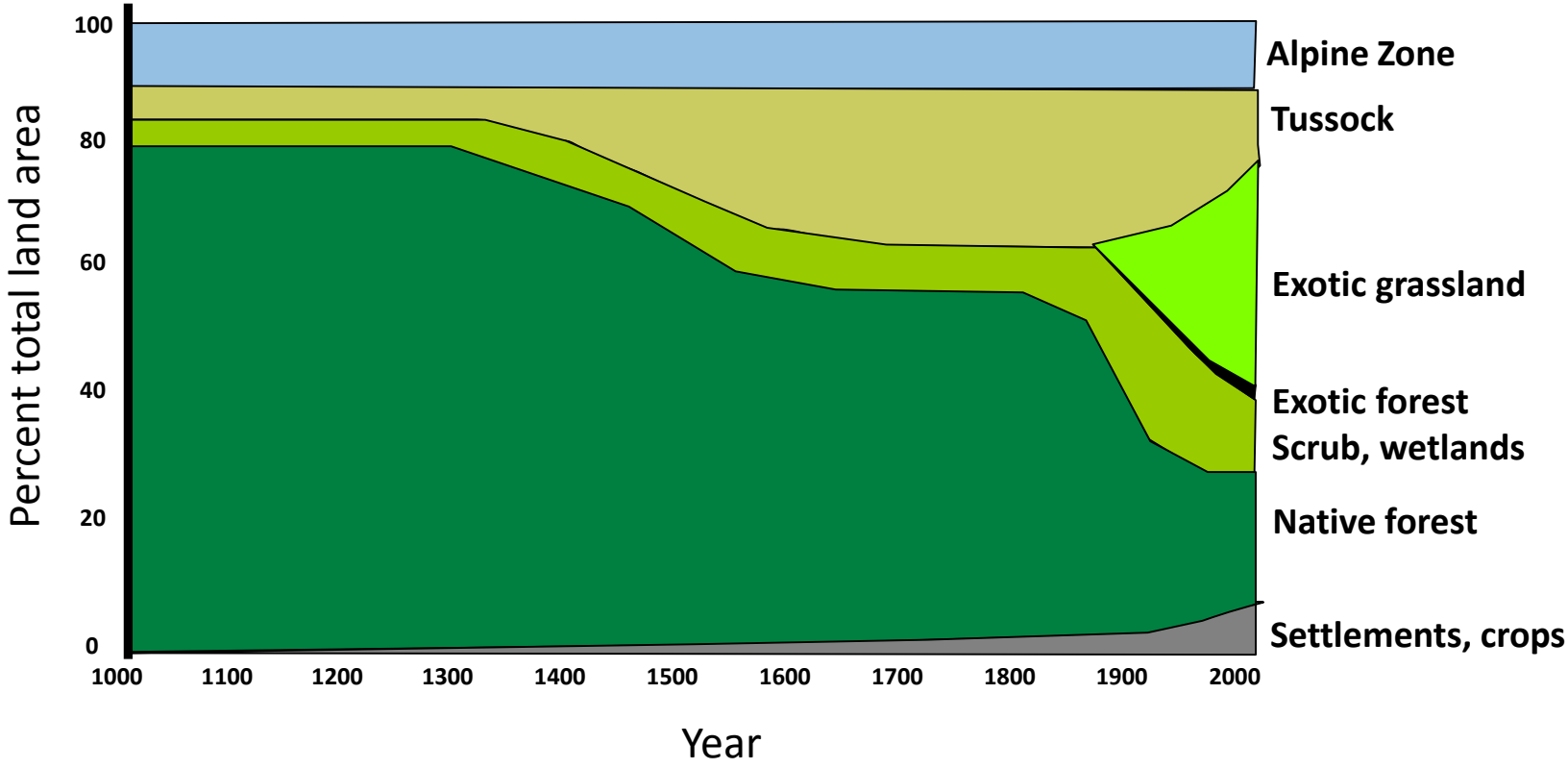
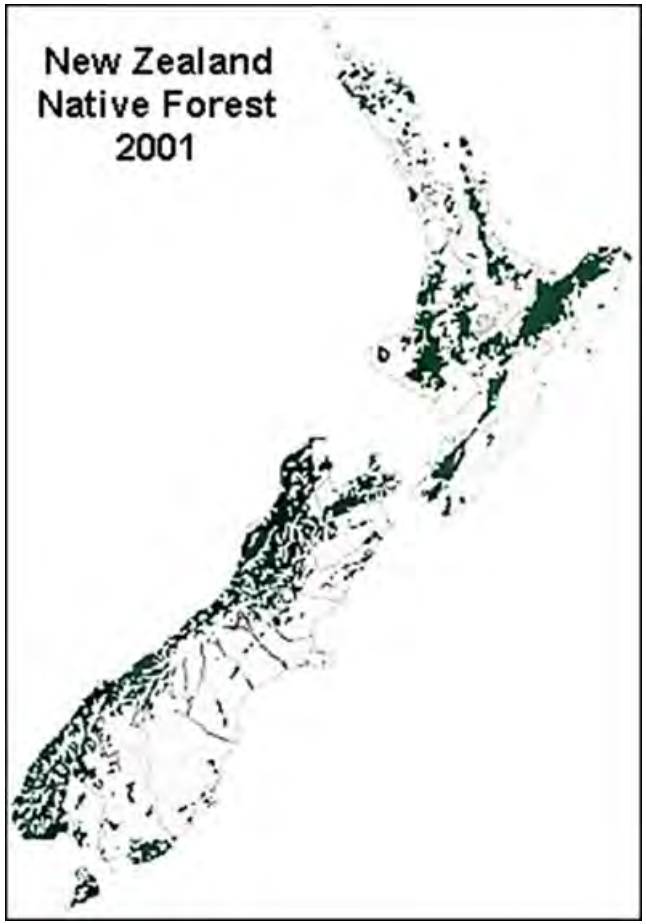
Historical land cover in New Zealand



Ministry for the Environment 1997

NZ Forests 1000-2001



Ministry for the Environment 1997

Farming everywhere?

Forestry = frontier activity

- **Agriculture/horticulture "highest and best" land uses**
  - Arable land
  - Lowlands
- **High altitude land**
  - Steepland
  - Soil erosion, infertile soils
  - Climate limitations
- **"Frontier" of sustainability for conventional agriculture**
- **What happens to Wairoa?**

Frontier of sustainability

Photo source: stuff.co.nz

Frontier of sustainability

Photo source: stuff.co.nz

Photo source: stuff.co.nz

Saviour or Sinner for Wairoa?

Conclusions

- Nitrogen feeds and pollutes the world
- Biology cannot be fooled
- Sustainable legume based systems exist!
- Regulation – more is coming
- Clean/synthetic proteins = opportunity/the end or Ag
- Forestry = a problem or a solution?
- Science is needed to answer the questions

Excellent agricultural science only happens in the field

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