Hill country management

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Dryland Pastures Group
NZIAHS 23 Oct 2019

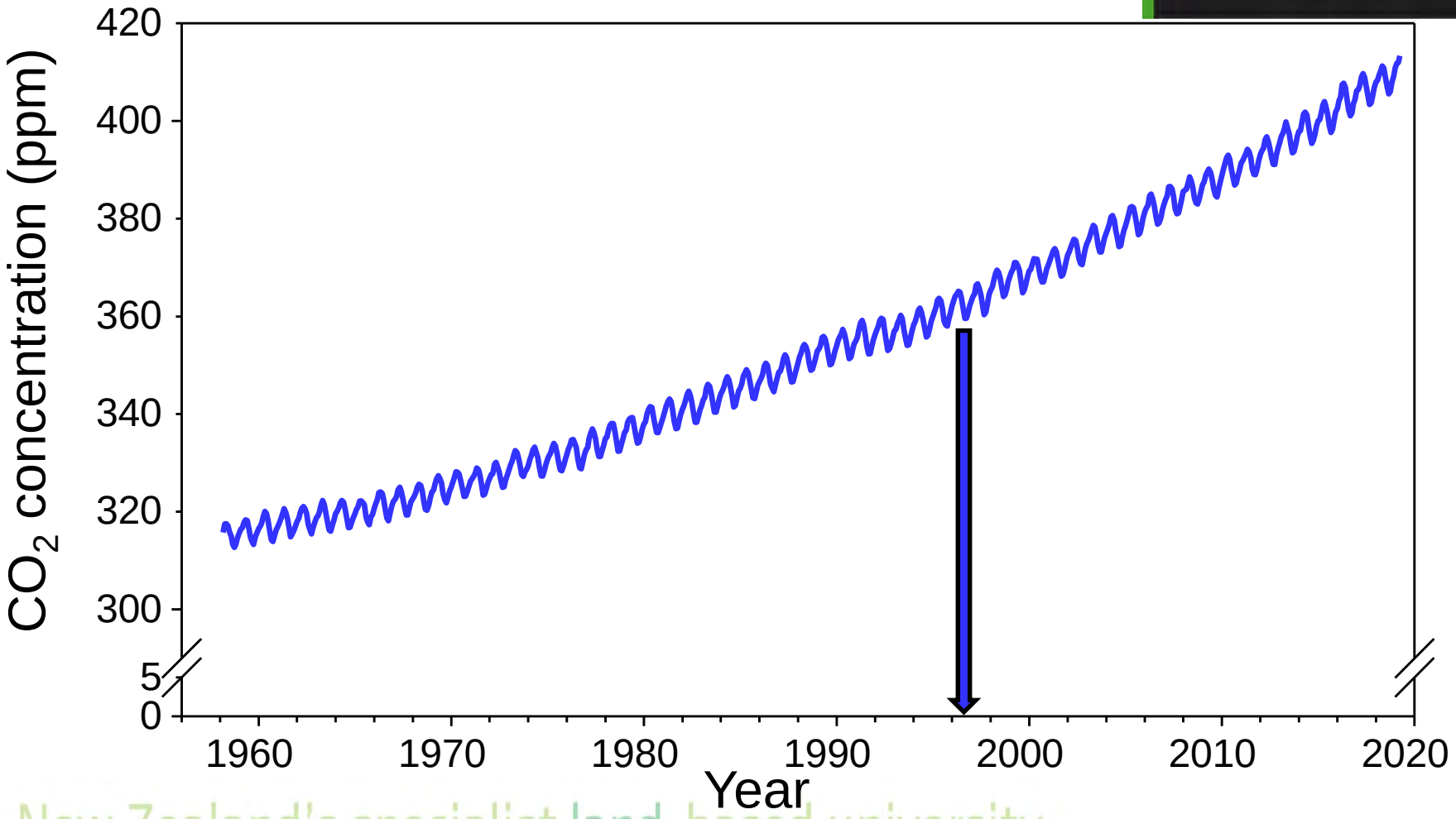


Introduction

- Drivers of climate change
- Agricultural responses
- Global issues – local response
- Production results of legume systems change
- Forestry - friend or foe?
- Financially, socially, environmentally resilient

Why legumes for GHG mitigation?

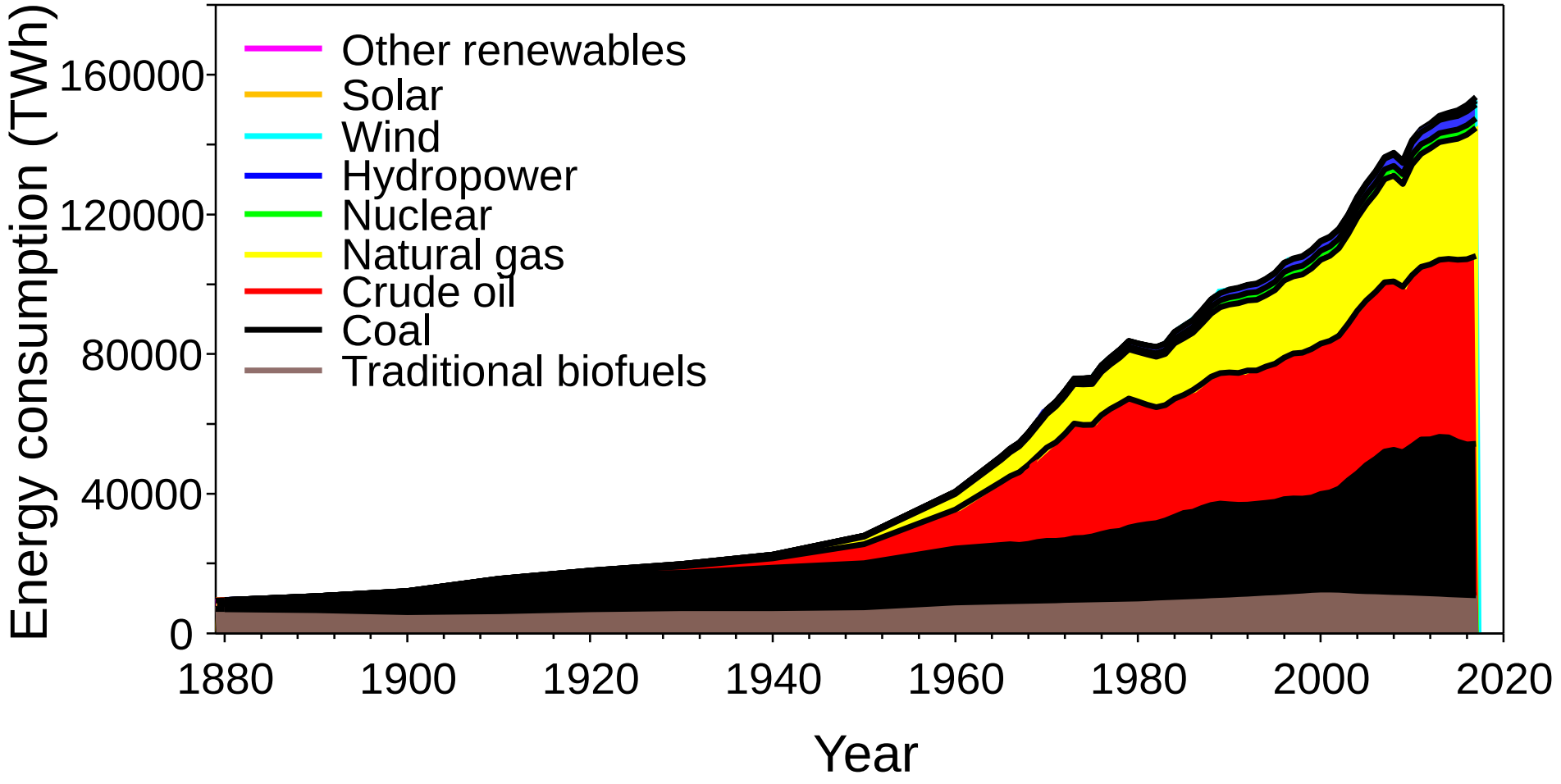
CO_2 at Mauna Loa, Hawaii



Data source:

Dr. Pieter Tans, NOAA/ESRL (www.esrl.noaa.gov/gmd/ccgg/trends/) and Dr. Ralph Keeling, Scripps Institution of Oceanography (scrippsco2.ucsd.edu/). (28/5/2019)

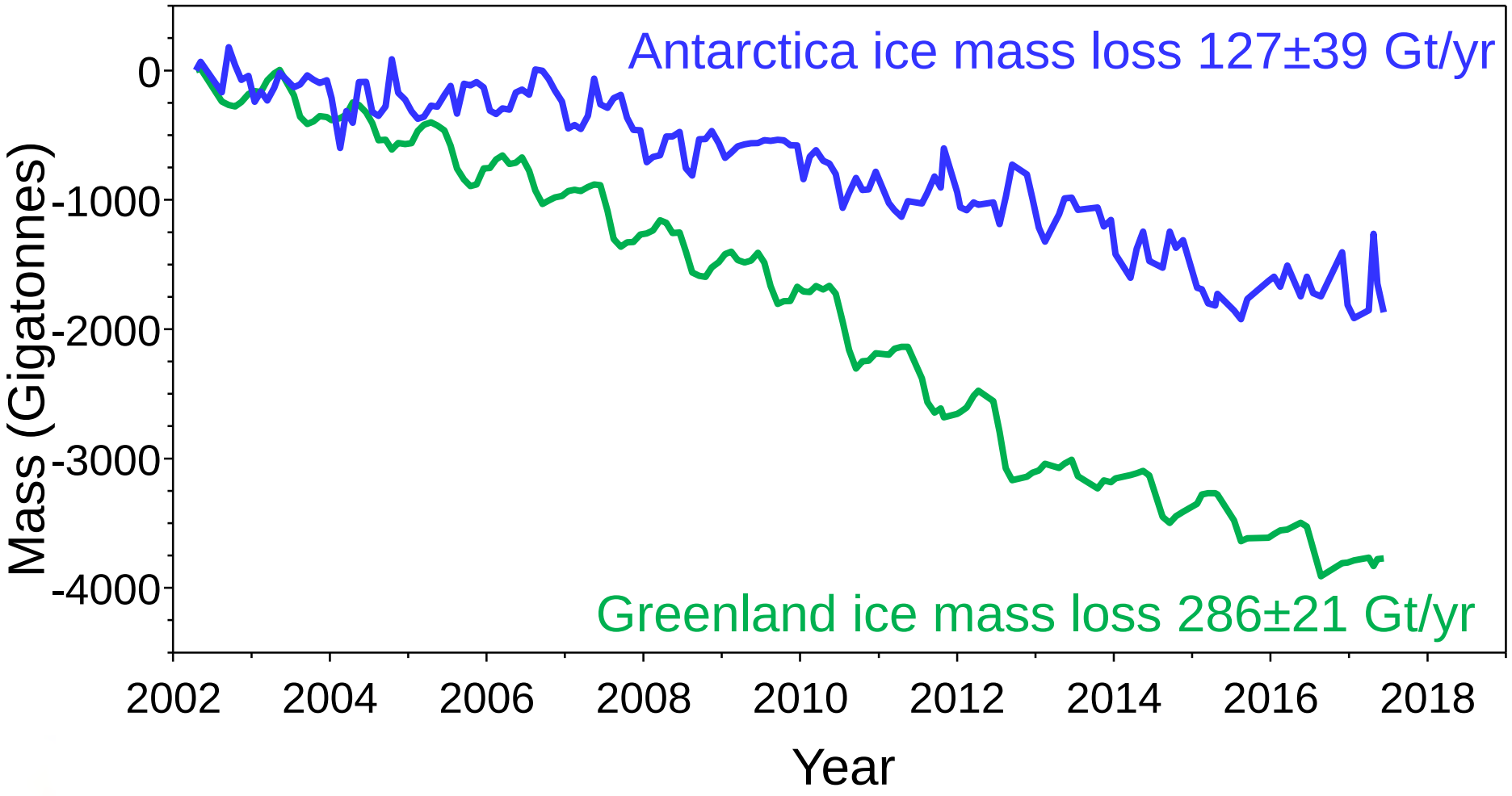
Global energy supply



Redrawn from: https://ourworldindata.org/energy-production-and-changing-energy-sources. Accessed: 2/10/2019. Based on data sourced from Smil 2017. http://vaclavsmil.com/2016/12/14/energy-transitions-global-and-national-perspectives-second-expanded-and-updated-edition/ ; https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html.

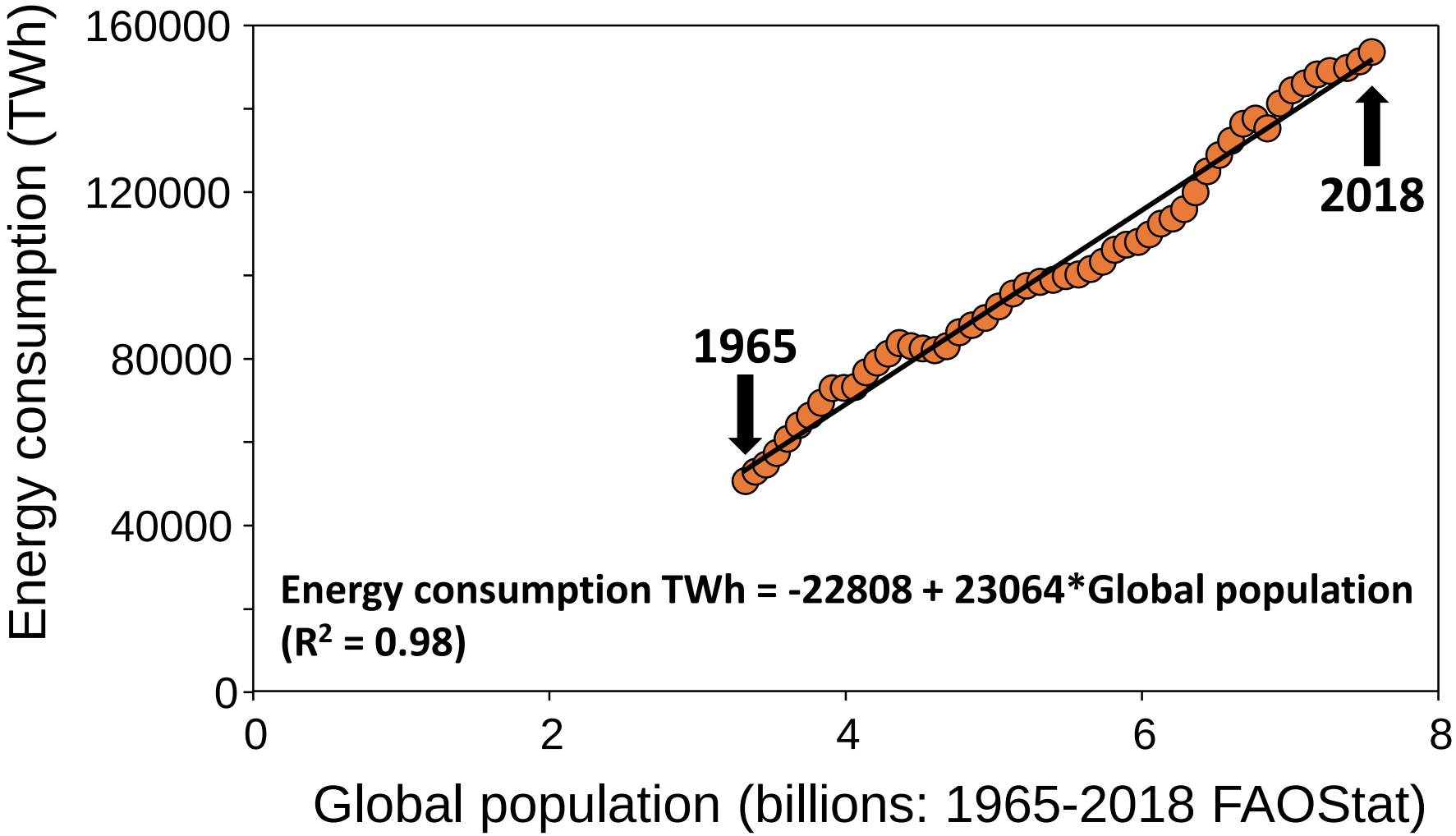
Ice sheet losses 2002-2017

(Anomalies relative to April 2002)



NASA. 2019. Ice mass measurement by NASA's GRACE satellites. https://climate.nasa.gov/vital-signs/ice-sheets/ ; Wiese et al. 2016

Energy consumption per capita



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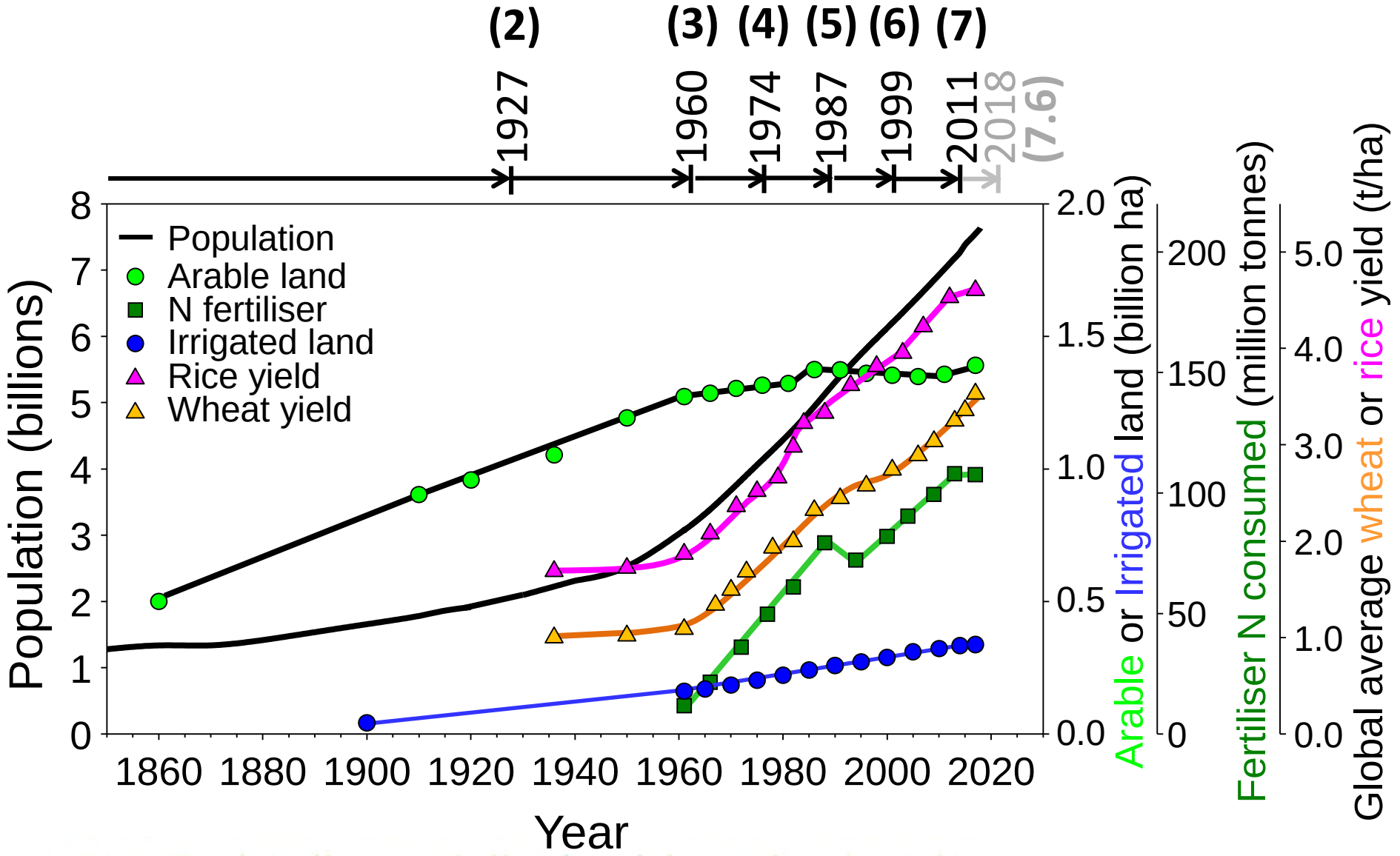
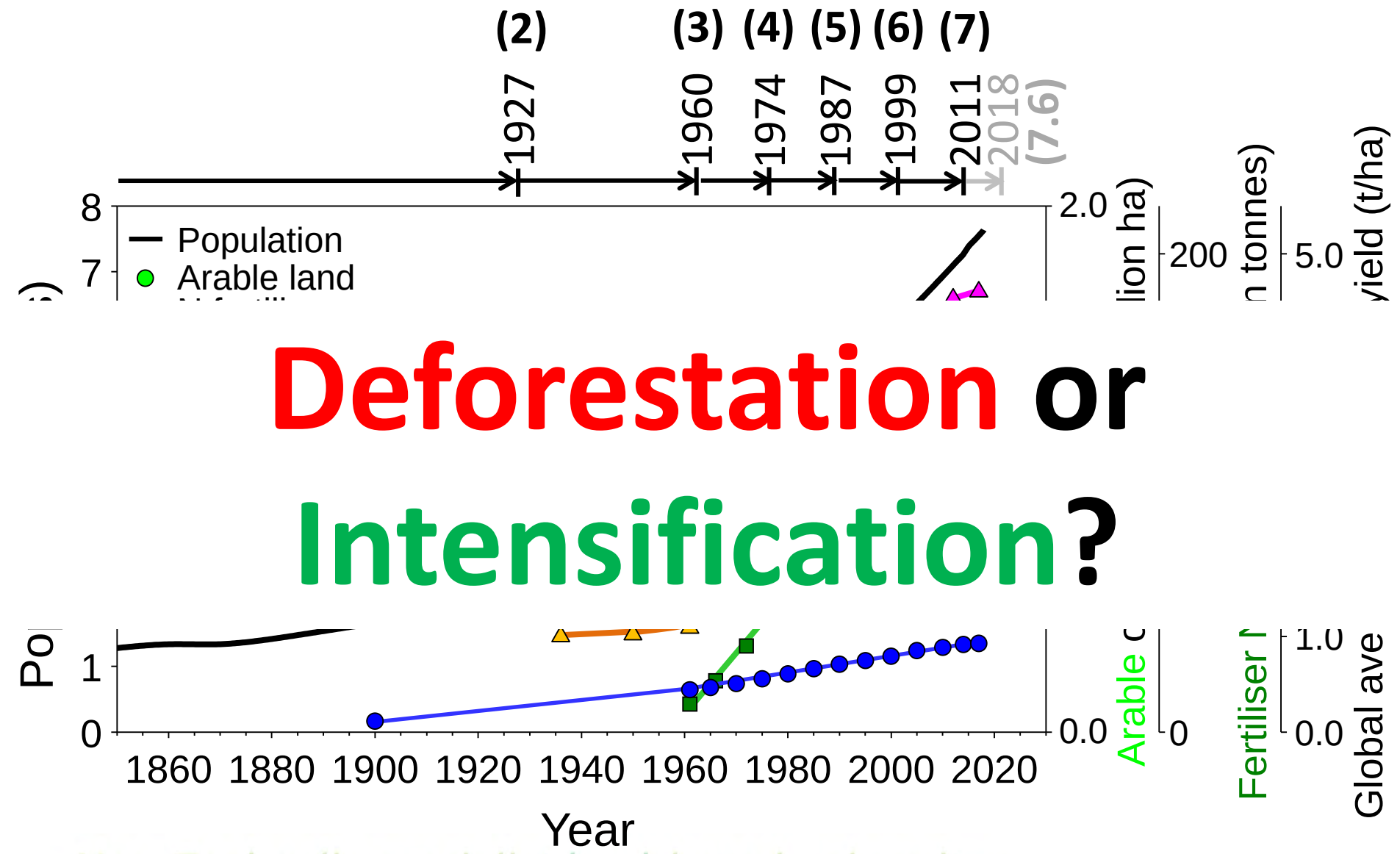


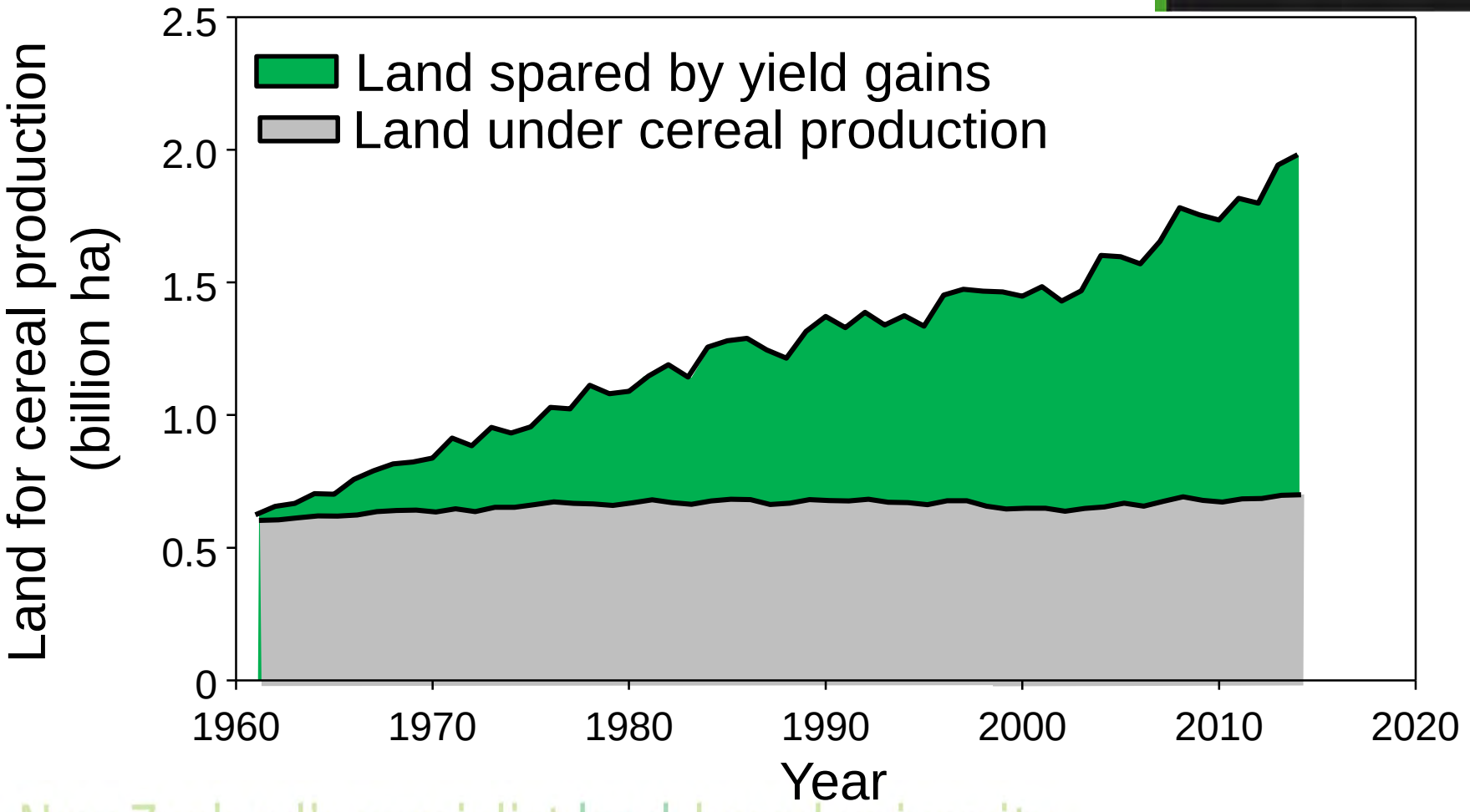
Recreated and updated from Evans 1998, van Ittersum 2011 & FAOSTAT 2019



Deforestation or Intensification?

Recreated from Evans 1998, M.K. van Ittersum & FAOSTAT (2019)

Impact of G x E x M



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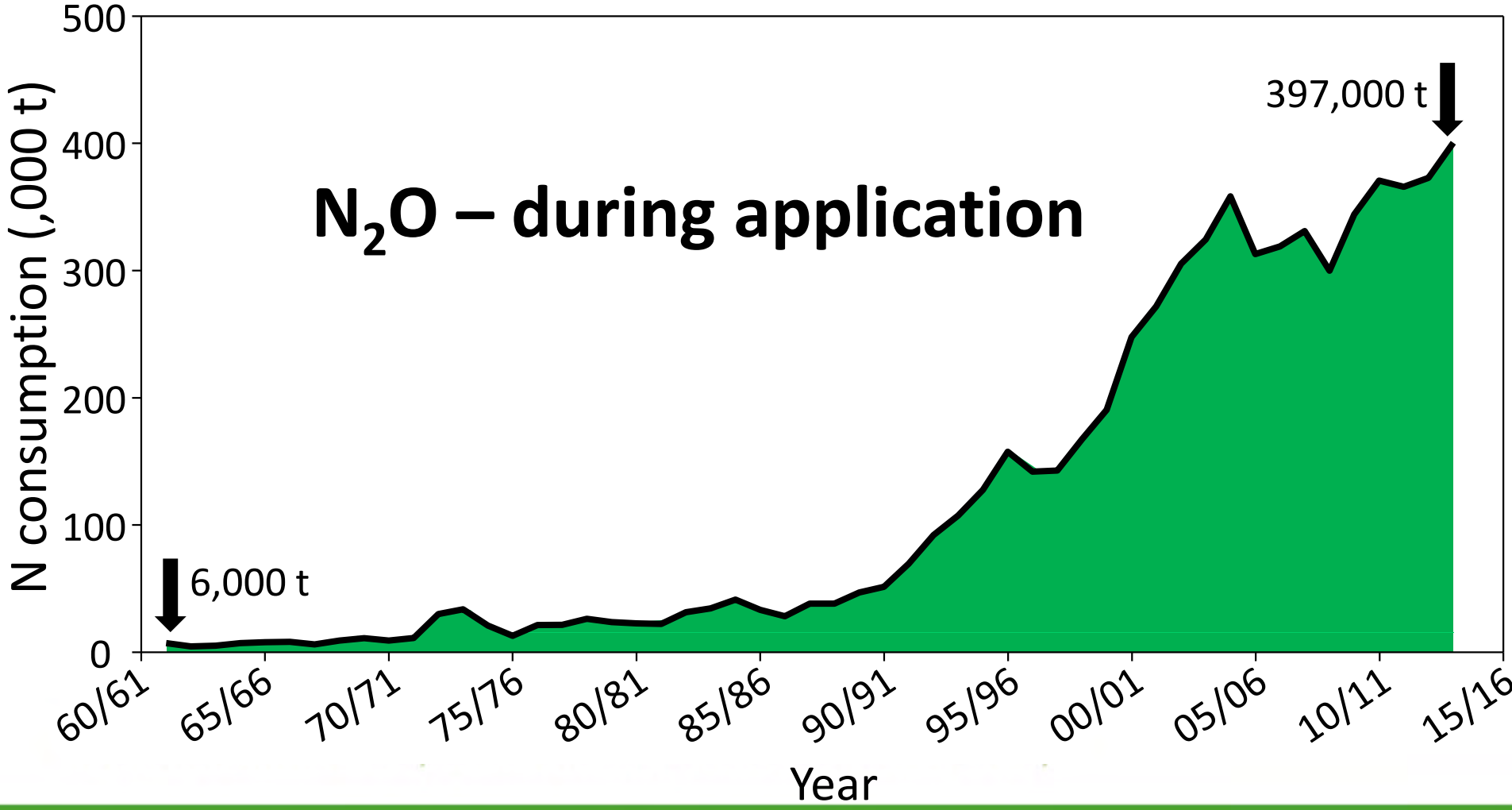
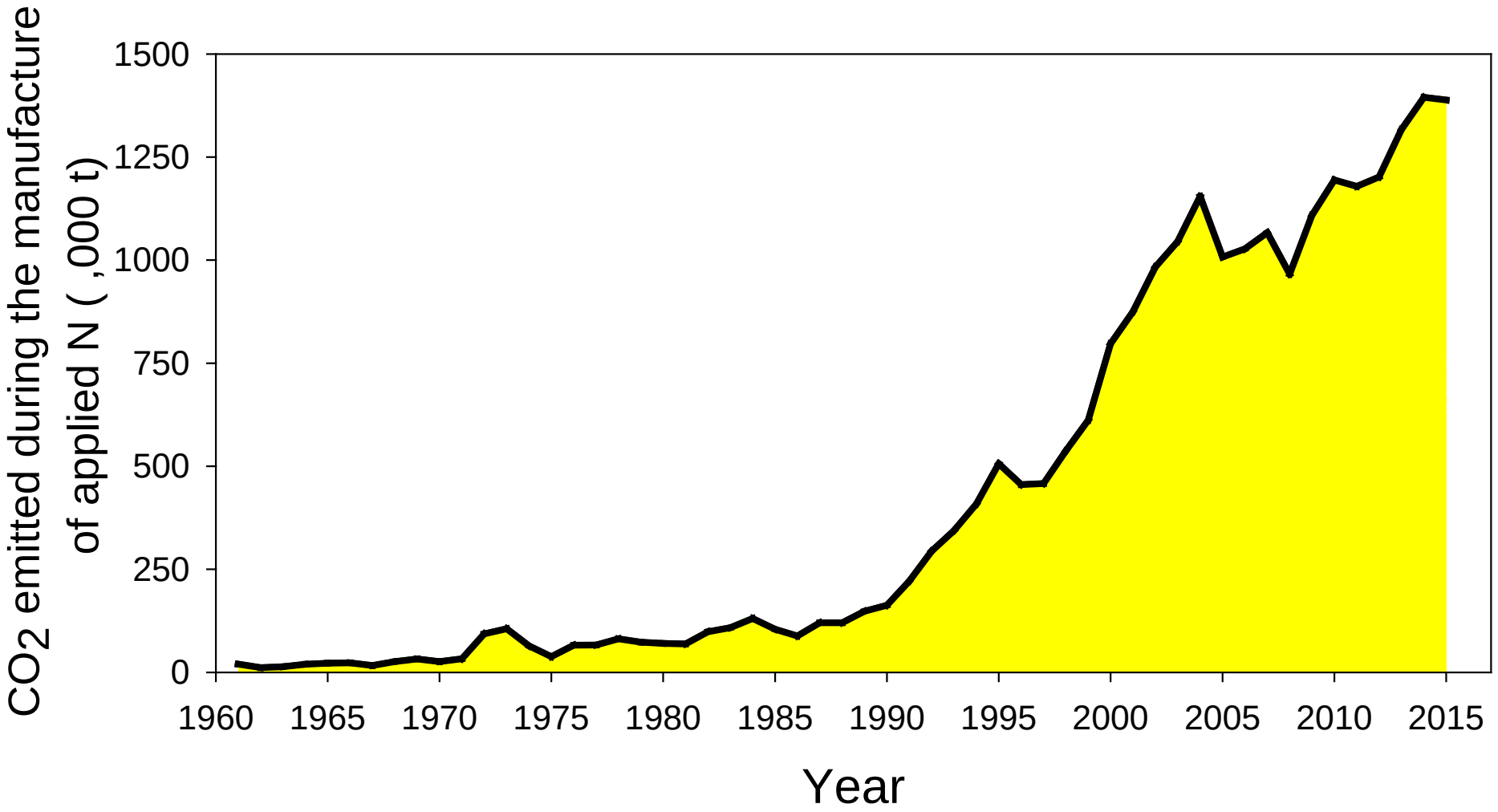
Nitrogen applied in NZ

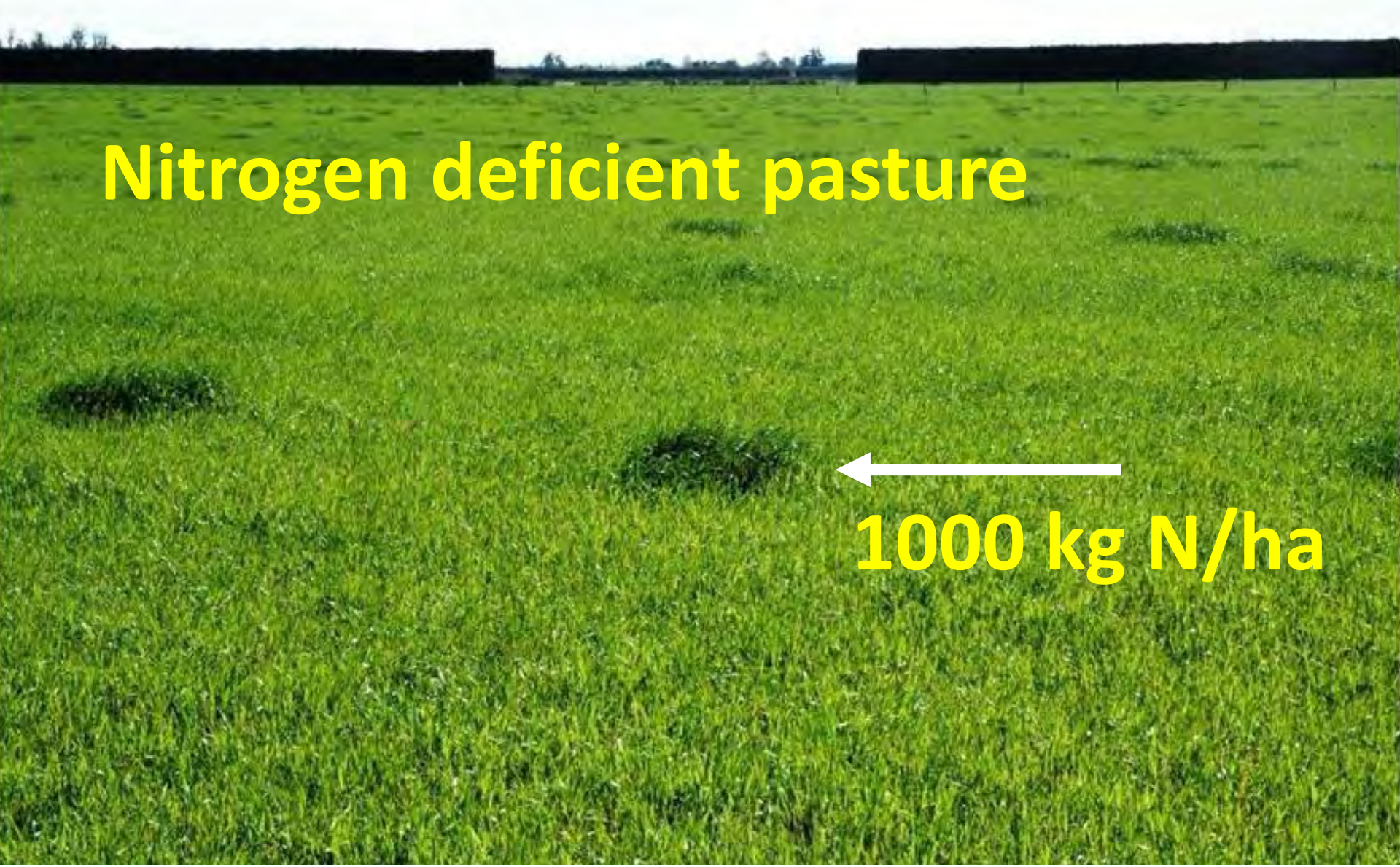


NZ Fertiliser Association, 2015

CO_2 emitted in production of our N

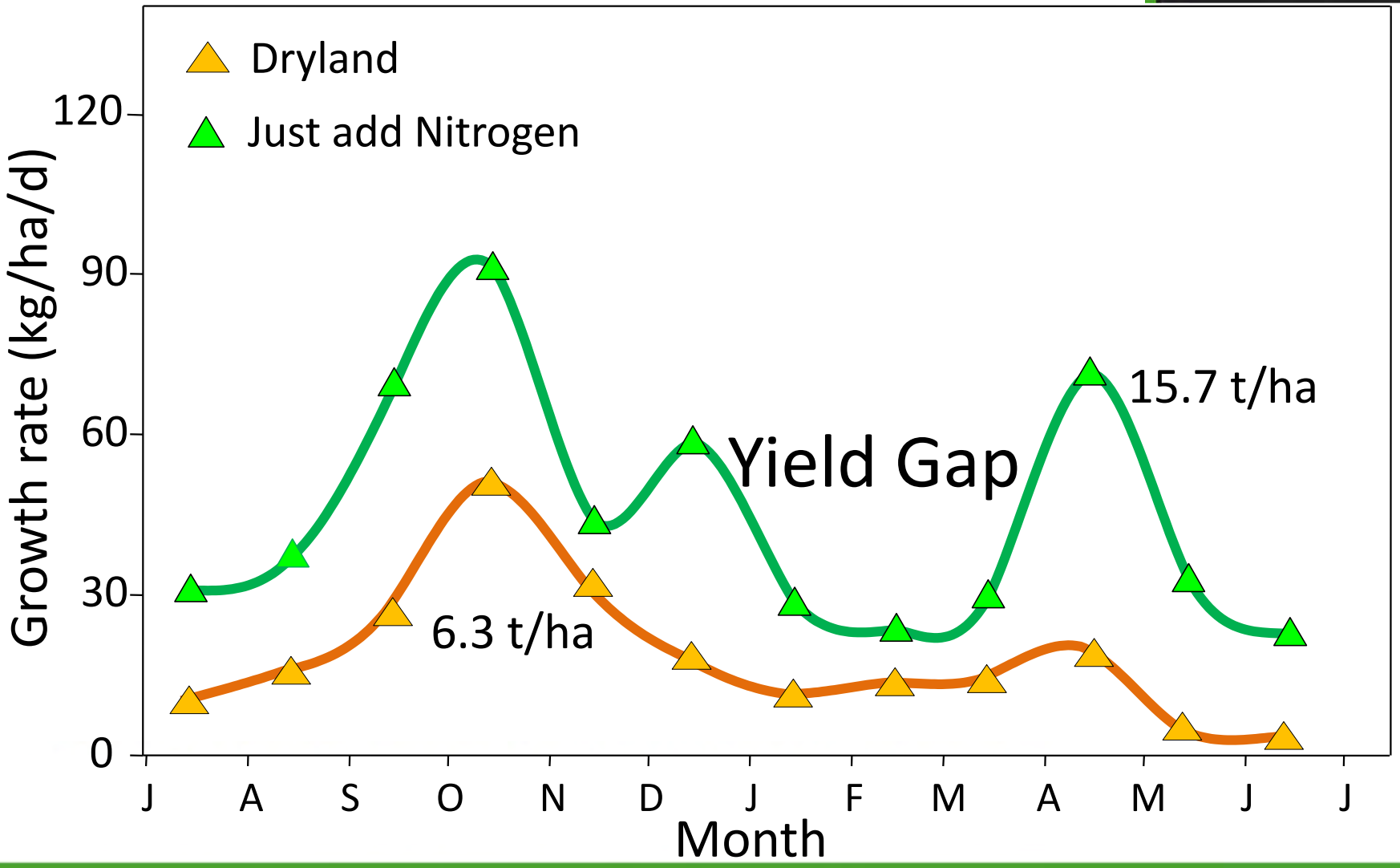


Based on energy use of 65 MJ/kg N produced and an emission rate of 0.05 kg CO_2/MJ energy used (Saunders *et al*. 2006)



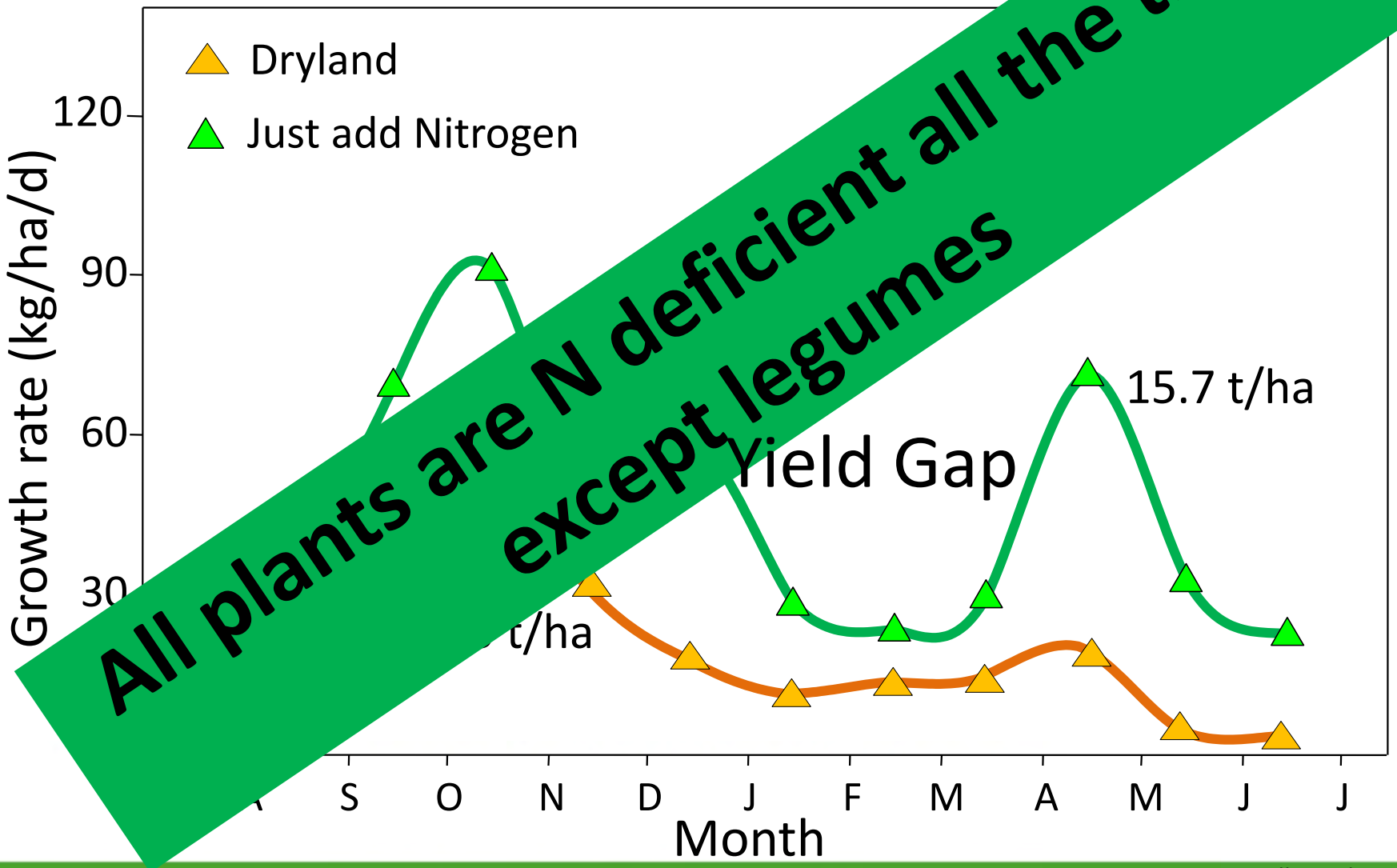
Same rate of evapotranspiration
– inefficient water use!

Growth rates (2 year means)



Mills *et al*. 2006, 2009

Growth rates (2 year means)

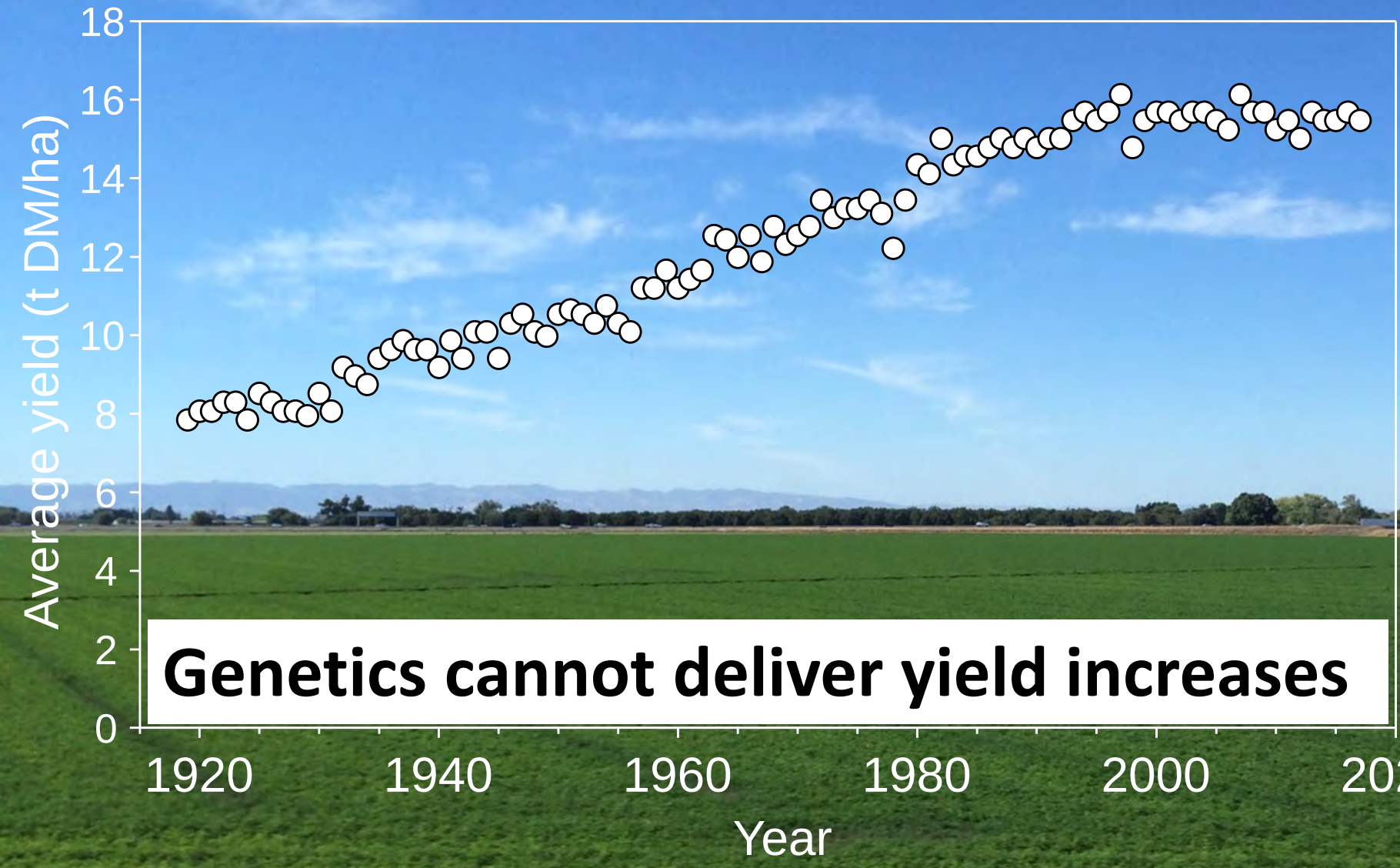


All plants are N deficient all the time except legumes

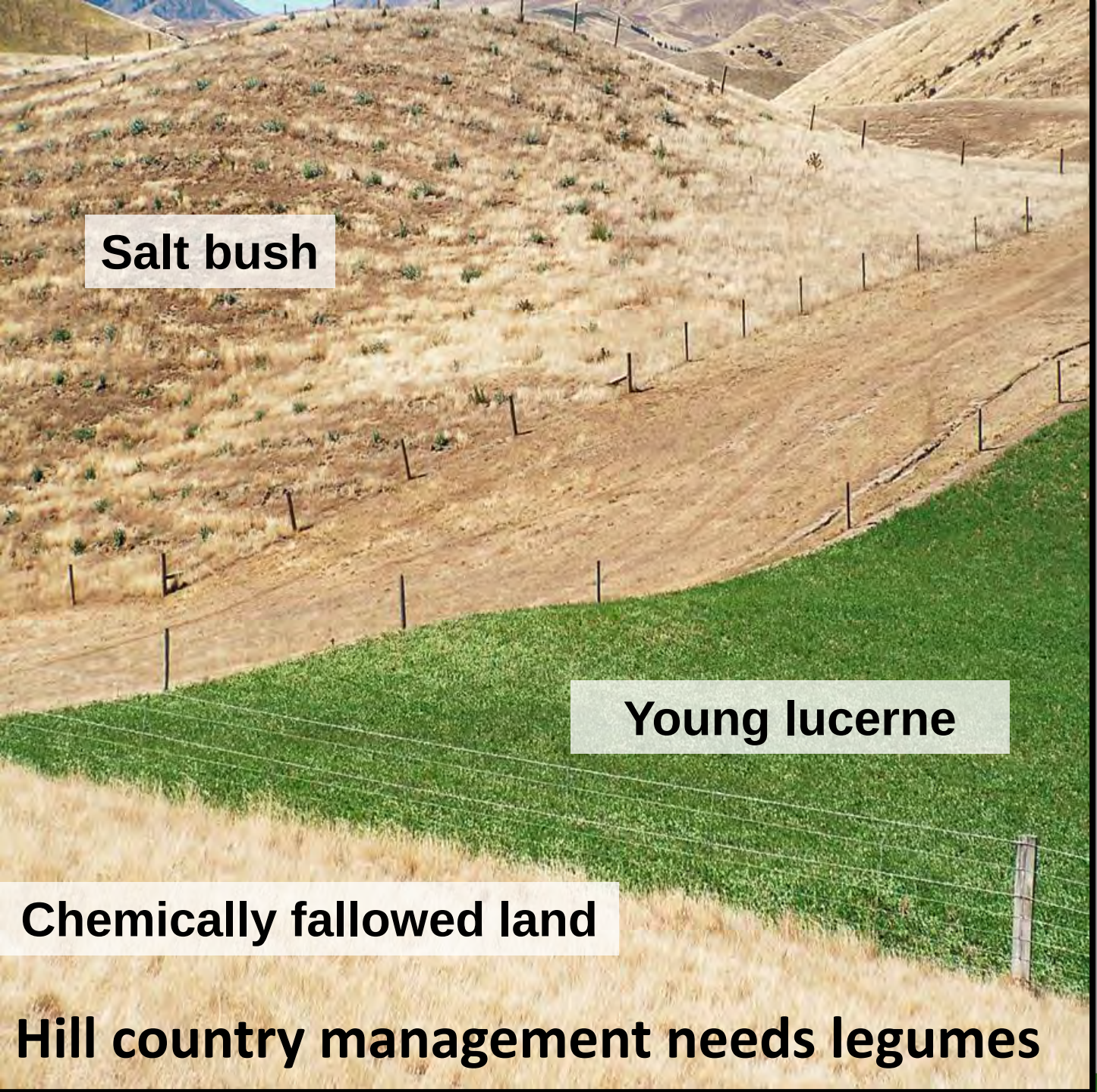
Mills *et al*. 2006, 2009

California - average lucerne yield

(USDA Ag Statistics)



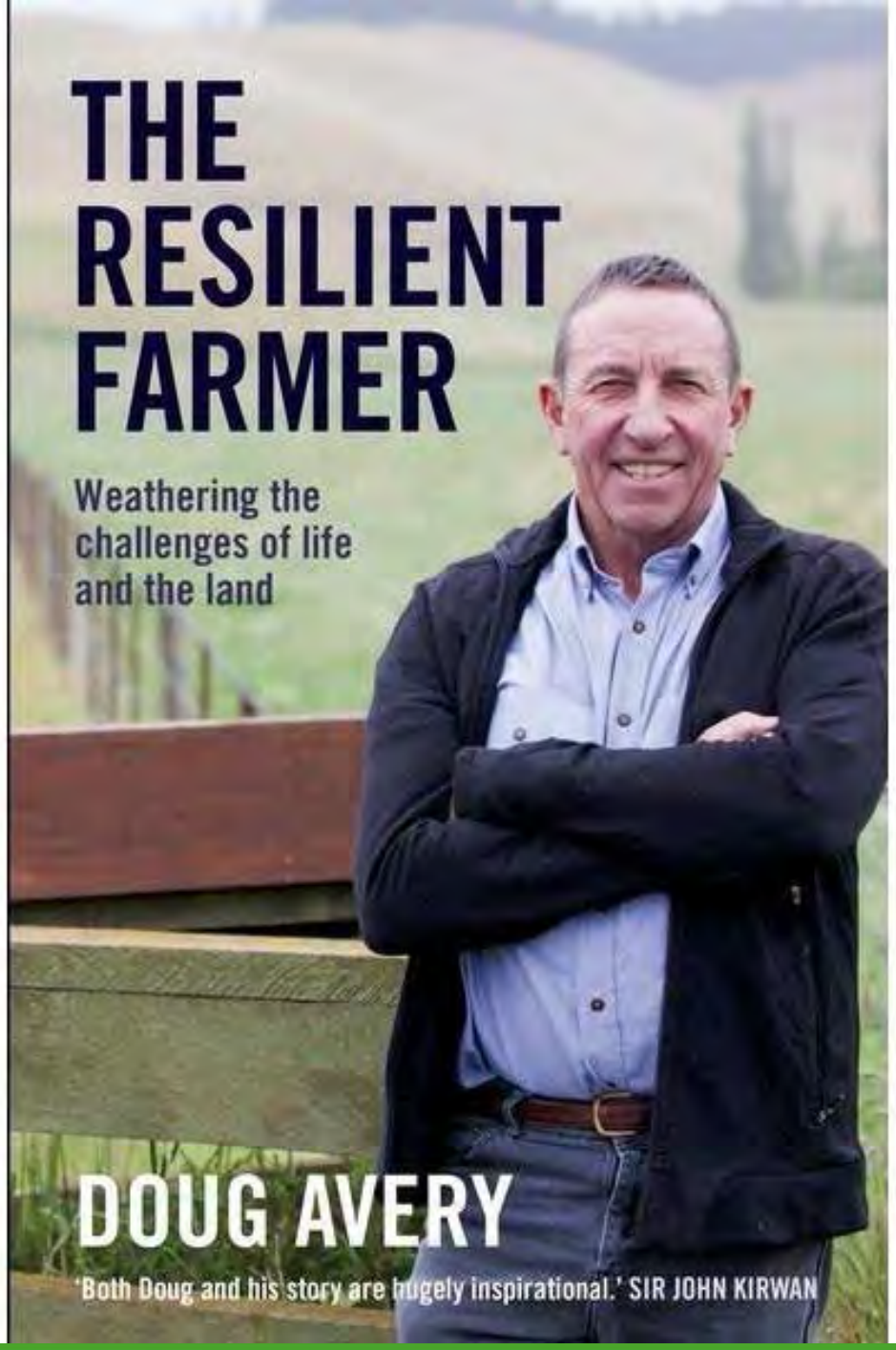
Supplied by: Charlie Brummer, UC Davis



Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH·NEW ZEALAND

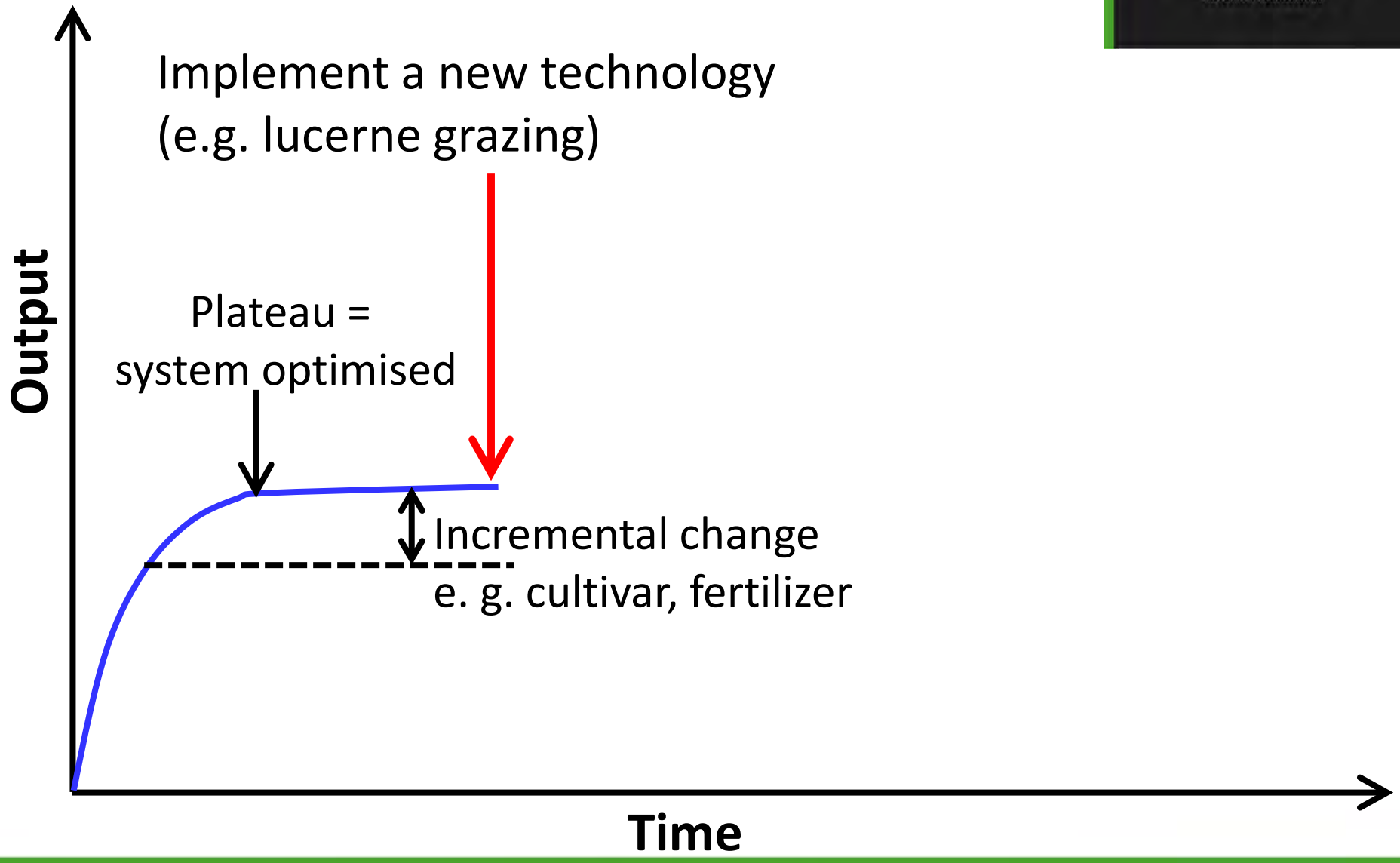
Hill country management needs legumes

Intensification allows afforestation

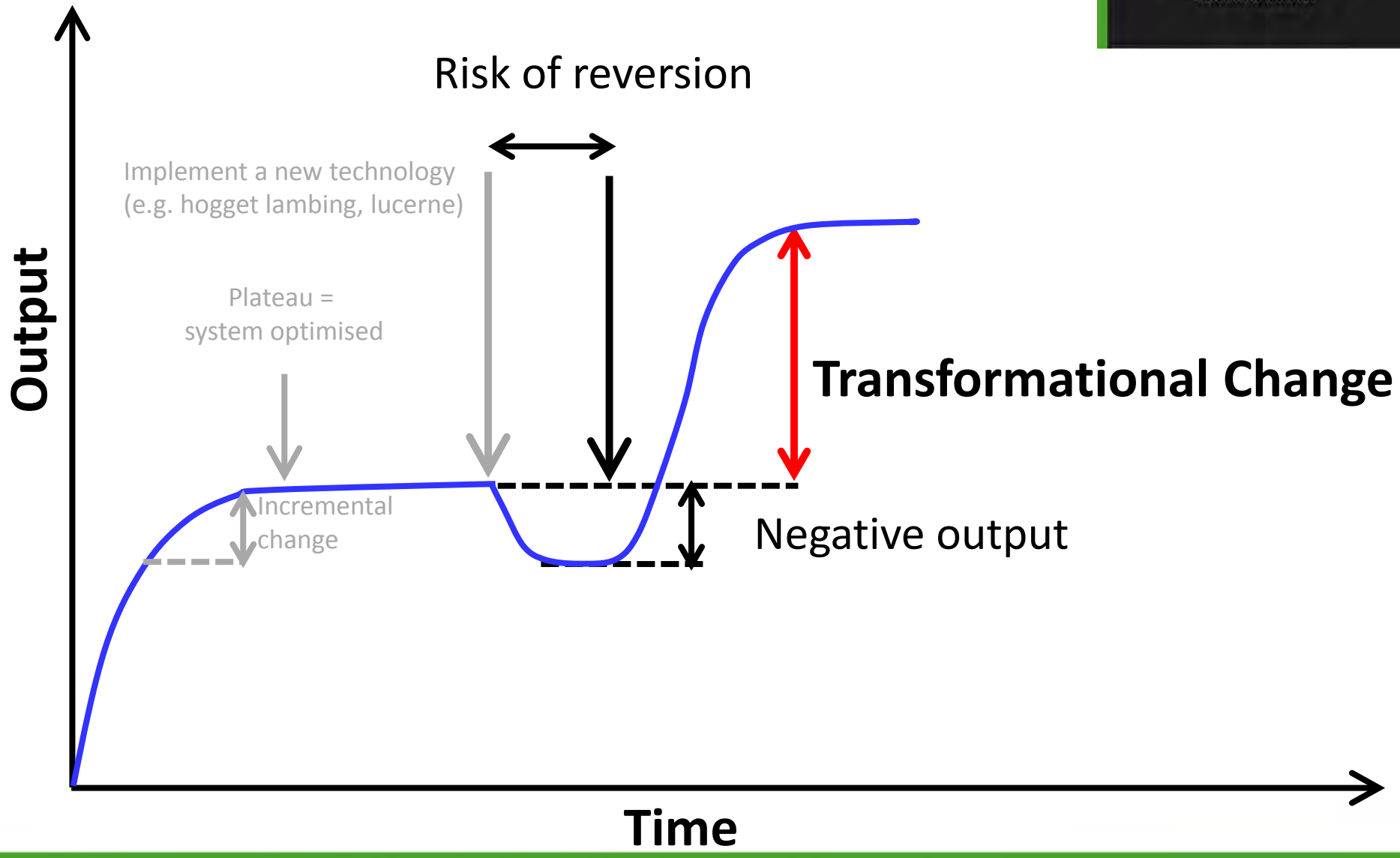


Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND

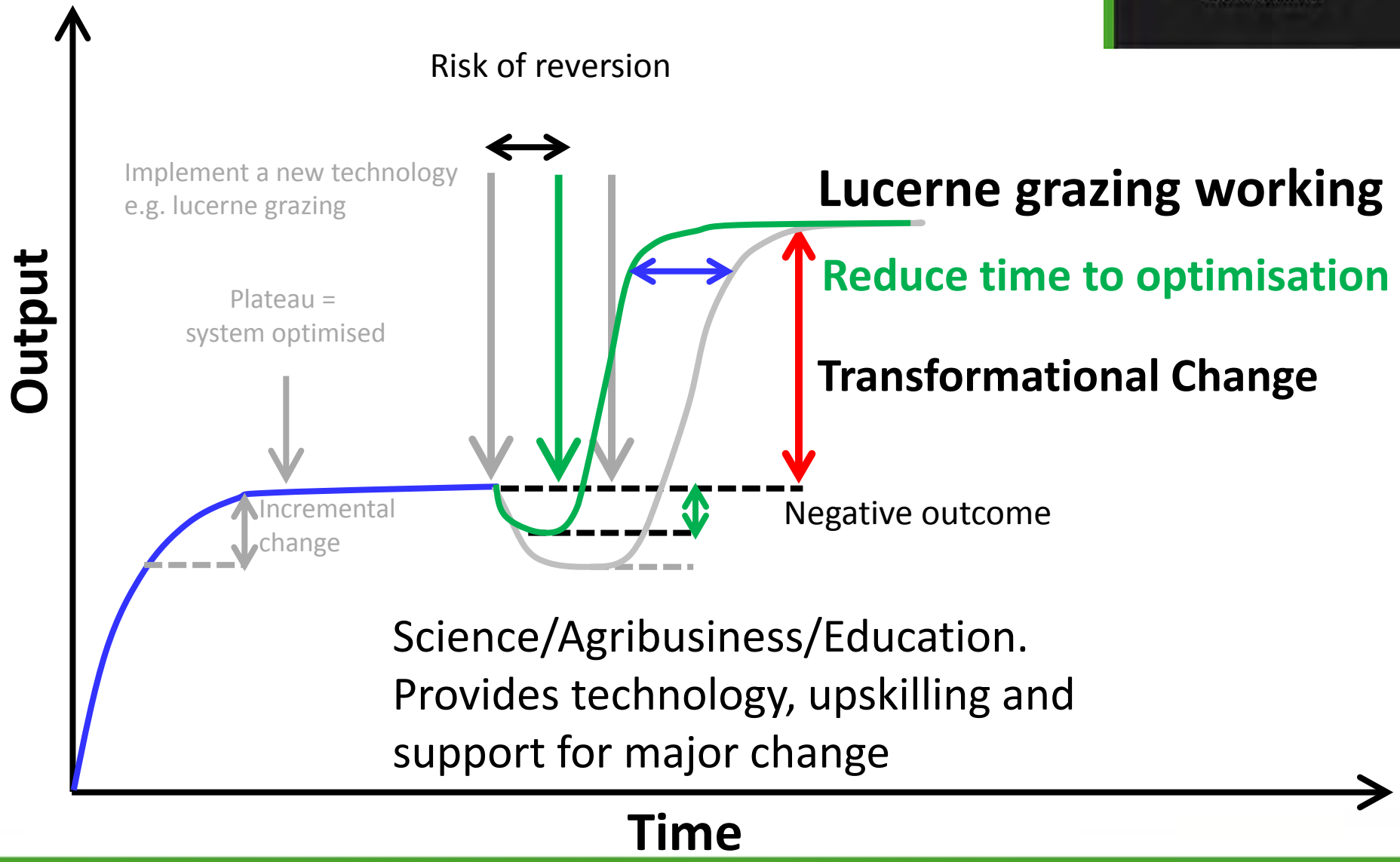
Pathway to change = mgmt



System optimisation



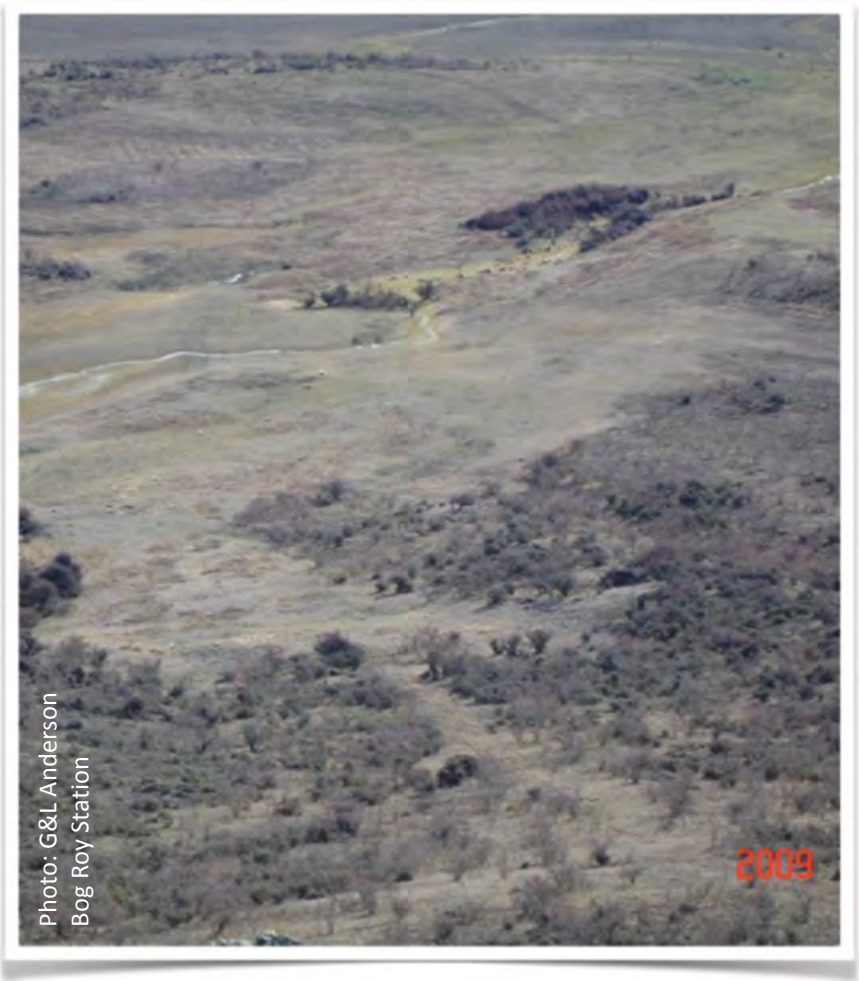
Pathway to change = Mgmt

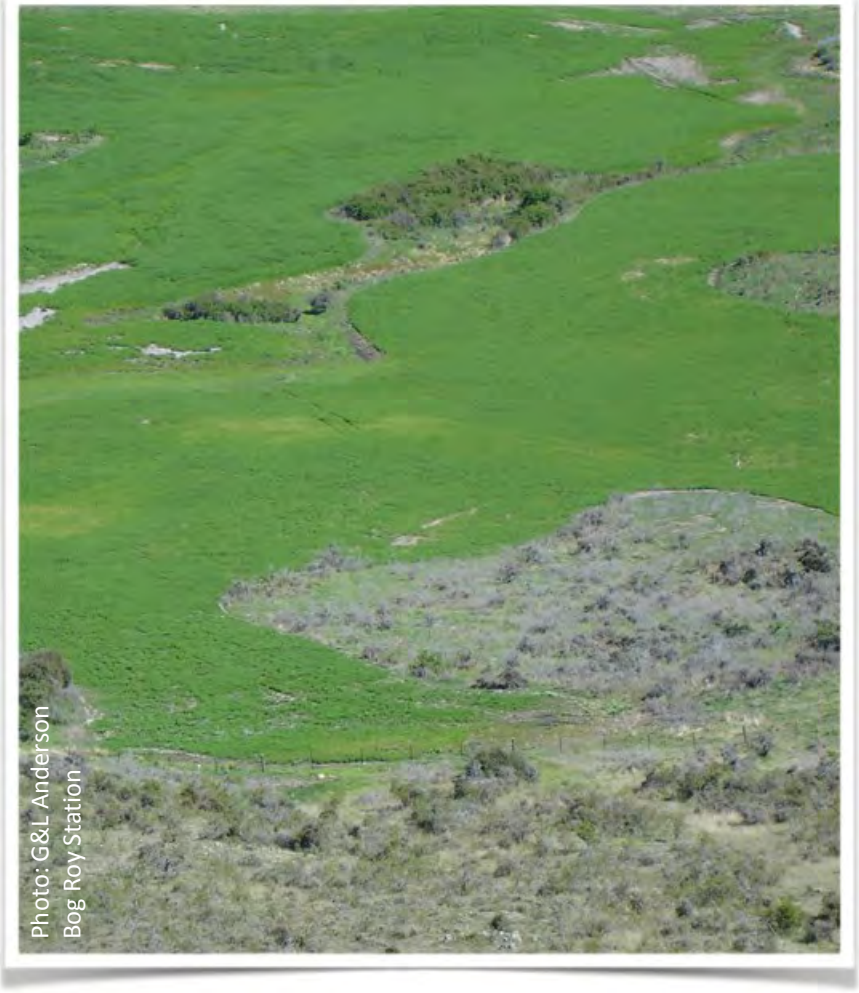


Science/Agribusiness/Education.
Provides technology, upskilling and support for major change

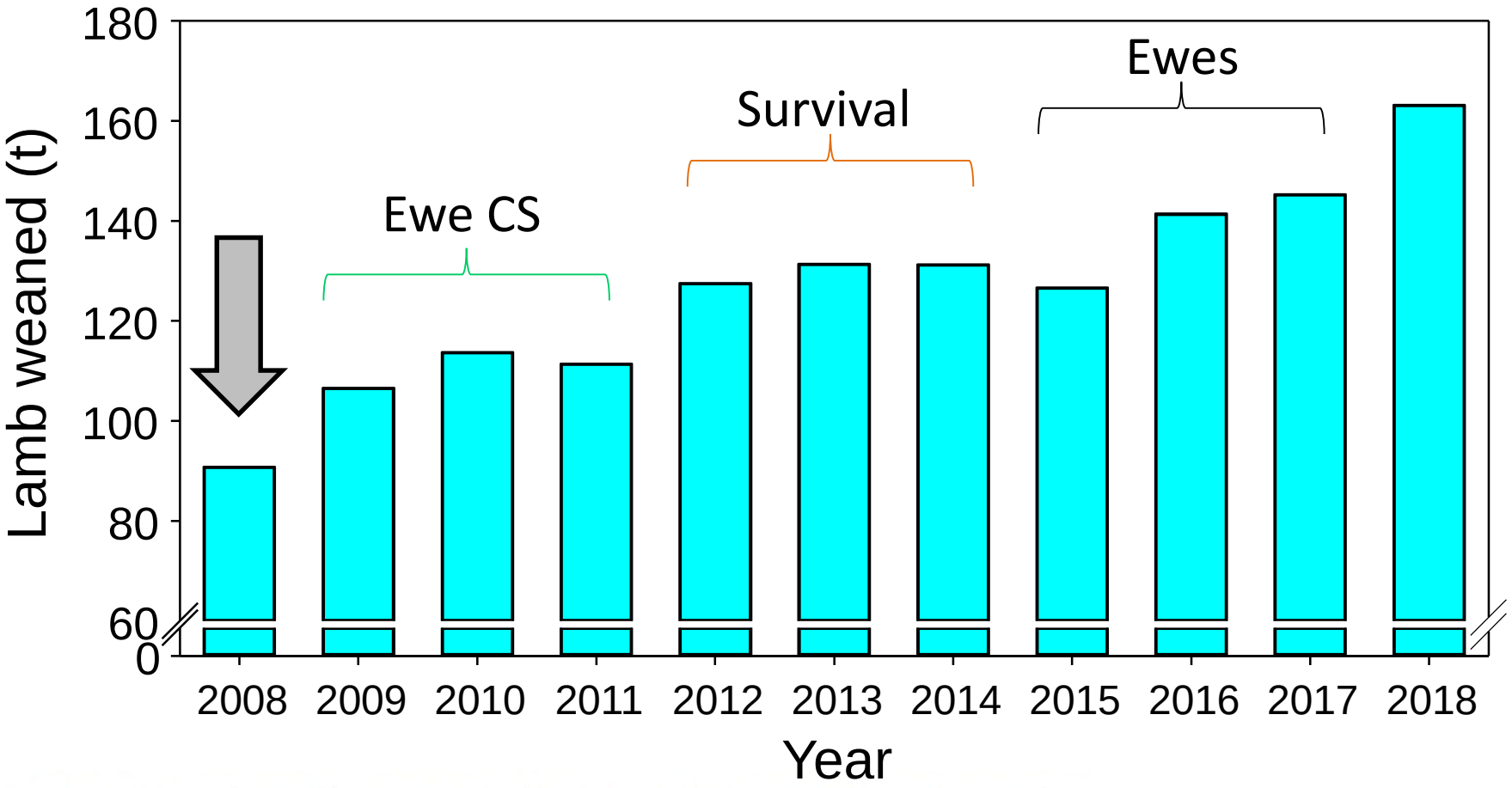

BOG ROY
EST. 1891
Mean annual rainfall = 450 mm

Landscape farming





Change in LWt produced at Bog Roy



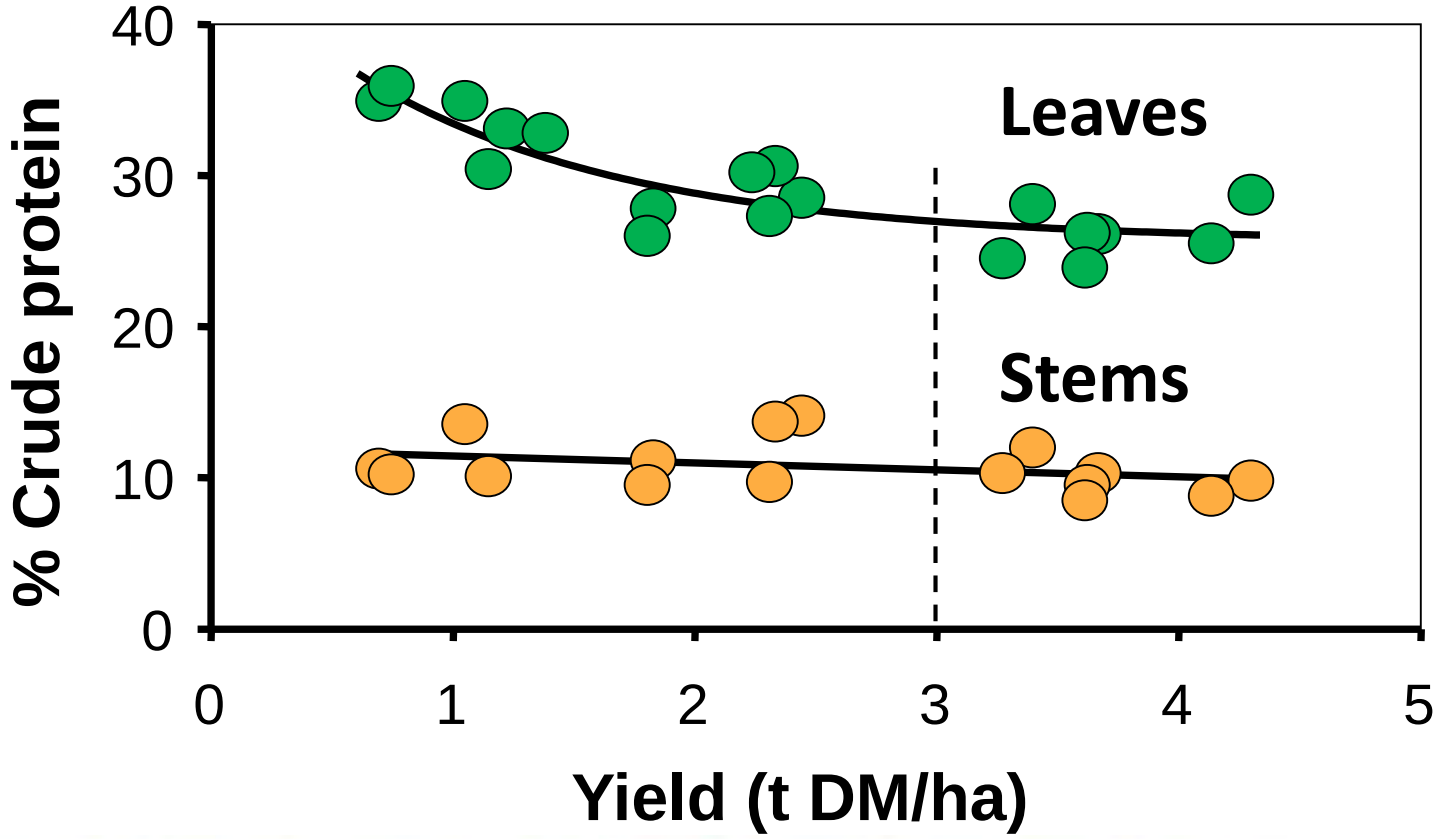
Moot et al. 2019

Lucerne grazing management

Photo: DJ Woot
Lincoln University

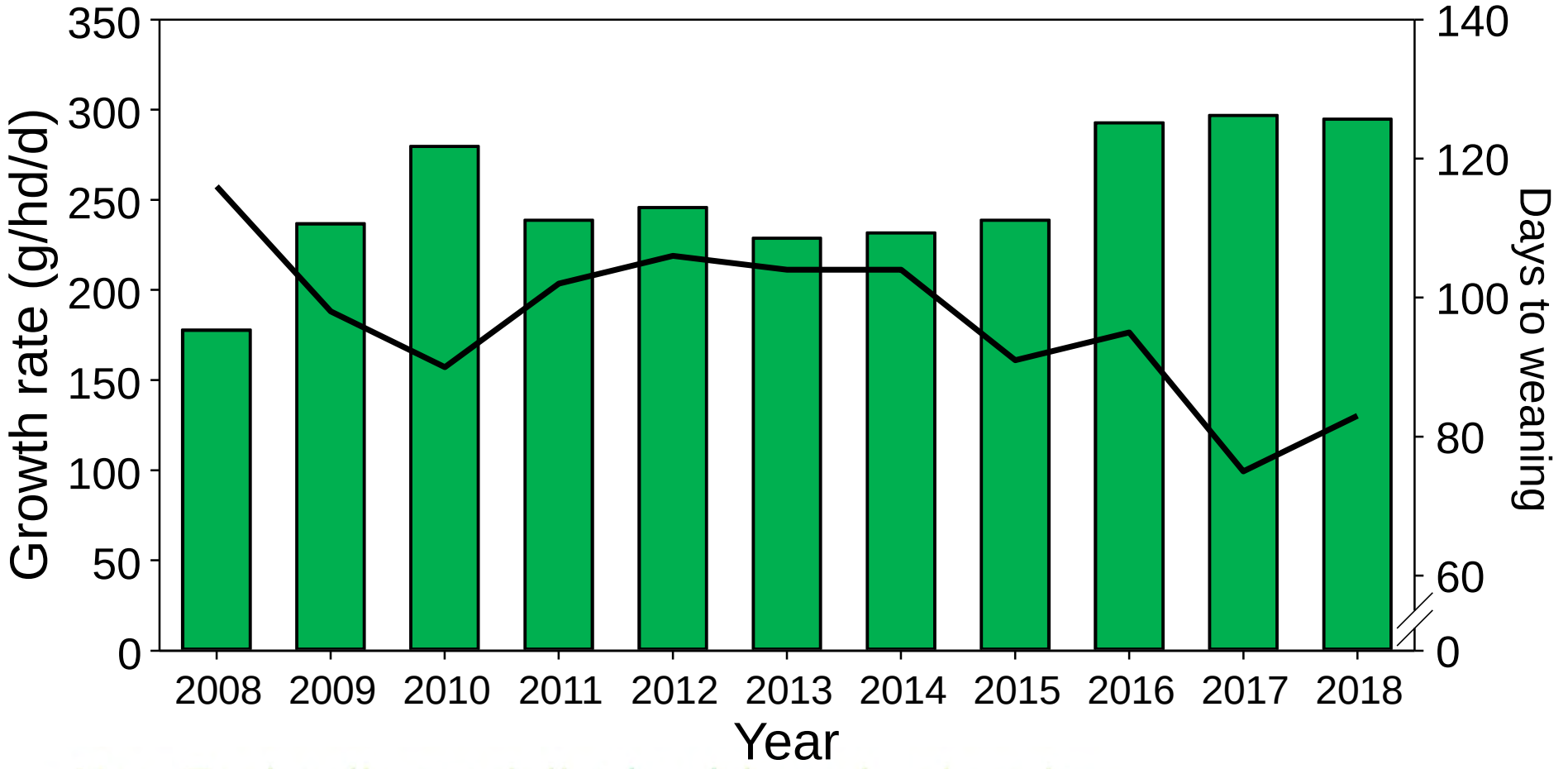
Landscape farming – Bog Roy Station

Crude protein of lucerne



Brown & Moot 2004

Mean daily lamb growth rate



Moot et al. 2019

Income and lamb sale weights over six years at Bog Roy Station

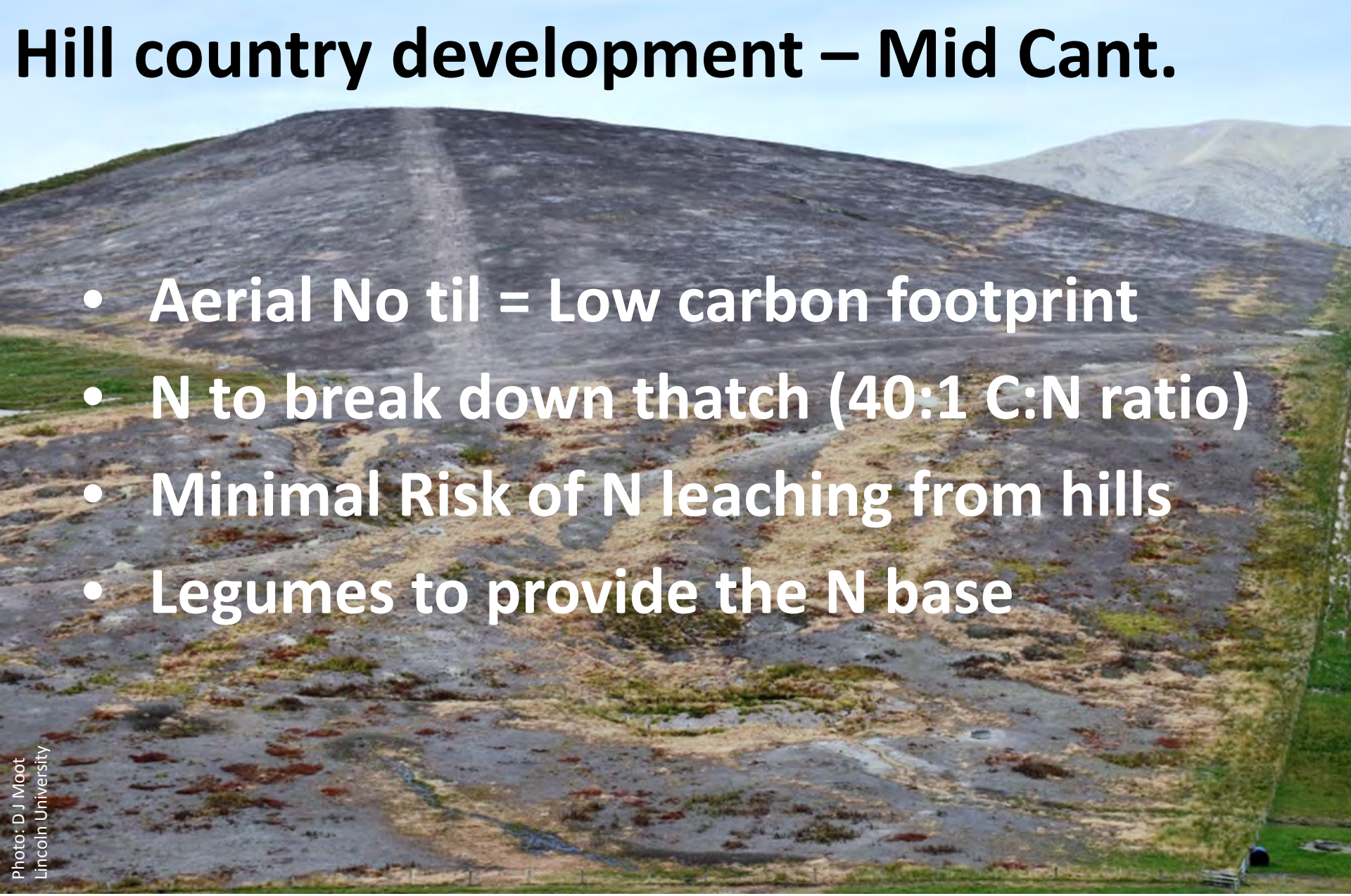
Year	Average lamb value ($/hd)	Total lamb income ($)	Average sale LWt (kg)	Average LWt value (¢/kg)
2012/13	73.97	236,409	31.5	234
2013/14	69.94	238,503	29.2	239
2014/15	74.12	256,911	31.6	234
2015/16	99.97	337,499	39.6	252
2016/17	117.21	436,956	39.4	297
2017/18	154.78	623,074	41.5	371

Moot et al. 2019

Banks Peninsula 10/10/2019

Photo: Malcolm Smith
Lincoln University

Hill country development – Mid Cant.



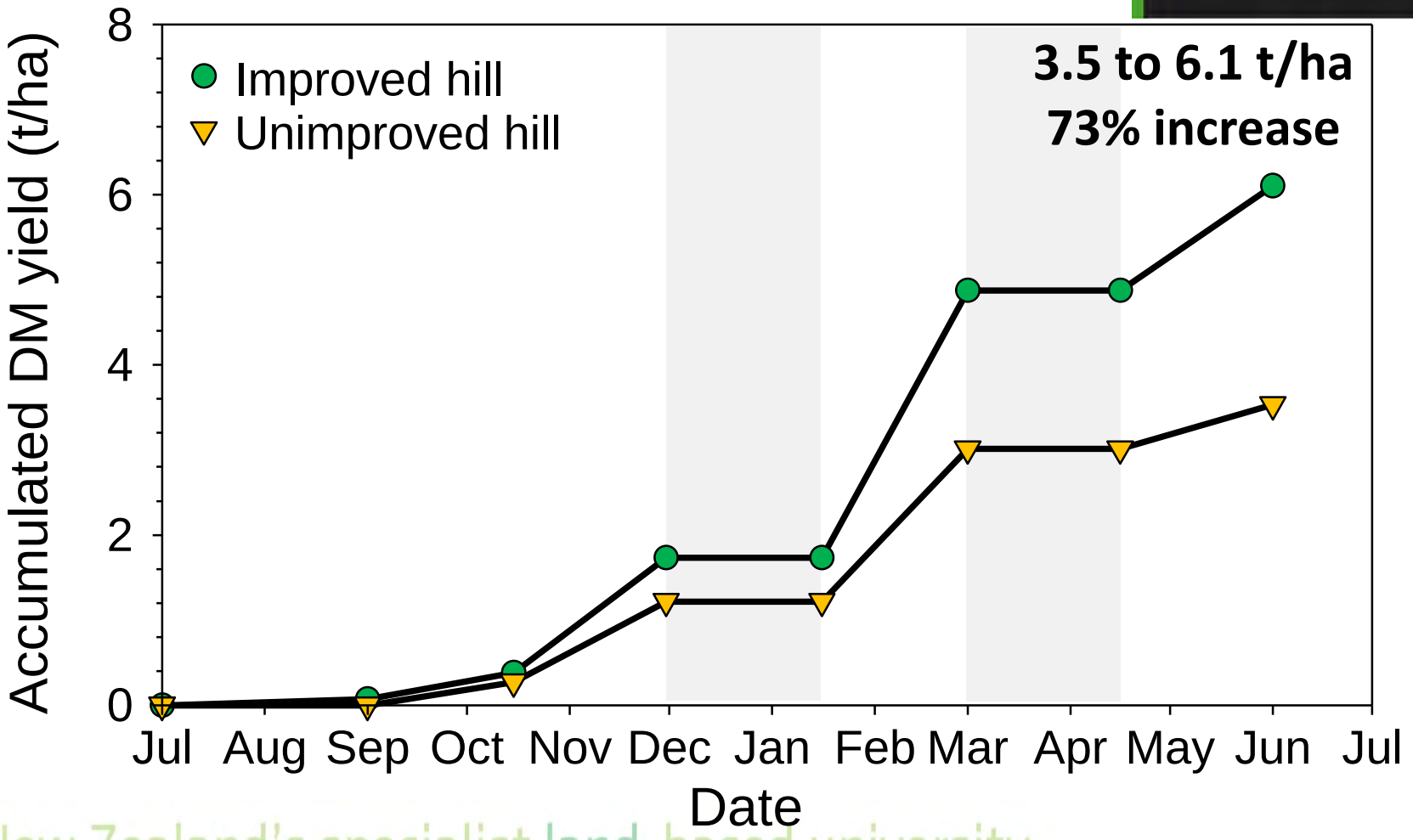
- Aerial No til = Low carbon footprint
- N to break down thatch (40:1 C:N ratio)
- Minimal Risk of N leaching from hills
- Legumes to provide the N base

Photo: D J Moot
Lincoln University

Regenerative or Intensive $CO_2 + CH_4$

Photos: DJ Moot
Lincoln University

Mid Canterbury



Wairarapa experiment

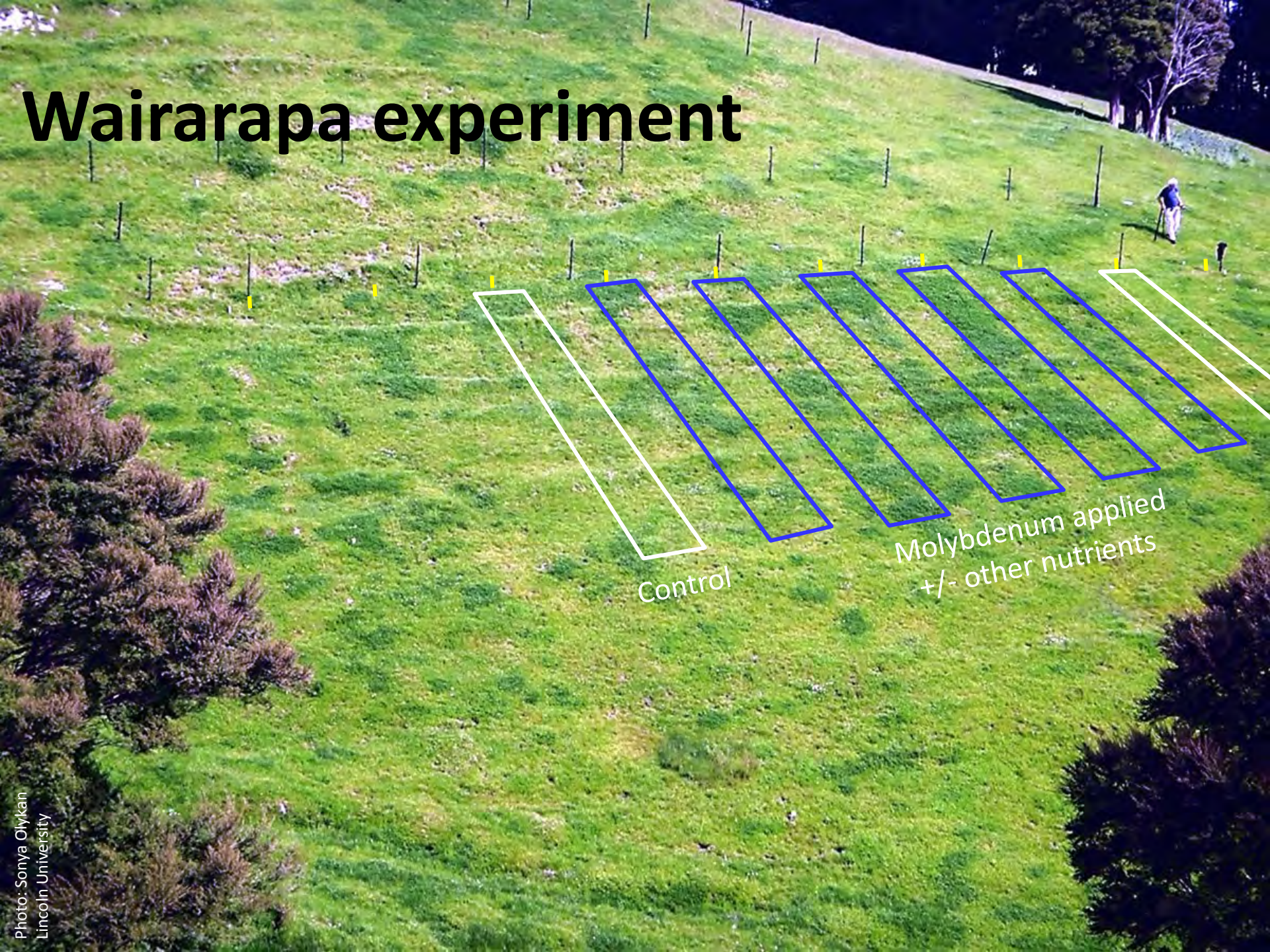
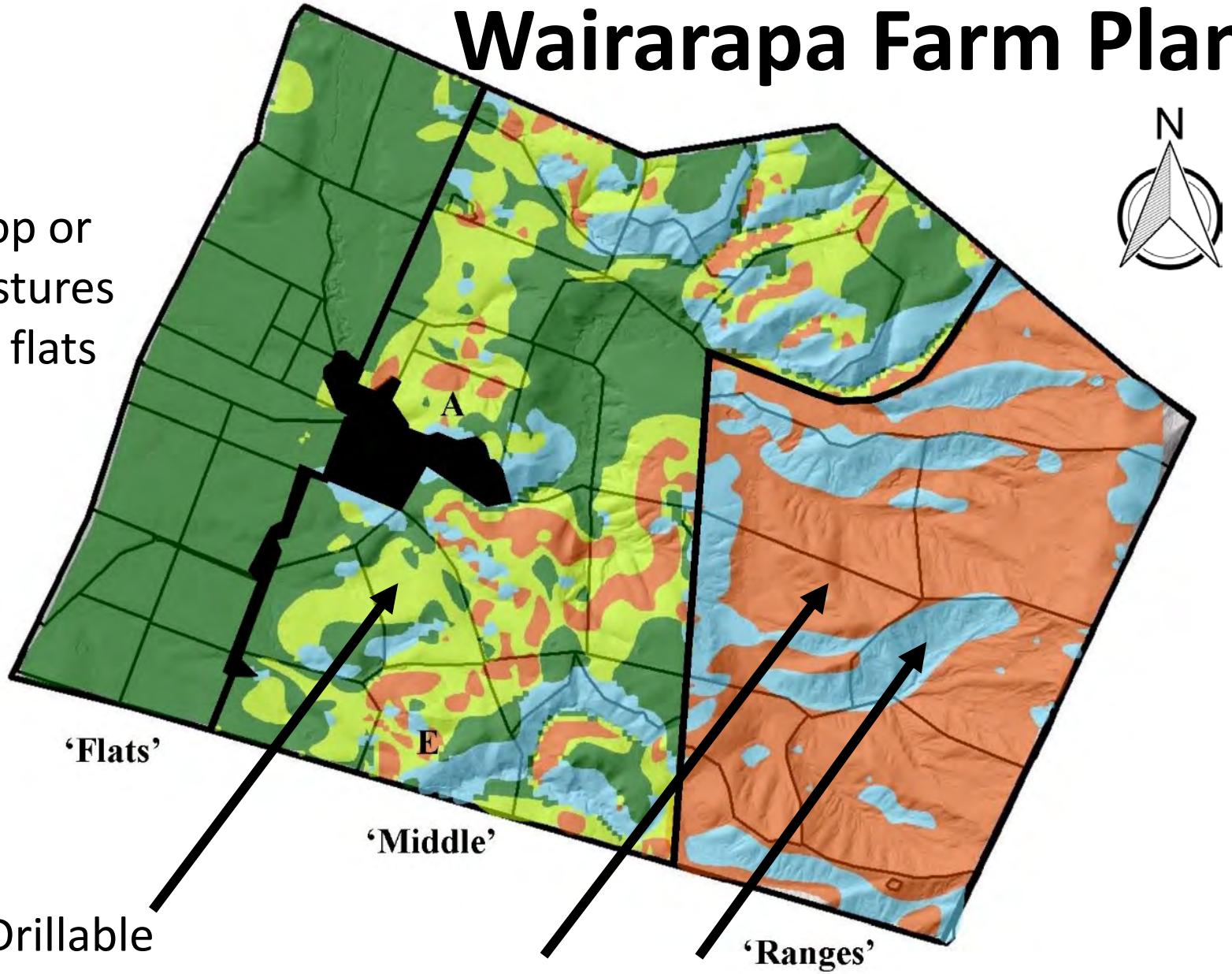


Photo: Sonya Olykan
Lincoln University

Wairarapa – P, K, Mo
(26/10/2017; Plot 25)
Fertility management

Photo: Sonya Olykan
Lincoln University

Wairarapa Farm Plan



Crop or pastures for flats

Drillable sunny Sub

Oversow Sub vs White

Southern Wairarapa = Summer dry

Sub clover ‘Antas’ drilled into pasture

Photo: Sonya Olykan, 26-10-17
Lincoln University

CH_4 reduced by faster LWG

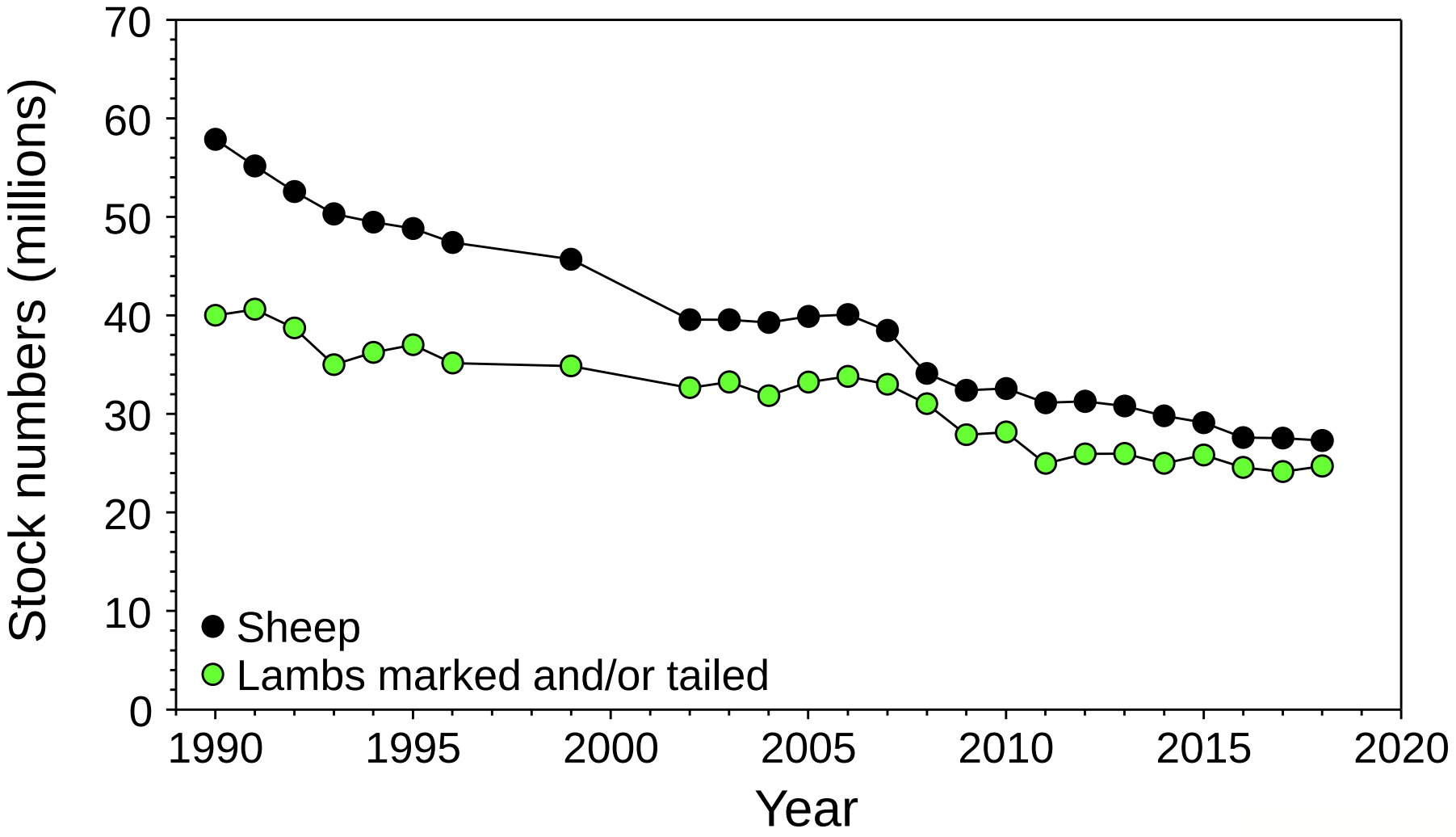
Energy requirement (MJ ME) for lamb growth from 25 to 35 kg liveweight

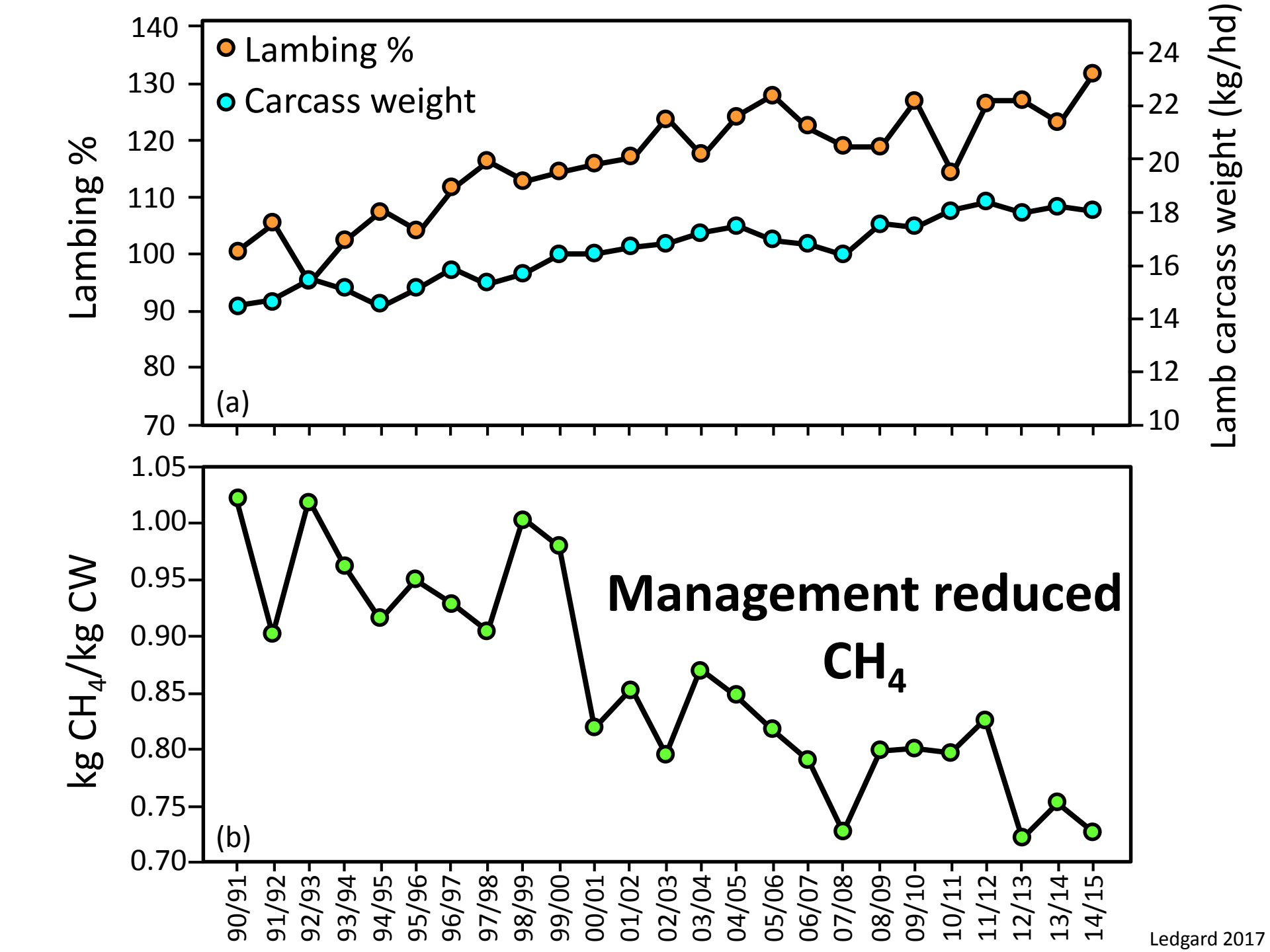
Lamb growth rate (g/hd/d)	Energy per lamb per day	Days on farm	Energy consumed per lamb
100	13	100	1300
200	17	50	850 (↓53%)
300	22	33	726 (↓79%)

MJ ME: megajoules of metabolisable energy

Based on Brown 1990

Sheep numbers in New Zealand





Ledgard 2017

Forestry = frontier activity

- High altitude land
  - Steep land
  - Soil erosion, infertile soils
  - Climate limitations
- "Frontier" of sustainability for conventional agriculture
- Land use distorted by subsidies

Courtesy Mark Bloomberg

Frontier of sustainability ?

Photo source: stuff.co.nz

Photo: DJ Moot
Lincoln University

New Zealand's specialist land-based university

Photo source: stuff.co.nz

Saviour or Sinner for east coast?

East Coast – August 2019

Photo: Paul Cook
Lincoln University

- 2 Million ha for wilding pines = Management!
- Need managed planting of appropriate land
- “Only biological emissions offset on-farm” PCE

Conclusions

- Fossil fuel for energy is driving climate change
- Population increases energy and food demand
- Intensification of land use reduces deforestation
- And allows reforestation/regeneration
- Mgmt. for legumes in hill country intensification
- Legume based systems deliver on GHG targets

Which legume drives your system?

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External Data Sources

Slide 3:

CO_2 at Muana Loa, Hawaii. Dr. Pieter Tans, NOAA/ESRL (www.esrl.noaa.gov/gmd/ccgg/trends/) and Dr. Ralph Keeling, Scripps Institution of Oceanography (scrippsco2.ucsd.edu/). (28/5/2019).

Slide 4:

Energy consumption (TWh) graph data sourced from: https://ourworldindata.org/energy-production-and-changing-energy-sources. Accessed 2/10/2019. Original graph data derived from: Vaclav Smil (2017). Energy Transitions: Global and National Perspectives. & BP Statistical Review of World Energy. Online: http://vaclavsmil.com/2016/12/14/energy-transitions-global-and-national-perspectives-second-expanded-and-updated-edition/ ; https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html.

Slide 5:

NASA. 2019. Ice mass measurement by NASA's GRACE satellites. https://climate.nasa.gov/vital-signs/ice-sheets/ ; Wiese et al. 2016.

Slide 6:

Data sourced from: https://ourworldindata.org/energy-production-and-changing-energy-sources Accessed 2/10/2019; Smil 2017; http://www.fao.org/faostat/en/#data/OA Accessed 4/10/2019. Regression equation fitted by DPR Team, Lincoln University.

Slide 7/8:

Recreated from Evans 1998, van Ittersum 2011 & FAOSTAT 2019. FAOSTAT. 2019. Global population, rice and wheat yields, N fertiliser consumption, Irrigated land area 1961-2018 sourced from: http://www.fao.org/faostat/en/#data/OA. Accessed 4/10/2019. (some points removed for clarity. General trend lines added by eye DPR Team, Lincoln University).

Slide 9;

Redrawn from: https://ourworldindata.org/grapher/global-land-spared-as-a-result-of-cereal-yield-improvements . Accessed: 4/10/2019. Based on data sourced from: http://data.worldbank.org/data-catalog/world-development-indicators. Accessed: 18/7/2017.