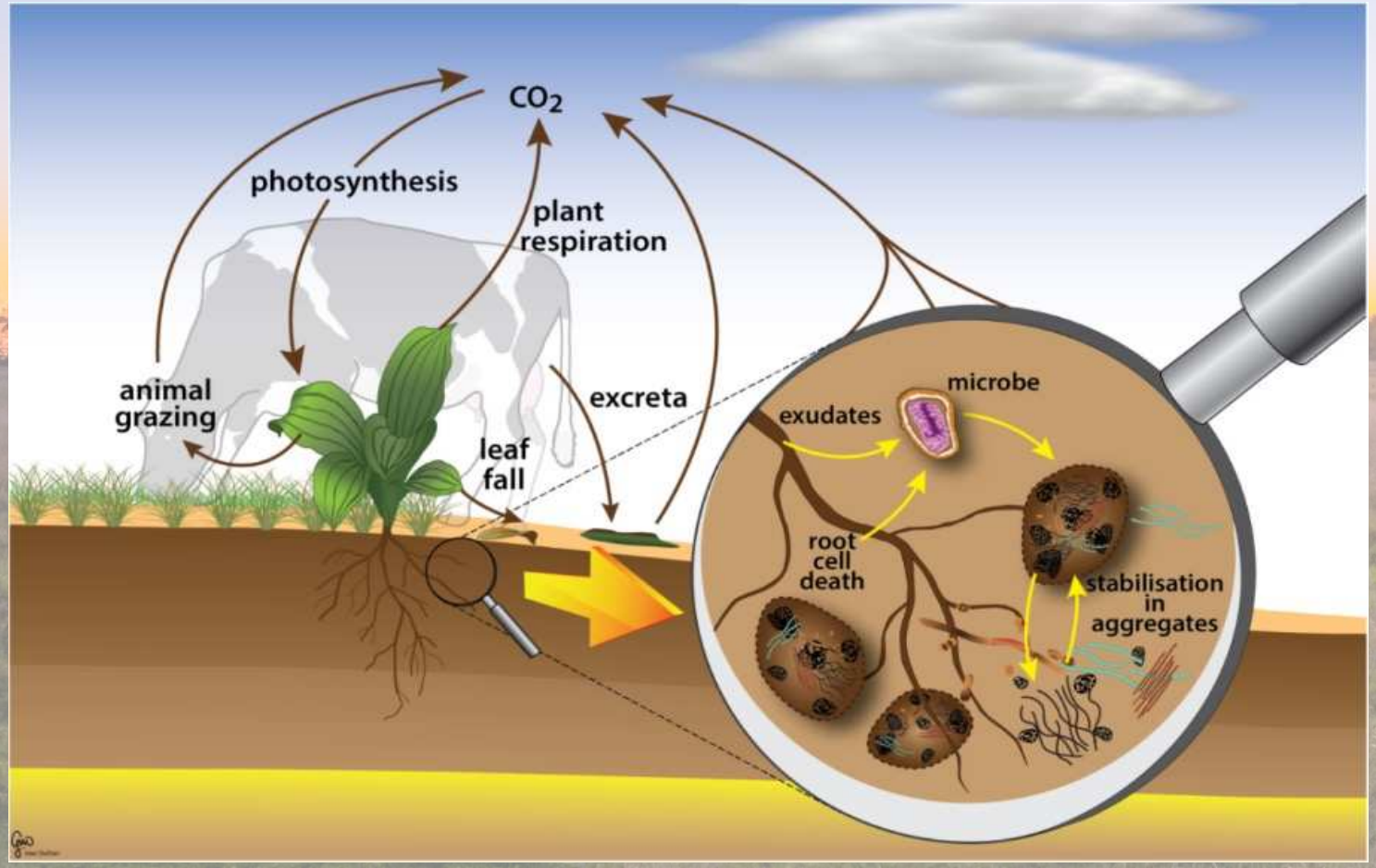
NEW ZEALAND
AGRICULTURAL GREENHOUSE GAS
Research Centre

Soil Carbon Management

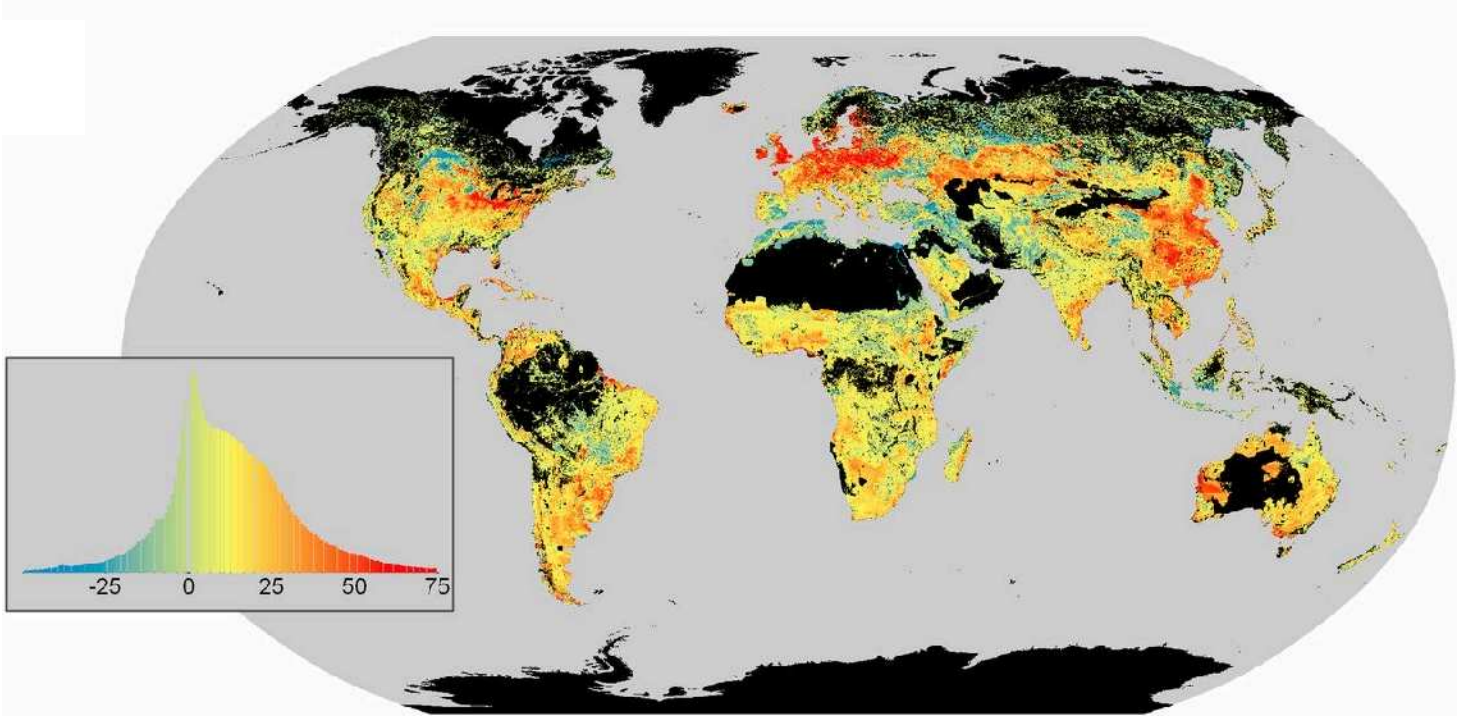
Louis Schipper, Aaron Wall



Current and future research

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

“Soil carbon debt of 12,000 years of human land use” due to excessive cropping and over grazing



Red: high loss
Yellow: intermediate loss
Blue: gains

Need approaches that:

- Reduce losses
- Achieve gains

Jonathan Sanderman et al. PNAS 2017;114:36:9575-9580

Measurement using carbon balance approach

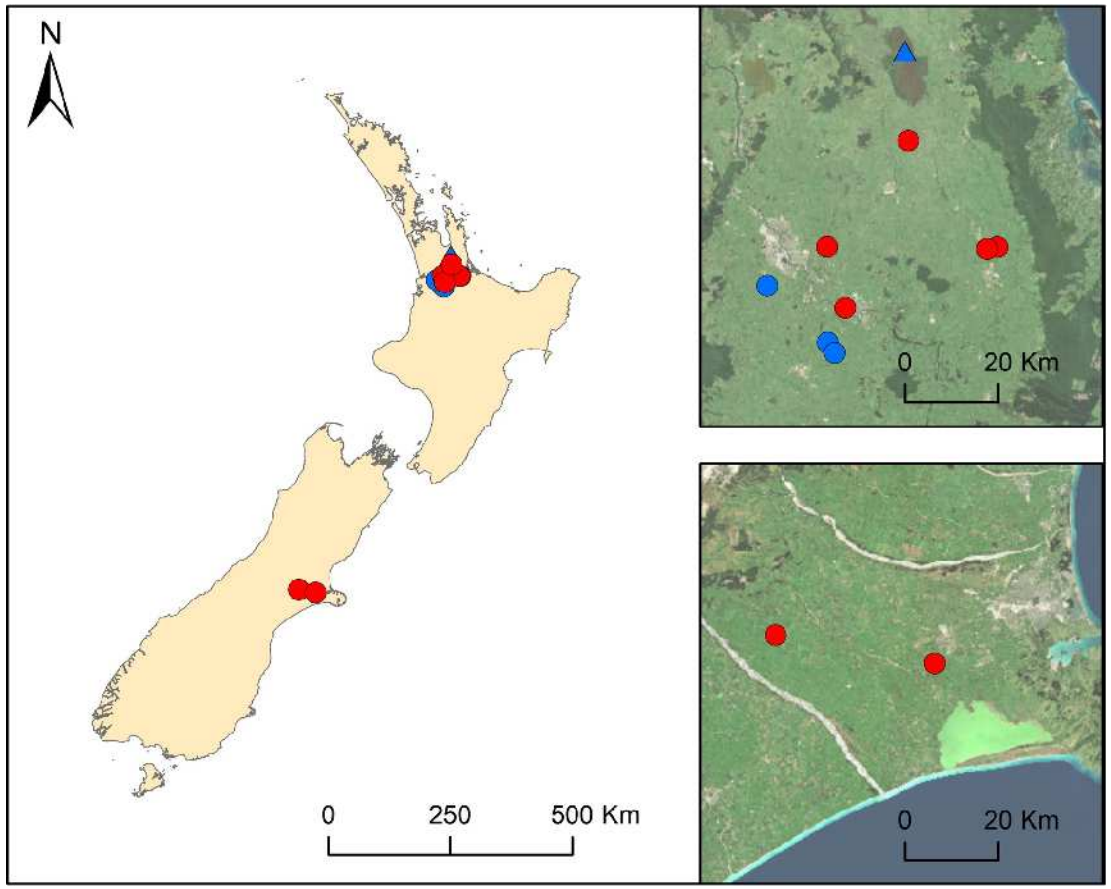


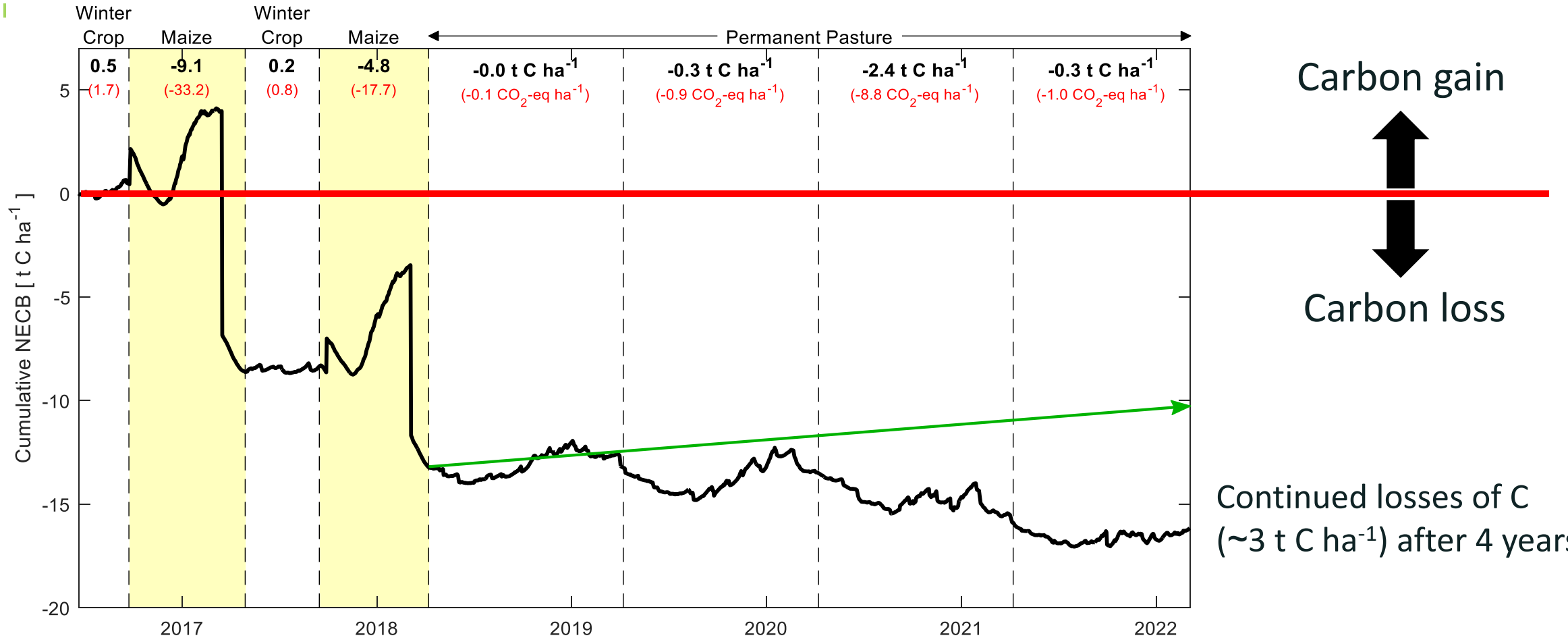

Photo: Anne Wecking

(i) What is the best supplemental/alternative feed

- Maize silage
- Turnips/kale/rape
- More diverse swards

Used during pasture renewal resulting in bare soil with carbon losses

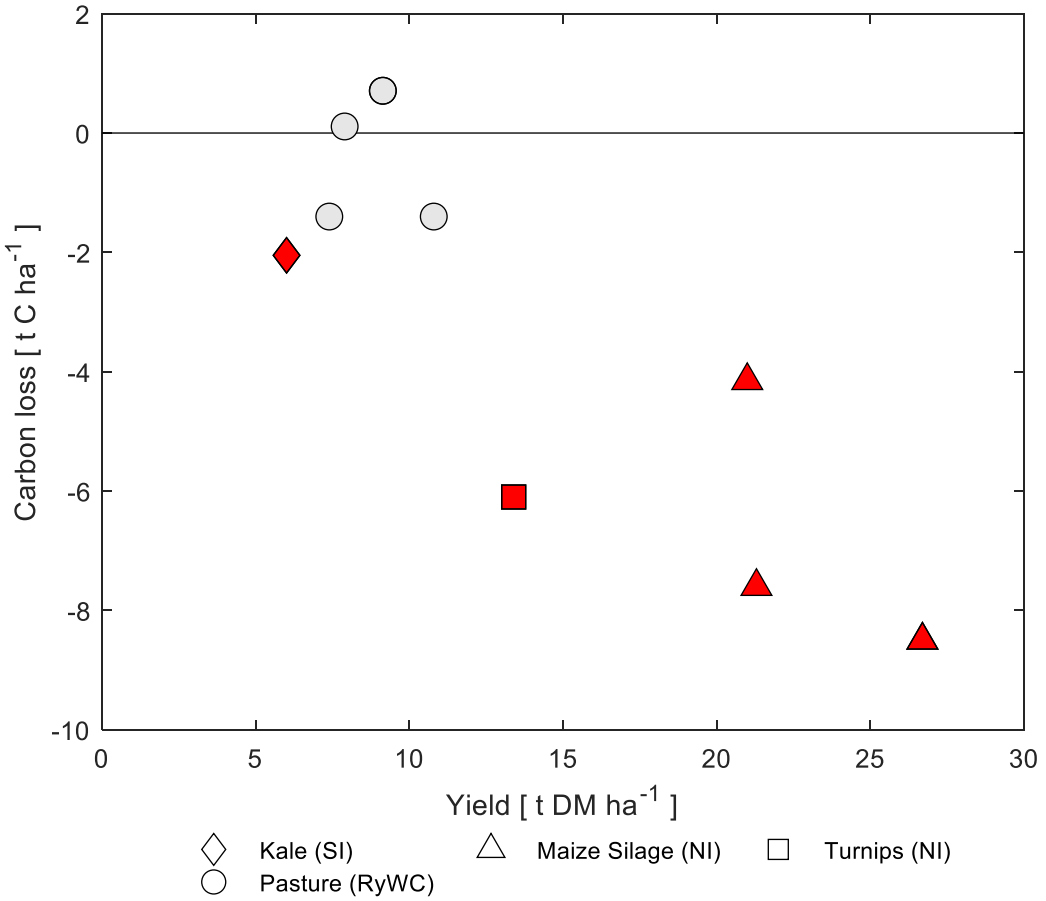
(i) Best supplemental feed: Losses during two maize crops



Continued losses of C (~3 t C ha^{-1}) after 4 years

(i) Best supplemental feed: carbon loss vs yield

- Periodic maize and winter forage could emit 1% and 5.9% of net national emissions, respectively
- The carbon recovery rate under pasture will determine the safe return period



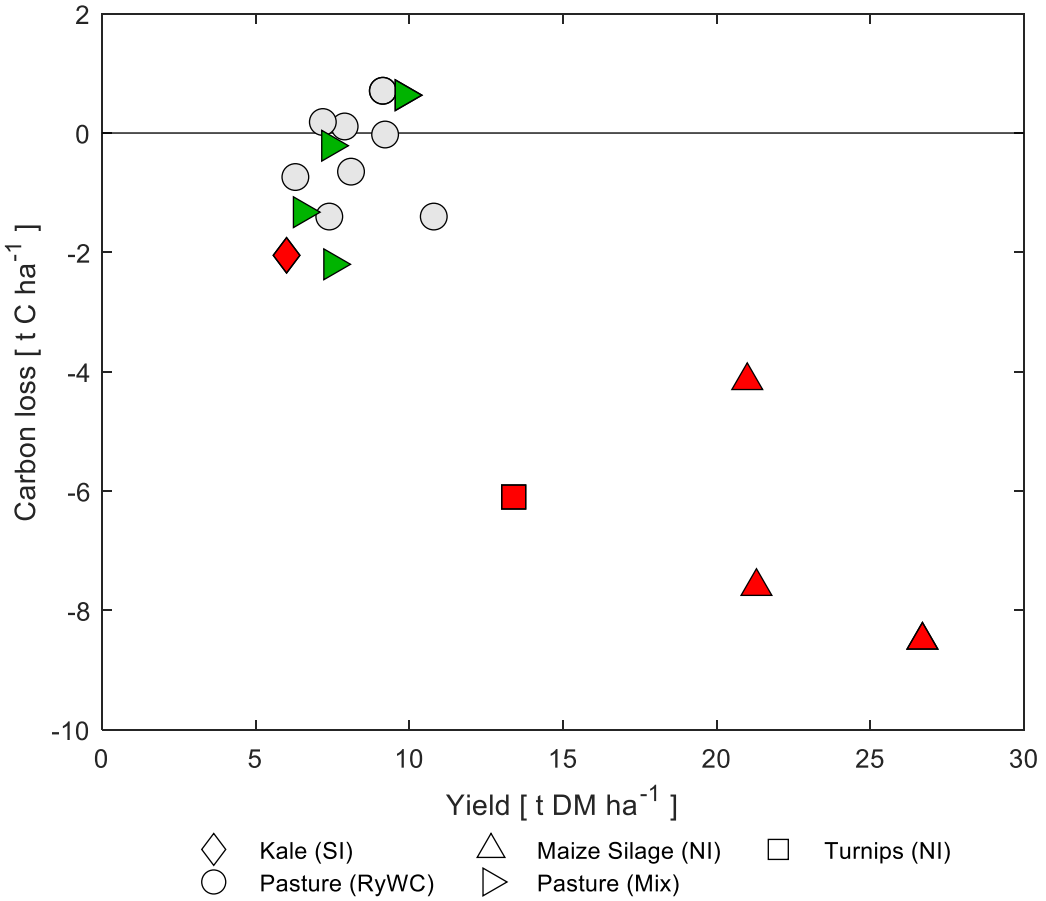
Carbon gain

Carbon loss

For October to April

(i) Best supplemental feed: diverse pastures

- No evidence that diverse pastures increased C stocks



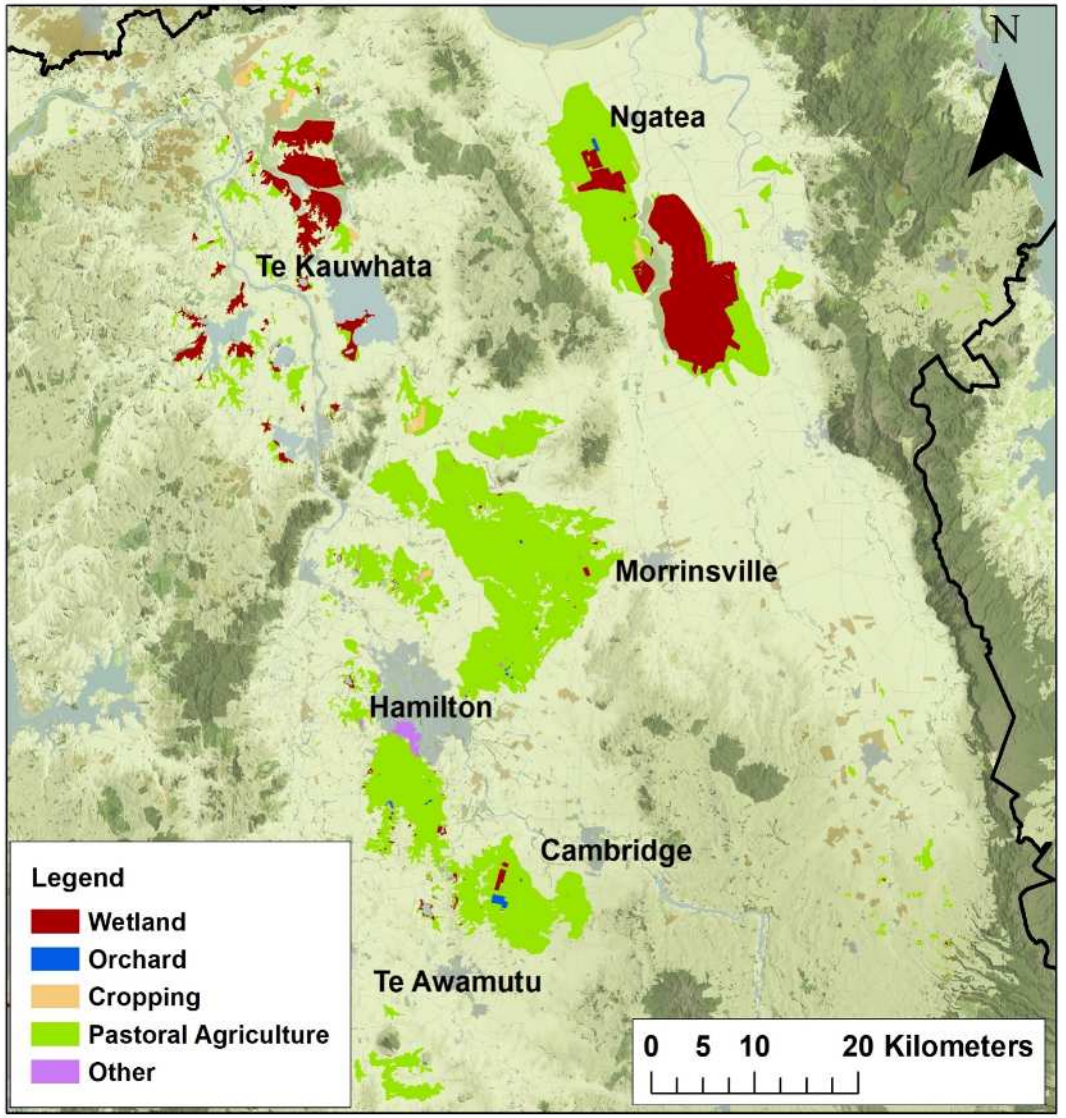
Carbon gain

Carbon loss

For October to April

(ii) Drained peatlands

- About 160,000 ha drained peat
- Important part of economy
- Peatland drainage leads to greenhouse gas emissions
- Will continue for 100s years



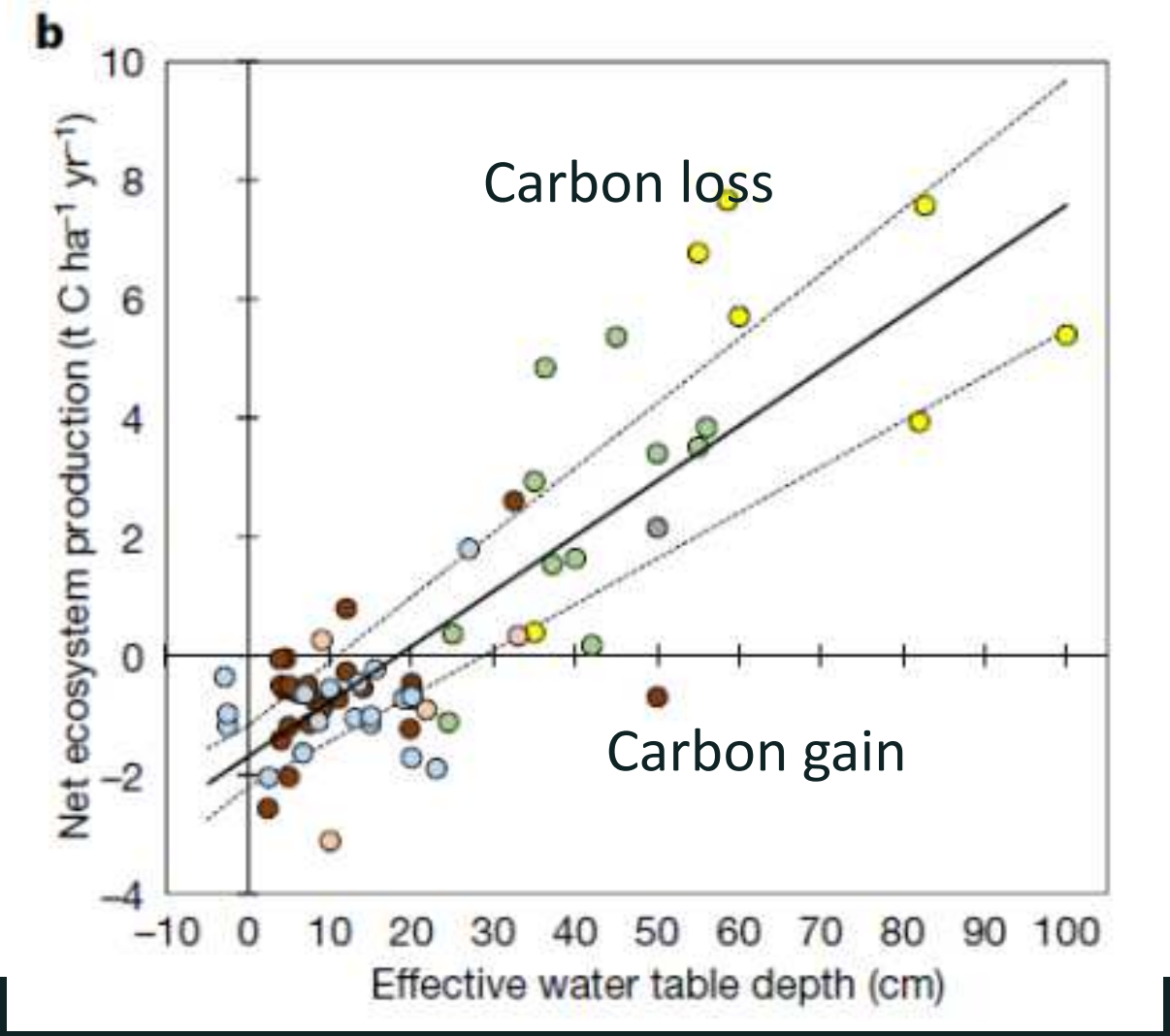
Adapted from Jack Pronger, Manaaki Whenua

(ii) Drained peatlands: Using IPCC defaults for grassland and crops

- Current methodology estimates about 4.4% of NZ net emissions
- Updated methodology estimates about 9.8% of NZ net emissions
- **Limited** NZ data 3 sites (6 years total) agrees with latter estimate

(ii) Drained peatlands: raising water tables

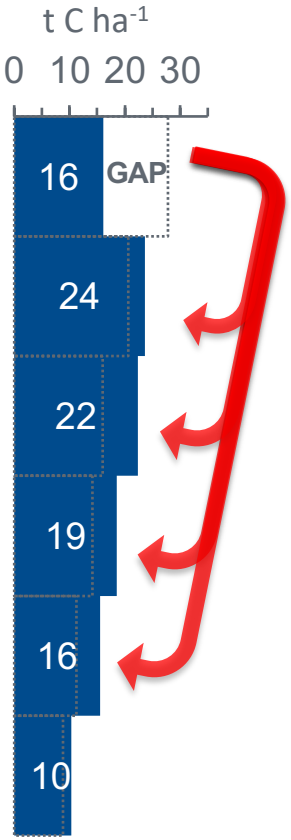
- Wet agriculture
- Restoration to peatlands that capture carbon



Evans, C.D., Peacock, M., Baird, A.J. *et al. Nature* **593,** 548–552 (2021).

(iii) Full inversion tillage (FIT) pasture renewal

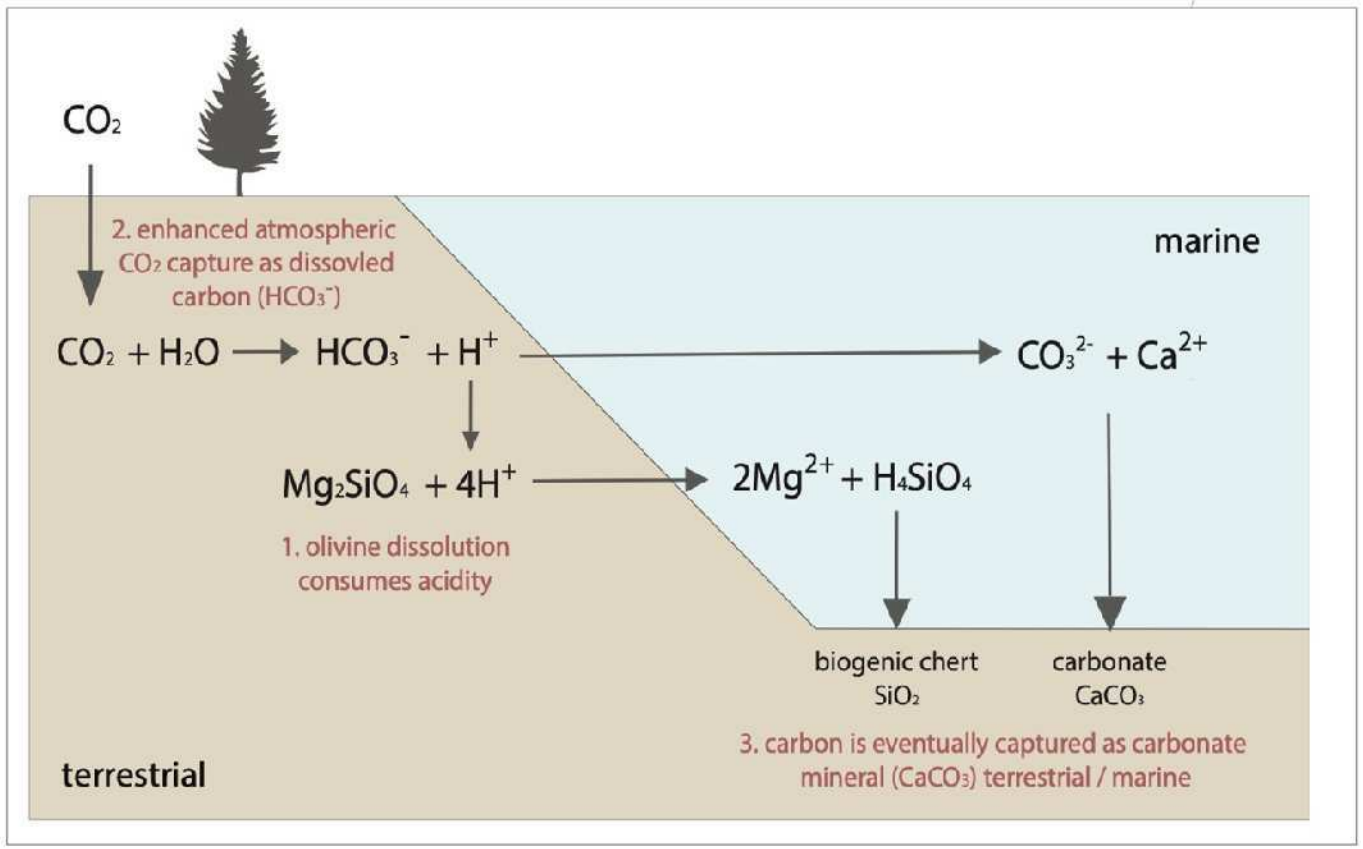
- One-off FIT renewal event compared to pasture or no-till:
  - Increased production of pasture & forage crops
  - Modelled SOC sequestration = 0.62-0.82 t C/ha/yr
- Forecast National Impacts:
  - Applied to all suitable land (≈2.0 – 2.6 M ha)
  - Sufficient to offset 9.6-17.5% of NZ Ag emissions over 20 yrs



Lawrence-Smith et al. 2020 Global Change Biology

(iv) Enhanced rock weathering

- As silicate minerals weather, they capture CO_2
- UK study could offset 45% of national emissions
  Kantzas et al (2022) Nature Geoscience 15: 382–389
- Current NZ trials (with Dunite) are ongoing (results expected soon)



Summary

- Important to protect and maintain soil carbon
- Threats and opportunities:
  - Optimising cropping and sufficient recovery periods
  - Maintaining plant cover and below-ground inputs
  - Drained peat, raised water tables
  - Full inversion tillage
  - Enhanced rock weathering

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New Zealand Government
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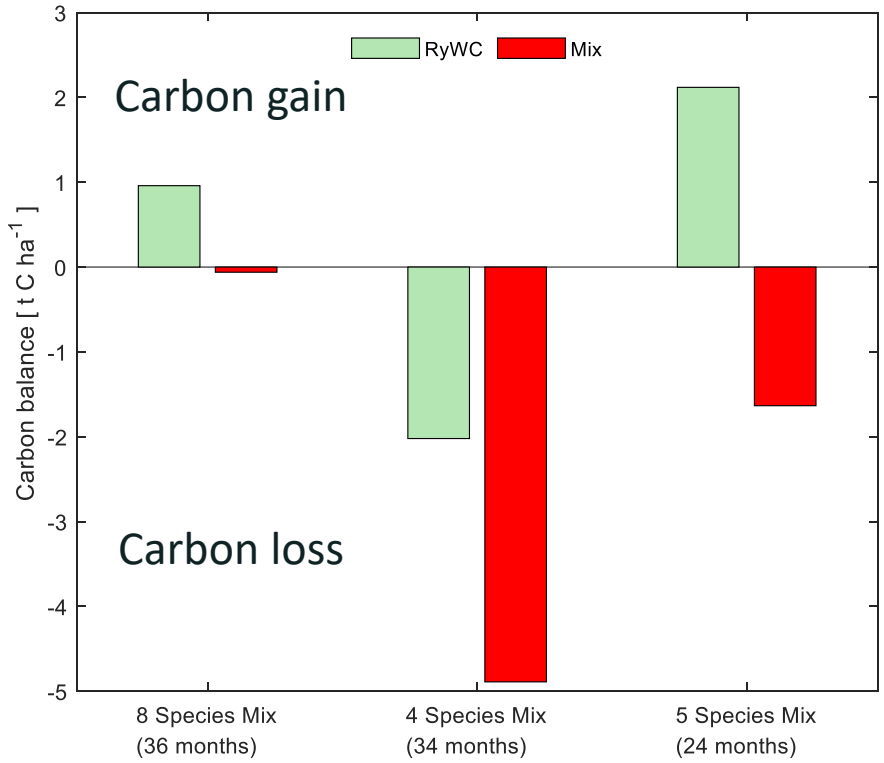
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin
THÜNEN

(i) Best supplemental feed: plant diversity

Three studies found more carbon loss with increased pasture diversity

Potential reasons:

- Difficulty establishing and maintaining diversity
- Allocation to above ground biomass



Currently lacking evidence for diverse pastures to increase soil C at paddock scale

Data also from Manaaki Whenua