



Trade-offs in reducing nitrogen losses and maintaining soil carbon on dairy farms

Reducing nitrogen losses from farms

MBIE Endeavour Programme 2016-2021



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19 October 2021



► Healthy land, healthy soil, healthy people

Our land 2021

New Zealand's Environmental Reporting Series



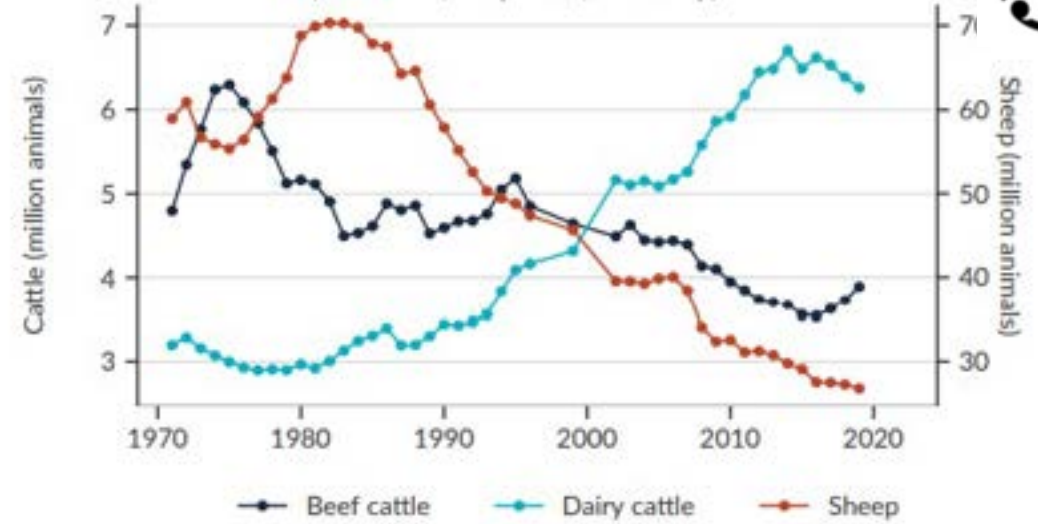
Ministry for the
Environment
Manatū Mō Te Taiao

Stats **NZ**
Tatauranga Aotearoa

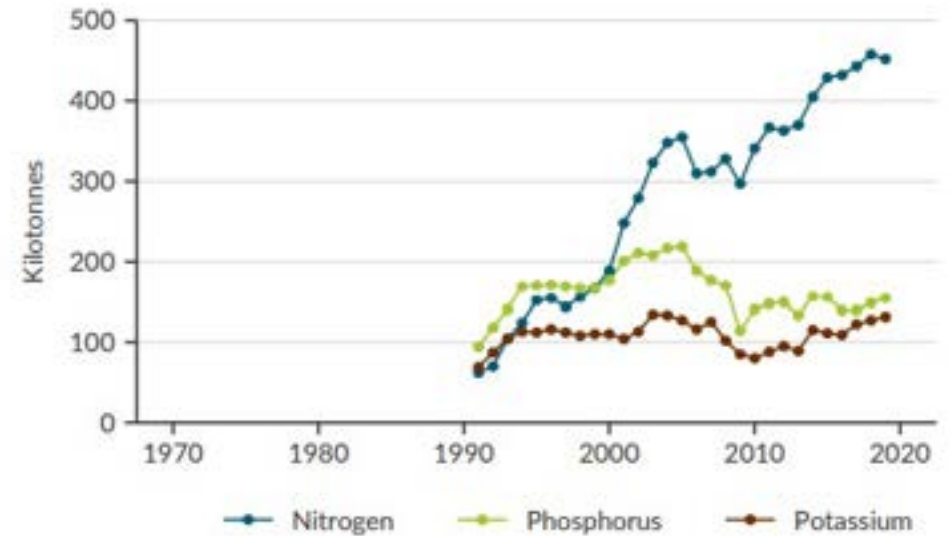


New Zealand livestock numbers

(Beef cattle, dairy cattle, and sheep)



New Zealand fertiliser sales



Canterbury Plains



6

- 40% of NZ's land area is exotic grazed grassland
- Dairy cattle num
- Government tar export earnings
- Irrigated land (5 dairy farming) c
- 64% irrigated la
- Evidence that ir of soil carbon a
- Need to increas productivity, inc change
- Excess nitrogen freshwater ecosystems





MATAURANGA MAORI THEME

Project

Innovative ways to reduce farm nitrogen loss

M! tauranga M! ori Theme

"M! tauranga M! ori informed approaches to improve environmental quality in production contexts, consistent with the exercise of kaitiakitanga"

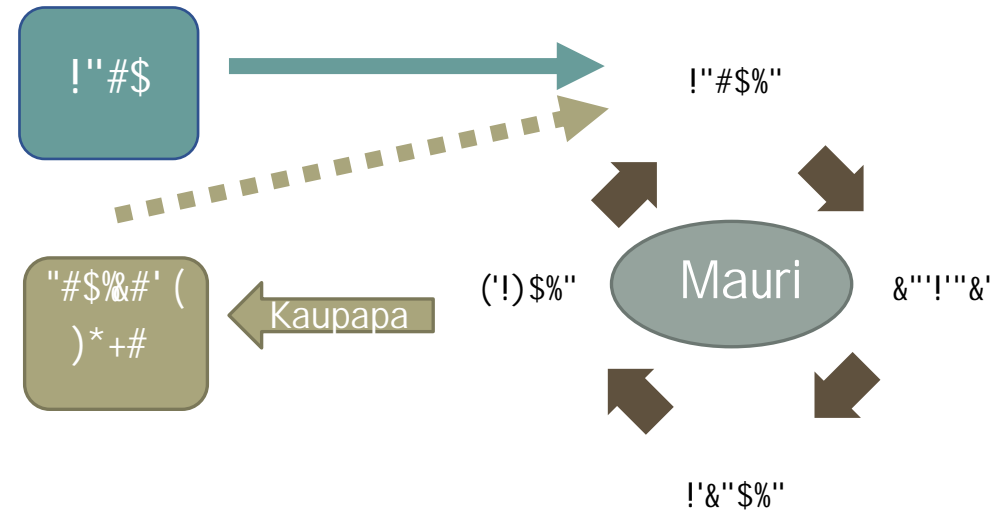


Plural knowledges
Collaboration not integration



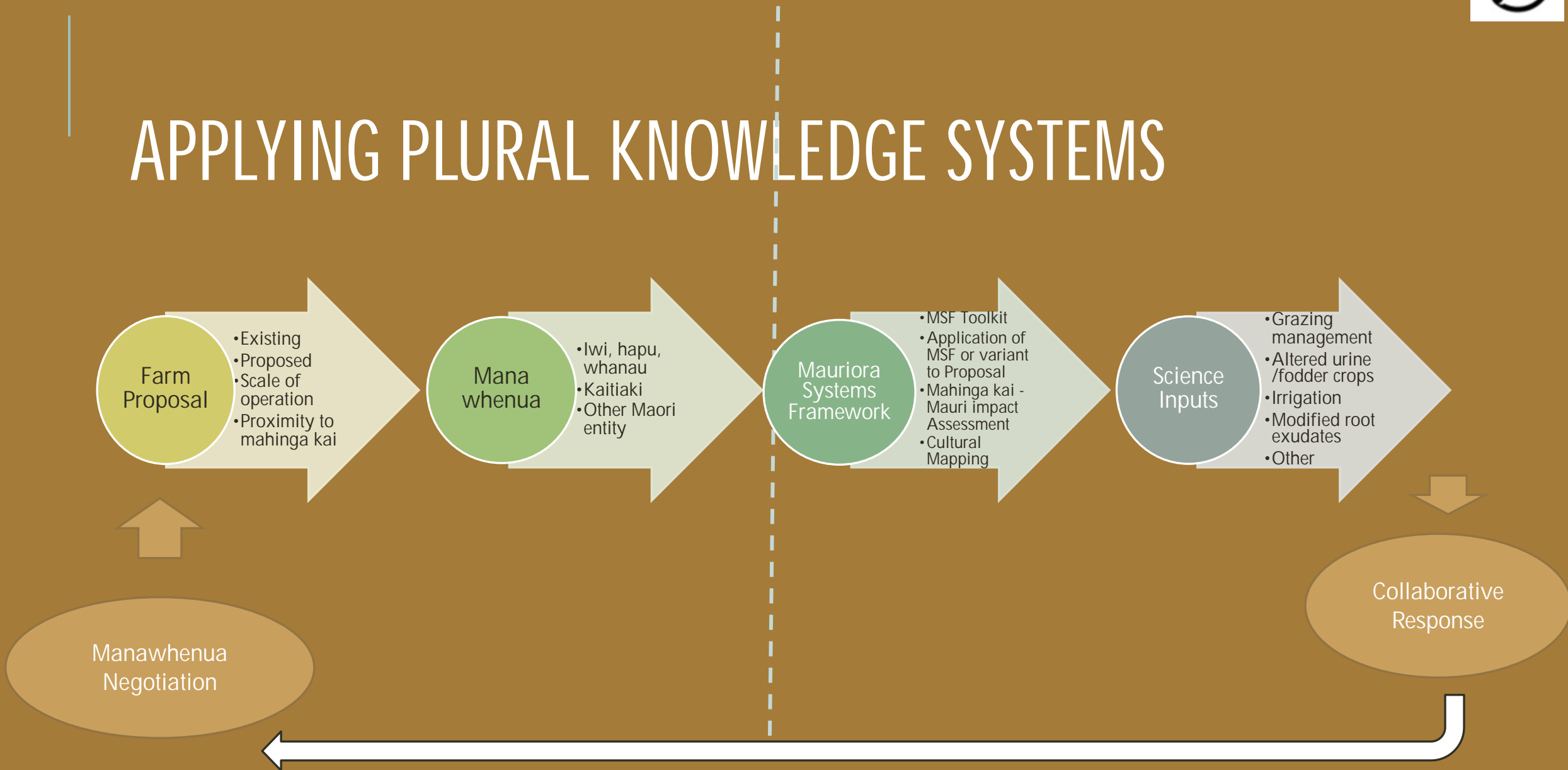
MAURIORA SYSTEMS FRAMEWORK: MAURI MONITOR

- ! Decision making grounded in Te Ao M! ori
- ! Interaction between taonga, kaitiaki, tikanga
- ! Focus = Protecting , maintaining & enhancing the mauri of taonga (valued resources) in the broader ecosystem
- ! Ki uta ki tai : Interconnection between taonga
- ! Ecosystem rather than property boundaries
- ! Mahinga kai as critical indicators of ecosystem health





APPLYING PLURAL KNOWLEDGE SYSTEMS





Ashley Dene Research & Developm



Balmoral stony silt loam
Bradley White
Manaaki Whenua



Lincoln University

William Talbot used an array of 40 lysimeters measuring nitrogen inputs and leaching losses in relation to sward composition, urine composition and added carbon



Key findings to reduce nitrogen leaching losses

- Incorporate Italian ryegrass and plantain into swards
- Reducing urine-N concentration (low N feeds/supplements) or amount in each urine patch (di-uretic)
- Incorporate winter-active crops
- Fodder beet urine has a potential BNI effect
- Applying readily available carbon to soil (no increase in N₂O emissions)



Talbot et al 2019 New Zealand Journal of Agricultural Research doi: 10.1080/00288233.2019.1581237

Talbot et al 2020 Nutrient Cycling in Agroecosystems doi: 10.1007/s10705-020-10050-4

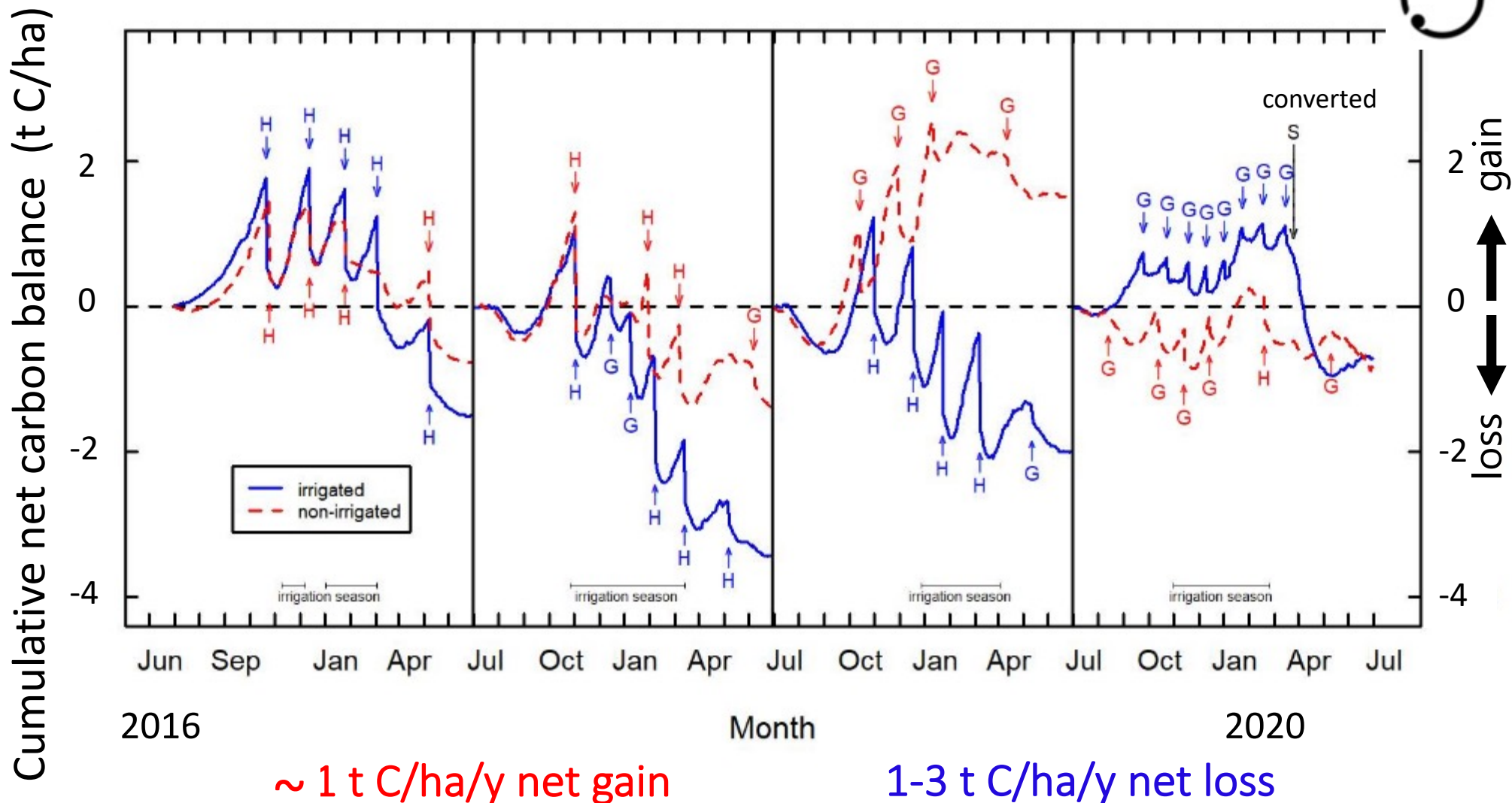
Talbot et al 2020 Soil Use and Management doi: 10.1111/sum.12652



Bradley White
Manaaki Whenua

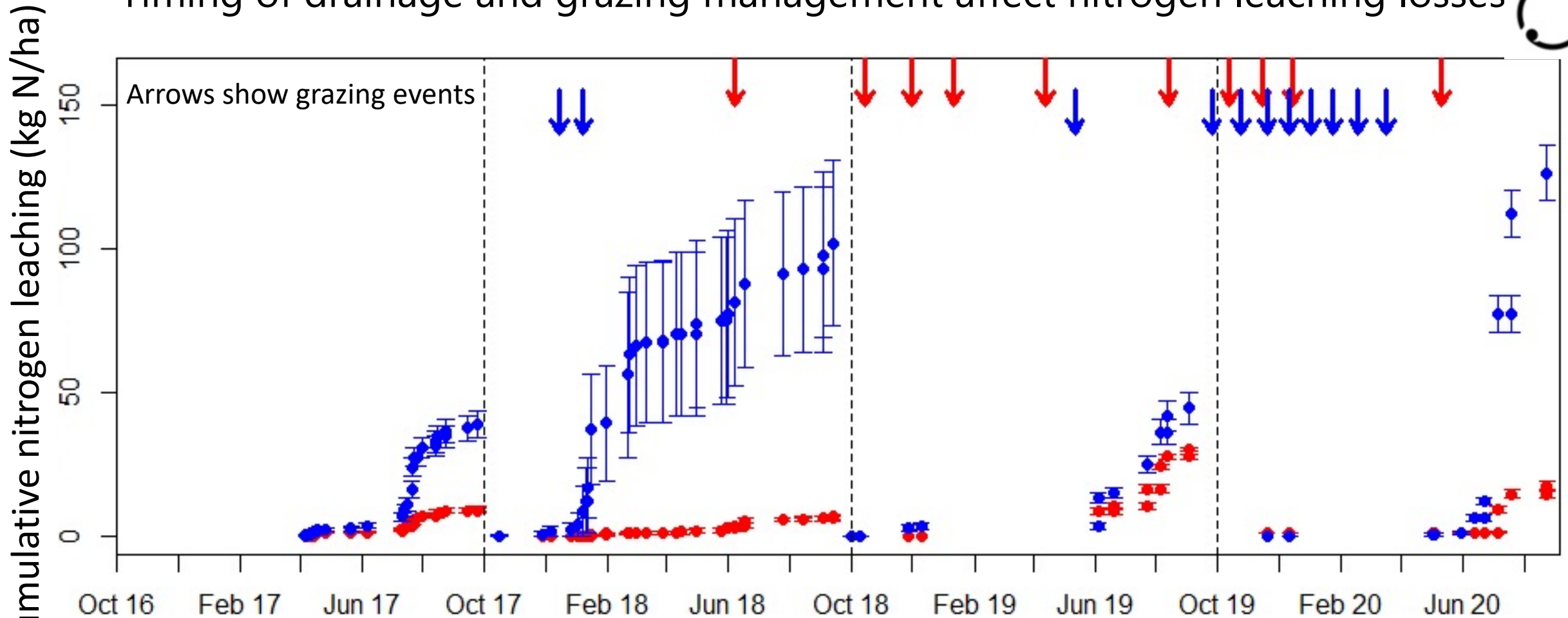


Carbon balance is affected by grazing and irrigation management



Laubach et al 2019 Science of the Total Environment doi: 10.1016/j.scitotenv.2019.06.40
 Graham et al 2019 Agricultural Water Management doi: 10.1016/j.agwat.2019.105790
 Graham et al 2021 Agricultural Water Management doi: 10.1016/j.agwat.2021.107233

Timing of drainage and grazing management affect nitrogen leaching losses



- 1.5 – 15 times greater nitrogen loss under irrigation
- Timing of drainage is important
- 3 times greater nitrogen loss with grazing relative to cut-and-carry

Trade-offs and recommendations



Soil carbon

- Losses of 1 t C/ha/y from non-irrigated lucerne for cut-and-carry
- 2-3 t C/ha under irrigation
- Grazing can lead to net carbon gain, particularly with high rates of supplementation

Nitrogen leaching

- Losses of 7 – 9 kg N/ha/y from non-irrigated lucerne for cut-and-carry
- Losses 3 times greater with grazing
- Losses of 39 – 102 kg N/ha/y under irrigation with mixed management
- Nitrogen inputs 60% greater under irrigation, losses 85% greater

Recommendations

- Lucerne is not a mitigation strategy for soil carbon and nitrogen leaching losses
- Grazing/cutting management leads to trade-off
- Deficit irrigation, particularly late in the season, will decrease water use, minimise drainage, and potentially prevent soil carbon loss
- Trade-off effects can be further explored using farm scale modelling



Bradley White
Manaaki Whenua

31 research
contributors

20 scientific
publications,
12 magazines

Numerous
farm visits

3 PhD
degrees
awarded

Engagement
with ECan,
MPI,
Overseer®

Framework for
engagement with
Tangata Whenua

For full details, go to the programme website at [Reducing nitrogen losses from farms](#)

For a short video of the programme highlights, go to [Video of highlights](#)

For recorded presentations of the full findings from the programme, go to [Presentations of findings](#)

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