The role of carbon sinks - soil carbon
Louis Schipper, University of Waikato
What does this mean for NZ?

- Increase on managed grassland = 16 million t CO₂
- NZ’s annual agricultural GHG emissions = 38.7 million t CO₂

Soil carbon also critical for soil health

http://4p1000.org/understand
Outline

- How much soil C do we have and can we store more?
- Measuring change
- Options for gains
- Avoiding losses
- Avoiding trade-offs, finding co-benefits
- Options explored
How much soil C do we have and can we store more?

National C sequestration potential (millions t)

Total storage = 124 Mt (0-0.15 m)

McNally et al. (2017) GLOBAL CHANGE BIOLOGY: 23: 4544-4555

Soil carbon stock (t/ha)
A proposed strategy to measure a change of 2 t C ha$^{-1}$

About 400 sites sampled to 0.3 m
- Cropland
- Horticulture
- Dairy
- Flat-rolling drystock
- Hill-country drystock

Resampling through time

Grassland samples from LCDB

Funded by Ministry Primary Industries
Options for gains

- **Full inversion tillage**
  - 0.3 – 0.5 t C ha\(^{-1}\) y\(^{-1}\)

- **Feed import**
  - 5 t C ha\(^{-1}\) y\(^{-1}\)
  - Measured 0.7 t C ha\(^{-1}\) y\(^{-1}\)
  - Modelled 0.3-0.4 t C ha\(^{-1}\) y\(^{-1}\)

- **Increase species diversity**
  - Up to 0.8 t C ha\(^{-1}\) y\(^{-1}\)

References:
- Wall et al (accepted) Agriculture, Ecosystems and Environment
Avoid losses – improved renewal processes


10% renewal yr\(^{-1}\) of dairy pasture = 260,000 ha
Avoiding trade-offs, finding co-benefits

- Critical to ensure that mitigation practices designed to reduce N₂O and CH₄ do not compromise soil carbon stocks and visa versa
- Can we get wins in production and soil carbon accumulation
Avoiding trade-offs, finding co-benefits

Loss to atmosphere

Carbon gain not including losses in exported product
We need to develop one for pasture-based agriculture

## Management practices: Options explored to date

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<thead>
<tr>
<th>Tested or under testing</th>
<th>Losses/lost</th>
<th>Maintain</th>
<th>Gains/gained</th>
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<td>Irrigation</td>
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<td>Biochar</td>
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<td>Pasture renewal process</td>
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<td>Maize</td>
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<td>Conversion from forest to pasture</td>
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<td>Conversion from pasture to forest</td>
<td>Conversion to dairy?</td>
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<td>Known unknowns</td>
<td>Nitrogen fertiliser, fodder cropping, plantain, cut and carry, tussock management, grazing regimes...</td>
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**Synthetic reviews:**
Summary

• “The amount of carbon in soil is highly variable and, while soil carbon can be gradually increased through careful management, it can also be rapidly lost by inadvertent actions.” PCE (2019)

• We are identifying those practices that increase or decrease soil C
• We have developed a system that will allow us to track changes in soil carbon stocks

• “I wish agricultural innovation got as much attention as the impact on climate change from electricity, because its success is just as critical to stopping climate change.” Bill Gates 26th March 2019

Parliamentary Commissioner for the Environment (2019) Farms, forests and fossil fuels: The next great landscape transformation?
https://www.gatesnotes.com/Energy/We-should-discuss-soil-as-much-as-coal
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