

Soil carbon in grazing businesses

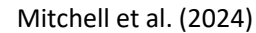
Warwick Badgery

NSW Department of Primary Industries and Regional Development

Overview

- To assess potential benefits of increasing soil C to a grazing business





Building soil C

Conversion from crop to pasture

- 5-year pasture phase: 0.74-0.78 t C/ha/year (0-30 cm) (Badgery et al. 2014; 2020)
- Longer-term: 0.26 t C/ha/year (25 years); 0.4 t C/ha/year (Chan et al. 2011)

Increasing nutrients

- Addition of superphosphate 0.5 t C/ha/year (20 years; Coonan et al 2019)

Grazing management (and changes to stocking rate)

- 0-0.2 t C/ha/year (McDonald et al. 2023)

Pasture improvement

- Establishing legumes: 0.38 t C/ha/year
- More productive grasses: 0.1 t C/ha/year (Henry et al. 2024)

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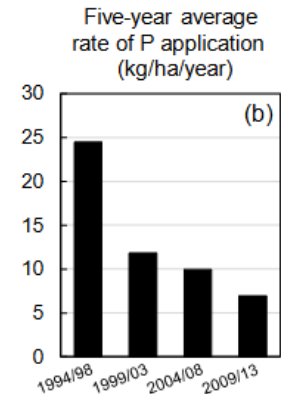
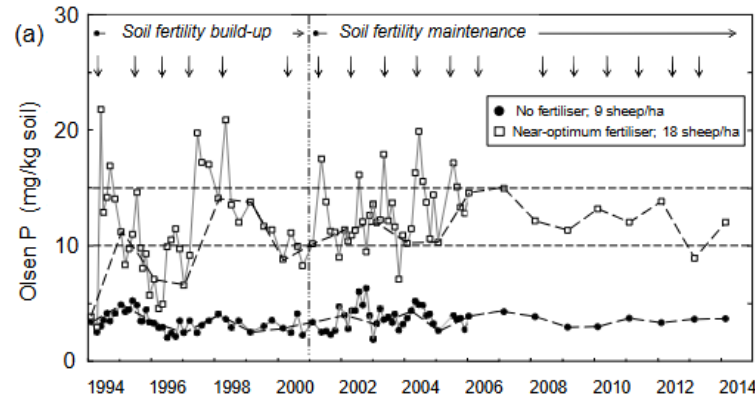
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Long-term P trial

20-year trial investigating P fertiliser and stocking rate

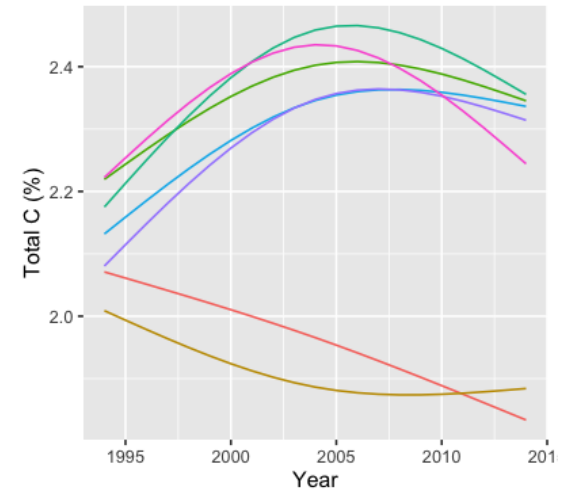
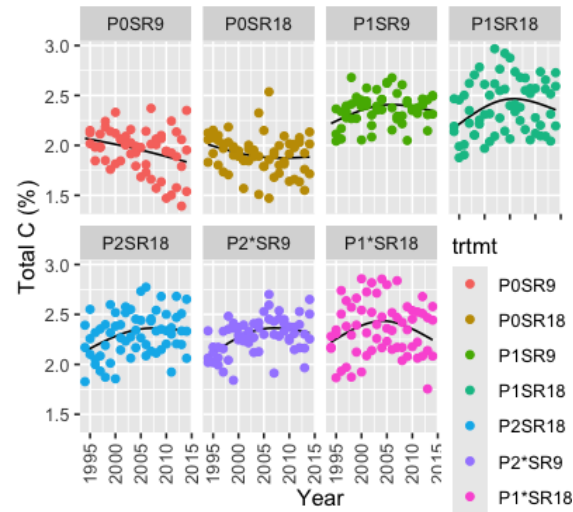


Simpson et al., (2015); Five Easy steps

Long-term P trial

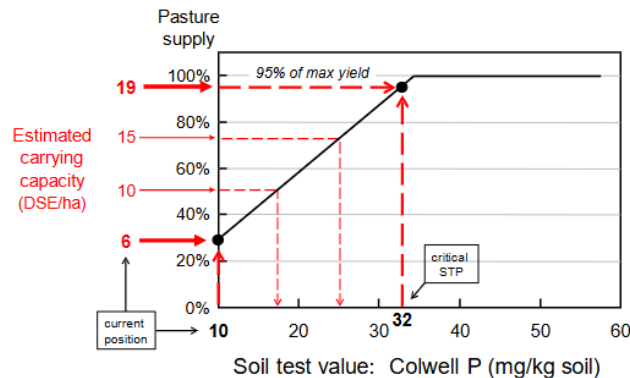
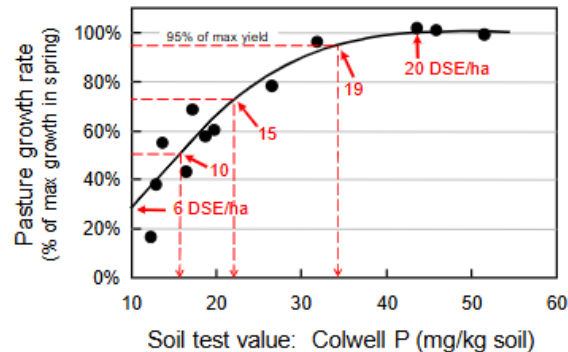
Results

- P fertiliser built soil C for ~10 years before reaching a new equilibrium
- Treatments without P decreased C steadily
- Stocking rate had minimal influence
- Substantial variation over time even in small plots (0.33-0.66 ha's)



Business benefits

- Pasture productivity increases up to optimum soil P levels
- Higher stocking rates to utilise additional pasture production
- Legume response is important, keep an eye on other limitations (e.g. pH, K soil depth/water)



Business benefits

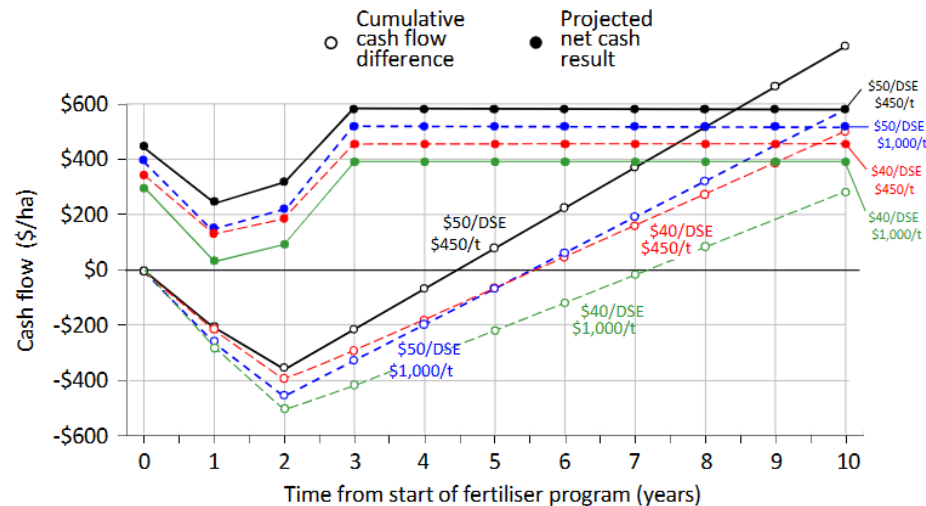
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- Increased profitability per ha



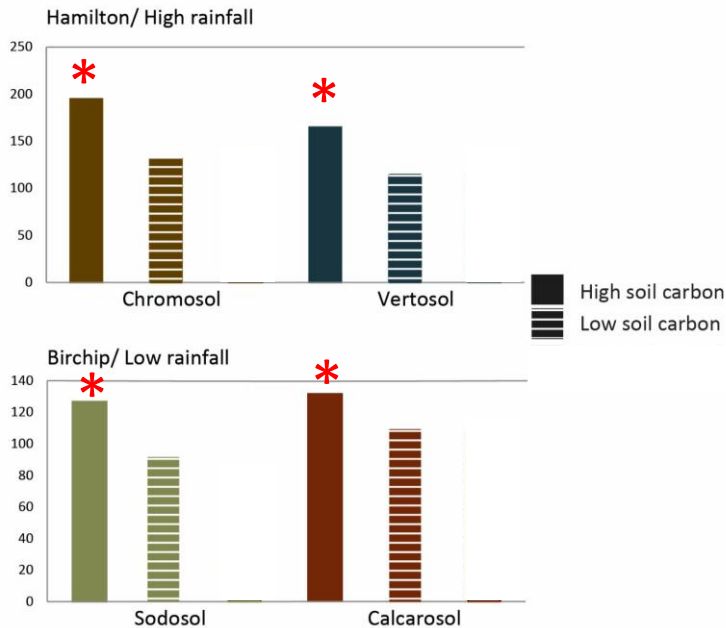
Cash flow budget	Current regime	Projected fertiliser option →					
Year	0	1	2	3	4	5	6+
Stocking rate (DSE/ha)	10	11.5	13	13	13	13	13
Fertiliser rate (kg/ha)	90	179	179	117	117	117	117
Expected Soil P fertility (mg Colwell P/kg)	17	19	22	22	22	22	22
^(a) Livestock gross margin income (\$/ha)	\$500	\$575	\$650	\$650	\$650	\$650	\$650
^(b) Fertiliser cost [incl. spreading] (\$/ha)	\$50.50	\$90.55	\$90.55	\$62.65	\$62.65	\$62.65	\$6.65
^(c) Livestock purchase cost (\$/ha)	\$0	\$240	\$240	\$0	\$0	\$0	\$0
^(d) Net cash result (\$/ha) (= a - b - c)	\$449.50	\$244.45	\$319.45	\$587.35	\$587.35	\$587.35	\$587.35
^(e)							
Annual difference in cash flow due to new fertiliser program (\$/ha) (= d - e)	\$0	-\$205.05	-\$130.05	\$137.85	\$137.85	\$137.85	\$137.85
Cumulative cash flow position with interest (\$/ha)	\$0	-\$213.25	-\$357.36	-\$220.32	-\$71.51	\$78.24	228.07+
Additional livestock capital (\$/ha)	\$0	\$240	\$480	\$480	\$480	\$480	\$480
Internal rate of return after 5 years						37%	

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Soil Carbon benefits in N mineralisation



Annual nitrogen mineralisation (kg N/ha/year)

- 24 to 77 kg N/ha/year more mineralised on high SOM soils
- Forage value: \$41 to \$95/ha/y
- Urea value: \$85 to \$105/ha/y

Carbon markets

- 5% risk of reversal buffer
- 25% temporary discount buffer applied to first sampling
- Consider cost of monitoring and administration of the project
- Understand potential sequestration levels over the long-term (often 10-30 t CO₂e/ha for project life)
- Stacking markets is likely to have greater benefits (IFLM method under development timber and soil C; biodiversity and environmental markets)

Greenhouse gas emissions intensity

Aim to reduce emissions while maintaining or increasing production

GHG Emissions

- Avoided emissions
- C sequestration

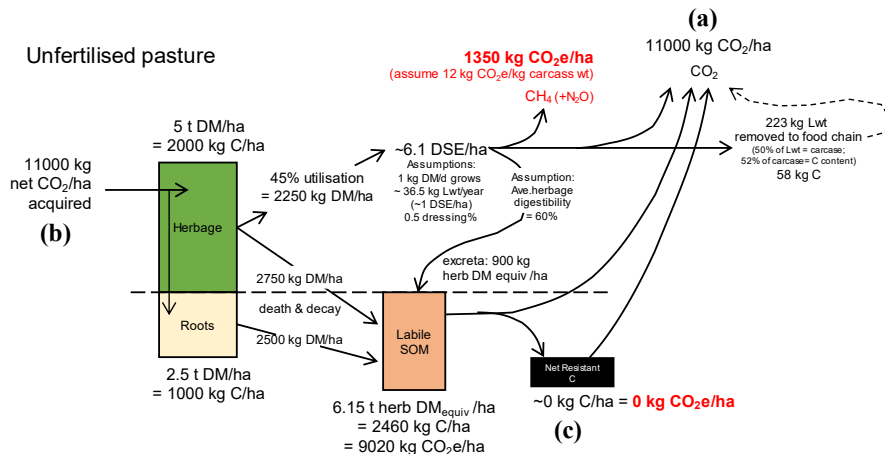


Production

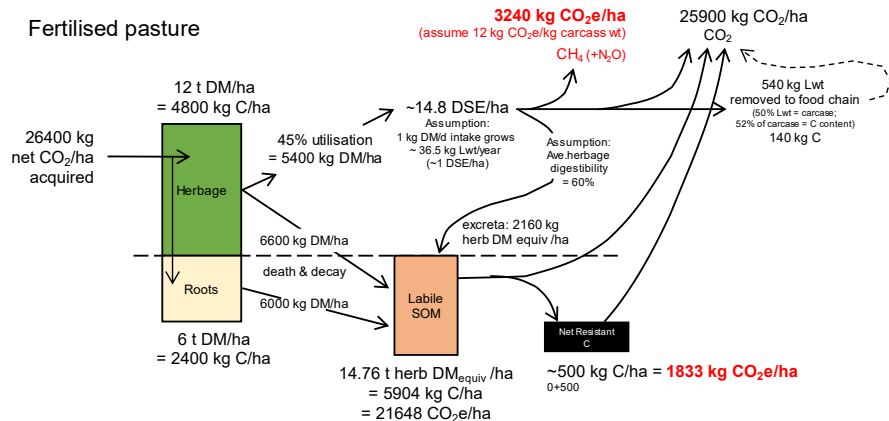
- Efficiencies that increase production with the same emissions

GHG emissions intensity = tonne of GHG per tonne of commodity

Greenhouse gas emissions intensity



Emissions Intensity: 6 kg CO₂e/kg live wt



Emissions Intensity: 2.6 kg CO₂e/kg live wt

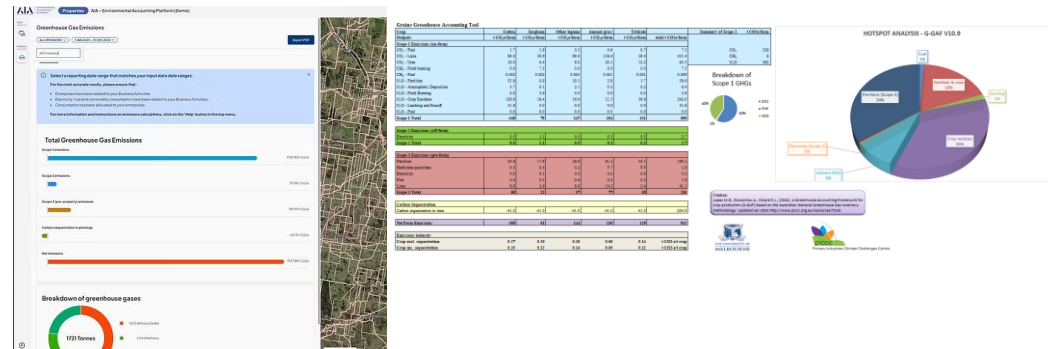
Calculating footprints and insetting

- Carbon footprint can be calculated for your farm
- Emissions intensity becoming of increasing interest with Scope 3 reporting within the supply chain
- Under the ISO standard soil C can be used to offset emissions – the ‘how’ is still being determined

Table 2: Expected values for emission intensity excluding sequestration (Wiedemann et al., 2015; Wiedemann, Yan, Henry, et al., 2016a)

Emission source	Emissions intensity expected range ¹	Unit
Sheep meat – breeding, growing, finishing	6–10	kg CO ₂ -e /kg LW
Wool	20–35	kg CO ₂ -e /kg greasy wool
Sheep meat (trade sheep) excluding scope 3 livestock emissions	2.5–4	kg CO ₂ -e /kg LWG
Beef – breeding, growing, finishing	9–18	kg CO ₂ -e /kg LW
Beef traded cattle excluding scope 3 livestock emissions	5–9	kg CO ₂ -e /kg LWG

SOURCE: MLA



Take home messages

- Reducing disturbance, increasing productivity and enhancing nutrient availability will all help build soil C
- Focus on a business outcome, which involves understanding GHG emissions, soil C sequestration and profit
- Using increased superphosphate fertiliser as an example:
 - There are greater potential returns from livestock production than C markets
 - The increased soil C can lower the emissions intensity of production

Tools and resources

Calculating carbon footprints:

- Primary Industries Climate Challenges Centre (PICCC) - Industry GAF tools and links to Soil Carbon (SOCRATES) and Vegetation tools <https://www.piccc.org.au/resources/Tools>
- Agricultural Innovation Australia - AIA Environmental Accounting Platform (EAP) <https://aginnovationaustralia.com.au/aiaeap/>
- **MLA Carbon Calculator and Quick Calculator** <https://carbon-calculator.mla.com.au/>
<https://elearning.mla.com.au/lessons/quick-balance-carbon-calculator/>

Five easy steps:

<https://www.mla.com.au/globalassets/mla-corporate/extensions-training-and-tools/5-easy-steps-guide.pdf>