Image credit: Arthur Lyons

Enterprise level natural capital accounting to connect local agroforestry decision making with local and global imperatives for restoration

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Introduction

- Trees are the nexus between **environment, food, fibre and fuel production and water**.
- Strategically integrating trees into agricultural systems can be a **win**[5]
- Australia is desperately in need of transformation in its agricultural landscapes to adapt to climate change, as well as **increase resilience** of its people and the natural environment
- We are exploring **natural capital** and natural capital accounting as a tool to help transform our agricultural systems and achieve **practice change** on the ground

Perennial Prosperity project

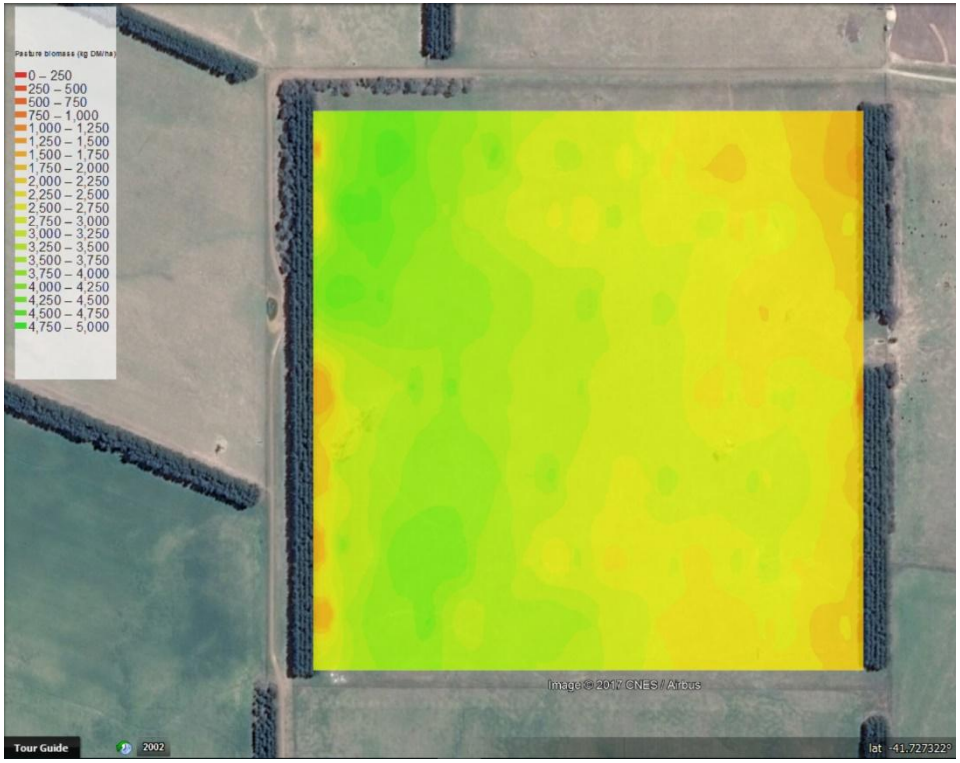
- We aimed to increase the area of trees on farms in southern Australia such that they **improve farm enterprise sustainability and profitability**
- We aim to achieve impact through improving the **value proposition for planting trees** on farms
  - moving from single factor decision-making to multi-factor
- Demonstrating optimum planting configurations
  - Commercial plantations
  - Environmental plantings
- Integration of values into a set of example **natural capital accounts** and an **environmental balance sheet**
- **Landscape transformation**

Demonstration plots

- We established over 200 ha of demonstration plots at 9 farms across Tasmania
  - These farms for the basis of our case study analysis
  - A mix of commercial and environmental plantings

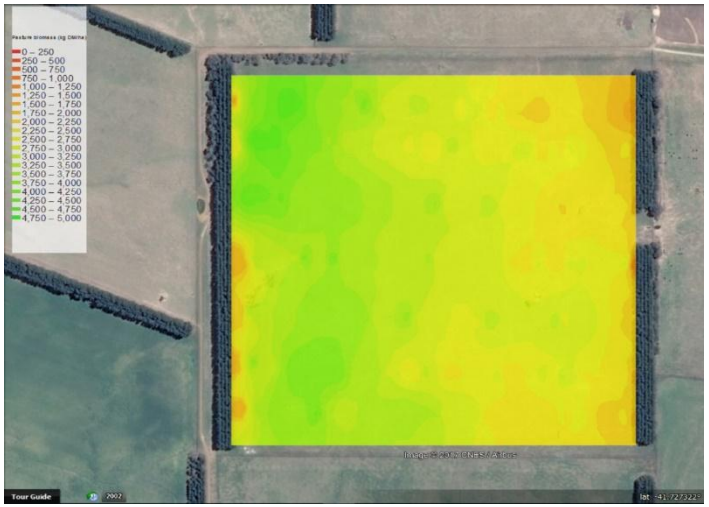
Quantifying the value of services from agroforestry systems - Ag productivity, Biodiversity, Carbon, Pollination, cultural

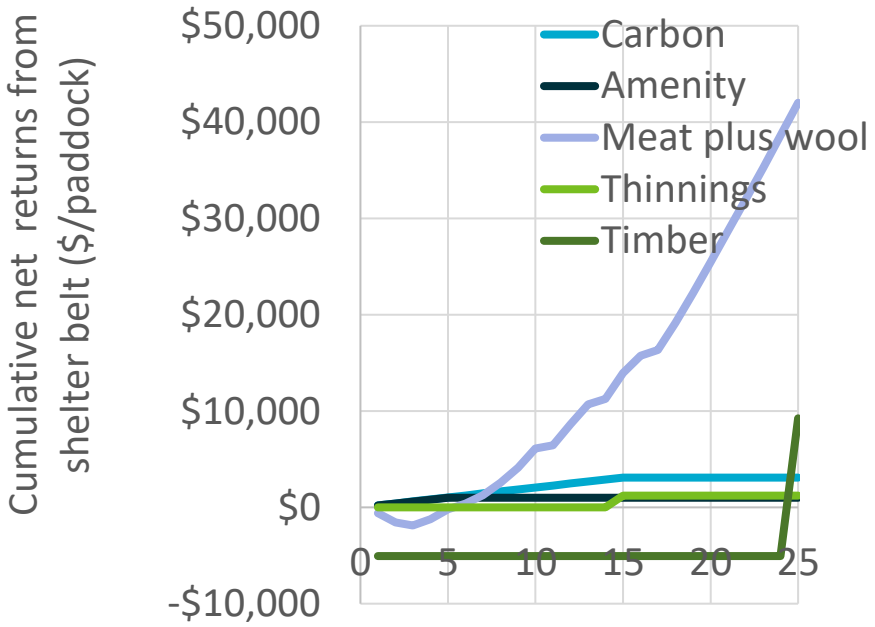
- *Agricultural productivity*
  - Including animal welfare and productivity
- *Biodiversity*
  - links CSIROs work on state and transition models with habitat condition
- *Carbon and Forest Products*
  - extends our understanding of carbon and forest products in shelterbelt situations
- *Pollination*
  - Understanding pollination benefits and adding value to our Manuka and leatherwood work
- *Cultural*
  - Understanding how residents and landholders value trees



Agricultural production

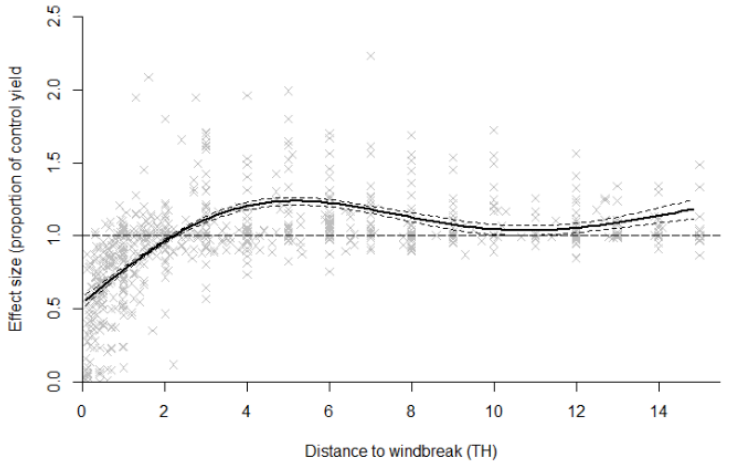
- Previous work showed strong returns from a 1 ha *P. radiata* shelter belt in a 25 ha pasture paddock at Cressy, Tasmania
- Gross returns over 25 years were ~$54k, consisting:
  - Tree harvest: $14k
  - Shelter benefits: $42k
  - Carbon sequestration: $3k
  - Amenity/land value: $1k
- Net costs of around $6k (including fencing)
- IRR of ~19%

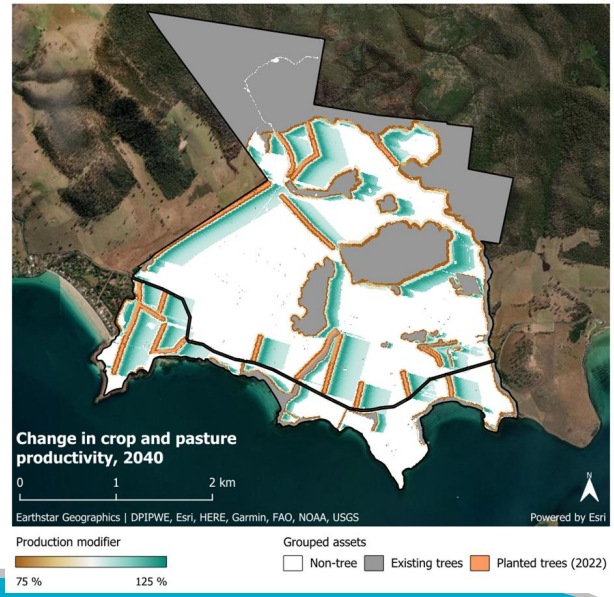




Generalising agricultural production benefits

- A systematic, quantitative review of the literature:
  - Shows that the effect we observed at Cressy is often found
  - We are exploring the dataset to understand what is driving the big gains in productivity
- Integrating the understanding of shelter benefits across the farm





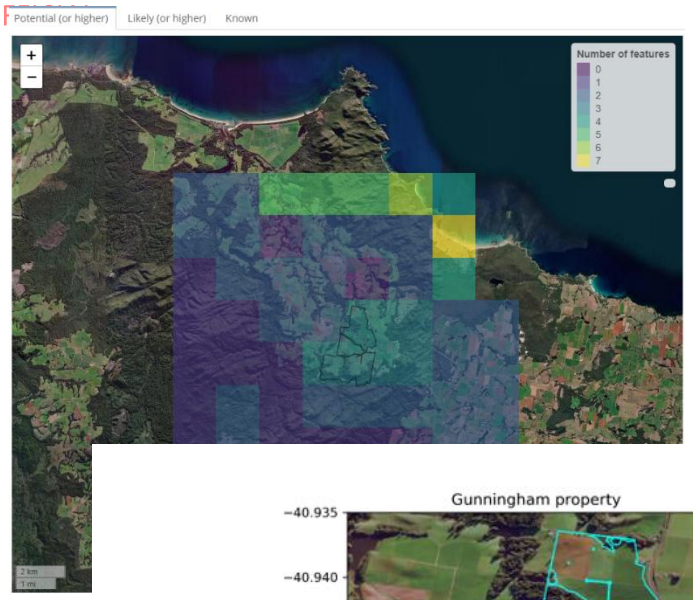
Baker, T. P., England, J. R., Brooks, S. T., Stewart, S. B., & Mendham, D. (2025). Effect of silvopasture, paddock trees and linear agroforestry systems on agricultural productivity: A global quantitative analysis. *Agricultural Systems*, *224*, 104240.

Water saving – including farm dams

- Shelter could make a big difference to farm dams
- Like this one at Nile – the shape and size is similar to the paddock at Formosa – likely savings of >30 ML of water evaporation per year
- If water is $200/ML, this equates to $6000 per year worth of water
- Whole-farm water balance could demonstrate landscape level water savings from strategic tree planting

Biodiversity

- We deployed the LOOC-B tool that uses remotely sensed habitat condition index and possible or likely threatened species. Metrics include
  - Habitat condition (%) – change across the farm area
  - Effective habitat area (ha) – is the equivalent number of hectares of 100% habitat condition.
  - Threatened species habitat hectares - integrates habitat condition with likely threatened species.



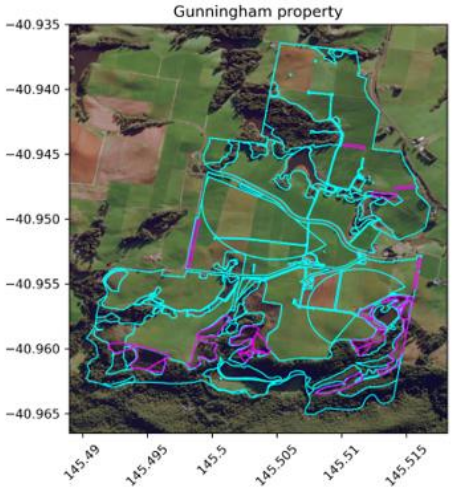


Figure 9. Farm overview. The farm boundary (and farm assets) are represented by the cyan coloured lines. Plantings are represented by magenta coloured lines.

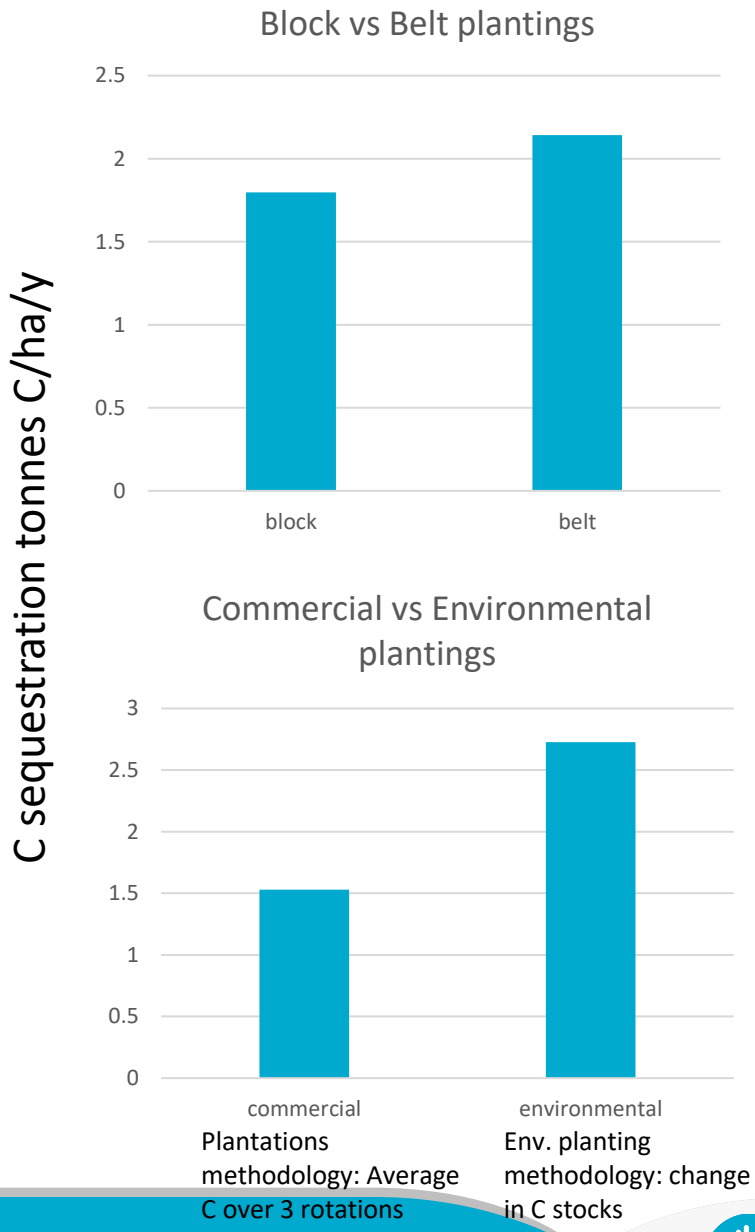
Table 4. Overall summary of indicators.

Indicator	2020	2040 forecast
Habitat condition (%)	21.0	21.7
Effective habitat area (ha)	95.4	98.4
Threatened species habitat (sp.ha)	17.4	18.72
Benefit for species persistence	62.5	62.5

Prober, S. M., Liedloff, A. C., England, J. R., Mokany, K., Ogilvy, S., & Richards, A. E. (2025). Accounting for the biodiversity benefits of woody plantings in agricultural landscapes: A global meta-analysis. *Agriculture, Ecosystems & Environment*, *381*, 109453.

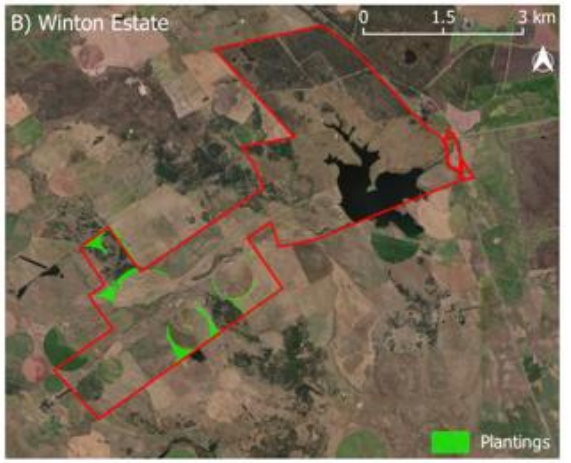
Carbon and Forest products

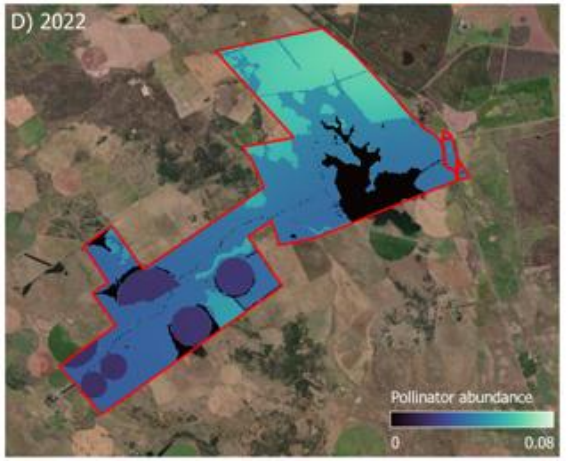
- We are addressing key questions around the carbon and timber benefits in:
  - belts vs blocks
  - Thinned vs unthinned
  - Commercial vs environmental
- Applying FullCAM and the CFI methodologies
  - Environmental plantings *or* Plantations methodologies
- Range in C sequestration across the demonstration plantings of 0.74 – 3.23 tonnes C/ha/y (average around 1.5 tC/ha/y)
- 1.5 tC/ha/y equates to around 137t CO_2/ha sequestered over the rotation
  - ~$3,000 worth at $20/tonne CO_2-e

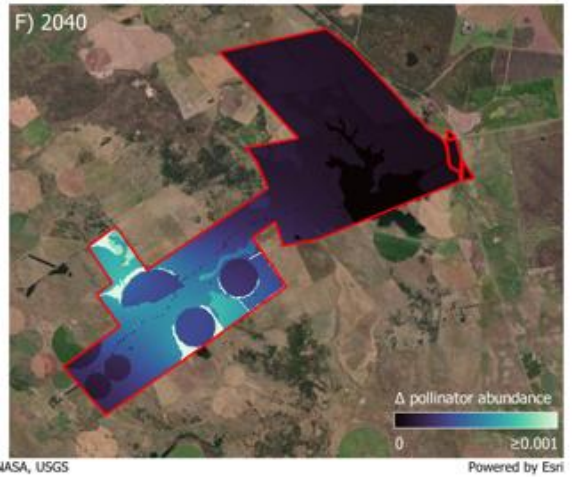


Pollination benefits

- Stewart et al., 2023 –“Modelling pollinator abundance on Tasmanian farms”
  - Positive impact on demonstration plantings on pollinator abundance
- Experiments on new agroforestry options that can increase pollinator abundance/outcomes:
  - Manuka (*Leptospermum scoparium*) – understanding flowering pattern and methylglyoxyl content of a range of Tasmanian provenances (lower average but wider range than NZ counterparts)
  - Leatherwood from cuttings – aiming to shorten the time to flowering from 75-200 years to 4-5 years





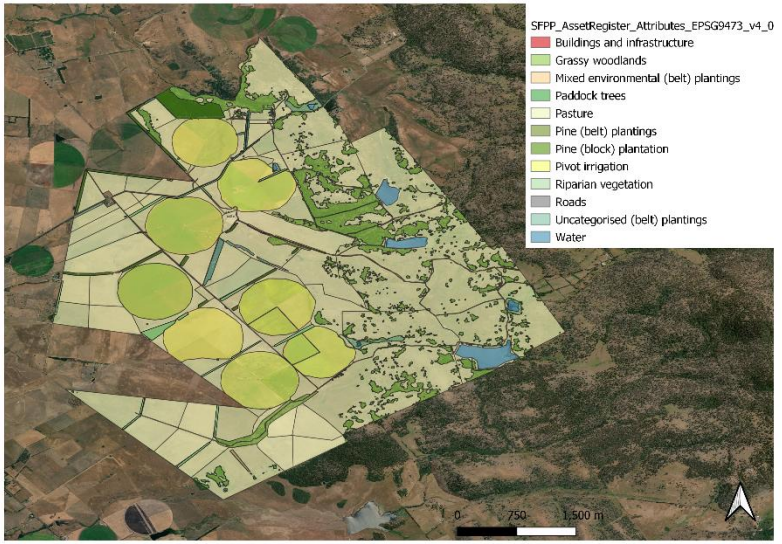


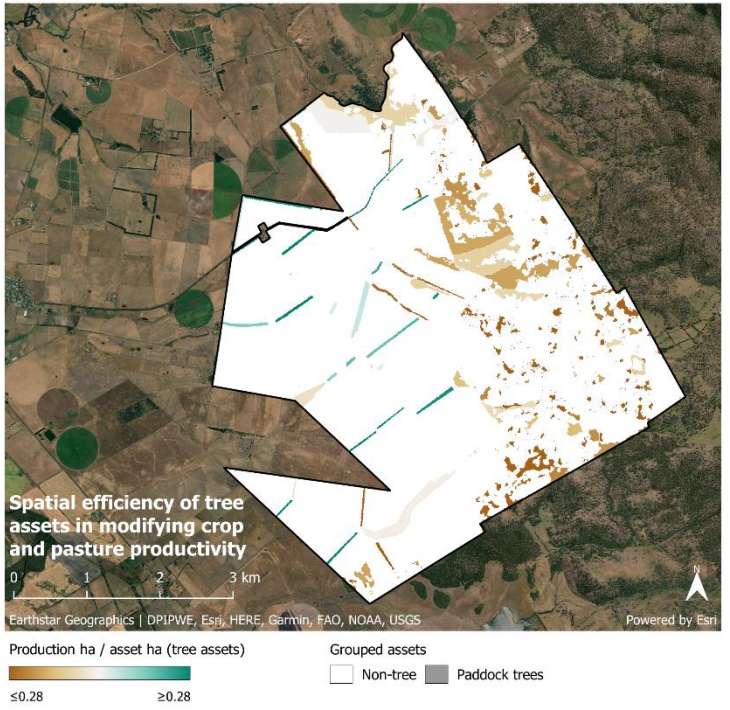
Integrating everything into a set of natural capital accounts

Natural Capital accounting = a way to bring sustainability and resilience of the farm enterprise onto a balance sheet

We can use whatever units are most appropriate to the natural capital services

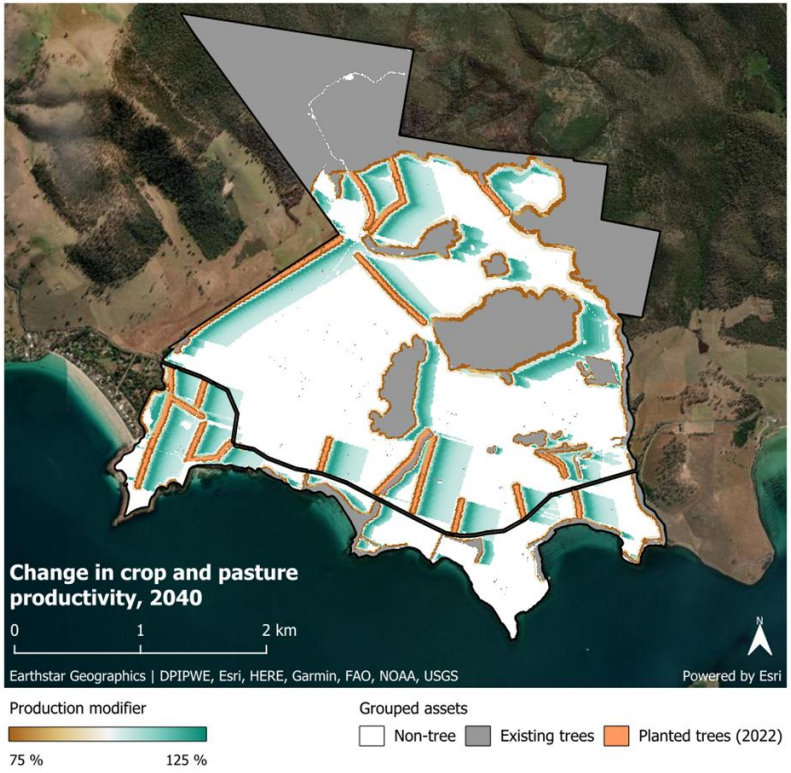
Planting of trees = establishment of a natural capital asset from which there will be a stream of benefits





How are the accounts developed?

- Each natural capital asset will have its own set of ecosystem services that we account for
- Capacity to forecast benefits:
  - We have capacity to understand different planning options



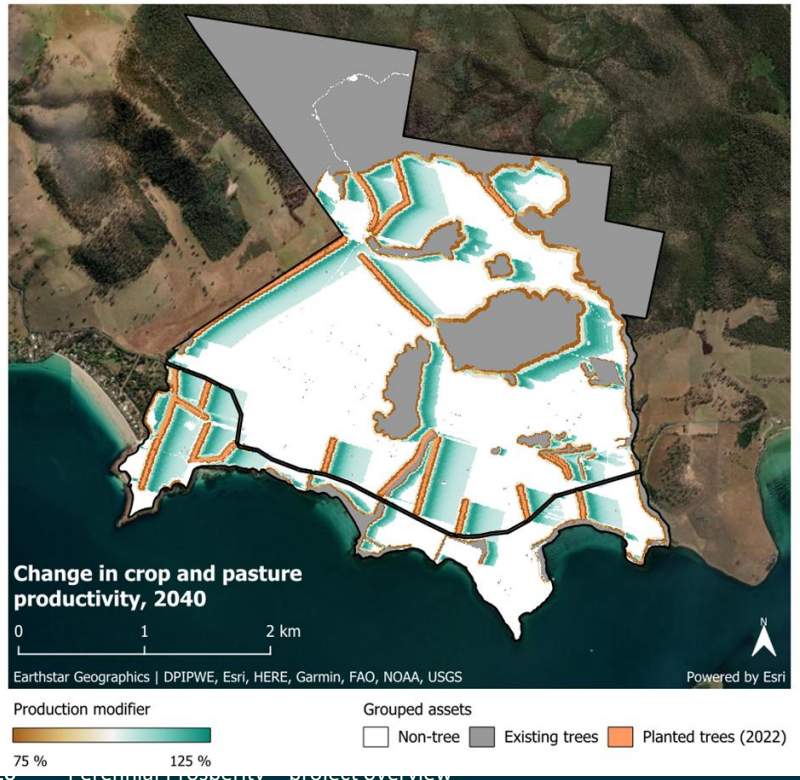
Example asset: 16ha new shelter belts at Fulham

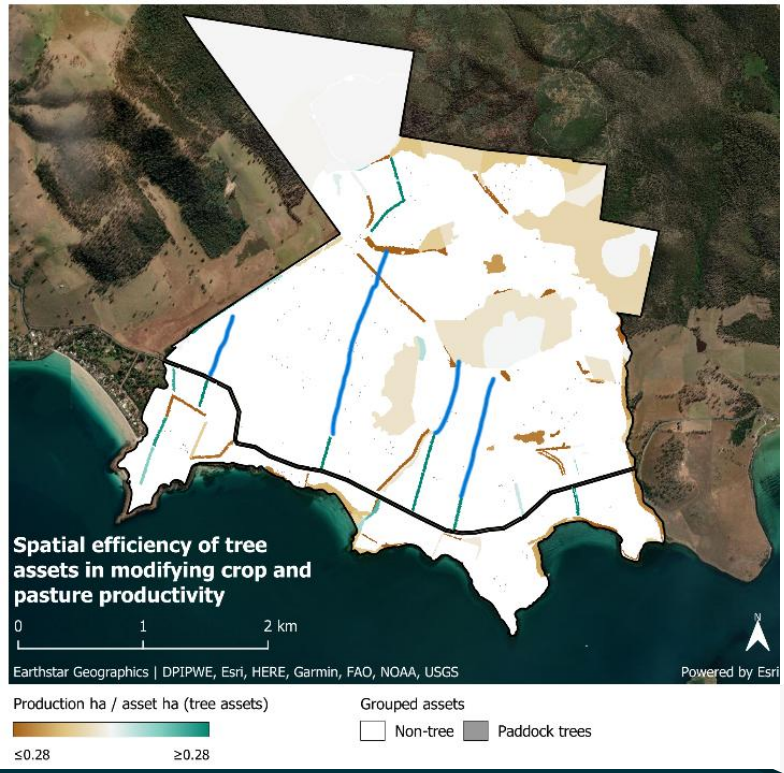
Table 2: Estimates of ecosystem services generated by the agroforestry assets of Fulham. Notes providing further information follow the table.

Fulham Projected Ecosystem Service Overview	Notes	2022	Additions (Reductions)	*2040 Projection*
Shade (area protected from sun – hectares)	10	12.8	*5.0*	*17.8*
Windbreak hectares (area protected from wind)	11	121.4	*124.0*	*245.4*
Shelter benefits (net 'virtual hectares')	12	(16.0)	*(2.2)*	*(18.2)*
Carbon storage ($ktCO_2e$)	13	147.7	*3.67*	*144.4*
Threatened species habitat (species.hectares)	14	4488.16	*123.48*	*4620.64*
Pollinator habitat (pollination hectares)	15	55.5	*1.3*	*56.8*

Planning and predicting?

- Different configurations of agroforestry plantings will have different ecosystem service outcomes
- Our understanding and tools can help farmers to forecast how different planning options can impact on the range of farm-level outcomes





Private benefits – across the case study farms

- 221 ha of new plantings across the 12,420 ha of farm area (<2%)

Ecosystem service	Units	Baseline (2020)	Predicted 2040	Attributable to newly planted trees (2040 prediction)
Shaded	Hectares protected from sun	148.92	167.18	24.75
Sheltered	Hectares protected from wind	1419.89	1870.97	500.97
Net crop/pasture productivity benefits	Virtual hectares	-175.09	-180.86	-11.55
Forest products	m^3 of standing timber	233,378	255,112	52,156[1]

Public benefits

- Across the 9 farms – benefits before and after new trees

Ecosystem service	units	Opening (2020)	Prediction (2040)	Attributable to newly planted trees (2040 prediction)
Carbon sequestration	kt CO_2-e	1,337	1,437	102.2[1]
Habitat condition	% of reference	17.75	19.35	1.6
Effective habitat area	ha	2563.44	2653.23	89.75
Threatened species habitat	Species ha	36,031.5	36,747.29	715.79
Pollinator habitat	pollination hectares	421.2	432.6	11.4

Connecting on-ground action with national and global imperatives

- Enterprise-level natural capital accounts
  - Useful for understanding the current status and potential improvements
  - Tools can be used to understand impacts of management decisions on future benefit streams
- Scaling up to landscape level – understanding how on-ground action contributes to landscape level change
  - Our landscapes need to transform to meet our multiple demands for:
    - Net zero
    - Energy transition
    - Nature positive
    - Future materials
    - Thriving communities
- NCA can help all actors in the value chain to understand and value the contribution that farm enterprises are making to the global picture

Conclusions

- Farmers are intrinsically aware of the benefits that trees bring
- Our work is quantifying and making the benefits transparent
  - Important for changing behaviour – from farm financiers and insurance through to customers
- NCA can help provide recognition to farmers for looking after their land
- NCA is a developing field that has captured a lot of interest at the moment and is a good way to integrate the benefits
- Our work is forging a pathway as to how this might look in future
- We are keen to continue developing these ideas, so that we can make a difference to Australian farming systems and the Australian natural environment.
  - Achieving landscape to national level outcomes
  - Realising the Win^5