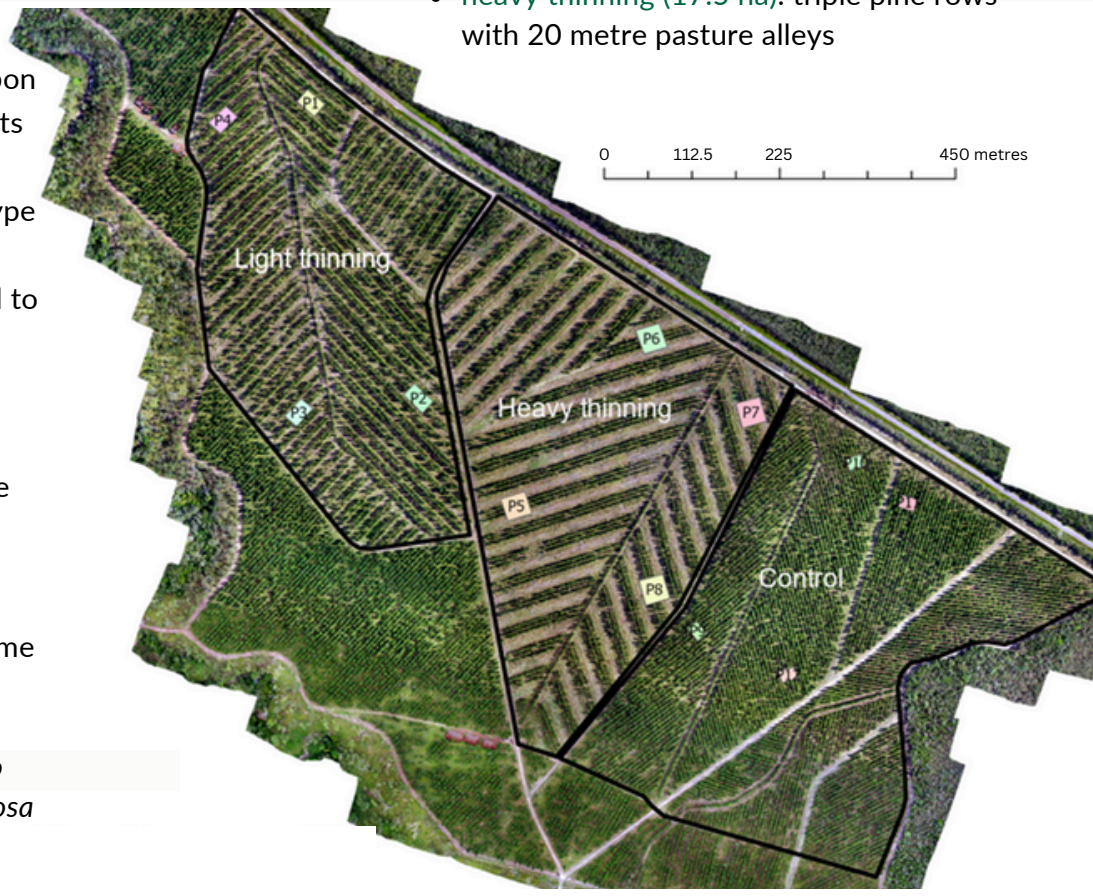
FACT SHEET

SILVOPASTORAL TRIALS OF COMMERCIAL PINE SYSTEMS IN NORTH QUEENSLAND

BACKGROUND

- this project undertook a 3-year trial of integrated cattle, carbon and wood production with Caribbean pine (*Pinus caribaea var. hondurensis*) in a silvopastoral system in North Queensland
  - the aim was to assess animal productivity, carbon and timber outputs and the financial benefits of this type of silvopastoral system compared to grazing only or timber only production
- pasture at the site was Guinea grass (*Megathyrsus maximus var. maximus*) with some legumes such as *Stylosanthes guianensis*, *Calopo mucunoides*, *Mimosa pudica* and *Sena obtusifolia*
- three scenarios (treatments) were evaluated in adjacent compartments:
  - control (17.5 ha): normally stocked pine plantation with no pasture alleys
  - light thinning (16.1 ha): double pine rows with 10 metre pasture alleys
  - heavy thinning (17.5 ha): triple pine rows with 20 metre pasture alleys



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TRIAL DESIGN

- the trial took place in a 6-year-old Caribbean pine plantation located near Cardwell, Queensland
- the plantation was established in February 2016 with a stocking of 1000 trees/ha spaced at 5x2 metres
- three treatments were selected for the experiment:
  - control: typical plantation with no thinning (1000 trees/ha)
  - light thinning: removal of one row in every three to create 10m pasture alleys (667 trees/ha)
  - heavy thinning: removal of three rows in every six to create 20m pasture alleys (550 trees/ha)
- each compartment had an initial stocking of 13 head of cattle which was increased to 23 head per compartment followed by a variable stocking rate late in the trial based on available pasture and condition

ILLUSTRATION OF THINNING CONFIGURATION
SAMPLE SHOWS 2 PINE ROWS WITH 10M ALLEYS

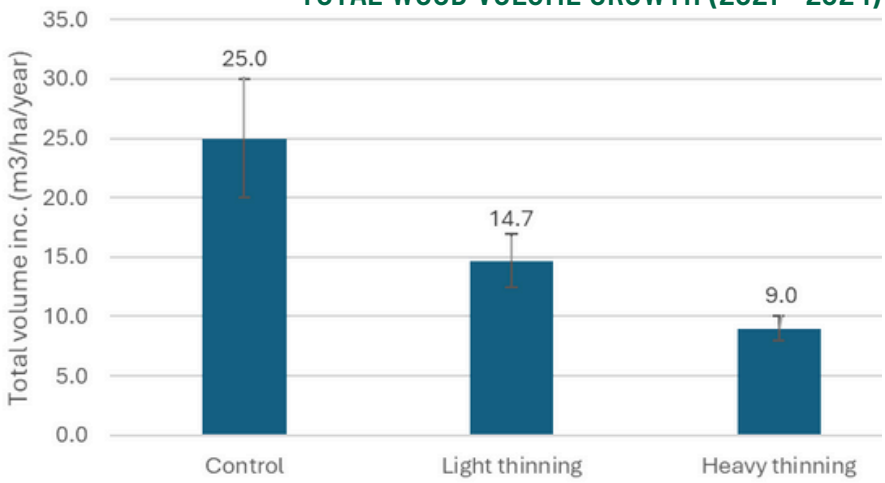
MEASUREMENTS AND MODELLING

- regular measurements were taken over the trial period to estimate pasture production, tree diameter and wood growth and cattle liveweight gain using the Optiweigh system
- the spatial behaviour of cattle was also investigated using data from GPS collars
- growth and yield of Caribbean pine was projected using the *SisPinus* software
- carbon outputs were calculated using published sequestration parameters and recent carbon market prices for ACCUs
- long-term pasture production and utilisation was estimated using the Long Paddock FORAGE system and site measurements

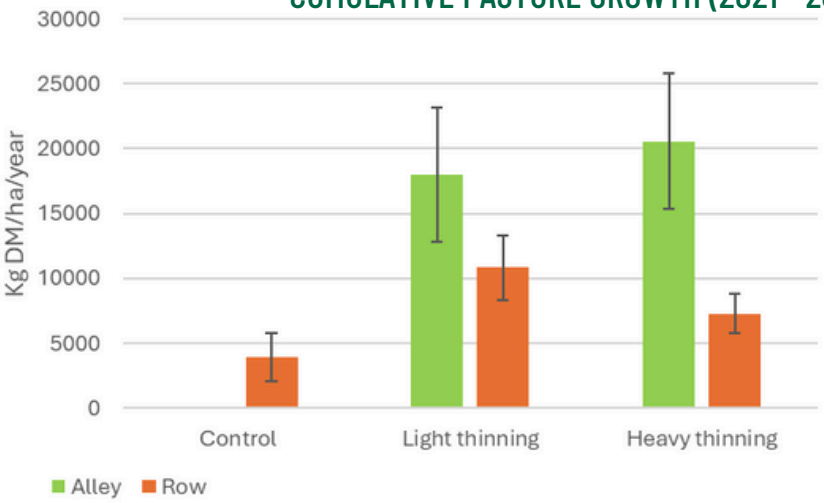
KEY BIOPHYSICAL RESULTS

- the on-site measurements and results were largely consistent with the expected hypotheses for the project:
  - total wood volume growth was higher for the control and decreased respectively for the lightly thinned and heavily thinned compartments
  - pasture production varied depending on its location either within the pasture alleys or tree rows with higher availability in the thinned treatments compared to the control, and was lower in the tree rows where there was more competition for resources such as light and water
  - lower pasture production within the tree rows of the heavy treatment was due to more intense competition between trees and pasture for light, water and nutrients due to the triple row of trees configuration
  - the effect of time, thinning treatment, and the interaction between time and treatments were all significant factors influencing cattle liveweight
  - both the light and heavy treatments maintained more stable weight trajectories through varying seasonal conditions compared to the control, which lacked the benefits of increased pasture availability from lower tree stocking
  - both the time of day and thinning treatment affected the likelihood of cattle being in tree rows, with cattle more likely to spend time in treed areas as the day progressed (i.e. hotter parts of the day)

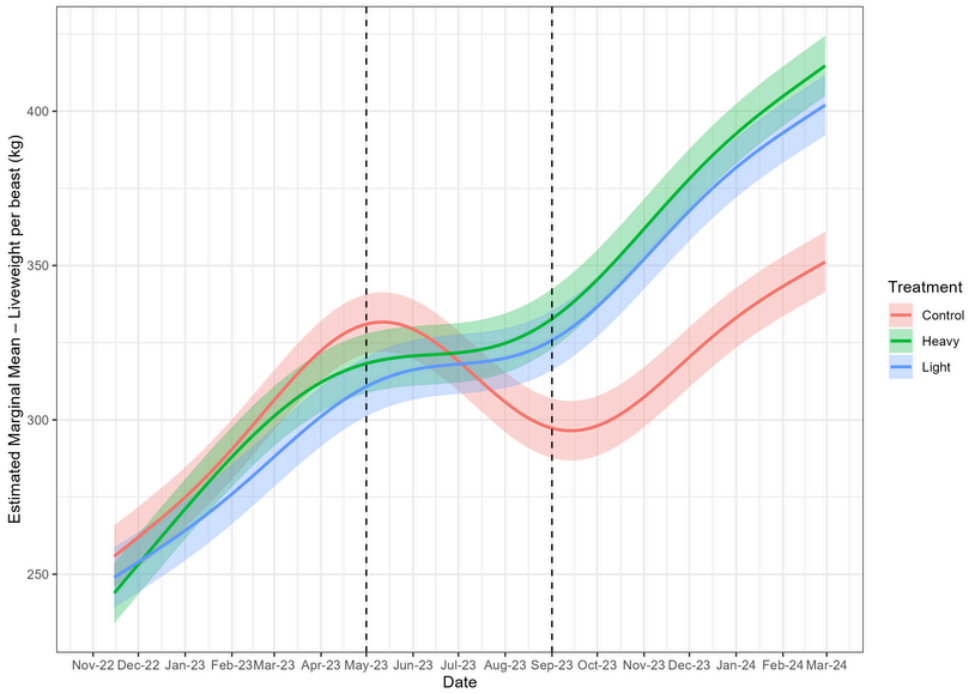
TOTAL WOOD VOLUME GROWTH (2021 - 2024)



CUMULATIVE PASTURE GROWTH (2021 - 2024)



ESTIMATED LIVEWEIGHT GAIN OVER TRIAL PERIOD

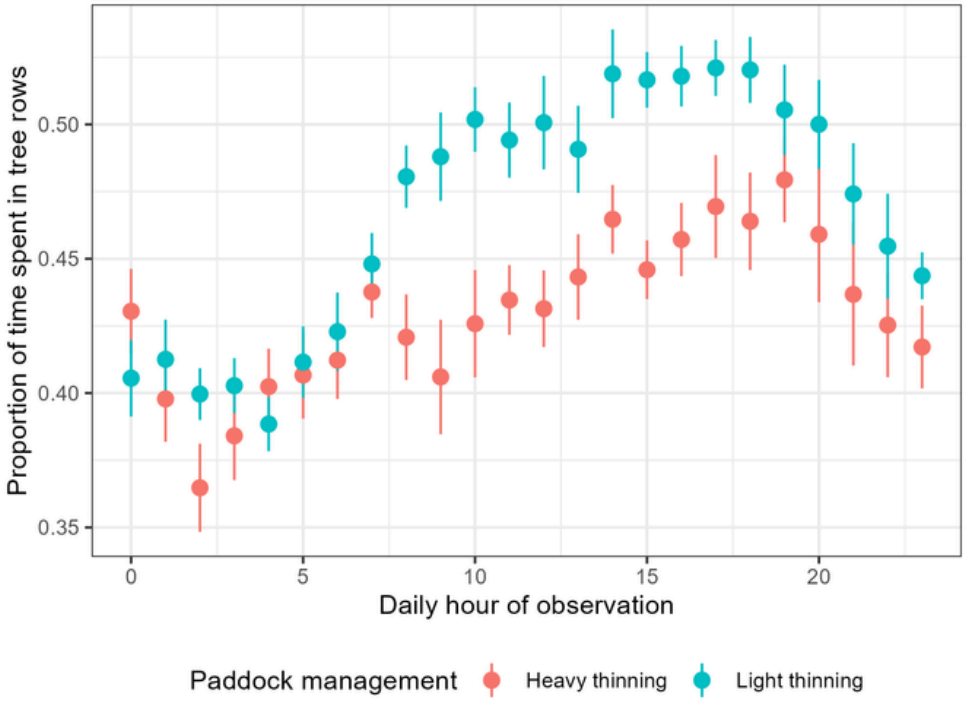


- three distinct seasons are delineated by the vertical dotted lines
- in the first wet season (Period One), animals under all treatments grew at a similar rate
- during the dry season (Period Two), the control animals lost weight, while those in thinned areas maintained their weight
- in the following wet season (Period Three), the liveweight gain for the thinned treatments were comparable to the first period, while the control animals grew at a slower rate

AVERAGE DAILY GAIN BETWEEN TREATMENTS ACROSS THREE DISTINCT PHASES

	Treatment (ADG; kg lw/d)		
Period	**Heavy Thinning**	**Light Thinning**	**Control**
Period One	0.453 ± 4.08	0.36 ± 4.08	0.456 ± 4.09
Period Two	0.091 ± 4.06	0.112 ± 4.07	-0.275 ± 4.07
Period Three	0.452 ± 4.08	0.42 ± 4.07	0.288 ± 4.09

TIME SPENT IN TREE ROWS



SIMULATED FINANCIAL OUTCOMES

- drawing on site data and the modelled estimates of biophysical parameters a financial model was used to calculate the net present value (NPV) per hectare
- 10 simulated management scenarios were assessed with a discount rate of 5% over a 25-year period, with assumed costs and revenues for a typical cattle breeding operation

- the financial analyses indicate higher financial returns from the adoption of silvopastoral systems (scenarios 1-9) or a typical plantation (scenario 10) when compared to open grazing with native pasture or improved pasture

SILVOPASTORAL SYSTEM SCENARIOS EVALUATED

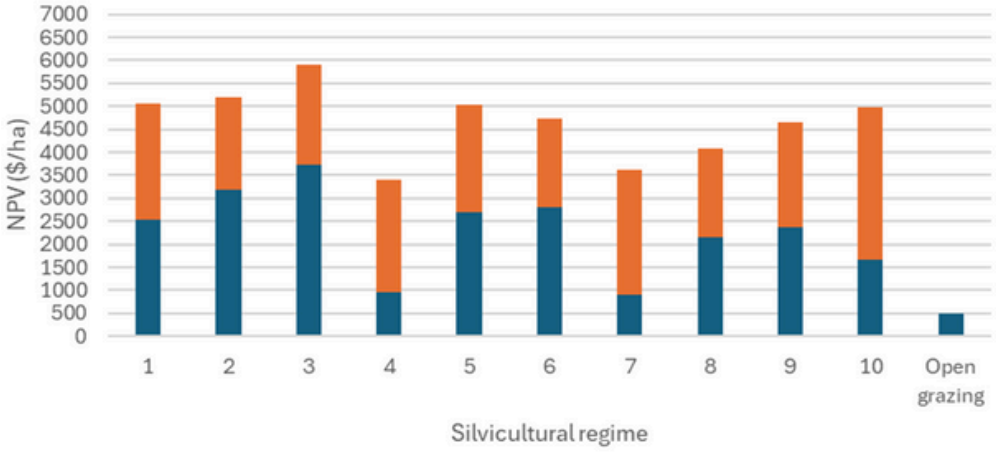
Silviculture	Silvopastoral system scenario									
	1	2	3	4	5	6	7	8	9	10
Initial planting density (SPH)	267	267	267	500	500	500	667	667	667	1000
Survival (%)	80	80	80	80	80	80	80	80	80	80
Stocking (trees per ha)	214	214	214	400	400	400	534	534	534	800
Selective commercial thin at age 10 (% of stems)		50			50			50		
Stocking after thinning (SPH)		107			200			267		
Selective commercial thin at age 15 (% of stems)			50			50			50	
Stocking after thinning (SPH)			107			200			267	
Clearfall at age 25 (SPH)	200	107	107	400	200	200	534	267	267	800

Note Scenarios 1-3 are below tree stocking at trial site; 4-6 approximates heavy treatment; and 7-9 the light treatment. SPH – stems/trees per ha

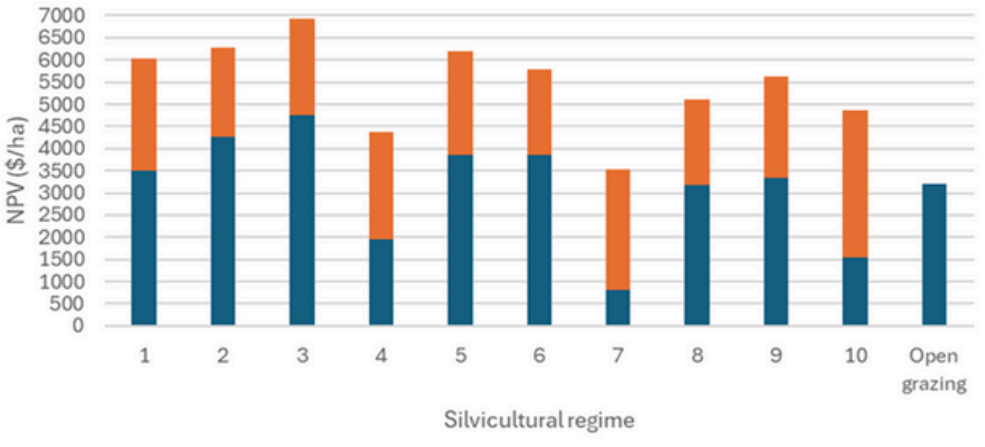
a key factor in the better results from the silvopastoral systems is the generation of revenue from the carbon sequestered in growing trees and harvested wood products

- the carbon contribution to the NPV for each scenario is reflected in the orange portion of each bar
- in the absence of carbon the combined income from grazing and timber still remains higher (blue proportion of each bar) than for open grazing with native pasture, and for many of the silvopastoral scenarios when compared with improved pasture
- cash flow is also an important factor when considering silvopastoral systems
- early annual income from cattle and carbon can help offset tree establishment costs and the longer time period for timber harvest returns

NPV TIMBER, CARBON AND GRAZING **NATIVE PASTURES** ($/HA)



NPV TIMBER, CARBON AND GRAZING **IMPROVED PASTURES** ($/HA)



IMPLICATIONS

- the case study has shown that silvopastoral systems can deliver high financial returns for this specific land type in North Queensland based on the modelled assumptions
- the general principles and benefits of silvopastoral systems are known but there is a need for assessments for other regions and land types that take into account different biographic conditions, tree species and markets
- silvopastoral systems can deliver positive impacts in terms of:
  - improved returns through combining beef, carbon and timber production
  - on-farm mitigation of GHG emissions (for carbon neutrality, the grazier would only be able to sell carbon credits in excess of livestock emissions, which would lower the NPVs of the modelled scenarios that assumed the full sale of credits)
  - increased income diversification and climate resilience
  - potential for expansion of pine production forestry in the region
- further information about the project can be found here

https://www.timberqueensland.com.au/Growing/Silvopasture.aspx