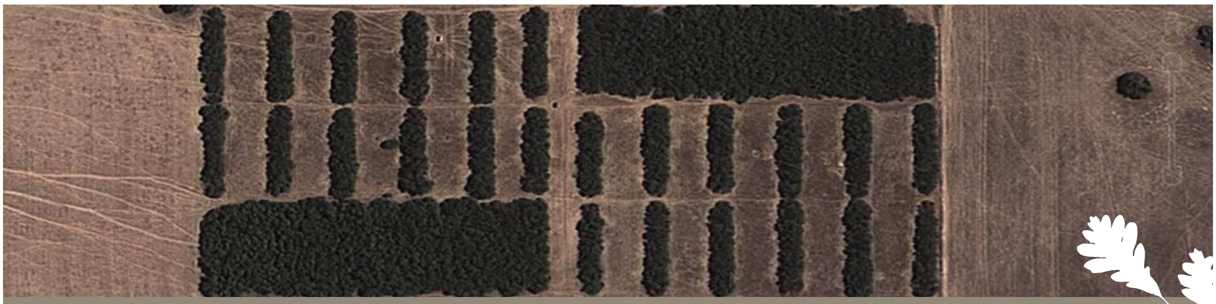

Case Study
EverCrop Carbon Plus

Introduction

The *EverCrop Carbon Plus* project examined the deep soil carbon sequestration potential of perennial species in cropping soils across a range of environments.

The species examined included the forage shrub species tagasaste and saltbush, tropical perennial grasses, and a small range of temperate herbaceous perennial species including lucerne. These were the most feasible perennial plant options for the regions of interest, which included the northern Western Australian wheatbelt, the South Australian Mallee and the medium-rainfall cropping zone of south-eastern Australia.

Cropping environments are typically dominated by annual species, such as wheat. A shift to a perennial-based system – with an increased ability to use rainfall and greater belowground allocation of carbon associated with root mass – has been suggested as a way to increase soil organic carbon in agricultural landscapes.

The researchers focused on soil depths beyond the Intergovernmental Panel on Climate Change (IPCC) standard of 0.3 metres. This took into account the deeper root systems of perennial plants and the likely greater permanence of carbon in root material in those soil profile layers that were less likely to decompose.

Findings

The researchers found little evidence of increased soil organic carbon under perennial species in the environments they tested, except tagasaste.

Project leader Richard Hayes said, "Tagasaste was the stand-out example because it was the one species where the perennial plant led to an increase in soil organic carbon. The tagasaste was not only able to store carbon in the soil but it was also able to store carbon in biomass.

"If we assume that the difference in carbon between the tagasaste and the annual control is carbon-sequestered, we calculate that at 9.25 tonnes CO_2 equivalents per hectare per year.

"It is a fairly brave assumption that all of that difference is carbon sequestration – some of that difference could be due to avoided loss out of the annual system – however, the difference between the tagasaste and the control is real."

What is tagasaste?

Tagasaste or tree lucerne (*Chamaecytisus proliferus*) is a herbaceous shrub or small tree growing to a height and crown diameter of about five metres, often with long, drooping, leafy branches. Variations occur, including upright and prostrate types. It grows prolifically and is broadly adapted to marginal environments such as the deep WA sand plains.

Tagasaste is a legume, so the roots have nodules that contain nitrogen-fixing rhizobium bacteria, although it may benefit from a phosphorus fertiliser in the establishment phase.

In Australian agriculture, it is used for windbreaks and shade but, as an evergreen, its main value is in providing high-quality fodder during summer and early autumn.

Economic analysis

The researchers investigated the economics of including emissions abatement as a new enterprise within systems where tagasaste is grown on deep sands and grazed by cattle. The purpose was to compare tagasaste-based enterprises with the existing annual pasture systems common in the areas suited to tagasaste.

Four scenarios were modelled:

1. A Block scenario: dense tagasaste rows at 7m intervals, with a carrying capacity of 10 Dry Sheep Equivalent per hectare (DSE/ha).
2. A Wide Alley scenario: less dense tagasaste alleys at 30m intervals, with a calculated carrying capacity of 5.95 DSE/ha.
3. A (default) Annual scenario, where low-cost annual pastures are grazed: due to poor soils, this scenario provides a low carrying capacity of 3.25 DSE/ha.
4. An Unmanaged scenario: an ungrazed, dense tagasaste plantation used only for carbon sequestration.

To conduct the analysis three models were developed:

- a cattle enterprise model
- an emissions model
- a sequestration model.

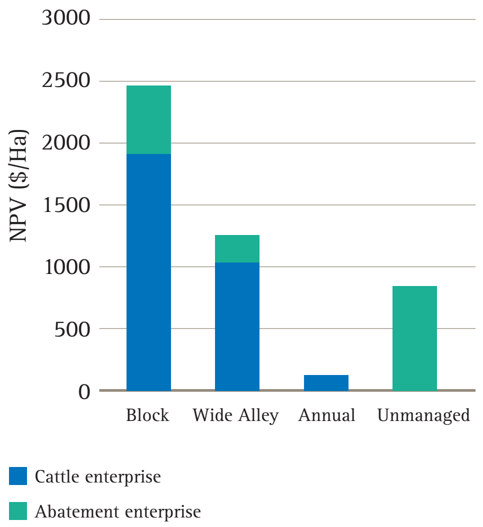

Figure 1. Net present value (NPV; $/ha) of modelled grazing and abatement enterprises based on tagasaste grown over 25 years in either a block (grazed by cattle or unmanaged) or wide alley arrangement.

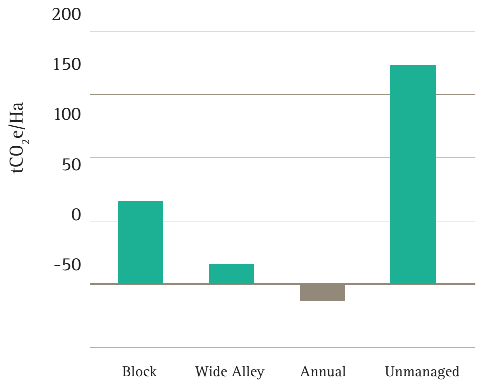

Figure 2. Calculated lifetime total abatement (tCO_2e/ha) of three tagasaste scenarios compared to an annual species.

The models fed into a discounted cash flow (DCF) where the net present value (NPV) for each scenario was calculated to compare scenarios.

Figure 1 illustrates the NPV results from the modelling with default parameters. The NPV from the abatement enterprise includes only the costs and income that are not part of the cattle enterprise.

The research demonstrated that abatement provided significant additional income. Even in the Wide Alley scenario, the abatement income more than covered the cost of establishing tagasaste, which is a significant constraint to the adoption of tagasaste plantations on-farm.

The Block scenario represented the best economic proposition, with its NPV being more than $2000/ha higher than the NPV attained under the Annual scenario.

Figure 2 illustrates the total abatement from each scenario over the lifetime of the project. The significantly greater emissions abatement achieved under the Unmanaged stand is explained by increased carbon sequestration in soil and herbage under the ungrazed plantation, and no methane emissions associated with grazing livestock. The annual scenario was modelled to have a slightly negative sequestration value, reflecting minimal C-sequestration and some methane emissions from a low stocking rate of grazing livestock.

While the Unmanaged scenario abated the most carbon dioxide, the Block scenario achieved 43 per cent of the Unmanaged net abatement and tripled the Unmanaged NPV.

Mr Hayes said, "A tagasaste plantation might provide opportunities for farmers, particularly on the Western Australian sand plains, but also further afield. Its large root system can explore the soil and access water at depths well below the rooting zone of wheat and other agricultural plants, so the farmer can grow more in the same environment.

"There are also advantages in taking marginal land – the areas where crop failure is more likely – out of cropping altogether. If a farmer can derive an income from abatement and take some of the risk out of their enterprise, that's a bonus."

John McGrath, research director of the former Future Farm Industries CRC, added, "The capacity of tagasaste to fix nitrogen and utilise other nutrients stored at depth in the soil profile makes it an ideal low-input, long-term crop. Additionally, the opportunity to graze tagasaste could provide farmers with more flexibility than plantings based on carbon storage only. This flexibility may be particularly important for farmers considering long-term changes in land use by establishing carbon plantings."

Conclusion

The study showed that receiving payments for emissions abatement improved the financial viability of tagasaste plantations for existing cattle grazing enterprises, and provided a new option for farmers without livestock to derive an income from tagasaste.

Examining decomposition rates of plant roots deep in the soil profile at Wagga Wagga, NSW

A sensitivity analysis on the carbon price found that if the carbon price was above $9 per tonne, both the Block and Wide Alley scenarios would receive enough abatement income to pay for the upfront establishment costs of the tagasaste under the discount rate regimes considered (up to 10 per cent). Obviously, the higher the carbon price is, the more financially appealing ungrazed tagasaste will be for farmers.

Mr Hayes said the most exciting thing about the tagasaste study was that it offered a non-livestock option for grain cropping farmers.

"When we look at perennials in cropping environments, usually we're relying on a livestock component to make it work. An unmanaged tagasaste stand might be feasible for pure cropping enterprises; for the mixed farming enterprises, it represents a third source of income."

He said there were sustainability benefits associated with reducing erosion and increasing biological function of soils. Tagasaste also provides year-round fodder, which offers a drought mitigation strategy.

If farmers on these landscapes could realise an additional income from emissions abatement by planting a shrub such as tagasaste, it would not only be of financial benefit to them – as the economic analysis suggests – but also lead to better environmental outcomes on marginal soils.

Further information: Richard Hayes,
NSW DPI, 0448 231 704
richard.hayes@dpi.nsw.gov.au

Acknowledgements: Robert Wocheslander, Richard Harper, Stan Sochacki, Lewis Walden (Murdoch University), Clinton Revell, David Ferris (DAFWA), Phil Ward, Gupta Vadakattu, Damian Mowatt, Rick Llewellyn (CSIRO), Susan Orgill, Albert Oates, Graeme Poile, Binbin Xu, Mark Conyers, Richard Hayes (NSW DPI), Quenten Thomas, John McGrath Chris Oldham (consultants). Ted Lefroy (now at the University of Tasmania) and his past colleagues collectively established the tagasaste site at Moora more than 20 years ago and Philip and Karl Yukich provided access to their land.