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Carbon credits to help conserve Top End's biodiversity?

Lucinda Douglass

Now that the Australian government's plan to price carbon is closer to reality, income from carbon credits offers real potential to change land management and conservation planning priorities. But how can authorities prioritise locations suitable for both biodiversity conservation and carbon storage? And what will be the influence of using income from carbon trading to offset the cost of more sustainable land management?

Credit: Lucinda Douglass

In July, the Australian government launched its Clean Energy Plan, which includes a Biodiversity Fund of $946 million over six years. The aim of the fund is to 'support landholders to undertake projects that establish, restore, protect or manage biodiverse carbon stores'.

The fund aims to achieve the dual objectives of conserving biodiversity and sequestering carbon by providing support to private landholders who establish, conserve and manage vegetation in the landscape.

Under the Clean Energy Plan, the government has also established a Regional Natural Resource Management (NRM) Planning for Climate Fund of $44 million over five years. The fund will support NRM agencies in developing plans that will guide where biosequestration (carbon retention) projects should be located.

Crucial to this planning effort are the following questions.

1. Where are the priority locations for implementing improved land management targeted at biodiversity conservation?
2. How do these locations and costs change when the potential revenue generated by carbon sequestration is deducted from the costs of conservation action? [1]
3. What are the opportunities and costs of meeting targets for both biodiversity and carbon storage?

To answer these questions, our research team investigated a novel approach for identifying priority areas for investment. We tested the approach in northern Australia's tropical savanna, a region of global significance for

biodiversity and carbon storage. [2]

Given that savannas span around one-sixth of the world's land surface and contribute some 30 per cent of the net primary productivity of terrestrial vegetation, their influence on carbon cycles is enormous.

Credit: Bruce Doran

In northern Australia's savannas, two key processes threaten biodiversity and carbon emissions: fires of high frequency and intensity, and ecologically inappropriate cattle-grazing regimes.

Fire is part of the natural cycle of northern Australia's savannas, with more fires each year in the northern third of the country than anywhere else in Australia. The strategic manipulation of fire regimes can reduce fuel loads, benefit biodiversity, reduce emissions from severe wildfires and increase landscape carbon storage (see Soil key to CO_2 saved by fewer fires in northern Australia below).

In rangeland areas, implementing sustainable stocking rates, rotational grazing and seasonal grazing practices to improve soil management can benefit carbon storage and biodiversity (see Carbon complexity below).

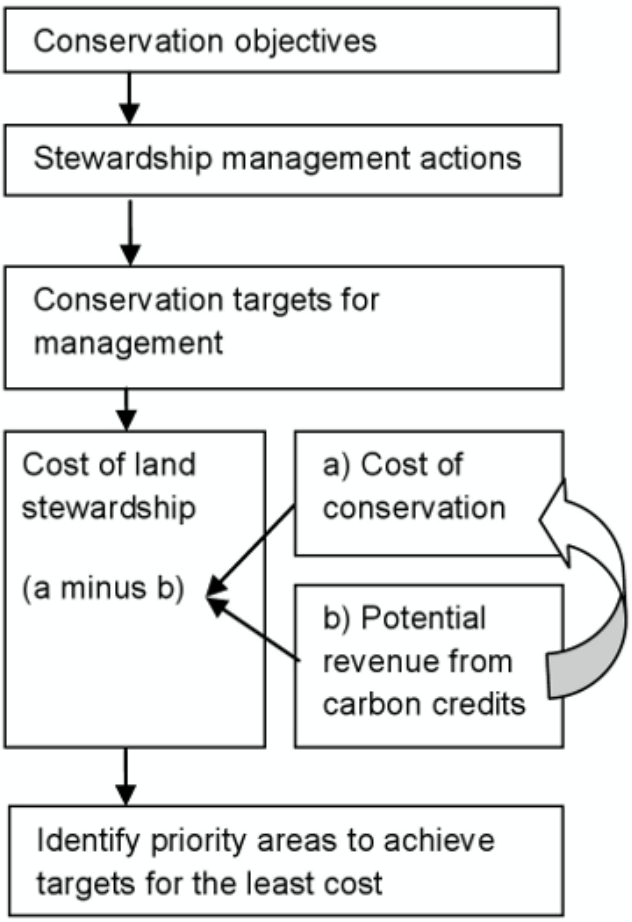
The Northern Territory's West Arnhem Land Fire Abatement Project is a good example of a voluntary carbon offset project based on managing the local fire regime that also brings biodiversity and economic benefits to local communities. We explored what might be possible with a similar program across the Top End – specifically, to see how carbon credits would influence spatial conservation priorities – using a simple accounting method within a conservation planning framework.

We know that the key management actions that would help reverse land degradation, conserve biodiversity and increase carbon stocks are:

1. improving fire management, involving ignition of low-intensity fires early in the dry season to reduce fuel buildup and decrease the potential for severe, late, dry season fires
2. retaining existing vegetation, resulting in foregone future agricultural production and reduced livestock densities.

We investigated the opportunity for potential carbon revenue using a carbon price of AU$20 per tonne of CO_2-e. Under our approach, payments to landholders were determined by foregone agricultural production and the implementation cost of fire management.

We then modelled the amount of carbon retained from changed management arrangements, converted this sequestered carbon to an economic value, and deducted this from the cost of the new arrangements.



The framework developed for prioritising stewardship payments for improved land management while accounting for potential carbon revenue.

Our improved land management scenarios targeted fire and grazing-sensitive birds and mammals. Our biodiversity targets included 30 per cent of the pre-European distribution of mammal species, 30 per cent of the current distribution of bird species and 15 per cent of the pre-European extent of each vegetation type within each bioregion.

The results of our study were dramatic. By reducing the area burned under late-season fires by 13 per cent and the stocking density by 50 per cent, our approach increased the Top End's potential for carbon storage by 350–600 million tonnes of carbon (or 7–11 tonnes of carbon per hectare) after 90 years.

This carbon benefit could potentially raise AU$7 per hectare per year and equate to a cumulative atmospheric greenhouse gas saving of 1–2 billion tonnes of CO_2-e per year after 90 years, which would offset Australia's agricultural emissions for the next 22 years.

This is only a fraction of the emissions-reductions potential from Australia´s land-use sectors, which has been estimated to be around 1 billion tonnes of CO_2-e per year over the next 20–50 years. [3]

Importantly, we have shown that the revenue raised from carbon credits could be used to reduce the costs of adopting more sustainable land management practices by three-quarters, or to double the number of biodiversity targets achieved.

Lucinda Douglass works with the Centre for Conservation Geography Centre for Conservation Geography and is an adjunct research fellow with the University of Queensland (UQ). The research group also included UQ's Professor Hugh Possingham, Director of the Centre of Excellence for Environmental Decisions (CEED); Josie Cawardine and Stephen Roxburgh, CSIRO; Carissa Klein and Kerrie Wilson, UQ; and Jeremy Russell-Smith, Charles Darwin University. This is an edited version of an article that appeared in Decision Point published by CEED.

Soil key to CO_2 saved by fewer fires in northern Australia

Barbie McKaige

CSIRO ecologist, Dr Anna Richards, has demonstrated that decreasing the frequency of wildfires in northern Australia would increase soil carbon stores, significantly lowering greenhouse gas emissions. [4]

Dr Anna Richards and Tiwi Ranger, Kim Brooks, collecting vegetation data on Melville Island as part of the Tiwi Carbon Study. CSIRO

Dr Richards says scientists have become concerned at the increase in frequency and intensity of wildfires over the past century.

'About half the Top End is burned each year, and this is changing the environment, as well as releasing large quantities of greenhouse gases into the atmosphere,' she says.

Until now, it was assumed that smoke largely contributed to these emissions, but Dr Richards has demonstrated an important interaction of fire with soil. When fire frequency is reduced, up to four times the amount of greenhouse gases are stored underground rather than being emitted into the atmosphere.

'The frequency of fires affects the chemistry of the soil and plant roots – hence the capacity of the soil to store carbon,' says Dr Richards. 'In general, the greater the frequency of fires, the more carbon is released from the soil, and vice versa.'

Using measurements of soil carbon from long-term fire experiments conducted near Darwin and sophisticated computer modelling, Dr Richards found that reducing fire frequency to one fire every four to six years is best for storing carbon.

‘These findings are significant for managing carbon in northern Australia, particularly for programs that use indigenous fire management practices to reduce fire frequency and severity,’ she says.

Dr Richards is conducting further research on the effects of fire on soil carbon in the Tiwi Islands, north of Darwin. The Tiwi Carbon Study is a partnership between CSIRO, the Tiwi Land Council, the Tiwi College and Tiwi Forests.

Dr Richards won the award for best contribution to research and innovation by a researcher under 35 at the recent Northern Territory Research and Innovation Awards.

Carbon complexity

The impact of fire and grazing on savanna ecosystems and the carbon cycle interact in complex non-linear ways.

Land degradation from livestock grazing reduces the accumulation of biomass and causes soil damage. This leads to the release of stored carbon and decreases the capacity of the landscape to sequester carbon.

Reducing both fire frequency and the extent of dry season fires increases landscape carbon storage. This is considered a priority for the Northern Territory’s efforts to reduce greenhouse gas emissions.

Grazing can reduce fuel loads and consequently prevent fire ignition through consumption and compaction. In the absence of fire, woody thickening can occur, which may increase carbon storage through increased biomass.

However, woody thickening also decreases pastoral productivity and consequently woody vegetation is often cleared or burnt, releasing greenhouse gasses.

Furthermore, intensive grazing reduces below-ground carbon, and the combined impact of fire and grazing can reduce tree density.

More information:
Managing fire’s impact on biodiversity

Mapping to improve fire management

Managing Tiwi fires for greenhouse gas abatement

Firing up biodiversity in the wheatbelt

1 A carbon market includes financial incentives for altering land management, either to reduce greenhouse gas emissions or increase the absorption and storage of carbon. This increase in landscape carbon (or decrease in atmospheric carbon) is traded in the form of carbon credits. Since greenhouse gases differ in their global warming potential, a carbon credit is measured in units of 1 tonne of carbon dioxide equivalent (CO_2-e).

2 Douglass LL, Possingham HP, Carwardine J, Klein CJ, Roxburgh SH, Russell-Smith J & Wilson KA (2011) The effect of carbon credits on savanna land management and priorities for biodiversity conservation. *PLoS ONE* 6(9): e23843. doi:10.1371/journal.pone.0023843.

3 Garnaut R (2008). *The Garnaut Climate Change Review*. Cambridge University Press, Melbourne.

4 Richards AE, Cook GD and Lynch BT(2011). Optimal fire regimes for soil carbon storage in tropical savannas of northern Australia. *Ecosystems*, doi:10.1007/s10021-011-9428-8

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