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# Assessing the Economic Impacts of Carbon Farming in Western NSW

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### Abstract

Emissions Reduction Fund (ERF) auctions have been used to secure agreements to sequester or retain carbon in vegetation on agricultural properties. There are at least 115 projects, covering 1.8 million ha in the Cobar Peneplain and Mulga Lands of NSW, with the main contracted methodologies being avoided deforestation (AD) and human induced regeneration (HIR). The Government has invested ~$590m in these projects but benefits and costs, especially opportunity costs, to landholders, are uncertain or unknown. This paper is part of a study using bio-economic modelling to quantify the trade-offs between pastoral enterprises and carbon farming at both farm and regional scales. For this paper, the net present values (NPV) of a combined Dorper sheep and goat harvesting business over 25 years, with and without a sequestration project, were estimated. We then estimated the time (years) until the opportunity costs of having a sequestration project started to accumulate. The longer the time frame, the more favourable it is to have a project.

Results from this case study suggest that early payments based on a price of >$10/tonne for carbon sequestration, carbon accumulation of >8 t/ha, would make a project an attractive proposition to include in a mixed grazing enterprise, even with a significant increase in meat prices or a modest increase in carrying capacity. We conclude with an outline of the limitations of this preliminary work and set out the steps to extend and deepen the study.

### Introduction

The national Emissions Reduction Fund (ERF) is designed to achieve cost-effective emission reductions across Australian economic sectors (Gowen and Bray 2016). More than $590m has been allocated through several rounds of auctions to fund 115 projects covering 1.8 million ha across two bioregions of New South Wales: the Cobar Peneplain; and Mulga Lands. These regions have traditionally been used for extensive grazing, with land clearing and regrowth control to facilitate the growth of native pastures. ERF contracts generally require cessation of clearing and the promotion of woody biomass. Most contracts have a contract and payment period of 7-10 years and an obligation for project area protection of 25 or 100 years. For the study regions, the overwhelming majority of contracts opted for a 10 year payment and 100 year protection option, meaning that landholders have effectively placed a long-term covenant over project areas. This also means there could be a considerable reduction in carrying capacity for commercial livestock into the far future. Therefore, a comparison of profits between carbon projects and pastoral enterprise is crucial to understanding short and long-term consequences (Gowen and Bray 2016). This study is part of a larger research project using bioeconomic modelling to quantify the trade-offs between the traditional pastoral enterprises and carbon offsetting enterprise at both farm and regional scales. This study starts to explore these trade-offs through a comparison of net present values from meat production (Dorper sheep and goat harvesting) with and without a carbon project.

### Materials and Methods

The greater project will cover representative locations in the Cobar Peneplain and Mulga Lands, and this study is based on a composite case study property in the Bourke district (Fig. 1).

### *Case study region*

The Bourke area receives an average rainfall of 370 mm/year. There are 54 ERF projects in the broader district with an average area of 32,000 ha. For simplicity we modelled a 30,000 ha property and assumed a 10,000 ha project. Scale is not yet critical as fixed costs are assumed to be common with or without a carbon project and so only enterprise margins are considered at this stage.

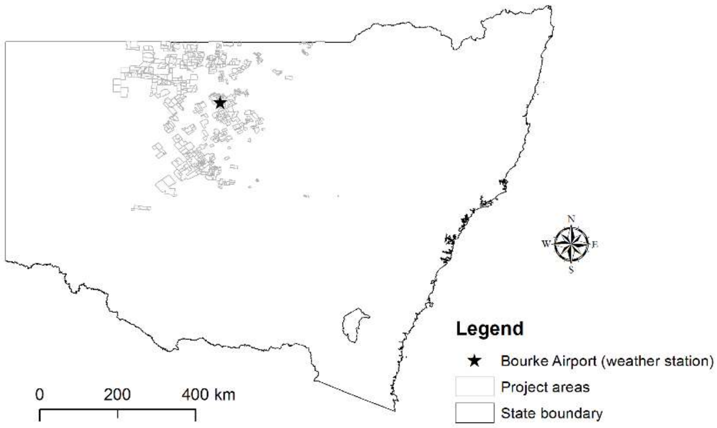


**Fig. 1.** Study area showing the weather station and ERF projects.

### *Pasture growth modelling*

We estimated the average carrying capacity using GRASP, a point-based model of climate-soil-plant-animal-management in Australia (Rickert *et al.* 2000). GRASP simulates pasture growth and animal production from the inputs of daily climate (rainfall, temperature, humidity, pan evaporation, and solar radiation), soil (field capacities and wilting points), plant growth, cover and animal intake data (MacLeod *et al.* 2004). It has been widely used to estimate long-term carrying capacity based on pasture growth across many regions of Northern Australia, QLD, and NSW (Richards *et al.* 2001; McKoen *et al.* 2009; Wish *et al.* 2016). We used climate data from the SILO-enhanced database, the soil data from the APSoil database, and vegetation data from the NSW office of Environment and Heritage. The most recent 30-year period (1986-2016) was chosen to simulate the pasture growth in order to capture the impacts of climate variability in the region. We used default settings of GRASP parameters with some modifications (Table 1).

**Table 1:** GRASP Model Parameters

| **Parameters** | **Values** |
|---|---|
| **Tree Cover** | |
| Woody basal Area ($m^2$/ha) | 1.22 |
| **Pasture** | |
| Temperature | C3 Temperature |
| Leaf/Stem | Average |
| Fertility | Very low |
| Detachment Summer | Rapid |
| Detachment Winter | Slow |
| **Soil** | |
| Run-off | Scanlan |
| Texture | Average |
| Depth | Average |
| Air Dry Soil layer 1 | 2 |
| Air Dry Soil layer 2 | 0.09 |

The pasture production in the case study site was determined by the rainfall as shown in the Fig. 2. The average pasture production as simulated by GRASP is 850 kg/ha (SD = 251 kg/ha) with large temporal variations.

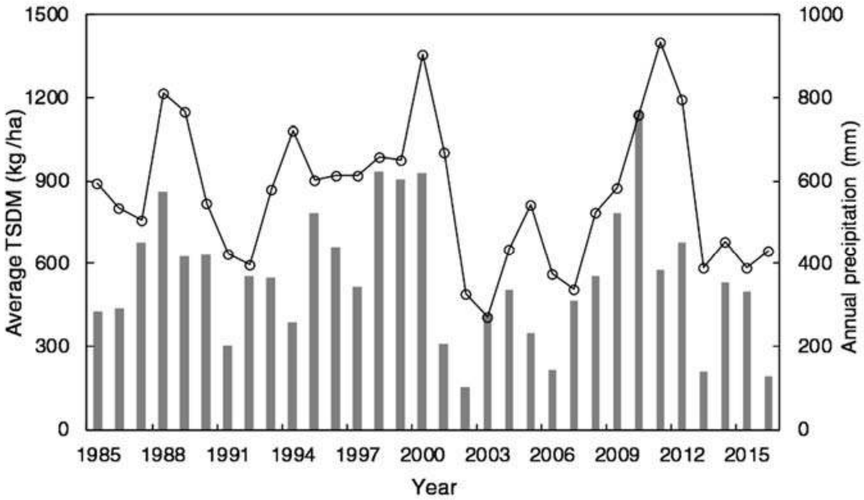


**Figure 2:** Average total standing dry matter and rainfall for study site (30 years)

***Economic model***

Gross margins were calculated using carrying capacity from GRASP, estimates of goat and kangaroo density and sheep production data. Carbon parameters were derived from project summaries (Clean Energy Regulator 2016). We assumed 10% utilization of annual herbage growth for safe stocking rates (Hunt *et al.* 2014). The key parameters for a baseline scenario are in Table 2. We then varied some of these (see results) and compared net present values (NPVs).

**Table 2:** Summary of the parameters for the economic model

| Parameters | Units | Property (Carbon Project) |
|---|---|---|
| Property area (carbon project area) | | 30,000 ha (10,000 ha) |
| Total property carrying capacity[1] | 0.18 DSE/ha | 5400 DSE |
| Sheep | 1.6 DSE/ewe w lamb | 2025 ewes/3240 DSE (1500 ewes)[2] |
| Kangaroos | 0.2 DSE x 0.16/ha[3] | 4800 head/960 DSE |
| Goats | 0.4 DSE x 0.1/ha[4] | 3000 head/1200 DSE |
| Sheep reproduction[5] | Marking 100% | Weaning 90% |
| Sheep mortality | | 2% |
| Net sheep revenue[5] | Net $98/ewe | $198,525 ($146,916)/yr |
| Goat harvesting | 0.3 of population/yr | 1200 head/yr |
| Goat revenue[6] | Net $4/kg x 30 kg | $43,000/yr |
| Carbon project revenue | $12.50/t[6] & $120/ha | $1.2m |
| Carbon payment schedule[8] | First 3 years | 40%; 40%; 20% (of total) |

[1]GRASP modelling (see Figure 2); [2]Assumes lower productivity areas allocated to project; [3](Laughlin *et al.* 2006); [4](Khairo *et al.* 2011) [5](NSW Government 2016) and excludes predation; [6]Average of all projects in the two regions; [7]Median of projects in the Bourke region, excluding outlier prices for native forest regeneration projects. [8]Representative of preference for early payments amongst all regional projects.

## Results and Discussions

*Average costs, benefits and gross margins*

The net present values with and without project are shown in the Fig. 3. Critical to this analysis is that most landholders have opted for early and large payments, which would be expected to skew the NPV outcomes heavily towards having a carbon project and this is evident in the summary of results (Table 3).

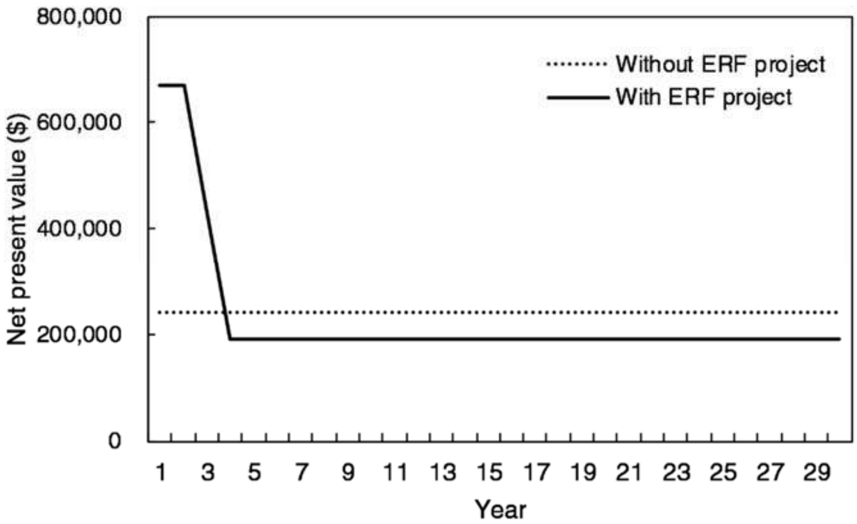


**Figure 3:** Cash flow with and without a project

**Table 3:** Times until the opportunity costs of projects start by scenarios

| Scenario | Time until opportunity costs start (project yrs) | |
|---|---|---|
| @ Discount rate | *5%* | *7%* |
| Base scenario | 100+ | 100+ |
| Meat prices +50% | ~80 | ~90 |
| Carrying capacity +20% | ~50 | 100+ |
| Carbon price/yield @ $60/ha | ~17 | ~21 |
| C payments spread over 10 years | ~60 | 100+ |

There are several key points from this preliminary work. Early payments strongly favour having a carbon sequestration project, if we consider conventional economic thinking about the value of future income, as accounted for in the discount rate. Furthermore, such schemes could still be advantageous to landholders even if payments were spread across the early years or the carbon price or stock yield estimates were lower. The most sensitive variables are price and agreed contract yield. The influence of variables such as commodity prices and carrying capacity are overwhelmed by those early and significant payments.

These are however, indicative and preliminary results. We need a wider range of case studies with more vegetation and land types. We need to examine: the influence of carbon stock estimates by vegetation type and age; the influence of tree basal area on outcomes; and the effects of taxation and income variability. This work also highlights the need for checking the assumptions against experience and expertise, particular in relation to: Dorper fertility and weaning rates in western areas; reviewing GRASP inputs; and the reasons for the wide range of prices for projects.

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