A bioeconomic model of carbon trading within an Australian grazing enterprise

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Abstract

The Carbon Farming Initiative (CFI) and other carbon trading programs have been promoted as alternative sources of income for agricultural producers, particularly those on marginal land. This paper presents the results of a bioeconomic model developed to compare the relative returns from a beef enterprise against changing regrowth management practices to sequester additional carbon and sell carbon offsets. The model is constructed based on a 1000 hectare parcel of land in Central Queensland and is calculated for two landtypes; Brigalow and Eucalypt. Assuming zero transaction costs and a 20 year contract period, a carbon-cattle enterprise has higher returns that a cattle-only enterprise at relatively low carbon prices for both land types. However, results are highly dependent on the underlying assumptions regarding transaction costs, previous clearing methods and opportunity costs of cattle production. The impact of these variables and alternative policy settings were evaluated using an optimization model which identifies the optimal allocation between the two enterprises at different carbon prices. Whilst the model indicates that some beef producers could increase returns by supplying carbon offsets, the results are highly variable and do not account for the risk and uncertainty associated with long term contracts to supply a non-market good into a new market.

Keywords

Carbon, bioeconomic modelling, grazing economics

Introduction

The Carbon Farming Initiative (CFI) and other carbon trading programs have been promoted as alternative sources of income for agricultural producers, particularly those on marginal land. This paper presents the results of a bioeconomic model developed to compare the relative returns from a beef enterprise against changing regrowth management practices to sequester additional carbon and sell carbon offsets. The model is constructed based on a 1000 hectare parcel of land in Central Queensland and is calculated for two landtypes; Brigalow and Eucalypt. Assuming zero transaction costs and a 20 year contract period, a carbon-cattle enterprise has higher returns that a cattle-only enterprise at relatively low carbon prices for both land types. However, results are highly dependent on the underlying assumptions regarding transaction costs, previous clearing methods and opportunity costs of cattle production. The impact of these variables and alternative policy settings were evaluated using an optimization model which identifies the optimal allocation between the two enterprises at different carbon prices. Whilst the model indicates that some beef producers could increase returns by supplying carbon offsets, the results are highly variable and do not account for the risk and uncertainty associated with long term contracts to supply a non-market good into a new market.

Methods

Carbon sequestration and cattle production were estimated using allometric equations based on vegetative regrowth and grass production. Landtype and age of existing regrowth determine the starting (Year 0) cattle carrying capacity and carbon stocks. Allometric equations which relate grass production and carbon sequestration to tree basal area are used to estimate ongoing cattle and offsets production. The model compares the business as usual scenario, i.e. cattle production, no carbon sequestration and no requirement to account for carbon emissions to; ending regrowth control to allow sequestration over time. The model was designed to allow for the testing of various policy settings including the need to account for on-farm methane emissions, varying transaction costs as well as the comparison of alternative baselines to allow for heterogeneity in current practices.

The economic component of the model was based on the assumption that a landholder maximises present value (I) of sum of the stream of annual payments from cattle and carbon production. The present value function can be defined as:

$$I = \sum_{n=1}^{N} [(GMAE) + h(CPS_n)](1 + r^{-n}) \tag{1}$$

Where N is the decision period in years
GM is the Gross Margin per Adult Equivalent for cattle production
AE is the carrying capacity in Adult Equivalents for the enterprise
CP is the carbon price
S is the amount of carbon sequestered (tonnes of CO$_2^{-e}$/ha)
h is the area of the enterprise (hectares)
r is the discount rate

The model is based only on variable costs and does not include any changes to fixed costs over the short or long term.

The pasture-carbon component was developed using regrowth functions and grass production functions from a variety of sources depending on best available data and is a modification of the model described in {Donaghy, 2009 #75}. Cattle carrying capacity is calculated in terms of the number of adult equivalents (AE) as a function of grass production. The regrowth and grass production functions for both the Brigalow and Eucalypt are shown in Table 1. Equations 2-4 define the conversions from basal area to carbon sequestration. The development of the model in this format allows evaluation of the effect of the age of regrowth and type of regrowth control on cattle and carbon production.

There are several common methods of regrowth control. In Brigalow areas a common method of clearing Brigalow has been blade-ploughing which not only removes the tree but suppresses regrowth. A modification to the tree growth function for Brigalow is used to calculate grass production and sequestration under this scenario.

Table 1 Regrowth production functions (per hectare)

	Regrowth (t)	Grass Production (g)	Carrying capacity (AE/ha)
Brigalow	$-0.77x^2 + 0.6262x$	$3320.8 + 6.4119t^2 - 239.18t$	$\frac{g.u}{i.365}$
Brigalow suppressed	$-0.0041x^2 + 0.2663x$		
Eucalypt	$-0.0024x^2 + 3477x$	$2488.1 + 6.5822t^2 - 237.14t$	

x = years since clearing

t = tree basal area (m^2)

g = grass production (tonnes per hectare)

u = grass utilisation rate

i = intake (kg/day)

Carbon stocks per hectare are defined as:

above ground

$$C_a = (3.5t)\left[0.5\left(\frac{44}{12}\right)\right] \quad \textbf{(2)}$$

below ground

$$C_b = (3.5t \times 0.4)\left[0.5\left(\frac{44}{12}\right)\right] \quad \textbf{(3)}$$

where t equals tree basal area

Carbon sequestration (S) in year n is defined as:

$$S_n = (C_{an} + C_{bn}) - (C_{an-1} + C_{bn-1}) \quad \textbf{(4)}$$

The cost of carbon sequestration is the opportunity cost of the alternative land-use (in this case cattle production) plus the transaction costs of achieving additional carbon sequestration and participating in a carbon trading program. For ease of calculation and because the level of transaction costs is not known, they are initially assumed to be zero. Thus the cost of sequestration is equal to the present value of cattle production under the status quo clearing regime. The cost effectiveness of carbon sequestration methods is the present value of the cost of sequestration per ton of carbon sequestered.

The parameters for the cattle production model were calculated using the Breedcow Dynama™ software package {Holmes, 2010 #273}. The model was based on a regionally representative breeder herd turning off finished (Brigalow) or store (Eucalypt) steers herds as constructed by Best {, 2007 #38} and Holmes {, 2009 #256}. The key parameters for each model are described in Table 2.

Table 2 Cattle production parameters {adapted from \Best, 2007 #38}

	Brigalow	**Eucalypt**
Weaning rate	**70%**	**65%**
Breeder mortality rate	3%	4%
Age of turnoff	24-30 months	18-24 months
Weight at turnoff (kg live)	500-620	360
Market	EU/Jap Ox	store steer
Fodder costs ($/hd)	$10.00	$15.00

Using this model Net Present Value (NPV) is calculated for the enterprise under a business as usual scenario and for a carbon trading enterprise. Option 1 is the business-as-usual (BAU) cattle production enterprise. Option 2 is the option to enter a voluntary trading scheme, reduce cattle numbers and trade carbon from additional regrowth. In this scenario there is no requirement to account for methane emissions. The base model assumptions for options 1 and 2 for Brigalow and Eucalypt landtypes are shown in Table 3. An initial carbon price of $23 per tonne CO_2^{-e} is used as it is the published starting price for the proposed Australian mandatory price on carbon.

Table 3 Bioeconomic base model assumptions

Base model	Brigalow	Eucalypt
Discount rate	6%	6%
Plot size (ha)	1 000	1 000
Starting year	2011	2011
Cattle GM ($/AE)	$155	$105
Include methane emissions (Y/N)	No	No
Clearing method	Bladeplough	Pull/Stick rake
Clearing costs ($/ha)	$150	$60
Clearing cycle (yrs)	20	20
Regrowth age at Year 0 (yrs)	20	20
Contract establishment costs ($/contract)	$0	$0
Annual monitoring costs ($/ha)	$0	$0
Contract length (yrs)	20	20

Carbon price (\$/t CO_2^{-e})	\$23	\$23

Results

At \$23 per tonne CO_2^{-e} the NPV of selling carbon offsets compared to producing only cattle is approximately twice as high on Brigalow landtypes (assuming regrowth suppressed) and almost ten times higher on Eucalypt landtypes (see Table 4). The higher return from Eucalypt is due to the lower assumed opportunity costs (\$105 gross margin/AE compared to \$155/AE for Brigalow) and the higher carbon sequestration (63 tonnes per hectare compared to 4 tonnes per hectare on Brigalow). The cost per tonne is the cost in terms of lost grazing (opportunity cost). It is calculated as the NPV for cattle divided by the number of tonnes sequestered for each of the carbon scenarios. Table 5 also shows the results of Brigalow if regrowth is not suppressed which affects both sequestration rate and cattle carrying capacity. If regrowth is not suppressed, sequestration on Brigalow is approximately 29 tonnes per hectare and the average carrying capacities for the cattle-only and the cattle-carbon enterprises are approximately 150AE and 97AE respectively. Based on these results participating in a carbon trading enterprise would appear to be a profitable alternative enterprise for many cattle producers in Central Queensland.

Table 4 Base model results

Per 1000 hectare plot	Brigalow– suppressed	Brigalow – not suppressed	Eucalypt
Average AE (cattle)	189	150	120
Average AE (cattle and carbon)	166	97	68
Tonnes of Carbon sequestered	4 165	29 340	63 179
NPV cattle	\$208,082	\$145,466	\$98,539
NPV cattle & carbon	\$403,692	\$644,072	\$979,607
Cost per tonne	\$49.96	\$4.96	\$1.56

Sensitivity analysis

The key factors which determine the relative profitability of carbon offsets versus cattle are the price of carbon, transaction costs and the opportunity cost of grazing. Figure 1 and Figure 2 show the variation in NPV under a range of carbon prices. In Brigalow areas (Figure 1) a mixed carbon-cattle enterprise has a higher NPV than a straight cattle enterprise at carbon prices greater than \$2 per tonne CO_2^{-e}. In Eucalypt areas (Figure 2), even at \$0 per tonne CO_2^{-e} the carbon-cattle enterprise has higher returns than the straight cattle enterprise as the reduced clearing costs more than compensate for the reduction in carrying capacity. A carbon enterprise is profitable at low carbon prices because there are no longer any clearing costs and cattle carrying capacities decline slowly thus there is income from both cattle and carbon for a time. However, these figures do not take into account the transaction costs of participating in carbon trading nor the risk of signing a long term contract for an uncertain good. These factors will be considered in the next section.

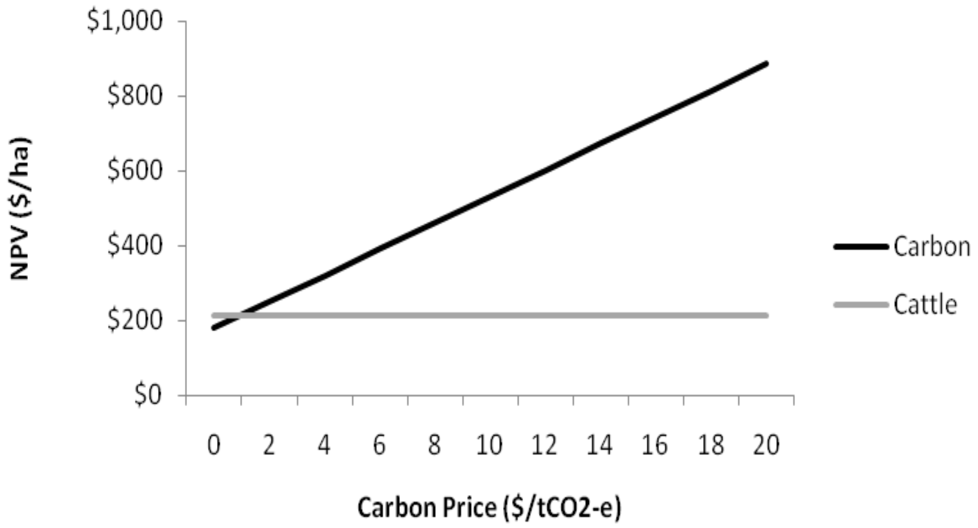


Figure 1 Sensitivity to Carbon Price - Brigalow

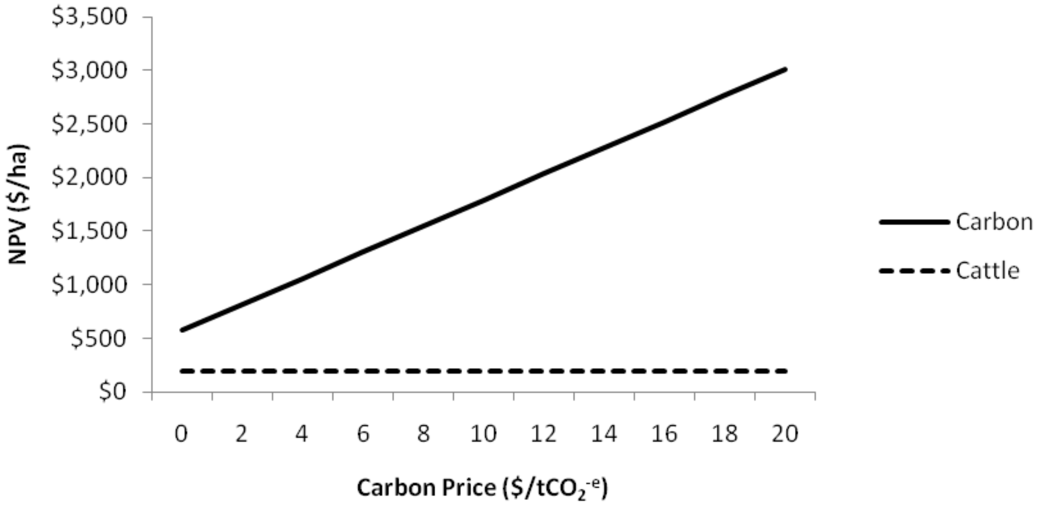


Figure 2 Sensitivity to Carbon Price – Eucalypt

Optimizing cattle and carbon enterprise mix

The decision to participate in a carbon offsets model is two step; first the decision to participate, secondly the decision as to how many carbon offsets to supply. To answer the second part of the question requires analysis at the enterprise scale to determine the optimal enterprise mix between cattle and carbon. The model assumes a single decision point and constant allocation for the decision period.

Modifying equation (1), the NPV for landtype *l* under a given allocation to each enterprise is given by:

$$I_l = \sum_{n=1}^{N} \left[\left(h_g SR_g GM_l \right) + \left(\left(h_c SR_c GM_l \right) + \left(h_c S_l CP \right) \right) \right] \left(1 + r^{-n} \right) \qquad (5)$$

where *g* denotes a grazing only enterprise and *c* denotes a grazing and carbon enterprise.

The optimisation is calculated using the Microsoft Excel Solver and Visual Basic for Excel. All scenarios are based on a 1000 hectare parcel of land which is homogenous in land-type, carrying capacity and carbon sequestration potential across the parcel. Each iteration reports the minimum carbon price at which optimal allocation (as measure by maximized total NPV) to the cattle-carbon enterprise becomes positive. Figures 4 and 5 (below) shows the optimal allocation to each enterprise as the carbon price increases using the assumptions shown in Table 5. These assumptions are used as the basis for the sensitivity analysis shown in the next sections.

Table 5 Base optimization assumptions

	Brigalow	**Eucalypt**
Discount rate	6%	6%
Cattle GM ($/AE)	$155	$105
Include methane emissions (Y/N)	No	No
Clearing method	Bladeplough	Pull/Stick rake
Clearing costs ($/ha)	$150	$60
Clearing cycle (yrs)	20	20
Regrowth age at Year 0 (yrs)	20	20
Contract establishment costs ($/contract)	$2000	$2000
Annual monitoring costs ($/ha)	$10	$10
Contract length (yrs)	20	20

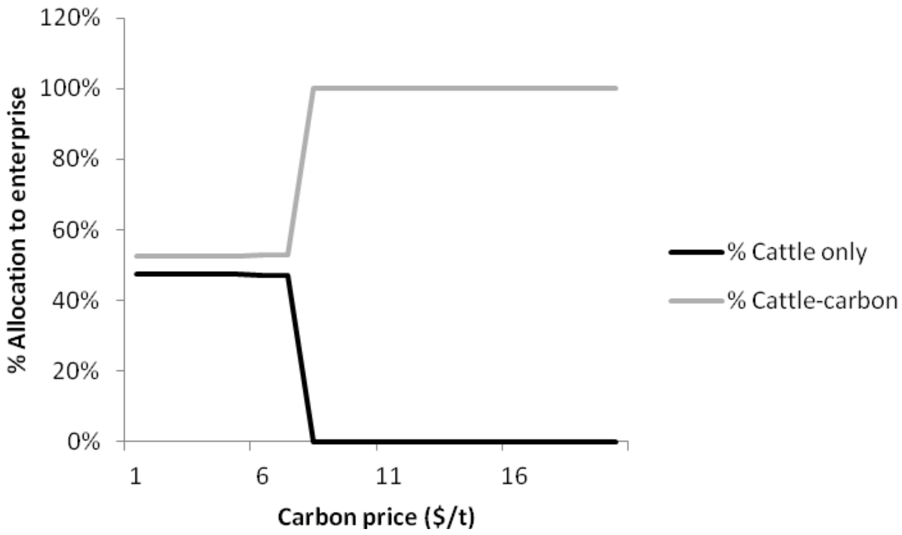


Figure 3 Base optimization results - Brigalow

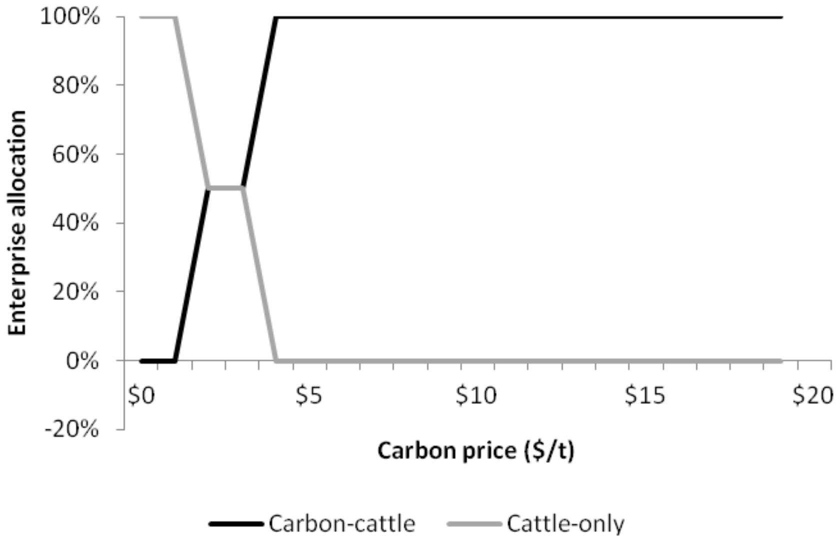


Figure 4 Base optimization results – Eucalypt

A further series of optimization runs were made to evaluate the impact of the age of regrowth, opportunity costs, contract length and transaction costs. The results of the optimization model reflect expectations based on earlier results. Due to the higher opportunity costs and lower sequestration rates Brigalow landtypes are far more sensitive to changes in transaction costs and carbon prices than Eucalypt landtypes.

Transaction costs

Estimating likely transaction costs for carbon offset contracts is very difficult due to an absence of data. However, based on similar programs some broad estimates were made. Establishing the contract itself is expected to require some form of assistance, possibly in the form of a carbon broker or legal representative. A figure of $2000 per contract was deemed to be reasonable. Annual monitoring costs are even more difficult to predict as they are based on the activity being undertaken as well as the technology available. Therefore a range of costs were considered, from $5 per hectare to $100 per hectare. It is unlikely that costs would reach $100 per hectare as monitoring systems are expected to improve over time and become less expensive and more accurate.

Brigalow

Figure 5 shows the optimal allocation to the carbon enterprise as carbon prices and transaction costs increase. If annual transaction costs are $10 per hectare, the optimal allocation is 50% to each enterprise at carbon prices of between $1 per tonne and $6 per tonne. If carbon prices increase to $7 per tonne the optimal allocation increases to 100% carbon-cattle. If transaction costs are $40 per hectare per year the optimal allocation to carbon-cattle is zero until carbon prices reach a minimum of $88 per tonne. 100% allocation would require prices much greater than $100 per tonne which is not expected to occur, at least in the early stages of any carbon trading scheme, thus it was not estimated.

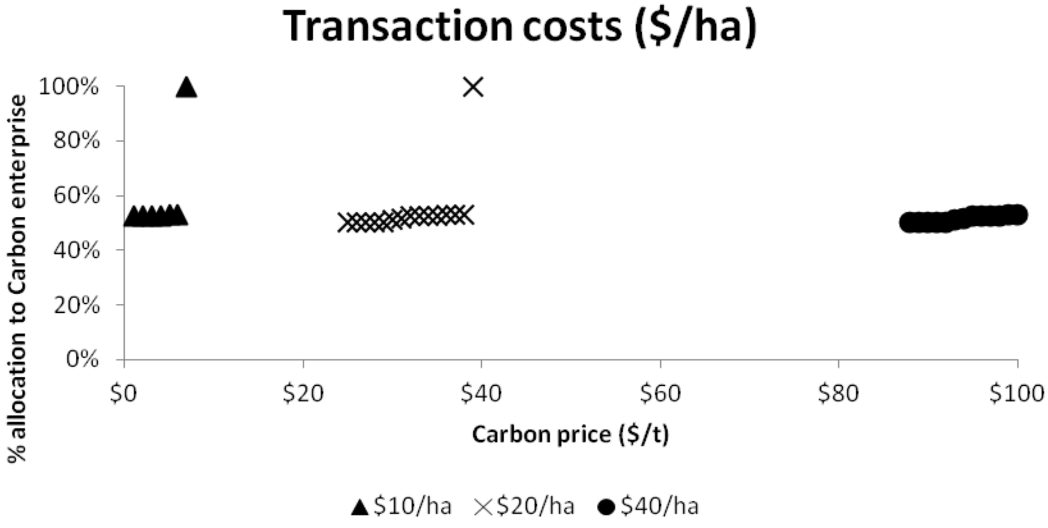


Figure 5 Transaction cost optimization – Brigalow

Eucalypt

At $10 per hectare annual transaction costs carbon prices need only be $2 per tonne for the optimal allocation to be 50 per cent to cattle-only and 50 per cent to carbon-cattle. A slight increase in the carbon price at each transaction cost level increases the optimal allocation to 100 per cent carbon-cattle. This result highlights the sensitivity of these results to slight changes in parameters. The minimum carbon price at which a carbon enterprise becomes viable is much lower for the Eucalypt than the Brigalow due to lower opportunity costs and higher sequestration rate. A eucalypt based carbon enterprise can therefore absorb much higher transaction costs before becoming unviable.

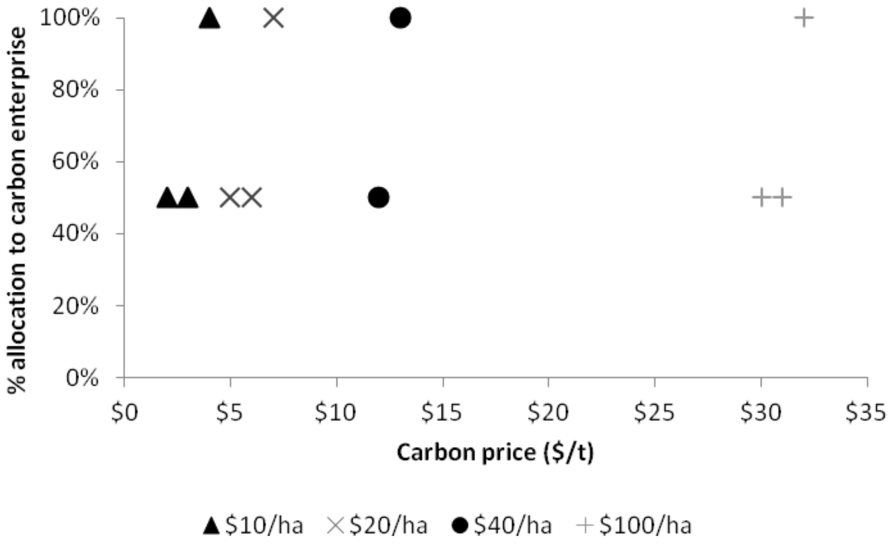


Figure 6 Transaction cost sensitivity - Eucalypt

For the remainder of the optimization scenarios transaction costs are assumed to be $2000 at establishment and $10 per hectare per year.

Age of regrowth

The original analysis assumed that the decision point occurred at the point where re-growth is ready to be re-cleared, approximately 20 years of age. The age of regrowth at year zero affects the amount of additional carbon which can be sequestered, therefore the income potential of supplying carbon offsets. The age of regrowth at year zero also determines how far into the investment period re-clearing is required for the status quo (cattle) scenario, and cattle carrying capacity for both enterprises. This affects the opportunity cost of carbon sequestration therefore the relative profitability of each enterprise. If regrowth is 20 years old, the amount of additional carbon that can be sequestered is lower therefore the carbon price needed to switch over is higher. If, however the paddock had just been cleared the year before, there is the potential to sequester a lot more carbon therefore the price needed to switch is much lower (even after accounting for the fact that there would be no clearing costs in the base option and carrying capacity would be higher). The figures and tables below show the impact of the age of regrowth on minimum carbon price, carbon sequestration potential and cattle carrying capacity for Brigalow and Eucalypt respectively.

Brigalow

As the age of regrowth increases and fewer credits are available to sell the minimum price at which participation is induced increases. At the same time NPV is reduced for both the cattle-only and the carbon-cattle enterprise because carrying capacity and additional tonnes of carbon sequestered decline. The NPV for the Cattle-only 100% scenario is the same at 0 and 20years because the clearing cycle has been set at 20 years so year 20 from the first run becomes year 0 for the next. NPV is maximised if regrowth is 5 years old at the beginning of the contract.

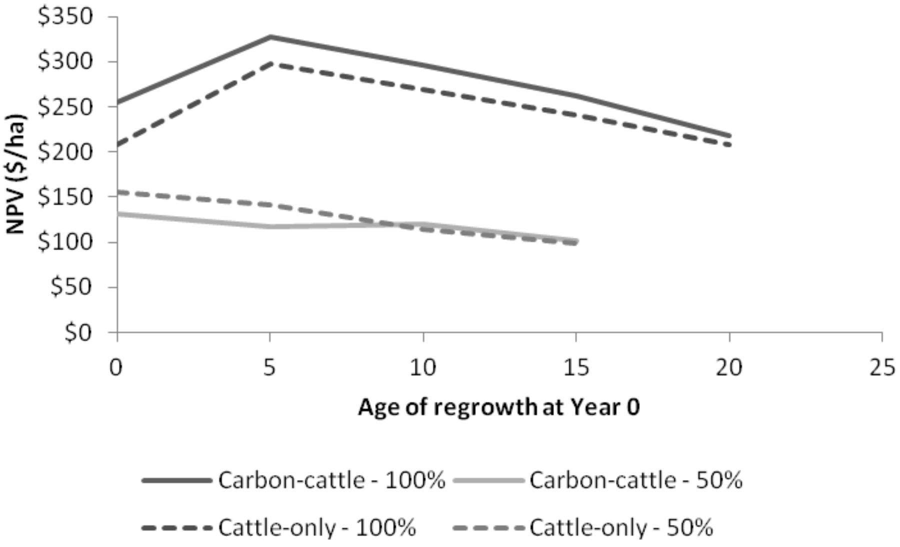


Figure 7 Effect of age of regrowth on NPV - Brigalow

Eucalypt

On the Eucalypt landtype age of regrowth does not dramatically change the minimum price at which optimal allocation to the carbon-cattle enterprise becomes positive or complete. Even though the tonnes of carbon sequestered decreases as the age of regrowth at year zero increases, NPV for the 20 year old scenario is higher than for the 15 year old scenario because participation is not induced until prices reach $4 per tonne versus $3 in the previous iteration. Figure 8 also shows the NPV for cattle-only if 100% of the area is allocated to this enterprise. As in the Brigalow the NPV for Eucalypt Cattle-only 100% is the same at 0 years since cleared and 20 years since cleared. NPV is also maximised if regrowth is 5 years old at the beginning of the contract.

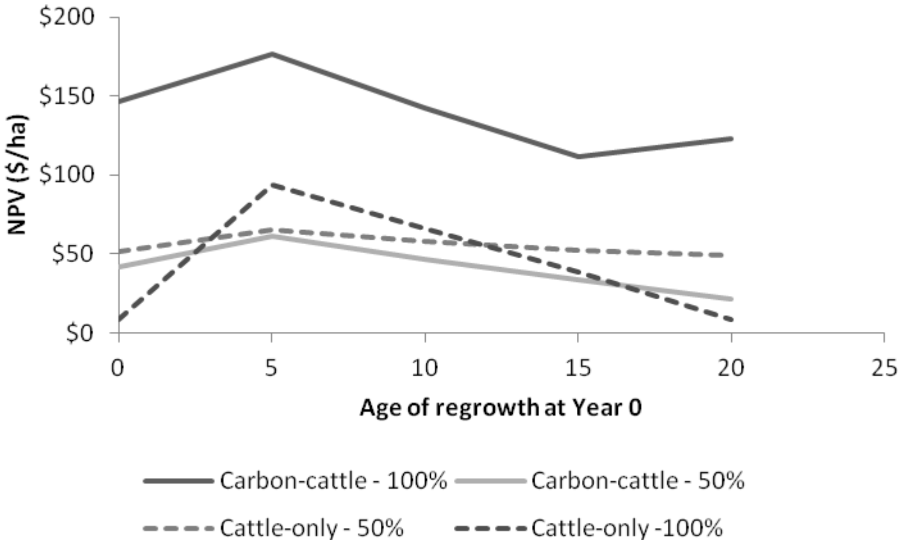


Figure 8 Effect of age of regrowth at year 0 - Eucalypt

Regrowth clearing costs

The method of regrowth control has an impact not only on the costs of clearing but also the length of the interval between clearing and the speed with which regrowth occurs. A series of scenarios were developed to evaluate these impacts.

Brigalow

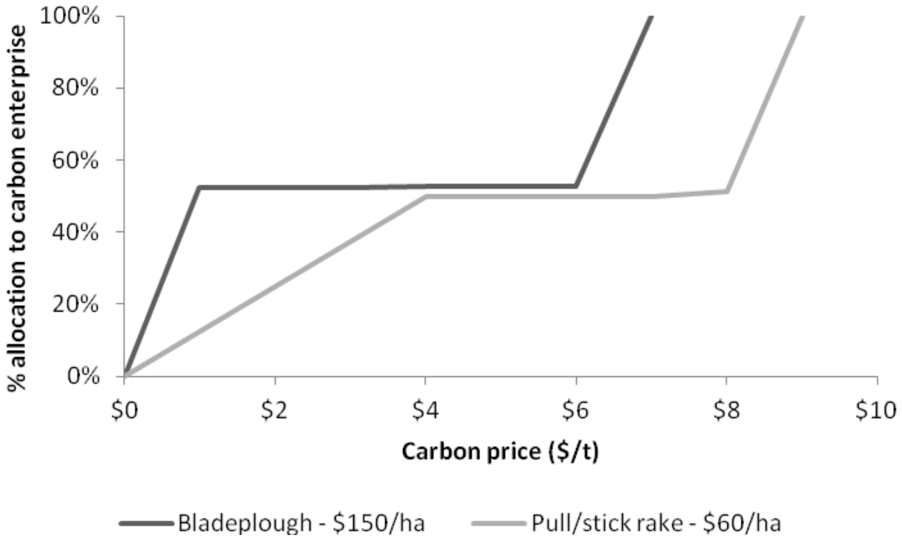
Scenario 1 – Bladeplough

The paddock is bladeploughed once in Year 0 only. Costs are $150 per hectare. Due to the suppression affect of bladeploughing regrowth is limited in both the cattle-only and carbon-cattle enterprises

Scenario 2 - Pull/stick rake

The paddock is cleared once in Year 0 using a less aggressive method. Costs are lower at $60 per hectare. This method of clearing will not suppress regrowth. As expected, a higher carbon price is required to induce the switch to supply carbon offsets as cheaper clearing costs mean higher opportunity costs.

The results show that clearing costs and whether or not regrowth is suppressed are important factors. Whether regrowth is suppressed in the carbon option depends on which clearing method was used in the previous clearing cycle although suppression has the greatest impact in the early years of regrowth thus if regrowth is already 20 years old the affects will be minimal.



Eucalypt

Scenario 1 - $60 per hectare regrowth clearing costs

Scenario 2 - $30 per hectare regrowth clearing costs

Scenario 3 - $15 per hectare regrowth clearing costs

All scenarios are based on 20 year clearing cycles and 20 year old regrowth at Year 0. There is no assumption of suppression in any of the Eucalypt scenarios, thus the amount of carbon sequestered is the same for each scenario.

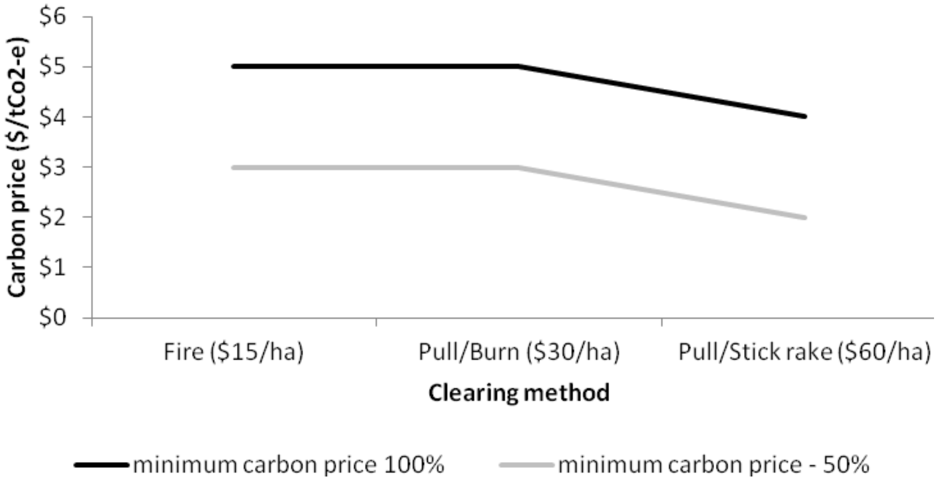


Figure 9 Effect of regrowth control method - Eucalypt

Gross margins

The profitability of cattle enterprises in Central Queensland varies significantly, even amongst those on very similar land resource bases. Variation is largely driven by management skills as well as the specific production system, breed and location. As expected, as the gross margin decreases (lower opportunity costs) the carbon price at which it becomes profitable to switch to producing carbon offsets also decreases. However, the mixed allocation for Eucalypt occurs at the same carbon price for each scenario.

Brigalow

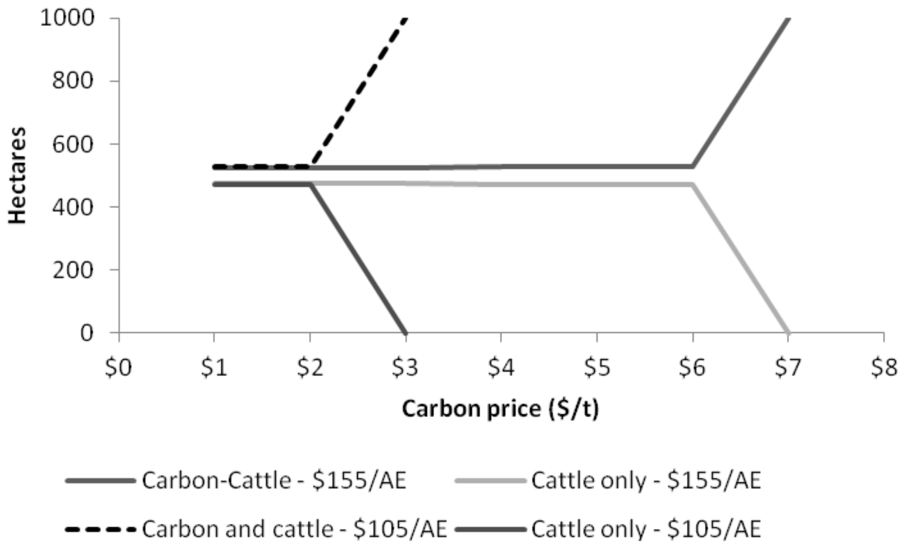


Figure 10 Gross margin effect - Brigalow

Eucalypt

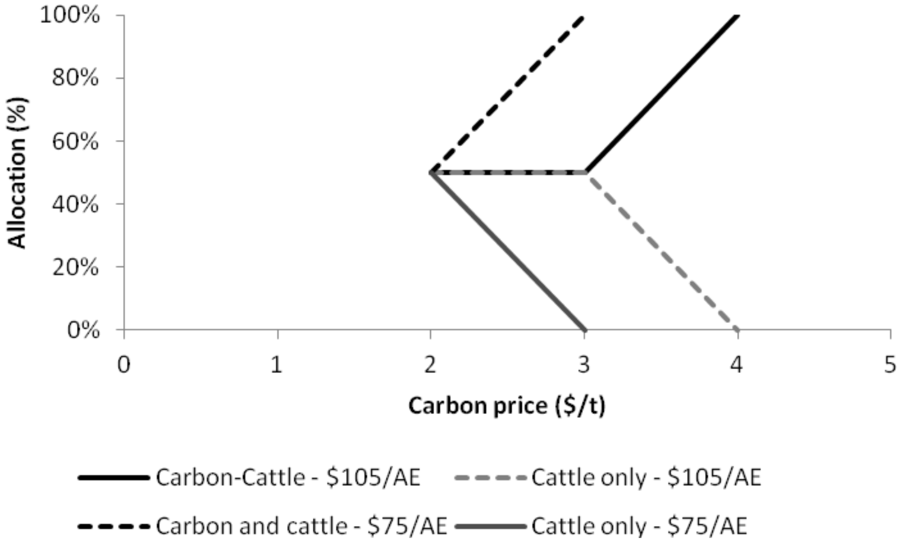


Figure 11 Allocations under changing gross margin– Eucalypt

Carbon sequestration rate

The biological growth models used to estimate carbon sequestration are subject to a potential degree of error. To measure the impact of this error sensitivity on the rate of carbon sequestration was conducted at -20%, -10%, -5%, +5%, +10% and +20% of the base sequestration estimates. The results are shown below:

Brigalow

The results show that even if the sequestration models are inaccurate by plus or minus 20% of the base estimates the price at which full participation becomes optimal does not change dramatically. The major impact is on the tonnes of carbon traded and the NPV.

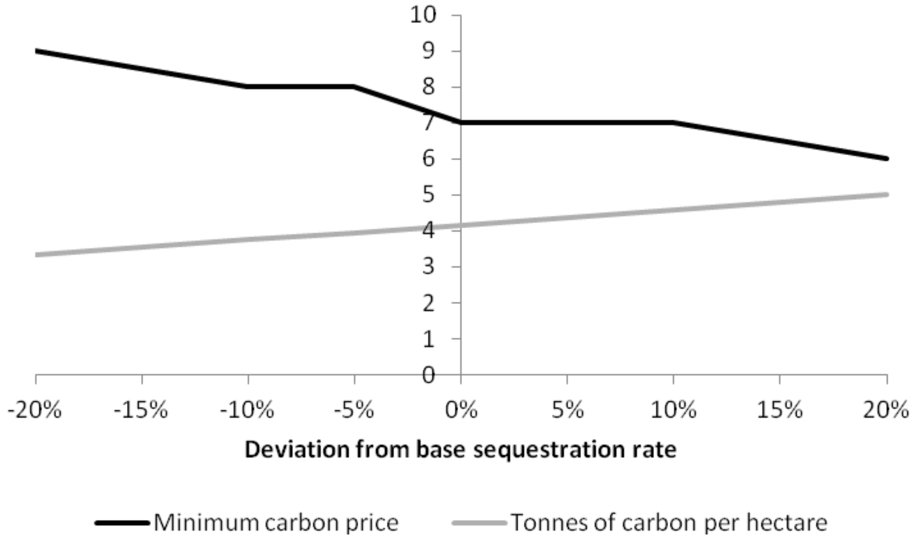


Figure 12 Allocation under varying sequestration rates - Brigalow

Sequestration sensitivity	-20%	-10%	-5%	0%	5%	10%	20%
Carbon price ($/t)	$6	$7	$7	$7	$8	$8	$9
Tonnes carbon/ha	5.00	4.58	4.37	4.16	3.96	3.75	3.33
NPV ($/ha)	$219	$221	$220	$218	$221	$219	$219

Eucalypt

The graph below shows the tonnes of sequestration and the minimum carbon price at which NPV is optimised by allocating 100 per cent of the area to the carbon-cattle enterprise under varying estimates of sequestration. As with the Brigalow variation of greater or less than 20 per cent of the original sequestration estimates do not dramatically change the price at which 100 per cent allocation occurs.

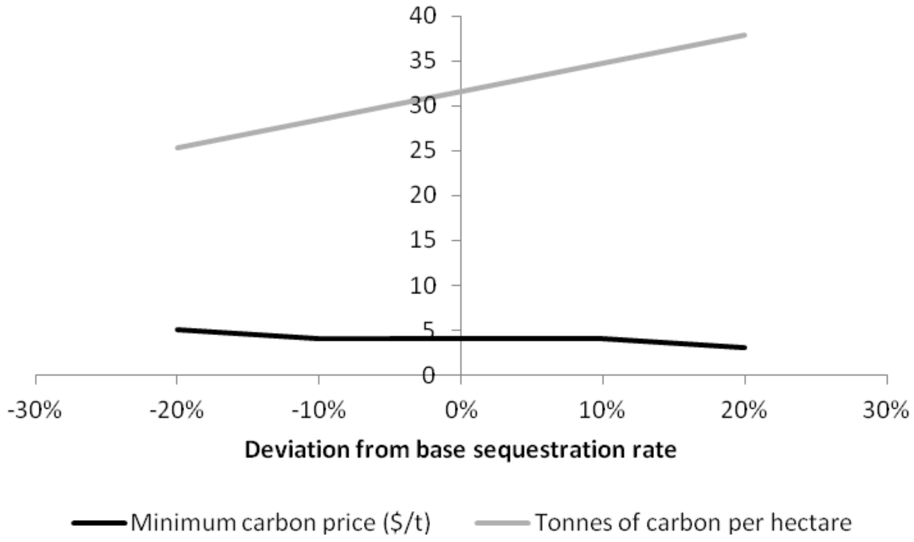


Figure 13 Sequestration rate sensitivity - Eucalypt

Sequestration sensitivity	-20%	-10%	-5%	0%	+5%	+10%	+20%
Carbon price ($/t)	$5	$4	$4	$4	$4	$4	$3
Tonnes carbon/ha	50.5	56.9	06	63	66	69	75.8
NPV ($/ha)	$123	$108	$115	$123	$131	$138	$108

Alternative Policy

As discussed in previous sections the viability of carbon trading as an alternative enterprise for beef producers is largely dependent on the design and implementation of the trading scheme. One of the major issues is how on-farm emissions are treated. Under the rules of the proposed Carbon Farming Initiative in Australia agricultural producers are not required to offset their own on-farm emissions. However, as significant contributors to greenhouse gas emissions it is possible that this could change in the future. For beef producers the largest emission liability comes from enteric methane. There are several ways in which methane production can be reduced, including alternative feeding regimes and further research is underway into a possible vaccine or other rumen manipulation that would reduce methane emissions {Burns, 2009 #45}. In the meantime if beef producers were required to account for their emissions it would dramatically change the relative profitability of cattle and carbon production. The most likely scenario at least in the short terms is that beef producers would be exempt from emissions accounting unless they choose to trade offsets in which case they would only be able to sell credits sequestered over and above on-farm methane emissions.

Brigalow

Under the base case assumptions (outlined in Table 5) the impact of whether methane is accounted for or not is minimal but changes to the parameters of these assumptions can have a significant effect. If transaction costs are low (less than \$10 per hectare^{-yr}) the switch point is the same, but if transaction costs are \$10 per hectare per year, carbon prices must be \$30 per tonne to induce full participation compared to only \$7 per tonne if methane is ignored. Higher transaction costs would require carbon prices in excess of \$100 per tonne to make a complete switch more profitable than the cattle-only enterprise.

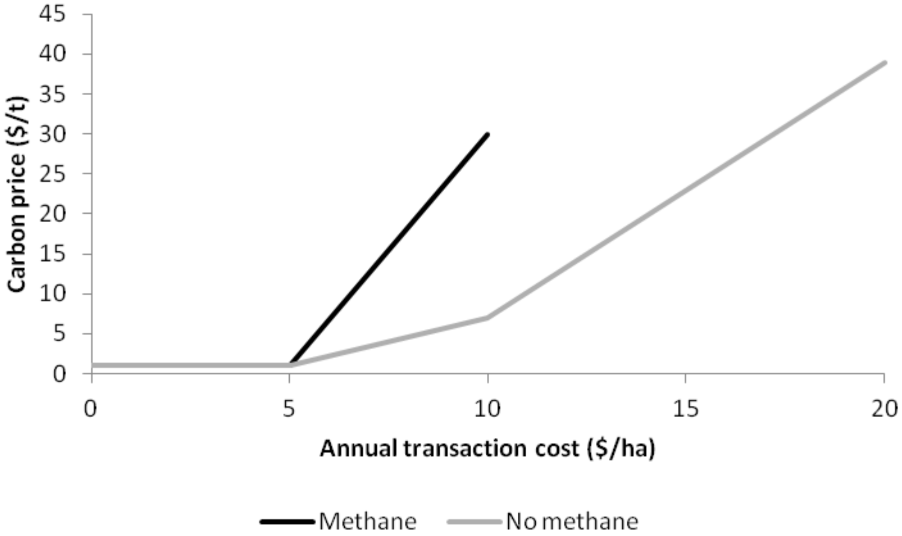


Figure 14 Effect of methane and transaction costs – Brigalow

An interesting result occurs when looking at the tonnes of carbon traded as the age of the regrowth at year 0 changes. If only offsets net of methane emissions ("Methane" in Figure 15) can be traded, offsets are actually negative when regrowth is 20 years old at year 0. This occurs because the rate of sequestration declines and actually becomes negative in year 14 whilst the cattle carrying capacity declines much more slowly. Total NPV is still optimized at this point as the model has not required that extra emissions are paid for and the cost-savings from not clearing regrowth in the carbon-cattle option still outweigh the reduction in carrying capacity.

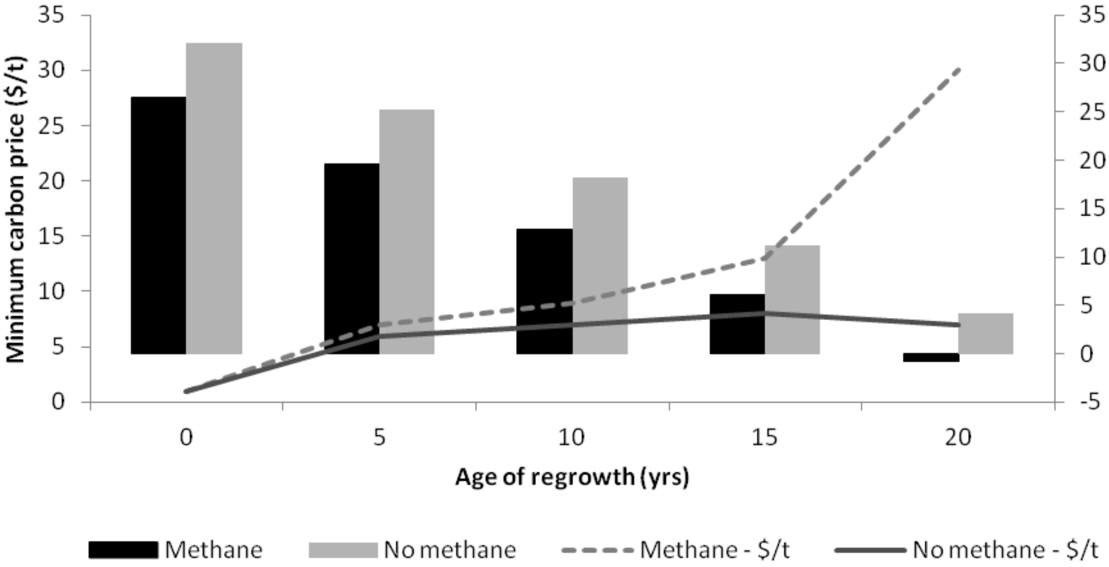


Figure 15 Age of regrowth and methane – Brigalow

Eucalypt

The average methane emitted on the Eucalypt landtype is 0.16 per cent of the possible sequestration whilst in Brigalow areas the higher carrying capacity and lower sequestration means that methane emissions would negate 30 per cent of possible sequestration. Thus, discounting offsets by the amount of methane emitted has a relatively smaller impact in the Eucalypt example due to the greater sequestration achieved on this landtype and the lower cattle carrying capacity. This is demonstrated in Figure.16 which shows relatively little difference between the switch points of the ‘No methane’ and ‘Methane’ series over varying transaction costs. For the age of regrowth, clearing cost, gross margin and sequestration rate sensitivity analyses the switch points are exactly the same.

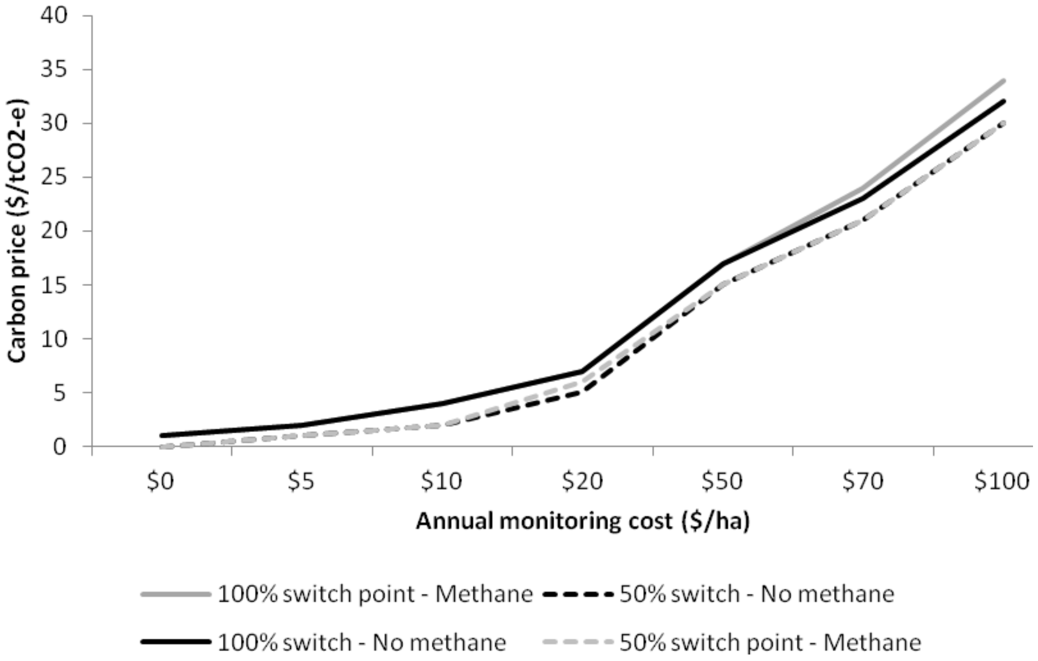


Figure.16 Effect of methane and transaction costs – Eucalypt

Avoided deforestation

The other major policy change which could significantly impact the number of landholders willing to sign up to a carbon trading program is the issue of avoided deforestation. Additionality is a major determinant of eligibility for carbon offsets and has important implications, particularly for agro-forestry based offset programs. Additionality requires that the action would not have occurred without the price signal from a carbon market. It could be argued that a landholder who has land which can be legally cleared and who chooses not to in order to sequester additional carbon and sell offsets has also offset the emissions from the avoided deforestation when the standing vegetation was not cleared. The effect of allowing this would be to radically increase the number of offsets available for sale, particularly in areas where the vegetation is already a number of years old. This would lower the minimum price at which participation becomes optimal and increase the number of offsets traded.

Brigalow

Figure 17 shows the number of tonnes of carbon traded per hectare and the price point at which 100% participation in carbon trading becomes optimal for the base and avoided deforestation models. As expected, if the current carbon stock can be traded as avoided deforestation offsets the number of tonnes of carbon traded increases significantly[1]. However, the price point at which participation becomes optimal is the same for both the avoided deforestation scenario and the base model.

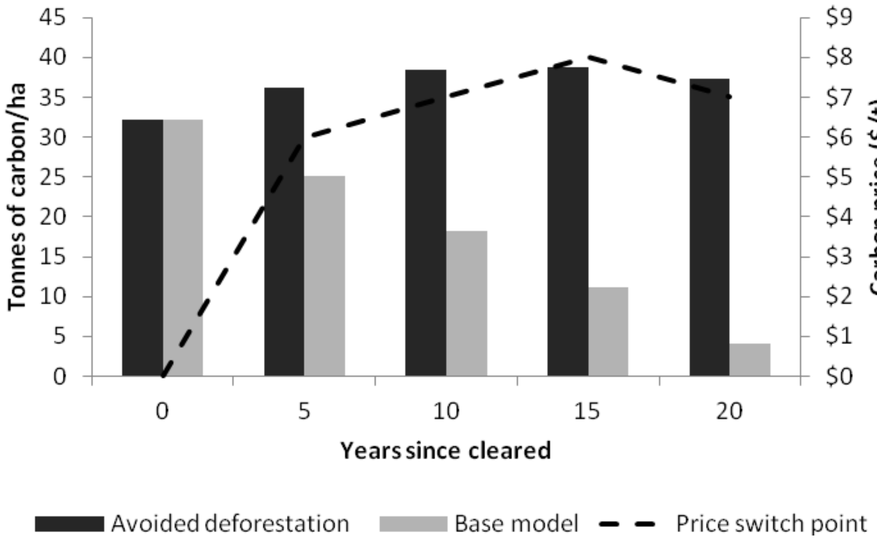


Figure 17 Avoided deforestation - Brigalow

Eucalypt

Similar results are found for the Eucalypt model and again the price switch point is not affected.

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[1] If regrowth is zero years old at Year 0 the number of offsets traded is the same because the current carbon stock is zero, therefore there are no avoided deforestation credits to be traded.

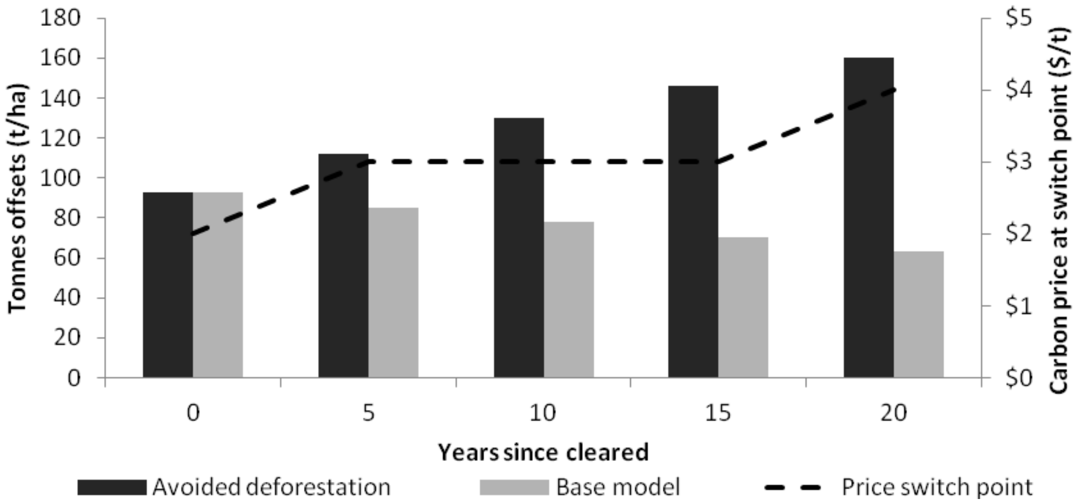

Figure 18 Avoided deforestation - Eucalypt

Discussion

Based on a 20 year, discounted cash flow analysis a combined carbon-cattle enterprise appears to be profitable at relatively low carbon prices. However, the relative profitability of carbon trading and cattle production are very sensitive to changes in variables, including transaction costs, the age of regrowth, the cost of regrowth control, the value of cattle production and the rate of carbon sequestration. Due to the higher sequestration rates and lower opportunity costs of cattle production, it is profitable to move into carbon trading at a lower carbon price on Eucalypt land than Brigalow land. Thus Eucalypt areas generally offer a much more efficient source of carbon offsets than Brigalow areas. This result is significant as it offers the opportunity for a 'win-win' situation in which carbon policies could be targeted at lower productivity Eucalypt land whilst maintaining food production on Brigalow areas. The profitability of offsets from Eucalypt areas is also more robust to changes cost and price assumptions as well as larger policy changes such as the requirement to account for on-farm methane emissions.

These results contribute by adding economic values to previous estimates of the potential supply of carbon offsets from agricultural land. However actual participation rates by landholders will also be determined by individuals' perception of and attitude towards risk, their non-financial motivations for participating (or not) in a carbon trading program, the treatment of credits beyond the contract period and any potential change in opportunity costs. As shown by the variability in the presented results, it is difficult to make any general comments about the relative profitability of carbon trading which may also be a barrier to participation, at least in the early stages. Demonstration of relative profitability has been shown to be a major influence on the level and rate of adoption thus many landholders are likely to prefer to wait and see how others fare.

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