Department of Employment, Economic Development and Innovation

# Strategies to improve the profitability of extensive grazing systems in central Queensland

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Queensland Government

# Strategies to improve the profitability of extensive grazing systems in central Queensland

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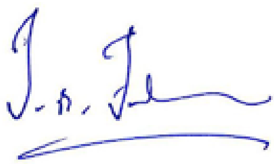
On 26 March 2009, the Department of Primary Industries and Fisheries was amalgamated with other government departments to form the Department of Employment, Economic Development and Innovation.

# Foreword

The Department of Employment, Economic Development and Innovation (DEEDI) has a vision of a strong Queensland economy underpinned by a skilled workforce, prosperous regional economies and sustained economic growth. Queensland's beef industry is a critical component of the State's economy, accounting for the largest proportion of Australia's cattle herd, 38% of all jobs in Queensland agriculture and one third of the gross value of production of Queensland's agriculture. Improving beef business profitability and productivity remains a priority for DEEDI.

DEEDI understands the importance of directing resources toward areas of a business that will have the greatest impact on profit. The CQ *BEEF* project is a DEEDI led initiative that provides graziers with an opportunity to undertake a complete business analysis to identify underperforming parts of a business as well as business profit centres. CQ *BEEF* is just one of many nutrition, grazing, breeding and business management FutureBeef projects being coordinated throughout the state to improve profitability and sustainability in the Queensland beef industry. By understanding what's working or not working within a business, managers can make better use of their resources to improve profitability. The case studies set out in this book are examples of innovations implemented by Queensland graziers as a result of the CQ *BEEF* project. I commend this book to anyone involved in Queensland's beef supply chain interested in improving the profitability and productivity of Queensland's extensive grazing industry.



***Ian Fletcher***
Director General
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# Definitions

**Adult equivalent** – an adult equivalent (AE) refers to a method of comparison between animals of different feed requirements with a recognised standard of a single adult animal feed ration. The international standard being a single non-pregnant, non lactating animal of 455 kilograms live weight equals 1 AE.

**Beast area** – beast area measures the hectares of land required to sustainably support one AE.

**Blade plough** – a blade plough is a giant, single tyne plough pulled by large bulldozers. It can plough standing scrub and forest to 12 metres in height whilst sowing improved pastures in a single pass.

**'Bullocks' computer programme** – the bullocks computer programme is a gross margin calculator lying within the Breedcow and Dynama Herd Budgeting software.

**Cost benefit analysis** – a financial technique that uses a discounted cashflow budget to estimate the net present value (NPV) or lump sum present value equivalent of the incremental net cash flow stream over an investment period (e.g. 25 years). It arises directly as a result of estimating the difference in the annual cash flow pattern for the property, with and without any proposed changes in management options. The net present value is calculated as:

$$NPV = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t}$$

where $n$ = number of periods in the investment
$r$ = the discount rate
$t$ = the year of the cash flow
$C_t$ = cash flow at year $t$

**Discount rate** – the percentage of compound interest at which future benefits and costs are adjusted to their equivalent present-day values.

**Feeder heifer** – a category of heifer marketed to the feedlot trade at 280–340 kg live weight.

**Gross margin** – the gross margin for an operation within a stable herd structure is equivalent to the gross income received less the variable costs incurred. Variable costs are those directly attributable to an individual animal which varies in proportion to the size of the operation. Examples include animal husbandry and marketing expenses. Gross margins per adult equivalent provide an indication of gross margin per beast area, enabling gross margin comparisons between different land types.

**Hot standard carcase weight (HSCW) –** HSCW refers to the weight of a beef carcase after bleeding, hide removal and removal of internal organs. Slaughter prices are generally quoted on $/kg HSCW.

**Land condition** – land condition is defined as the capacity of land to respond to rain and produce useful forage and is a measure of how well the ecosystem is functioning. The ABCD land condition framework was developed by Meat and Livestock Australia (MLA) in partnership with the Queensland government and is used to classify the condition of land (Chilcott et al., 2006). Land in A condition has good coverage of perennial pastures, has less than 30% of bare ground in most years, has few weeds and no significant infestations, good soil condition, no erosion and good surface condition and no sign or only early signs of woodland thickening. At the other extreme land in D condition is characterised by a general lack of perennial grasses, has severe erosion or scalding and thickets of woody plants cover most of the area.

**Land regeneration** – land regeneration refers to the process of restoring grazing land from a degraded state to an improved condition.

**Leucaena** – leucaena is a high quality, long-lived leguminous forage tree. First introduced to Australia by CSIRO in the 1950s for extensive grazed systems for tropical Australia. Leucaena produces highly palatable, nutritious, high protein leaf for cattle giving liveweight gains of 215–245 kg/hd/yr, at a stocking rate of 1 AE: 1.6 ha.

**Meat Standards Australia™ (MSA)** – MSA is a beef, lamb and sheepmeat eating quality program that removes the need for consumers to have specialist knowledge of beef and sheepmeat. MSA labels the red meat product with a guaranteed grade and recommended cooking method to identify eating quality according to consumer perceptions.

**Sucker regrowth** – due to the tree clearing techniques used to develop much of Queensland's rangelands, vegetative suckering from root stocks and seedling establishment occurs resulting in regrowth control being a persistent problem requiring recurrent clearing for many Queensland graziers. This vegetative suckering is referred to as 'sucker regrowth'.

**Total factor productivity** – total factor productivity (TFP) measures outputs relative to total inputs used to produce the outputs. Beef producers in northern Australia have achieved an annual average TFP growth of 1.2% per year (ABARE 2009).

# Introduction

The grazing industry accounts for 45% of the total value of agricultural production in Australia, with beef cattle production representing the single largest industry within this sector. Over the past ten years Australia's extensive grazing industry has been expanding in terms of production. This expansion has occurred most significantly on large (1,600 to 5,400 head) or very large (> 5,400 head) properties in northern Australia (ABARE 2009).

Productivity growth in agriculture has been an important source of wealth in Australia. However, recent data suggests this productivity growth has slowed. In particular the rate of productivity growth in extensive cropping and grazing systems has fallen from 2.1% to 1.5% in the previous decade (Sheng et al 2010). This fall in productivity growth is due largely to a long term reduction in funded research and development and poor seasonal conditions. In addition, the majority of the productivity growth that has occurred has been as a result of efficiency improvements (management efficiency) rather than technological progress (Gregg and Rolfe 2010).

An important determinant of productivity growth is innovation, which put simply is the development and adoption of more efficient technologies and management practices by industry (Liao and Martin 2009). To facilitate the best long term outcomes for grazing profitability and productivity, graziers require well formulated business and investment plans to ensure they make appropriate decisions regarding investments in innovation in times of prosperity and are well informed on management and technology options in times of change.

A challenge for graziers when seeking out innovation is obtaining objective economic assessments of innovation in a context relevant to their business. This book is an attempt to pull together a number of economic assessments of innovative practices relevant to northern Australia's extensive grazing industry. Where possible each analysis was undertaken using data and assumptions obtained from grazing businesses that had either adopted or were in the process of adopting the technology or changed management practice. Each of the case studies presented was developed in response to a thorough business analysis as a strategy to improve enterprise gross margins, reduce overheads or increase business turnover. Each case study was identified as the single most important contributor to profit growth that could be influenced by management.

The innovations analysed comprise a mix of new technologies and improvements in management practice in question. They include:

- Restoring degraded grazing lands
- Supplementing for improved reproduction rates
- Phosphorous supplementation
- Enterprise options analysis
- Turnoff options for breed/finish businesses
- High value perennial forages (leucaena)
- Rotational vs continuously stocked grazing systems
- Silvopastoral grazing systems
- Profiting from enhanced herd fertility.

Whilst every effort has been made to ensure the assumptions used in each analysis are accurate and validated with industry participants, relevant experts or published scientific studies, the results presented should be viewed as indicative only. Readers are strongly encouraged to undertake there own economic assessments of any of the innovations presented prior to investing any of their own funds. A list of key contacts has been included at the end of each case study so that individuals wanting to learn more about specific innovations or practices can contact the appropriate authors directly.

# Economic case studies

## High value perennial forage: leucaena

### Background

The profitability of many central Queensland grazing businesses is limited by low turnover. Development of an improved forage pasture system has been identified as one option available to intensify production and improve turnover without having to purchase or lease additional land. Leucaena was chosen for its high protein content, long life (over 30 years) and ability to sustain high stocking rates. It is also extremely palatable and relatively drought tolerant. Leucaena is currently planted on over 150,000 hectares in Queensland and this area continues to increase. This case study reports on the agronomic, managerial, production and economic considerations of developing dry land leucaena in central Queensland.

### Methodology/analysis

The computer programme 'Bullocks' was used to model gross margin returns from both the grass only and leucaena supplemented operations. This information was used as input into a discounted cash flow analysis which compared the costs and benefits of a proposed leucaena development in present value terms. This allows proposals which have benefits and costs in different years to be compared directly.

### Modelling assumptions

The assumptions used to calculate the gross margin are included in table 1. A nominal discount rate of 6.5% was used for modelling purposes.

### Key findings

- Leucaena offers an intensification path for beef producers
- Intensification is seen as a viable property development strategy
- Increased throughput offers a strategic response to low turnover
- Leucaena development offers superior weight gain and gross margin improvement
- Economic analysis indicates the potential profitability of leucaena investment

*Table 1. Gross margin assumptions*

| Assumptions | Grass only | Leucaena-grass |
|---|---|---|
| Purchase weight (kg) | 520 | 520 |
| Sale weight (kg liveweight) | 635 | 635 |
| Purchase price ($/kg, landed) | $1.52 | $1.52 |
| Sale price ($/kg HSCW[1]) | $3.02 | $3.02 |
| Dressing percentage | 49.50% | 50.50% |
| Av. daily liveweight gain (kg) | 0.6 | 1.0 |
| Mortality (%) | 0.25% | 0.25% |
| Variable costs ($/head) | $5.35 | $5.35 |

Expected yields and weight gain from grass fed operations were available from detailed farm records. However, given the lack of experimental data on expected leucaena production, estimates used in the analysis were based on central Queensland production results sourced from technical extension experts.

Development costs, shown in table 2 were included in the model from records of actual expenses. Total costs for the initial development (48.5 ha) were $388/ha, rising to $398/ha accounting for fuel cost increases and fertiliser usage throughout the development.

Maintenance and rejuvenation costs such as on-going slashing and ripping expenses were also accounted for in the model. It was assumed that the land was already owned and used for extensive grazing – that is, the sale and purchase of the land was not included in the comparative partial budgets.

A sensitivity analysis was undertaken to test the sensitivity of the results to changes in the discount rate, dressing percentage and meat prices used in the analysis.

*Table 2. Leucaena development budget*

| Item | Cost ($) | Notes |
|---|---|---|
| Fencing | $3,787 | includes materials and contract labour |
| Labour | $700 | 2 persons @ $70/day for five days (internal fencing) |
| Seed | $2,500 | |
| Herbicides | $4,412 | includes beetle baiting and seed innoculation |
| Fuel | $514 | |
| Contractor | $6,942 | includes ploughing, spraying, and hiring planter |
| **TOTAL** | **$18,855** | |

## Leucaena development

The leucaena was planted in three metre wide fallow strips separated by four metre wide grassed strips. Prior to planting all cattle were removed from the paddock (14 August 2006) to allow the fallow strips to store moisture (6 month fallow). Planting was done on a one metre double row spacing (21 February 2007) at the centre of each fallow strip. In total the rows were seven metres apart from centre to centre or six metres from one leucaena row to the next. Rows were orientated north-south. The leucaena was sown in a black clay type soil. Ploughing was used to control weeds in the fallow strips prior to planting. Post planting, all livestock were excluded from the paddock for a further 11 months to allow the leucaena to establish. In total the paddock was destocked for 17 months. The opportunity cost of foregone grazing during this fallow period was included in the analysis[2].

The leucaena cultivar *Cunningham* was used in the analysis. Leucaena seed was planted by calibrating the seeder to plant one seed every 100 mm in a double row. This equated to 115 kg of seed for the 48.5 hectares or 2.4 kg/ha. The seed was planted at a depth of 50 mm. The leucaena seed was also inoculated at planting.

One week after planting the 3 m cultivated strip was sprayed with glyphosate and Spinnaker® and beetle baited.

## Fertiliser

Fertiliser was not used to establish the leucaena in 2007. Half of the second planting received fertiliser, with no appreciable performance difference noted by the landholder. It is anticipated that a superphosphate blend fertiliser will be used for future plantings into poorer quality soils. Estimated cost is $11/hectare.

It is also anticipated that fertiliser may be required in the future management of the established leucaena to maintain optimum productivity, particularly as the leucaena ages.

[1]HSCW, Hot Standard Carcase Weight, the standard weight measurement used to value cattle

[2]As an indication of this opportunity cost, the portion of forgone grass-based production is estimated at $960 for the remainder of the 2006 production year and the yearly opportunity cost estimate for the area is $3,308 or $68/ha. Typical of intensified animal production systems, leucanea has a period of lag between initial investment and the generation of positive net return.

## Results

The model generates an initial net present value of $144,939 meaning that the producer is better off by that amount by choosing to invest in dry land leucaena, compared with the existing production system based on buffel grass pastures. The initial internal rate of return generated by the project of 22% exceeds the discount rate applied, implying that the project is netting sufficient returns to cover the cost of capital.

The leucaena supplemented finishing systems offer a superior annualised gross margin based on the relatively short time required on forage to finish animals. This point is further illustrated by comparison with gross margin expectations from a grass only operation as outlined in table 3, where animals have to spend more time on forage to achieve target weights due to lower daily weight gain.

*Table 3. Expected gross margins across a range of dressing percentages*

| Dressing (%) | Gross margin/adult equivalent less interest | |
|---|---|---|
| | Grass only | Leucaena-grass system |
| 48.5 | $153.59 | $333.32 |
| 49.0 | $167.67 | $357.00 |
| 49.5 | $181.75 | $380.67 |
| 50.0 | $195.83 | $404.34 |

## Price sensitivities

The impact of altering sale price on gross margins is displayed in table 4. The gross margins were found to be highly sensitive to changes in price. A 5% increase in price was found to increase the gross margin by 40–160% in the case of grass finished beef and 30–80% in the case of leucaena.

*Table 4. Gross margin results across a range of sale prices*

| Nominal sale price ($/kg) | Gross margin less interest ($/AE) | |
|---|---|---|
| | Grass only | Leucaena-grass |
| $2.75 | $43.28 | $143.16 |
| $2.90 | $112.51 | $261.91 |
| $3.05 | $181.75 | $380.67 |
| $3.20 | $250.99 | $499.42 |

## Conclusions

The economic analysis conducted on the proposed dry-land leucaena finishing operation indicates the grazier would have been $144,939 better-off over 20 years developing 174 ha of leucaena. Unsurprisingly, results are highly sensitive to gross margin returns. Modelling indicates the leucaena supplemented operation outperforming grass in terms of superior gross margin returns due to higher daily weight gain and the resultant shorter timeframes on forage to achieve target weights.

Analysis of the proposed development supports the view that subject to good management, developing leucaena will increase turnover and dilute overheads due to increased productivity leading to higher gross product. An additional key point of the analysis is that although supporting the benefits of leucaena, potential adopters should be well aware of the relatively long pay back period associated with its use.

Strategic issues to consider when planting leucaena:

- There is potential for a winter feed gap of between one to five months due to frost defoliating the plant. This may reduce the number of grazing rotations available in a year.
- Future considerations may include ripping the grass pasture in the interrow zone to maintain grass production. The cost of ripping is estimated to be $101/ha and is anticipated to occur four years after initial planting and every fifth year thereafter. The leucaena/grass paddocks are all old cultivation paddocks.
- At the end of the thirty year growing period replanting will take place using a new cultivar. The existing leucaena would be removed using a blade plough prior to replanting.

## More Information

More information on leucaena economics in central Queensland can be found in the best practice guide 'Using high quality forages to meet beef markets' (Bowen et al 2010) available by contacting Rebecca Gowen or Mark Best on 13 25 23.

# Estimating the economic response to phosphorus supplementation

## Key findings

- Near infra red spectrometry (NIRS) faecal sampling is increasingly being used to determine nutrient deficiencies (including phosphorous) in beef cattle.
- Phosphorous deficiency in beef cattle reduces live weight gain and lowers conception rates.
- Herd modelling suggest implementing a phosphorous supplementation plan improves herd gross margins by 24% leaving the grazier $130,000 better off over six years in phosphorous deficient country.

## Background

Lack of phosphorus (P) in soils affects economic performance due to lower conception rates and live weight gain. But is it actually worthwhile from a production standpoint to implement a wet season P supplementation plan? To answer this question, a central Queensland case study was developed to explore the benefits of such an investment.

## Methodology/analysis

Producer demonstration sites trialling P supplementation were undertaken in central Queensland in the 1990s (Middleton et al 1993 and Middleton 2001). The animal production changes documented in 'The Springs' and 'Plain View' producer demonstration trials suggest that with P supplementation conception was 70% with little variation as opposed to conception rates of between 50%–60% without P supplementation. Supplementation was also found to increases live weight gain by 40 kg per head per year.

A 10,000 ha case study property was developed based on coastal spear grass with seca stylo over sown. It was assumed that the property was operating a store steer enterprise with land in B condition and a long term sustainable stocking rate of 1 AE to 10.73 ha. It was also assumed that the country was phosphors (P) 'deficient' (4 to 6 ppm $P_B$[3]), and all breeding stock were supplemented with

[3]ppm $P_B$ refers to parts per million of bicarbonate phosphorous referred to as available phosphorous.

Kynofos which is 21% P. The Kynofos was fed for 20 weeks over the wet season. The target P intake was 6 g/hd/day, and supplement intake was targeted at 20 g/hd/day. It was assumed that the cost for Kynofos was $1,100/t making the feeding cost $3.08 per head (including an attractant such a molasses).

A herd scenario was developed through Breedcow using the Beef CRC Representative Herd Templates for Northern Australia. This information was then put into a six year discounted cash flow budget to estimate the net benefit or cost to the grazier (expressed as net present value) of implementing a wet season P plan. The net present value can be interpreted as the value of undertaking an investment in today's dollar value. A 6% real interest rate was used to discount the annual cash flow.

## Results

The herd gross margin estimated without P supplementary feeding was $116/AE. The herd gross margin with P supplementary feeding and taking into account the animal production changes was $144/AE. It was also assumed that an additional two hours per week of labour would be required to feed out the Kynofos. The decision to address P deficiency by feeding Kynofos left the grazier $129,621 better-off over six years.

Table 5 presents the key assumptions used in the analysis including the herd gross margins with and without P supplementation and the discounted cashflow budget.

## Conclusion

For the case study presented here it is estimated that the grazier would be $129,621 better off supplementing P than not feeding P over a six year time frame. This is attributed to increased conception and weaning rates and increased live weight gain. It is important to acknowledge that changes in management practice are most effective when implemented in conjunction with other improved practices such as P supplementation and effective weaning management.

It also important to note that with NIRS faecal sampling detecting P deficiency in cattle is now relatively straight forward. Graziers experiencing persistently low conception and weaning rates in P deficit country are encouraged to contact DEEDI extension staff to discuss P deficiency and NIRS sampling.

## References

Middleton, CH, Murphy, K, Blight GW and Hansen, VL (1993) Large Scale Property Demonstrations of the Effect of Seca Stylo and Phosphorous on beef cattle growth in Central Queensland, Australia. Proceedings of the XVII International Grassland's Congress Vol 3, P1994-1996.

Middleton, C. (2001) Producer Demonstration Sites Report 2000-2001 Project Report, Department of Primary Industries Queensland, Beef Industries Institute.

More information on P deficiency or the analysis presented here can be obtained by contacting Ken Murphy or Megan Star on 13 25 23.

*Table 5. Investment analysis for P supplementary feeding plan*

| | | | |
|---|---|---|---|
| Land type | Coastal spear grass | Labour | |
| Enterprise | Store steers | Cost/hr | 30 |
| Land condition | B | Hr/wk | 2 |
| Property size (ha) | 10,000 | Wks/yr/feed | 20 |
| AE/ha | 1/10.73 | | |
| Total AEs | 931 | | |
| Discount rate | 6% | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Without P supplementation** | | | | | | |
| Yr | 0 | 1 | 2 | 3 | 4 | 5 |
| GM/AE | 116 | 116 | 116 | 116 | 116 | 116 |
| GM/property | 107,996 | 107,996 | 107,996 | 107,996 | 107,996 | 107,996 |
| **With P supplementation** | | | | | | |
| GM/AE | 144 | 144 | 144 | 144 | 144 | 144 |
| Additional labour | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| GM/property | 132,864 | 132,864 | 132,864 | 132,864 | 132,864 | 132,864 |
| Annual cash flow | 24,868 | 24,868 | 24,868 | 24,868 | 24,868 | 24,868 |
| Discounted cash flow | 24,868 | 23,460 | 22,132 | 20,880 | 19,698 | 18,583 |
| **Net present value** | **$129,621** | | | | | |

# The economics of land regeneration

## Key findings

- Excessive grazing pressure reduces land condition, ground cover and the productivity and sustainability of rangelands.
- Land condition can be restored through either changed management practices, mechanical intervention or a combination of both.
- Restoring land condition on highly productive land types (e.g. brigalow blackbutt) is financially rewarding offering landholders substantial returns over a short period of time.
- Restoring land condition on less fertile lands is more challenging with landholders unlikely to recoup their initial investment, particularly when restoring land in D condition back to B condition.

## Background

Long-term land decline affects economic performance in grazing businesses due to lower carrying capacity and productivity. But is it actually worthwhile, from a business perspective to bring highly degraded land back to good health? To answer this question, a case study for central Queensland was developed to explore the benefits and costs of land regeneration for two common landtypes.

## Methodology/analysis

The economics of land regeneration was analysed for two land types: brigalow blackbutt; and narrow-leaved ironbark woodlands. It was assumed that the brigalow blackbutt land type turned off finished bullocks for the Jap Ox market (with a gross margin of $176 per beast area) and the narrow-leafed ironbark woodlands turned off 18 month old store steers (with a gross margin of $149.50 per beast area). A whole property analysis was conducted over 20 years based on a 5,000 ha property in the case of brigalow blackbutt and 10,000 ha for narrow-leaf ironbark. The key assumptions and costs used in the analysis are listed in table 6.

*Table 6. Land regeneration expenses and assumptions*

| | | Cost ($) | Assumptions |
|---|---|---|---|
| **Land regeneration** | Deep rip ($/ha) | 80.45 | Total area in D condition |
| | Buffel seed 1.5 kg/ha @ $7.00/kg | 1.50 | Total area in D condition |
| | Fencing ($/Km) | 5,000 | 1 km for every 100 ha of D condition land |
| **Waters** | Poly pipe ($/km) | 5,000 | 1 km for every 100 ha of D condition land |
| | Poly tank ($ per tank) | 5,000 | Refer to scenarios |
| | Trough ($/trough) | 1,200 | Refer to scenarios |

*Table 7. Land regeneration assumptions*

| | Time period (yr) | Intervention | Source |
|---|---|---|---|
| **Brigalow blackbutt** | 0 | Deep ripped re-seed with buffel grass.<br>Average rainfall | (Queensland Government 2008)<br>(Orr et al. 2006)<br>(Campbell et al. 2006)<br>(MacLeod et al. 2004) |
| | 1 | No stock for 12 months | (McIvor 2001) |
| | 2 | Stocked to a D condition stocking rate | (McIvor 2001) |
| | 3 | Stocked to a C condition stocking rate | (McIvor 2001) |
| | 4 | Wet season spelling for 6 weeks<br>Stocked to a B condition stocking rate | (Ash et al. 2002)<br>(Paton 2004) |
| | 5–20 | Stocked to a B condition stocking rate | (McIvor and Monypenny 1995) |
| **Narrow-leaved ironbark woodlands** | 0 | Deep ripped re-seeded with buffel grass.<br>Average rainfall | (Queensland Government 2008)<br>(Orr et al. 2006)<br>(Brown and Ash 1996) |
| | 1 | No stock for 12 months | (McIvor 2001) |
| | 2 | Stocked to a D condition stocking rate | (Chilcott et al. 2005) |
| | 3 | Stocked to a D condition stocking rate | |
| | 4 | Stocked to C condition stocking rate<br>Wet season spelling for 8 weeks | (Paton 2004)<br>(Ash et al. 2002) |
| | 5–20 | Stocked to a B condition stocking rate | |

In order to determine the time periods in which regeneration would occur, relevant literature was reviewed and key land regeneration assumptions made (table 7).

To demonstrate the different approaches to land regeneration two scenarios were modelled. Each involved different capital costs and methodologies. Each scenario was then applied to 100 ha, 500 ha, 1,000 ha and 2,000 ha.

## *Scenario one*

It was assumed in scenario one that the area degraded occurred in proximity of a current watering point, and the degraded area was required to be fenced off from the rest of the paddock and a new watering point installed. The fencing required was assumed to be one kilometre for every one hundred hectares of degraded land being restored. The area degraded was removed from grazing for the first twelve months, ripped and re-seeded (table 6).

On brigalow blackbutt land it was assumed that one watering point would be required for 500 ha, two watering points would be required for 1,000 ha and three additional watering points for 2,000 ha. The total cost for fencing and watering points per hectare for 500 ha was $203, for 1,000 ha it was $203 per hectare, and for 2,000 ha the cost was $200 per hectare.

The narrow-leaved ironbark woodlands also followed this same method of regeneration however, as the areas were assumed to be larger the cost per hectare changed: 1,000 hectares had a cost of $203 per hectare, 2,000 hectare of land to be regenerated was assumed to incur a cost of $200 per hectare, and for 4,000 ha of degraded land four water points were installed and the cost was $197 per hectare.

## *Scenario two*

Scenario two involved the degraded area being a part of a larger paddock where the remaining area was not degraded. The degraded area of the paddock was restored by completing the re-seeding and ripping on the degraded area then removing cattle from the entire paddock. This results in reduced capital expenditure (no additional fencing or watering points) however, it does incur an opportunity cost of forgone grazing as the land within the paddock that is not degraded is also unable to be grazed. The portion of the paddock in degraded condition differed for the two land types to reflect the geographical location. The ratio of degraded land to the rest of the paddock is presented in tables 8 and 9.

*Table 8. Brigalow blackbutt portion of larger paddock declined*

| | | | |
|---|---|---|---|
| Area of entire paddock (ha) | 1,000 | 2,000 | 2,500 |
| Area of paddock in declined condition (ha) | 500 | 1,000 | 2,000 |

*Table 9. Narrow-leaved ironbark woodlands portion of larger paddock in declined condition*

| | | | |
|---|---|---|---|
| Area of entire paddock (ha) | 2,000 | 3,000 | 5,000 |
| Area of paddock in declined condition (ha) | 1,000 | 2,000 | 4,000 |

Due to the whole paddock being taken out of production and only ripping and re-seeding occurring there is decreased capital expenditure with no fencing or waters installed. For both the land types the costs per hectare is $91. However the income forgone in opportunity cost varies between the two land types as the carrying capacity differs between the two land types.

## Results

### *Scenario one*

An economic analysis was undertaken using a cost benefit framework over 20 years and a 5% real discount rate. Twenty years was the estimated time that one manager or owner will maintain control of the property to reap the benefits or costs of the analysis. A discount rate ensures that the future benefits or costs are translated into today's current dollar value and account for inflation. The net present value (NPV) can be interpreted as the estimated return or loss that is reaped from the investment in today's dollar terms.

For scenario one regenerating brigalow blackbutt resulted in a positive NPV for treatment and regeneration for all areas analysed. Regenerating land in D condition to B condition using the costs detailed in table 1 would have left the grazier $34,972 better-off for 500 ha regenerated, $114,493 better-off for 1,000 ha, and $262,755 better-off for 2,000 ha over 20 years.

The analysis for the narrow-leaved ironbark woodlands did not result in any positive returns for any of the areas to be regenerated, for either of the scenarios. This was due to the high investment cost in the regeneration process and the low productivity gains that are achieved. The time taken for the regeneration process to occur also hinders achieving positive returns. For 1,000 ha to be regenerated there is a loss incurred by the landholder of $136,224, and for 2,000 ha and 4,000 ha this loss increases to -$232,228 and -$383,774 respectively. This indicates that a landholder would be financially worse-off restoring narrow leaf ironbark country for the scenarios modelled and highlights the importance of retaining narrow-leaf ironbark county in B or A condition.

### *Scenario two*

The regeneration methods used in scenario two, involved only part of the paddock being in D condition. This portion of the paddock was ripped and re-seeded however the whole paddock was removed from production.

Brigalow blackbutt again yielded a positive net present value for all areas to be regenerated. As there was a reduced amount of initial capital spent the net present values were increased from scenario one for all areas being regenerated (figure 1). The narrow leaved ironbark in scenario two generated large negative returns (similar to scenario 1). Having the whole paddock out of production decreased returns further as the opportunity cost of foregoing income in a lower productivity property impacted negatively on farm cash flow (figure 2).

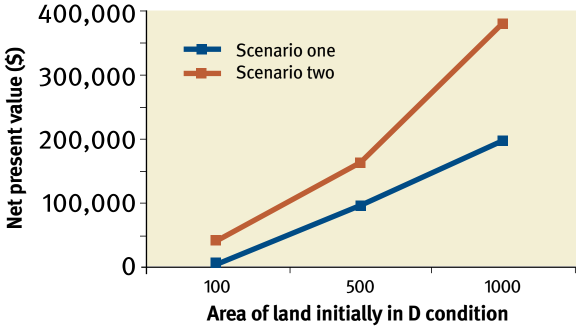


*Figure 1. Brigalow blackbutt net present values for land regeneration D condition to B condition*

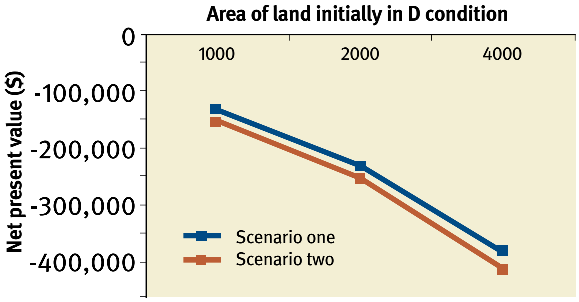


*Figure 2. Narrow-leaved ironbark woodlands net present values for land regeneration D condition to B condition*

## Conclusion

This analysis demonstrates that land type, carrying capacity and required capital investments are important variables when considering land regeneration. Land which is highly productive such as brigalow blackbutt in D condition or C condition, is a viable investment option to regenerate back to B condition. However, for land that is not as productive, such as narrow-leaved ironbark woodlands, there are economic challenges in regenerating condition from D to B particularly for smaller areas. The only economically attractive strategy is to focus on restoring land from C to B condition and to prevent land condition declining in the first instance.

This case study evaluates a limited number of scenarios which demonstrate just one of many ways to restore land.

It is important that each landholder seeks individual economic advice to determine the viability of their investment.

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## More information

More information on land restoration economics in central Queensland can be found in 'Enhancing Economic input to the CQSS2: project report' (Star and Donaghy 2009, Department of Employment, Economic Development and Innovation), available at www.fba.org.au or by contacting Megan Star on 13 25 23.

# Assessing turnoff strategies for steers, cows and heifers

## Key findings

- This analysis compared turnoff strategies for steers, trade cows and cull heifers in the Mackenzie River and Mundubbera regions of Queensland.
- Feeder steers (450 kg turnoff) were compared against Jap Ox bullocks (635 kg turnoff) with feeder steers returning a higher gross margin and higher turnover rates for the case study properties.
- The cow trading scenario results were similar to the feeder steer scenario however this option carries more risk as profitability is highly dependent on purchase price.
- The most profitable option for cull heifers was to sell them at approximately 20 months of age (380 kg) as feeder heifers. This option is highly dependent on the feedlot market and in the absence of this market, fattening heifers for an additional twelve months to reach MSA specifications was found to be the second most profitable option as long as at least 60% of the heifers meet the MSA specifications.

## Background

Extensive benchmarking and business analysis conducted through the CQ *BEEF* project has revealed two key challenges to improving beef business profitability. The first is turnover (largely influenced by scale) and the second is overheads. Analysing alternative turnoff weights and ages allows a beef business to focus on enterprise structures which offer higher gross margins, increased turnover (both in terms of numbers and value) and in turn dilute overhead costs.

This case study will focus on two examples of how beef businesses in the Mackenzie River and Mundubbera regions have used quantitative herd modelling to examine their current turnoff strategies and compare these to alternatives.

## Methodology/analysis

The costs and benefits of the turnoff strategies were compared using the Bullocks program contained within the *Breedcow and Dynama* software. This program compares gross margins (difference between income and direct costs) per year per adult equivalent (AE) which allows different classes and ages of cattle to be directly compared.

The analysis was based on a purchase weight of 250 kg and purchase price of $2.08/kg. Animal health costs of $14.40 per head and delivery costs of $8 per head, were assumed for both options. The key assumptions used and results of each option analysis are shown in table 10.

## Mackenzie River case study

The Mackenzie River property had traditionally run a breeder operation finishing steers for the Jap Ox market. The property has good quality brigalow soil with buffel pasture. By completing a comprehensive business analysis using ProfitProbe™ the owners identified an opportunity to increase turnover and improve cash flow by changing their turnoff strategy. The assumptions used in the analysis are shown in table 10. The results show that switching to turning off feeder steers at 450 kg compared to Jap Ox at 600+ kg increased the gross margin per AE $112 to $314 (180% improvement). Kilograms of beef produced per hectare also increased by 63 per cent for the property (22 kg per year higher than the district average).

*Table 10. Mackenzie River assumptions and results*

| Production scenario | Feeder steer | Jap Ox |
|---|---|---|
| Purchase price (kg) | $2.08 | $2.08 |
| Purchase weight (kg) | 250 | 250 |
| Target turnoff liveweight (kg) | 450 | 635 |
| Annual mortality (%) | 1% | 1% |
| Average daily liveweight gain (kg/hd/day) | 0.67 | 0.50 |
| Days to reach turnoff weight | 300 | 770 |
| Post induction tick treatments ($/hd) | $4.70 | $4.70 |
| Post induction HGP treatment ($/hd) | $6.70 | $6.70 |
| Dressing percentage | NA | 52% |
| Carcase weight (HSCW ) (kg) | NA | 330 |
| Carcase sale price ($/kg) | NA | $2.90 |
| Sale price ($/kg – live) | $1.60 | NA |
| Sales freight ($/hd) | $11.00 | $16.00 |
| Sales commission (%) | 3% | NA |
| MLA levy ($/hd) | $5.00 | $5.00 |
| **GROSS MARGIN ($/AE)** | **$314** | **$112** |

Liveweight gains are averaged over the life of the animal, growth rates are slower in older cattle, therefore reducing the average liveweight gain for the period of analysis. Even if growth rates of 0.67 kg/hd/day could be maintained, the Jap Ox system still results in a lower gross margin ($176/AE) than feeder steers. Feeder steer prices would have to fall significantly (to $1.30/kg) or Jap Ox prices increase significantly (to $4.26/kg) to make the Jap Ox scenario more profitable.

## Cow finishing scenario

A cow finishing scenario based on locally sourced cows was also investigated. These animals were bought in at 450 kg liveweight with a purchase price of $1/kg. The cows were assumed to gain 0.65 kg liveweight per day and sold after gaining 100 kilograms. A dressing percentage of 49% was used. Results for these analyses are shown in Table 11.

*Table 11. Cow finishing sale price sensitivity*

| Selling price ($/kg HSCW) | GM ($/AE) |
|---|---|
| $2.30 | $216 |
| $2.40 | $272 |
| $2.50 | $328 |

These results compare favourably with the Feeder steer option. However, this is very much a production option driven by opportunity purchasing as its viability is very dependant on purchase price. For example, if purchase price was $1.10/kg, gross margin falls to $173/AE and at $1.20, gross margin is $74. Such sensitivity emphasises the need to fully analyse such opportunities.

As a result of this initial analysis the owners switched to a system of turning off feeder steers. They are also moving toward a trading operation as a result of further analysis of options to increase turnover and improve cashflow.

### *Mundubbera case study*

The Mundubbera operation is based around purchasing steers to fatten for the Jap-Ox market. Steers are managed on an intensive rotational grazing system and leucaena development is underway. The aim of the analysis was to compare

*Table 12. Mundubbera assumptions and results*

| Production scenario | Feeder steer | Jap Ox |
|---|---|---|
| Purchase price (kg) | $2.00 | $2.00 |
| Purchase weight (kg) | $240 | $240 |
| Target turnoff liveweight (kg) | $440 | $630 |
| Annual mortality (%) | 100% | 100% |
| Average daily liveweight gain (kg/hd/day) | 0.65 | 0.65 |
| Days to reach turnoff weight | 308 | 600 |
| Induction costs | $18 | $18 |
| Dressing percentage | NA | 51% |
| Carcase weight (HSCW1 ) (kg) | NA | $321 |
| Carcase sale price ($/kg) | $1.70 | $3.03 |
| Sale price ($/kg – live) | $1.70 | $1.55 |
| Sales freight ($/hd) | $11.00 | $16.00 |
| Sales commission (%) | 3% | NA |
| MLA levy ($/hd) | $5.00 | $5.00 |
| **GROSS MARGIN ($/AE)** | **$385** | **$296** |

the relative profitability of backgrounding steers for the feedlot market or fattening to meet Jap Ox specifications. Similar to the Mackenzie River case, the Mundubbera operation showed that producing feeder steers achieved a significantly higher (30%) gross margin per AE than Jap Ox.

## Scenario sensitivity analysis

Because of the variability experienced in growth rates and purchase and sale prices it is important to test the sensitivity of the production system to changes in growth rate, cattle purchase and sale prices.

Tables 13 and 14 presents the Mundubbera gross margins for a range of purchase and sale prices. The shading indicates when the feeder steers return a higher gross margin than the Jap Ox for the relative purchase and sale prices.

Factors such as labour use between classes of cattle, the risk exposure incurred in growing animals out beyond the year long production cycle of backgrounding, as well as the cash flow impacts of switching from backgrounding to longer Jap Ox production have not been considered in this analysis. Cash flow budgeting is commonly used to explore such issues.

## Conclusion

Economic analysis comparing a range of grass-fed turnoff strategies in central Queensland indicated that a younger turnoff at 400–450 kilograms returned a higher gross margin than finishing cattle to Jap Ox specifications. This result remained consistent under a range of purchase and sale prices in both case studies. Higher gross margins per AE will result in a higher turnover value for the business. Turning animals off at a younger age may also allow breeder numbers to be increased and therefore turnoff additional numbers of cattle. Incorporating a mix of turnoff and trading strategies can provide businesses with improved flexibility to take advantage of above average seasonal conditions and manage dry conditions. The results indicate that significant gains in profitability can be identified by using quantitative modelling to determine optimum turnoff strategies based on location, productive capacity and market access.

## More information

More information on gross margins for different cattle production enterprises in central Queensland can be found in 'The economics of beef in central Queensland' (Best, 2007, Department of Primary Industries and Fisheries, available at www.agbiz.com.au – Library) or by contacting Mark Best or Rebecca Gowen on 13 25 23.

*Table 13. Mundubbera feeder steer purchase and sale price sensitivity*

| | | Gross margin per adult equivalent (GM/AE) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sale price ($/kg live)** | | **$1.40** | **$1.50** | **$1.60** | **$1.70** | **$1.80** | **$1.90** | **$2.00** |
| Purchase prices ($/kg live) | $1.70 | $292 | $361 | $430 | $499 | $568 | $637 | $706 |
| | $1.80 | $253 | $323 | $392 | $461 | $530 | $599 | $668 |
| | $1.90 | $215 | $285 | $354 | $423 | $492 | $561 | $630 |
| | $2.00 | $177 | $246 | $316 | **$385** | $454 | $523 | $592 |
| | $2.10 | $139 | $208 | $277 | $347 | $416 | $485 | $554 |
| | $2.20 | $101 | $170 | $239 | $308 | $378 | $447 | $516 |
| | $2.30 | $63 | $132 | $201 | $270 | $340 | $409 | $478 |

*Table 14. Mundubbera Jap Ox purchase and sale price sensitivity*

| | | Gross margin per adult equivalent (GM/AE) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sale price ($/kg HSCW)** | | **$2.73** | **$2.83** | **$2.93** | **$3.03** | **$3.13** | **$3.23** | **$3.33** |
| **Sale price ($/kg live)** | | **$1.39** | **$1.44** | **$1.49** | **$1.55** | **$1.60** | **$1.65** | **$1.70** |
| Purchase prices ($/kg live) | $1.70 | $281 | $302 | $322 | $342 | $362 | $383 | $403 |
| | $1.80 | $266 | $286 | $307 | $327 | $347 | $367 | $388 |
| | $1.90 | $251 | $271 | $291 | $312 | $332 | $352 | $372 |
| | $2.00 | $236 | $256 | $276 | **$296** | $317 | $337 | $357 |
| | $2.10 | $220 | $241 | $261 | $281 | $301 | $322 | $342 |
| | $2.20 | $205 | $225 | $246 | $266 | $286 | $306 | $327 |
| | $2.30 | $190 | $210 | $230 | $251 | $271 | $291 | $311 |

# Using forage crops to improve land condition

## Background

Maintaining breeder nutrition is a key component of ensuring good reproductive rates but is often found to be difficult on lighter coastal country, particularly if land condition has declined. One option for improving land condition and thus breeder nutrition and reproduction rates is the strategic use of forage crops to spell pastures.

In this case study a series of below average years had deteriorated pastures to C condition and herd fertility had fallen resulting in a consistently low (55%) weaning rate. After ruling out disease the decision was made to reduce breeder numbers by a third (from 580 to 410) and to plant a forage sorghum and Dolichos lab lab pasture. The forage crop was intended to provide a bulk of feed which would allow pastures on the remaining portion of the property to be rested during the wet season, to set seed and encourage recruitment of preferred pasture species. Spelling also encourages an increase in ground cover, reduced runoff and improved water infiltration. Individual grass plants develop deeper roots facilitating access to moisture further down the soil profile. The improved land condition and reduced breeder numbers also reduced the need for dry season supplementation.

## Methodology/analysis

The forage crop paddock was first blade ploughed to remove eucalypt sucker regrowth and followed with

## Key findings

- During a period of persistently below average seasons a paddock in B condition declined to C condition and herd fertility fell resulting in a 55% weaning rate.
- One strategy to improve land condition, breeder nutrition and reproduction rates is the strategic use of forage crops to spell pastures during the wet season.
- Reducing breeder numbers whilst improving nutrition increased weaning rates by 18% and herd gross margins by 15%.
- Over 20 years reducing breeder numbers increased net returns by $48,000 and restored degraded land back to B condition.

a one pass ploughing and seeding operation with seed boxes mounted on an offset plough. The forage sorghum and Dolichos lab lab were both planted at 7 kg/ha.

Table 15 contains an estimate of the costs of establishing the forage crop.

*Table 15. Forage crop establishment costs*

| Costs | per hectare | Total (48 ha) |
|---|---|---|
| Forage crop - planting costs | $292 | $14,000 |
| Forage sorghum seed | $42 | $2,016 |
| Lab lab seed | $42 | $2,016 |
| **Total** | **$376** | **$18,032** |

Animal productivity was not compromised as the forage crop provided a large bulk of highly nutritious feed. With the retained breeders now in a smaller paddock they received greater exposure to the bulls during the mating season.

After the first wet season the costs of growing the forage crop and reducing stock numbers were compared to the increased returns from improved conception rates and better growth rates in young cattle. Using the *Breedcow Dynama* herd modelling software the herd structure for the original herd was compared to the new herd size under two scenarios, turning off either bullocks or feeder steers. Gross margins were calculated based on actual weights and weaning rates from property records. Prices for cattle and variable costs used in the analysis were based on June 2009 rates. Table 16 shows the herd modelling assumptions used to describe each of the alternative herd structures. The base case shows the number of breeders and progeny under the current stocking rates. ‘Reduced breeders – bullock’s and ‘Reduced breeders – feeder steers’ show the herd structure with fewer breeders turning off bullocks or feeder steers respectively.

*Table 16. Herd modelling assumptions*

| | | Reduced breeders | |
|---|---|---|---|
| | Base case | bullocks | feeder steers |
| Total adult equivalents | 1200 | 950 | 950 |
| Total cattle carried | 1276 | 984 | 1008 |
| Total breeders mated | 579 | 411 | 489 |
| Total calves weaned | 311 | 271 | 322 |
| Weaners/total cows mated | 54% | 66% | 66% |
| Heifer joining age | 2 | 2 | 2 |
| Total cows & heifers sold | 148 | 130 | 154 |
| Total steers & bullocks sold | 153 | 133 | 159 |
| Max bullock turnoff age | 4 | 4 | 3 |

Using the results from the herd modelling a discounted cash flow analysis was used to compare the long term returns from the investment in pasture improvement and the change in herd fertility.

## Results

Table 17 shows the results of the herd modelling under the alternative herd structures including net sales, changes in capital value of the herd and gross margins for the herd on an AE basis. After accounting for interest on herd capital, the gross margin per adult equivalent increases from $122 to $156 under the bullocks scenario and to $161 for feeder steers. At the herd level the reduced breeder numbers actually leads to a slight reduction in gross margin for the bullocks scenario but an overall increase for the feeder steer scenario to $152,726 (after interest).

Table 18 shows how the costs and benefits of the three scenarios compare over a 20 year investment period. The analysis assumed that forage planting would be required every six years to maintain sufficient pasture quality and quantity to allow other paddocks to be spelled. The investment analysis shows that reducing breeder numbers and developing a forage crop results in a net loss of $7,000 compared to the base scenario if a bullock turnoff is maintained. Under the same breeder and

*Table 17. Herd modelling results*

| | | Increased fertility | |
|---|---|---|---|
| | Base case | bullocks | feeder steers |
| Average female price ($) | 513 | 532 | 532 |
| Average steer/bullock price | 954 | 954 | 735 |
| Capital value of herd ($) | 584,601 | 483,171 | 455,785 |
| Imputed interest on herd val. ($) | 58,460 | 48,317 | 45,579 |
| Net cattle sales ($) | 223,287 | 197,805 | 200,184 |
| Direct costs excluding bulls | 0 | 0 | 0 |
| Bull replacement ($) | 2,060 | 1,582 | 1,879 |
| Gross margin for herd ($) | 204,427 | 196,224 | 198,304 |
| GM after imputed interest | 145,968 | 147,907 | 152,726 |
| GM per adult equivalent ($) | 170 | 207 | 209 |
| GM/AE after interest ($) | 122 | 156 | 161 |

*Table 18. Investment analysis for forage development*

| | | Base herd | Improved fertility – bullocks | Improved fertility – steers |
|---|---|---|---|---|
| **Income** | | | | |
| GM/AE (pre-supplement costs) | | $136 | $156 | $161 |
| AEs | | 1200 | 950 | 950 |
| **Total** | | **$162,768** | **$148,200** | **$152,950** |
| **Costs** | | | | |
| Additional Supplements | Every year | $16,800 | | |
| Forage crop - planting costs | Every 6 years | | $14,000 | $14,000 |
| Forage sorghum seed | Every 6 years | | $2,016 | $2,016 |
| Lab lab seed | Every 6 years | | $2,016 | $2,016 |
| **Total** | | **$16,800** | **$18,032** | **$18,032** |
| **Net** | | **$145,968** | **$130,168** | **$134,918** |
| Discount rate | | 7% | 7% | 7% |
| NPV | | $1,692,355 | $1,685,010 | $1,740,082 |
| **Difference** | | | **-$7,345** | **$47,727** |

forage development scenario with a feeder steer turnoff the producer is $48,000 better off than if they had maintained their current structure.

## Conclusion

Despite an average wet season, the pasture spelling was successful in improving land condition to ‘A’ level. Conception rates improved from 54% to 66%. Quantifying these results shows an increase in gross margin per adult equivalent from $122 to $156 for bullock turnoff or $161 for feeder steer turnoff. The reduction in cattle numbers is more than compensated for by better cow weights, better weaner weights and improved growth rates for steers. Over a 20 year period, even assuming that the forage crop was planted 3 times; fewer cows with better fertility means returns of up to $48,000 more than under the old system. Supplement costs are also reduced due to both lower stocking rates and the improvement in pasture condition. The smaller cow herd also gives the producer better flexibility to sell fat cows in a dry season or to take advantage of a good season with the option of trading additional steers to fatten on the forage crop.

More information on the economics of regenerating land condition using forage crops can be obtained by contacting Ken Murphy or Rebecca Gowen on 13 25 23.

# Silvopastoral grazing systems

## Key findings

- Silvopastoralism may offer landholders considerable advantages over traditional grazing systems in terms of income diversification, environmental benefits through increased woody vegetation cover and areas of stimulated versus constrained pasture growth.
- The decision to clear regrowth and retain regrowth strips as part of a silvopastoralism grazing system (timber strips 20 m wide every 60 m over a 1000 ha paddock) would have left the grazier marginally out of pocket (-$1701) on the eucalypt land and $14,732 worse off on brigalow land over 25 years.
- The decision to clear brigalow regrowth and plant spotted gum strips 50 m wide every 150 m for the purposes of harvesting electrical transmission poles, whilst continuing to graze would have left the grazier $209,087 better off than clearing all the regrowth and continuing to graze only. If the grazier had instead opted to plant spotted gum for pulp production whilst continuing to graze, the NPV would have been $99,155.
- Whilst the electrical pole or timber pulp models were significantly more profitable than conventional grazing systems, a sensitivity analysis suggests they also carry significant levels of downside risk and long payback periods.

## Background

Currently, little is known about the economic opportunities and risks associated with operating silvopastoral enterprises in central Queensland. Silvopastoralism may offer landholders considerable advantages over traditional grazing systems in terms of income diversification, environmental benefits through increased woody vegetation cover and areas of stimulated versus constrained pasture growth. RIRDC commissioned this investigation to better understand whether an agro-forestry production system produces better financial and environmental outcomes for graziers than traditional extensive grazing systems.

## Methodology/analysis

The economic feasibility of six agroforestry options was evaluated using discounted cash flow analysis, regional costs and prices for both livestock and forestry products, and a purpose built bioeconomic model calibrated for central Queensland. Tree growth data investigated included the TRAPS (Transect Recording and Processing System) woodland monitoring system, various plantation trials managed by Queensland Primary Industries and Fisheries (QPIF) and private industry, spatial tree cover and productivity indices from the National Forest Inventory and physiological growth models such as 3-PG (Landsberg & Waring 1997). These data were used to derive an indicative range of possible wood yields. Pasture yields for given tree basal areas were calculated or obtained from recent agroforestry scenarios using the GRASP/AussieGRASS pasture growth models either developed for central Queensland or observed from direct grazing trials.

The resultant measures of enterprise profitability (that is, net present value (NPV)) were used to compare the silvopastoralism options to extensive grazing management systems. The modelling assumed each scenario was managed to maintain or enhance land condition utilising best management grazing and silvicultural practices.

## Results

The decision to clear regrowth and retain timber strips as part of a silvopastoralism grazing system (timber strips 20 m wide every 60 m over a 1000 ha paddock) would have left the grazier marginally out of pocket (-$1701) on the eucalypt land and $14,732 worse off on brigalow land over 25 years (table 19).

The decision to clear brigalow regrowth and plant spotted gum strips 50 m wide every 150 m for the purposes of harvesting electrical transmission poles, whilst continuing to graze would have left the grazier $209,087 better off than clearing all the regrowth and continuing to graze only. If the grazier had instead opted to plant spotted gum for pulp production whilst continuing to graze, the NPV would have been $99,155. Whilst the timber pulp model provided a reasonable return to the grazier the sensitivity of the results to price and yield changes dramatically altered the outcomes and provided significant levels of down-side risk (table 20).

## Conclusion

Central Queensland appears to have large areas of land suitable for agroforestry or silvopastoralism systems. Of the land identified as suitable for agroforestry purposes, 3.3 million hectares is within a 50 kilometre radius of existing timber mills, 4.5 Mha within 100 km, 4.8 Mha within 150 km and 4.9 Mha within a 200 km radius.

Rangeland grazing research has previously focused on the direct impacts of animal stocking rate and tree basal area on pasture biomass and livestock production, with an emphasis on the competitive effects of tree density on pasture growth. This focus essentially regards woody vegetation (i.e. trees) as an impediment to grazing profitability. The results presented here for alley belt systems capture the holistic value of multiple-use grazing systems compared to grazing only systems. For these scenarios, encouraging natural regrowth or planted trees is a potentially valuable activity that gives rise to not only the direct commercial benefits available from planted or natural regrowth, but also the combined natural resource management benefits associated with increased trees in the landscape, including soil and water function, carbon sequestration and biodiversity.

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## More Information

More information on silvopastoral grazing systems in central Queensland can be found in 'The bioeconomic potential for agroforestry in northern cattle grazing systems – An evaluation of tree alley scenarios in central Queensland'
Project Number: PRJ-000915 (Donaghy et. al, 2009), (RIRDC), available at https://rirdc.infoservices.com.au/collections/aft or by contacting Peter Donaghy on 13 25 23.

*Table 19. NPV of retaining tree strip and selling sequestered carbon net of methane emissions*

| | NPV of grazing without tree strips | NPV of grazing with tree strips | NPV of change |
|---|---|---|---|
| Brigalow land type | $268,392 | $253,660 | -$14,732 |
| Eucalypt land type | $126,024 | $124,323 | -$1,701 |

*Table 20. NPV of grazing with complementary plantation timber strips*

| | NPV of grazing without tree strips | NPV of grazing with plantation strips | NPV of change |
|---|---|---|---|
| Brigalow land type (electrical poles) | $268,392 | $477,479 | $209,087 |
| Brigalow land type (pulp) | $268,392 | $365,547 | $99,155 |

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