Australian Agricultural and Resource Economics Society National Conference 2010

An economic assessment of a proposed dry land Leucaena development within the Brigalow Belt of Central Queensland: An operational case study perspective

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Abstract

This following case study focuses on beef production using dry land leucaena to increase production on a property of alluvial scrub flats south of Biloela, Queensland. The investment proposal is for development of the property through the growing of the fodder legume tree crop leucaena. The benefit of finishing cattle on leucaena is estimated using partial budgeting techniques. The case study reports on aspects of agronomic, managerial, production and economic considerations for 174 hectares of dry land leucaena development, staged over four years.

A discounted cash flow approach was applied in order to model expected returns over time. Net cash flows between the existing grass based operation and the proposed leucaena supplemented operation are estimated. Comparison between grass only and leucaena supplemented gross margins provide the marginal benefit from developing leucaena. These future cash flows were discounted to assign their present values.

Productive capacity estimates were used in the analysis. Expected yields and weight gain from grass fed operations were available from detailed management records. However, given the lack of scientifically verified data on expected leucaena production across land types, production estimates were based on localised production results and sourced from technical extension experts.

The use of adult equivalents and accounting for the opportunity cost of maintaining particular herd structures allows for direct comparison of gross margins across different land types and herd structures.

By choosing to plant leucaena, the owner is $144,939 better off, achieves a 22% internal rate of return, a benefit-cost ratio of 3.2:1, and breaks even on the investment in seven years.

Introduction

Turnover is a key driver of business profitability. Intensification offers a way to increase productivity without acquiring additional land. In addition, increasing gross product decreases per kilogram overhead costs.

This case study focuses on beef production from a dry land leucanea production system operating south of Biloela, Queensland. The economic benefit of finishing cattle has been estimated using applied partial budgeting techniques[1]. The case study property is on alluvial soft-wood scrub flats.

The case study reports on agronomic, managerial, production and economic considerations for a dry land leucanea development of 174 hectares. By choosing to plant leucaena, the owner is $144,939 better off, achieves a 22% rate of return[2], a benefit-cost ratio of 3.2:1 from the development and breaks even on the investment in seven years[3].

Conduct of Operations

The operators see increased turnover as a key driver of business profitability and believe intensification offers a way to increase productivity without acquiring additional land. Increasing turnover by increasing the amount of kilograms of beef produced per hectare will decrease per kilogram overhead costs. The operators believe that utilisation of leucanea in their operation will enable them to realise a one-third increase in annual beef production.

Methodology

A discounted cash flow approach was applied in order to model expected returns, using time value of money concepts. Net cash flows between the existing grass based operation and the proposed leucaena supplemented operation were estimated. These future cash flows were discounted to assign their present values.

The computer programme 'Bullocks'[4] was used to model gross margin returns from both the grass only and leucaena supplemented operations. Entry and sale weights were inputted, along with corresponding prices. Other required inputs included dressing percentage, mortality rate, variable costs per head and interest rate. The programme calculates gross margin per head, gross margin per adult equivalent, as well as gross margin net of interest costs and percentage return on capital on an annual basis. Gross margin per adult equivalent less interest costs were used to estimate production returns. This information was used as input into a discounted cash flow spreadsheet. Comparison between grass only and leucanea gross margins provided the marginal benefit from developing leucanea.

The use of adult equivalents to estimate carrying capacity requirements allows comparison of results between different production systems. In order to account for the forage demand of the herd, allowances are made for each animal class, according to the breed, weight and lactation status of the animal. All animals within the herd are assigned values in proportion to the feed demands of an adult maintenance ration. In this way limiting factors of production including land type and herd

[1] A technique using proposed (partial) budgets to estimate whole farm operating profit effects.

[2] Where returns exceed the cost of capital.

[3] Using an applied nominal discount rate of six-and-a-half per cent across a thirty year investment window.

[4] 'Bullocks' is a gross margin calculator lying within the Breedcow and Dynama Herd Budgeting Software Package (Holmes, 2009).

feed requirements are accounted for when comparing different herd structures and grazing strategies.

The value of livestock capital is the total value of the retained herd. The opportunity cost[5] of holding that stock has been estimated by using a notional interest rate of 6.5 per cent and is termed the opportunity cost of livestock capital. By including the opportunity of livestock capital in an economic analysis, the economic returns from different herd structures, with differing capital requirements, can be compared.

Thus, the use of adult equivalents and accounting for the opportunity cost of maintaining a particular herd structure, allows for direct comparison of gross margins across different land types and herd structures.

Using adult equivalents to account for feed consumption differences among animal classes, allowing for differing capital requirements according to herd structure (influenced mainly by age of male turnoff), allows fair comparison of gross margins across different herd structures.

Productive capacity estimates were used in the analysis. Expected yields and weight gain from grass fed operations were available from detailed farm grower records. However, given the lack of scientifically verified data on expected leucaena production across land types using different managerial techniques, leucaena production estimates were based on localised production results and sourced from technical extension experts.

Development costs were included in the model from records of actual expenses held by the producer. Fixed cost expenditures were allocated on a proportionate basis from existing farm management account records. Maintenance and rejuvenation costs such as on going slashing and ripping expenses were also accounted for in the model.

A nominal discount rate of 6.5% was used for modelling purposes.

It should be noted that the analysis uses partial budgeting techniques to model the marginal economic benefit of the production system. Land acquisition outlay and land value increase associated with the use of leucaena lie outside the scope of this analysis and therefore have not been included.

With initial results generated, changes were made within the model in order to test parameter sensitivities within the model. Sensitivity testing of the discount rate used, dressing percentage and meat prices tested the effects of gross margin changes on investment returns.

Initial Development Budget

Table 1 provides a cost breakdown for development planting and paddock subdivision for an area of 48.5 Ha (120 acres)[6]. Total costs for the initial development calculates at $388/Ha, rising to $398/Ha accounting for fuel cost increases and fertiliser usage throughout the development.

[5] Using that capital invested in cattle for some alternate use such as loan repayment or investment.

[6] Costs have been tabulated using actual costs on 48.5 hectares. An additional 10 hectare paddock is also used as part of the rotation plan.

Table 1: Leucanea development budget

Item	Cost ($)	Notes
Internal fencing contractor	$1,148	
Posts	$731	
Barbed wire	$1,373	
Gate material	$120	
Stays	$175	
Strainers	$240	
Labour	$700	2 persons @ $70/day for five days (internal fencing)
Round-up, spinnaker	$4,077	
Bettle baiting	$324	
Seed	$2,500	
Innoculation	$11	
Fuel	$514	
Contractor	$6,942	Includes ploughing, spraying, and hiring planter
TOTAL	**$18,855**	

Results

The model generates a 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 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. Assuming current expected returns, the investment would break even in year 7.

Table 2 provides information on project net present value with various discount rates applied.

Table 2: Project net present value results at various discount rates

Discount Rate (%)	NPV ($)
4.5	$197,194
5.5	$168,972
6.5	**$144,939**
7.5	$124,353
8.5	$106,621

Leucanea Development

Table 3 provides information on the areas expected to be developed.

Table 3: Proposed leucaena development areas

Timing	Area developed (Ha)
2007	48.5
2008	81
2009	24
2010	20

Initial development for leucanea of 48.5 hectares began with planting in February 2007. Prior to planting, all cattle were removed from the paddock on the 14th August 2006, implying an opportunity cost of not using the land for beef production across this time[7]. The animals were

[7] 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.

removed from the paddock in order for the cultivated strips to store enough moisture for planting. Due to the poor season, this meant a six month period without productive use before leucaena was planted and a further 11 months to allow the Leucaena to establish before the first graze. In total the paddock was unproductive for a total of 17 months, compared to continuous grazing of the buffel pasture.

The leucaena paddock was prepared by ploughing three metre wide strips for the leucaena and leaving four metre grass strips down the centre. Ploughing was used to control weeds, until sufficient moisture was stored in the cultivated strips for planting. Planting was done on a one metre double row on the 21st February 2007 at the centre of the three metre strip. In total the rows are seven metres apart from centre to centre or six metres from one leucaena row to the next. Rows are orientated north-south. Soil is a black clay type.

The leucaena cultivar *Cunningham* was used for all planting. Leucaena seed was planted by calibrating the seeder to plant 1 seed every 100mm in a double row. This equated to approximately 115kg of seed for the 48.5 hectare area or 2.4 Kg/Ha. The seed was planted at a depth of 50mm. The leucaena seed was also inoculated at planting.

1 week after planting the producer sprayed the 3m cultivated strip with the chemicals Glyphosate and Spinnaker®. The planted leucaena was also beetle baited.

Use of Fertiliser

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

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

Production Performance

Expected weight gain from existing buffel grass-based pastures is 0.6 kilograms per head per day on average. The expected stocking rate is 1.5 hectares per adult equivalent (AE)[8]. Leucanea development should see an average of **three rotations** annually with an average weight gain of one kilogram per head per day, effectively tripling carrying capacity. Cattle weights into the leucaena will be 520 kilograms and target turn-off weight is 630-640 kilograms live weight (Lw). The expected production figures are in line with local production, being taken from the neighbouring property. The aim of this production system is to finish animals for the Jap Ox market. Usual market is the meatworks at Biloela. At the time of analysis, typical price range was $3.00 to $3.20/kilogram dressed, with all modelling based around a price of $3.05/kg dressed.

No hormonal growth promotant (HGP) is currently used in production, with a view to allowing cattle to be graded for the EU market as practicable. HGP usage is currently being considered in order to increase carcase dressing percentage and make quicker live weight gains.

The paddock management of the typical grass pasture was to set stock the paddocks, with prior mentioned outcomes. Management of the leucaena/grass pastures will be a five paddock rotational system and will be managed according to growth of both the leucaena and grass. Movement will

[8] Based on average calculations with an AE being equivalent to a dry, non-pregnant, non-lactating animal of 455 kilograms. In this case the stocking rate is in line with traditional stocking rate benchmarks used widely across the surrounding area.

depend on timing and also visual assessment of the paddocks to gain optimum growth on animals, whilst maintaining optimum performance from the leucaena/grass pasture.

Steers are brought into the production system from granite country at 520 kilograms live weight and dress at 50.5% off leucanea at full weights (no curfew). Kill sheet results indicate that finishing on leucaena offers superior dressing percentage to the previous grass only operation. Typical dressing percentage from grass is around 49.5% of full weights (no curfew). It can be seen that the use of leucaena offers an earlier finishing, more consistent product with superior dressing percentage and therefore superior gross margin results. The relationship between gross margin results, dressing percentage and sales price is further explored at Appendix 1.

Strategic Issues

The producer is well aware of the potential winter feed gap from leucaena/grass pastures when compared to standard grass paddocks. It is anticipated that the winter feed gap could typically range from one to five months depending on seasonal conditions. Management strategies are to maintain a small number of animals in the paddock which have open range to all rotation paddocks during the winter months. This method decreases pressure on the leucaena in the cooler months and also maintains the rumen bacteria that cattle require to effectively utilise leucaena. This particular area is also subject to heavy frosting and in some years this will be an advantage by making the leucaena sprout from the base. This may also limit the chopping that may be required to manage the height of the leucaena into the future. It is also anticipated that during warm, wet winters additional growth could be achieved, this is however not calculated and merely seen as a bonus for the spring and will not be taken advantage of during the winter months.

Future considerations have included ripping the grass pastures to maintain grass production. Cost of ripping is $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, it is thought that replanting will take place with a new cultivar type. It is probable that blade ploughing or similar activity will be necessary in order to replant.

Conclusion

Economic analysis conducted on the proposed dry land leucaena finishing operation indicates a positive net value of the investment, with the project internal rate of return exceeding the discounted rate applied.

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 adapters should be well aware of the pay back period associated with its use.

Acknowledgements

The authors wish to extend their thanks to Stuart Buck, Fred Chudleigh, Peter Donaghy and Mick Sullivan, all of Queensland Primary Industries and Fisheries, for useful comment in the formative and finalisation stages of this paper.

Thanks are also extended to the Biloela based graziers, upon which this case study is based, in offering to share their financial and production economic information.

References

Holmes, W.E. (2009). Breedcow and Dynama Herd Budgeting Software Package, Version 5.05 for Windows 95, 98, Me, NT, 2000 and XP. Training Series QE99002, Queensland Department of Primary Industries and Fisheries, Townsville.

Appendix 1: Dressing percentage and sale price effects on gross margin results

Table 5: Leucaena gross margins across a range of dressing percentages

Dressing (%)	Gross margin/adult equivalent less interest ($/AE)
49.5	$333.32
50.0	$357.00
50.5	**$380.67**
51.0	$404.34

The leucaena supplemented finishing system offers 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 6, where animals have to spend more time on forage to achieve target weights due to lower daily weight gain.

Table 6: Expected gross margins (grass only operation)

Dressing (%)	Gross margin/adult equivalent less interest ($/AE)
48.5	$153.59
49.0	$167.67
49.5	**$181.75**
50.0	$195.83
50.5	$209.91
51.0	$223.99

Price sensitivities

Gross margin results based around price sensitivities are shown in tables 7 and 8.

Table 7: Gross margin results (grass only)

Nominal sale price ($/kg)	Gross margin less interest ($/AE)
$2.75	$43.28
$2.90	$112.51
$3.05	**$181.75**
$3.20	$250.99

Table 8: Gross margin result (leucanea)

Nominal sale price ($/kg)	Gross margin less interest ($/AE)
$2.75	$143.16
$2.90	$261.91
$3.05	**$380.67**
$3.20	$499.42

It can seen that the leucaena based operation generates higher gross margins across all price levels due to superior live weight gain from the relatively shorter grazing periods required to reach target weight.