

The net benefits from growing lucerne in the Broken Plains area of north-eastern Victoria.

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Abstract. The clearing of trees and native vegetation over the past 160 years has caused deep drainage to groundwater in the Broken Plains area. Predictions are that continuing recharge will bring the water-table to within 2 metres of the surface over the next 30 years. This will lead to water-logging and dryland salinity. A solution is to introduce deep-rooted perennial species such as lucerne. Lucerne extracts more water than annual crops and pasture. Farmers in this area believe that lucerne is riskier than annual legume pastures. Results of this analysis show that the change to lucerne increases expected profitability and cumulative net cash flow.

Keywords: lucerne production, lucerne farming systems, economic and financial analyses

Introduction

The Broken Plains Sub-Catchment (280,000 ha.) encompasses 15 percent of the area of the dryland zone of the Goulburn-Broken Catchment Area (GBCA) and produces 60 percent of its gross value of agricultural production. The farming is mixed with 60 percent of land used for crops and 40 percent for pasture. The grazing activities comprise around 75 percent sheep and 25 percent cattle.

Dryland salinization is expected to increase in the GBCA. Presently, there is little salinization of soil in the Broken Plains. The amount of salt generated per square kilometre is the least of all the sub-catchments in the dryland zone of the GBCA. Nevertheless, hydrologists identify it as the sub-catchment likely to suffer the greatest increases in dryland salinity over the next 100 years. Watertables are predicted to rise to within 2 metres of the surface over around 30 per cent of the area (Sinclair Knights and Mertz 1999). Rising watertables will also be accompanied by wide scale waterlogging. The net effect will be a substantial economic loss from lower productivity of agricultural production.

Dryland salinization is largely attributed to overclearing of native woodlands by European settlers over the past 160 years or so (Schofield 1990, Macumber 1991, Hatton and Nulsen 2001). Overclearing of trees and replacing them with shallow rooted annual crops and pasture has disturbed the pre-existing hydrological balance by increasing the accession of water from the surface to the groundwater. Rising water tables, especially those of a saline nature, are extremely detrimental to the physiology of crops and pastures once they reach to within 2 metres of the surface. Introducing deep-rooted perennial plants into the landscape reduces deep drainage. Lucerne (*Medicago sativa*) effectively restores hydrological balance in areas such as the Broken Plains where annual rainfalls are less than 600 mm per annum (Angus *et al.* 2001, Hirth *et al.*, 2001, Ridley *et al.* 2001).

Lucerne uses water more efficiently, is more productive and contributes greater amounts of biologically fixed nitrogen than subterranean clover (Peoples *et al.* 1998, Angus 2001). Substituting lucerne for subterranean clover in ley-farming systems in this sub-catchment can improve the productivity of crop production and importantly, reduce deep drainage of rainfall to groundwater. Lucerne can help protect the farming areas from waterlogging and dryland salinization. This farming system involves a phase of 3 to 4 years of lucerne in rotation with annual crops.

Previous research shows that in high rainfall cropping areas like the Broken Plains, rotating crops with a phase of lucerne positively benefits the environment (Peoples *et al.* 1998, Ridley *et al.* 2001, Whitfield 2001). Deep drainage is reduced and increases in mineralized nitrogen increase crop yields and quality. Still, there are several perceived barriers to farmers adopting phase farming with lucerne. They believe that lucerne is expensive to establish; it has a high risk of failure; having established lucerne, it is hard to remove to make way for successive crops; the first crop grown after lucerne does not yield as well as a crop grown after the annual legume pasture. The overall result is that producers are not convinced about the economic benefit of lucerne phase farming given the added risk and uncertainty involved (Ransom *et al.* 2003)

Aims of this study

The aim of this study was to determine whether economic and financial benefits could be obtained by farmers in the Broken Plains substituting lucerne for subterranean clover in rotation with crops.

Approach

The approach taken was to identify 5 case study farmers who had changed from cropping with subterranean clover to phase farming with lucerne. Information was collected from each of them about physical data and the stream of income and costs that occurred over the length of the two different farming rotations.

Method

Benefit-cost analyses were used to assess the after-tax profitability of sowing crops with lucerne instead of subterranean clover. This is the appropriate method for assessing the relative net benefits of investment programs that involve capital budgeting over the medium to long term (Van Horne 1977, Zerbe and Dively 1994, Sinden and Thampapillai 1995). The results of the analyses were expressed as Net Present Values (NPV) where the rotation lengths were the same for the two systems or as annuities when they differed (Gitman *et al.* 1995). In calculating NPV's and annuities, account was taken of the case study farmer's views about risk in changing to lucerne phase farming. For example, the farmer may reckon from experience that lucerne can be successfully established in 9 years out of 10. The probability of success would be 0.9 or 90 per cent. Conversely, the probability of failure to establish would be 0.1 or 10 per cent. The cost of failure of lucerne to establish was handled by multiplying the cost of establishment in the first year of the rotation by the probability of failure, that is, 10%, then using that contingency value in each of the remaining years of the pasture-crop rotation. Note that in this study, the rotation commenced with the decision of changing the pasture phase from subterranean clover to lucerne.

A nominal discount rate of 15 per cent per annum after tax rate was used. The differences in profitability were estimated as the differences in NPV's or annuities for cropping with lucerne versus cropping with annual legume pasture.

Whilst changes in profitability for the two systems are important, financial characteristics from making the change are equally or more important for some producers in making a decision to change. Financial characteristics are differences in cumulative cash flow for the two systems, the peak deficit, the year in which the peak deficit occurs, and the time for the cumulative cash deficit to be repaid from cash receipts, that is, the pay-back period (Makeham and Malcolm 1993).

Results of economic and financial analyses

In Table 1 is shown a summary of the results for the 5 case study farms. There are differences between cropping with lucerne and cropping with subterranean clover; differences in livestock activities for the two systems; changes in profitability; and cumulative cash flows.

In all cases, profit increased by substituting lucerne for subterranean clover in the rotations. The financial analyses showed that the cash deficits caused by the change were repaid in 2 years for the Goorambat, Tungamah and Violet Town farms. The Bungeet and Dookie farms had longer but reasonable pay-back periods of 5 and 6 years.

Discussion and conclusions

In Table 1 it is shown that in 3 out of the 5 case study farms (Bungeet, Dookie and Tungamah), the change to lucerne was accompanied by an increase in the length of the pasture phase. For the Bungeet, Dookie, Goorambat and Tungamah farms, the increase in profit from the change to lucerne came mostly from increases in livestock production. Lucerne produced more dry matter and allowed stocking rates to increase. The green herbage lucerne provided when out of season thunder storms fell was an added bonus providing flexibility and opportunities in the grazing system.

In each case the yields of crops grown after lucerne were about the same as those that followed subterranean clover, but protein contents of wheat, barley and triticale were greater, and the prices received were higher.

The profitability of the Violet Town farm was similarly increased by increases in stocking rates and by the change from cattle to fattening store lambs. Part of that increase was due to green leaf being available for weight increases over the summer period when sale prices for lambs were high. Unlike the other farms, large contributions to increased profit were provided by the doubling of crop yields and increases in protein content of grain. The large increase in crop yields was caused by the installation of raised beds that removed the tendency of soils to waterlog.

Economic and financial benefits can be obtained from substituting lucerne for subterranean clover in rotation with crops. Much research has been devoted to reducing the other major perceived barriers to cropping with lucerne. Risk in establishment has been lowered by improving sowing techniques and mineralized nitrogen available to subsequent crops has been found to increase by its early removal before the commencement of the cropping phase. What remains is for lucerne production to be increased across the Broken Plains. This would help reduce the threat of land degradation posed by increased waterlogging and dryland salinity.

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Table 1. Summary of the results of 5 case study farms showing differences in rotations between cropping with lucerne and cropping with annual legume pastures, differences in livestock activities for the two, changes in profitability, and characteristics of the resulting cumulative cash flow from substituting lucerne for subterranean clover.

Location	Cropping with annual legumes	Cropping with lucerne	Livestock activities on subterranean clover	Stocking rate on sub-clover (DSE/ha)	Livestock activities on lucerne	Stocking rate on lucerne (DSE/ha)	Change in profitability (%)	Peak deficit (\$/ha)	Year of peak deficit	Pay-back period (Years)
Bungeet	4 yrs pasture, C,W,T,C,W,T	6 yrs lucerne, Lcn silage, Lcn hay, W,W,C,W,W,T	Cattle breeding for vealers, XB ewes for prime lms.	7.0	Cattle for vealers, XB ewes for prime lms.	12.0	33	541	2	5
Dookie	3 yrs pasture, C,W,T,C,W,C,T	6 yrs lucerne, W,C,W,Lu,W,VOh,	Merino flock for wool	6.0	Merino flock for wool	12.0	22	294	5	6
Goorambat	4 yrs pasture, W,Lu,W,T	4 yrs lucerne, W,C,W,Lu,W,T	XB ewes for prime lms.	6.0	XB ewes for prime lms.	8.0	36	58	1	2
Tungamah	4 yrs pasture, W,W,C,W,B	6 yrs lucerne, W,W,C,W,B	Merino flock for wool	9.0	Merino flock for wool	12.5	11	460	1	2
Violet Town ^a	5 yrs pasture, W,W,T,Lu,W,T,Fb,W,W	5 yrs lucerne, Lcn silage, Lcn hay, W,W,C,W,W,Os,C,W,W,W	Cattle breeding for prime yearlings	12.0	Store lambs for fattening	20.0	60	300	2	2

C = Canola W = Wheat T = Triticale Lu = Lupins VOh = Vetch and Oaten hay B = Barley Fb = Faba beans Os = Oaten silage

a Raised beds were constructed on this farm as well as changing from cropping with subterranean clover to cropping with lucerne.