Case Farm Two

(Hay Plains, New South Wales)

Part of the report

An economic analysis of native pasture on the plains of south-eastern Australia

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Disclaimer

The options for this paper have been developed for the purposes of this study. They do not constitute recommendations for this property and should not be used as such without a more thorough examination of the validity of the assumptions used and of alternative investment opportunities that might be available. The saltbush options require further validation before they can be recommended.

1. Nature of the case study

This case study is used to explore the situation facing small to medium size grazing properties on the Hay plains of New South Wales. In this case, the property has an irrigation block though without a secure water entitlement.

There are several management issues involving conservation, vegetation management and family livelihood.

The first involves the management requirements likely to be required under provisions of the *Native Vegetation Conservation Act* 1998, and the implications for the farm business of meeting them.

The second issue concerns the management of the extensive native grasslands across the property in order to maintain their long-term productivity.

An issue which is secondary to the main objectives of this project on native grasslands is how areas of other remnant vegetation along sandy ridges and also in prior streams which comprises trees, shrubs and ground layers fits into the farm system and the consequences of managing these areas to maximise conservation outcomes.

2. The current farming system

2.1 Background to the farm

The farm is located between Hay, Deniliquin and Jerilderie on the Hay Plain. The Hay Plain forms part of the larger alluvial Riverine Plain associated with the Murray, Murrumbidgee and Lachlan rivers and extending from Ivanhoe south to north-central Victoria. Long-term average rainfall is estimated to be 350mm.

The property is 8,000 hectares in size. Most of the property is native grassland. There is some scrub, and 530 hectares has been contoured for irrigation.

A self-replacing merino flock is the main activity with 3,500 breeding ewes. 400 of the older ewes are mated to Ramboullet rams to produce first cross meat lambs. Rice production is now the second most important activity with an average 60 hectares grown each year using water from the Colleambally outfall. There is also a cattle enterprise with 60 breeding cows. The number of breeding cows is expected to increase slightly to replace the 50 cattle that have been carried on agistment in recent years.

The dry sheep equivalents (DSE) for the stock carried in each enterprise are shown in Table 2-1.[1]

Table 2-1 Stocking - total and per hectare

	DSE
Self Replacing Merinos	7,429
Beef cattle	1,190
Total	8,619
dse/ha	1.1

2.2 Conservation overview

The farm is in the Western Riverina Natural Grasslands, an area designated under the *Native Vegetation Conservation Act* 1998 as having native grasslands of conservation significance. This Act requires any clearing to be undertaken in accordance with a regional Plan of Management[2]. The draft plan specifies that a) sites of known high conservation value must be retained, b) that grassland must not be cleared below a Basic Threshold Limit of 15 per cent of the property area, and c) a tiered approvals process applies with the process depending on the level of bush or shrub cover. Areas with under five per cent shrub can be cleared subject to b) above. Areas with between five and ten per cent shrub cover require inspection and approval by a vegetation management officer, while areas with more than ten per cent shrub require more detailed assessment and higher level approval.

There are large areas where the proportion of shrub eg. cotton bush and dillon bush exceeds five per cent. Dillon bush is naturally occurring on the Hay Plains; there may however be conservation concerns if it is expanding in cover (see later discussion). Species composition was surveyed at several sites as part of this project. Sites of high conservation value have not previously been identified on this property, and the survey did not identify any such areas. Survey results are outlined in a later section of this report.

Blackbox woodland is found over possibly 5% of the whole property, mainly along creeks. There is dense shrub woodland in one corner of the property.

2.3 Farmer goals

The property has been managed by a couple, now with four young children, since 1986. The property was purchased in 1963 by a partnership involving other family members. Financial management of this property has been integrated into the larger

[1] Dry sheep equivalents are a standard used to compare the feed requirements of different classes of livestock; one DSE is the amount of feed required to maintain a wether sheep weighing 48 kg for a year.

[2] This plan is likely to be similar to the Plan of Management for Specified Native Grasslands in the Western Riverina. (Nd) which was prepared prior to the Act coming into force.

partnership unit until recently. Now the family partnership is being dissolved. The current managers own most of the property and will buy the remainder.

Priorities for the managers are generating income, paying off the farm and sustainable management. There is no off-farm income. The owners are interested in the resource management and rangelands management issues. They are increasingly aware of the effect of different management practices on the land, and are concerned to seek out farming methods which will meet income requirements while maintaining long-term productivity.

3. The state of the pastures and their utilisation

An inspection of the property was carried out on 22 September 1997 by rangeland management and research consultant Allan Wilson and botanist Bill Mulham. The content of this section draws heavily on information they provided during the visit to the property, and on comments by Allan Wilson on a draft document outlining the pasture assessment. They are not responsible for any errors in this analysis.

3.1 State of the soils

Soils are mostly friable red and grey clay loams. Only in one or two paddocks are there large areas of one soil type. The grades in soil type are quite subtle and stock are not selectively grazing one type. Consequently separate management and fencing by soil type is not justified, except possibly on the small areas of sandy soils which were not closely inspected.

The soil condition across most of the property was estimated by A. Wilson to be fair based on the degree of soil roughness (see Table 3-1).[3] The original vegetation of saltbush and cottonbush has a mound/inter-mound structure that traps soil and nutrients. Cover of perennial bushes and perennial grasses is now low, except in a few paddocks. Erosion potential is limited as the soils are mostly clay based and flat meaning they are not prone to washing or blowing. There are only small areas of sandy soils where more care is required in management.

The owners state that in some years in spring, grass will be 40cm or more high across the paddocks. The year that the property was inspected was a low rainfall year, and at the time of inspection the pasture height, between bushes, was approximately 10cm. Apart from the bushes, growing species were largely confined to the irregular depressions which criss-cross the soil surface.

Table 3-1 Estimates of soil condition

	Good			Poor
Scale	1	2	3	4
Area	Little	Most of farm.	Little	1%
Comment	In two paddocks	Lost some roughness and cottonbush		May be completely bare

[3] This estimate is based on surface roughness (Tongway 1994) which is regarded as a more consistent (between observers and over time) measure than amount of ground cover (A. Wilson pers comm).

3.2 Species composition

A table showing the species found at each of the 14 sites inspected is included in the appendices. Excluding trees and wattles, a total of 84 species were identified on the property, 59 of which were native species and 25 were exotic species. The most species at any one site was 32, of which 19 were native.

The survey was undertaken in September 1997, after a dry winter and spring. Pasture composition varies greatly with the season of measurement and the amount of rainfall received. The conditions at the time of survey mean that the botanical diversity is likely to be grossly under-estimated, and it has been suggested that there could be another 50 or 60 species found on the property in a favourable year (B. Mulham pers comm).

3.3 The pasture, feed supply and seasonal management

Historically, Bladder saltbush (*Atriplex vesicaria*) was the dominant species with other bushes, annual native forbs (eg. daisies, lilies, orchids), some native grasses and small palatable chenopods always present. Oldman saltbush (*Atriplex nummularia*) occupied depressions that received run-off in wetter years. Saltbush disappeared from most properties in the region many years ago due to grazing pressure. Cottonbush (*Maireana aphylla*) then became the main shrub cover. Frequently, the cotton bush has also been grazed out on parts of many properties leaving a predominance of annual species and greater areas of bare ground. Unpalatable dillon bush (*Nitraria billardieri*) has then colonised the bare areas (A. Wilson pers comm). Very heavy stocking on this property in the past is suggested by the large areas without cotton bush cover, the high proportion of annual grasses in most pastures and the extensive cover of dillon bush.

Each component of the vegetation as it was found on this property is now discussed. Estimates of the proportion of dry matter accounted for by each vegetation category were made using the dry weight rank technique (Jones & Hargraves 1979); results are shown in Table 3-2. Annual species, which are dominant in the pastures on this property, as well as warm season perennial grasses, are likely to be under-recorded because of seasonal conditions at the time of the survey.

Bushes remain an important component of the vegetation, generally accounting for between 5 per cent and 10 per cent of the vegetation. The bushes, except for dillon bush, provide valuable feed in late summer and autumn when more palatable species are no longer producing green feed. The bushes also create a valuable micro-climate which shelters both other plant species and stock. On most of the property cotton bush is now relatively sparse at under 10 per cent of the cover, though it comprises up to 40 per cent of the vegetation on parts of two paddocks. The cotton bush has been grazed hard in recent years (A. Wilson pers comm). While the bushes can survive if they are then rested, hard grazing will kill emerging seedling bushes. The cotton bush does not appear to be regenerating, though this assessment was made in a very dry spring. It is likely that the established dillon bush plants are gradually expanding in size across large areas of this property (A.Wilson pers comm). There is little poverty bush -

though it has increased enormously in the region in the last 20-30 years. Blue bush accounts for 60 per cent of the vegetation at the site surveyed in one paddock.

Table 3-2 Estimated species composition (per cent dry weight) by site [4]

Site	1	2	8	9	10	11	13	14
Paddock	Kent	Kent	Horse	Horse	Pool	Scrub	Horse	Long
Soil type	grey	red	red	red	grey	grey, some sand	red	grey
Naturalised annuals								
grasses	75	50	40	37	50	10	90	80
forbs-medics	8	10	10	10		20		10
Native annuals								
forbs	3	30	10	20	10	10		5
Native perennials								
cool season grasses		3		2				
warm season grasses					25			
shrub - cottonbush		3	40	28	15			2
shrub - bluebush						60		
palatable chenopod and sida		2		3				3
Miscellaneous	10						10	
Total	100	100	100	100	100	100	100	100
Annuals	>86	90	60	67	60	40	>90	95
Naturalised	83	60	50	47	50	30	>90	90

Annual species, both naturalised and native, currently account for a very high proportion of the vegetation - an estimated 60 per cent or more at all but one of the sites inspected. At the time of survey, naturalised annual grasses were the main form of vegetation over most of the property, comprising upwards of 40 per cent of the vegetation in most areas and over 80 per cent in parts of some paddocks. They include ryegrass, barley grass and wild oats. In winter and spring they provide the bulk of feed for stock. The livestock system is organised around this, with available green feed matching peak demand from lactating ewes and weaner lambs. Barley grass responds quickly to rain in late autumn and early winter. Rye grass complements it by producing most of its bulk in early to mid spring. The feed available from annual grasses, and how long it remains green, varies with the season. If the season is good, weaner lambs and cull stock will have been sold while the annual grasses are still providing the bulk of feed. After the grasses dry off, they do retain some feed value, sufficient to maintain dry sheep.

Medics, which are naturalised annual forbs, provide their most palatable feed at the same time as the naturalised annual grasses. They comprise between 10 per cent and 20 per cent of the vegetation across most of the farm, though they are not present in

[4] Survey estimates were validated with quadrat throws at two sites - see Table 12-7 in the appendices. Where native forbs were a major component of the pasture, as at site two, their importance relative to annual grasses may have been under-stated. This is unlikely to be significant in terms of livestock production, but it does mean that the pastures may be more 'native' than estimated visually. The results for cottonbush also suggest this.

some areas. Burr from medics is reputed to be a valuable feed source through the summer, and the owners have found this to be so in difficult years, though trial results have found that sheep lose weight rapidly when it becomes a major part of the diet (Wilson *et. al*. 1969).

After summer storms, these annual pastures will grow lots of annual and biennial plants, including grasses. Stock management problems arise mainly in years these storms do not occur (A. Wilson pers comm).

Annual native forbs account for a large number of the species present. They were found to make up between 5 per cent and 30 per cent of the vegetation at the different sites inspected. Depending on the species, they will produce feed from winter through as long as the rains last. Seasonal conditions greatly influence which species appear and their abundance.

Several summer-active grasses are found, but not across the property. Spear grasses (*Stipa spp*.) are found occasionally, and fairy or blow-away grass (*Sporobulus caroli*) is common in one paddock where it comprises 25 per cent of the vegetation in possibly 33% of the paddock. Blow-away grass appears across the property in wet years. The summer-active grasses are responsive to summer storms. The extent of their contribution to filling in feed gaps will vary from year to year depending on the rains.

Generally, perennial grasses was found to be relatively uncommon in the pasture, partly because of the seasonal conditions at the time of survey. Wallaby grass (*Danthonia spp.*) is the only perennial cool-season grass. It comprised under 3 per cent of the vegetation at two sites, and was observed at other places, but absent from many. It is likely that Wallaby grass is not suited to the friable soils, although grazing management may have contributed to their loss. In a run of wet seasons, more will appear, especially if winters are wet. If the right run of seasons do not come, it will go.

Palatable perennial forbs - chenopods such as ruby saltbush, and other plants like fissure weed (*Maireana pentagona*) and sidas (e.g S*ida corrugata*) are a small but valuable component of the pasture, comprising at most 3 per cent of the vegetation. These species are not as digestible as soft grass and legumes. They are good quality in spring but won’t be eaten until the December-May period. These species fill the same feed niche as saltbush and cotton bush, but are too small to provide the equivalent landscape stability as those shrubs (A. Wilson pers comm).

The pasture is reasonably well-suited to animal production because of the combination of annual and perennial species. The annuals have high growth rates and have high nutritional value, but being reliant on adequate rainfall, they provide less feed during dry periods. This pattern is reflected in sheep grazing preferences. The perennial species provide resilience and help meet animal requirements during the dry seasons and in drought. These pastures carry more stock than the original vegetation which had a higher perennial bush component, but the feed supply is more variable (A. Wilson pers comm).

3.4 Stock moves

A record was kept by the owner of the movement of stock between paddocks to assist this project. The aim was to identify how different pasture types were being utilised. However, on this property as indicated above, there is little obvious difference in how stock are utilising pasture types, and only the small areas of sandy soils are thought to need special treatment. The data on stock movements has thus not proven as useful as initially expected.

The data on pasture utilisation might be valuable for comparing paddocks, and planning future use. This has not been done for this case farm because the analysis of options (see later discussion) has been at an aggregate level for the whole property.

4. Economic and financial state of the current farm business

Total farm capital is estimated at $1,650,000 of which $1,300,000 is the land value. Equity of the family couple is estimated at 82 per cent.

Expected profitability and cash flow in future years are now estimated, based on an assumption that the farm will continue to be managed as it is now. The results do reflect what might occur in any one year, but are based on a 'typical' year or on expected values which take account of seasonal fluctuations.

Expected gross margin for each enterprise is shown in Table 4-1.[5] Break-up of gross margins are shown in Table 12-2 and Table 12-3 in the appendices. The expected long-term values used to derive income in the sheep enterprise are: six kg/head wool clip, $4/kg greasy wool price, and a $25 average weaner sale price.

Table 4-1 Gross margin for the sheep enterprise

	Gross margin		
	Total		Per DSE
	$'000	%	$
Sheep	112	61	15
Cattle	12	7	10
Rice	59	33	

Expected annual operating profit after tax and return to capital are shown in Table 4-2. Overhead costs are small, apart from operator's allowance which is costed at $50,000. This allowance includes the extra labour cost (50 per cent of the full-time cost of employing a jackaroo) that would be incurred if there was no contribution from the wife to the farm business (leaving aside her contribution to the farm household). Whole farm unallocated variable costs which are not directly attributable to the sheep enterprises include, fuel, repairs and maintenance, fencing and weed spraying.

Expected annual return to capital is estimated to be two per cent.

[5] Gross margin is gross income less variable costs (e.g. shearing, health costs) associated with the particular enterprise.

Table 4-2 Expected Annual Profit and Loss

	$
Income from activities	
Self Replacing Merinos	172,484
Beef cattle	12,896
Rice	108,000
Total income	*$293,379*
Activity variable costs	
Self Replacing Merinos	60,281
Cattle	1,258
Rice	48,720
Whole farm unallocated variable costs	$56,750
Overhead costs (incl labour & depn)	$80,700
Total costs	*$247,709*
Operating profit before tax	$45,670
Tax payable	$13,113
Operating profit after tax	*$32,557*
Return to capital	
Total farm capital	$1,646,337
Return to capital	2.0%

Expected net cash flow is shown in Table 4-3.[6] This includes a family consumption allowance of $40,000 (which is based on family consumption needs, unlike the operator's allowance above). Part of the farm is leased from the larger family partnership. As the couple intend to buy it, interest at five per cent and principal repayments over 15 years are assumed. Net cash flow does not include equipment replacement or investment out of cash flow for farm development.

[6] Estimated tax payable is because it is based on total income less deductions which include variable costs, overheads, estimated interest payable, livestock purchase costs and depreciation on equipment aged 10 years and less.

Table 4-3 Expected Annual Uses of Cash Statement

	$'000
Cash in	
Sales	293
Cash out	
Activity variable costs	110
Whole farm variable costs	57
Cash overheads	18
Income tax	11
Interest	15
Principal on loan	20
Consumption	40
Total	270
Net cash flow (before equipment replacement or investment out of cash flow for farm development)	23

5. The future - current plans and other opportunities

The objectives of the owners for the farm business are primarily to maintain viability of the farm business as well as pasture productivity over the long-term. The farm is generating a modest annual cash surplus, with its combination of grazing and irrigated cropping. However, the owners feel it may not be sufficient to meet future investment needs as well as paying off the family loan. This is particularly because decisions about the area that can be irrigated have to be made on a year to year basis.

There are two immediate issues relating to vegetation management that may influence consideration about the future of the property.

Firstly, the farm is in an area is designated under the *Native Vegetation Conservation Act* 1998 as having native shrublands of conservation significance. This has no implications for current management, but it might place constraints on further clearing of native shrublands for the purposes of irrigation.

Secondly, effective grazing pressure may be increasing. This is because the area occupied by unpalatable shrubs, notably dillon bush, may be expanding slowly. It is the considered opinion of a rangeland management and research consultant that dillon bush is expanding, possibly at the rate of one or two per cent a year (A. Wilson pers comm). This is due to past heavy stocking which encouraged the growth of annual grasses and bare ground at the expense of more palatable shrubs such as cotton bush. The dillon bush, while always present in this region but at low densities, then established more of a foothold on areas of bare ground. While current management is

not contributing to the problem, it is believed to be insufficient to halt or reverse the spread of dillon bush (A. Wilson pers comm). The inspection on which this assessment is based took place during a very dry spring. Further visits, and discussions which draw on the owner's experience with dillon bush, may help confirm or revise the finding and the level of concern it causes.

The cover of dillon bush suggests that stocking rates have been and may be still too high for the long term productivity of this property (A. Wilson pers comm). Reducing stocking levels in the late summer and autumn by up to 33 per cent on the extensive grazing areas for over 15 years is seen as necessary in order to encourage the return of desirable shrubs (A. Wilson pers comm). The expectation is that with a reduced stocking rate, the increase in dillon bush would be halted, and over a long term, some return to cottonbush might be expected and even a return to saltbush. However, the latter might require a still lower stocking rate and would certainly require the establishment of some seed sources; it is not considered economically justified. An expansion in the cover of these shrubs over large areas of the property is desirable because shrubs provide green leaf over a long period as well as giving stability to the soils and creating a more favourable micro-climate for other plants. Friable soils make it unlikely that large areas of native perennial grasses will establish.

The proposal for reduced stocking is based on an old grazing trial that was conducted on Emmett Vale, north of Wanganella in the 1960's, where the long term sustainable stocking rate was found to be in the vicinity of one DSE for every four acres. This is mainly set by the stock that can be carried in the dry years, and particularly through the autumn period (Wilson *et. al*. 1969). The crucial time for reduced stocking is when the shrubs germinate in wet years. However, reduced stocking in only those years is insufficient. It is difficult to anticipate those years, and research in Western Australian shrublands has shown that half the decline in shrub numbers is due to persistent pressure every year (A.Wilson pers comm).

5.1 Possible options

Three options have been selected for evaluation. They are:

1. Do nothing different. Results will be tested for two situations:
   (a) a continuing decline in pasture condition with the continuation of the management *status quo* (as the consultant suggests) and,
   (b) pasture productivity will be maintained (as the owner suggests),

1. Reduce stocking levels by one-third. Even though there are likely to be some compensating benefits as well as the obvious costs, this option is likely to cause financial difficulties for the owners, but is important to consider so that realistic public policy choices can be developed,

3. Establishing saltbush plantations to supplement the pasture.

Several other less significant and less likely options which potentially contribute to current levels of net income while stocking levels are reduced.[7] These options, which are not examined further, are:

(a) Developing the area under irrigated crop. The owner is already pursuing this option. However, opportunities are limited because surplus water from Coleambally irrigation area is used and there is no secure water entitlement. Ground water nearby has proven saline, and consequently sinking a deep bore to pump water for irrigation is not being considered. Grazing stubble from irrigated cropping may contribute to the summer/autumn feed supply. The option is not considered further as the owner can only expand the area irrigated on an *ad hoc* basis when confident that it will deliver a quick return.
(b) Fencing by soil type. This is not considered feasible, except in a few areas, given the way soil types are mixed.
(c) Harvesting kangaroos is considered a possibility for the future, rather than a realistic one at present.
(d) Increasing cattle numbers and reducing sheep. Cattle do not graze as closely as sheep.
(e) Changing flock composition to allow for more flexibility in animal numbers. This would involve reducing the number of breeding ewes and increasing the numbers of wethers which can be more easily moved off the property or sold in dry years.
(f) Sub-dividing and rotating stock using grazing farming principles (i.e. HRM systems) like a few other farmers in the region are doing. However, the owners are concerned about the additional management inputs required, and believe a better investment may be to irrigate more land.
(g) Purchasing more land. This would involve either purchasing nearby land if it became available, or moving to a different property.

5.2 General approach to analysis of the options

Partial budgets, both steady state and discounted cash flow, are used to identify the profitability and pre-tax cash flow effects of additional investments.[8] These budgets allow a comparison of the farm situation - before and after - to be made.

The steady state partial budget involves a snapshot into the future to the point of peak production after all development expenditures have occurred. This budget requires all gains and losses associated with the new situation to be identified. The result indicates the net gain or loss relative to the situation before the investment. It is used to ask ‘is it worth getting there?’.

[7] identified in discussion with the owners and rangeland management consultant, A. Wilson
[8] An alternative is to use whole farm budgets. This would be appropriate where a new farm buyer was evaluating the potential of the property - it can be used to show the return to capital of the current farm system as well as the return if additional investments were made.

The discounted cash flow budget helps compare options in which revenue and cost streams occur over a different time sequence. All cash flows are discounted to the same point in time irrespective of when they occur to give a net present value (NPV). This budget is useful for answering the question 'is it profitable after taking account of the cost of getting there?' By using salvage values, this budget can handle expected productivity of the initial investment beyond the period of the budget. Falls in revenue can also be incorporated, e.g. declining revenue associated with a drop in pasture productivity after a certain period.

Expected values rather than actual prices or costs are used in these budgets. This is appropriate as the future is unknown. Where an event will occur, but it is uncertain in which year, an expected value is used in each possible year. For instance, if a drought is expected every five years and in such circumstances drought rations will cost $20,000, the expected value each year is $4,000. This approximates the drought preparedness strategy of 'putting a little away each year'. The alternative when using relatively simple spreadsheet models is to guess which year the drought will occur in.

The analysis is run over 15 years in the discounted cash flow budgets. In terms of farm planning, it is a relatively long period—half a farming generation. Real discount rates of five per cent, 10 per cent and 15 per cent are used. Most farmers would require a 10 - 15 per cent return on marginal capital, compared to an expected return of two to three per cent on whole farm capital. The discount rate represents the cost of the capital involved, i.e. the opportunity cost of the funds involved, the actual cost of funds borrowed, or a weighted average of both (Makeham & Malcolm 1993). A high rate is realistic given the choices, often risky, facing farmers about what to do with their borrowings or marginal investment funds. So that options with costs occurring over a different time sequence can be compared, all cash flows (of costs and returns) are discounted to the same point in time irrespective of when they occur to give a net present value (NPV).

In the financial analysis associated with the discounted cash flow budgets, each investment is assumed to be funded with an overdraft at 12 per cent interest per annum. Once debt is paid off, cumulative cash surpluses are invested at five per cent interest per annum.

6. **Option 1 - No changes to management**

Current stocking rate is 1.12/DSE hectare. Two different assumptions are made about how this stocking rate (and animal performance) will change.

Firstly, it is assumed that the current stocking rate will be maintained for the case where no pasture productivity decline is assumed (the owner's expectation). Secondly, it is assumed that a decline in pasture productivity will occur (the consultant's expectation) which is expected to lead to a reduction in stocking rate of one per cent per year. The eventual minimum stocking rate is expected to be 0.9 DSE/hectare. For ease of analysis it is assumed that all the effects of lower pasture productivity are reflected in a lower stocking rate and not in animal performance.

In reality the effect of any increased stocking pressure is likely to show up in animal performance (e.g. weaning per centage, mortality, wool cut, weaner weights), and drought related costs. Such changes might be incremental and either co-incidental with or lagging behind the increase in effective stocking rate. It has been observed that animal performance may be maintained for some time after pasture condition has obviously deteriorated (N. MacLeod pers comm). Alternatively, the changes might take the effect of a major and irreversible shock to the system, occurring well into the future but over a very small timespan (Perrings & Walker 1997). This is less likely given what is known about the ecological mechanisms involved in this pasture (A. Wilson pers comm).

If no pasture decline effect is anticipated, annual gross margin from the sheep enterprise is expected to be $130,175 as shown in Table 6-1. The effect of a decline in pasture productivity (at one per cent per annum) on income from the sheep enterprise is illustrated at five year intervals in Table 6-1. For the purpose of this analysis, it is assumed that there is a close link between pasture decline and animal performance. By year 15, income from the sheep enterprise is expected to have declined by approximately $16,000. These pre-tax results do not account for the interest that could be earned on capital released by the sale of excess stock. Year by year results for the pasture decline case are shown in Table 12-4 in the appendices.

If the pasture decline occurs at a lesser rate of 0.05 per cent per annum, the annual gross margin from the sheep enterprise is expected to be $113,089 in year 15, meaning a decline of $8,000.

Table 6-1 Expected income effects if stocking rate declines

Year	1	5	10	15
Stocking rate - with decline	1.08	1.03	0.98	0.94
Total stock carried (dse)	8,619	8,279	7,873	7,487
Excess stock sold		84	80	76
Gross margin	130,175	125,046	118,917	113,089
Sale of excess stock	0	1,451	1,379	1,312
Total	130,175	126,496	120,297	114,401

7. Option 2 - Reduced stocking

The second option is for a one-third reduction in sheep numbers from current levels. Such a reduction can be achieved by reducing the overall number of animals carried or by selling off stock in dry years and buying again in better years. The option of reducing overall numbers is evaluated here.

Lighter stocking is likely to improve animal performance, reduce drought feeding costs, and may reduce overhead costs and free up labour for on or off-farm work. This may or may not be enough to compensate for the income effects of carrying fewer stock.

The effect of lighter stocking on livestock performance will vary with the seasonal conditions in each year. the property owners and A.Wilson were asked to indicate the expected seasonal conditions over the next 10 years using categories of good, OK, poor or bad (following Buxton & Stafford Smith 1996). Table 7-1 is based on their responses, after adjusting for minor differences. [9]

Table 7-1 Expected seasons over next 10 years

Season	Good	OK	Poor	Bad
Years in 10 (expected)	2	3	3	2

Animal performance measures that are likely to be affected include weaning per centage, wool cut, animal health and sheep sale weights. Lighter stocking is also likely to give more flexibility in the timing of sheep sales. Estimating effect on weaning per centage and wool cut is relatively straight forward. Animal health is more difficult as health problems can arise in both very good and very bad years. Sheep sale weight and timing of sheep sales can both affect the price received; however, the owner of this property has found that price is largely determined by the demand for young sheep. The weaner ewes are sold to first cross lamb producers for breeding purposes, and the timing of when they buy is set by their seasonal conditions which may be different to those on the riverina plains. A lighter stocking rate should make mating some of the merino ewes to a meat ram and selling prime lambs feasible. However, the owner's recent experiences at doing this, and using irrigated pasture to fatten them, has not been successful.

The variation in animal performance, and drought feed costs, between current and light stocking across seasons, is shown in Table 7-2. The differences only show up in poor or bad seasons as there is plenty of feed available in better years at both stocking rates. Averages are based on the expected number of seasons of each type. The difference

[9] The owners were the most pessimistic - expecting three bad seasons out of 10.
Annual rainfall is not necessarily a good indicator of seasonal condition as rainfall may not fall at the time of year when it is particularly needed (A. Wilson pers comm).

between the average for the two stocking rates is shown in the last column; this figure will be the basis of the economic evaluation of the two options.

Table 7-2 Seasonal conditions, livestock performance and stocking rate

	Season	Good	OK	Poor	Bad	Average	Difference
Weaning rate	Current stocking	100%	90%	75%	60%	82%	
	Light stocking	100%	90%	85%	70%	87%	5%
Wool cut - kg/hd	Current stocking	6.8	6.0	5.4	4.9	5.8	
	Light stocking	6.8	6.0	5.8	5.4	5.6	0.2
Drought rations - $/hd	Current stocking				$13.00	$2.60	
	Light stocking				$6.50	$1.40	-$1.20

Expected drought costs are discussed in the next section.

7.1 Results

The new stocking rate, for sheep only, is expected to be 0.61 DSE/hectare compared to the current rate of 0.93 DSE/hectare.[10] There will be 2,333 ewes instead of 3,500, and DSEs carried will total 4,903.

While overall stocking rate and activity gross margin will fall, gross margin per DSE will increase as shown in Table 7-3 below.

Table 7-3 Effect of reduced stocking on sheep gross margin

	Extra wool	Extra lamb sales
New stock numbers	4903 DSE	2310 ewes
Extra gain	0.22 extra kg/dse	5% extra weaning %
Quantity	1079 kg	116 extra lambs
Unit value	4.00 $/kg	25 $/lamb
Extra gm/DSE	0.88 $/dse	0.59 $/dse
Extra gross margin	$4,315	$2,888

Estimated savings in drought feeding costs are shown in Table 7-4. It is expected that the costs incurred in drought on this property are roughly similar irrespective of whether the drought response tactics are to sell stock cheap and buy back dear, or to purchase drought rations.[11] Hence the breeding flock of 3,500 adult sheep is to be fed, with cull sheep assumed to be sold before the drought breaks. The amount being fed is 3.5kg of grain per sheep per week costing $0.15/kg for 26 weeks; this is estimated to

[10] Stocking rate taking account of both cattle and sheep is 1.08 DSE/hectare.

[11] It is assumed that in a drought year, irrigation water is not available. Currently, when the owners anticipate a dry year, millet on which to feed young sheep is planted and irrigated if water is available.

provide half the rations of the large-framed sheep (A. Wilson pers comm). The owner expects a 'bad' year twice in 10 years. A drought requiring six months of rations will almost certainly occur once in 10 years and a second drought requiring a lesser period of feeding will also occur. These expectations have been simplified by assuming that a drought lasting six months will occur once every seven years.

Table 7-4 Drought feeding costs and stock numbers

	Current	New
Cost/week/head	$0.50	$0.50
Weeks fed	26	13
Cost/head	$13.00	$6.50
Numbers fed	3500	2310
Cost	$45,500	$15,015
Difference		$30,485
Expected value - 1:7 occurrence		$4,355

The partial budget in Table 7-5 shows the effects of reduced stocking in a steady state year. This option if implemented will have several effects on operation of the whole farm which may at least partly compensate for the direct effects of the reduction in activity gross margin on operating profit. The option will release capital otherwise tied up in livestock (which could be used to reduce debt and save interest payments, or to invest and earn interest), it will reduce the labour requirement and it may reduce some farm costs. It is assumed that farm costs will be reduced by an additional $5,000 across areas such as fuel, repairs, casual labour, insurance and power. It is also assumed that one of the owners will now be free to take a part-time job off-farm and earn $5,000. The extent to which a stock reduction would free up labour is difficult to judge as sheep handling time, for those tasks in the paddock where the second person now helps, will not decrease proportionately as mob size is reduced.

The immediate effect of reducing stocking by one-third is an expected drop in activity gross margin of over $38,000. However, as also shown in Table 7-5, the net effect after accounting for the expected gains and losses is expected to be a loss of about $10,000. Nevertheless, this is still a substantial sum and results in a reduction to net profit after tax for the farm business of almost one-third as shown in Table 7-6. If there are no labour savings, the reduction will be closer to $15,000.

Table 7-5 Partial steady state budget - reduced sheep numbers

	$
Gains	
Revenue gained if changes made	
Better wool cut	4,315
More lamb sales	2,888
Employment of freed labour	5,000
Costs avoided if changes made	
Drought feed costs	4,355
Overheads	5,000
Total gains	21,557
Losses	
Revenue foregone if changes made	
Sheep gross margin	38,149
Costs incurred if changes made	
Nil	0
Total losses	38,149
Total gain/loss	-$16,592
Marginal tax rate	20%
Extra taxable income	
Tax on extra gain/loss	-$3,318
Total gain/loss after tax	-$13,274
Released capital	$44,262
Return on capital (after tax)	6.5%
Interest on released capital	$2,877
Net gain/loss after tax and interest	-$10,397

Table 7-6 Farm (after tax) profit - before and after change

	$
Current farm profit after tax	32,557
Net gain/loss after tax and interest	-10,397
Farm profit after change	22,161

The net present value (over 15 years) of the expected net loss from reducing stocking is shown in the first column of Table 7-7. It gives an indication of what the owner might hypothetically want as compensation for reducing stocking; this sum will vary with the owner's expected rate of return.

These results change considerably if a decline in pasture productivity which leads to a forced reduction in stocking over time is assumed - as in Option 1 - No changes to

Management. Rather than an expected net loss of $10,000 occurring every year, the loss is expected to progressively decline and disappear by year 15. That is, the decrease in stocking rate would have happened anyway. The full results are presented in the appendices in Table 12-5. However, if the rate of pasture decline is half the expected rate (of one per cent per year), then the annual net loss is expected to fall to $4,000 by year 15.

The implications are highlighted in Table 7-7 which compares the present values of the losses for different rates of pasture decline. It shows that the lump sum the owners might hypothetically require as compensation is significantly lower if pasture decline is expected to occur at a rate of one per cent a year and have the effects outlined above. However, it is clear that the resource owners are facing a cost if they reduce stocking regardless.

Table 7-7 Expected present value of the losses associated with the reduced stocking option

	Rate of pasture decline		
Discount rate	no decline	0.5% p.a.	1% p.a.
5% real	$107,901	$80,059	$53,319
10% real	$79,069	$61,378	$44,337
15% real	$60,786	$49,008	$37,628

Other studies have demonstrated that under certain conditions, lighter stocking can increase profitability (e.g. Buxton & Stafford Smith 1996).[12] The results from this analysis differ and show that, on the assumptions used and for this property, a loss is likely if stocking is reduced by one-third.

Even where current management will lead to a drop in pasture productivity which directly affects stocking rate, it may be most profitable to continue current management in spite of the long-term consequences. This is particularly so if the drop in pasture productivity is expected not to occur for some time. However, for property owners who anticipate a slow but steady drop in pasture productivity, this analysis has shown that the loss from a one-off cut in the level of stock may not nearly as high as might be expected if foregone gross margin alone were taken into account.

[12] Buxton & Stafford Smith model stock reductions on beef cattle properties in northern Australia. Meat production varies according to feed supply more than wool production; this partly accounts for the different results.

8. Option 3 - Planting saltbush

Saltbush plantations if established on this property might have three main purposes - better animal performance, saved drought costs and improving pasture condition.[13]

Saltbush plantations can be grazed heavily by large numbers of stock for short periods of the year. The stocking rate, averaged over the year, is expected to be much higher than for the same area of pasture. Fencing out small areas of paddocks for saltbush plantations will mean a slight reduction in the area of pasture normally available to livestock.

For the purposes of this analysis, it is assumed that all saltbush plantations are established in one year. While the results will give an indication of likely profitability, the assumptions on which the analysis is based have not been widely tested because only limited data is available. If the owners establish saltbush plantations, they are likely to establish a relatively small area and then proceed cautiously with larger areas depending on the initial results.

There are some important considerations about the technical feasibility of saltbush. Saltbush may not grow well on the grey friable soils on this property (A. Wilson pers comm). Another constraint may be organisation of the farm system. Shifting the timing of lambing to later than June may be desirable if the main period of use of saltbush is from February to May; however, this may be difficult given cropping preparation and early spring sheep work (A. Wilson pers comm).

8.1 Area planted, planting density and stocking levels

Plantations are assumed to be 20 hectares in size with 690 bushes per hectare. Each plantation can carry 45 livestock units per hectare for 60 days and each bush can feed one livestock unit for four days if it supplies 0.5 kg of leaf per day and pasture in the plantation also contributes. A livestock unit is defined as a dry sheep weighing 50kg. These and other assumptions made about saltbush plantations are shown in Table 8-1. There is limited data available about the performance of saltbush on properties in this region. The data is mostly derived from the experience of the owner of case farm one who estimates that 500 sheep can be carried for two months on an eight hectare plantation with 1,000 bushes per hectare. It is assumed that similar results will apply on a proportional basis to the larger 20 hectare plantation.[14]

[13] The benefits of saltbush on this property would differ from case farm one. The owner of this property regards better sale prices for young stock as unlikely, and does not expect to save on supplementary feed purchase costs. The area of the farm set aside for irrigated cropping is used to grow millet in drier years when it is risky growing rice; the millet is grazed by young stock. In other years, no supplementary feeding occurs. The owner of case farm one is already stocking lightly, and is unlikely to increase animal performance with saltbush.

[14] One obvious difference will be a greater quantity of grasses on offer.

Both weaner sheep and adult ewes are carried on the saltbush. As weaner sheep graze to a lesser height than adult sheep, and the energy requirements of a growing sheep are higher, stocking rates are more or less the same. Each are treated as equivalent to one DSE.

Table 8-1 Assumptions about saltbush plantations

	Unit	8 ha plantation	20 ha plantation	Source
Planting density	stems/hectare	1,041	690	- industry
Spacing	metres	2.4 * 4	2.4 * 6	- industry
Bushes	number	8,328	13,800	- derived
Capacity	livestock units/60 days	500		- case farm one experience
	livestock units/60 days/hectare	62.5	45	- based on 500 livestock units/60 days
	livestock unit days	30,000	54,000	- industry
	days/bush	4	4	- derived
Sheep requirements	kg/day	0.5 bush, 0.5 pasture	0.5 bush, 0.5 pasture	- A. Wilson
Necessary yield	kg/bush	2	2	- derived
Drought capacity	plants/livestock unit/2 months	16.7		- 8328/500
	plants/livestock unit/6 months	50		- 16.7*3

The consequences of stocking rate only reaching 50 per cent and 75 per cent of the rate shown in Table 8-1 will be tested. While the data from case farm one suggests that 50 plants are required to feed a dry sheep for six months, this is considerably below the 110 calculated by A. Wilson (1998) which is based on weights of sheep grazing saltbush. It should also be noted that recent research has shown that some claims for Oldman Saltbush have been shown to be overstated because of weighing of stems as well as leaf (A. Wilson pers comm).

It is estimated that 233 hectares of saltbush are required (Table 8-2). This assumes that the area planted for drought feeding can be used to increase animal performance and to aid in pasture recovery in non-drought years. In drought years, it is assumed that only the breeding flock of 3,500 ewes are carried through the drought, ie. cull sheep have already been sold and the drought ends before the feed requirements of ewes increases in the last two months of pregnancy.[15] In other years, the saltbush will also carry the 900 one year old replacement ewes, but for a shorter period of time.

[15] Relaxing this assumption will increase drought feed costs - see later discussion about Table 7-4.

Table 8-2 Deriving the required area of saltbush

	Drought feeding	Animal performance & pasture recovery
No. DSE to be fed	3500	4400
Weeks sheep will require feeding	24	17
Weeks feed is available per saltbush plantation	8	8
Maximum livestock units/ha carried per plantation	45.0	45.0
Area (ha) needed for each purpose	233	208
Utilised ….one year in	5	1
Total area (ha) required		233

8.2 Benefits

The same area of saltbush can be used to improve animal performance and enhance pasture condition. However, in a drought year the better animal performance will be foregone. Each benefit is now addressed in turn.

Animal performance is expected to increase because saltbush can be used to lighten the effective stocking rate and increase the average weaning per centage and higher wool cut. In years when seasonal conditions are poor, increased lambing per centages and higher wool cut are likely as a direct consequence of the availability of saltbush. The benefits are equivalent to those resulting from lighter stocking as outlined in the previous section. As discussed previously, the wool cut is expected to be 0.2 kg/DSE higher and the average weaning per centage five per cent higher if the property was stocked one-third lighter. Excluding these benefits in a 'bad' year, the average is four per cent for weaning and 0.15 kg/DSE for wool cut (Table 8-3).

Table 8-3 Extra gross margin related to improved animal performance

	Extra wool	Extra weaning %
New stock numbers	7429 DSE	3500 ewes
Extra gain	0.15 Kg/head	4% extra weaning %
Quantity	1114 kg	131 extra lambs
Unit value	4.00 $/kg	25 $/lamb
Extra gm/dse	0.60 $/dse	0.94 $/dse
Extra gross margin	$4,457	$3,281

Saltbush plantations are expected to save costs in drought. A major drought lasting six months is assumed to occur every seven years (see discussion under Option 2 - Reduced stocking). The effect of increasing this frequency will be tested. Drought feed costs are those shown in the first column in Table 7-4 - the sum that has to be put aside annually to meet this cost is $6,500.

Saltbush plantations might aid pasture recovery by allowing all sheep to be taken off pasture for four months a year. This is expected by the consultant to prevent a slow decline in stocking rate (as discussed in the previous section). Assumptions relating to

the future stocking rate are shown in Table 8-4. The gain from sowing saltbush is equal to the difference between the stocking rate expected with saltbush and the stocking rate expected in its absence.

Table 8-4 Assumptions about future stocking rate

Assuming pasture productivity is maintained	
Stocking rate on pasture	1.08 dse/ha
Assuming pasture productivity decline without saltbush	
Estimated annual rate of pasture decline	1%
Expected minimum if decline continues	0.9 dse/ha

It is assumed that the full benefits will be available from the saltbush plantation in the third year after establishment. The effects on profitability of a delay will be tested.

Saltbush is salvaged at 100 per cent of the initial investment cost, given that it is expected to last at least 40 years if managed appropriately. Salvage value of the fencing and water supply at 15 years is included at 50 per cent of initial cost.

8.3 Costs

Establishment costs are based mostly on information provided by other property owners who have already established some saltbush. Costs are as follows:

- seedlings $0.18 each;
- fencing $1,500/km (an existing fence will be utilised along one side);
- stock water costs $600 for troughs per plantation, totalling $7,000. Plantations are established near existing water pipes;
- It is assumed that all the area sown requires ripping. Ripping costs $13/hectare. This is based on use of a 138kw tractor costing $20/hour to run (ie variable costs). Using the tractor will not change tractor overhead costs, so this factor is not included. Ripping is estimated to take 0.7 hours/hectare.
- Rotary hoeing costs $8/hectare. This is based on use of a 64kw tractor costing $10/hour to run. Overhead costs are not included. The operation will take an estimated 0.8 hours/hectare.
- Planting costs $7/hectare. This is based on use of a 64kw tractor costing $10/hour to run. Overhead costs are not included. The operation will take an estimated 0.7 hours/hectare.
- Watering newly established plants is likely to be required every fourth year. It costs $167/hectare (an average of $42/hectare every year). This is based on use of a trailer pulled by a 64kw tractor costing $10/hour to run. Overhead costs are not included. The operation will take an estimated 16.7 hours/hectare.
- Herbicide will be required in very wet years to control weeds. It is assumed to be required every fourth year, is done by contract and costs $20/hectare.

- It is assumed that paid labour is not required and establishment can be matched with seasonal demands on family labour. This is likely where small areas are established but not for large plantations;
- Likelihood of failure was assumed to be 1:5 in which case costs for seedlings, rotary hoeing, and replanting will be required in the second year.

Revenue will be foregone from grazing on land previously occupied by the saltbush plantation. This applies only in the years that a benefit from the saltbush is received - in the expected five 'poor' or 'bad' years (Table 7-2). In other years it is assumed stock will have some access to the plantation. It is expected that saltbush will be planted in less productive areas; stocking rate is assumed to be 0.8 DSE/hectarecompared to the property average of 1.1 DSE/ha.

Table 8-5 Revenue foregone from grazing

Area planted (ha)	233
Former stocking rate (dse/ha)	0.8
Gross margin ($/ha)	15.10
Foregone grazing in poor year	$2,819
Foregone grazing in good year	$0
Average grazing foregone	$1,408

8.4 Results

Two scenarios are examined which reflect the differing expectations about pasture decline occurring on the property. The scenarios are:

Scenario 1 Saltbush increases animal performance and saves drought feed costs, but does not affect stocking rate and there is no long-term decline

Scenario 2 Saltbush increases animal performance and saves drought feed costs, and also prevents a decline in stocking rate

In the second scenario, extra stock are carried relative to what would have been the case without saltbush. Derivation of the extra stock and the associated gross margin for selected years for this scenario is shown in Table 8-6.

Table 8-6 Saltbush scenario 2 - extra stock carried and gross margin by year

	Year	1	5	10	15
Stocking rate - with decline	dse/ha	1.08	1.03	0.98	0.94
Stocking rate - with saltbush	dse/ha	1.08	1.08	1.08	1.08
Difference		0.00	0.04	0.09	0.14
Difference in stock carried	dse	-	340	745	1,131
Extra gross margin	$	-	5,129	11,258	17,086

Derivation of the expected net gain or loss associated with the second saltbush scenario for selected years is shown in Table 8-7. The expected net gain for scenario one does not change over time, and is represented by the first column of the same table.

Table 8-7 Saltbush scenario 2 - partial steady state budget

	Year 1	Year 5	Year 15
Stocking rate - DSE/ha	1.08		
- if pasture had declined		1.03	0.98
- with saltbush		1.08	1.08
- difference		0.05	0.10
- extra stock carried	0.00	371	743
Gains			
Revenue gained if changes made			
Better wool cut	$4,457	$4,457	$4,457
More lamb sales	$3,281	$3,281	$3,281
Extra gm - pasture recovery		$5,129	$17,086
Costs avoided if changes made			
Drought feed costs	$6,500	$6,500	$6,500
Total gains	$14,239	$19,368	$31,325
Losses			
Revenue foregone if changes made			
Pasture no longer available	$1,410	$1,410	$1,410
Costs incurred if changes made			
Depreciation on fence/water supply	$1,108	$1,108	$1,108
Stock build up costs			
Total losses	$1,410	$1,410	$1,410
Total gain/loss	$12,829	$17,958	$29,915
Marginal tax rate	20%	20%	20%
Extra taxable income			
Tax on extra gain/loss	$2,566	$3,592	$5,983
Total gain/loss after tax	$10,263	$14,366	$23,932
Released capital	$44,262	$44,263	$44,263
Return on capital (after tax)	6.5%	6.5%	6.5%
Interest on released capital	$2,877	$2,877	$2,877
Net gain/loss after tax and interest	$13,140	$17,243	$26,809

The effect on net farm profit is shown in Table 8-8. Saltbush can be expected to contribute substantially to annual net profit whether or not pasture decline is included as a benefit. If the pasture decline effect is included, it is expected to increase annual net profit by at least 50% over the current level in real terms.

Table 8-8 Net farm profit (after tax) - before and after change

	Year 1	Year 5	Year 15
Current farm profit after tax	$32,557	$32,557	$32,557
Net gain/loss after tax and interest	$13,140	$17,243	$26,809
Farm profit after change	$45,697	$49,801	$59,366

The analysis so far has not taken account of establishment costs. Assessing the profitability of saltbush plantations requires a discounted cash flow analysis to take account of the establishment cost and annual costs and benefits for 15 years. This analysis will also indicate the financial feasibility of establishing all plantations in one year - this may be a useful guide to the owners as they plan out the sequence of plantings over time.

Expected results are shown in Table 8-9 and Table 8-10. The saltbush budget for scenario two is included in Table 12-6 in the appendices.

With the benefits of improved animal performance and drought recovery, saltbush is expected to have an acceptable rate of return (scenario 1). With a pasture recovery benefit added (scenario 2), the rate of return increases and the net present value jumps substantially.

Table 8-9 Profitability (after tax) of saltbush plantings for each scenario

		Scenario 1	Scenario 2
		No pasture effect	Prevent decline
Net Present Value @			
	5% real	76,936	141,523
	10% real	24,791	65,684
	15% real		23,121
		(3,971)	
Internal Rate of Return		14%	20%

The establishment of all the saltbush at once carries significant risk (which is one of the reasons why a high rate of return would required). It is expected to be eight years before the saltbush plantations will pay for themselves if all the money is borrowed even on the best scenario ie. where saltbush is used to prevent pasture decline (Table 8-10). Peak debt is expected to reach $100,000.

Table 8-10 Financial implications of the saltbush plantings

	Scenario 1	Scenario 2
	No pasture effect	Prevent decline
Years to positive cash flow	13	8
Peak Debt	100,543	100,543
Year of Peak Debt	2	2
Cumulative cash flow		
after year 3	(97,063)	(94,703)
after year 7	(74,574)	(45,070)
after year 10	(45,596)	31,607
after year 15	31,445	247,356

What happens if these results are tested for sensitivity to change in key assumptions? Testing a range of assumptions is relevant because there has been little economic work done previously on saltbush plantations in this region, and guidance is needed on which technical data needs to be collected if evaluation is to be on a firmer basis.

The effect of changes in the following assumptions have been tested:

- expected stocking rate on saltbush
- saltbush seedling cost
- expected frequency of drought, and hence savings in drought feed cost
- expected year in which benefits from saltbush plantations first occur. Changing the year can be used as a proxy for different rates of growth of the plantation.
- expected rate of pasture decline

Results for both scenarios are shown in the following tables. The first column of data shows the expected value used in the analysis to date.

Table 8-11 Sensitivity to expected stocking rate on saltbush

	Scenario 1			Scenario 2		
	No pasture effect			Prevent decline		
Livestock units/ha	45	33.75	22.5	45	33.75	22.5
NPV @ 15%	-3,971	-22,298	-58,873	23,121	4,468	-32,244
IRR	14%	10%	8%	20%	16%	12%

If expected stocking rate is lower than expected, profitability is likely to be unacceptably low under scenario one. Unless there is more certainty about both stocking rate and about the role of saltbush in preventing pasture decline ie. that scenario two will occur, the owners are justified in being very cautious about saltbush plantations. If the stocking rate is only 50 per cent of the expected rate, then the relevant question is how much would other factors (eg. seedling cost) have to change to make it worthwhile.

Table 8-12 Sensitivity to saltbush seedling cost

	Scenario 1			Scenario 2		
	No pasture effect			Prevent decline		
Seedling Cost	0.18	0.135	0.09	0.18	0.135	0.09
NPV @ 15%	-3,971	60	4,104	23,121	27,230	31,343
IRR	14%	15%	16%	20%	21%	22%

A drop in the cost of saltbush seedlings by three and six cents per unit has a considerable effect on profitability, and suggests that efforts to establish direct seeding techniques which lower the costs even further are worthwhile.

Table 8-13 Sensitivity to expected frequency of drought, and hence savings in drought feed cost

	Scenario 1			Scenario 2		
	No pasture effect			Prevent decline		
Drought frequency	1:07	1:06	1:05	1:07	1:06	1:05
NPV @ 15%	-3,971	215	6,104	23,121	27,370	33,365
IRR	14%	15%	16%	20%	20%	22%

If major drought is expected more than one year in seven, the benefits of establishing saltbush increase considerably.

Table 8-14 Sensitivity to expected year in which benefits from saltbush plantations first occur

	Scenario 1			Scenario 2		
	No pasture effect			Prevent decline		
Year of first benefit	3	4	5	3	4	5
NPV @ 15%	-3,971	-11,514	-18,142	23,121	14,127	5,700
IRR	14%	13%	11%	20%	18%	16%

The present analysis assumes that the full benefits from saltbush are available from the third year after planting. The saltbush plantations might not provide adequate feed if a major drought occurred in the third, and even the fourth, year. If the full benefit is not achieved till the fourth or fifth year, this has a large effect on the results.

Table 8-15 Sensitivity to expected rate of pasture decline

	Scenario 1	Scenario 2	
	No pasture effect	Prevent decline	
Rate of pasture decline		1%	0.75%	0.05%
NPV @ 15%		23,121	16,483	9,758
IRR		20%	18%	17%

If the rate of pasture decline is only half the expected rate, the saltbush plantations are still profitable. However, this may not be the case if other critical assumptions such as expected stocking rate also change.

Other important variables which have not been tested include cost of labour.

Testing the sensitivity of results to changing different combinations of these variables would also help clarify which technical information should be sought. Guidance from property owners, advisors and others with an interest in saltbush plantations on which combinations to test would help.

The issue of whether saltbush can be profitable when established for only one purpose needs consideration. The expected results from discounted cash flow analyses are shown in Table 8-16. The pasture recovery benefit is based on preventing a decline in stocking rate, and does not allow for saltbush to increase stocking rate. Planting saltbush for one purpose is not likely to generate an acceptable rate of return based on these results.

Table 8-16 Profitability of saltbush plantations with only one benefit

	Drought benefit only	Animal performance only	Pasture recovery
Net Present Value @ 5% real	25,951	30,791	42,884
10% real	(10,883)	(4,418)	17
15% real	(29,964)	(22,906)	(22,226)
Internal Rate of Return	8%	9%	10%

9. Conservation management

The role of native grasslands in the farming system has already been discussed. This section evaluates the effect of managing the remnant bush, mainly along sandy ridges and prior streams, for conservation purposes. It is assumed this area is 2.5 per cent of the total farm area. This area is to be totally destocked initially (Table 9-1), and once regeneration occurs rested for an extended period each year (Table 9-2).

As shown in Table 9-2, the cost of managing 200 hectares, or 2.5 per cent of the farm area, differently is expected to be about $2,600 and $1,300 respectively.

Table 9-1 Destocking land

Area involved - ha	200
Estimated stocking reduction in dse/ha	1.08
Gross margin/dse	$15
Capital value per dse	$18
Sale value of stock	$3,984
Gains	
Interest earned on sale value of stock (after tax)	$220
Saved fertiliser costs (one in four years)	
Total savings	$220
Losses	
Gross margin	$3,254
Net gains/loss before tax	-$3,034
less Marginal tax savings @ 15%	-$455
Net profit/loss after tax savings	-$2,579

Table 9-2 Resting land for an extended period every year

Area involved - ha	200
Estimated stocking reduction in dse/ha	0.5
Gross margin/dse	$15
Capital value per dse	$18
Sale value of stock	$1,992
Gains	
Interest earned on sale value of stock (after tax)	$110
Losses	
Gross margin	$1,627
Net gain/loss before tax	-$1,517
less Marginal tax savings @ 15%	-$228
Net profit/loss after tax savings	-$1,290

10. General conclusions

The property has some very diverse pastures. Annual grasses and native forbs predominate. The survey in 1997 under-estimated the diversity because of the very dry spring that year. Cotton bush can be found scattered across the property, but is concentrated in only a few paddocks. Unpalatable dillon bush is thought to be slowly encroaching on more productive species.

The *Native Vegetation Conservation Act* 1998 requires that areas with bush of greater than five per cent be retained. As the Act does not distinguish between agriculturally productive and unproductive bush, on this property there may be a net loss of conservation values and of productivity in the long-term. This is because unpalatable dillon bush is thought to be slowly expanding, which means an indirect increase in stocking rate and consequent pressure on other vegetation. Here is a case where action which goes beyond the requirements of the Act may be needed to achieve desired vegetation management outcomes.

The owners who take a serious interest in natural resource management issues in the region, and are committed to maintaining the long-term productivity of their property, are not convinced such action is required. This divergence of views between farmer and scientist/advisor is not new or uncommon. In the study region, extension material has been prepared which explicitly attempts to draw out the differences on a range of issues so as to advance discussion for the regional vegetation management committee. Recognition of the value of farmer knowledge is very important for achieving public policy goals on private land (Millar and Curtis 1995). Where property owners are sceptical of research findings or extension advice, this may have a sound basis which can be linked to their own experience, observations, profitability requirements or risk preferences. There are also cases where extension advice has been later proven incorrect. The likelihood of this divergence of views needs to be taken into account in design of policy mechanisms.

Possible solutions fall into three categories - reducing investment in grazing, investing in other activities and expanding investment in grazing.

Even if the owners were convinced that there is a resource management problem, their income requirements preclude a reduction in stocking which might halt the postulated expansion of dillon bush. Reducing stocking by one-third has been shown in this report to cost the owners between $10-15,000 of their net income per year, after allowing for off-farm re-investment of funds now tied up in livestock. The hypothetical level of compensation they might expect in order to reduce stocking to this level has been estimated at $50,000 per annum or more. Whether policy can be directed at changing other aspects of the farm operation in order to avoid or reduce the need to make such a payment while still achieving public policy goals is now examined.

Irrigated cropping has been established in recent years, and has contributed significantly to the income of the property. Irrigation water is secured opportunistically

and there is only limited scope for making further investments of significance in the cropping enterprises.

Investment can be expanded in the grazing enterprise in one of two ways. Firstly, fencing and water structures to allow rotational grazing of the current flocks using holistic resource management (HRM) principles. Secondly, investment in saltbush plantations.

Rotational grazing has not been investigated here - none of the case farms are using these principles and a sound economic analysis would require financial data from properties which are implementing this approach. It should be noted that this approach requires a very large up-front investment, especially when paddock sizes are very large relative to stocking rate as is the case on the Hay Plains.

The investigation of the saltbush plantations has been based on assumptions which, for lack of information, may or may not apply precisely on this property. Nevertheless, some general conclusions can be drawn. Establishing saltbush plantations is likely to be profitable if the plantations can be used for multiple purposes eg. drought feeding as well as better animal performance in non-drought years. On this property, pasture recovery is an additional benefit. With or without this last benefit, saltbush is expected to be profitable on the given assumptions.

The expected stocking rate on the saltbush is one critical assumption - a stocking rate of 45 DSE/hectare for two months, or four sheep days per bush, combined with the above benefits is expected to give a 20 per cent return on investment. However, the return drops to 16 per cent if the stocking rate achieved is 75 per cent of the target and to 12 per cent if it is 50 per cent of the target. If pasture recovery benefit is not thought likely, the rate of return becomes unacceptably low if the expected stocking rate is not achieved.

The analysis of saltbush is based on the total area of saltbush required on the property if the multiple purposes are to be achieved. In reality, a property owner is likely to proceed cautiously with one or two plantations and if profitable to continue planting until the marginal gains from a further plantation were not sufficient to justify the cost or the risk.

Other important assumptions which influence the outcome of the analysis have been tested. Whether the results will be more, or less, favourable for saltbush cannot be easily determined. A further analysis which draws on the expected values of several property owners and saltbush ‘experts’ might be a useful next step. Further research priorities based on the factors influencing most critical assumptions could then be undertaken. One aspect of this research is likely to include effective monitoring the performance of existing saltbush plantations.

A 20 year vision for the property might be for a viable property with improved conservation values and productivity maintained. This could involve: carrying the same number of sheep; many plantations of saltbush contributing to the feed supply; cotton bush returning across large areas; the same diversity of grasses, small chenopods and other plants; a halt to the expansion of dillon bush and signs of its break-down as

competition for water and nutrients by other plants increases; Plains Wanderer being frequently sited; the property has secure entitlement to the modest amount of irrigation water now periodically available from the Colleambally outfall (this will depend on factors outside the owner's control); and investment of surpluses off-farm once saltbush plantations are established.

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12. Appendices

12.1 The pastures

12.1.1 Assessment method

The aim was to gain an appreciation of the different pasture types on the property, their distribution across the farm and how they might be contributing to production in different seasons. Allan Wilson, consultant in rangeland research and management, was involved in this assessment and in following discussions with the owners about management options. Bill Mulham, botanist, did the species identification. The content of this report has drawn heavily on information they provided during the visit to the property.

The owners provided background information about paddock types using a farm plan, aerial photos and a 1958 soil type/pasture map. They then drove us around the property. At selected sites, species were recorded against a species list for the Hay plains (based on Community 4 identified by Benson *et. al.* 1996). Visual estimates of the abundance of bushes, naturalised annual grasses and forbs, and native grasses and forbs were made at several sites, with these abundance estimates validated by quadrat throws at two sites.

12.1.2 Species composition

Table 12-1 List of species identified by site - 22 September 1997

			Site							
Exotic	**Species**	**Common Name**	1	2	8	9	11	12	13	Also
			Kent	Kent	Horse	Horse	Pool	Bush	Horse	Long
			grey	red	red	red	grey			
1	Arctotheca calendula	Cape Weed			o					
1	Avena fatua	Wild Oats			o	o				
1	Bromus madritensis			o	o	c			o	
1	Bromus molliformis									
1	Capsella bersa-pastoris							o		
1	Cirsium vulgare	Spear Thistle	o	o					o	
1	Cotula bipinnata	Ferny Cotula			o					
1	Echium plantagineum						o			
1	Erodium cicutarium	Common Heron's-bill	c	o	o	o	o		o	
1	Hedypnois rhagadioloides subsp. Cretica	Cretan Hedypois					o		o	
1	Hordeum leporinum		l	l	c	o	o	c	A	
1	Hypochaeris glabra	Smooth Cat's Ear	o	A	o	c				
1	Isoetopsis graminifolia		A	o					o	
1	Lolium rigidum	Wimmera Rye-grass	A	c	c	o	o	o	A	
1	Medicago polymorpha		c	c	c	c	c		o	
1	Medicago truncatula				c	c				
1	Podospermum resedifolium		o	o						
1	Schismus babatus							o		
1	Sisymbrium erisimoides		l	o				c		
1	Sisymbrium orientale							o		
1	Sonchus asper subsp. Glaucescens	Rough Sow-thistle			o	o				
1	Sonchus oleraceus	Sow-thistle	o	o					o	
1	Spergularia rubra	Red Sand-spurrey	o	o			o			
1	Vulpia bromoides	Squirrel-tail Fescue								#
1	Vulpia myuros	Rat's Tail Fescue	c	o	A	A	o			
	Atriplex leptocarpa	Slender-fruit Saltbush					c			
	Atriplex semibaccata	Berry Saltbush					o	o		
	Brachycome lineariloba	Hard-head daisy		o						
	Brachycome species B		o	o						
	Bulbine semibarbata	Leek Lily		o						
	Calandrinia eremea							nr		
	Calocephalus sonderi	Pale Beauty-heads	o		A	c			o	
	Calotis scabiosifolia var. scabiosifolia									#
	Chamaesyce drummondii	Flat Spurge						o		
	Chenopodium nitrariaceum	Nitre Goosefoot					A	c		
	Chloris truncata	Windmill Grass								
	Chrysocephalum apiculatum s.l.	Common everlasting		o						
	Crassula colorata var. acuminata	Dense Crassula	o						o	
	Danthonia caespitosa		o	c	o	c			o	
	Daucus glochidiatus form G		o	o					o	
	Einadia nutans	Nodding Saltbush	l	o	c	c				
	Enchylaena tomentosa	Ruby Saltbush					o	c		
	Eragrostis australasica	Cane Grass	o							
	Goodenia fascicularis	Silky Goodenia		c	o					

			Site							
Exotic	**Species**	**Common Name**	1	2	8	9	11	12	13	Also

			Kent	Kent	Horse	Horse	Pool	Bush	Horse	Long
			grey	red	red	red	grey			
	Goodenia pusilliflora	Small-leaf Goodenia	A	A		c			o	
	Homopholis proluta	Rigid Panic								#
	Juncus sp.	A Rush			o					
	Maireana aphyllaVic		o	A	A	A			r	
	Maireana pentagona	Slender Bluebush	o	o	o	c	o		o	
	Muehlenbeckia florulenta	Tangled Lignum								#
	Nitraria billardierei	Nitre-bush	c	o	o	o			o	
	Oxalis perennans	Grassland Wood-sorrel	c			o	o	o	o	
	Plantago spp	Plantain	A	c		o	o		o	
	Podolepis muelleri			o		c				
	Pycnosorus chrysanthes	Common Billy-buttons			o	o				
	Rhagodia spinescens						o	A		
	Rhodanthe corymbiflora	Paper sunray	o	o	c	o	o	o	o	
	Sclerolaena muricata						o	o	o	
	Sclerolaena muricata var. semiglabra	Five-spinned Bassia	o							
	Sclerolaena stelligera						o			
	Sclerolaena tricuspis									#
	Sida corrugata	Variable Sida	o	o	o	o	o		o	
	Solanum esuriale	Quena							nr	
	Sporobolus caroliVic	Fairy grass								#
	Stipa sp.	Spear Grass Corkscew		c				o		
	Swainsona procumbens	Broughton Pea		o						
	Tetragonia tetragonioides							o		
	Teucrium racemosum	Grey Germander		o						
	Wurmbea dioica subsp. Dioica	Common Early Nancy								#
	Zygophyllum glaucum									#
	Zygophylum ammophilum							o		
		Total species	28	32	23	23	20	18	23	8
		Exotics	12	13	12	10	8	6	9	1
		Native	16	19	11	13	12	12	14	7

a - abundant; c - common; o - occasional; l - localised; r - rare; nr - not recorded

12.2 Gross margins - livestock and crop enterprises

Table 12-2 Gross margins - livestock enterprises

	Cattle	Self Replacing Merinos
INCOME :		
Wool (gross)		$13.88
Livestock trading profit/loss	$10.84	$9.33
Total Income	$10.84	$23.22
COSTS :		
Shearing & crutching		$3.71
Mulesing		$0.17
Animal health	$0.58	$1.18
Supplementary feed	$0.00	$0.00
Freight	$0.48	$0.80
Wool tax		$1.18
Wool selling expenses		$0.56
Stock selling expenses	$0.67	$0.52
Total Costs	$1.06	$8.11
GM PER DSE	$9.78	$15.10
CAPITAL VALUE	$18.49	$17.35

Table 12-3 Gross margin - rice

	unit		$/unit		per ha	total
Area planted	60	ha				
					$	$
Income	9	tonnes/ha	200	$/tonne	1,800	108,000
Crop variable costs			700	$/ha	700	42,000
Water	16	ml/ha	7	$/ml	112	6,720
					812	48,720
Gross margin					988	59,280

12.3 Livestock trading schedule - sheep

	$/hd	No.	Value $		$/hd	No.	Value $
Opening stock				**Sales**			
Breeding ewes	28	3,500	96,250	cfa ewes	30	770	23,100
1 yo maiden ewes	18	901	16,223	1 yo ewes	18	0	0
				Ewe weaners	25	626	15,643
				Wether weaners	25	1,528	38,194
Rams	156	105	16,380	Rams	12	23	277
Births		3,150		**Deaths**		230	
Purchases				**Closing stock**			
				Ewes	28	3,500	96,250
Rams	300	26	7,875	1 yo maiden ewes	18	901	16,223
Rams	300	26	7,875	Rams	156	105	16,380
Profit/Loss			69,339				
		7,683	206,066			7,683	206,066

12.4 Livestock gross margin - in case of pasture decline

Table 12-4 Livestock gross margin over 15 years in event of 1% p.a. pasture decline

year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Stocking rate - with decline	1.08	1.07	1.06	1.05	1.03	1.02	1.01	1.00	0.99	0.98	0.97	0.96	0.95	0.95	0.94
Total stock carried (dse)	8619	8532	8447	8363	8279	8196	8114	8033	7953	7873	7795	7717	7639	7563	7487
Excess stock sold		86.19	85.32	84.47	83.63	82.79	81.96	81.14	80.33	79.53	78.73	77.95	77.17	76.39	75.63
Gross margin	130175	128873	127585	126309	125046	123795	122557	121332	120118	118917	117728	116551	115385	114231	113089
Sale of excess stock	0	1495	1480	1465	1451	1436	1422	1407	1393	1379	1366	1352	1338	1325	1312
Total	130175	130368	129065	127774	126496	125231	123979	122739	121512	120297	119094	117903	116724	115557	114401

The minimum stocking rate at the end of 15 years is set at 0.9 DSE/ha.

12.5 Net profit/loss from lighter stocking

Table 12-5 Partial discounted cash flow budget - net gain from lighter stocking over 15 years - with/without pasture decline

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Gains															
Total gains (from Partial budget)	21557	21557	21557	21557	21557	21557	21557	21557	21557	21557	21557	21557	21557	21557	21
Losses															
Gross margin before stock reduction															
….. if pasture declines	112202	111080	109969	108869	107781	106703	105636	104579	103534	102498	101473	100459	99454	98459	97
Gross margin after stock reduction	74054	74054	74054	74054	74054	74054	74054	74054	74054	74054	74054	74054	74054	74054	74
Total losses ie. foregone gm	38148	37026	35915	34815	33727	32649	31582	30525	29480	28444	27419	26405	25400	24405	23
Total gain/loss	-16,591	-15,469	-14,358	-13,258	-12,169	-11,092	-10,025	-8,968	-7,922	-6,887	-5,862	-4,847	-3,843	-2,848	-1,
Marginal tax rate	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	2
Extra taxable income															
Tax on extra gain/loss	-3,318	-3,094	-2,872	-2,652	-2,434	-2,218	-2,005	-1,794	-1,584	-1,377	-1,172	-969	-769	-570	-
Total gain/loss after tax	-13,273	-12,375	-11,486	-10,606	-9,736	-8,873	-8,020	-7,175	-6,338	-5,510	-4,690	-3,878	-3,074	-2,279	-1,
Released capital	44,262	44,263	44,264	44,265	44,266	44,267	44,268	44,269	44,270	44,271	44,272	44,273	44,274	44,275	44,
Return on released capital	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.
Interest on released capital	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,878	2,878	2,878	2,878	2,878	2,878	2,
Net gain/loss after tax and interest	-10,395	-9,498	-8,609	-7,729	-6,858	-5,996	-5,142	-4,297	-3,460	-2,632	-1,812	-1,000	-196	599	1,
Income in case of reduced sheep numbers - when pasture condition would not have declined															
Net gain/loss after tax and interest	-10,395	-10,395	-10,395	-10,395	-10,395	-10,395	-10,395	-10,395	-10,395	-10,395	-10,395	-10,395	-10,395	-10,395	-10,

12.6 Saltbush budget

The budget is for saltbush plantings for scenario 2 - when saltbush will prevent pasture decline, but not lead to a higher stocking rate.

Table 12-6 Partial discounted cash flow budget for saltbush plantings

12.7 Validation of the abundance estimates

Abundance was estimated by A.Wilson and B.Mulham by visual inspection and assessed by the dry weight rank technique (Jones & Hargraves 1979). In order to verify the accuracy of their estimates, quadrats were thrown at two sites. The visual estimates accurately determined the relative importance of the major categories. Annual grasses were correctly estimated to comprise the bulk of the vegetation.

Although cottonbush comprises under 10% of the vegetation at both sites, the estimate was significantly lower than the quadrat result. The visual inspection estimated that naturalised species comprised 60% and 90% of the vegetation for site 2 and 14 respectively, but the quadrat survey demonstrated that in each case the estimate was at least 10% too high.

Table 12-7 Comparison of abundance measures - visual estimates and quadrat throws at two sites

	Site 2 % composition				Site 14 % composition			
	Estimate	Actual *	Error	Error propn	Estimated	Actual *	Error	Error propn
Naturalised annuals								
grasses	50	38	12	.32	80	71	9	.13
forbs (medics)	10	11	1	.09	10	8	2	.25
Native annuals								
forbs	30	35	2	.40	5	5	0	0
Native perennials								
grasses - danthonia	3	5	3	.38				
shrub - cottonbush	3	8	5	.14	2	6	4	.66
palatable chenopod	2	2	0	0	3	2	1	.50

*based on 50 quadrats