Economics of controlling African Lovegrass (*Eragrostis curvula*) in native pasture in the Far South Coast of NSW

Part One – Overview

by

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This report was commissioned by the South East Local Land Services. It is part of a wider project examining the management of native pastures and unpalatable grass weed invasion, primarily by African lovegrass,

About the authors:

Jim Crosthwaite is an agricultural economist by training who completed his PhD in 2001 on Farm Businesses and Natural Resource Management. From 1988 until 2012 he worked for the Victorian Government. He managed major research projects relating to farm businesses and biodiversity, and drivers of land use change, and managed the Conservation Management Network program for some years. His publications, many co-authored, include *Economic benefits of native grasslands on farms, Future investment in landscape change in southern Australia, Incentives for sustainable wool production*, and *Retaining native vegetation on farms: understanding its private value*.

Josh Dorrough is an ecologist by training. His research has focused on understanding the interactions between native ecosystems and agricultural production. He completed his PhD on the effects of management and exotic plant invasion on Monaro native grasslands in 2001. He worked as research scientist for the Victorian State Government until 2008 and has been a visiting scientist at the CSIRO since 2007. He has over 20 international research publications on the management and restoration of native ecosystems within agricultural landscapes.

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Responsibility for the approach and findings remain with Jim Crosthwaite.

Executive summary

In this report we explore the economic consequences of managing African Lovegrass (ALG) in dryland native pastures. These pastures dominate large areas of the Bega Valley, and are prone to invasion by ALG.

The focus of the analysis in this report is a 100 ha block of native pasture. We analyse two main options.

- **Roller Wiping**, both before and after the ALG is dense and rank.
- **Slashing** and grazing management, as part of a utilisation strategy, after a heavy invasion of the ALG.

Other choices, such as stocking less heavily to reduce the capacity of ALG to establish are considered briefly.

We assess the relative profitability of each of these options compared to doing nothing (**Do nothing**), that is undertaking no control and allowing ALG to take over. As ALG increases in dominance, without some intervention, reductions in potential carrying capacity are dramatic. At the whole-farm level, a reduction in farm income of 25% would not be unreasonable for a property with a moderate infestation and no intervention to minimise impact. Such a reduction in income could halve profit and cash flow as all overhead costs must be paid irrespective of income.

Where appropriate, we interpret the results in the context of the whole farm.

There are two types of economic analysis that we employ.

Firstly, we look some years after the control measures have started and a 'steady state' situation has been reached. This is useful for telling us which strategies give a positive cash flow and appear to be profitable, thus worth exploring in more depth. Steady state analyses do not take into account higher costs incurred in the initial years or the costs of capital outlays and only apply when costs and income have stabilised.

Secondly, a discounted cash flow analysis is used in order to compare the profitability of options in which the cash flow changes from year to year. We look at a 10 year period over which time the stocking rate may decline (if the ALG density increases) or increase (if the control measure works). The costs of control may be higher in the first years if the infestation of ALG is very heavy.

The steady state analysis for options on both fertilised and unfertilised native pasture shows that, on our given assumptions, expected net cash flow for roller wiping is greater than doing nothing to control African Lovegrass. For slashing it is expected to be less than doing nothing unless we make some major changes to the assumptions about stocking rate, livestock price and cost of control.

Slashing unfertilised native pasture is expected to be the most uneconomic, and is not examined further.

For roller wiping, using a 10 year discounted cash flow analysis, we find that

- Early control with roller wiping is expected to be more profitable than doing nothing or starting control after the African Lovegrass has become tall and rank.
- Control by roller wiping on fertilised native pasture with a heavy infestation is expected to be profitable across a wider range of assumptions about stocking rate, livestock price and cost of control.

- Roller wiping on unfertilised native pasture once a heavy infestation has taken hold is expected to be unprofitable.

For Slashing fertilised native pasture, the results for the discounted cash flow analysis show that

- Slashing can only be profitable in limited circumstances depending on the frequency of control, potential stocking rate achieved, livestock price and cost of control.

There are many questions about the effectiveness of Slashing and Roller Wiping. In addition, there is uncertainty around our estimates of the effects of these on stocking rate. We don't know the true values BUT we think they lie somewhere near the estimates provided. If Slashing and/or Roller Wiping are less effective then the gain in stocking rate is going to be less or slower. Results with a lower stocking rate may be more appropriate for some farmers, while those with a faster / higher stocking rate may be right for other farmers.

Similarly, some farmers may get a lower or higher sale price for their livestock, in which case they should look carefully at how a change in gross margin affects the results. Cost of Slashing and Roller Wiping is the other key factor requiring careful attention.

The discounted cash flow analyses and associated sensitivity testing provide some guidance on how varying the assumptions modify the results. For Roller Wiping, changes in the maximum potential stocking rate achieved and livestock gross margin have the greatest impact on potential returns relative to Do Nothing. For Slashing, reducing the frequency has a very large impact, but even then in many circumstances Slashing is less profitable than Do Nothing.

Ultimately, each farmer will make their own decisions about how to manage their native pasture in the context of the whole farm and the goals for the farm. The economic advantages of controlling ALG will be one factor in their decisions.

Contents

Introduction

African Lovegrass (*Eragrostis curvula*, from here on ALG) is widespread in Far South Coast New South Wales, posing major management problems for farmers and significant threats to other environmental values, in particular having a direct threat to lowland grassy woodlands. For many farmers ALG poses a threat not just to particular paddocks but to the whole farm business.

In this report we explore the economic consequences of managing ALG in dryland native pastures. These pastures dominate large areas of the Bega Valley, and are prone to invasion by ALG.

This report has two parts – an Overview (this document) and a Technical Report. The report fits within a larger project investigating management of native pastures and Grassy Woodlands to prevent unpalatable grass weed invasion in the Bega Valley.

Method

In this exploration, there are many uncertainties relating to pasture productivity and having some information on their likely values is crucial for estimating the economic outcomes. For example:

- How much production do different farmers get from their native pasture?
- How does this vary with fertiliser history?
- How long does it take for ALG to invade a pasture? How does ALG affect stocking rate?
- How does stocking rate change over time with a control measure such as Roller Wiping or Slashing?

To assess the economic implications of managing ALG it was necessary for us to make assumptions about all of these factors. In some cases we were able to base our estimates on actual data or observations. However, at other times we needed to estimate possible values in the absence of supporting data, but we varied these estimates to see what difference this made to the outcomes.

We also make assumptions about the costs of producing livestock, their sale value, and the costs of controlling ALG. Many of these are reasonably well supported by local information, but actual values will vary from year-to-year and among farmers. Finally, we assume that investing in the most profitable alternative is what all farmers will do, though we are aware that farmers make decisions based on many factors and profitability is but one consideration. Most farmers are not purely motivated by profit, as there are other important reasons why they farm. As economists we put dollar values on the most crucial aspects of each choice that might be made about controlling ALG. We cannot easily account for other goals in a budget except to the extent we can give a value to factors of production, such as family labour and capital expenditure. We price family labour because, in nearly all cases, it could be used productively to earn extra money elsewhere on or off the farm. We put a value on capital equipment because it has to be replaced at some time.

Six farmers were interviewed to obtain information on costs of production and costs of control, effects of ALG on stocking rates and responses to control measures. Farmers for interviewing were selected carefully following agreed criteria. Information was obtained on the farm business, livestock carrying capacity, and role of ALG in farm management.

Contractors who do Slashing and weed control were also interviewed to obtain information on their hourly rates for different control strategies and other information such as implements used, ground speeds or area covered per hour. These provide an approximate guide to likely farmer costs.

Carrying capacity of fertilised and unfertilised native pastures with different levels of infestation by ALG was estimated based on information provided by farmers and advisors.

Estimates were made of how farm income might be affected by ALG, as well the management and control measures. The benefits of controlling ALG or maintaining a control strategy to avoid losses were identified.

Detailed budgets were prepared for Slashing and Roller Wiping on 100 hectares. A 'steady state' analysis was first conducted, followed by an economic analysis that was run over 10 years.

Finally, sensitivity testing was conducted to show the effect of changing the key factors that influence the economic results.

Do Nothing and impact on whole farm profits

We show using a hypothetical example of a cattle/sheep farm that loss of farm carrying capacity of 25 per cent due to ALG could lead to net profit and return on capital falling by about 50 per cent. Farms are likely to vary in the extent to which ALG affects the whole farm. An intensively run dairy farm will differ to a small beef/sheep property. See the Technical Report for more details.

Options.

The most effective solution may be to get in early to control ALG (vigilant spot spraying or chipping) – but also to manage pastures so that ground cover is maintained. This may require running less stock than typical for the area, especially as pasture growth declines during dry conditions or drought. However, we understand that most farmers have not done this, although many will have paddocks that are free of ALG. In this report, we address post-invasion strategies.

At the early stages of invasion, Roller Wiping is likely to be used, usually once ALG reaches a density that makes spot spraying or chipping less effective. Roller Wiping or Slashing are options when ALG has become thick and rank.

Once ALG is well established, on-going control is necessary. The focus in this report is on examining Roller Wiping and utilisation based on a 100 hectare block.

Roller Wiping is used to reduce the density of ALG in the pasture and provide a competitive advantage to more palatable species. Initially Roller Wiping is required annually (for at least 2 years) and then follow up Roller Wiping is necessary every 2 to 3 years, once ALG densities have been reduced.

Utilisation focuses on the use of Slashing, high density rotational grazing and fertiliser to increase the palatability of ALG and by also increasing light availability, encourage the establishment of other more palatable plant species. Utilisation does not aim to reduce ALG density to any great extent. Utilisation typically relies on Slashing every 12 or 18 months, though tis will depend on livestock management and seasonal conditions.

Cost of control.

On an annual basis, Roller Wiping costs approximately $42 per hectare and Slashing costs an estimated $91 per hectare based on information supplied by local contractors and farmers, although there is variation around estimates between contractors, and between farmers. This cost includes an allowance for labour and an annuity to cover the costs of the equipment, including the towing vehicle. In the case of Roller Wiping, excluding labour and the equipment allowance, means costs drop to an estimated $15 - $21 per hectare (on two of the farms) , and capital costs comprise an estimated 21% – 29% of total cost.

The cost of bringing dense rank ALG back to a more manageable state is an estimated $72 per hectare for Roller Wiping and an estimated $191 per hectare for Slashing. These costs are incurred for the initial one or two years, but would depend on many factors and in some circumstances these higher costs could be incurred for a greater length of time. Strategic use of fire in rank ALG could allow farmers to avoid the initial high costs of slashing.

More detail is provided in the accompanying Technical Report.

Effect on carrying capacity and gross margin.

The effects of ALG on farm income depend primarily on the carrying capacity of the native pasture, and whether it has a past history of fertiliser application or not. Based on information from several local advisors and farmers, previously fertilised native pasture with a colwell phosphorus of 15-25ppm is expected to carry on average 6 DSE per hectare prior to ALG invasion and is expected to halve once an ALG infestation becomes dense (>66% cover). On long unfertilised native pasture, with a colwell phosphorus level <15ppm, the respective carrying capacity is expected to be 3.0 DSE per hectare in the absence of ALG and 1.5 DSE per hectare once ALG become dense. Some variation occurs around these figures. Feedback from local farmers suggests also that once ALG becomes very dense (ie approaching 90% of pasture cover) and rank potential carrying capacities could be much less and pastures may carry 1 dse or less regardless of past fertiliser history.

We estimate that scattered to light infestations of ALG, comprising no more than 33% cover, do not affect carrying capacity.

Dense infestations of ALG, with over 66% cover of ALG, have significant effects on productivity.

On a 100 hectare block of previously fertilised native pasture, the carrying capacity before ALG has an effect on productivity is estimated at a total of 600 DSE. This can be made up of 100 dry cattle at 450kg (6.0 DSE each) or 65 growing cattle at 540kg (9.2 DSE each). If turnoff each year is estimated at 45 animals at $500 each, this would give gross sales of $22,500. At $25 gross margin per DSE (Gross margin is livestock income less livestock costs), net gross margin is $15,000 for the 100 hectare paddock. These figures are expected to at least halve once there is a dense infestation of ALG.

For unfertilised native pasture, the figures are expected to halve again, once there is a dense infestation of ALG.

When ALG is light (<33% pasture cover) – evaluating management choices

Here we look at Roller Wiping. Other alternatives are spot spraying, or boom spraying with pasture re-sowing. Boom spraying is not addressed in this report.

Stocking rate changes

Estimated stocking rate changes over time are shown in Table 1. In a light infestation stocking rates will gradually decline as ALG densities increase, if no control is undertaken. Roller Wiping will maintain the current stocking rates.

Roller Wiping – steady state analysis at some future time

Here we compare annual Roller Wiping to Do Nothing at some point in the future. Stock numbers have been restored by Roller Wiping and remain low for Do Nothing. It costs an estimated $40 per hectare to hire a contractor. Roller Wiping allows stocking rates to be increased.

Options for farmers include purchasing the equipment or using contractors.

On fertilised native pasture, hiring a contractor to roller wipe every three years avoids losses of an estimated $6,180 or $62 per hectare (see Table 2). On unfertilised native pasture, the control option is expected to avoid losses compared to Do Nothing by an estimated $2,430 or $24 per hectare. We used a simple partial budget to obtain these results.

Small changes in some of our base assumptions can make a substantial difference to the expected benefits or losses in each pasture type. Change in gross margin is most significant. If gross margin per hectare falls by $5 per hectare to $20 per hectare, then the gain in net cash flow between Control and No control falls from $87 per hectare to $32 per hectare on fertilised native pasture. On unfertilised native pasture, the fall is from $37 per hectare to $9 per hectare.

Table 1. Changes in stocking rates over 10 years in lightly infested pastures with and without Roller Wiping for dryland native pastures with two different fertility levels.

	Year					
Scenario	**1**	**2**	**3**	**4**	**5**	**6 +**
Light Infestation - fertilised native pasture						
Do Nothing	6	6	5.75	5.5	5	4.5 - 3
Roller Wiping	6	6	6	6	6	6
Light Infestation - unfertilised native pasture						
Do Nothing	3	2.7	2.5	2.2	1.8	1.5
Roller Wiping	3	3	3	3	3	3

Table 2 Steady State - Estimated net benefits of Roller Wiping 100 ha of fertilised and unfertilised native pasture by pasture type at a gross margin of $25/ha and with control costs of $40/hectare

	Fertilised native pasture			**Unfertilised native pasture**		
	No control	**Control**	**Difference**	**No control**	**Control**	**Difference**
	$	**$**	**$**	**$**	**$**	**$**
Net Income from stock	7,500	15,000		3,750	7,500	
Cost of ALG control	0	-1,320		0	-1,320	
Net Cash Flow before tax	7,500	13,680	**6,180**	3,750	6,180	**2,430**

Roller Wiping – light infestations - discounted cash flow analysis

We have shown above that Roller Wiping is expected to be profitable on fertilised native pasture, but not for unfertilised native pasture.

What if we incorporate a gradual decline in stocking rate due to increasing ALG densities in the absence of control?

We use a spreadsheet that runs over 10 years, and convert income and expenses each year back to the base year using a discount, or interest, rate. Results can be expressed in terms of an annuity, Net Present Value or Internal Rate of Return (see the footnote for definitions).[1]

[1] Discount rate – The discount rate is equivalent to the interest rate on a loan or the return the capital invested could earn in another use. It is the rate at which future streams of income or expenditure are discounted to present day values. Discounting is used because we value having money in hand more than in the future. People generally would rather $20,000 now rather than $2,000 in each of the next 10 years.
NPV – Net present value is the present value of all future receipts (income) less costs, after future benefits and costs have been discounted at the opportunity cost rate of interest. The NPV helps to compare the magnitude of future flows of income and expenditure that are of different size and timings. The NPV is estimated over a fixed time, usually 10 to 15 years into the future. It allows the relative value of alternative investments involving the same capital outlay to be compared.

In the Do Nothing case, stocking rates will gradually decline and, to retain total stock numbers livestock would need to be agisted. Do Nothing has some important assumptions including that the farmer will want to keep livestock numbers at the same level – this means either agisting or feeding stock. We use agistment, which means that the total livestock income remains the same, but the cost of agistment is included. Alternatively if the farmer were to reduce livestock numbers, the income received from those sales would be included in the 10 year analysis.

Table 3 Fertilised native pasture – expected results for Roller Wiping and Do Nothing

	Gross Margin = $25/DSE		
	Do Nothing	Roller Wipe	Difference
Annuity @ 5%	$11,883	$13,680	$1,797
NPV @5%	$91,755	$105,633	$13,878
NPV @10%	$75,236	$84,058	$8,822

Key assumptions

- Gross margin is $25 per hectare.
- For light infestations, 33 ha of Roller Wiping is carried out every year, so the whole 100 hectares is done every three years.
- Cost of engaging a contractor for Roller Wiping is $40 per hectare for light infestations.

As in the steady state analysis, Roller Wiping is more profitable than Do Nothing (see Table 3). The annuities suggest that at a gross margin of $25 per hectare, the farmer will be better off each year by an average $17.95 per hectare (or $1,797 for the 100 hectare example) (Table 3).

Table 4. Unfertilised native pasture – expected results for Roller Wiping and Do Nothing

	Gross Margin = $25/DSE		
	Do Nothing	Roller Wipe	Difference
Annuity @ 5%	$6,513	$6,180	-$333
NPV @5%	$50,288	$47,720	-$2,568
NPV @10%	$40,754	$37,973	-$2,781

On unfertilised native pasture, Roller Wiping is likely to be less profitable than Do Nothing (see Table 4) based on our assumptions. However, it is more profitable if a higher gross margin/DSE is combined with a higher stocking rate change than we allow – this is shown further below.

The effect of ALG density on stocking rates is a major influence on profitability relative to Do Nothing. But;

- what if rates of ALG invasion are faster or slower than we have estimated in the base case assumption?
- what if the actual carrying capacity potentially falls below what we estimated?

We know relatively little about how quickly stocking rate is likely to change, and the extent to which it changes. So it is important to test the results for stocking rate curves that are higher or lower. This is explored in detail in the Technical Report. In general we found that the faster the likely rates of invasion, the more profitable Roller Wiping will be compared to Do Nothing. Conversely, it can be

Annuity – a fixed sum of money paid or received every year. In this report, we calculate the annuity of the lump sum NPV by taking the Net Present Value and working out how much it would be equivalent to if spread evenly over 10 years (at a given interest rate).

unprofitable to roller wipe if actual rates of invasion, especially when in early stages, are expected to be much lower than we have estimated. Importantly however, Roller Wiping will assist in preventing a later infestation.

These results are based on assumptions that may not be appropriate on all farms. Circumstances in which results on particular farms may be different include:

- Different livestock sale prices and cost of managing stock (increasing or decreasing gross margin)
- Pasture productivity and numbers of stock run
- Failure of Roller Wiping in one year, requiring it to be repeated
- Control costs if equipment is purchased instead of hiring a contractor

When ALG is dense (>66% cover) – evaluating management choices

Here we investigate paddocks where ALG is over 66% of ground cover, and is having a significant effect on productivity. Both Roller Wiping and Slashing are realistic options for bringing heavy infestations under control, and then to provide on-going management.

Table 5 shows expected stocking rates over time.

Table 5. Changes in stocking rates over 10 years in heavily infested pastures with and without Roller Wiping for dryland native pastures with two different fertility levels.

	Year					
Scenario	1	2	3	4	5	6 +
Heavy Infestation - fertilised native pasture						
Do Nothing	3	3	3	3	3	3
Roller Wiping	3	3	4	5	6	6
Slashing	3	4	5	6	6	6
Heavy Infestation - unfertilised native pasture						
Do Nothing	1.5	1.5	1.5	1.5	1.5	1.5
Roller Wiping	1.5	1.5	2	2.75	3	3

Now we use a development budget running over 10 years to analyse Roller Wiping when income and costs change over time. Results are in the form of Net Present Value (a lump sum value for future net benefits and costs) and annuities, which show what that amount would be if evened out equally over the 10 years.

This is followed by an analysis of Slashing, both in the steady state and when control costs and stocking rate change over time.

Roller Wiping – once the infestation is dense

Annuity results are shown in Table 6. The results support those shown earlier and indicate that acting ***before*** a heavy infestation is expected to be profitable on both pasture types.

Once a heavy infestation has occurred on fertilised native pasture, controlling ALG is expected to result in a small positive difference compared to Do Nothing.

For unfertilised native pasture there is a small expected loss compared to Do Nothing.

Table 6. Expected economic benefit of Roller Wiping ALG on 100 hectares over a 10 year period. Gross margin = $25

	Fertilised native pasture			Unfertilised native pasture		
	Do Nothing	After heavy infestation	Before heavy infestation	Do Nothing	After heavy infestation	Before heavy infestation
	$	$	$	$	$	$
Using a contractor						
Annuity @ 5%	7,500	9,115	13,680	3,750	3,272	6,180
Difference		1,615	6,180		-478	2,430
Difference/ha		16.15	61.80		-4.78	24.30
Using a purchased roller wiper						
Annuity @ 5%	7,500	8,336	12,804	3,750	2,492	5,304
Difference						
Difference/ha						

Note: the roller wiper has an assumed replacement value of $10,000.

Slashing – steady state analysis at some future time

Slashing is usually started once ALG is significantly affecting carrying capacity ie when it has reached a ground cover of 66 % or more. We examine this situation.

We first examine the steady state situation. At some point in the future, stock numbers will have been restored by Slashing but remain low for Do Nothing.

It costs an estimated $92 per hectare to hire a Slashing contractor. All necessary capital expenditure on fencing and water points to obtain sufficient livestock densities is assumed to have occurred.

Table 7 Steady State - Estimated net benefits of Slashing 100 ha of fertilised and unfertilised native pasture at a gross margin of $25/ha and with control costs of $92/hectare

	Fertilised native pasture			**Unfertilised native pasture**		
	No control	**Control**	**Difference**	**No control**	**Control**	**Difference**
	$	**$**	**$**	**$**	**$**	**$**
Net Income from stock	7,500	15,000		3,750	7,500	
Cost of ALG control	0	9,200		0	9,200	
Net Cash Flow before tax	7,500	5,800	-1,700	3,750	-1,700	-5,450
Per hectare			-17.00			-54.50

Slashing is expected to be unprofitable compared to Do Nothing, and by a big margin for unfertilised native pasture (Table 7). Slashing unfertilised native pasture is therefore not examined any further.

Under some circumstances, Slashing can be expected to be profitable on fertilised pasture as shown in Table 8.

Table 8. Expected difference in net cash flow between Control and No Control when key variables change for fertilised native pasture

Variable		$ difference
Base case	As above (table 7)	-1,700
DSE / ha	Increase by 1	2,500
Gross margin	$30	-200
Control cost/ha	$60	1,500

A higher stocking rate relative to Do Nothing or a higher gross margin each are both expected to make Slashing more profitable (Table 8). A reduction in control costs of approximately 30% can be justified if slashing is done every 18 months, compared to every 12 months.[2]

It is important to note that variables may also change in a negative direction – compared to the positive direction shown in these tables. For example potential stocking rates may be less than we assume here or gross margins may not reach $25 or $30 /dse. If this happened, there would be a greater loss from implementing a Slashing strategy than shown here.

Slashing – accounting for changes in stocking rate and Slashing costs

Here we investigate if Slashing fertilised native pasture is still worthwhile if the analysis begins with a low stocking rate and higher costs of Slashing in the first year. Discounted cash flow analysis is required in order to account for the changes over time.

In this analysis we have assumed a contractor does the work to maintain consistency. Capital costs for fencing and water points to control grazing and prevent the ALG from becoming rank of $20,000 have been included, spread out over years two and three. Fertiliser is applied every three years at $30 per hectare to increase the palatability of the ALG, and to favour other palatable species. Other assumptions including costs associated with Slashing are shown in the Assumptions section of the Technical Report.

Based on the above assumptions, Slashing is not expected to be more profitable than doing nothing in Table 9 – either starting before or after a heavy infestation. Results for a farmer buying a slasher and possibly a tractor are similarly negative – when compared to Do Nothing.

Table 9. Expected economic benefit of Slashing ALG on 100 hectares using a contractor starting before a heavy ALG infestation, or after the ALG is thick and rank for a 10 year investment period with a Gross margin = $25. Difference is the estimated difference in annuity compared to the Do Nothing scenario

		Fertilised native pasture	
	Do Nothing	After heavy infestation	Before heavy infestation
	$	$	$
Annuity @ 5%	7,500	-547	675
Difference	-	-8,047	-6,825

[2] This scenario also arises if labour is excluded from the costings (see earlier section on costs of slashing). However, assume for a moment that the farmer is doing the slashing, this deduction of labour should only be made in the unlikely case that there are no other productive uses for the family labour.

Similarly, control costs can be reduced if the slasher and towing vehicle are valued at much less than in this analysis. Bear in mind that they will have to be replaced at some time in the future.

However, often slashing is employed in situations where ALG densities approach 100%. Under these circumstances it is possible that potential carrying capacities under the Do Nothing scenario are less than what we have assumed here. Also, adopting slashing is but part of an intensive management strategy for dense lovegrass. When adopted in conjunction with intensive grazing management, in some cases slashing frequency could be lowered to an average of every 18 months in the medium term. Under this scenario the profitability of Slashing would be higher and can exceed that of doing nothing. For particular farms, there may well be cumulative effects relating to frequency, control cost, gross margin and stocking rate that make Slashing more profitable than Do Nothing.

Avoiding ALG, and managing an emerging infestation

Based on our findings that getting in early is the best strategy to control ALG, we would also expect that acting to avoid ALG in the first place would be a worthwhile strategy. However, we have not analysed this. It could mean slightly lower stocking rates in order to maintain ground cover going into extended dry periods. It could also require farmers to be more focused on condition of their pastures and the likely availability of feed. It would also require a willingness to sell excess stock or agist them, and then to bring animals back in when the season breaks.

Benefits of ALG in drought

The value of ALG in comparison to other pasture grasses during drought is recognised by many farmers. It allows stock to be kept on for longer, and possibly for less fodder and supplementary feed to be bought. This has not been directly addressed in this analysis.

ALG control and the farm business

We review the issue of ALG management from a farm business perspective in the discussion section of the Technical Report. The review is summarised here.

Is it possible and profitable to manage these pastures in such a way so as to avoid the invasion of African Love grass, or to minimise its impact?

Yes, as a strategy for keeping ALG in check on fertilised native pastures before it starts to affect productivity, Roller Wiping is expected to be more profitable than allowing the native pastures to decline. On unfertilised native pastures, Roller Wiping is expected to be profitable only under limited conditions.

We have not evaluated an avoidance strategy, but suspect that it is also likely to be profitable even on unfertilised native pasture - particularly when combined with a grazing strategy that is attuned to ground cover.

How can farmers best manage native pastures already or potentially invaded by ALG if profitability is not necessarily their main goal?

Some investments in Roller Wiping or Slashing native pasture give a positive return, but are not as profitable as Do Nothing to control ALG. If farmers have other goals relating to the native pasture, it can be rational for them to pursue their preferred control measure instead of Do Nothing. The net income they are likely to forgo by doing so will in some cases be insubstantial but in other cases it could be substantial.

Once AGL has invaded, is it economic to bring it under control or to utilise it?

A heavy infestation increases first year control costs, and several years pass before income from livestock reaches previous levels. Roller Wiping fertilised native pasture is expected to be successful in many circumstances – but getting in first can be worthwhile as discussed above.

Under very limited circumstances, Slashing and then utilising the ALG may be profitable on fertilised native pasture that is heavily infested with ALG. Stocking rate, frequency of Slashing and cost of control are key factors. Slashing frequency in particular has a large effect. Where utilisation is

possible with existing rather than new fence and water infrastructure, there is an increased chance that utilising ALG will be more profitable.

Can native pastures contribute to the success of the farm business, or at least not significantly affect it - both before and after ALG has invaded?

The results suggest that controlling ALG in fertilised native pastures are profitable – it can thus contribute to the farm business. Unfertilised native pasture is expected to contribute much less to the farm business. However, our results suggest that Roller Wiping these pastures is only a little less profitable than Do Nothing, if it is done early. Secondly, while the unfertilised areas are generally a small proportion of the whole farm, they may provide valuable feed at times when fertilised pastures are less productive eg. during drought.

What are the key factors influencing future profitability of the whole farm where there is a risk of ALG taking hold in native pastures, or where it already has established?

Failure to act early stands out as a key factor. Our results show that it pays off. Moreover, control of ALG can consume precious time and resources that could be devoted to other income-earning or leisure activities.

Another key factor is the size of the infested area relative to the whole farm. Control activities can be more easily managed, with the right equipment on a larger farm. For smaller infestations using a contractor may be a more cost-effective strategy in many circumstances.

If the economics of maintaining the native component of pastures is negative, will farmers who maintain at least some areas of native pasture (say 25 to 100 ha) be financially worse off and if so, by how much?

If 100 hectares of unfertilised native pasture is infested with ALG, the farmer will be worse off on average each year by the difference in two net cash flows –Do Nothing *less* the control action. This is captured in the annuities. Our results show that, using a contractor and at a gross margin of $25, the expected figures are $6,513 and $6,180 respectively. The difference is $333, or $3.33 per hectare.

On fertilised native pasture, the result is expected to be much more favourable.

Is there much variation between farms, whether by enterprise or size, and by whether the native pasture is fertilised or not?

The profitability of control is unlikely to change much between different enterprises. The size of a farm will influence how significant the infested area is to the overall operation. Controlling ALG on a dairy farm that is intensively run and has a large turnover will be much more easily absorbed in the whole farm operation than on a smaller cattle or sheep farm.

Our results demonstrate that the private benefits of controlling ALG are substantially greater in fertilised native pastures, and likely to be even greater in sown pastures. This is likely to play out on an individual farm with more productive land prioritised for control.

Further investigation

Further work that could be undertaken includes:

- Investigate alternatives to avoid or prevent early infestation spreading. Our results suggest that acting early will be more profitable than bringing a larger infestation under control, but the actions required and their costs are uncertain.
- Investigation of spot spraying as an alternative in its own right

There are some very significant assumptions about rates of ALG invasion, relationships between ALG density and carrying capacity and also the response of pastures to control measure and how this affects carrying capacities. Further work could refine these estimates. In particular an

understanding of how rates of invasion vary is fundamental to a better knowledge of the economics of control.

Our models do not take into account year to year climatic variation or variation in stock prices. While exact future values are not known, variation in the range of possible scenarios and their likelihoods can be modelled. Such a modelling approach would provide a useful addition to the work presented.