A BASELINE OF ADOPTION OF PASTURE MANAGEMENT PRACTICES - GOULBURN BROKEN REGION

August 2001

CENTRE FOR LAND PROTECTION RESEARCH

Monitoring Report No. 34

Contributors:
Komala Karunaratne - CLPR Bendigo
Neil Barr - CLPR Bendigo

Published by the Department of Natural Resources and Environment
Agriculture Victoria Bendigo - CLPR
Cnr Midland Highway and Taylor St
Epsom Vic 3550

Website: http://www.nre.vic.gov.au/agvic/profiles/clpr.htm

The National Library of Australia Cataloguing-in-Publication entry:

A baseline of adoption of pasture management practices : Goulburn Broken region.

ISBN 0 7311 4874 6.

1. Pastures - Victoria - Goulburn Region. 2. Pastures - Victoria - Broken River Region. 3. Range management - Victoria - Broken River Region. 4. Range management - Victoria - Goulburn Region. I. Centre for Land Protection Research (Vic.). (Series : Monitoring report (Centre for Land Protection Research) ; no. 34).

633.202099454

ISSN 1324 4388

Abbreviations

ABS	Australian Bureau of Statistics
LMU	Land Management Units
GDSMP	Goulburn Dryland Salinity Management Plan

SUMMARY

The aim of this report is to document baseline information about the state of adoption of pasture establishment and management practices in the Goulburn Broken Region of Victoria and to evaluate the tools for continued monitoring of the adoption of these practices.

Based upon the available data, the progress towards adoption of pasture management practices in the Goulburn Broken Region can be summarised as follows:

- There is only one comprehensive measure of the rate of perennial pasture establishment in the Goulburn Broken Region. The ABS farm survey for 1993/94 shows the rate of all perennial pasture sown or resown in the region to be 1 percent per annum, with 0.8 percent to phalaris based pastures and 0.2 percent to lucerne. Both these measures were increased during 1995/96 reaching a total resown rate of 3 percent.

- There is no available independent study which can be used to calibrate the ABS pasture sowing data. It would be necessary to obtain more information on pasture resowing and improved pasture management practices in the region through farm surveys.

- Previous farm censuses did not differentiate annual from perennial pasture. However, it can be deduced from these that the rate of pasture sowing peaked in 1986/87 during a short period of high wool prices, fell in the latter part of the 1980s, and appears to have continued to fall since.

- This low rate of perennial pasture sowing is unlikely to promote a significant increase in the area of active perennial pasture in the catchment. At this rate it is unlikely to maintain the area of existing perennial pasture, as there is evidence that the lack of maintenance of perennial pasture is likely to reduce the persistence of pastures. ABS and other local studies revealed a low adoption of improved pasture management systems, such as top dressing and rotational grazing management strategies in the region.

- The ABS farm survey in 1994/95 showed the rate of pasture top dressing to be 18 percent. This increased in 1996 due to a reduction in total pasture area reported during that year. There is no other data available in the region which can be used to calibrate the ABS fertiliser data. However, comparisons between ABS data and data from farm surveys in other regions have shown that the ABS fertiliser question provides a reliable measure of the maintenance of improved perennial pastures.

- There is no ABS data which can be used to monitor the use of grazing rotation practices. Further information is needed to comment on pasture management practices adopted on resown perennial pastures in the region.

- Financial constraints and lack of labour availability were the most important constraints identified to adopting improved pasture management practices. Establishment difficulties, poor persistence and management problems in both perennial pasture and lucerne were also considered as major constraints to adopting these practices.

- Increasing farmers' knowledge and understanding of the importance of improved pasture management practices, and increasing government incentives to provide farmers with necessary financial resources were shown to be important measures to help increase pasture establishment in the region.

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A BASELINE OF ADOPTION OF PASTURE MANAGEMENT PRACTICES - GOULBURN BROKEN REGION

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KOMALA KARUNARATNE & NEIL BARR

Centre for Land Protection Research, Department of Natural Resources & Environment, Cnr Midland Highway & Taylor St, Epsom. Vic. 3551.

1 THE GOULBURN BROKEN REGION

1.1 Sustainability in the Goulburn Broken Region

The Goulburn Broken catchment lies in northern Victoria and includes both the Goulburn River catchment and the Broken River catchment. This covers a total of approximately 2.3 million hectares and forms a key part of the Murray Darling Basin. The region experiences hot and relatively dry summers and cool wet winter and spring periods. Rainfall varies from 400 mm/yr in the west and north of the region to 2000 mm/yr in alpine areas.

Agricultural production in the Goulburn Broken Region is extremely diverse. Dairy and horticultural production predominates in the irrigation area and produces 25 percent of Victoria's export earnings. The upper catchments in the dryland area are mainly utilised for grazing of sheep and cattle, while broadacre cropping is carried out on approximately 5 percent (120 000 ha), particularly in the north of the region. Improved pastures are grown on most alluvial soils on the Riverine Plains while pasture has remained largely unimproved in the steeper, rockier and less accessible areas in the mid-Goulburn and western highlands where woolgrowing is the predominant production activity. Grazing cattle is the main enterprise in high rainfall areas in the southern region, while sheep for wool production predominate in the drier areas (Goulburn Broken Regional Landcare Plan 1993).

The major land management units (LMUs) dominating in the Goulburn Broken Region are Riverine Plains, Sedimentary Rises, Volcanic Plains/Rises and Granites. The land management units identified in the salinity management and Landcare plans are combined into these four units and shown in Figure 1.

The major land degradation forms in the region are dryland and irrigation salinity, soil and stream erosion, soil acidification, soil structure decline and pest plants and animals. Land management methods such as excessive grazing, overcultivation and replacement of woodlands and native perennial grasslands with introduced annual pasture species have largely contributed to these problems. A total of 3500 ha in the region is estimated to be visibly salt affected and a further 3500 ha is in the initial stages of salinisation. With the estimated rate of increase of 2-5 percent per year, the visible salt affected areas will total 9235-38 225 ha with another 9235-38 225 ha showing the initial stages of salinisation in 50 years, if no preventative action is taken (Goulburn Broken Region Draft Salinity Management Plan 1989; Goulburn Broken Regional Catchment Strategy 1997). An annual loss to agricultural production of approximately $500 000 due to salinity was estimated in the region (Goulburn Broken Region Draft Salinity Management Plan 1989).

Establishment and improved management of perennial pastures, strategic tree planting and fencing and revegetation of affected areas, along with a series of other cropping practices, are promoted in the area as solutions to these problems.

The benefits of sowing perennial pastures in overcoming soil degradation lies with the potential to reduce recharge by extracting water from a greater volume of soil than annual pastures using their deep root system. Perennial pastures also have the capacity to trap leached nitrates, reducing the rate of soil acidification by 50 kg lime/ha/year compared to annuals (Ridley *et al.* 1990). However, appropriate pasture management practices such as use of fertiliser, pest and disease control methods, and more importantly, grazing management systems, largely affect the maximum water use of perennial pastures.

The potential to increase carrying capacity and gross margin per hectare are additional benefits associated with perennial pasture. However, the initial capital costs involved in establishing perennial pastures are a major concern of farmers in the region.

1.2 Indicator practices

The following practices have been selected as indicators of the extent of adoption of sustainable pasture management practices in the grazing industry in the Goulburn Broken Region.

- Perennial pasture sowing rate

The Goulburn Dryland Salinity Management Plan recommends sowing perennial pastures and lucerne pastures on high and moderate recharge areas as a salinity control measure in the region. The plan sets a 20 year target to be achieved on each land management unit of a total of 12 000 ha of perennial pasture on high recharge areas, and 28 300 ha of perennial pastures and 4200 ha of lucerne on moderate recharge areas. The total of 44 500 ha sets an annual target of 2225 ha of perennial pastures to be established in the region. Given that perennial pastures need to be maintained by a resowing program, a measure of the rate of resowing is used as an acceptable proxy for the area of perennial pasture.

- Top dressing of perennial pastures

Annual top dressing of newly sown pastures is an important factor in maintaining a dense, vigorous pasture in order to have an impact on reducing the watertable, and also to gain high productivity through increased gross margins. Unfertilised pastures will decline to annual pastures and eventually to an annual and native pasture mix.

- Stock management methods used: rotational grazing systems

Heavy grazing needs to be introduced through increased stocking rates to utilise newly sown pastures to achieve maximum profitability. Heavy grazing is often the best method to deal with any weeds and to ensure optimum pasture growth. To assist in salinity control, it is also necessary to introduce rotational grazing systems which enable the pastures to increase leaf area, plant growth and root development, thus maximising the water use of perennial pastures.

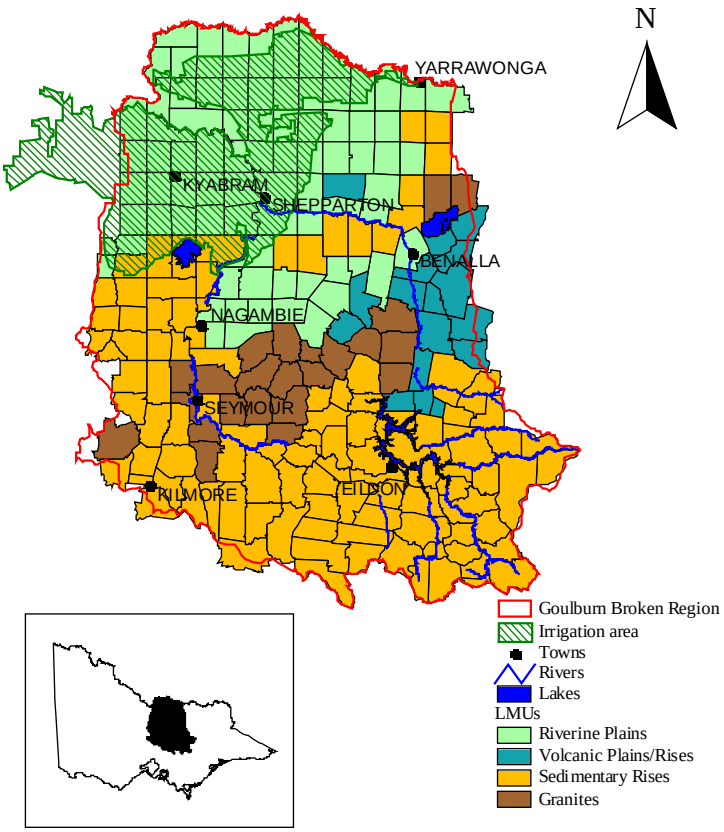


Figure 1 Land management units in the Goulburn Broken Region

2 DATA SOURCES AVAILABLE

2.1 Australian Bureau of Statistics

The Australian Bureau of Statistics (ABS) farm census is distributed annually to all Australian farming businesses which meet a minimum gross income criterion. There is a legislative requirement that all farm business operators complete and return the farm census. In the last decade the ABS farm census has intermittently included questions covering use of fallow, grain legumes, soil ameliorants, fertiliser use and pastures. In recent years questions have covered the total area and resown area of perennial pastures and lucerne pasture. Data from the ABS farm census is normally available only in aggregated form at state or local government area. As part of this project, data is purchased disaggregated at parish levels. As parishes are significantly smaller than local government areas, the ABS data is reaggregated according to catchment and soil type boundaries. In this report ABS data is reported for the dryland areas of the Goulburn Broken Region.

2.2 Dryland management plan - land and water salinity in the catchment of Goulburn Broken rivers Victoria (McGowen International 1988)

The Salinity Pilot Program Management Team and consultants, McGowan International Pty Ltd, carried out a study in the Goulburn Broken river catchments to assist the Salinity Pilot Program Advisory Council to set out and evaluate salinity control options to formulate the regional dryland salinity management plan. As part of this study, a survey of 120 land-holders was undertaken by a mail-out questionnaire to determine key aspects of land use, land-holder perceptions of the salinity problem, and willingness and capacity to participate in programs to control salinity. The survey received a 54 percent response rate.

2.3 Land-holders' attitudes towards the salinity control options in the Goulburn Salinity Management Plan (Fontana 1991)

A study on land-holders' attitudes towards salinity control practices was carried out in the Goulburn Broken Region, as a part of a degree course in environmental management at Deakin University. The aim of the study was to determine the degree of farmers' preference for each management option and the reasons for that preference. A 42 percent response rate was achieved from a questionnaire mailed to 300 land-holders, selected from five of eleven Landcare groups representing farmers from both low and high recharge areas in the catchment. As the respondents were all Landcare members this sample would have a bias towards a greater concern for salinity and other land degradation issues.

2.4 Survey of community inputs to the Goulburn Dryland Salinity Management Plan (GDSMP) (Madden 1992)

As the GDSMP was based on a cost-sharing agreement between the government and the community of the Goulburn Region, it was necessary to estimate the magnitude of community inputs, to justify the government's annual contribution of $1.7 million. Hence, the sub-committee on Measurement of Community Inputs, carried out a survey on eight land management units across the whole catchment, to estimate the levels of community inputs in the form of on-farm work and time. A two stage stratified sample was used to represent all LMUs and different farm sizes, identified using a rates list from the 16 shires in the region. The survey received an overall 69 percent response rate with a reasonable consistency across all strata.

2.5 Adoption and success of, and influences on, perennial grass establishment in the mid Goulburn catchment of Victoria (Montgomery 1993)

An in-depth study of graziers were carried out in 1992, to ascertain the rate of adoption, and success of introduction, of perennial grasses into annual pastures in the mid-Goulburn catchment. This study also explored the factors influencing adoption and success of pasture improvement, and farmers future intentions to sow pastures. It included personal interviews with a random sample of 64 graziers in the Seymour district, using both structured and open-ended questions.

2.6 The use of remote sensing to map perennial pastures (Crawford 1994)

A study was conducted to investigate the feasibility of using remote sensing technology to map the distribution and area of perennial pastures in the Seymour district. The main aim of the study was to assess the technical and economic viability of this methodology and its future use in monitoring purposes. A 30 km by 30 km area in the Seymour district was analysed using satellite images to obtain the distribution of land use in the area.

2.7 Landholders' knowledge and perceptions of salinity and salinity control options in the Broadford and Kilmore shires (Nicoll 1994)

A study was carried out as part of a degree program in environmental management at Deakin University to determine land-holders' knowledge and perception of salinity and salinity control measures in the south-west of the Goulburn Broken catchment. This study also looked at the degree of implementation of salinity control practices and the reasons for non-implementation of control practices. A sample of 290 land-holders was surveyed using a mailed questionnaire. These properties had high recharge areas and were located in a high priority salinity area in the Broadford and Kilmore shires. The survey received a 40 percent response rate.

MEASURING PERENNIAL PASTURE ESTABLISHMENT AND MANAGEMENT

3.1 Pasture resown rates

3.1.1 Australian Bureau of Statistics

The questions on the ABS census from 1984 to 1990 asked farmers for total pasture areas and areas sown or resown with pastures during the survey year. The pasture resown area data could be used to compare the pasture resown rates although these questions do not distinguish between perennial and annual pastures. However, local knowledge suggests that the absolute rate of pasture resowing may be a reasonable indicator of adoption of perennial pastures. Research in NSW and Victoria shows there is tremendous variation in the quality of pastures described as 'perennial' by farmers.

Pasture questions from 1991 to 1993 included only the total pasture area, and did not measure pasture resown area, making the information useless for measuring adoption rates.

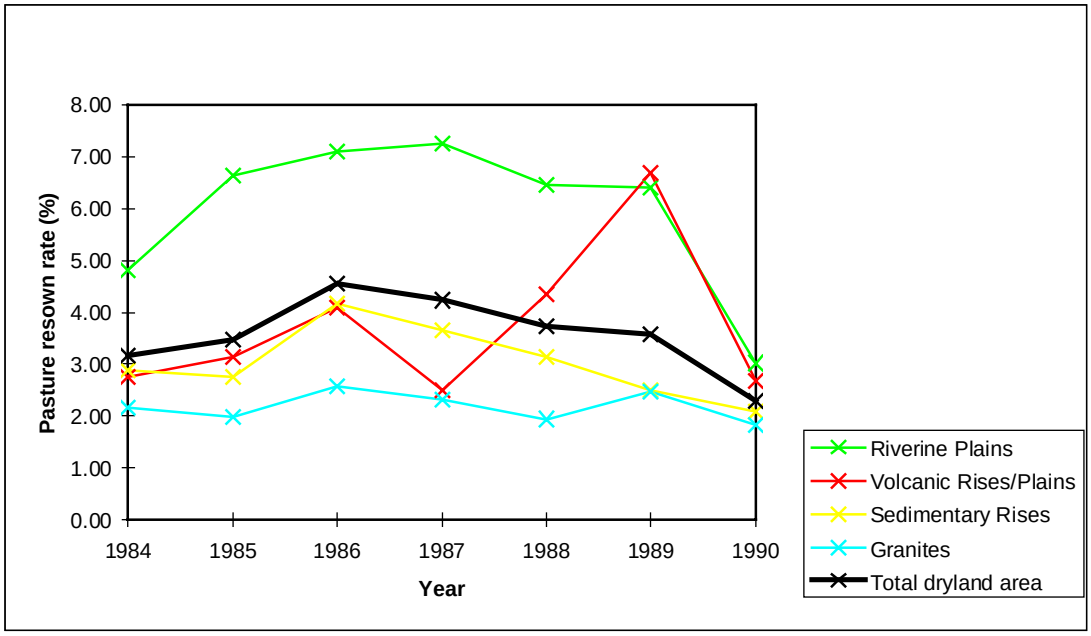
The questions included in the 1993/94 census provide the most valuable information on perennial pasture resown rates. This separates the total area of pasture and the pasture resown during that year, allowing the calculation of the pasture resown rate. A major advantage of this set of questions is that it separates lucerne, other perennial pasture and annual pastures in pasture mixtures.

The questions in the 1994/95 census asked for the pastures sown or resown during that year and did not include the total pasture area. This difference between the two sets of questions during 1993/94 and 1994/95 has led to unreliable responses to the 1994/95 question, with many farmers filling in the total area of pasture rather than the sown area. Hence, these results are not included in this report.

A pasture question similar to the 1993/94 format was repeated in the 1995/96 and 1996/97 censuses, and can be used as a measure of change in lucerne and perennial pasture adoption rates.

The pasture questions on the census in different years are shown in Appendix 1. The inconsistency of pasture questions in the ABS censuses during the last decade limits their role in determining a trend in perennial pasture and lucerne adoption rates.

Total pasture resown rates from 1984 to 1990 on different land management units are shown in Figure 2. Figures for the total dryland area in the region show a relationship between wool prices and pasture resowing rates. With high wool prices in the mid 1980s there was an increase in pasture resown rates, followed by a drop in the latter part of the 1980s. This trend is shown on all land management units (LMUs) except on the Volcanic Rises. The Sedimentary Rises, where perennial pasture establishment was identified as a priority Landcare activity, had low pasture resown rates. The Riverine Plains LMU had the highest resown rates while the Granites LMU showed the lowest rates in the region during this period. This measure, however, does not give the distinction between the perennial and annual pastures resown, but is still an indicator of resowing rate changes for perennial pasture.

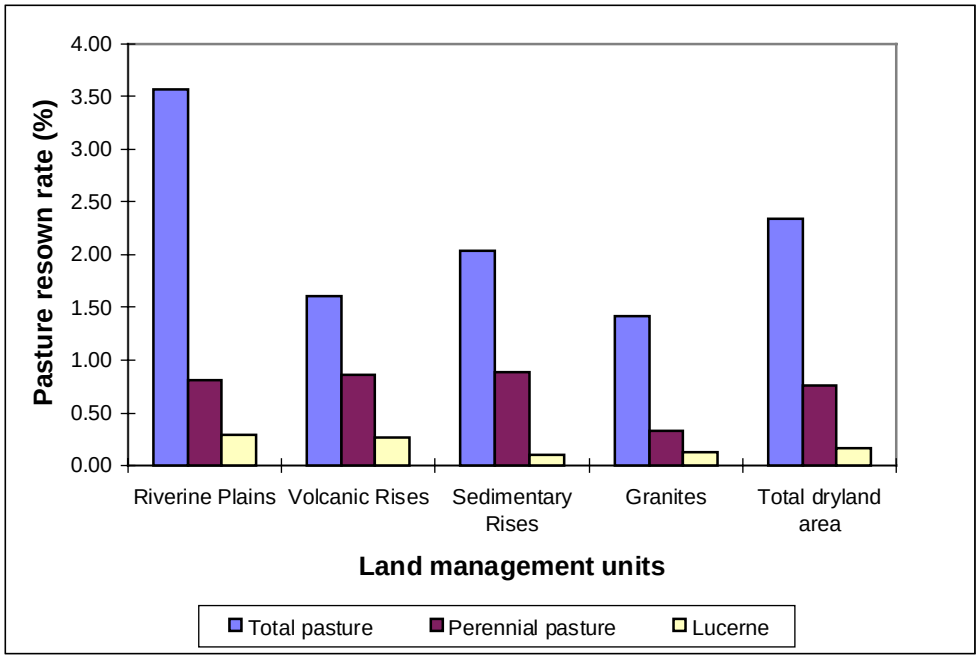


Source: Australian Bureau of Statistics (1984-1990)

Figure 2 Total pasture resown rate on different land management units in the Goulburn Broken Region (1984-1990)

The 1993/94 ABS farm census data shows that 19.5 percent of the existing pasture in the Goulburn Broken dryland area was described as perennial pastures, while another 4.5 percent was under lucerne pastures. However, field surveys suggest that the quality of much of this existing perennial pasture may be low (Quigley & Morgan 1990).

For the 1993/94 season, lucerne resowing rates were calculated considering pure lucerne resown, together with a mixture of lucerne and other pasture species, as a percentage of total pasture area. Similarly the perennial pasture resown rates included pastures with a mixture of perennial grasses and legumes, excluding lucerne. Of the total pasture area in the region, 0.48 percent was sown or resown with perennial pastures during this season, while only 0.2 percent was resown to lucerne. The Sedimentary Rises LMU dominated in perennial pasture resowing rates, reaching 0.9 percent of the total pasture area (Figure 3). Both the Sedimentary Rises and Riverine Plains LMUs had high lucerne resown areas (Table 1). Perennial pasture and lucerne pasture resown rates in 1993/94 in the Goulburn Broken Region are shown in Figure 4.



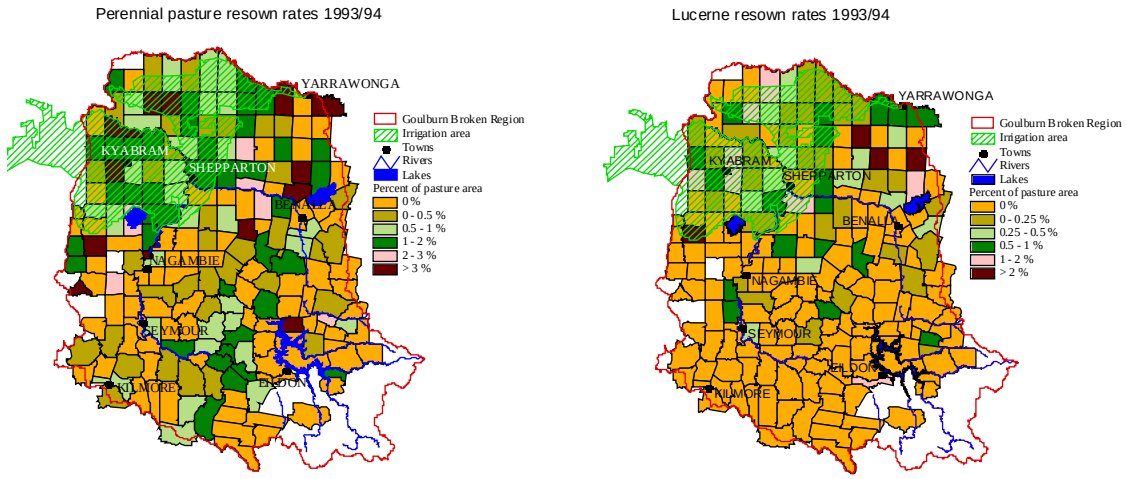
Source: Australian Bureau of Statistics (1993/94)

Figure 3 Pasture resown rates in the Goulburn Broken Region (1993/94)

Table 1 Pasture resown area (ha) in the Goulburn Broken Region according to LMUs (1993/94).

LMU	Lucerne	Perennial pasture	Total pasture area
Riverine Plains	573	1581	195485
Volcanic Rises	64	209	24313
Sedimentary Rises	348	3103	350843
Granites	161	414	124889
Total dryland area	1146	5307	695530

Source: Australian Bureau of Statistics (1993/94).



Source: Australian Bureau of Statistics (1993/94)

Figure 4 Perennial pasture resown rates in the Goulburn Broken region (1993/94)

The 1995/96 farm census data shows that the percentage of existing pasture reported as perennial pasture had increased by 9 percent during the two years from 1994 to 1996, while the percentage of lucerne pasture had declined (Table 2). There was an increase in both lucerne and perennial pasture resown rates, with more farmers sowing or resowing these pastures on larger areas in 1996 compared to 1994 (Table 2). This increase is consistent on all land management units. The Riverine plains and Sedimentary Rises LMUs had the highest resown areas for both lucerne and perennial pastures (Table 3 and Figure 5). Perennial pasture and lucerne pasture resown rates in 1995/96 in the Goulburn Broken Region are mapped in Figure 6.

Table 2 Pasture resown areas (ha) in the Goulburn Broken Region (1993/94-1996/97)

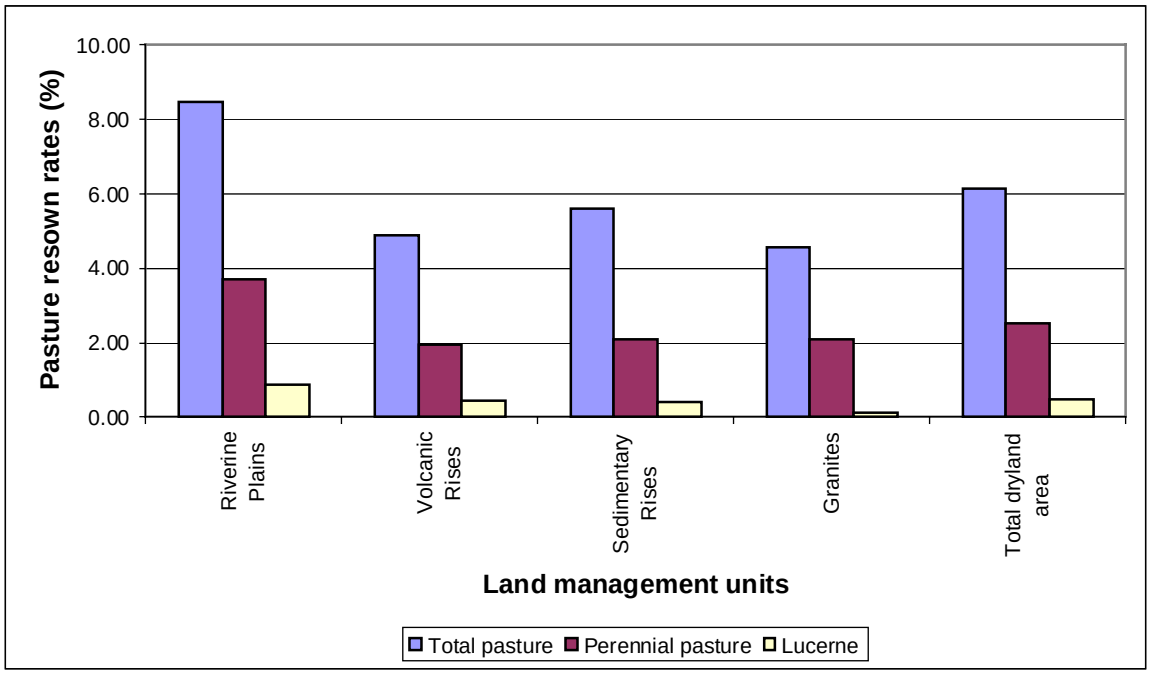
Measure	1993/94	1995/96	1996/97
Total pasture area (ha)	695531	435483	470585
Total pasture reswon area (ha)	16271	26747	29090
Total perennial pasture area (ha)	135334	124310	155241
Total lucerne area (ha)	31321	7650	7991
Perennial pasture resown area (ha)	5308	10964	11035
Lucerne resown area (ha)	1147	2171	2779
Percent of perennial pasture (%)	19.6	28.6	32.9
Percent of lucrene pasture (%)	4.5	1.8	1.7
Perennial pasture resown rate (%)	0.76	2.5	2.3
Lucerne resown rate (%)	0.16	0.5	0.59

Source: Australian Bureau of Statistics (1993/94-1996/97).

Table 3 Pasture resown area (ha) in the Goulburn Broken Region according to LMUs (1995/96, 1996/97)

LMU	1995/96			1996/97		
	Lucerne	Perennial pasture	Total pasture area	Lucerne	Perennial pasture	Total pasture area
Riverine Plains	1053	4377	117830	1227	2294	126590
Volcanic Rises	247	1066	54472	292	961	53812
Sedimentary Rises	799	4165	198513	1107	4976	212219
Granites	72	1356	64668	153	2804	77964
Total dryland area	2171	10964	435483	2779	11035	470585

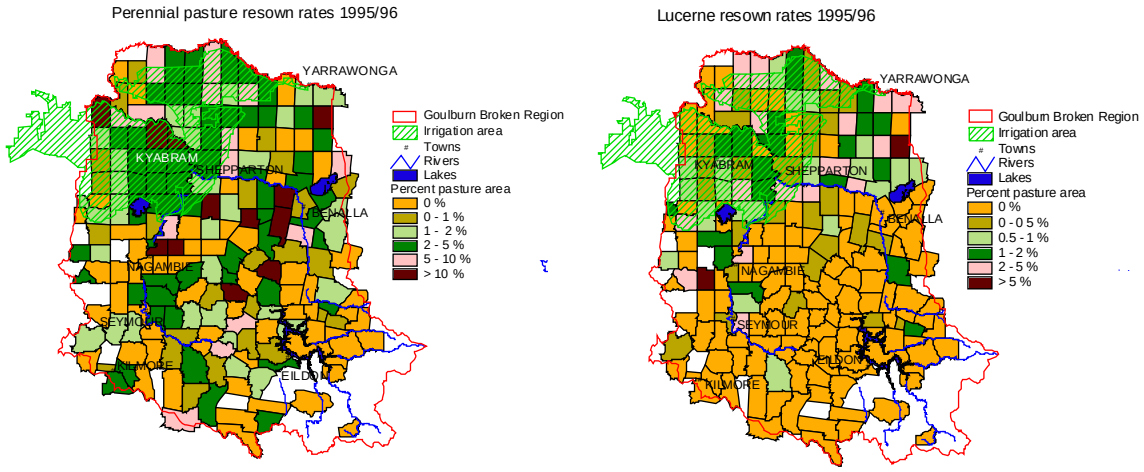
Source: Australian Bureau of Statistics (1995/96, 1996/97).



Source: Australian Bureau of Statistics (1995/96)

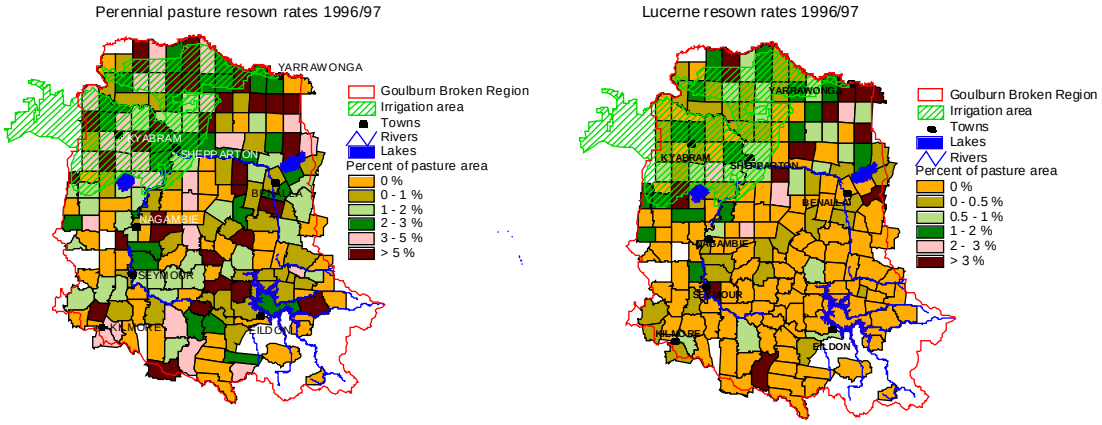
Figure 5 Pasture resown rates in the Goulburn Broken Region (1995/96)

No significant difference in total pasture resown areas were reported in 1996/97 (Table 2). However, perennial pasture resown rates in the 1996/97 season were lower than the previous year, mainly due to the reduction in total pasture area reported in the region. Less perennial pastures were resown on the Riverine Plains LMU in 1996/97, compared to the previous year, while the Sedimentary Rises and the Granites LMUs had an increased resown area (Table 3). Perennial pasture and lucerne resown rates for 1996/97 are mapped in Figure 7.



Source: Australian Bureau of Statistics (1995/96)

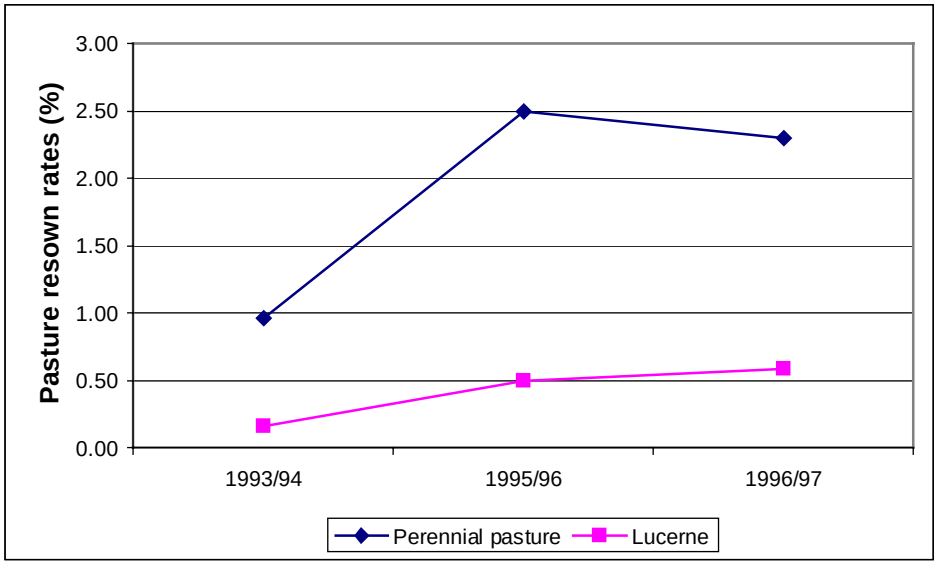
Figure 6 Pasture resown rates in the Goulburn Broken Region (1995/96)



Source: Australian Bureau of Statistics (1996/97).

Figure 7 Pasture resown rates in the Goulburn Broken Region (1996/97)

Figure 8 shows the overall trends in pasture resowing rates in the dryland area of the Goulburn Broken Region from 1994 to 1997. Lucerne had a continuing increase in resown rates, while the sharp increase in perennial pastures had started to decline by 1997.



Source: Australian Bureau of Statistics (1993/94-1996/97)

Figure 8 Trends in pasture resown rates in the Goulburn Broken Region (1993/94-1996/97)

3.1.2 Dryland management plan - land and water salinity in the catchment of Goulburn Broken rivers Victoria (McGowan International 1988)

From 1985 to 1987, land protection groups in five surveyed catchments carried out perennial pasture resowings over 3600 ha of recharge area and 400 ha of discharge area through the existing salinity program.

3.1.3 Land-holders' attitudes towards the salinity control options in the Goulburn Salinity Management Plan (Fontana 1991)

This survey included a question to identify the level of practices land-holders have undertaken in 1989/90 and those they intend to undertake in 1990/91. These include high and low density tree planting, and perennial pasture and lucerne establishment. The results are reported as percentages of the number of responses to particular questions. As raw data from the survey was available, these percentages were recalculated using total numbers of responses to the survey. Perennial pasture was established by 29 percent of land-holders on a total of 1815 ha, averaging 52 ha per farm. Sixty-two percent of respondents said they did not sow any perennial pastures during the survey year while the rest did not respond to the question.

Lucerne was the least preferred salinity control option in the area and was established by only a minority of farmers. Only 6 percent of land-holders sowed lucerne on 313 ha, averaging 45 ha per farm. Farmers from the two Landcare groups in the high recharge areas did not report any area sown to lucerne during the survey period. Lucerne was considered unsuitable to the area. However, the figures for perennial pasture and lucerne pasture areas are incomplete as many farmers failed to report their sowing areas. Hence this survey is unsuitable for comparison purposes.

Farmers reporting the intention to establish perennial pastures in 1990/91 fell to 25 percent with the area intending to sow falling by half the amount established in 1989/90. Only farmers in high recharge areas showed some increase in these figures. Farmers reporting the intention to carry out lucerne establishment doubled in numbers, but on smaller areas.

3.1.4 Survey of community inputs to the Goulburn Dryland Salinity Management Plan (GDSMP) (Madden 1992)

This survey included information on on-farm works such as tree planting, perennial pasture and lucerne establishment, and fencing-off carried out by the farmers in the region during 1991/92. Estimates of total work are reported in the study by extrapolating the survey results to the whole region. The survey sample (5 percent of the population) had sown an area of 2267 ha of perennial pastures and 242 ha of lucerne during the survey year, for estimated totals of 22 400 ha and 2223 ha respectively throughout the region. This is equivalent to 2.2 percent and 0.2 percent sowing rates of perennial pastures and lucerne respectively across the region.

3.1.5 Adoption and success of, and influences on, perennial grass establishment (Montgomery 1993)

This study measured the pasture resown areas for a period of 10 years between 1983 to 1992. In this study percentages and resown rates are calculated to the 'tractorable' pasture area (accessible to wheel tractors), which accounts for 97 percent of all pastures and covers about 85 percent of total farm area. During this period, 15 percent of the pasture area accessible to wheel tractors (13 percent of the total pasture area) was sown by 78 percent of the graziers. This was equivalent to an average of four paddocks, each with an average size of 25 ha per farm resown to pastures during the 10 year period. The study estimated a total area of 46 070 ha were sown to pastures during the past decade in the study area.

There was an overall upward trend in pasture resown rates, rising from about 1 percent per year to 2 percent per year at the end of the decade – an average of 1.5 percent per annum. The estimated total of 46 070 ha of resown pasture over these 10 years for the whole study area is of comparable order to the targets set in the salinity management plan. The study also estimates that the remaining 85 percent of the area not sown to pastures will be sown in another 42 years if the sowing rates continue to remain at 2 percent per annum.

Success of pasture establishment and improvement was measured by rating at least one paddock on each farm, on a scale between one and five (from failure to excellent pasture, depending on the availability of desirable pasture species and absence of weeds). About 70 percent of the paddocks were reported to be successfully sown, with clover having a higher success rate than perennial pastures. Poor persistence of perennial pasture was considered a significant and worrying problem by 10 percent of graziers.

3.1.6 The use of remote sensing to map perennial pastures (Crawford 1994)

The remote sensing images utilised in this study revealed that 56 percent of the image area was annual pastures while perennial pastures accounted for 16.4 percent. Perennial pasture covered 22.7 percent of the total pasture area. The ABS statistics for the region in 1993/94 season shows 24 percent of the pasture area sown to perennial pastures. However, figures from this study should be treated with caution as this area was purposely selected to have a significant amount of perennial pastures and small areas of crops. Furthermore, the report cautions that the accuracy of the perennial pasture area obtained using this method was not high and needed to be improved further.

3.1.7 Land-holders' knowledge and perceptions of salinity and salinity control options in the Broadford and Kilmore shires (Nicoll 1994)

Fifteen percent of respondents in this survey had established perennial pastures on their properties as a salinity control option. Seventy-four percent of land-holders wanted to carry out salinity control practices on their properties within the next two years, although this data does not differentiate between individual practices.

Financial assistance was the most important factor mentioned by land-holders that would encourage them to carry out these practices in future. Most farmers also preferred more written information about pasture establishment.

3.2 Fertiliser applications on pasture

Fertiliser rates and frequency of applications plays an important role in maintaining a stable perennial pasture growth free of weeds and inferior grasses. Poorly managed perennial pastures will have no greater impact on watertable control than will annual pastures. Hence, application of fertiliser on pastures is used as a proxy for measuring level of pasture management undertaken by farmers in the region.

3.2.1 Australian Bureau of Statistics

In the 1987/88 agricultural census, farmers were asked the areas of pure lucerne, other pastures and crops fertilised, as well as the type and quantity of fertiliser applied. The 1988/89 and 1989/90 census questions collected the same information for total pasture area, but did not separate pure lucerne from other pastures. A similar set of questions was asked again in 1994/95 season. The 1995/96 and 1996/97 census asked for the total pasture areas top-dressed or fertilised, but did not collect information on types of fertilisers used. These sets of questions are shown in Appendix 2.

A little over one third of the pasture area was fertilised by 53 percent of farmers in 1987/88 and there was no significant change in both these measures during 1988/89. Both the percentage of pasture area fertilised and the percentage of farmers using fertiliser reduced in 1989/90 (Table 4). However, more farmers had applied fertiliser on pastures in 1989/90 than the previous year, the percentage reduction being a result of a higher rate of increase in the number of total farms responding to the census in 1990 than the rate of increase in number of farmers using fertilisers. Nevertheless, the total pasture area fertilised during 1989/90 dropped, while the total pasture area reported increased, both contributing to the reduction in percentages. There was a huge drop in fertiliser usage during the five years from 1990 to 1995. Both the area fertilised and the number of farmers using fertiliser decreased, with only 30 percent of farmers using fertiliser on 18 percent of the pasture area. No significant change in the adoption of fertiliser was evident in the following year. However, the percentage of pasture area fertilised in 1996 increased due to a huge reduction in the total pasture area reported during this year. The reduction in use of fertiliser is clearly related to the prolonged period of poor wool prices. Fertiliser use again slightly increased during 1996/97 with one third of pasture area being fertilised by 33 percent of the farmers (Table 4).

The rate of application of superphosphate as kilograms per hectare over the total pasture area fertilised, and the total pasture area in the region, is shown in Table 5. A drop in fertiliser rates was shown during 1990 followed by an increase in 1995 (Table 5). Higher apparent rates of superphosphate application in 1995 was a result of fewer farmers using superphosphate on smaller areas of pasture. These rates were higher on all land management units except on the Riverine Plains (Table 6).

Table 4 Measure of fertiliser application on pastures in Goulburn Broken Region (1988-1997)

Measure	1987/88	1988/89	1989/90	1994/95	1995/96	1996/97
Pasture area fertilised, as a proportion of total farm area (%)	27.1	27.1	24.7	13.8	13.7	16.9
Proportion of pasture area fertilised (%)	34.6	34.8	31.4	18.1	28.9	33.5
Percentage of farmers using fertiliser on pastures (%)	52.7	54.2	50.6	29.2	28.4	33.0
Percentage of lucerne area fertilised (%)	65.0	*	*	*	*	*
Percentage of farmers using fertiliser on lucerne (%)	62.0	*	*	*	*	*

Source Australian Bureau of Statistics (1988-1997)
*Information for lucerne was not collected during these seasons

Table 5 Rate of application of superphosphate (kg/ha) (1988-1995)

Measure	1988	1989	1990	1995
Rate per area fertilised	122	140	116.4	135.5
Rate per entire pasture area	42	49	36.5	24.5
Rate on lucerne pastures	288	*	*	*

Source: Australian Bureau of Statistics (1988-1995)
*Information for lucerne was not collected during these seasons

Table 6 Rate of application of superphosphate on different LMUs (kg/ha) (1988-1995)

	1988		1989	1990	1995
LMU	Perennial pastures	Lucerne	Perennial pastures		
Riverine Plains	119	260	240	125	122
Volcanic Rises	284	245	135	110	153
Sedimentary Rises	117	290	116	117	136
Granites	114	266	108	105	133

Source: Australian Bureau of Statistics (1988-1995)

3.2.2 Survey of community inputs to the Goulburn Dryland Salinity Management Plan (GDSMP) (Madden 1992)

The survey sample used 2335 tonnes of superphosphate and 922 tonnes of lime on perennial pastures during the year 1991/92. Thus an estimated total of 16 009 tonnes of superphosphate and 3543 tonnes of lime were used throughout the region. The use of these figures is limited for calculation of application rates as the survey does not provide information either on total pasture area or pasture area fertilised.

3.3 Grazing management on pasture

3.3.1 Land-holders' attitudes towards the salinity control options in the Goulburn Salinity Management Plan (Fontana 1991)

This study determined that only 27 percent of farmers in the region modified their grazing management practices in the five years from 1984/85 to 1989/90 by reducing their stocking rates.

4 UNDERSTANDING LOW RATES OF ADOPTION

In promoting the adoption of perennial pastures and improved pasture management practices it is important to understand the factors influencing and/or limiting the use of these practices. Several studies have identified these factors and the following section summarises these studies in Goulburn Broken Region.

4.1 Dryland Management Plan - land and water salinity in the catchment of Goulburn Broken rivers Victoria (McGowen International 1988)

The capacity of land-holders to participate, the status of their technical knowledge, financial returns from the program, and support services and funding resources available were identified as the main issues affecting the rate of implementation of salinity control programs in the region. More than 80 percent of respondents to the survey indicated a willingness to participate in such programs and agreed to devote over 10 days per year. However, financial constraints and lack of labour availability were the most important constraints indicated by the land-holders to adopting the control measures.

Strategic grazing control is perceived to have an adverse effect on financial returns from grazing. This was mentioned as a possible factor limiting the acceptability of strategic grazing by farmers. The farmer understanding of the need for a change in grazing management in order to increase water use by perennial pastures was also identified as important in achieving high acceptance of strategic grazing.

4.2 Land-holders' attitudes towards the salinity control options in the Goulburn Salinity Management Plan (Fontana 1991)

On average, establishing perennial pastures was highly favoured as a salinity control option (next to high density tree planting) by the land-holders in the area. Perennial pasture was most favoured in the main cropping areas, and was perceived as a way of reducing groundwater without putting land out of production. A preference for pasture establishment was also related to farm size, with large land-holders showing a stronger preference. Lucerne establishment was the least favoured practice, mainly due to the unsuitability of acidic soils in the area for lucerne establishment.

Establishment difficulties, poor persistence and management problems in both perennial pastures and lucerne were of major concern to most farmers in the area, as well as long and short-term losses in production while perennial pasture and lucerne are being established. Time and costs involved in carrying out these practices were the main factors restricting their adoption. The availability of information and physical problems on individual farms, such as farm size and steepness of slopes, were mentioned as minor problems.

Land protection incentive schemes were identified as a key factor in determining the amount and type of work carried out on farms. Farmers in high recharge areas were influenced to sow more perennial pastures by the higher rates of land protection incentives.

Increasing government incentives (mainly in low recharge areas) promoting Landcare, and setting up demonstration trials throughout the catchment were seen as important measures in increasing pasture establishment in the region.

4.3 Adoption and success of, and influences on, perennial grass establishment (Montgomery 1993)

This study looked at the factors motivating farmers to sow perennial pastures and the constraints to pasture improvement. Most farmers (50 percent) were motivated to sow pasture by greater production capacity, improved production, and more and better feed availability. Soil conservation issues were a motivation for only a minority. The study notes that a majority of farmers in the area are interested in pasture improvement and are now well into the adoption stage, having passed the trial stage. Three-quarters of farmers expressed interest in sowing pastures in the future.

High costs associated with pasture improvement were considered the main constraint to pasture resowing by 55 percent of graziers. The physical condition of the farms, seasonal conditions and the time involved in resowing were the next most important factors mentioned.

This study highlighted the necessity to address farmers' financial management and cash flow problems through increased whole farm productivity and profitability. Issues identified included the introduction of a program of sowing pasture under oats to encourage carefully managed undersowing, and the provision of individual assistance to farmers having problems with pasture improvement.

The success of pastures in the region was associated with methods of sowing and also the source of advice received by farmers. Direct drilling and cultivation (with or without herbicides) had higher success rates of sowing than undersowing or drilling without spraying.

4.4 Land-holders' knowledge and perceptions of salinity and salinity control options in the Broadford and Kilmore shires (Nicoll 1994)

This study did not specifically analyse the barriers to perennial pasture establishment, but looked at the reasons given by land-holders for not carrying out salinity control practices on their properties. Financial and time constraints were the major factors mentioned by the landowners for not implementing the salinity management practices. Sixty-nine percent of land-holders were aware of financial assistance schemes available from the government, while only 16 percent of those who were aware of the schemes have actually received this assistance. Time constraint was the main reason given for not obtaining this assistance. Lack of awareness of the salinity management plan and the salinity problems on their properties was also a factor limiting adoption of salinity control practices. The size of holdings or the source of income did not seem to be affect adoption rates. More salinity control works were reported by land-holders owning smaller properties and/or earning less than 10 percent of their total household income from their property. However, the reduced time spent on properties contributed to a lack of understanding of the salinity problems and control issues in the area.

Properties in this study area identified as high recharge areas were not directly affected by dryland salinity, and owners of these properties were less likely to be interested in adopting salinity management practices.

5 RECOMMENDATIONS

The aim of this report is to provide baseline information and establish trends in the adoption of pasture management practices in the Goulburn Broken Region. The information in this report is based on available research studies and provides reasonable trends in the adoption of these practices in the region. Accurate long-term measures of the area of phalaris pastures sown in the region will need to be obtained by continued use of the ABS farm censuses. One of the limitations to using ABS data in determining adoption trends is the changing format of questions each year. The consistency of the format of questions is important in getting reliable information to measure trends in adoption rates. The adoption rates estimated from 1993/94 ABS data provide a reasonably reliable baseline and can be used to monitor future adoption of these practices. A question similar to the 1993/94 format was repeated in 1995/96 and will provide suitable continuity of data. Hence, the same format can be used in future to estimate the adoption of perennial pastures.

The 1994/95 fertiliser question provides data to measure the use of selected fertilisers on established pastures. This question appears to be an acceptably accurate measure of pasture maintenance by top dressing. This survey, however, does not provide information on other maintenance practices important in pasture management, particularly rotational grazing. The 1995/96 ABS census included a question on maintenance and management of established pastures which can be used in future to monitor the adoption of pasture management practices. This also does not include information on rotational grazing. To determine the adoption of improved grazing management techniques, it will be necessary to collect more data on grazing management practices.

The format of this question is as follows:

ABS Pasture maintenance question in 1995/96

Maintenance and management of established pastures between 1 April 1995 and 31 March 1996

Area of established pasture over which the following maintenance or management operations were carried out:

	Hectares
Top dressing of fertiliser ……..	
Weed control or spraying ……..	
Pest and disease control or spraying ……..	
Slashing or burning (other than prior to sowing the paddock)……..	

6 REFERENCES AND DATA SOURCES

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7 APPENDICES AUSTRALIAN BUREAU OF STATISTICS FARM CENSUS QUESTIONS

Appendix 1 ABS pasture questions

ABS pasture question 1984-1990

Pastures (including lucerne, clovers and grasses) for all purposes

PASTURE AREA AT 31 MARCH 1985 | PASTURE SOWN OR RESOWN 1984-85

Exclude
- Crops(e.g. oats) grazed or cut. *Include* these with crops in section 5 below

Include
- Areas oversown into native pasture or crops

Include
- Lucerne sown with grasses

Pure Lucerne .....
Other pasture legumes only .....
-Clovers and/or medics .....
-Other pasture legumes .....
Sown grasses only .....
Mixture of grasses, legumes, etc .....
Native pasture .....

ABS pasture question from 1991-1993

Pastures for all purposes at 31 March 1993

Total area of pastures at 31 March 1993 Hectares

Exclude
Crops (e.g. oats) grazed or cut. *Include* these with crops in Section 6 below

Include
- Areas oversown into native pasture or crops

Pure lucerne .....
Other pasture legumes .....
Sown grasses only .....
Mixture of grasses, legumes etc. .....
Other pastures (native and naturalised) .....

ABS pasture question 1993/94

Pastures for all purposes at 31 March 1994

Exclude

- Crops (e.g. oats) grazed or cut. Include these with crops in Part 1c below

Include

- Areas oversown into native pasture or crops

Perennial grasses include phalaris, cocksfoot and perennial ryegrass

	Total area of pasture at 31 March 1994 Hectares	Pasture sown or resown during year ended 31 March 1994 Hectares
Pure lucerne		
Other pasture legumes		
Sown grasses only		
Mixture of lucerne and other pasture species.....		
Mixture of perennial grasses and legumes excluding lucerne		
Mixture of annual grasses and legumes excluding lucerne		
Other pastures (native and naturalised)		

ABS pasture question 1994/95-1996/97

Pastures sown or resown for all purposes during year ended 31 March 1997

Include

- Areas oversown into native pasture or crops

Perennial grasses include phalaris, cocksfoot and perennial ryegrass.

Legumes include clovers, medics and vetch.

Annual grasses include Wimmera rye grass.

	Total area of pasture at 31 March 1997 Hectares	Pasture sown or resown during year ended 31 March 1997 Hectares
• **Sowings including lucerne:**		
Pure lucerne		
Mixture of lucerne and other pasture species		
• **Sowings excluding lucerne:**		
Pasture legumes only		
Mixture of perennial grasses and legumes		
Mixture of annual grasses and legumes		
Sown grasses only		

Appendix 2 ABS fertiliser questions

ABS fertiliser question in 1987/88

Artificial fertiliser used (whether applied by you, by contractors, or others)
Season 1987-88

Exclude lime, gypsum and dolomite

Enter double and triple strength superphosphate as single strength equivalent,

Pastures and Crops Fertilised	Area Fertilised	**Quantity and Type of Fertiliser Used**				
		Super-phosphate (including super with trace elements)	Straight nitrogenous types (e.g. urea, sulphate of ammonia)	Straight Potash	Mixtures of super, and potash	Other artificial fertilisers including complex mixtures and mixtures containing nitrogen
	Hectares	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes
Pure lucerne						
Other pastures (sown or native)						
Wheat						
Oats						
Barley						
Field peas						
Other cereals						
Oilseeds						
Vegetables for human consumption						
Fruit (including nuts)						
Grape vines						
Other (please specify)						

ABS fertiliser question in 1988/89 and 1989/90

Artificial fertiliser used (whether applied by you, by contractors, or others) Season 1988-89

Exclude lime, gypsum and dolomite

Enter double and triple strength superphosphate as single strength equivalent,

Pastures and Crops Fertilised	Area Fertilised	Quantity and Type of Fertiliser Used				
		Super-phosphate (including super with trace elements)	Straight nitrogenous types (eg. urea, sulphate of ammonia)	Straight Potash	Mixtures of super, and potash	Other artificial fertilisers including complex mixtures and mixtures containing nitrogen
	Hectares	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes
Pastures sown or native						
Wheat						
All other crops						

ABS fertiliser question in 1994/95

Use of selected fertilisers on established pastures (whether applied by you, by contractors or by others) - Season 1994-95

Exclude

- Pastures sown during the 1994-95 season

Note

- Use total fertiliser weight not weight of active constituents.

Include

- Double and triple super-phosphate, MAP or DAP

	Hectares
Area of existing pasture top-dressed with fertilisers specified below	

	Tonnes
Single superphosphate used for top dressing existing pastures	
High analysis fertilisers used for top dressing existing pastures	
Super-potash blends used for top dressing existing pastures	