Farm Practice Baseline Report

2010

CARING FOR OUR COUNTRY

GRDC
Grains Research & Development Corporation

Title: ***2010 GRDC Farm Practices Baseline Report***

This report outlines the adoption of key management practices used in Australian grain growing regions. Specific practices include:

1. Matching land use to land capabilities;
2. Reduced or no-tillage;
3. Stubble retention;
4. Crop rotation with pastures, oilseeds and pulses;
5. Controlled traffic and precision agriculture;
6. Integrated weed / pest / disease management in crops and pastures;
7. Nutrient budgeting and soil testing;
8. Use of perennials in systems;
9. Stocking rate and intensity;
10. Managing biodiversity, and
11. Water budgeting

Authors: Stuart Kearns and Alan Umbers

Stuart Kearns
Grains Research & Development Corporation
PO Box 5367
KINGSTON ACT 2604
P: 02 6166 4500
E: s.kearns@grdc.com.au

Alan Umbers
Umbers Rural Services
PO Box 138
GRENFELL NSW 2810
P: 02 6343 7188
E: alan.umbers@bigpond.com

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Foreword

Agriculture is characterised by change. Coping with changing seasonal conditions, commodity prices and other external forces is a feature of Australian farming.

Over recent years, grain growers have demonstrated their resourcefulness and success in managing their response to what has been a run of challenging seasons.

Within the grains (and mixed farming) industries, the farming practices in use today continue to provide grain farmers with tools and options to prosper in the face of such challenges.

The adoption of sustainable practices in tillage, fertilizer application, crop residue management, integrated pest, disease and weed management, rotations, precision agriculture, and others have all contributed to the success and resilience of grain businesses.

The grains industry, through GRDC, continues to invest in farming practices research. To effectively invest in research that can better deliver improved practices, it is necessary to assess which farming systems and practices are working well, and where 'gaps' are evident.

The GRDC invests around $117 million of grain levies and government funds each year in research, development and extension. Of this, around $37 million is invested in farming practices research providing grain growers with better choices and information to enhance farm productivity and sustainability.

The GRDC, in partnership with the Australian Government's Caring for our Country program, have worked with Solutions Marketing and Umbers Rural Services to conduct a national survey of growers to capture and present information about the farming practices currently in use on grain and mixed farms across Australia.

This information provides an important means for monitoring and evaluating the success of RD&E investments, i.e. the levels of adoption around Australia, identification of successes and gaps, and for assistance in directing future investments, or for modifying existing projects.

Recently, the GRDC and associated agencies in the grains industry identified a number of key management practices, considered important in driving productivity, profitability, sustainability and environmental improvements on grain farms.

This report details the scale at which these farming practices are being used by Australian grain growers and will become a focal point in planning and evaluating GRDC R&D initiatives such as its Water Use Efficiency, Grain & Graze 2 and Crop Sequencing programs.

We look forward to working with our industry's growers, advisers and research partners in new and proven ways to improve these baselines, making our industry more sustainable and profitable.

Steve Thomas
Executive Manger, Practices
Grains Research and Development Corporation

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Historic Baseline Information of the 11 major farming practices

Executive Summary of Main trends

The GRDC and associated agencies in the grains industry have identified a number of key management practices, considered important in driving productivity, sustainability and environmental effects on grain farms.

11 Key Management Practices

The GRDC and MLA have identified the following sustainable farm practices that are to be targeted in a Mixed Farming Systems Program to achieve on-farm impact for both enhanced productivity and environmental management.

- Land use - land use to land class. The actual use of land on the farm and how well this relates to land capability as described by land class
- Reduced or no-tillage. The use of minimum zero- or no-tillage systems for crop and pasture establishment
- Stubble retention. The level of retention of crop and pasture residues following harvest or grazing.
- Crop rotation with pastures oilseeds and pulses.
- Controlled traffic/ precision agriculture
- Integrated weed/pest/disease management in crops and pasture.
- Nutrient budgeting and soil testing in crop and pasture.
- Use of perennials in systems.
- Stocking rate/intensity.
- Managing biodiversity
- Water budgeting

Encouraging increased levels of adoption of these practices remains an objective of the investments within the grains industry.

Measurement of farming practices – establishing Baseline data.

In late 2009 GRDC commissioned a market research company (Solutions Market Research) to contact a national subset of grain producers and gather data about their farm operations and practices directly from these. The survey was based on the operations on the farms for the 2008 (winter) cropping year.

Methodology

Questions were selected to allow data to be gathered about the 11 key practices as listed above, and sought quantitative answers wherever possible.

Qualitative questions would require considerable additional time, a different questioning technique, and be best considered in separate surveys or other activities.

The questionnaire was restricted to 15 minutes in length and was carried out in October 2009.

Data was prepared by Solutions into spreadsheet format with question coding and the data aligned, before being sent to the Farming practices database project for processing, interpreting and presenting.

A total of 1300 sets of data were provided for analysis, providing a spread of farms in each AE-Zone.

The Solutions data was imported into the Farming Practices Database, various manipulations and calculations carried out to ensure conformity with the database, and for ease of amalgamation to AE-Zone level. Each record was checked for validity, errors and simple keying mistakes.

Data has been presented in most cases amalgamated to AE-Zone level.

Data are presented in tabular, graphic and map format.

Major findings from the analysis of Farming Practice data for 2008.

Numbers of farms, growers and basic crop statistics.

Number of grain holdings in the dataset

The survey of 2009 represented 3.4% of grain growers as compared with ABS, though based on industry estimates of 27,000 properties, this would be approximately 4.8%. As a rough approximation, **the survey of 2009 provided data for close to 5% of the grain farms in Australia**.

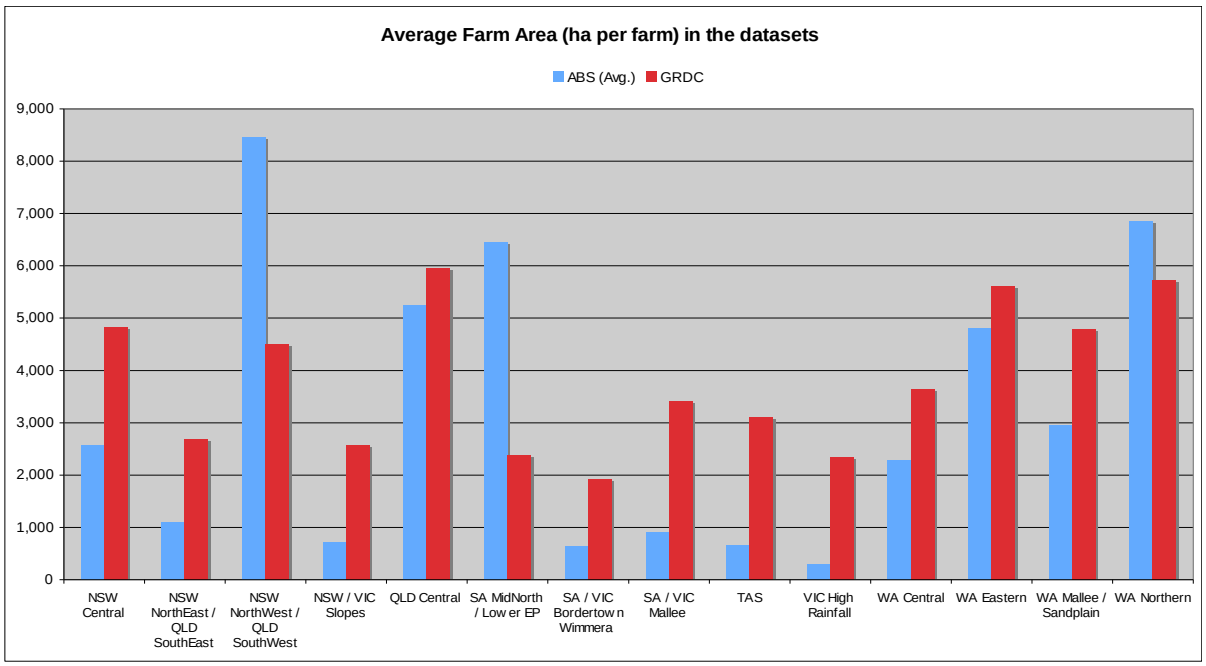
In some AE-Zones the 2009 data represents fewer than 2% of grain farms, while in one case more than 10% of properties participated.

The industry is characterized in having a strong minority of farms tending to produce a large majority of the grain. Hence, an examination of the cropped areas represented in the dataset is a valuable adjunct to a consideration of the number of farms participating.

Farm Size

The GRDC dataset covers farmers who are at least or larger than average in size. The dataset is seen to represent the nature of the industry, whereby it is likely to reflect the practices carried out on the 90% or so of the area of the crop, as farmed by 50% of the grower population.

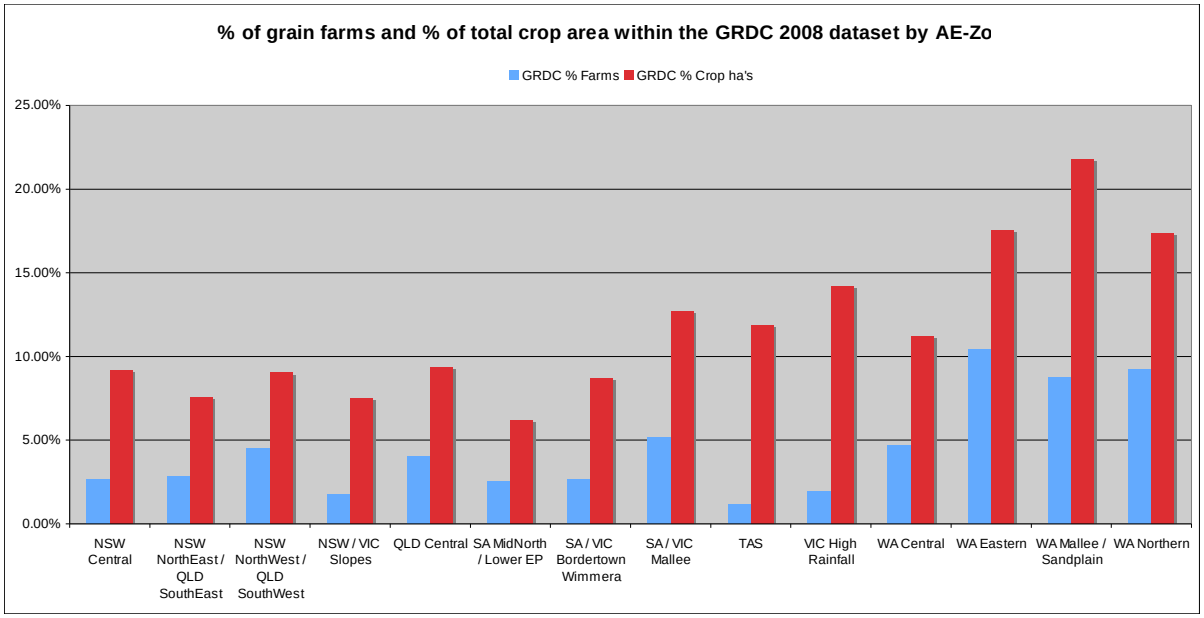
Farm size (average per farm) from ABS (avg. of 2000 and 2005) and from GRDC 2008, by AE-Zone



Crop Areas:

The total area of crop as represented in each AE-Zone in the GRDC dataset is greater than the proportion of either total farms or total farmland in the dataset. The total number of grain farms in the 2008 dataset is around 5%, while the area of crop these represent is over 10%.

Percentage of farms and cropped area represented by the GRDC dataset by AE-Zone



The dataset from the survey of 2009 can be said to give some approximation to the management practices used on a 'typical' 10% or so of the area of crop production in Australia. In some AE-Zones well over 10% of the crop area is represented and in others less than 10% appears.

Area of crop per farm

The data suggest that the farmers in this survey crop between 40% and over 60% of their farmland.

Land use - land use to land class. The actual use of land on the farm, and how well this relates to land capability as described by land class.

Farms and areas where land has been characterised for capability.

Approximately one third, and in some AE-Zones considerably more, of grain farmers have characterised their land for capability for the various enterprises carried out.

It is apparent that a considerable proportion of cropping land has been characterised for land capability by these farmers. The areas of land that has been characterised for capability is around 30% of the total cropping areas in these AE-Zones.

In many or most AE-Zones, almost all the average crop area on those farms doing land characterisation has been characterised. This is a powerful result and indicates that grain farmers, notably the larger or more intensive operations are considering their land capability, and have considered this in their operations on their farms.

Farms and areas where crop planting has been matched to land capability.

The GRDC dataset suggests that most who have characterised their land are then matching their cropping activities to the land capability.

The area of crop where matching has occurred is generally high at this time (approximately 20% of total land area, and over 30% of total crop area), when the practice of land characterisation and matching is relatively new.

The striking statistic is that in many AE-Zones, those farmers that have matched their cropped area to land capability have done so on almost all their cropped area, and in some cases on areas other than where crop is grown. This suggests that some farmers are using the approach of land and enterprise matching on more than their cropping areas.

Tillage.

Reduced or no-tillage. The use of minimum, zero- or no-tillage systems for crop and pasture establishment

The adoption of No-Till is extremely high, at over 90% of the cropped area in most AE-Zones, and below 80% in only one. This is an enormous change from only 8 years earlier. The data indicate the use of a multiple-tillage based system almost disappearing in this period.

Breakdown of the categories of Tillage for the 2008 (winter) crop year

Both 'no-till' and 'minimum tillage' were further divided into sub categories as follows:

No-Tillage:

- No-Till 10: Where soil engaging machinery use at planting disturbs less than 10% of the soil surface.
- No-Till 30: Where machinery disturbs more than 10% but less than 30% of the soil surface across the planting width.
- No-Till DD: Where machinery disturbs effectively the full width of soil across the machine.

Minimum Tillage:

- Min Till 2: This is where less than 2 (and most often only one cultivation) occurs prior to the planting operation, normally with a 'full soil disturbance' implement.
- Min Till Red: Where more than two, but less than the 'normal' conventional numerous multiple tillage operations occur before planting.

Multiple Tillage

This tends to be a system, often including a long, cultivation-based fallow, where tillage is the dominant method of soil preparation prior to planting. This category has previously been known as "conventional cultivation", where the objective has been to ensure a weed and residue-free fine and loose soil at planting.

The adoption of no-till 10 and no-till 30 are now higher than that of no-till DD in almost every AE-Zone, indicating that growers seek to disturb their soil as little as possible. The adoption of no-till 10 is highest in much of NSW and QLD and in the high rainfall areas of Victoria.

In WA, the use of knife-type planting systems remains high, though disc-based implements are also significant now.

The levels of minimum tillage are generally very low in all AE-Zones, such that it can be claimed that no-till is now by far the most dominant crop (and perhaps pasture) establishment system in use in Australia, certainly among the larger grain-producing farmers.

Considering the management of soil, and the desire to minimize soil erosion and maximize moisture storage, the adoption of very minimal soil disturbance practices would be seen as very strong movement by grain producers to combine productivity and environmental benefits.

Stubble Retention.

Areas of various stubble (crop residue) management practices.

The vast majority of stubble on farms in the survey is either left intact or left not-standing, with over 90% retained in most AE-Zones, with very small proportions burnt or otherwise managed.

Crop Rotation with pasture, oilseeds, pulses etc.

Area of crop per farm

As a general observation, area of crop per farm has increased through the 2000's, though whether this is a consequence of a similar increase in farm size, or as an increase in amount of crop per farm is difficult to determine, though perhaps a combination of both is present to some extent, at least in some of the AE-Zones where grain production dominates.

Percentage of crop (as proportion of total farm area) per farm

It appears that in WA, central QLD, and parts of NSW the proportion of crop to farm area has increased, signaling increased crop intensity, though in other AE-Zones this is less apparent.

The GRDC dataset suggests that the farms in the survey are at least as crop intensive as that suggested by ABS, or that crop intensity on farms has grown in recent years.

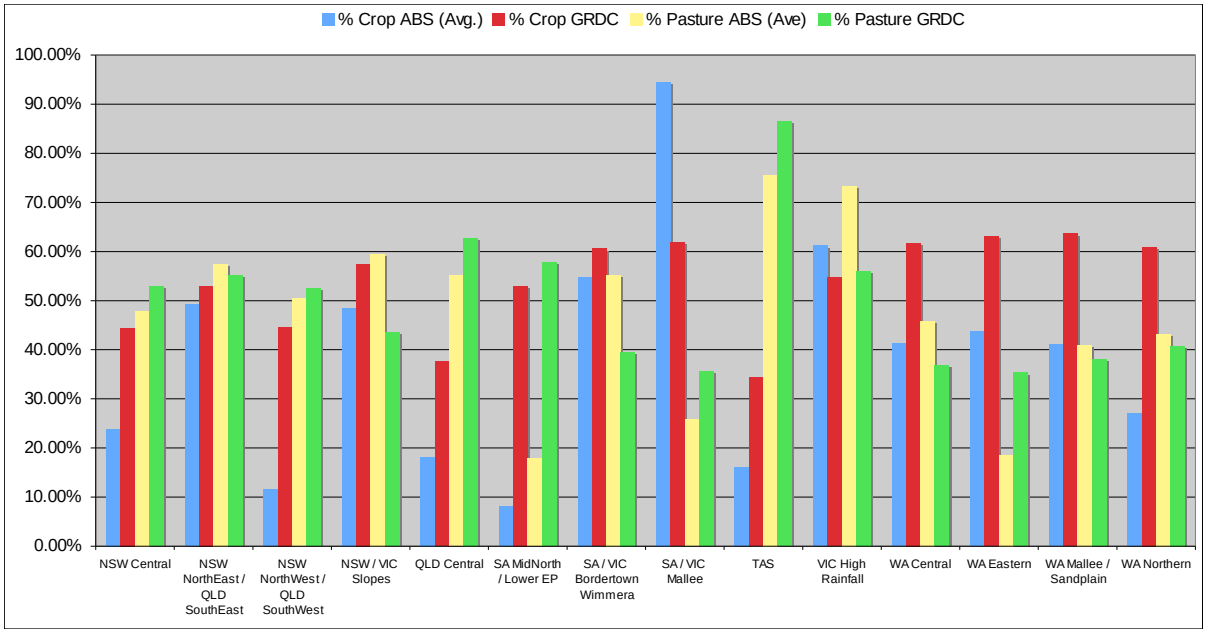
Pasture Areas:

Data on 'pastures' is often complicated by the definition of a 'pasture', since pastures can be perennial or annual-based, 'improved' (i.e. planted and managed as a dedicated pasture), or 'unimproved' (i.e. volunteer plants, or native species that simply emerge on land otherwise not managed), or several combinations of these.

For these reasons data about pastures often fluctuates widely between censuses and is often difficult to make solid interpretations about.

However, as a general rule, where area of crop is high, pasture is expected to be low, and *vice versa.*

Average % of total area as crop and pasture per farm by AE-Zone (ABS and GRDC)



Crop Mix on Grain Farms

The proportion of wheat would appear to have declined in many AE-Zones in recent years, though ABS data suggest some increases in WA, Victoria and central QLD. The three datasets tend to agree on the decline in NSW and parts of SA and the Mallee.

ABS data shows a relatively strong growth in barley plantings (as a proportion of crop area) between 2000 and 2005, though the GRDC survey of 2008 shows a general decline by that year.

The GRDC dataset indicates very small proportion of other cereals in the crop mix. "Other cereals" tends to include oats and triticale.

Summer crop essentially only appears in the northern grain areas, notably in northern NSW and Queensland. The areas have remained at between 20% and 30% of the crop area, though the data suggests this has declined slightly in 2008.

The proportion of oilseeds planted has shown a general downtrend since 2000, with all datasets suggesting this.

The proportion of pulses has decreased in almost all AE-Zones (except Queensland, possibly driven by soybeans and mungbeans). Pulses are now relatively minor crops, especially as indicated by the GRDC data.

Precision Agriculture.

1. Controlled Traffic (CT).

The data shows that adoption of controlled traffic among grain farms in the dataset represented approximately 15% of both the hectares and number of farms, with some AE-Zones showing higher level than this, for example, all AE-Zones in the northern region, and the high rainfall areas of Victoria.

Those who were using CT were using it on a large proportion of their crop areas.

In every AE-Zone those farmers adopting CT are larger grain farmers than the average, and are using CT on this area of crop on their farms. This suggests that those who have adopted CT are using it pretty much on all their cropping country.

2. Autosteer.

The data from the GRDC survey show the adoption of autosteer at quite high levels, considering this technology has been available only in relatively recent years.

In the main grain AE-Zones the use of autosteer is over 50%, and in some cases around 75% of the crop area.

Again, the indication is that the larger grain farms are embracing this technology, with a suggestion that autosteer is used on all the crop area of the farms where it is used. That is, the larger farms are adopting this technology, and because they are larger, a greater proportion of the crop is using this technology.

3. Variable rate Technology as used with Fertiliser application.

The use of this technology is lower than that for Autosteer, though in many AE-Zones appears little different to that for CT, at around 12% to 13%. In some AE-Zones it is as high as 20% or more of the area and number of farms, notably in the Vic / SA Mallee.

This technology is relatively new, and can be quite complex, and to see the levels of adoption at these levels is an indicator of some note.

However, as opposed to the data for CT and Autosteer, where VRT is used it is not used on areas of crop as large as for CT and Autosteer, possibly indicating farmers as still learning how best to employ this technology before using it on the whole of their crop area.

4. Yield Mapping.

Yield mapping is adopted at levels similar to those of CT, at generally around 20% of the total area though slightly less in terms of number of farms.

However, the data also suggest that where it is used, the area is often large, suggesting that there are farmers who use yield mapping where they do not use other PA techniques, for example, Autosteer. This seems to be the case in WA, the mallee, much of SA and parts of NSW.

It is also possible that where contract harvesters are used, many of these will have yield mapping capability, and so the farmers will be able to obtain yield maps where they are not using other PA techniques.

5. Levels of adoption between the various elements of PA.

It appears that (in general) CT is widely used on larger farms with larger crop areas in the eastern areas of WA, the mallee, and the NSW NW / QLD SW AE-Zones.

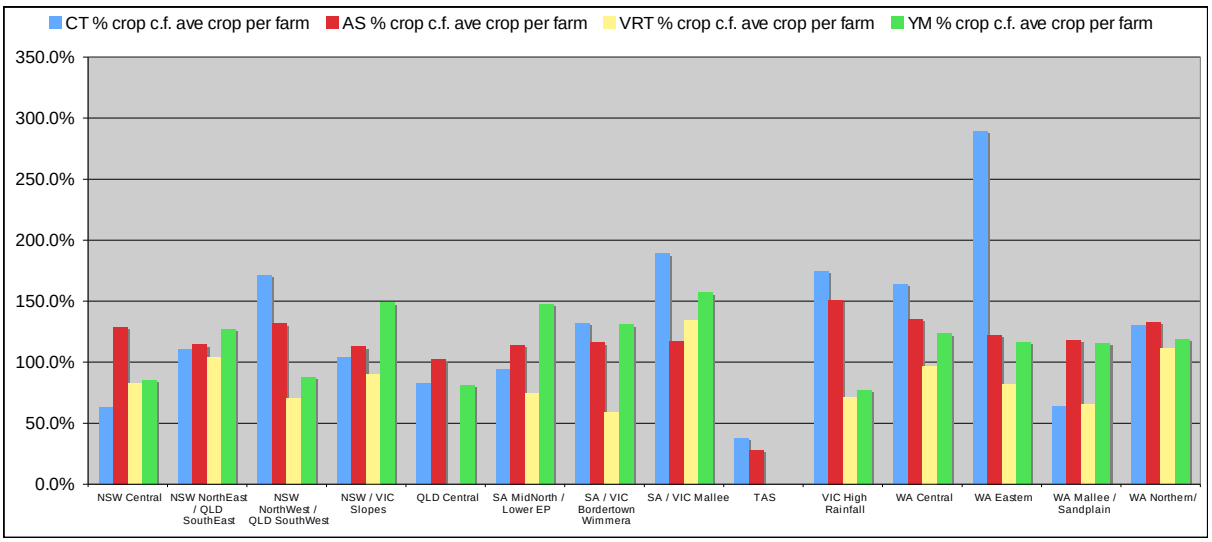
Autosteer appears relatively popular everywhere, with most or all of the crop using this where it is used.

The use of variable rate technology is just that: variable, suggesting that farmers are still learning where this is best applied, or that the adoption is not yet high.

The use of Yield mapping is also relatively high, with most of the crop being mapped on farms where this technology is available.

Nonetheless, as a general comment the adoption of the various elements of precision agriculture can be considered high, and relatively rapid.

Figure 14. % of total crop where various elements of precision agriculture are used as compared to the average of crop area in the survey dataset as a whole. (GRDC, 2009)

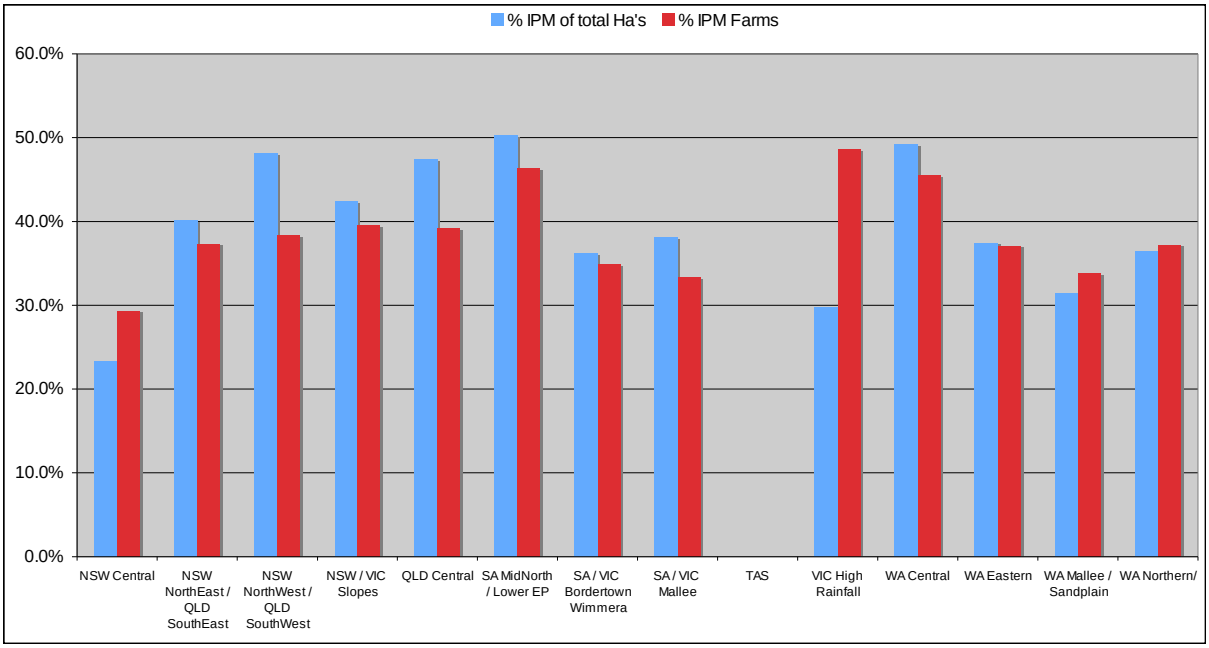


Integrated Pest, Disease and Weed Management.

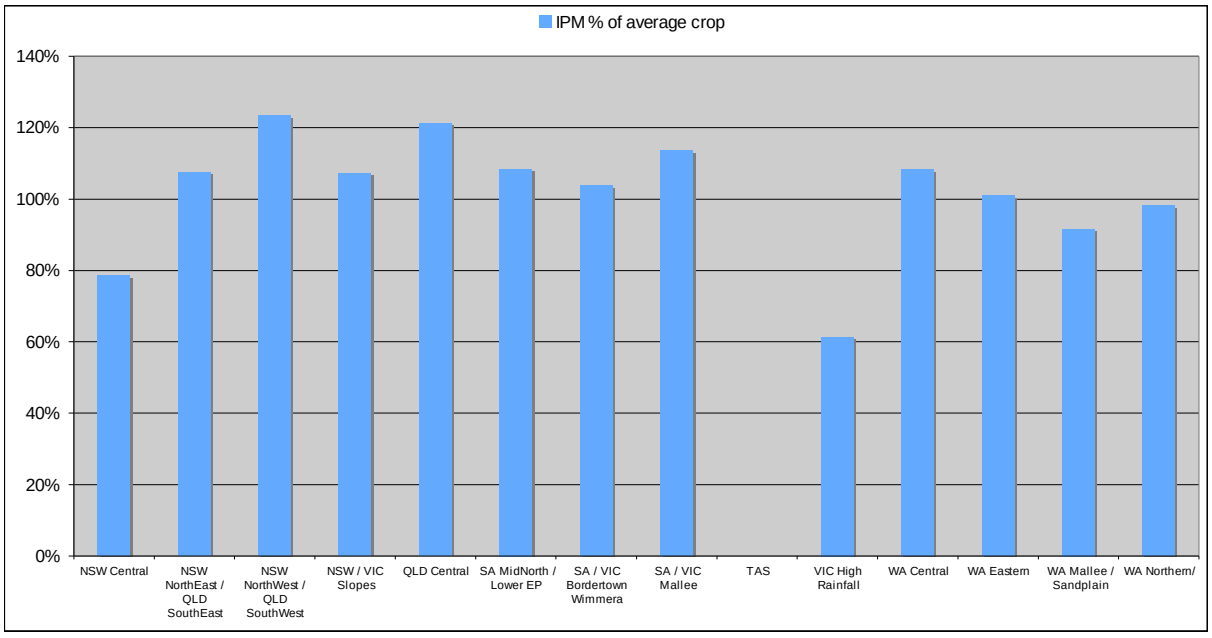
Almost 40% of the crop area in the sample reported using a range of IPM practices, on just over 38% of the farms.

However, when one looks at the area of crop on these farms using IPM, it appears that almost all of the crop is managed with IPM techniques on these farms. That is, where IPM is practiced, it is used on all the crop area, and perhaps some non-crop areas, for example, pastures.

% of total crop area (ha) where IPM is used, and % of farms using IPM (GRDC, 2009)



Area of crop where IPM is used (on farms using IPM) as compared to the average crop area in the dataset (GRDC, 2009)



Nutrient budgeting and soil testing in crop and pasture. Area of soil testing, nutrient budgeting and phased use of fertiliser

Amount of soil testing being carried out on grain farms in 2008

Approximately two thirds of grain farms are using soil tests, with this representing just over three quarters of the total crop area. These figures are slightly lower in SA, and higher in NSW and WA.

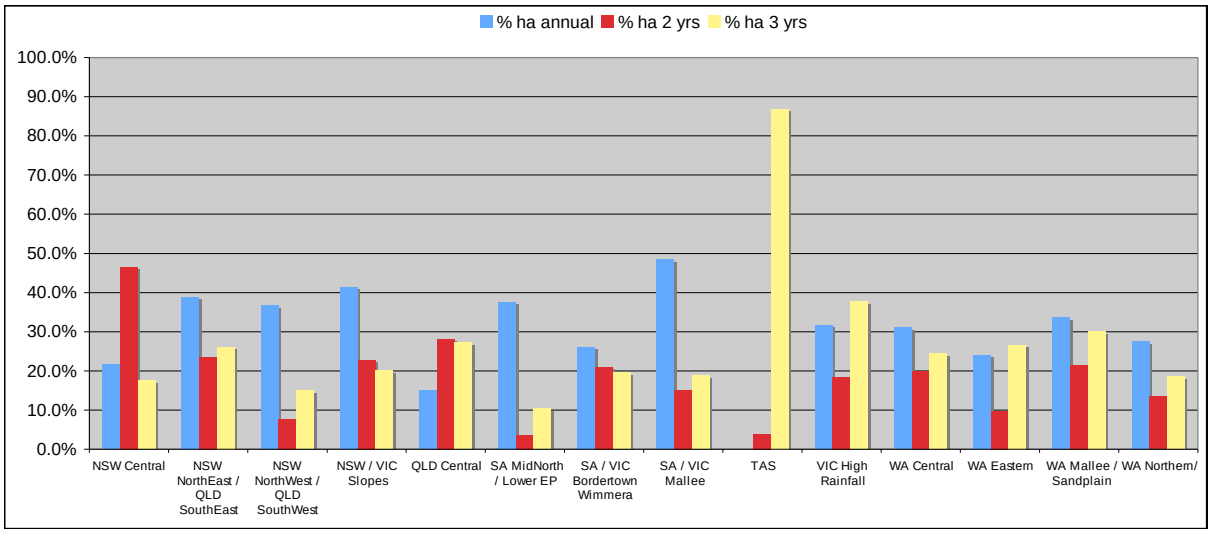
The average area tested exceeds the average area of crop in the dataset, suggesting that the farms doing soil tests are larger crop farms, and/or that they test all or almost all of their crop areas, or that areas of pasture are also soil tested. This suggests that soil testing is a practice carried out on larger or more crop-intensive farms, and where practiced is done on all of the soils of interest.

It is apparent that soil testing is a relatively common practice in Australia, both in terms of number of farms and cropping area.

Frequency of soil testing being carried out on grain farms in 2008

The data suggest that the frequency of testing is relatively evenly spread, with about one third testing annually, 2-yearly or 3-yearly, with a slight dominance for annual testing. There are some differences between AE-Zones, though these are relatively minor.

% of crop area (ha) where Soil is tested annually, every two or every three years (GRDC, 2009)



Use of Fertiliser program based on soil testing in 2008

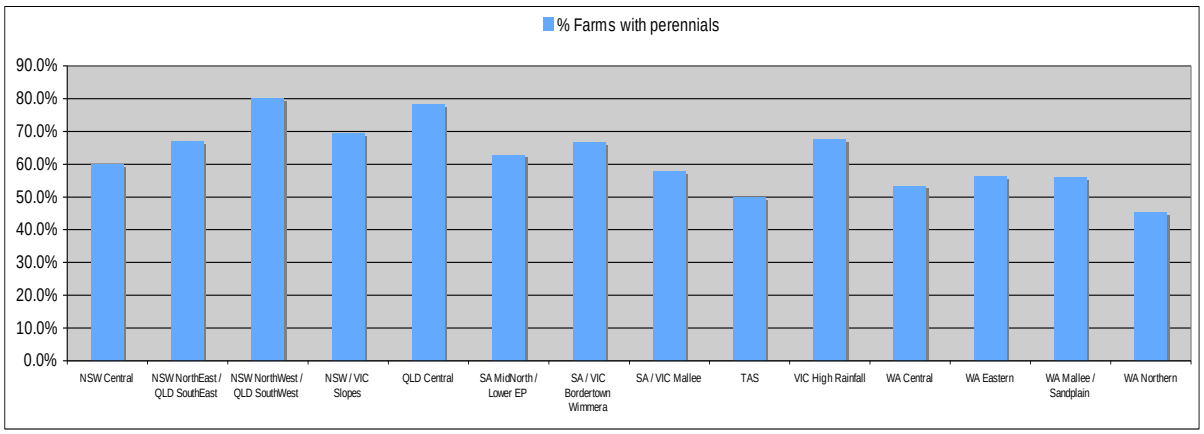
These data show about 60% of farms were matching their fertiliser plans with the results from soil tests. Further, that where they do, this it is done on the majority of the crop area of the farm. Looking at the average crop area where this is done, the area where this practice is done exceeds the average crop area of the dataset, suggesting that these farms are larger in cropping terms, and are matching their fertiliser use to soil tests on most or all of their crop area.

It is clear that where soil testing is carried out, it is heavily used to inform fertiliser use and tactics more or less across the cropping area in a general sense.

Use of Perennials in systems.

Area of perennial pasture, area of native and permanent vegetation, area of replanted and protected areas

Average % of farms with perennial vegetation in 2008, by AE-Zone (GRDC, 2009)



The data presented in the figure above show that the number of farms reporting some areas of perennials greatly exceeds that reported to ABS a few years earlier, with more than 50% of farms in most AE-Zones having areas of perennial vegetation.

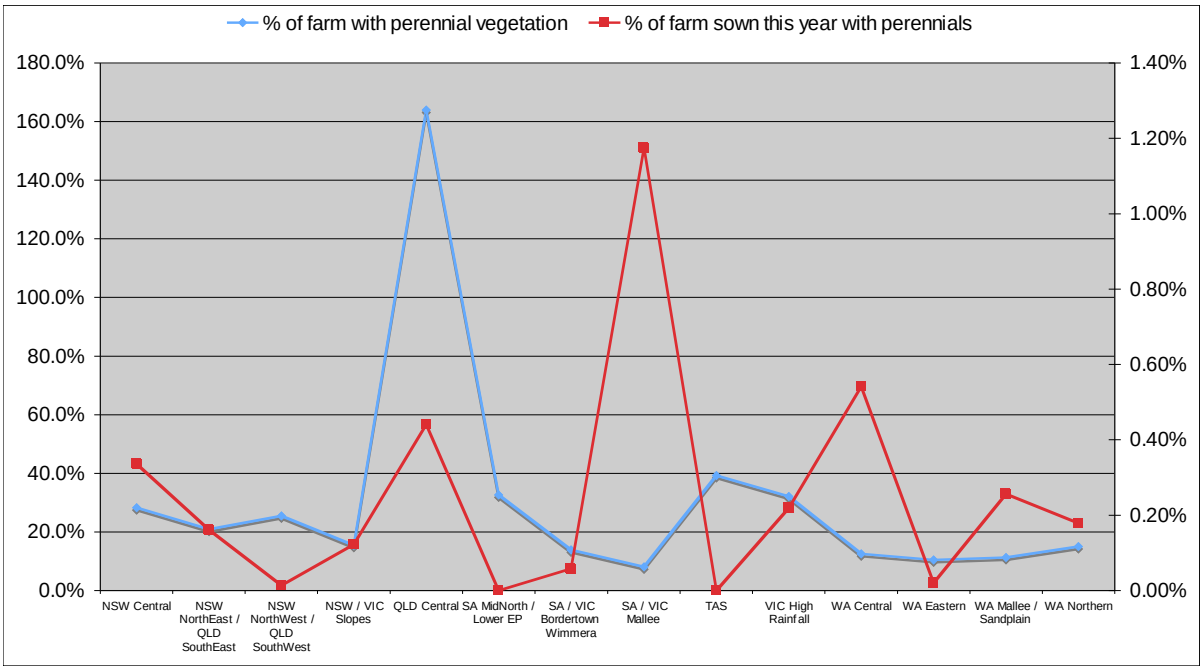
The figure shows (in general) that in most AE-Zones, most farms have perennials, and in some AE-Zones the area of perennial vegetation on farms can be significant, exceeding 20% of farm area in approximately half the AE-Zones.

However, these data are at odds with ABS data from earlier censuses, and reasons for this are difficult to ascribe since the questions asked by ABS in the census and those in the GRDC survey of 2008 either are or have been interpreted by growers quite differently in how they have been answered.

The general category of 'perennial vegetation' on farms is open to wide interpretation as to what it includes, and how to report. Therefore some further thought needs to be given to describing what is meant when asking such questions in the future, to ensure consistency of response and validity of making comparisons.

Nonetheless, it appears that there are healthy areas of perennial vegetation on many grain farms in Australia.

Figure 5. Average % of farm with perennial vegetation, and average % of farm area planted with new perennial vegetation in 2008, by AE-Zone (GRDC, 2009)

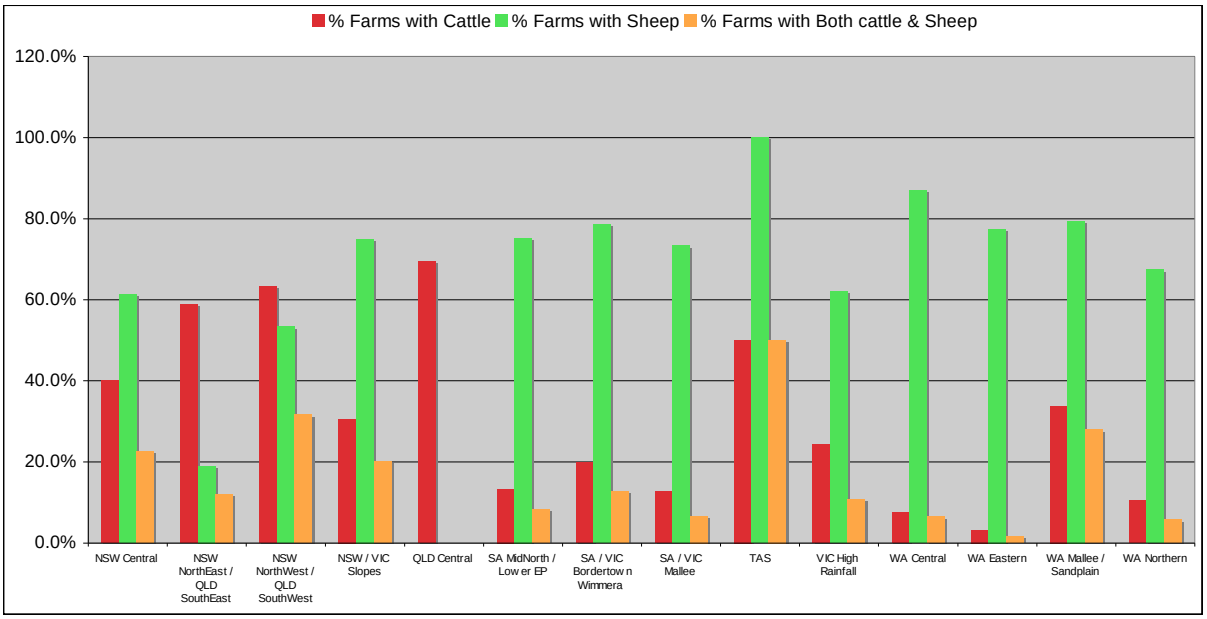


As opposed to the ABS data shown above, the close connection between area of perennials on farms and the area planted in the year is not as apparent, and quite divergent in some cases (for example, in the Mallee). Perhaps it is a feature of perennials, whereby farmers do not need to plant these every year for them to be present, and hence how much is planted in any one year is due to circumstances in operation in that year, for example seasonal conditions, pasture health (in the case of perennial pasture), or other factors.

Livestock Management.

Number of mixed grain and livestock farms

% of farms with cattle, sheep or both in 2008, by AE-Zone. (GRDC, 2009)



About one quarter of grain farms have cattle and two thirds have sheep, with 12% having both cattle and sheep.

Cattle dominate in Queensland and northern NSW, and sheep in all southern areas.

Cattle numbers are also higher in the northern AE-Zones and sheep numbers higher in the more extensive areas of western NSW, SA and WA. High sheep numbers are also apparent in the higher rainfall areas of Victoria and in Tasmania.

Proportion of pasture area used for grazing on mixed grain and livestock farms

The GRDC dataset has been manipulated to show the proportion of pasture area used by those farms with cattle and sheep, or both.

The areas of pastures used to support cattle or sheep on grain farms tend to follow a similar pattern as that seen with the number of farms and stock numbers, that is, more pasture is used for cattle in northern Australian and more for sheep in southern AE-Zones. The areas used for sheep approximate about double the areas for cattle as an overall average.

Proportion of mixed grain and livestock farms adjusting stocking rate for Cattle and/or Sheep to optimize ground cover

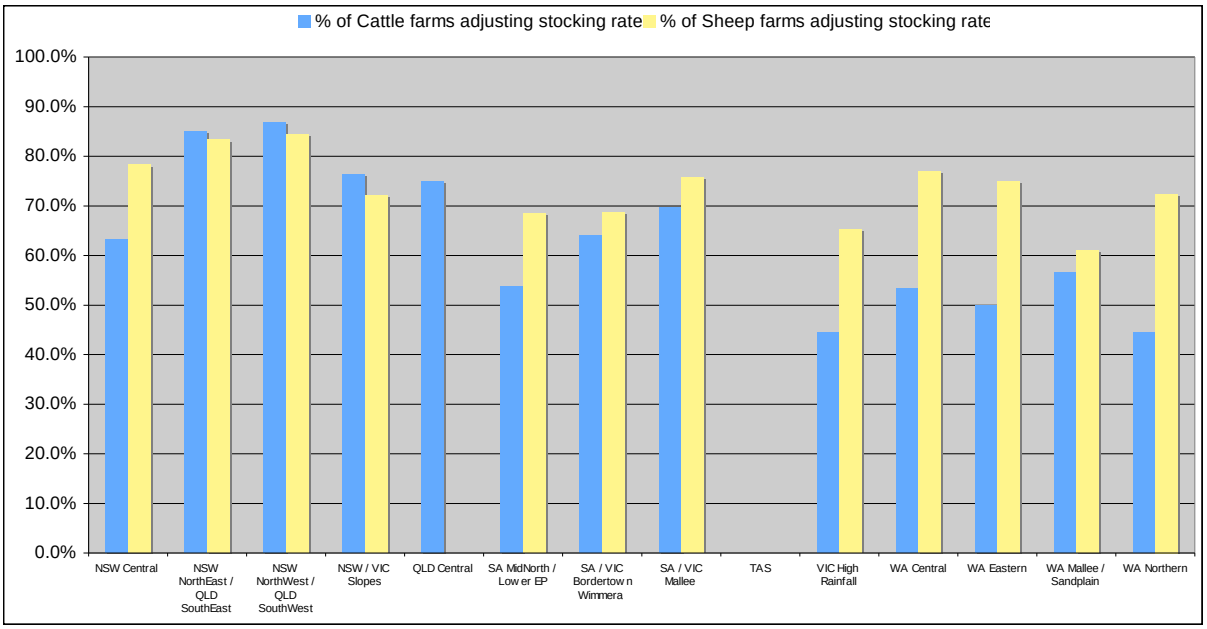
The key practice of interest is how much grain farmers who also have livestock are adjusting their livestock management, mainly stocking rate, in light of the feed on offer, and the amount of ground cover present.

Analysing actual stocking rates does not provide meaningful information since without knowledge of the feed on offer, and ground cover, any stocking rate may be appropriate, too low or high.

However, the practice of adjusting stocking rate to match both feed on offer and ground cover is seen as a good practice from both productivity and environmental management viewpoints, since it considers both the livestock and the soil and pasture resource.

It is apparent that over half of all grain farms with livestock have adopted this practice, with levels over 80% in some AE-Zones, notably in northern NSW and QLD, and also on sheep farms in WA and much of the southern AE-Zones.

% of grain farms with cattle or sheep where stocking rate is adjusted in light of feed and ground cover in 2008, by AE-Zone. (Source: GRDC, 2009)



Proportion of mixed grain and livestock pasture area where stocking rate for Cattle and/or Sheep is adjusted to optimize ground cover

The data show higher levels of adoption of this practice compared to only the proportion of farms, indicating that where this practice is used, it is used on all or most of the pastures used for grazing. It is also possible that these are larger farms (in terms of livestock numbers) and so are representing a larger cohort of the livestock farms, with this indicating that the larger livestock producers are adopting this practice.

The data are a strong indicator that mixed grain and livestock farmers are adopting the practice of adjusting their stocking rate to best match the feed on offer and the ground cover on their pasture areas. Approximately three quarters of the pasture areas where livestock are present are managed using this practice.

Managing biodiversity – remnant and native vegetation, riparian zone and waterway management and fencing off for protection

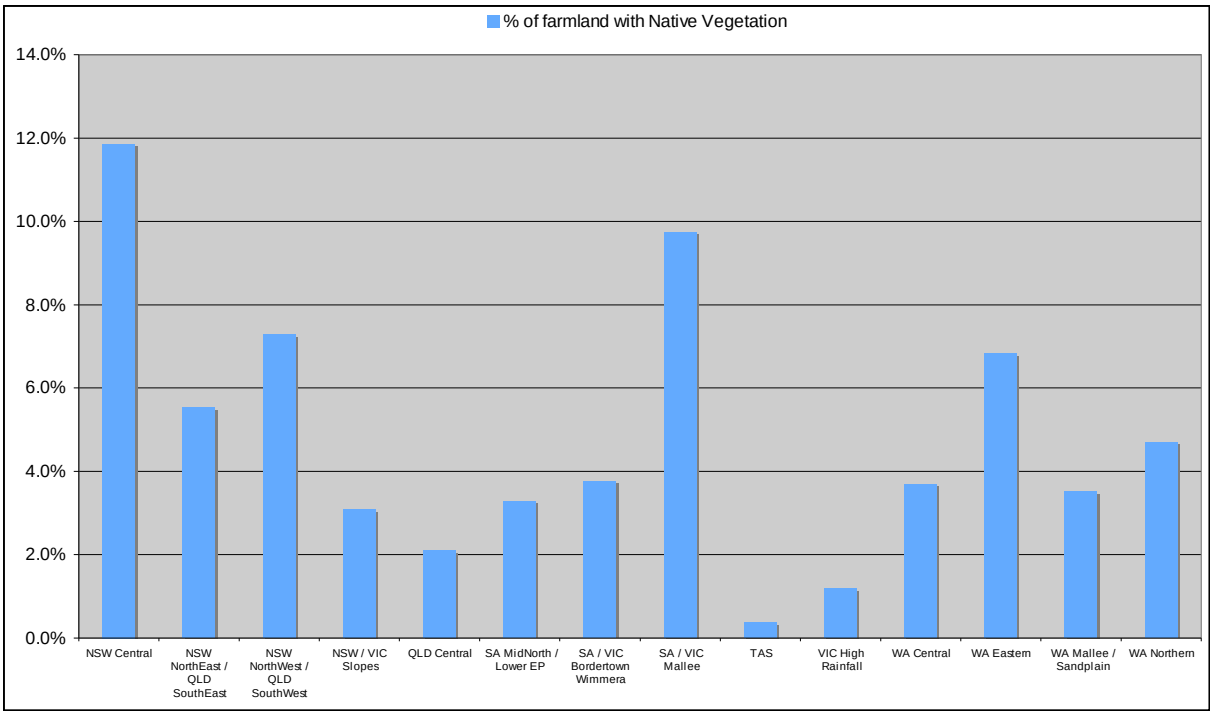
In the GRDC survey, landholders were asked to describe the proportion of native vegetation on their properties as being in 'good', 'moderate' or 'poor' condition. These data are therefore subjective, and subject to the landholders' view as to what 'good', 'moderate' or 'poor' means, and hence may not reflect a more objective assessment of vegetation condition.

The proportion of farmland reported as having native vegetation is roughly similar to the data from ABS of 8 years earlier, though departs from this in a few AE-Zones, with the Mallee, for example, showing a higher proportion in these data than those from ABS gathered earlier.

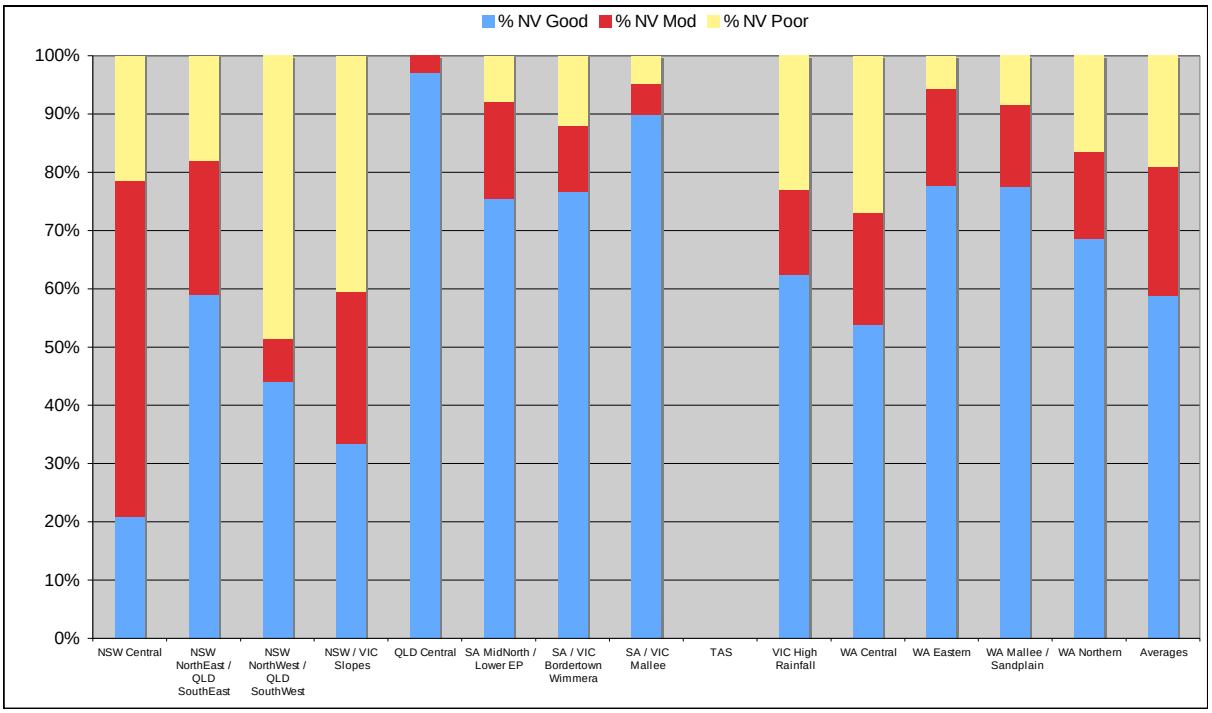
As a general observation, approximately 6% of property area has native vegetation, though there are differences between AE-Zones, with central NSW and the Mallee having larger proportions under native vegetation.

The area of native vegetation on farms appears to NOT have declined in the period between the ABS census and the GRDC data collection.

Average % of farmland having native vegetation in 2008, by AE-Zone. (GRDC 2009)



Condition (% of native vegetation described as 'good, 'moderate' and 'poor') on farmland in 2008, by AE-Zone. (GRDC 2009)



Considering the condition of native vegetation as assessed by landholders in 2008, the areas where 'good' native vegetation are dominant include most of WA, SA, QLD and Victoria. Poorer quality native vegetation seems to be more prevalent in NSW.

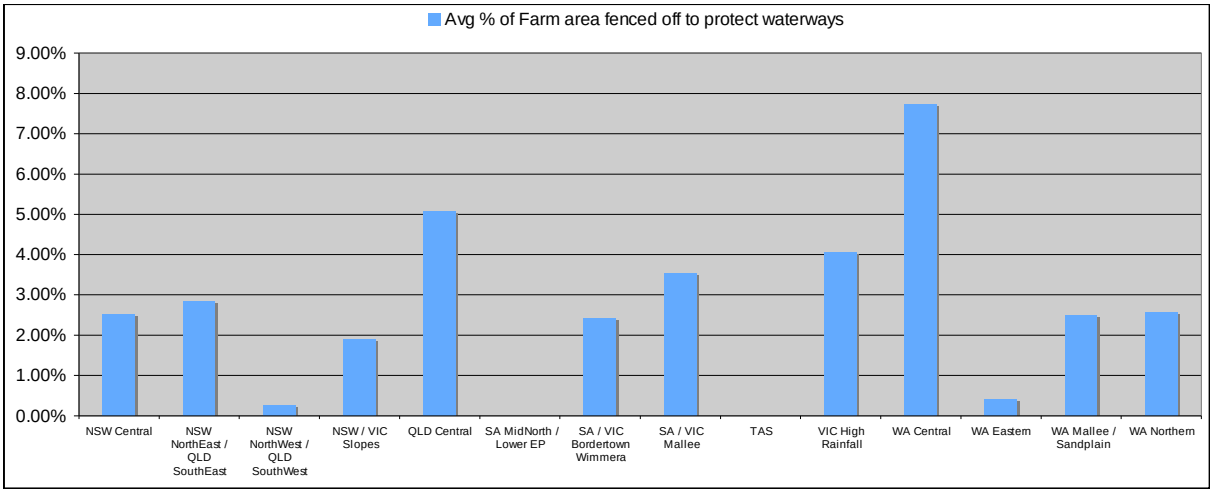
Area fenced off or otherwise protected for various purposes

Areas fenced off to protect waterways.

The data from GRDC for the 2008 year shows a considerably greater area and proportion of farmland (expressed as average per farm) fenced off to protect waterways as compared to the ABS data. This could be due to these (GRDC) data representing the total areas fenced off **as at** 2008 and not fenced off **during** 2008.

The data do show those areas likely to have more waterways (QLD, Vic High rainfall) to have more fenced off, though the relatively high area in WA central is at variance with these.

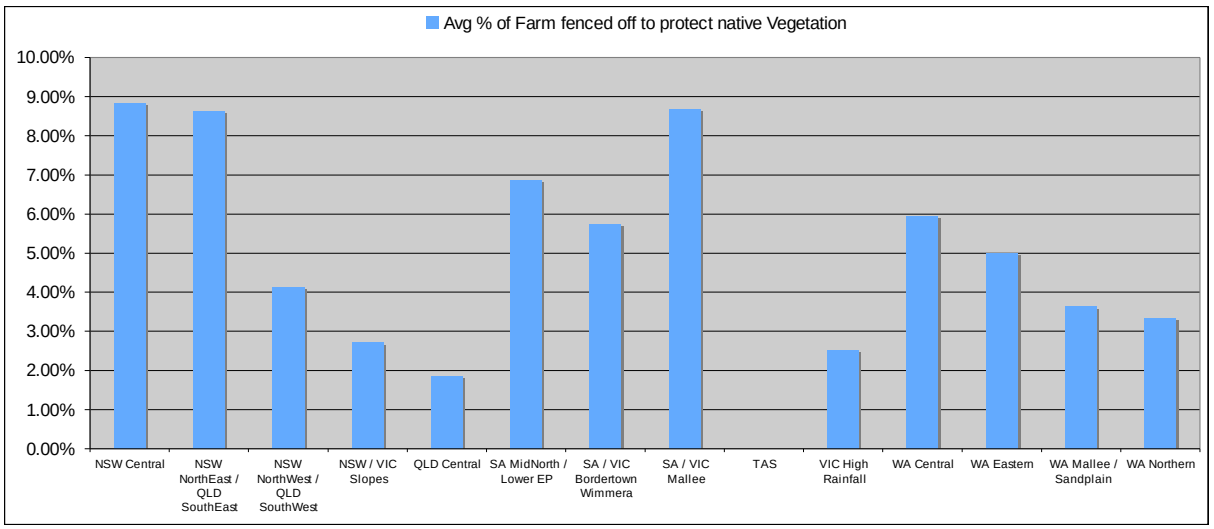
Figure 8. Average proportion of farmland (%) fenced off to protect waterways, by AE-Zone in 2008. (GRDC 2009)



Areas fenced off to protect native vegetation.

ABS Data shows in general well under 1% of the farmland in all AE-Zones has been fenced off to protect native vegetation as at both census dates.

Average proportion of farmland (%) fenced off to protect native vegetation, by AE-Zone in 2008. (GRDC, 2009)



Landholders in 2008 are reporting a considerably larger area and proportion of their farms as having been fenced off to protect native vegetation than that reported by both ABS censuses.

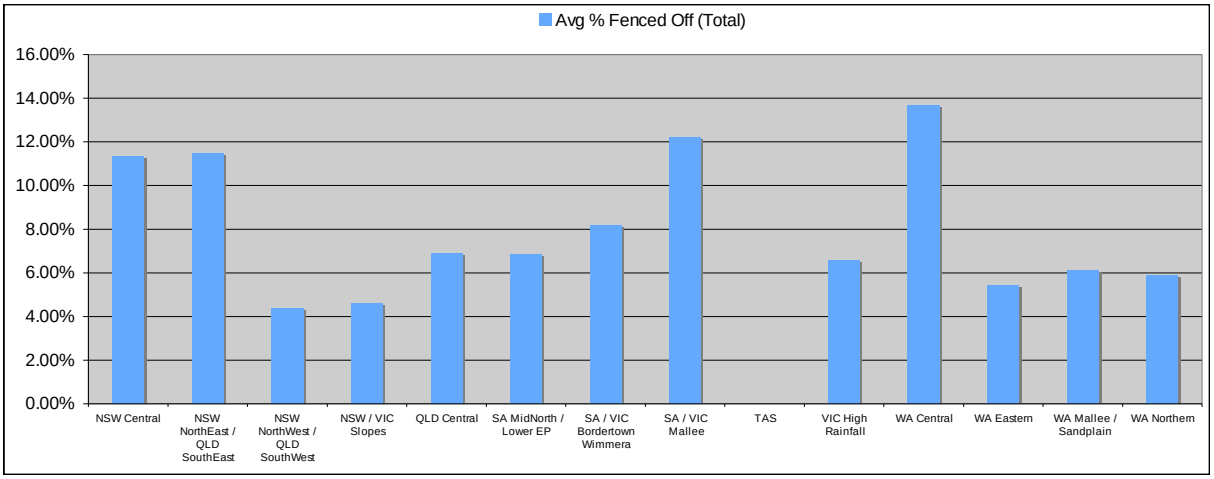
This may reflect the larger properties included in the 2008 dataset, or that landholders were reporting total areas fenced off on their farms **as at** 2008, rather than only what had been fenced off in the year of 2008. The latter case is likely, and suggests that around 5% of farmland on farms is now fenced off to protect native vegetation.

This suggests that some farmers are fencing off areas that are larger than the native vegetation they actually have.

Areas fenced off in total for protection of waterways or vegetation.

The data from ABS shows well under 1% of farmland having been fenced off for all purposes related to protection of waterways and vegetation.

Average proportions of farmland (%) fenced off in total for protection of vegetation or waterways, by AE-Zone in 2008. (GRDC)



Again, it is apparent that the total area fenced off as recorded in the 2008 survey again greatly exceeds the area as reported by ABS. The areas shown in the 2008 data are suggested to be the total area fenced off on the farms (as % of farm area) **as at** 2008, and not **what was fenced off in 2008**.

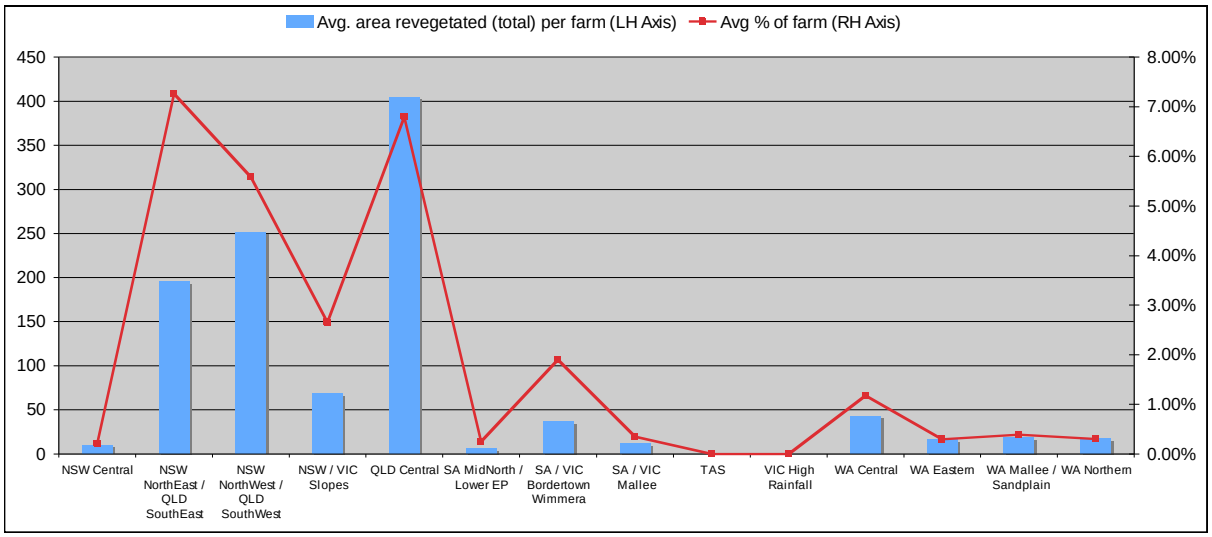
These data therefore are taken to represent the total area actually now fenced off on farms (expressed as an average % of the total farmland) as at 2008.

Of interest, the overall average proportion of farmland fenced off for all purposes exceeds the general average of native vegetation on farms, and can thus be considered to cover waterways and trees on farms. It is highly likely that as at 2008, much or most of the fencing off of areas on farms for protection of trees, native vegetation and waterways has been done.

In many AE-Zones, over 10% of the total farm area has now been fenced off for such protection.

5. Areas replanted with new permanent vegetation for all purposes.

Average area (ha) and proportion (%) of farmland planted or replanted for all purposes by AE-Zone in 2008. (GRDC)



The data from 2008 show larger areas and proportions of farmland having been replanted as compared to the earlier data from ABS. Reasons for this have been previously mentioned concerning

size of property in the GRDC dataset, and again, the possibility that the landholder answered the questions describing all areas that have been replanted or planted **as at 2008**, rather than **in 2008**.

Nonetheless, the majority of replanting has seen to occur in QLD and northern NSW, with relatively little being done in other AE-Zones.

Identification of practices that assist with optimising water Use efficiency (WUE), including crop yields, planting and harvest date and estimates of soil water at planting and in-crop.

Water Use Efficiency is an indicator of how effectively or efficiently crops use the water available (i.e. rainfall and stored soil moisture) in producing grain. It is commonly expressed in kg of grain produced per mm of available moisture. WUE can be influenced by a range of factors including several management practices available to grain producers.

WUE of crops averaged across AE-Zones in 2008.

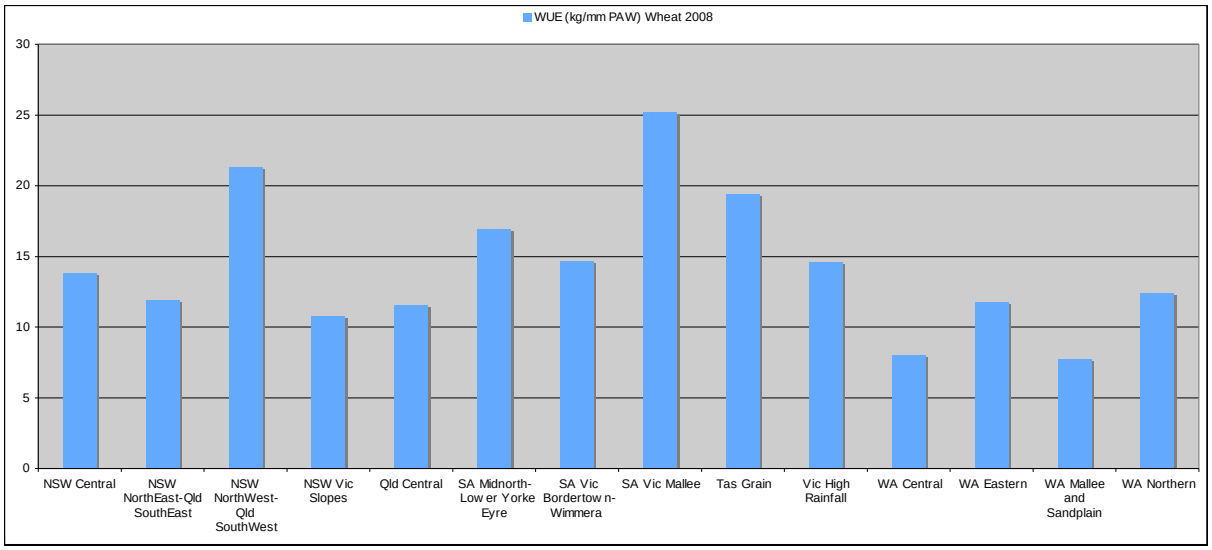
The data from the survey of GRDC for the 2008 crop year has been manipulated to calculate WUE of the various crops. This has followed the French and Schultz methodologies; though in amalgamating data to AE-Zone level brings deficiencies. The WUE data as presented are overall general averages for the whole AE-Zone, and can only be used to broad guidance as to what WUE was achieved for that year. Individual farms will have a large range of WUE results, since each farm (or paddock) and crop will have their own rainfall and crop yield data.

As such, the data are for use as overall generalities for this year, though can serve as comparisons with previous data derived using the same methodologies from ABS data of the previous censuses.

One can see quite high WUE figures for the Mallee, NE NSW, SE QLD and parts of SA for this year.

Conclusions as to reasons for the differences would require a more detailed analysis of the data, and knowledge of factors operating in each AE-Zone that may have impacted on WUE, for example timing of rainfall, sowing dates and the presence of limiting factors including frost, drought, weed and disease pressures.

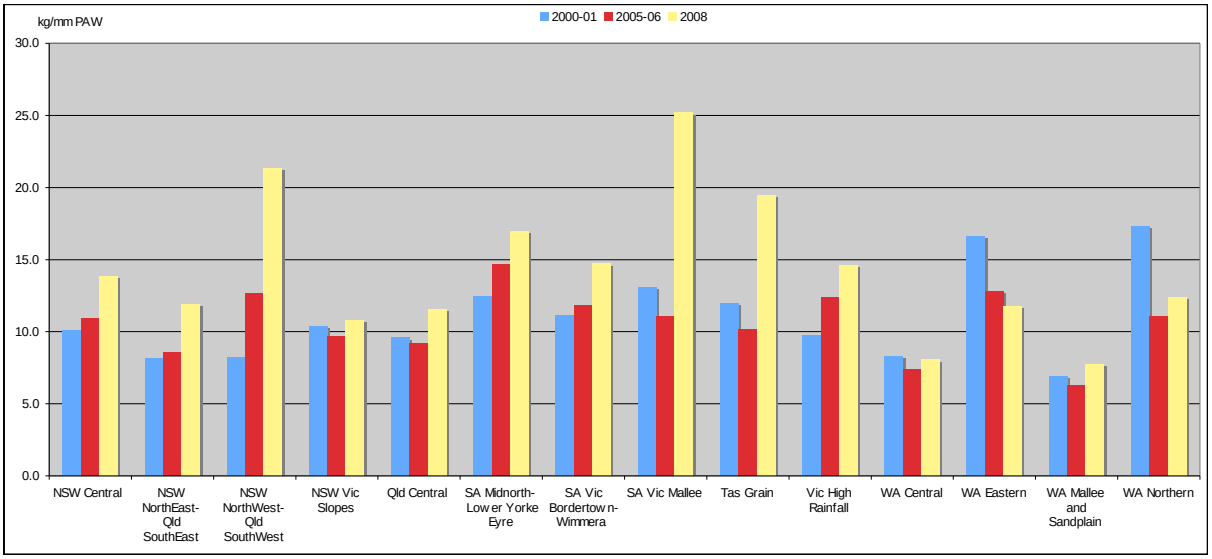
Water Use Efficiency (WUE) of wheat (kg grain per mm PAW) by AE-Zone. (Source: derived from GRDC data and BOM 2008)



Comparison of WUE across AE-Zones between 2000, 2005 and 2008.

Since similar methodologies were used to derive the E-Zone-level WUE figures for all data (i.e. ABS and GRDC data), it is possible to examine these for differences between these years.

Water Use Efficiency (WUE) of wheat (kg grain per mm PAW) by AE-Zone between 2000, 2005 and 2008. (Source: derived from ABS and GRDC data and BoM)



It is apparent that in general WUE (of wheat at least) has increased since 2005, in almost all AE-Zones, particularly in NSW and Victoria, but also in SA. Only in WA does WUE appear not to have shown a similar magnitude of increase, though it has over 2005 data in some areas.

Reasons for this are likely to reside in the nature of the GRDC data as compared to that from the ABS census (generally larger and perhaps more specialist grain producers), where one may expect higher WUE to be evident, seasonal conditions or other factors that can only be identified with finer analysis of individual farm data and knowledge of the seasonal and management regime under which the 2008 crop was grown.

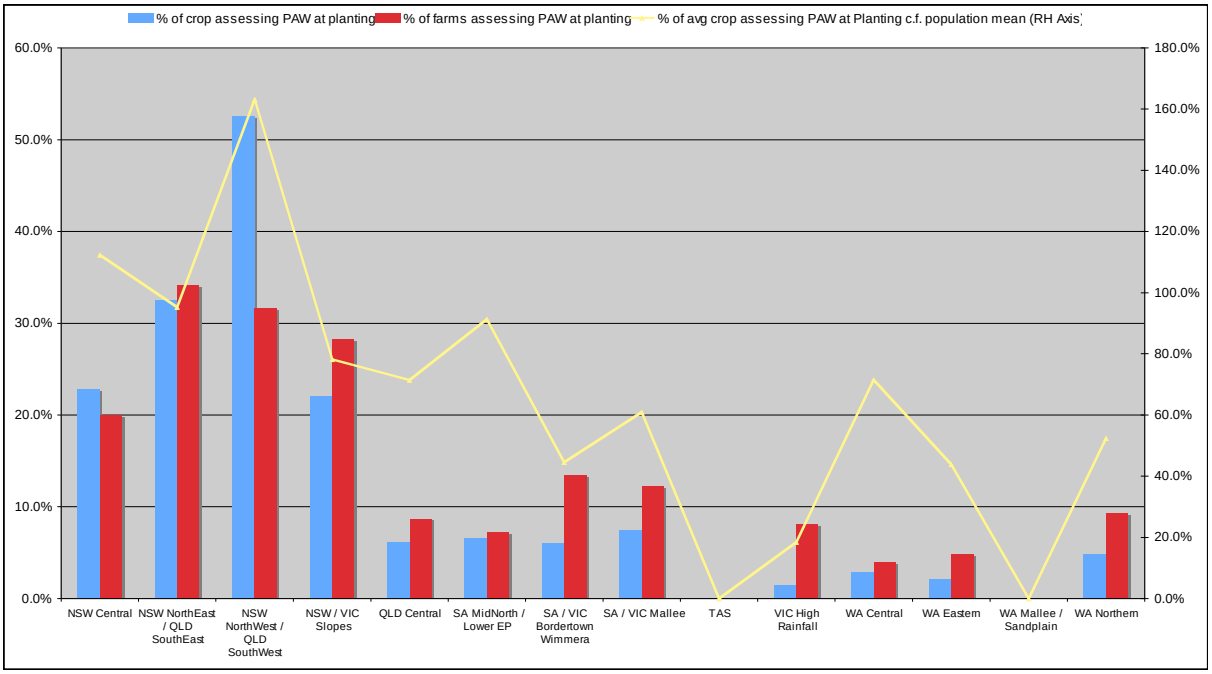
Nonetheless, the data do suggest a general increase in WUE through the 2000's.

Water Management Practices.

Within the survey carried out by GRDC two questions were included regarding the assessment of soil moisture both at planting and through the crop's life.

Assessment of soil moisture at planting to assist crop decisions

Average % of crop where soil moisture is assessed at planting, % of farms using this practice, and % of crop these farms represent as compared with the overall crop area in the dataset, by AE-Zone (GRDC 2009)

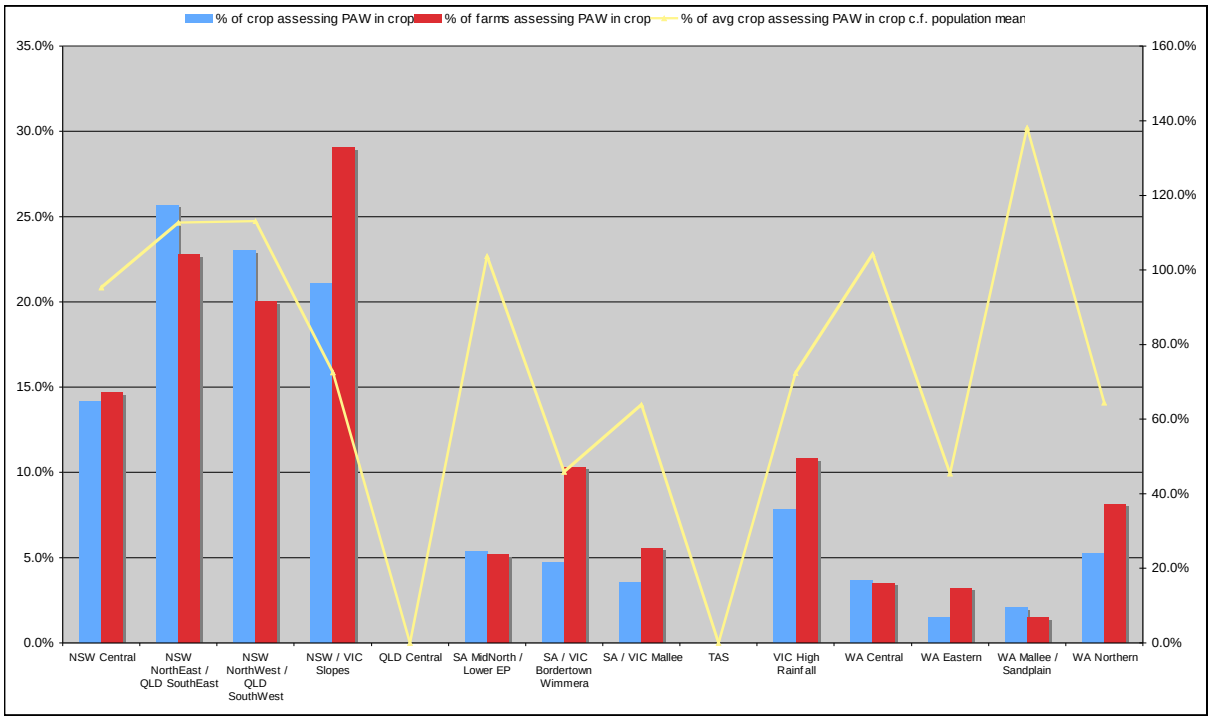


From the data above it appears that assessing soil moisture at planting is considerably more highly practiced in NSW and southern QLD than elsewhere, with WA not using this practice to any extent.

This is likely due to the nature of soils and the climate, such that in NSW and QLD soils are well known to store moisture from rainfall received prior to the crop being planted, and an assessment of pre-plant soil moisture is much more a standard practice in these soils. It is perhaps then less surprising that assessing soil moisture at planting is practiced where this is of value, and less so where it is not.

Assessment of soil moisture through the season to assist crop decisions

Average % of crop where soil moisture is assessed in-crop, % of farms using this practice, and % of crop these farms represent as compared with the overall crop area in the dataset, by AE-Zone (GRDC 2009)



Again, the stand out observation is the use of in-crop soil moisture monitoring in NSW (and Victorian slopes), though the data for central QLD was unable to be used in this analysis.

In keeping with the at-planting soil moisture data, it is apparent that where these practices are used they are used on much or all of the crop on these farms (yellow line, RH axis) where the average area exceeds the general average for the dataset, indicating that the farms where the practice is used are larger than average, and the practice is used on the whole crop area on these farms.

In WA both pre-plant and in-crop soil moisture testing is relatively low, though some are doing this. Knowing the WA seasonal situation where in-crop rainfall is the dominant factor in crop growth for decision making this is not surprising.

Matching land use to land capability:

The actual use of land on the farm, and how well this relates to land capability as described by land class.

It is not possible to determine if land use as carried out on farms is 'appropriate' to land use class from ABS or other publicly available survey data. However, it is possible to track the enterprise mix, as represented by % crop, % pasture and % native vegetation on farms in these public datasets. This data gives some idea of how land use changes and can give a broad indicator of changes in how farmers are managing their properties.

The survey data from the GRDC survey conducted in 2009, of practices as used on grain farms in the 2008 (winter) crop year, included some questions that do have relevance in assessing how farmers are considering the capability of their land when determining enterprise mix, or the use of the land they have.

Two specific questions included in the survey were:

- "What percentage of your land has been characterised to determine soil features (bulk density, texture, sodicity, salinity, rooting depth, water holding capacity)", and
- "What percentage of your arable land has been planted to match crop type with land capability"?

The section describing these two areas of data is towards the end of this report. (The first section of this report details some of the public data that is also available.)

Data gathered from farmers against these questions can be used to establish some baselines or benchmarks for use in assessing changes through time in how farmers utilize the land they have.

The data from the survey of 2009, while representing a set of larger or more intensive grain producers can give guidance as to some trends in how farmers are managing and matching land use to land capability, especially on these farms, believed to be more typical of the majority of grain production areas in Australia.

Land Use on Farms

How land is used on farms is a fundamental aspect of farm management, and one where the farmer or manager can have a major influence. The matching of land use to land use capability requires knowledge of the land capability, something not all farmers will have detailed information about, but will have some experience in how different enterprises perform on various land types they have on their farms.

In more recent times farmers have been able to learn about how to characterise their land types, for example, with many field days and other training activities now helping them learn about the various soil parameters that are important from a productivity viewpoint. This knowledge can assist farmers better match planned land use with soil characteristics and capability.

This report looks at the mix of cropping, pasture and native or remnant vegetation on farms either in the public datasets or from the more recent Solutions survey. The GRDC data from the 2008 crop year also contain some indicators of how much land has been characterised and how much land use is matched to land capability on the farms in the survey.

Number of Grain Farms

In order to get some feel for the population of farms in the grains industry, one can use ABS data from the census of 2000-01 and 2005-06. These data are presented in Table 1.

One can see there appears to have been a slight decrease in grain farm numbers between the two time periods. This would agree with industry understandings that a steady decline in farm numbers has occurred in the industry.

Table 1. Number of grain farms in Australia (source ABS 2000-01 and 2005-06)

AE-Zone	No of Grain Farms	
	ABS 2000	ABS 2005
NSW Central	2,924	2,696
NSW NorthEast / QLD SouthEast	5,959	5,176
NSW NorthWest / QLD SouthWest	1,382	1,299
NSW / VIC Slopes	6,849	7,255
QLD Central	636	504
SA MidNorth / Lower EP	3,885	3,707
SA / VIC Bordertown Wimmera	4,992	4,549
SA / VIC Mallee	3,654	3,312
TAS	373	311
VIC High Rainfall	1,824	1,950
WA Central	4,710	3,810
WA Eastern	599	589
WA Mallee / Sandplain	834	723
WA Northern	962	904
Totals	39,583	36,785

Figure 1. Number of grain farms in Australia (source ABS 2000-01 and 2005-06)

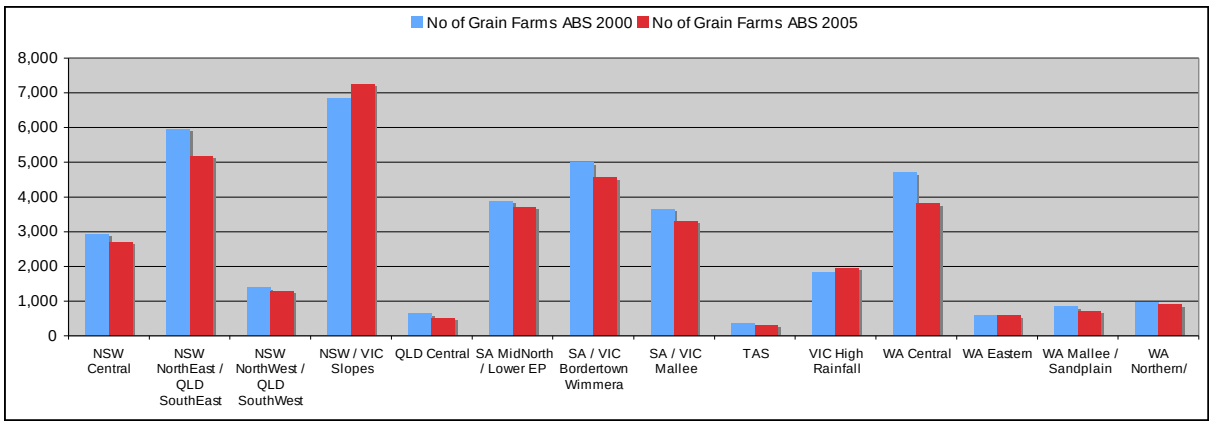
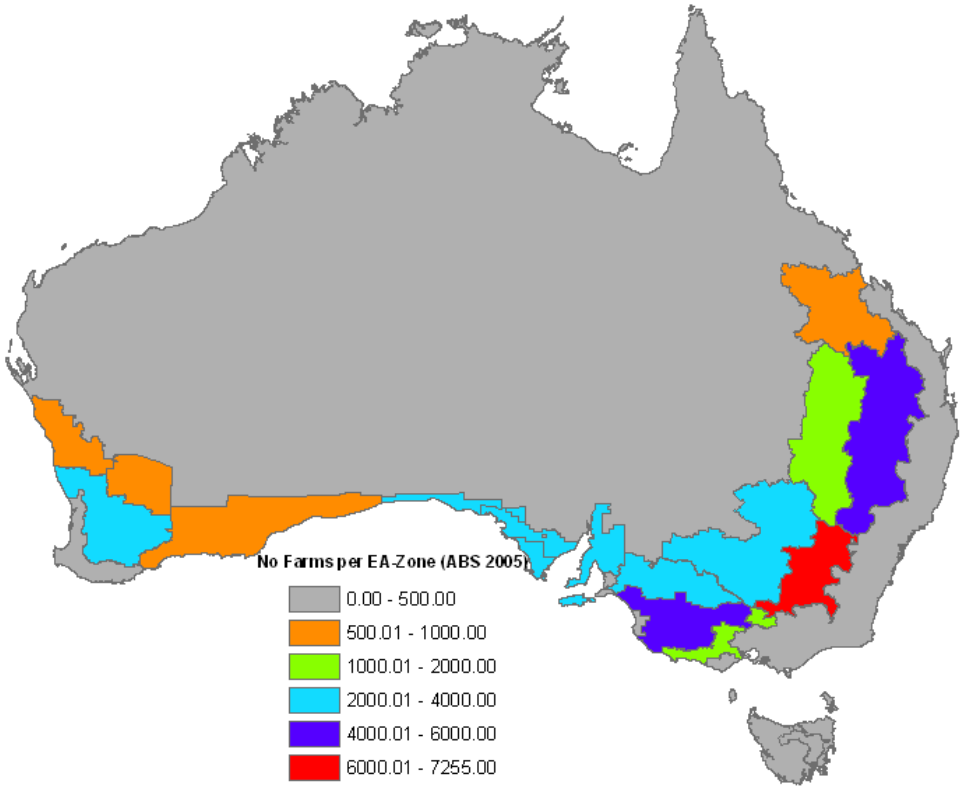


Figure 2. Number of Grain Farms by AE-Zone (source ABS 2005-06)



Farm Size

Data from both ABS censuses and GRDC for 2008, showing average farm size (ha), are presented in Table 2 and Figures 3 and 4.

One can see that, in keeping with the decline in number of farms, the average cropped area per farm has increased, as assessed by ABS. However, the data from GRDC for the cropping year of 2008 shows a striking increase over the ABS data, which is in keeping with earlier observations that this dataset comprises larger cropping farms, more typical of the major grain production areas.

These observations may indicate common practices on the larger, more typical or more specialist grain farms, making these a potentially good representation of activities on these 'mainstream' grain farms.

It is apparent from the 2008 dataset that the largest grain farms are in WA, the Mallee and western NSW.

Table 2. Average area (ha) of grain farms by AE-Zone (source ABS 2000-01 & 2005-06, GRDC 2009).

AE-Zone	Farm Size (ha)			
	2000 (ABS)	2005 (ABS)	ABS (Avg.)	GRDC (2008)
NSW Central	2,712	2,447	2,579	4,824
NSW NorthEast / QLD SouthEast	1,137	1,042	1,090	2,689
NSW NorthWest / QLD SouthWest	9,082	7,821	8,452	4,508
NSW / VIC Slopes	734	695	715	2,577
QLD Central	5,478	5,009	5,244	5,957
SA MidNorth / Lower EP	6,921	5,987	6,454	2,383
SA / VIC Bordertown Wimmera	652	649	650	1,928
SA / VIC Mallee	888	924	906	3,406
TAS	690	628	659	3,109
VIC High Rainfall	305	274	290	2,342
WA Central	2,639	1,928	2,284	3,641
WA Eastern	4,558	5,073	4,815	5,606
WA Mallee / Sandplain	3,341	2,547	2,944	4,780
WA Northern	7,527	6,181	6,854	5,731

Figure 3. Average area (ha) of Grain Farms by AE-Zone (source ABS 2005-06, GRDC 2008).

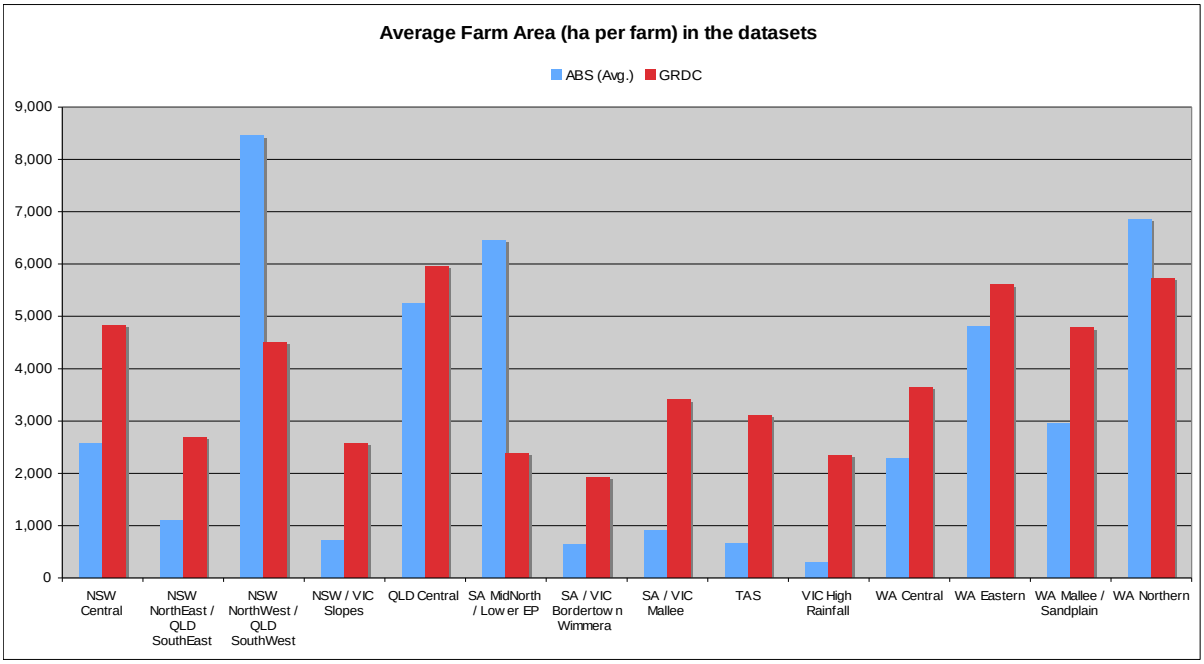
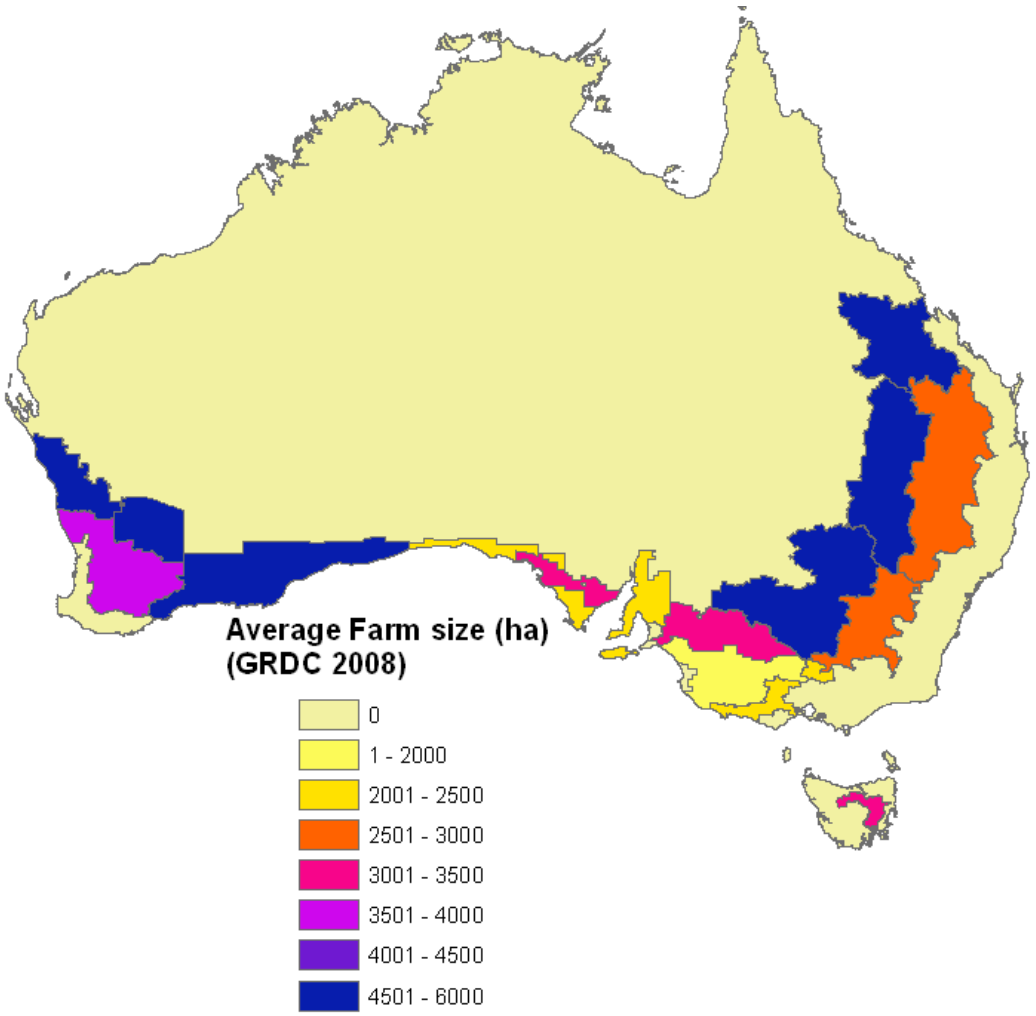


Figure 4. Average Size (ha) of Grain Farms by AE-Zone (source: GRDC 2009)



Area cropped per farm.

The area of crop planted per farm is notionally a better measure of the importance of the crop enterprise on the grain farms in Australia. These data are presented in Table 3 and Figures 5 and 6.

Again, one can see that the GRDC dataset comprises a set of the larger grain farms, or more intense and specialist growers, in keeping with the demographics of the industry. This suggests that while the Solutions dataset is not strictly 'representative' of the population as a whole, it would be useful as a measure of what is happening on the more 'typical' specialist or 'serious' grain producing farms.

Grain intensive farms tend to dominate (in terms of the area of crop planted) in WA and the more extensive areas of western NSW and Victoria and central QLD.

Table 3. Average area (ha) of crop on grain farms by AE-Zone (source ABS 2000-01 & 2005-06, GRDC 2009).

AE-Zone	Area of crop per farm (ha)		
	ABS 2000	**ABS 2005**	**GRDC 2008**
NSW Central	596	635	2,144
NSW NorthEast / QLD SouthEast	514	559	1,426
NSW NorthWest / QLD SouthWest	955	1,007	2,010
NSW / VIC Slopes	339	353	1,480
QLD Central	1,069	833	2,242
SA MidNorth / Lower EP	509	538	1,263
SA / VIC Bordertown Wimmera	343	370	1,168
SA / VIC Mallee	767	946	2,107
TAS	96	116	1,068
VIC High Rainfall	169	185	1,282
WA Central	949	935	2,247
WA Eastern	1,976	2,236	3,537
WA Mallee / Sandplain	1,078	1,341	3,040
WA Northern	1,828	1,878	3,489

Figure 5. Average area (ha) of crop on grain farms by AE-Zone (source ABS 2000-01 & 2005-06, GRDC 2009).

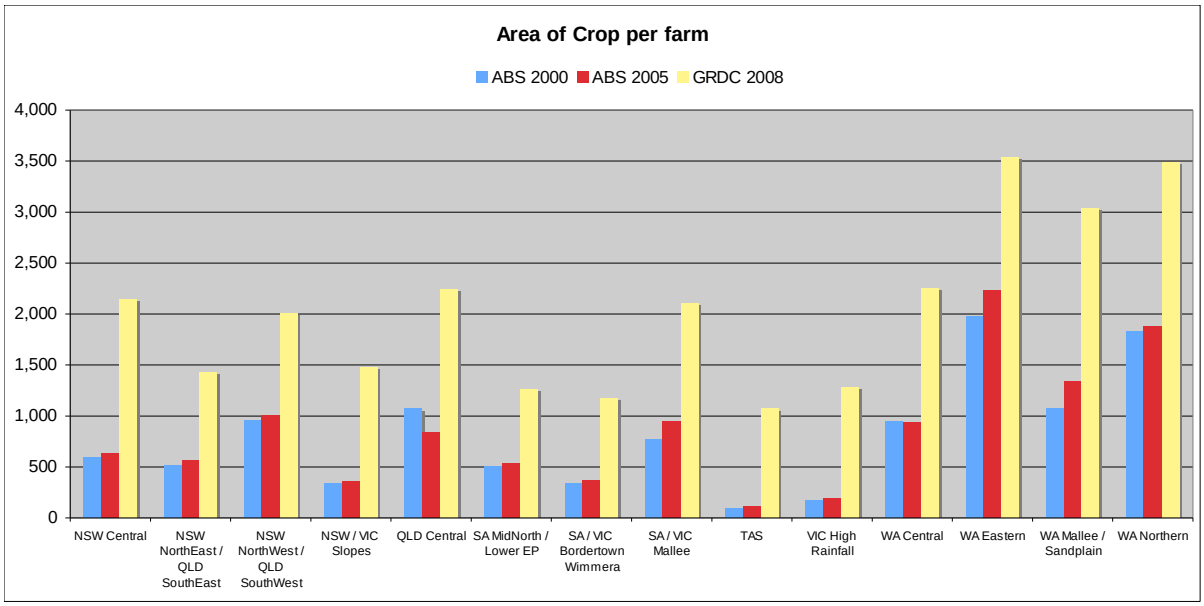
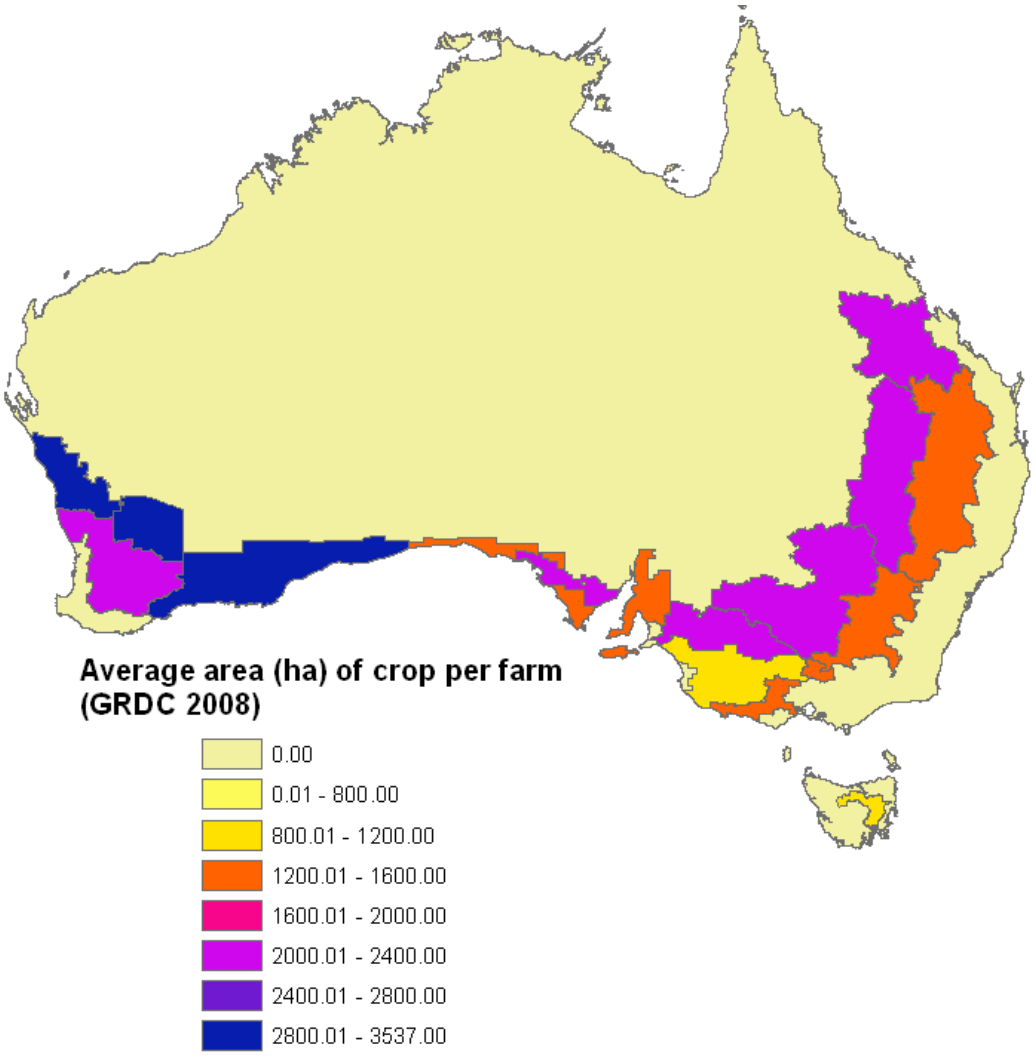


Figure 6. Average area (ha) of crop on grain farms by AE-Zone (source: GRDC 2009).



Percent of farmland cropped

One way of determining the mix of enterprises on farms, and one element in considering how well enterprise mix matches land capability is to consider the proportion of crop, pasture and native vegetation on farms. However, without knowing the capability of the land on each farm, one is unable to determine how 'suitable' the various land uses are. This is why public datasets like those from ABS are of limited value for examining the land use in relation to land capability. Similarly data from surveys are beset with the same limitations.

Nonetheless, some knowledge of the enterprise mix on farms is of some use in assessing the allocations of land on farms and can indicate some characteristics of the regional and climatic conditions, which do modify land use choice in conjunction with land use capability.

The percentage of farmland cropped is presented in Table 4, and Figures 7 and 8 below.

These show two features; that larger grain farms are present in the GRDC dataset, and that the more intensive grain farms are in WA, and the western areas of NSW, Vic and QLD, and the northern areas of SA.

Given that mixed farms (i.e. those with a mix of cropping and grazing operations remain in most areas, one would expect the proportion of pasture to balance with the proportion of crop in a general sense. The proportion of pasture on farms in the AE-Zones is presented in the next section.

Table 4. Average % of crop on grain farms by AE-Zone (source ABS 2000-01 & 2005-06, GRDC 2009).

	2000 (ABS)	2005 (ABS)	ABS (Avg.)	GRDC 2008
NSW Central	22.0%	25.9%	23.8%	44.4%
NSW NorthEast / QLD SouthEast	45.2%	53.7%	49.2%	53.0%
NSW NorthWest / QLD SouthWest	10.5%	12.9%	11.6%	44.6%
NSW / VIC Slopes	46.2%	50.9%	48.5%	57.4%
QLD Central	19.5%	16.6%	18.1%	37.6%
SA MidNorth / Lower EP	7.3%	9.0%	8.1%	53.0%
SA / VIC Bordertown Wimmera	52.6%	57.1%	54.8%	60.6%
SA / VIC Mallee	86.3%	102.4%	94.5%	61.9%
TAS	14.0%	18.4%	16.1%	34.4%
VIC High Rainfall	55.3%	67.6%	61.2%	54.8%
WA Central	35.9%	48.5%	41.2%	61.7%
WA Eastern	43.4%	44.1%	43.7%	63.1%
WA Mallee / Sandplain	32.3%	52.6%	41.1%	63.6%
WA Northern	24.3%	30.4%	27.0%	60.9%

Figure 7. Average % of land cropped on grain farms by AE-Zone (source: ABS & GRDC 2009).

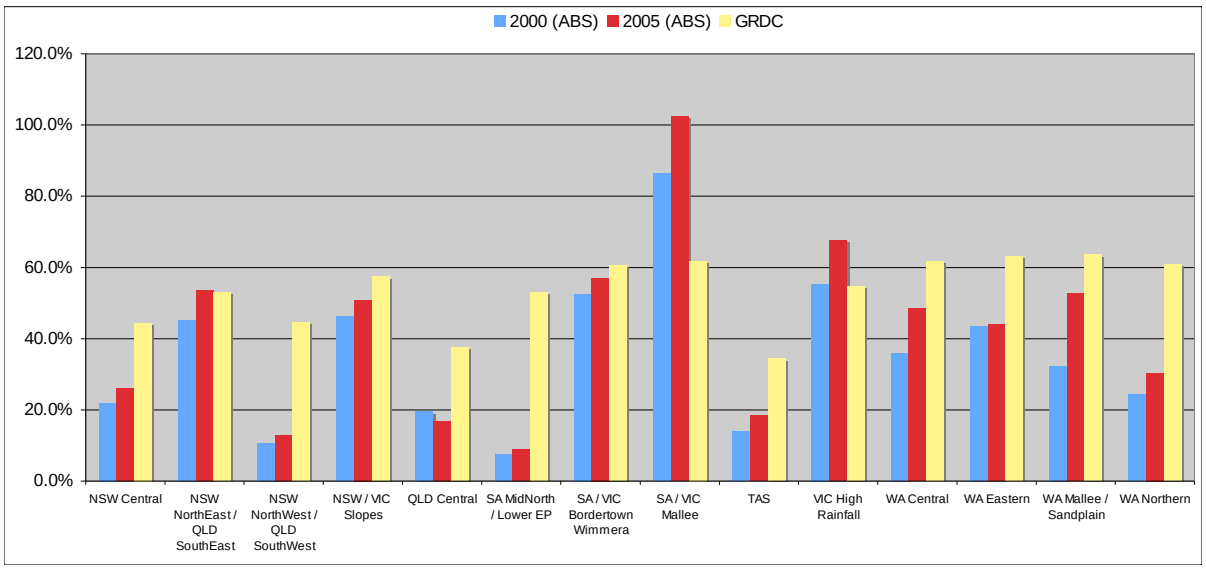
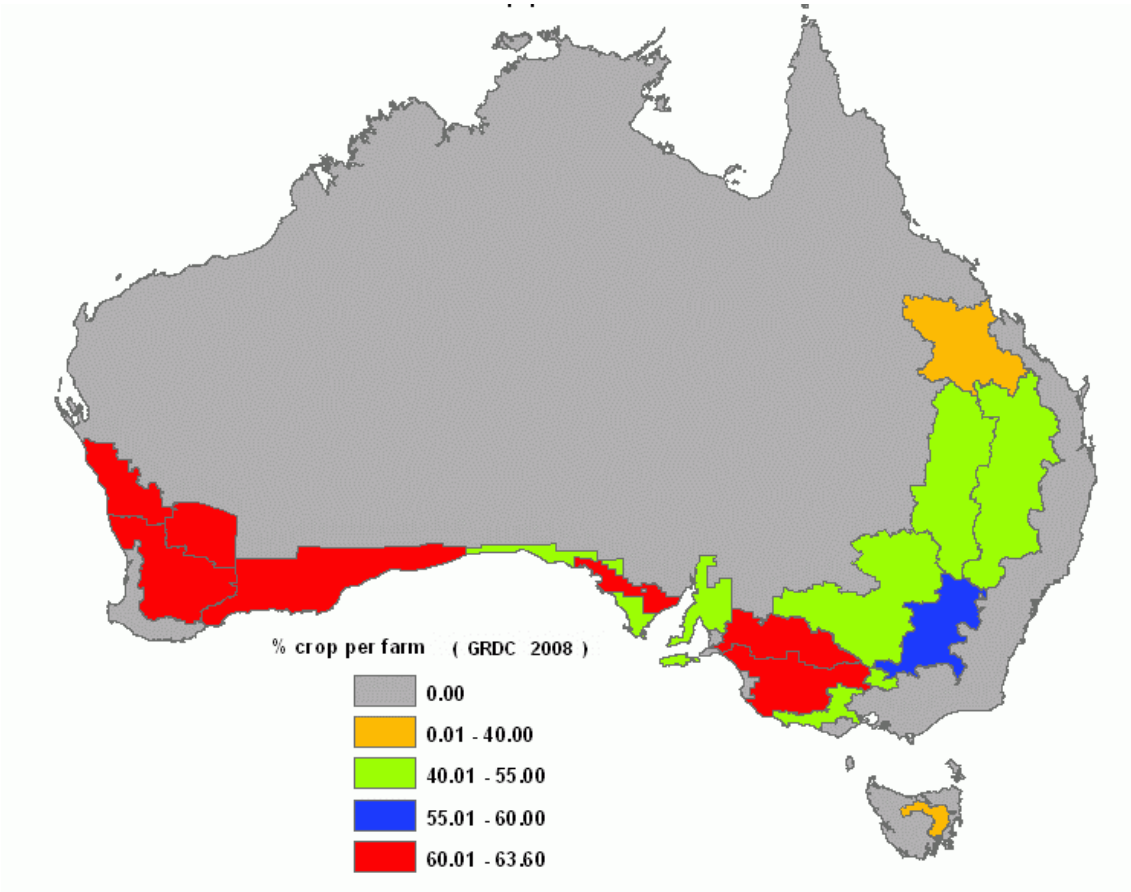


Figure 8. Average % of land cropped on grain farms by AE-Zone (source: GRDC 2008).



Percent of farmland under pasture

The proportion of pasture in a region would be expected to balance the proportion of crop, and so in most cases would make up the balance of the farmland, apart from areas of native or remnant vegetation. Data for the proportion of pasture on farms are presented in Table 5 and Figures 9 and 10.

Table 5. Average % of pasture on grain farms by AE-Zone (source ABS 2000-01 & 2005-06, GRDC 2009).

AE-Zone	Avg. % of Pasture per farm			
	2000 (ABS)	2005 (ABS)	ABS (Avg.)	GRDC (2008)
NSW Central	45.5%	80.5%	47.9%	52.9%
NSW NorthEast / QLD SouthEast	55.0%	68.3%	57.4%	55.2%
NSW NorthWest / QLD SouthWest	46.9%	88.9%	50.4%	52.5%
NSW / VIC Slopes	57.9%	66.4%	59.5%	43.5%
QLD Central	52.8%	89.5%	55.1%	62.8%
SA MidNorth / Lower EP	16.7%	91.4%	17.9%	57.8%
SA / VIC Bordertown Wimmera	55.1%	61.4%	55.2%	39.6%
SA / VIC Mallee	26.4%	43.3%	25.9%	35.6%
TAS	72.2%	74.3%	75.6%	86.5%
VIC High Rainfall	69.7%	74.3%	73.4%	56.0%
WA Central	39.6%	58.9%	45.8%	36.9%
WA Eastern	19.7%	41.8%	18.6%	35.3%
WA Mallee / Sandplain	36.1%	61.8%	41.0%	38.1%
WA Northern	39.4%	67.8%	43.2%	40.8%

Figure 9. Average % of land under pasture on grain farms by AE-Zone (source: GRDC 2009).

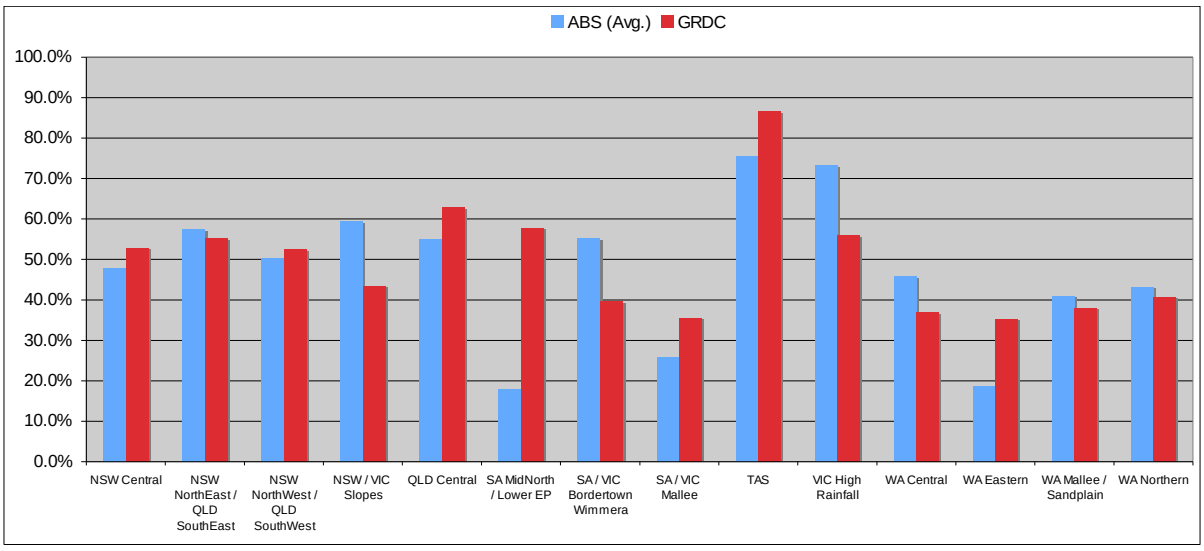
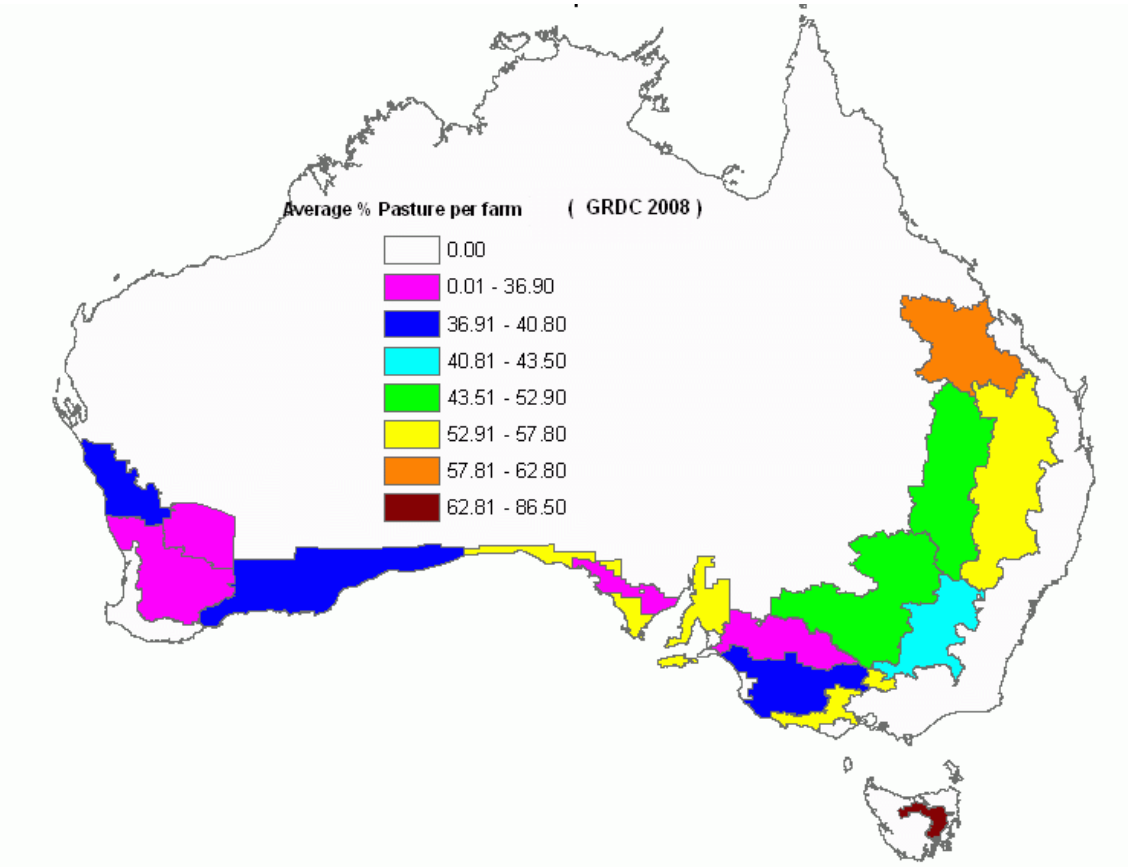


Figure 10. Average % of land under pasture on grain farms by AE-Zone (source: GRDC 2009).



Farmland with Native Vegetation

Not all farms in the 2008 dataset reported the presence of Native Vegetation on their farms. Table 6 and Figures 11 and 12 show these data, listing the number of farms reporting some native vegetation and the average areas of this on those farms.

Not all grain farms in the 2008 dataset have native vegetation. Only between about 15% and 40% of farms report the presence of native vegetation. Those that do, have varying amounts, notionally to do with their history, location and climate.

The amounts of native vegetation on grain farms, as reported in the GRDC 2008 survey, vary widely, with up to 1600 ha in some instances. It is not possible to determine if these areas are 'appropriate' without knowledge of the circumstances of the properties involved.

Table 6. Number of farms in the GRDC dataset reporting the presence of, and the average areas of native vegetation on the reporting farms by AE-Zone (source: GRDC 2009).

AE-Zone	% of farms	Avg. area per farm (ha)
NSW Central	36.0%	1589
NSW NorthEast / QLD SouthEast	26.6%	559
NSW NorthWest / QLD SouthWest	28.3%	1158
NSW / VIC Slopes	25.0%	317
QLD Central	17.4%	720
SA MidNorth / Lower EP	23.7%	330
SA / VIC Bordertown Wimmera	22.2%	327
SA / VIC Mallee	25.6%	1299
TAS	25.0%	45
VIC High Rainfall	21.6%	129
WA Central	36.0%	373
WA Eastern	41.9%	913
WA Mallee / Sandplain	33.8%	495
WA Northern	29.1%	926

Figure 11. % of farms reporting areas of Native Vegetation on grain farms by AE-Zone (source: GRDC 2009).

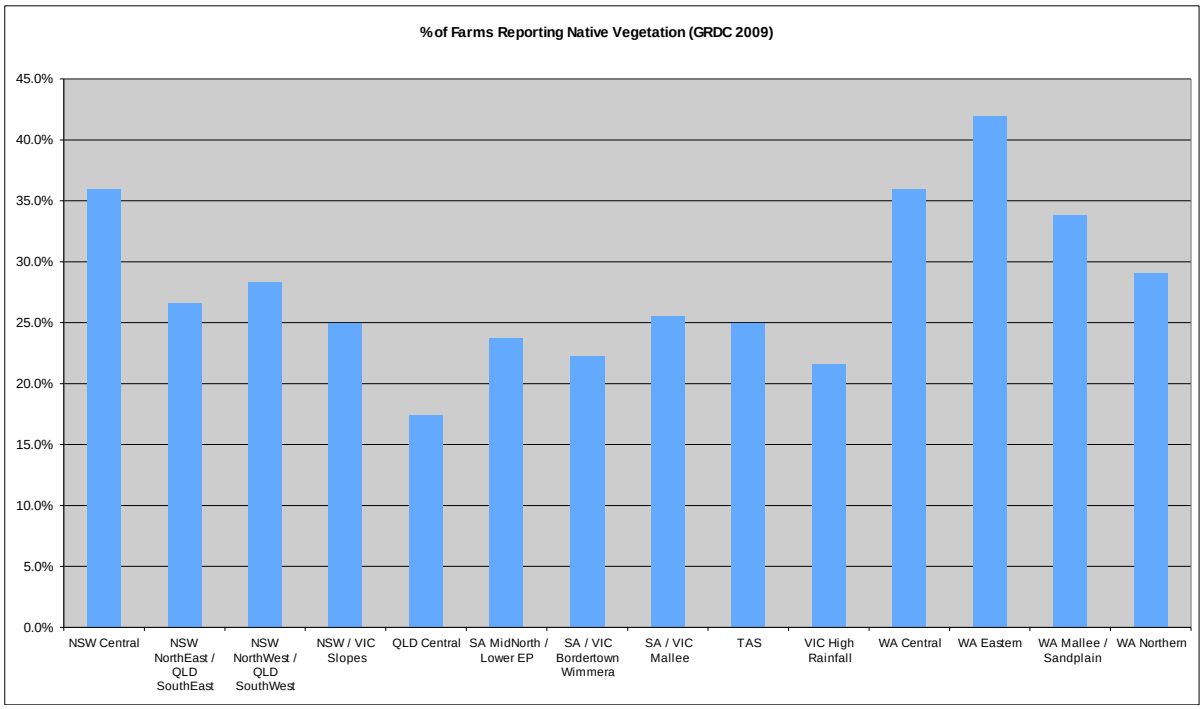
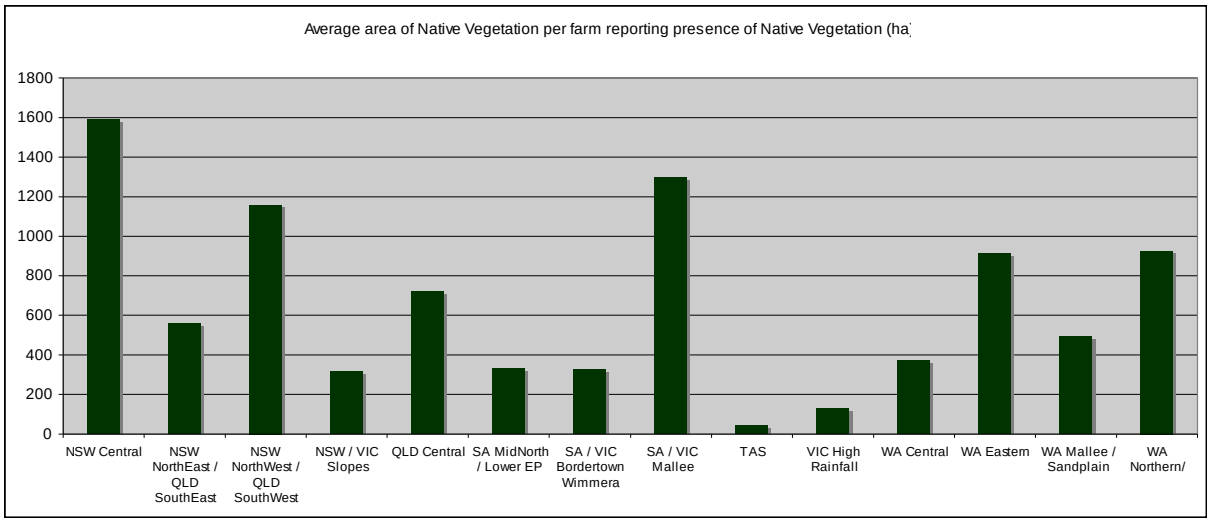


Figure 12. Average area (ha) of native vegetation on farms with native vegetation on grain farms by AE-Zone (source: GRDC 2009).



Farms and areas where land has been characterised for capability.

The GRDC survey of 2009 included some questions about whether farms had land capability assessed, or 'characterised' for suitability for various enterprises. This was intended to assess how many farms, and areas they represent had some form of land use capability assessment carried out. The data are presented in Table 7 and Figures 13, 14 and 15.

One can see that of the grain farms in the GRDC dataset, approximately one third, and in some AE-Zones considerably more, have characterised their land for capability for the various enterprises carried out.

These farms, being often the larger grain producing properties, represent a considerable proportion of the land managed by grain farms, with around 20% of the total land in the AE-Zone covered by this characterization. Additionally, when one looks at the cropped area that have been characterised for land capability, it is apparent that a considerable proportion of cropping land has been characterised for land capability by these farmers. The areas of land that has been characterised for capability is around 30% of the total cropping areas in these AE-Zones.

Further, when one looks at the average area cropped on the farms that have carried out land characterization, it is apparent that in many or most AE-Zones, almost all the average crop area on these farms has been characterised. This is a powerful result and indicates that grain farmers, notably the larger or more intensive operations are considering their land capability, and have considered this in their operations on their farms.

Table 7. Number of farms in the GRDC dataset, percentages and areas of land that has been characterised for land capability by AE-Zone (source: GRDC 2009).

AE-Zone	Land Characterised for land capability					
	No. of farms	% of farms	% of total land	% of total crop	Total ha per farm	% of average crop
NSW Central	28	37%	15%	34%	1935	90%
NSW NorthEast / QLD SouthEast	61	39%	20%	38%	1404	99%
NSW NorthWest / QLD SouthWest	21	35%	14%	33%	1860	93%
NSW / VIC Slopes	55	44%	22%	38%	1272	86%
QLD Central	4	17%	4%	10%	1319	59%
SA MidNorth / Lower EP	33	34%	9%	17%	641	51%
SA / VIC Bordertown Wimmera	49	39%	14%	24%	711	61%
SA / VIC Mallee	56	31%	14%	23%	1540	73%
TAS	2	50%	27%	79%	1680	157%
VIC High Rainfall	12	32%	5%	9%	358	28%
WA Central	66	33%	19%	32%	2143	95%
WA Eastern	20	32%	15%	24%	2584	73%
WA Mallee / Sandplain	20	29%	13%	20%	2047	67%
WA Northern	31	36%	20%	32%	3109	89%

Figure 13. % of grain farms where land capability has been characterised and the % of the average crop area this represents on these farms by AE-Zone (source: GRDC 2009).

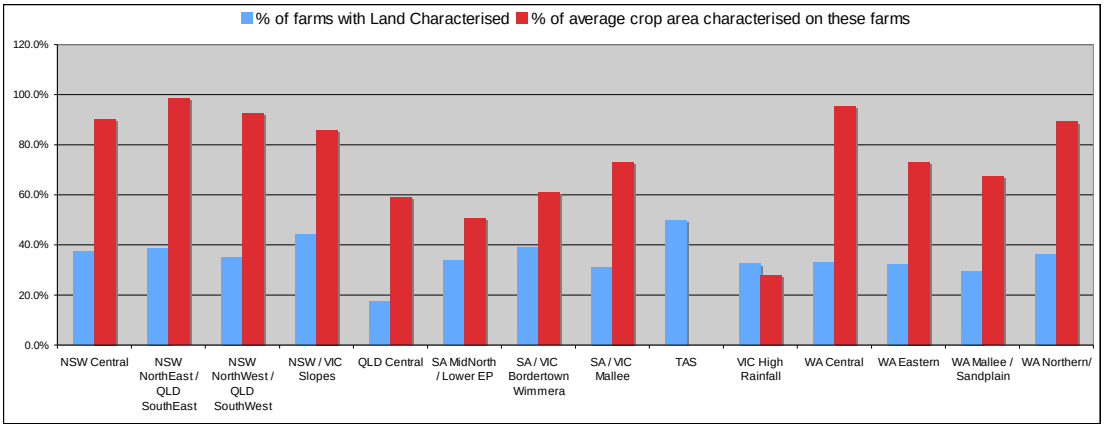


Figure 14. % of grain farms where land has been characterised for capability, by AE-Zone (source: GRDC 2009).

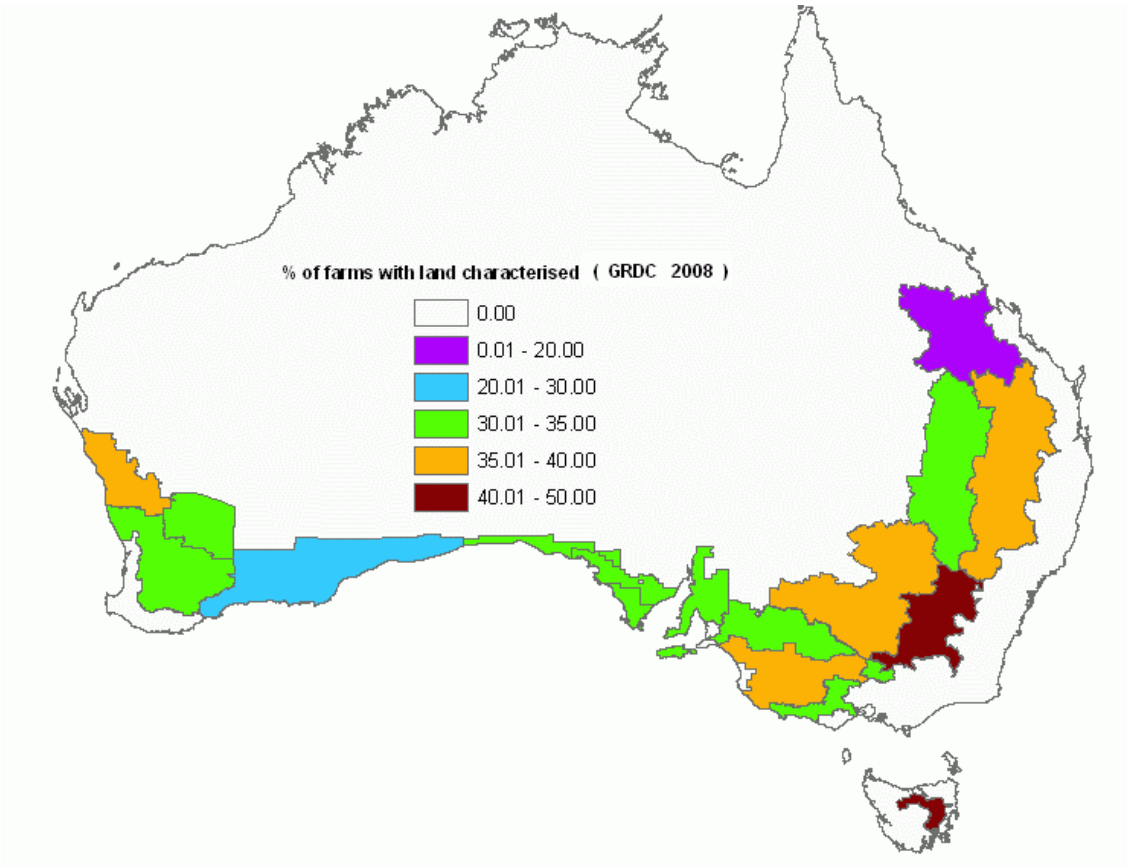
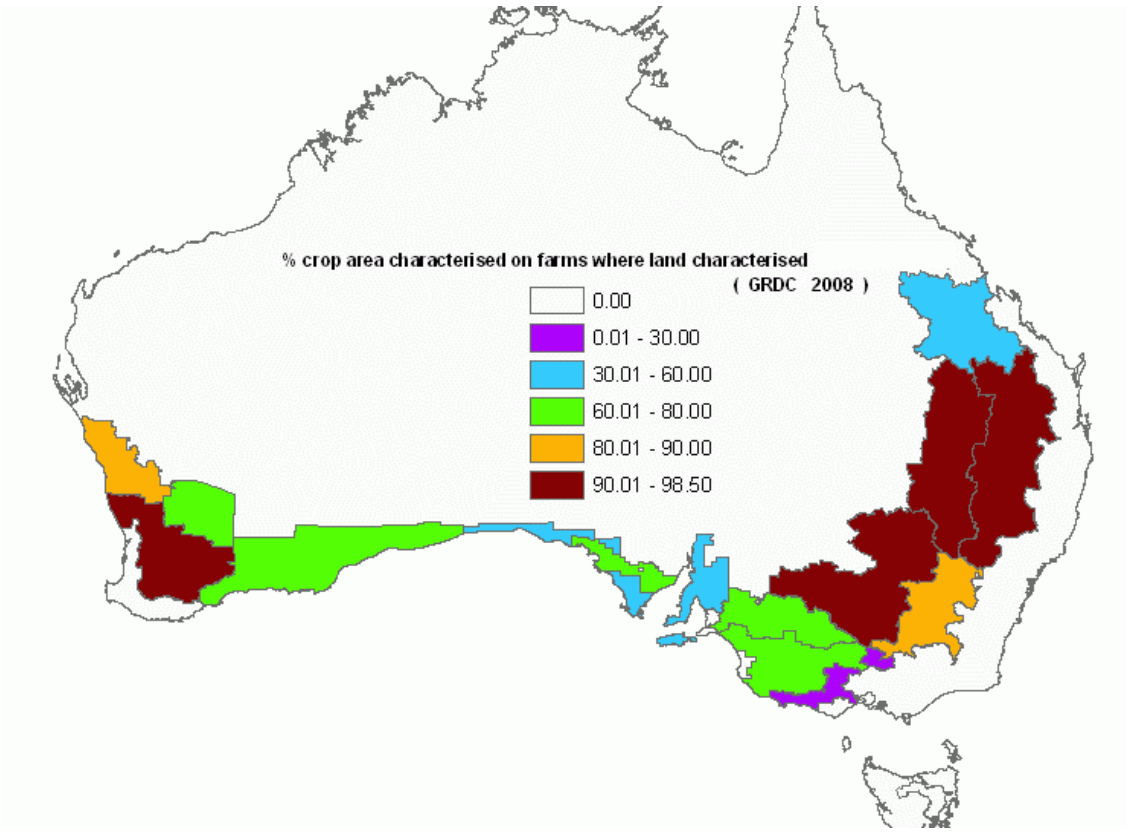


Figure 15. % of crop area characterised on grain farms where land has been characterised for capability by AE-Zone (source: GRDC 2009).



Farms and areas where crop planting has been matched to land capability.

Table 8. Number of farms in the GRDC dataset, percentages and areas of cropland that has been matched to land capability, by AE-Zone (source: GRDC 2009).

AE-Zone	Crop matched to land capability					
	Number of farms	% of farms	% of total area	% of total crop	Area (ha)	% of average crop
NSW Central	22	29.3%	17.2%	39.2%	2826	131.8%
NSW NorthEast / QLD SouthEast	49	31.0%	18.2%	34.2%	1574.6	110.4%
NSW NorthWest / QLD SouthWest	20	33.3%	19.2%	43.8%	2597.2	129.2%
NSW / VIC Slopes	48	38.7%	21.6%	37.6%	1435.9	97.0%
QLD Central	3	13.0%	3.4%	9.1%	1569	70.0%
SA MidNorth / Lower EP	25	25.8%	10.4%	19.6%	959.48	76.0%
SA / VIC Bordertown Wimmera	44	34.9%	20.8%	34.4%	1149.5	98.4%
SA / VIC Mallee	48	26.7%	20.6%	33.4%	2626.9	124.7%
TAS	2	50.0%	27.0%	78.6%	1679.5	157.2%
VIC High Rainfall	7	18.9%	4.4%	8.0%	542.86	42.3%
WA Central	57	28.5%	17.8%	28.8%	2268.6	101.0%
WA Eastern	18	29.0%	17.5%	27.7%	3373.7	95.4%
WA Mallee / Sandplain	20	29.4%	17.3%	27.7%	2817.4	92.7%
WA Northern	27	31.4%	18.5%	30.4%	3374.5	96.7%

It is one thing to characterise the land for its capability, it is perhaps at least as important to then match the land use to suit this capability. In this survey questions were asked about how much of the cropped area was 'matched to land capability' with this question being a natural follow on from the (above discussed) land characterisation question.

This is a key practice, whereby farmers are looking to better match their cropping program to the capability of the land they manage.

These data are presented in Table 8 and Figures 16 to 19.

The GRDC dataset suggests that most who have characterised their land are then matching their cropping activities to the land capability.

The area of crop where matching has occurred is generally high at this time (approximately 20% of total land area, and over 30% of total crop area), when the practice of land characterisation and matching is relatively new.

The striking statistic in this dataset is the proportion of the crop on the farms that have characterised their land and are then matching cropping to the land capability. In many AE-Zones, those farmers that have matched their cropped area to land capability have done so on almost all their cropped area, and in some cases on areas other than where crop is grown. This suggests that some farmers are using the approach of land and enterprise matching on more than their cropping areas.

Figure 16. % of farms where crop is planted to match soil capability, % of total crop this represents in the dataset, and the % of the average crop that is planted to match land capability on farms where this is practiced by AE-Zone (source: GRDC 2009).

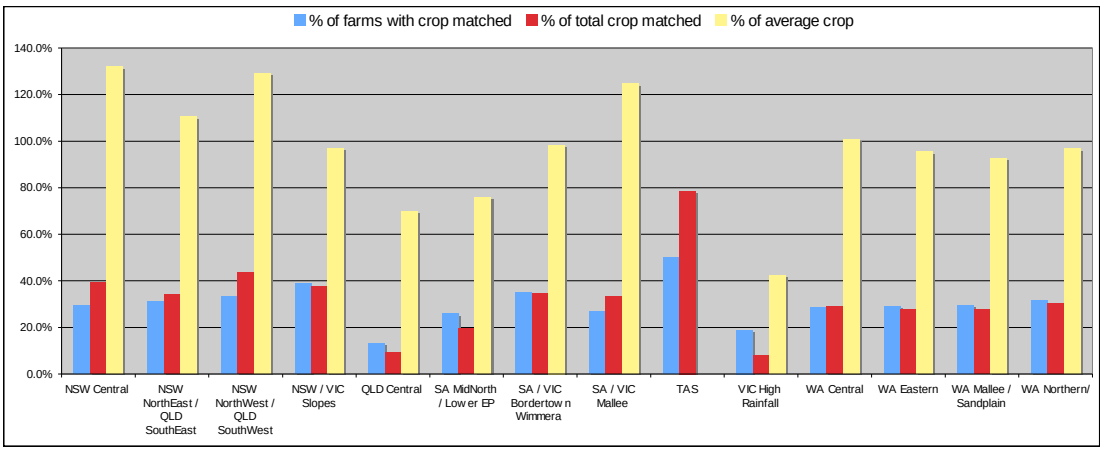


Figure 17. % of farms where crop is planted to match land capability by AE-Zone (source: Solutions 2009).

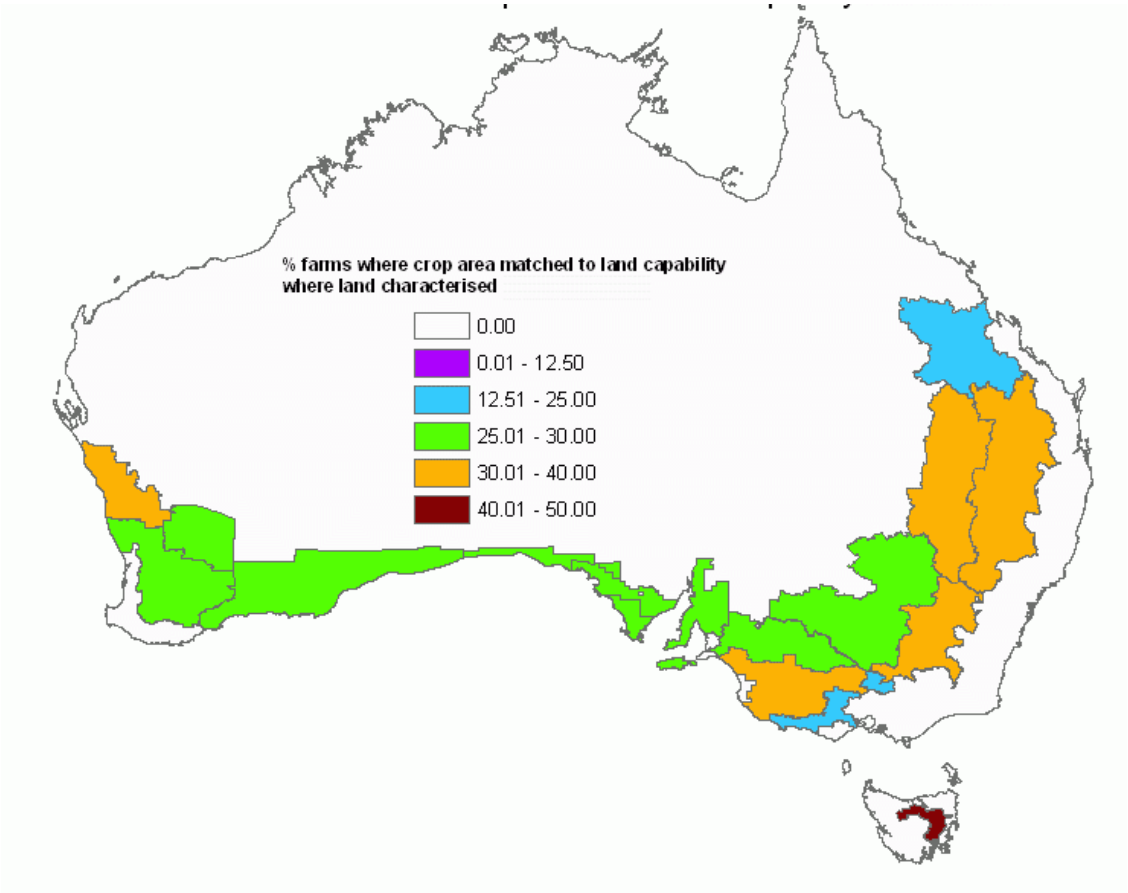


Figure 18. % of Total Crop in the dataset where crop is planted to match land capability by AE-Zone (source: Solutions 2009).

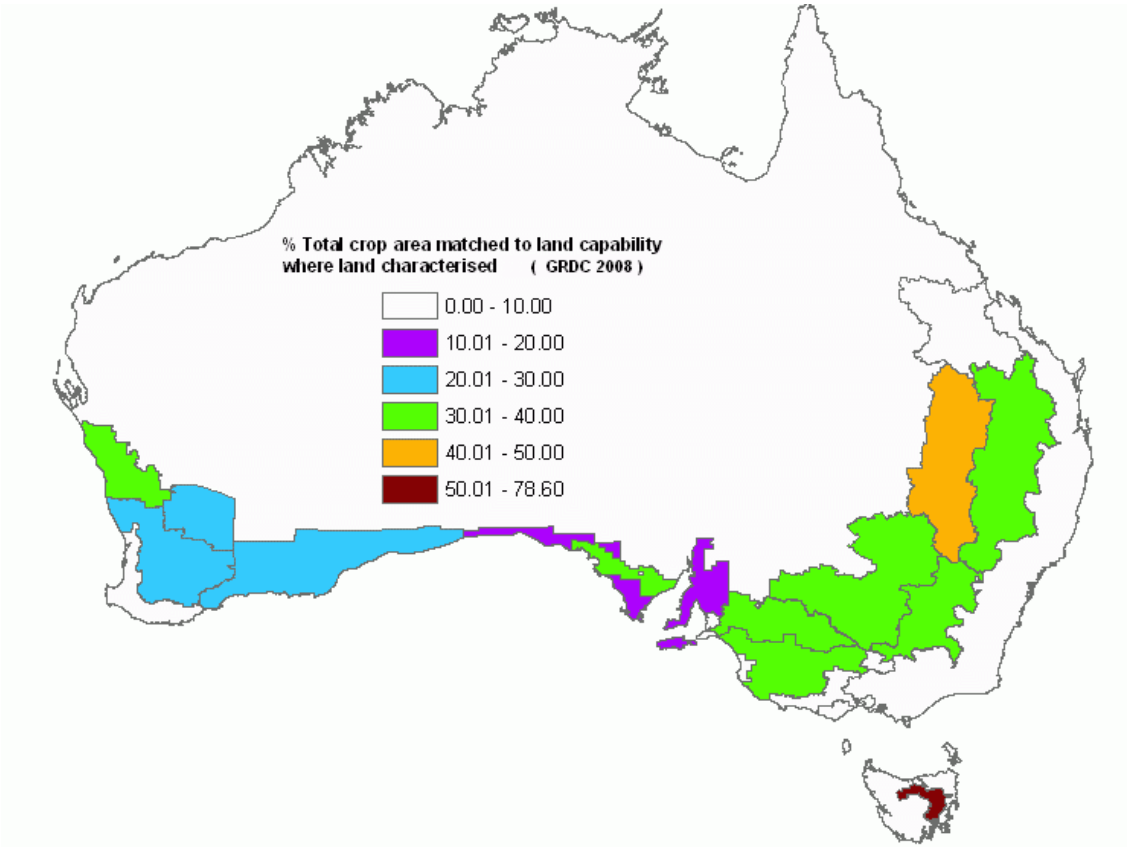
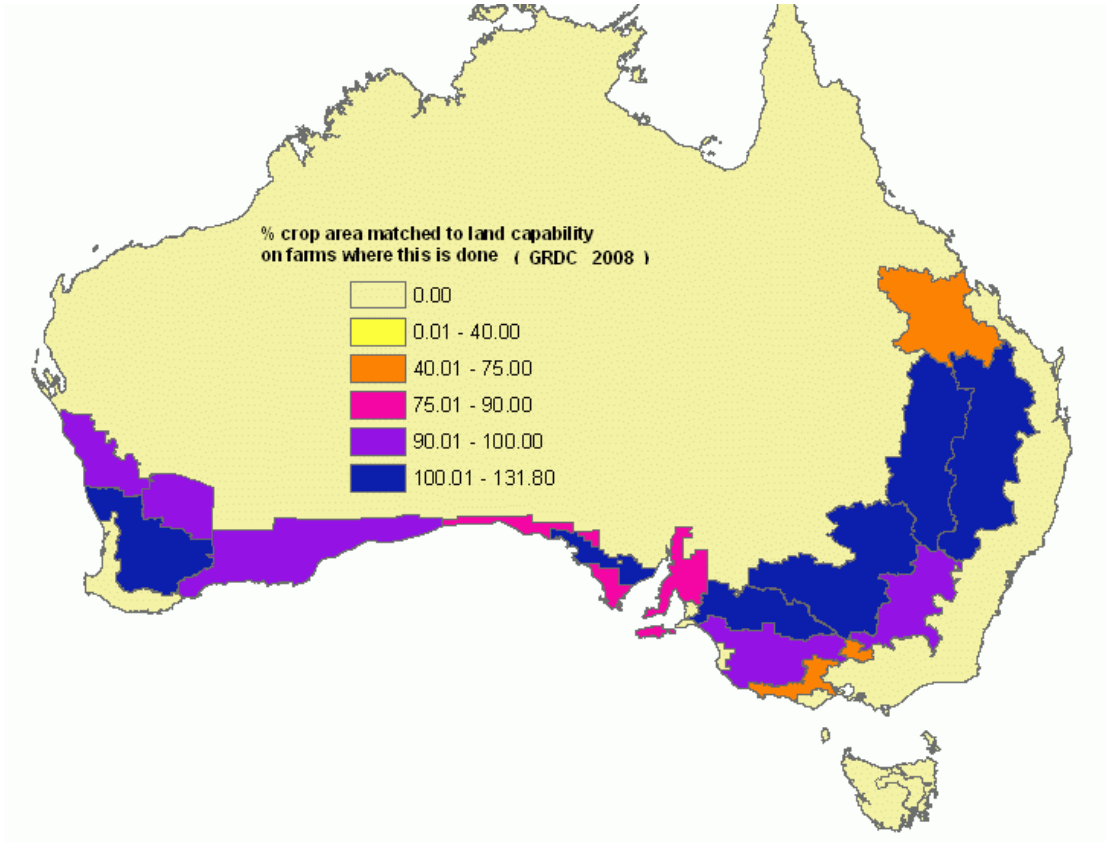


Figure 19. % of Average Crop on farms that do match crop to land capability where crop is planted to match land capability by AE-Zone (source: Solutions 2009).



Tillage

Reduced or no-tillage. The use of minimum, zero- or no-tillage systems for crop and pasture establishment

The area of tillage practice has seen considerable development over the past 20 or so years, with the first movements towards reducing tillage evidenced with the practice of 'direct drilling' introduced in the early 1980's.

The concept of moving away from repeated cultivation of soil for seedbed preparation and crop planting, was initially assisted with the introduction and use of broad spectrum herbicides for weed control, meaning that cultivation was no longer or less needed for this purpose.

Considerable research into machinery options for placement of seed into soil that had not previously been cultivated assisted further with the reduction in tillage practices, and now provides many options for farmers for various soil types and farming systems.

Cultivation can leave soil exposed and vulnerable to erosion from both wind and water, with soil erosion a major concern for many farmers and government agencies over the years. The adoption of reduced and no-tillage systems has seen major reductions in soil erosion in recent years.

Additionally, research has identified some strong productivity gains from reducing cultivation, and especially when coupled to retaining crop residues, can lead to enhanced soil moisture levels, better soil structure and organic matter content, with these reducing many of the risks in rainfed farming systems, allowing some strong gains in productivity to be realised.

There are many benefits from minimum and no-tillage cropping systems that can be described in other documents. Such reduced tillage systems are now seen as one practice and feature of benefit in both productivity and environmental management terms and so form a key practice for grain and mixed farmers.

Historic Public Data

Few ABS data exist for the adoption levels of different tillage practices especially that can be amalgamated to AE-Zone level. The ABS Agricultural Census of 2000-01 did ask about tillage at shire level, and so is able to be presented at AE-Zone level. In 2007-08 ABS conducted a survey of various farming practices, including tillage. However these data are only available at Natural Resource Body (NRM) level, which to do align at all well with AE-Zones. Nonetheless, this NRM level survey did suggest a very strong increase in the adoption of minimum tillage practices since 2000-01 (see report available separately).

The data from the ABS census of 2000-01 is presented in Table 1 and Figures 1 to 4 below.

Table 1. % of crop area planted using No-Tillage, Minimum Tillage and Multiple Tillage methods as at 2000-01 (source ABS 2001)

AE-Zone	ABS 2000-01 (% of area planted)		
	% No-Till	% Min-Till	% Multiple Till
NSW Central	18.6%	44.3%	37.1%
NSW NorthEast / QLD SouthEast	23.9%	41.0%	35.1%
NSW NorthWest / QLD SouthWest	20.7%	50.1%	29.2%
NSW / VIC Slopes	30.7%	50.4%	18.9%
QLD Central	37.2%	35.9%	26.9%
SA MidNorth / Lower EP	25.2%	66.5%	8.3%
SA / VIC Bordertown Wimmera	25.6%	55.1%	19.3%
SA / VIC Mallee	11.3%	53.8%	34.9%
TAS	19.5%	38.7%	41.9%
VIC High Rainfall	39.5%	47.6%	12.8%
WA Central	70.5%	27.6%	1.9%
WA Eastern	58.8%	35.4%	5.8%
WA Mallee / Sandplain	74.0%	21.7%	4.3%
WA Northern	71.6%	25.2%	3.2%

It is apparent that at this time, the adoption of minimum and no-till practices was well advanced in WA. There was still a significant area using conventional (or multiple tillage) practices in NSW and the Mallee at this time.

Figure 1. % of crop area planted using No-Tillage, Minimum Tillage and Multiple Tillage methods as at 2000-01 (source ABS 2001)

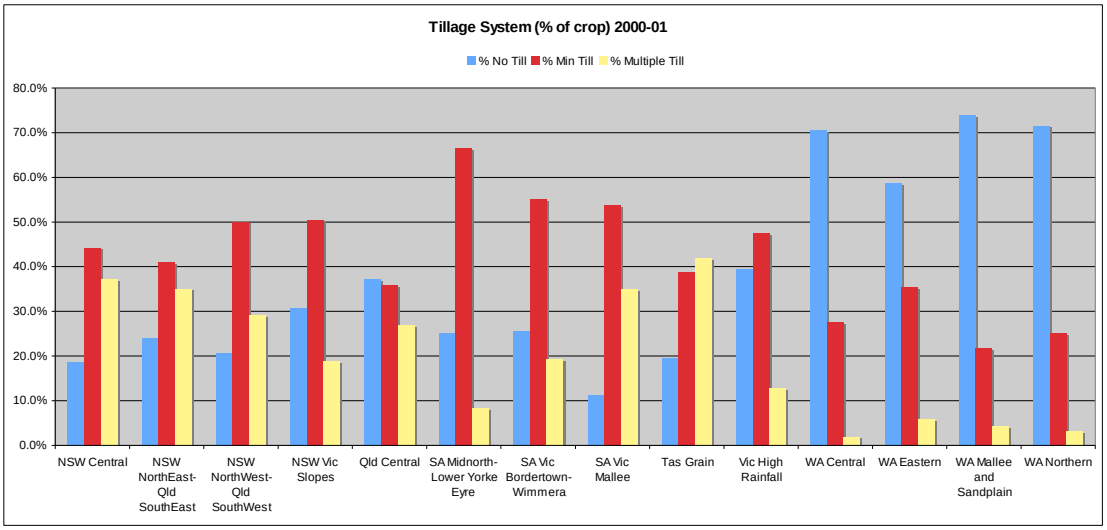


Figure 2. % of crop area planted using No-Tillage as at 2000-01 (source ABS 2001)

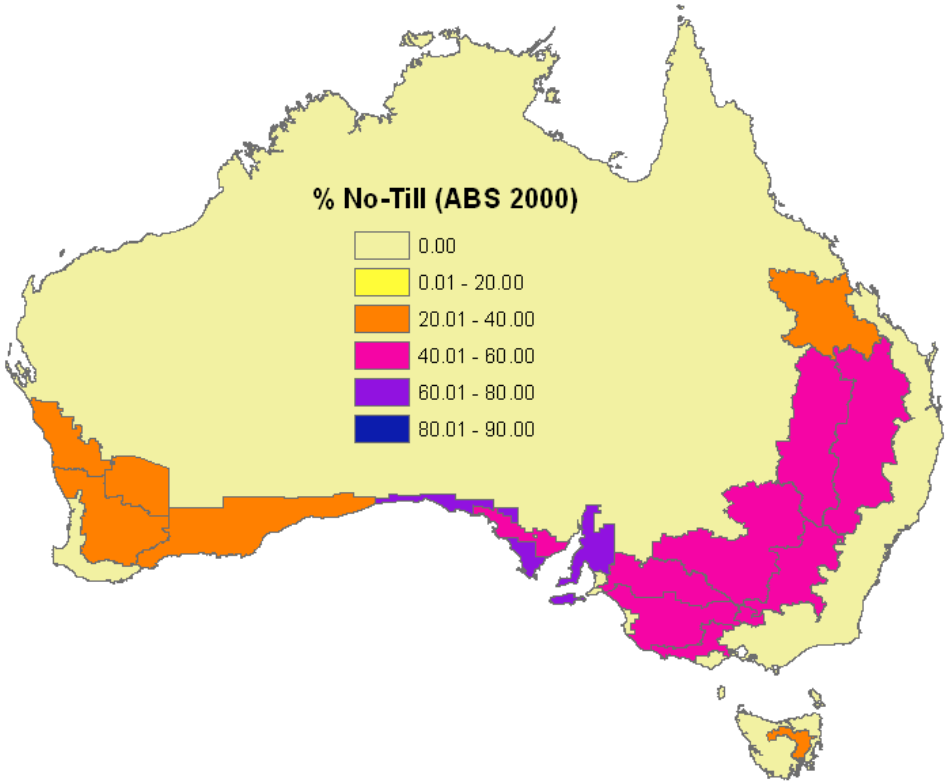


Figure 3. % of crop area planted using Minimum Tillage as at 2000-01 (source ABS 2001)

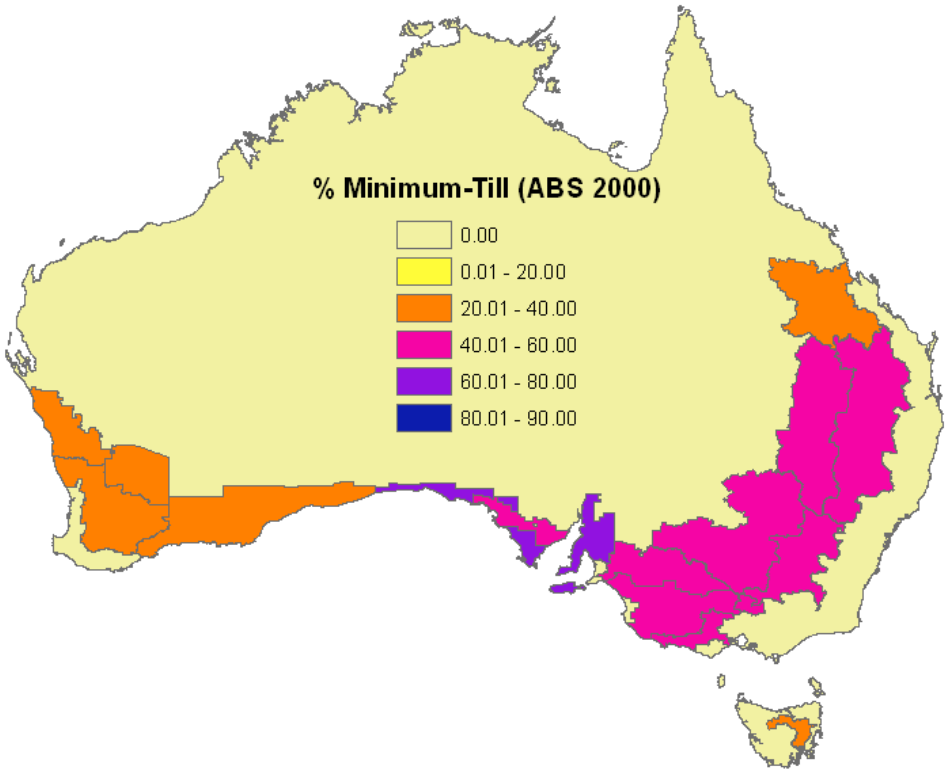
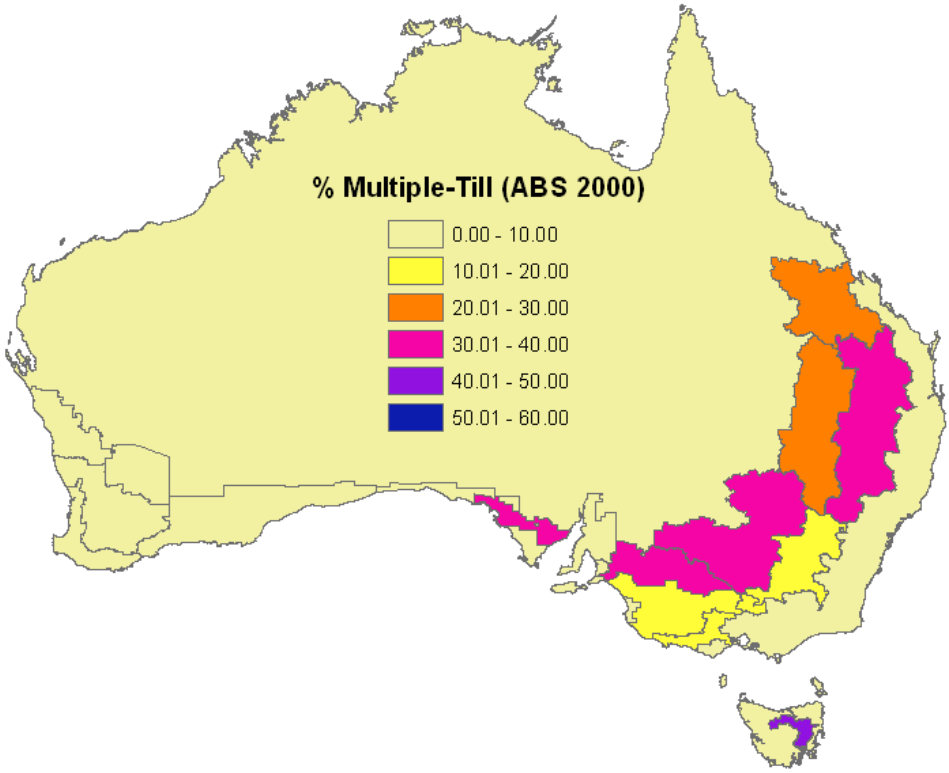


Figure 4. % of crop area planted using Multiple Tillage as at 2000-01 (source ABS 2001)

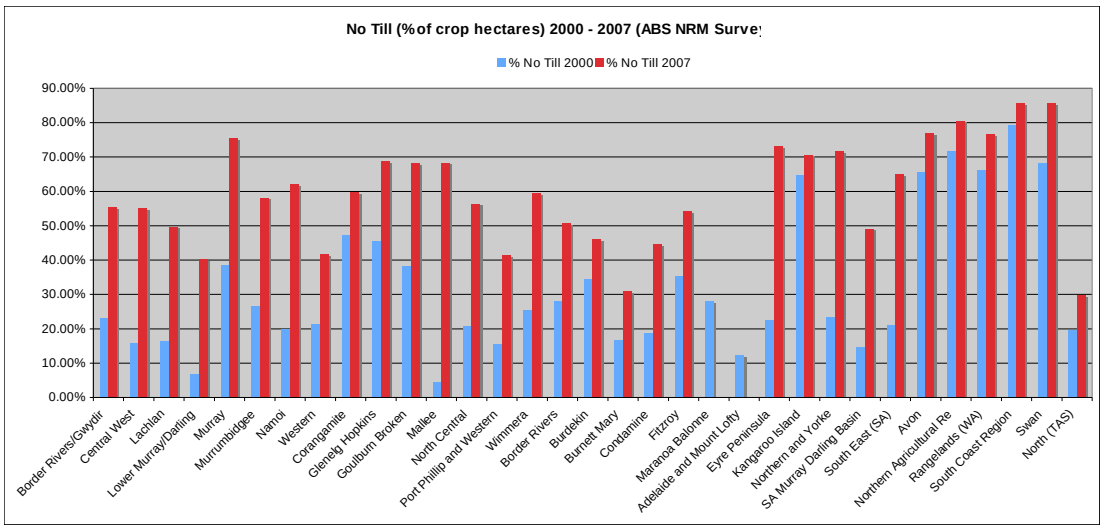


Data from the ABS NRM Survey (2008).

As mentioned, in 2007 ABS conducted a survey of agricultural producers, which provided data amalgamated at NRM level. The survey data was published in 2008. Included in the survey were questions about tillage practices. The data for No-Till is presented in Figure 5 (below). While these data are presented at NRM level, one can get a feel for the levels of adoption of No-Till at that time.

Clearly the data indicate a very strong increase in levels of adoption of No-till when compared against the ABS census data of 2000-01, especially in NSW, Victoria, and parts of Queensland and SA. Adoption continued to grow in WA, though being at relatively high levels in the earlier dataset, continued growth appears less striking than for other areas of Australia.

Figure 5. % of crop area planted using No-Tillage as at 2007 (source ABS 2008)



Data from CSIRO / GRDC for 2007/8

A GRDC funded project in partnership with CSIRO surveyed grain producers in 2008. This was a follow-up survey to an earlier project where growers were surveyed in 2003. This report shows a strong increase in the adoption of No-Till across all AE-Zones, with some evidence of a plateau in adoption of around 90% of cropped hectares in many cases.

Data from GRDC for the 2008 (winter) crop year

The data on tillage practices as gathered by GRDC for the 2008 crop year are presented in Table 2 and Figures 6 to 9. These data show the tillage practices grouped into relatively broad categories of 'No-Till', 'Minimum Till' and Multiple Till'.

Within each of these (especially the first two), further categorization is now possible. In the 'No-Till' category, the emergence of disc seeding techniques and other machinery configurations are able to provide for levels of soil disturbance of up to 10%, up to 30% or 'full cut' direct drill practice, where while only one pass of an implement occurs, giving soil disturbance across the full width of the implement.

In the 'Minimum Till' category, the practice can involve only 1 or 2 cultivations prior to sowing (Min-Till 2), or more than 2 cultivations (Min-Till red), with this being still a reduction than the 'Multiple tillage' practices category.

These sub-divisions are described in the next section of this report.

Table 2. % of crop area planted using No-Tillage, Minimum Tillage and Multiple Tillage methods as at 2008 (source: GRDC 2009)

AE-Zone	% No-Till	% Min-Till	% Multiple Till
NSW Central	78.0%	18.4%	3.6%
NSW NorthEast / QLD SouthEast	90.1%	9.1%	0.8%
NSW NorthWest / QLD SouthWest	96.3%	3.4%	0.3%
NSW / VIC Slopes	93.6%	6.4%	0.0%
QLD Central	93.5%	6.5%	0.0%
SA MidNorth / Lower EP	94.1%	5.9%	0.0%
SA / VIC Bordertown Wimmera	93.2%	6.3%	0.5%
SA / VIC Mallee	85.6%	13.0%	1.4%
TAS	96.2%	3.8%	0.0%
VIC High Rainfall	99.6%	0.3%	0.1%
WA Central	98.0%	2.0%	0.0%
WA Eastern	92.6%	7.4%	0.0%
WA Mallee / Sandplain	98.7%	1.3%	0.0%
WA Northern	92.7%	7.3%	0.0%

It is apparent that within the GRDC 2008 dataset, the adoption of No-Till is extremely high, at over 90% of the cropped area in most AE-Zones, and below 80% in only one. This is an enormous change from only 8 years earlier, and may be ascribed to several factors including, though not limited to:

- The feature of the dataset in capturing larger, perhaps more intensive and 'progressive' grain producers,
- The drought conditions that have been relatively widespread through the 2000's, meaning that little crop residue has often been present, making 'no-till' techniques relatively easy to use, even where this may not have been the 'normal' practice on the property.
- That adoption of 'No-Till' really has increased by the levels indicated.

Some combination of these factors is possible, and perhaps likely. However, the data certainly do indicate a strong increase in the use of no-till and minimum till practices, with the use of a multiple-tillage based system almost disappearing in this period.

Clearly there have been strong drivers for this remarkable change. These can be discussed elsewhere and by others, though in summary, one would propose that the benefits of minimising tillage are in productivity, profitability or otherwise that add up to significant value, and have been recognized by grain producers in the high adoption in evidence.

Figure 6. % of crop area planted using No-Tillage, Minimum Tillage and Multiple Tillage as at 2008 (source: GRDC, 2009)

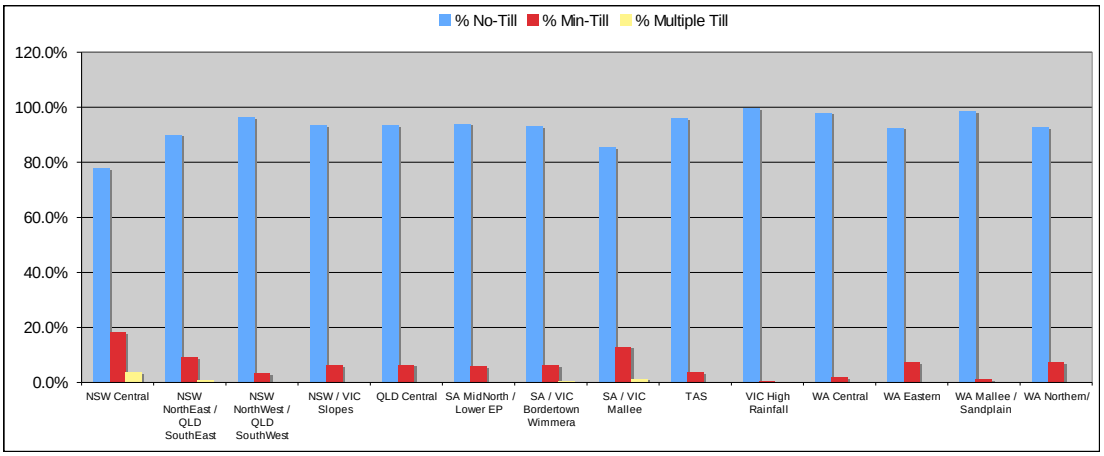


Figure 7. % of crop area planted using No-Tillage as at 2008 (source: GRDC, 2009)

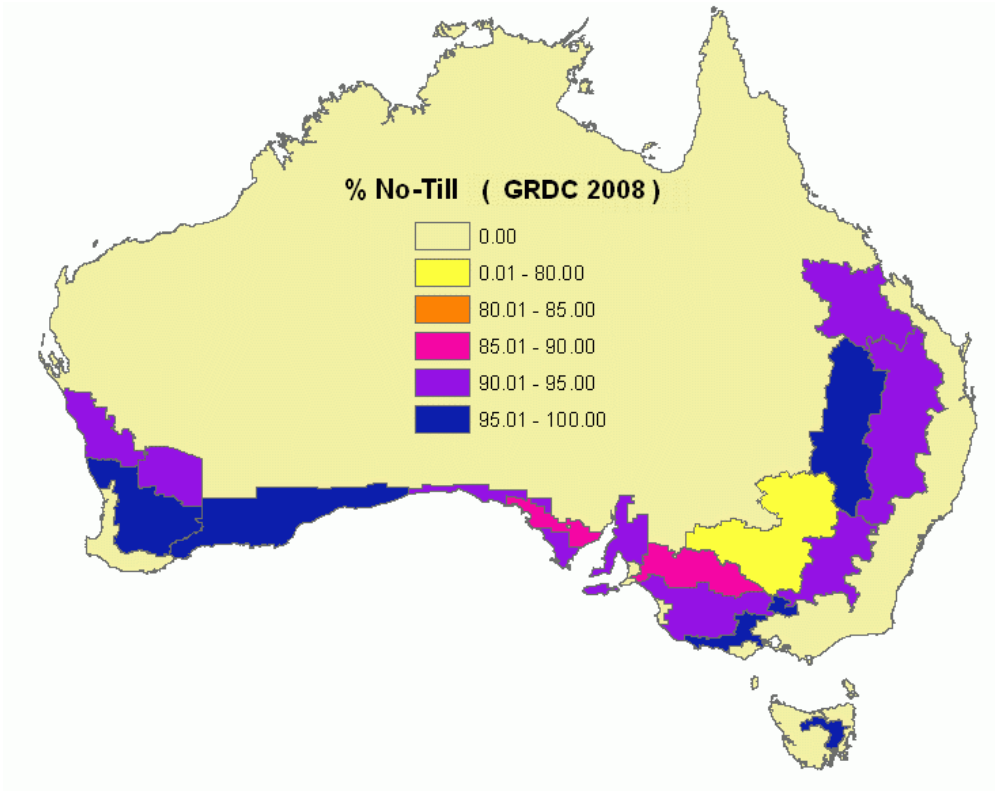


Figure 8. % of crop area planted using Minimum Tillage as at 2008 (source: GRDC, 2009)

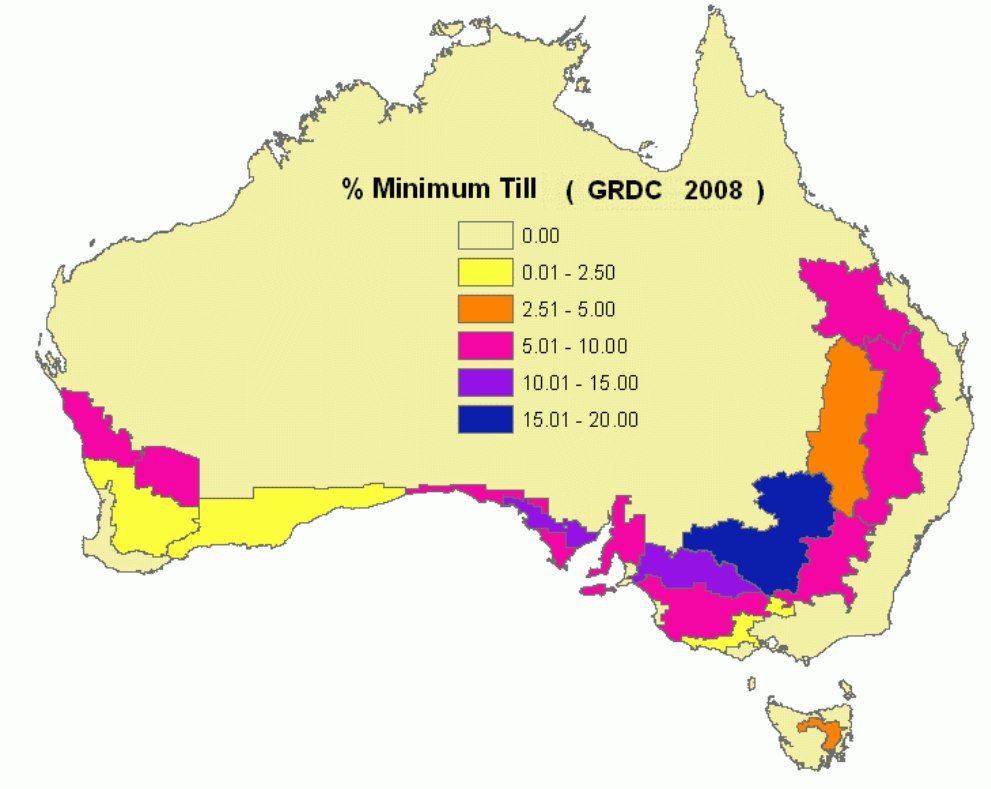
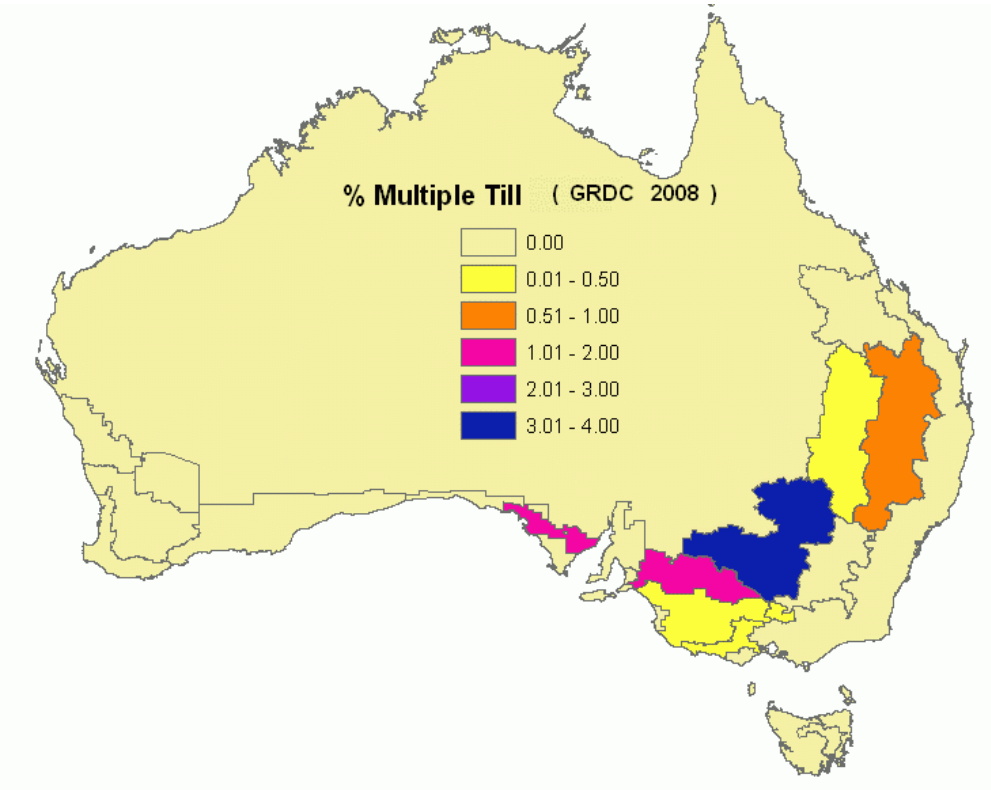


Figure 9. % of crop area planted using Multiple Tillage as at 2008 (source: GRDC 2009)



Breakdown of the categories of Tillage for the 2008 (winter) crop year

As mentioned earlier, the general categories of 'no-till', 'minimum tillage' and 'multiple tillage' can now be further subdivided.

In the survey conducted for the 2008 crop year (GRDC, 2009), both 'no-till' and 'minimum tillage' were further divided into sub categories as follows:

No-Tillage:

- No-Till 10: Where soil engaging machinery use at planting disturbs less than 10% of the soil surface. Typically such machinery would be a disc-based implement, where vertical or near-vertical discs (and several combinations are available, many with leading coulter discs), effectively 'slice' through the soil placing seed (and fertilizer) at the desired depth, leaving very little soil actually disturbed. Press wheels may or not be also used.
- No-Till 30: Where machinery disturbs more than 10% but less than 30% of the soil surface across the planting width. Typically such machinery consists of vary narrow, or 'knife' soil engaging tools, whereby a relatively narrow area of soil is moved aside, seed (and fertiliser) placed in the 'trench', with loosened soil then falling or pushed back in to cover the seed, and press wheels commonly used to firm the soil over the seed. Row spacing is often set wider than the conventional design to allow for ease of crop residue flow.
- No-Till DD: Where machinery disturbs effectively the full width of soil across the machine. While this is still a 'one-pass' planting operation, often more 'conventional', or modified conventional machines are used, with soil engaging points that loosen the soil across the whole planting width, providing a 'full cut' of the soil surface. Covering devices may consist of a range of options, from press wheels, to more conventional harrows in various forms.

Minimum Tillage:

Minimum Tillage involves at least one full soil cultivation in advance of the planting operation, though less than the often numerous cultivations that characterize "multiple tillage' systems.

- Min Till 2: This is where less than 2 (and most often only one cultivation) occurs prior to the planting operation, normally with a 'full soil disturbance' implement. Such cultivations are often used for weed control or to place previous crop residues into the soil so that planting operations (often with conventional machinery) are not impeded by such residue.
- Min Till Red: Where more than two, but less than the 'normal' conventional numerous multiple tillage operations occur before planting. This is a difficult category to describe, since there are no 'set' number of cultivations in the 'Multiple Tillage' category, so what constitutes 'Min Till Red' is often debatable.

Multiple Tillage

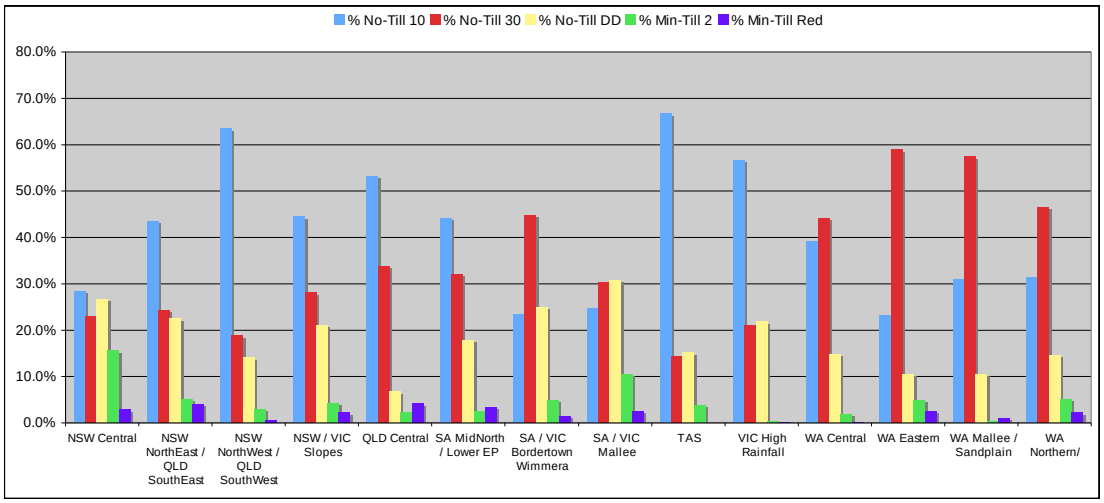
This tends to be a system, often including a long, cultivation-based fallow, where tillage is the dominant method of soil preparation prior to planting. This category has previously been known as "conventional cultivation", where the objective has been to ensure a weed and residue-free fine and loose soil at planting.

Table 3. % of crop area planted using No-Till 10, No-Till 30, No-Till DD, Min-Till 2 and Min-Till Red as at 2008 (source: GRDC 2009)

AE-Zone	% No-Till 10	% No-Till 30	% No-Till DD	% Min-Till 2	% Min-Till Red
NSW Central	28.4%	22.9%	26.7%	15.6%	2.9%

NSW NorthEast / QLD SouthEast	43.5%	24.2%	22.4%	5.1%	4.0%
NSW NorthWest / QLD SouthWest	63.4%	18.8%	14.1%	3.0%	0.5%
NSW / VIC Slopes	44.5%	28.0%	21.0%	4.3%	2.1%
QLD Central	53.1%	33.7%	6.7%	2.4%	4.1%
SA MidNorth / Lower EP	44.1%	32.1%	17.8%	2.5%	3.4%
SA / VIC Bordertown Wimmera	23.4%	44.8%	25.0%	4.9%	1.4%
SA / VIC Mallee	24.6%	30.3%	30.7%	10.5%	2.5%
TAS	66.7%	14.4%	15.2%	3.8%	0.0%
VIC High Rainfall	56.7%	21.0%	21.8%	0.2%	0.1%
WA Central	39.1%	44.1%	14.8%	1.8%	0.2%
WA Eastern	23.2%	59.0%	10.4%	4.9%	2.6%
WA Mallee / Sandplain	30.9%	57.4%	10.4%	0.4%	1.0%
WA Northern	31.4%	46.5%	14.7%	5.1%	2.2%

Figure 10. % of crop area planted using No-Till 10, No-Till 30, No-Till DD, Min-Till 2 and Min-Till Red as at 2008 (source: GRDC, 2009)



Whilst the comments above about the striking adoption levels of no-till are notable, within the category of no-till the adoption of the variants are also of interest. The adoption of no-till 10 and no-till 30 are now higher than that of no-till DD in almost every AE-Zone, indicating that growers seek to disturb their soil as little as possible. The adoption of no-till 10 is highest in much of NSW and QLD and in the high rainfall areas of Victoria.

In WA, the use of knife-type planting systems remains high, though disc-based implements are also significant now.

The levels of minimum tillage are generally very low in all AE-Zones, such that it can be claimed that no-till is now by far the most dominant crop (and perhaps pasture) establishment system in use in Australia, certainly among the larger grain-producing farmers.

The use of which variant if no-till (i.e. between disc, knife or full cut) tends to be influenced by matters of soil type, climate and level of crop residue. One tends to see a greater benefit from discs in more heavily textured soils, and less so in coarser, sandy soils. This may explain the continued use of knife-based systems in WA, and discs in northern and central NSW parts of Victoria and SA. Use of

discs for establishing pastures has been a technique available for some time in the higher rainfall areas, and so its use for crop establishment may be partly due to some growers' experiences with this.

Considering the management of soil, and the desire to minimize soil erosion and maximize moisture storage, the adoption of very minimal soil disturbance practices would be seen as very strong movement by grain producers to combine productivity and environmental benefits.

Figure 11. % of crop area planted using No-Till 10 as at 2008 (source: GRDC, 2009)

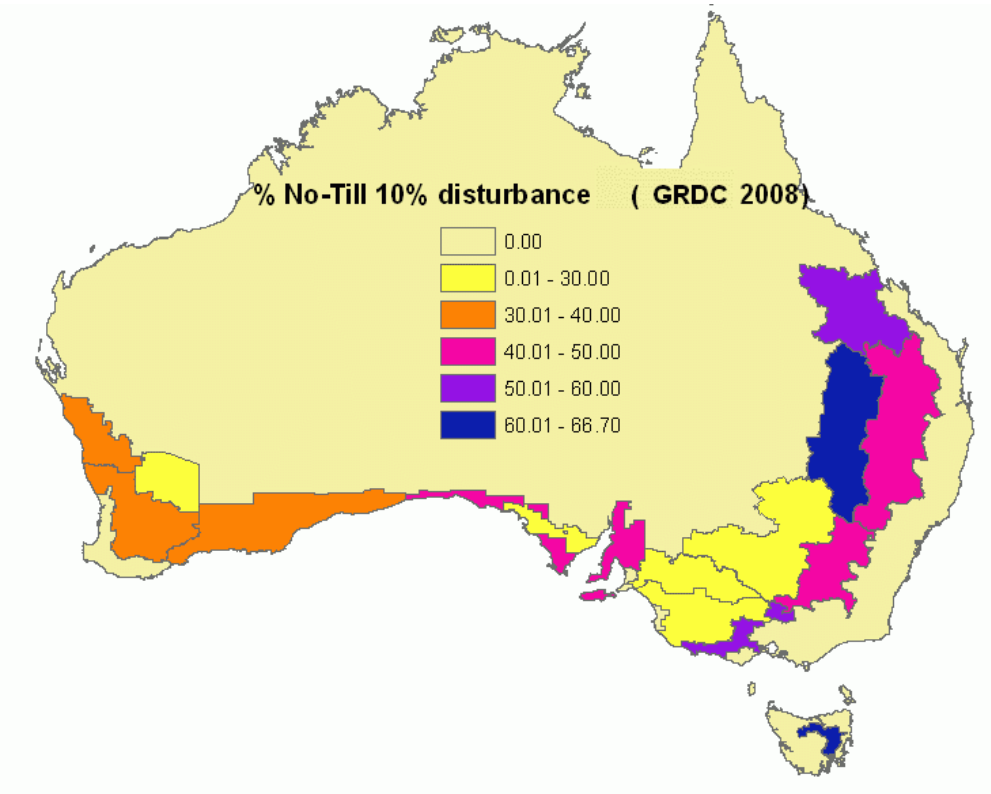


Figure 10. % of crop area planted using No-Till 30 as at 2008 (source: GRDC 2009)

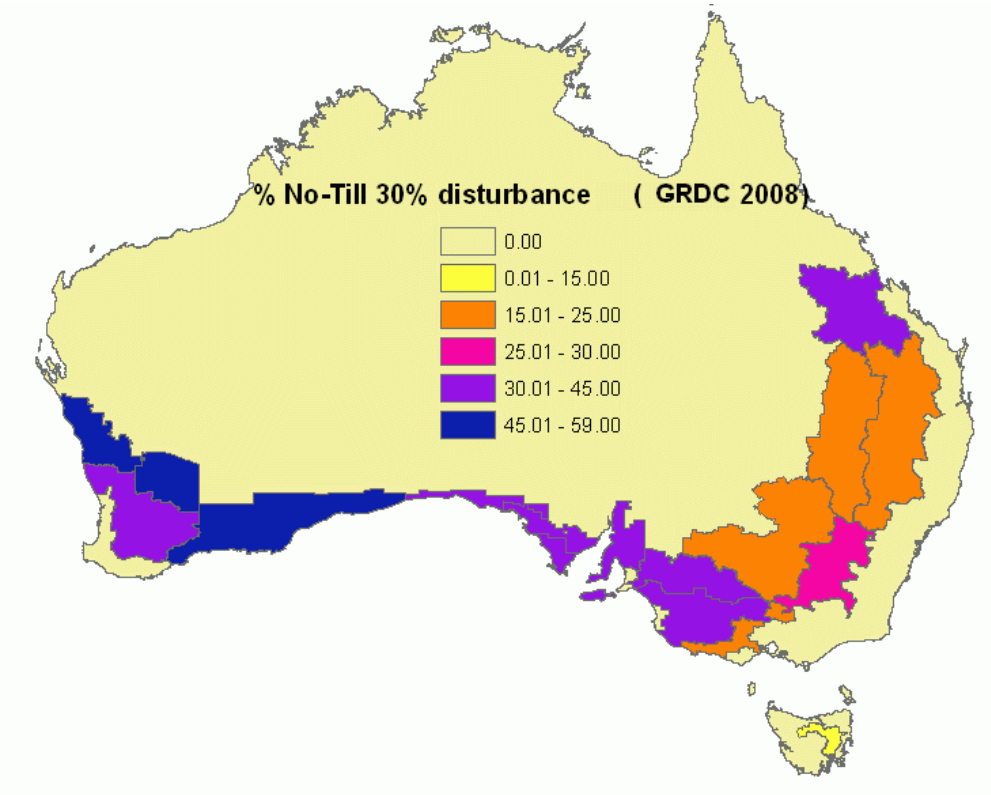


Figure 10. % of crop area planted using, No-Till DD as at 2008 (source: GRDC, 2009)

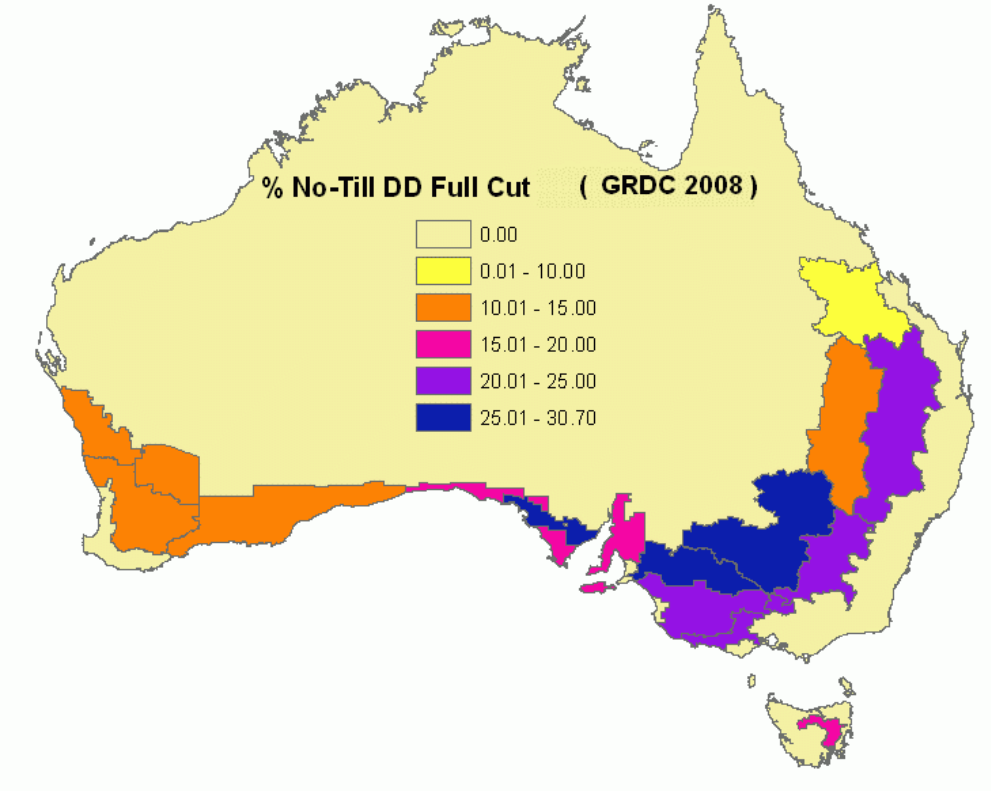


Figure 10. % of crop area planted using Min-Till 2 as at 2008 (source: GRDC, 2009)

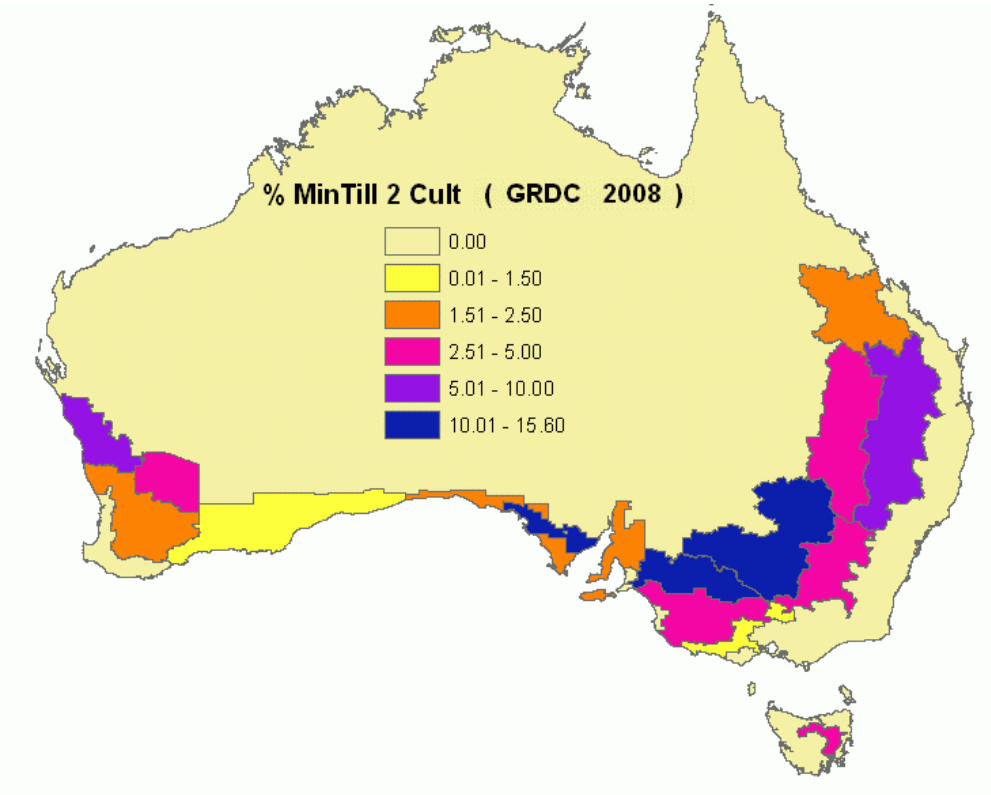
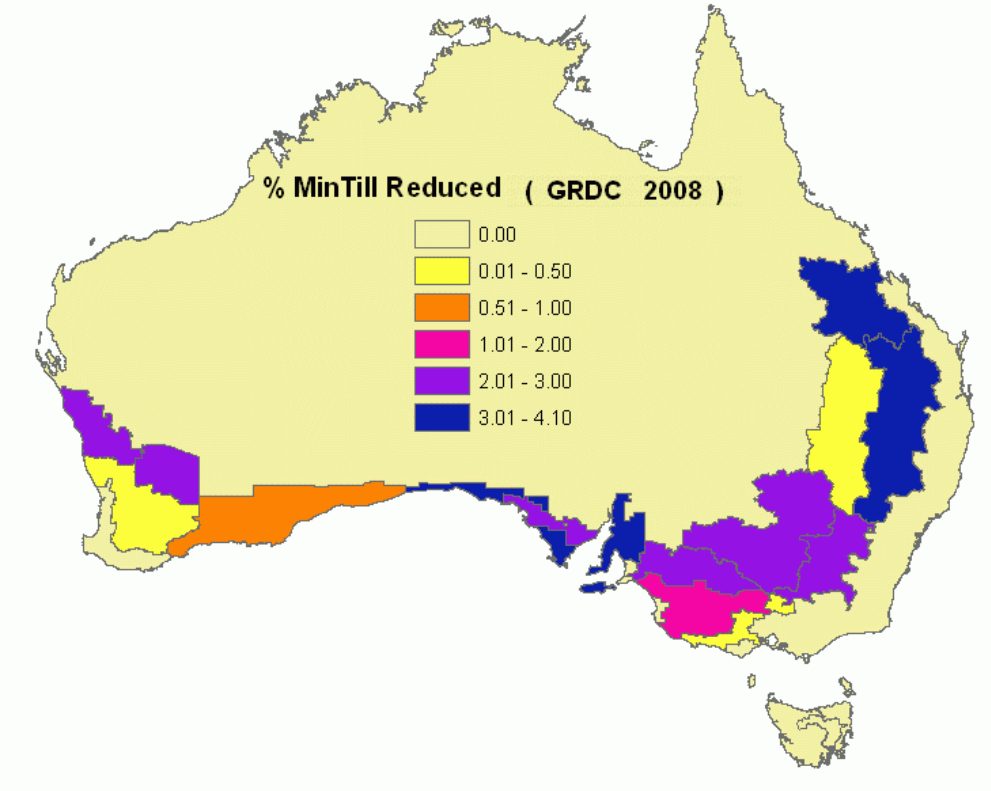


Figure 10. % of crop area planted using Min-Till Red as at 2008 (source: GRDC, 2009)



Stubble Retention

Areas of various stubble (crop residue) management practices.

This practice refers to the level of retention of crop and pasture residues following harvest or grazing. This frequently goes in hand with the tillage regime in place on the farm, and combined have a major impact on soil cover and erosion susceptibility.

Further, retention of crop residues provides soil cover and can assist with retention of moisture following rainfall, and in combination with no-tillage can assist with timeliness of planting, reducing risk and with optimizing the amount and availability of stored soil moisture.

Historic Public Data

ABS census data are available only for the 2000 cropping year for this practice.

In 2007-08 ABS conducted a survey of various farming practices, including crop residue management. However these data are only available at Natural Resource Body (NRM) level, which to do align at all well with AE-Zones.

Nonetheless, this NRM level survey did suggest a very strong increase in the adoption of minimum tillage practices since 2000-01 (see report available separately and some data presented further below in this report).

The data from the ABS census of 2000-01 is presented in Table 1 and Figures 1 to 4 below.

Table 1. % of stubble retained and Burnt by AE-Zone (Source: ABS 2001)

AE-Zone	% stubble retained	% stubble burnt
NSW Central	40%	22%
NSW NorthEast-QLD SouthEast	65%	7%
NSW NorthWest-QLD SouthWest	86%	12%
NSW Vic Slopes	32%	41%
QLD Central	75%	2%
SA Midnorth-Lower Yorke Eyre	55%	22%
SA Vic Bordertown-Wimmera	43%	27%
SA Vic Mallee	40%	8%
Tas Grain	49%	22%
Vic High Rainfall	25%	50%
WA Central	41%	9%
WA Eastern	48%	17%
WA Mallee and Sandplain	57%	3%
WA Northern	58%	12%

Note: Stubble management does not always add to 100% due to reporting errors and presence of fallow in many areas

In general, stubble retention dominated as at the crop year of 2000, with WA doing very little stubble burning, and only the high rainfall areas of Victoria (probably due to high stubble loads) burning more than is retained.

It also seems clear that high proportions of stubble retention were practiced in the northern cropping areas at this time, probably reflecting the accepted higher soil erosion risk in these regions.

In 2000 there appeared still to be large areas in western NSW and Victoria where retention of stubble in the cropping program were less than 60% of cropped area, and often less than 40%.

Figure 1. % of stubble retained and Burnt by AE-Zone (Source: ABS 2001)

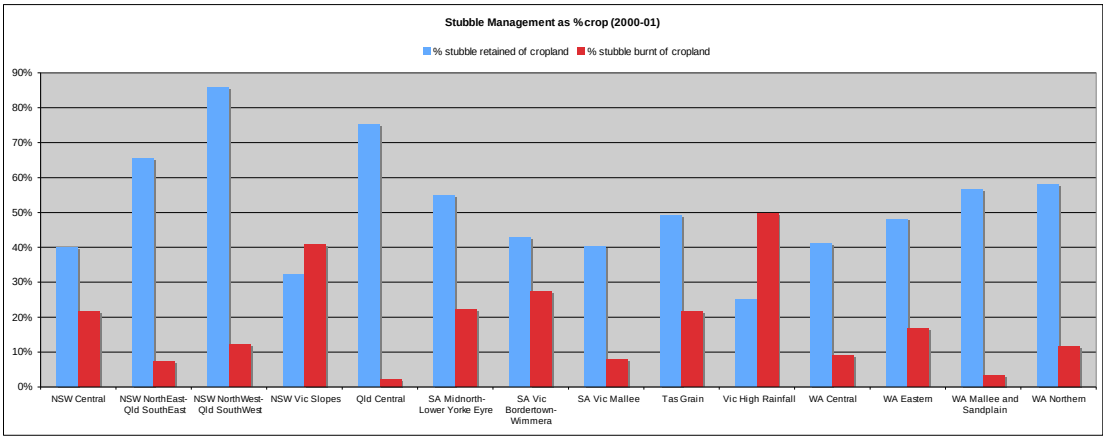


Figure 2. % of Stubble retained in 2000 (source: ABS 2001)

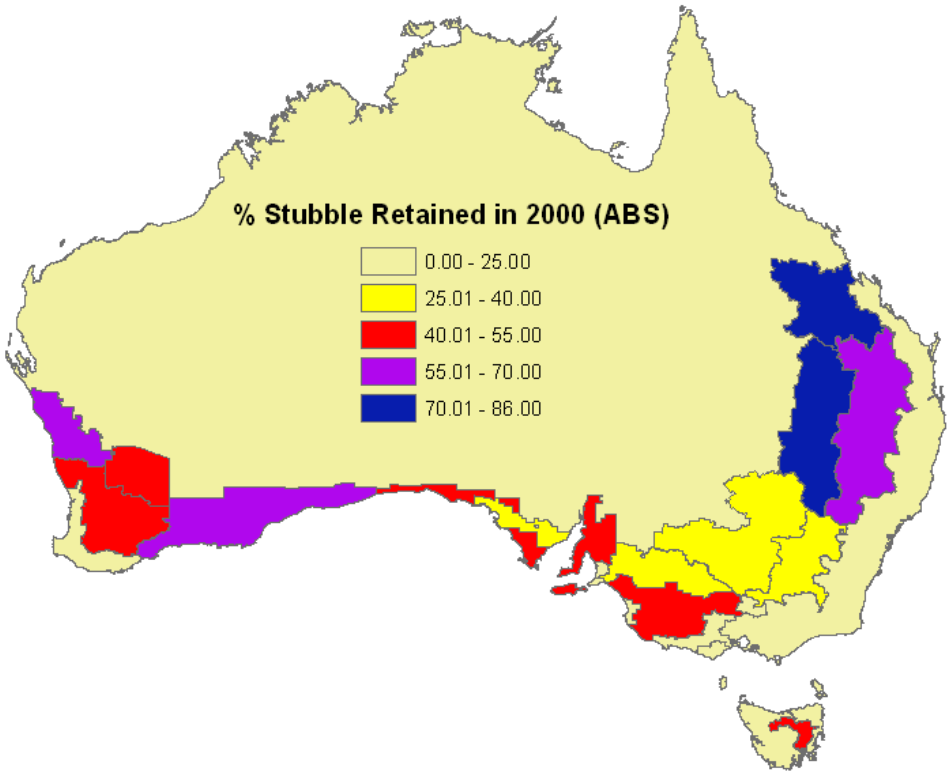
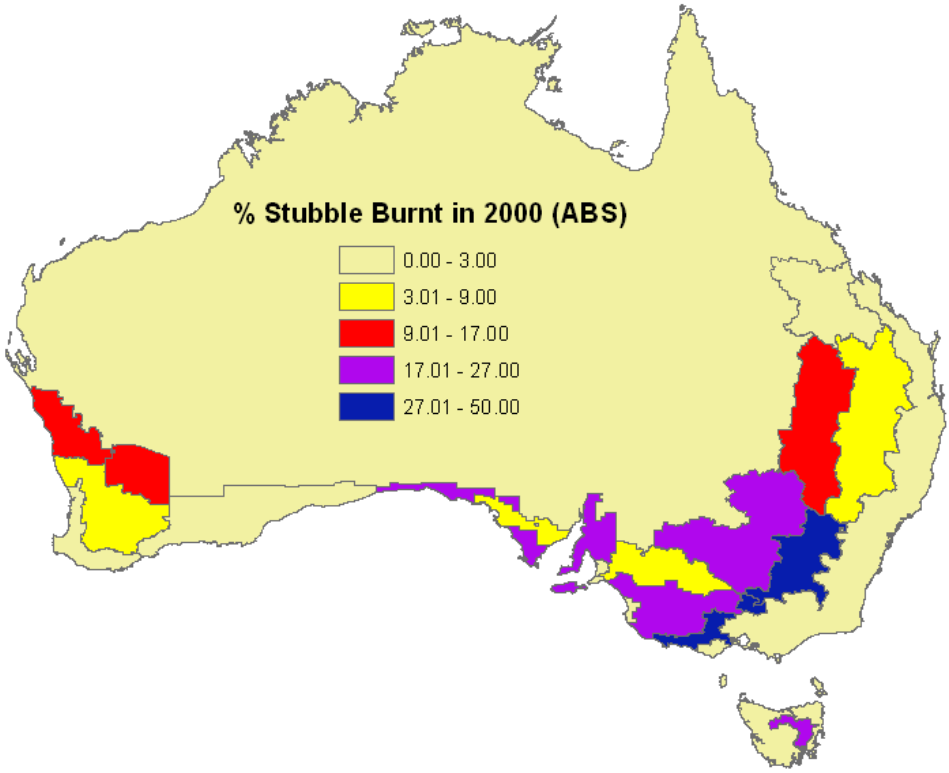


Figure 3. % of Stubble burnt in 2000 (source: ABS 2001)



Data from the ABS NRM Survey (2008).

As mentioned, in 2007 ABS conducted a survey of agricultural producers, which provided data amalgamated at NRM level. The survey data was published in 2008. Included in the survey were questions about stubble management practices. These data are presented in Table 2, and Figure 4 (below). While these data are presented at NRM level, one can get a feel for the levels of adoption of No-Till at that time.

The data indicate a flat or slight increase in levels of stubble retention when compared against the ABS census data of 2000-01, as a general comment. Adoption continued to grow in WA.

Stubble burning, however, had declined considerable compared with the earlier dataset, potentially indicating the poor crop year of 2006 which would have provided low stubble levels coming in the planting season of 2007, negating the need for much stubble to be burnt in this year.

The data from this ABS survey is difficult to reconcile with the AE-Zone level data in the ABS census and more recent Solutions dataset, since when compiled at NRM Region level, the data will include many properties that are very mixed, with a minor amount of crop, especially in the NRM Bodies containing considerable pastoral land.

The fact that stubble retention remained relatively high in general, suggests that on specialist crop properties (as more typical in WA) stubble retention continued to be practiced, and grew in adoption.

Table 2. % of stubble retained and Burnt by NRM Region (Source: ABS 2008)

Border Rivers/Gwydir	75.4%	74.1%	10.9%	1.3%

Central West	63.3%	58.4%	20.4%	0.8%
Lachlan	41.3%	40.2%	35.4%	0.9%
Lower Murray/Darling	56.5%	46.0%	7.2%	0.0%
Murray	42.4%	63.4%	47.9%	2.6%
Murrumbidgee	36.3%	48.1%	46.2%	4.5%
Namoi	82.2%	77.8%	9.6%	0.0%
Western	75.7%	60.8%	12.2%	0.0%
Corangamite	29.3%	40.8%	63.0%	25.4%
Glenelg Hopkins	27.4%	48.1%	61.9%	21.3%
Goulburn Broken	28.3%	43.0%	60.1%	8.8%
Mallee	48.7%	73.3%	10.5%	0.0%
North Central	52.4%	46.1%	27.1%	1.4%
Port Phillip and Western	44.2%	37.4%	26.2%	17.4%
Wimmera	48.5%	71.1%	28.8%	9.2%
Border Rivers	81.1%	71.9%	4.8%	1.0%
Condamine	89.2%	65.9%	3.5%	1.2%
Fitzroy	91.0%	85.8%	2.7%	0.3%
Eyre Peninsula	41.2%	70.7%	11.8%	0.7%
Kangaroo Island	47.4%	0.0%	25.5%	8.8%
Northern and Yorke	58.5%	69.4%	24.3%	3.6%
SA Murray Darling Basin	41.9%	50.4%	8.7%	0.0%
Avon	53.7%	72.3%	13.5%	4.7%
Northern Agricultural Re	68.0%	81.8%	14.7%	1.9%
Rangelands (WA)	62.7%	74.3%	6.0%	0.0%
South Coast Region	63.8%	77.9%	4.1%	3.4%
Swan	49.1%	33.6%	25.6%	0.0%
North (TAS)	50.8%	55.0%	23.6%	7.6%

Figure 4. % of crop area planted where stubble was retained, by NRM Region, as at 2000 and 2007 (source ABS 2001 and 2008)

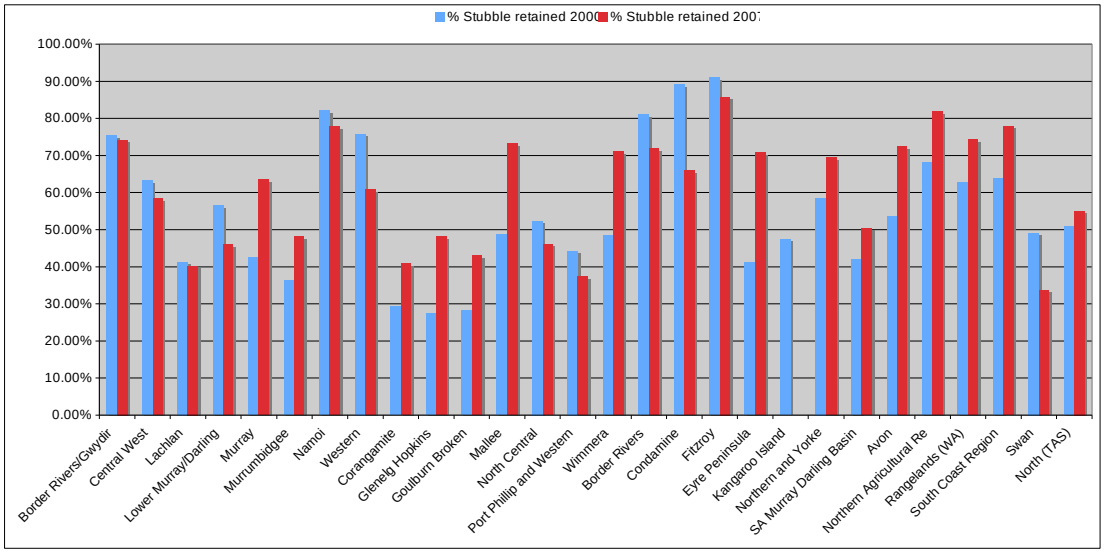
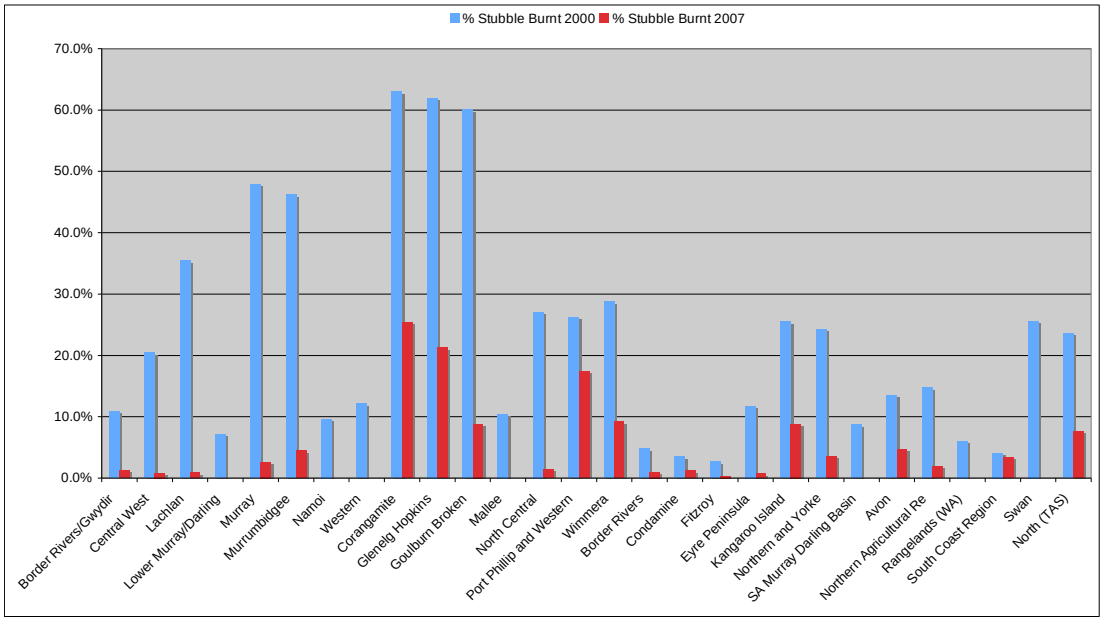


Figure 5. % of crop area planted where stubble was burnt, by NRM Region, as at 2000 and 2007 (source ABS 2000 and 2008)



CSIRO / SANTFA / CAAANZ / GRDC No-Till survey 2009

A GRDC-funded project conducted by CSIRO Sustainable Ecosystems, SANTFA and CAAANZ for the 2007-08 crop year also included some questions concerning crop residue management (see Llewellyn and Demden, 2009).

This survey found a generally high level of stubble being retained, though among some no-till farmers some stubble was still burnt. On average only 22% of growers surveyed burnt any stubble.

Data from GRDC for the 2008 (winter) crop year

The data on crop residue management practices as gathered by GRDC for the 2008 crop year are presented in Table 3 and Figures 6 to 10. These data show the stubble management practices allocated into several categories, with the major ones of interest being:

- Stubble retained intact: stubble is retained and not grazed, slashed, or otherwise managed

- Stubble retained – not standing: stubble can be grazed, slashed, or otherwise managed such that, while remaining in place, is not standing as per the 'Intact' category.
- Stubble burnt – Cool Burn: Stubble that is burnt quite late in the season, often just before or at the point of planting. Such burns are incomplete, leaving a proportion of the stubble remaining on or attached to the soil, but removing enough stubble to allow most planting (including conventional) machinery to get through.
- Stubble burnt – Hot Burn: Stubble is burnt often in late summer or early autumn, such that a (more or less) complete burn of stubble takes places, effectively removing all crop residue from the previous year. When combined with a multiple tillage crop establishment system soil is exposed and vulnerable to erosion, compaction and structural decline.
- Stubble retained – Other: This includes methods where stubble can be rolled, crimped, or other techniques which leave the stubble on the paddock, though do not fall into the other categories.
- Stubble – Raked: Where stubble is harrowed or raked to spread it more evenly over the paddock
- Stubble Windrowed: Where stubble is either cut and placed in windrows or simply raked into windrows. In some cases windrows can be baled, or burnt, with only the windrows being burnt. The latter case is used for herbicide weed resistance management in some cases, where the weed seeds in the windrows can thus be burnt.

Table 3. % of stubble managed by various practices, by AE-Zone (Source: GRDC 2009)

AE-Zone	Stubble Intact	Stubble Not standing	Stubble Cool Burn	Stubble Hot Burn	Stubble raked	Stubble Other	Stubble Windrowed
NSW Central	53.9%	44.4%	0.0%	1.1%	0.0%	0.5%	0.0%
NSW NorthEast / QLD SouthEast	64.8%	30.4%	2.6%	0.8%	1.2%	0.1%	0.1%
NSW NorthWest / QLD SouthWest	70.5%	28.3%	0.1%	0.0%	1.0%	0.0%	0.0%
NSW / VIC Slopes	54.5%	37.8%	1.7%	0.6%	1.8%	2.9%	0.8%
QLD Central	68.9%	25.5%	0.0%	0.0%	0.0%	5.7%	0.0%
SA MidNorth / Lower EP	50.0%	45.5%	0.5%	1.2%	1.2%	0.3%	1.3%
SA / VIC Bordertown Wimmera	45.4%	47.0%	2.7%	0.7%	0.3%	3.2%	0.7%
SA / VIC Mallee	50.5%	46.8%	0.0%	0.0%	0.5%	1.4%	0.9%
TAS	15.8%	63.2%	9.5%	0.0%	0.0%	8.6%	2.9%
VIC High Rainfall	36.8%	59.3%	1.1%	0.6%	1.4%	0.5%	0.3%
WA Central	43.3%	50.0%	2.4%	3.0%	0.6%	0.3%	0.4%
WA Eastern	56.2%	31.0%	3.7%	9.1%	0.0%	0.0%	0.0%
WA Mallee / Sandplain	58.6%	39.6%	0.3%	0.0%	0.0%	0.0%	1.4%
WA Northern	60.1%	33.2%	0.8%	2.4%	0.9%	0.0%	2.5%

It is apparent that in this dataset, the vast majority of stubble is either left intact, or left not-standing, with very small proportions burnt or otherwise managed.

Figures for the minor categories of stubble raked, 'other' or windrowed are not shown since the proportions are very small.

Figure 6. % of crop area managed using various stubble management techniques, by AE-Zone (source GRDC, 2009)

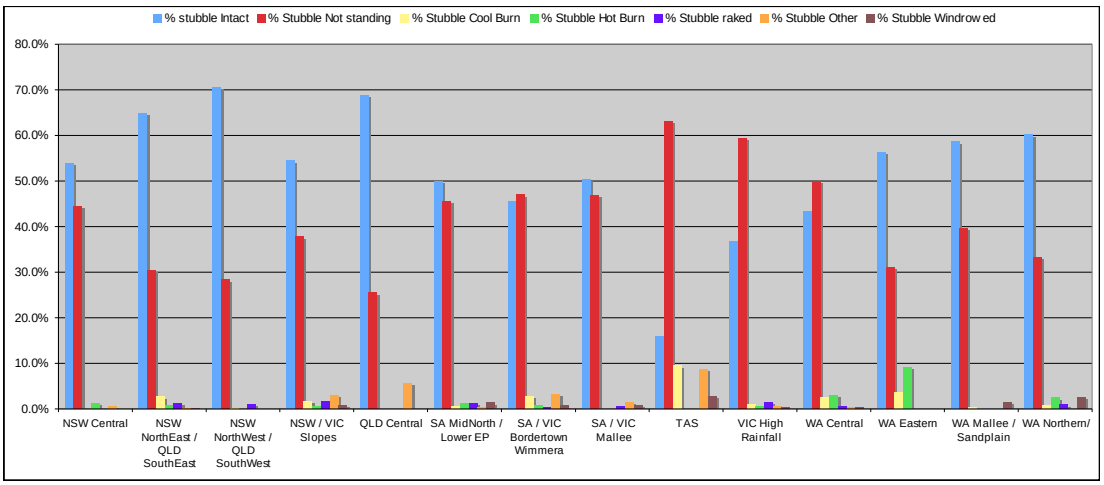


Figure 7. % of crop area where stubble was left intact in 2008, by AE-Zone (source GRDC 2009)

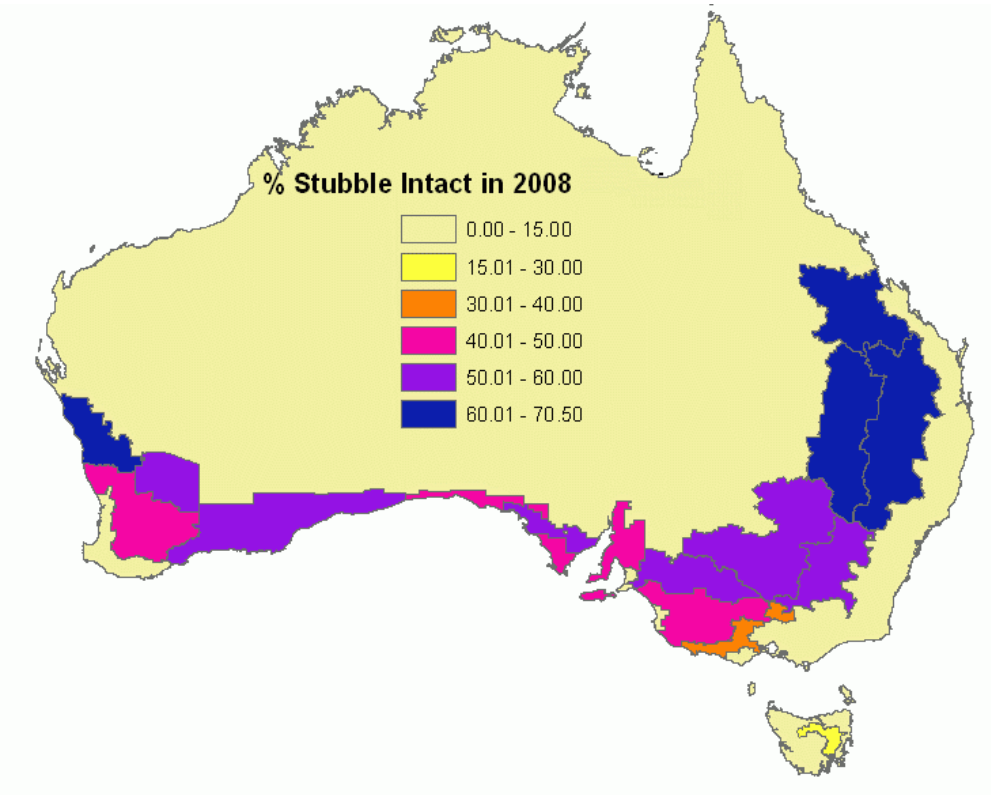


Figure 8. % of crop area where stubble was retained, though not standing intact in 2008, by AE-Zone (source GRDC, 2009)

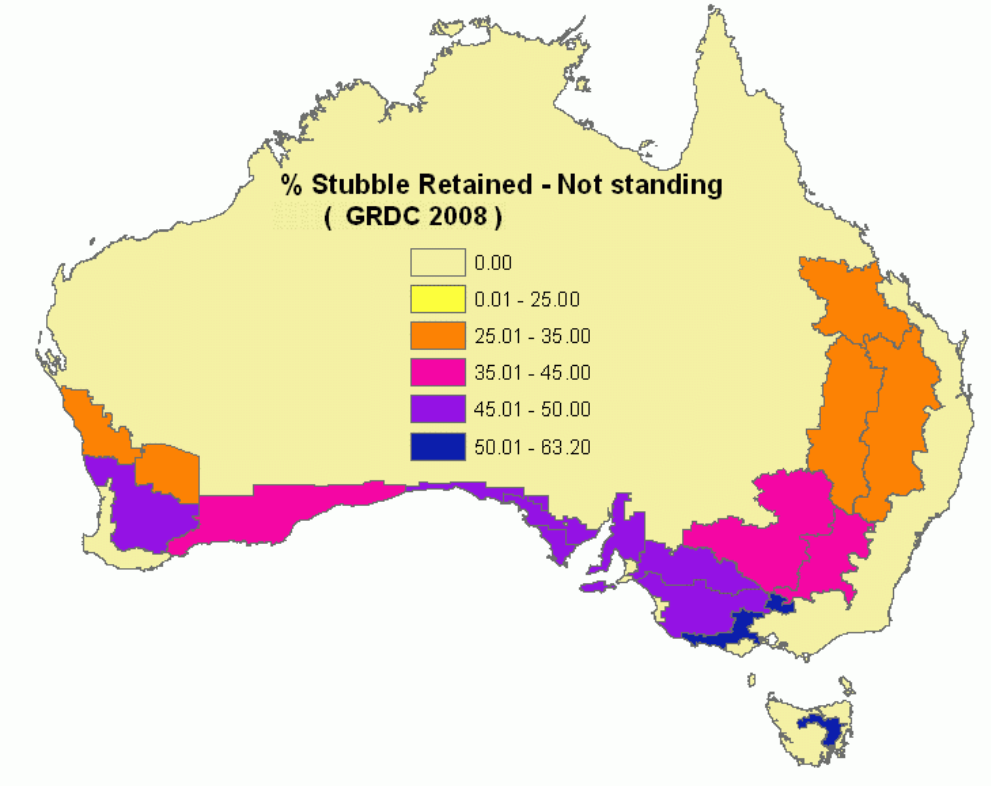


Figure 9. % of crop area where stubble was 'hot' burnt in 2008, by AE-Zone (source GRDC, 2009)

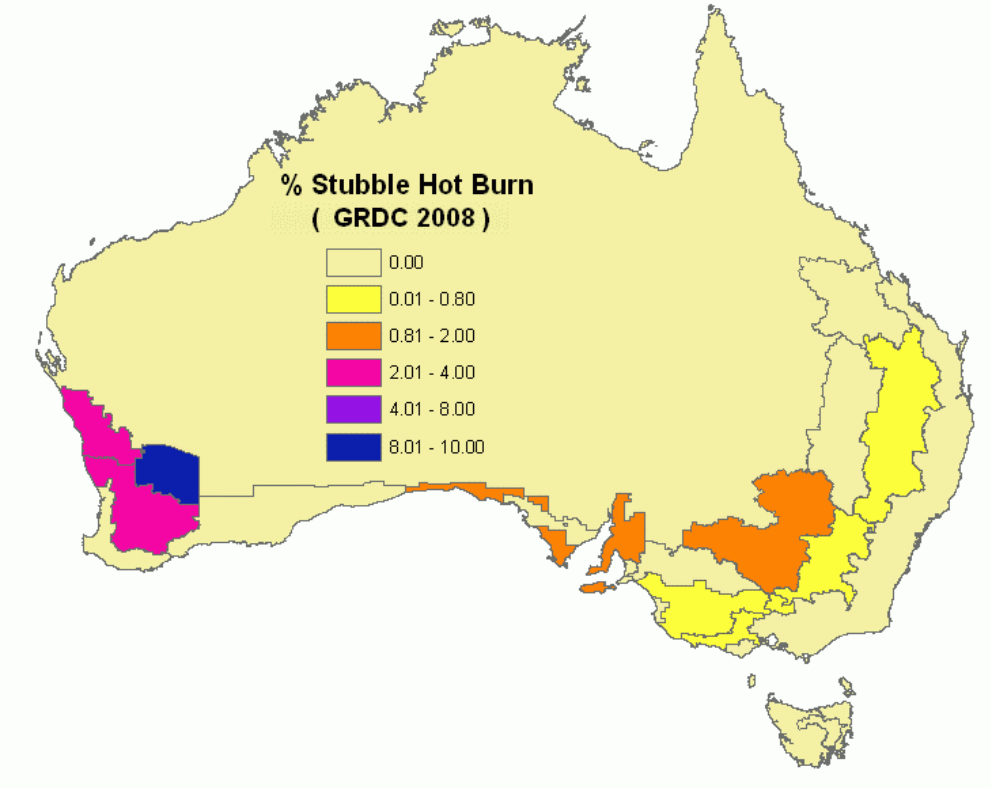
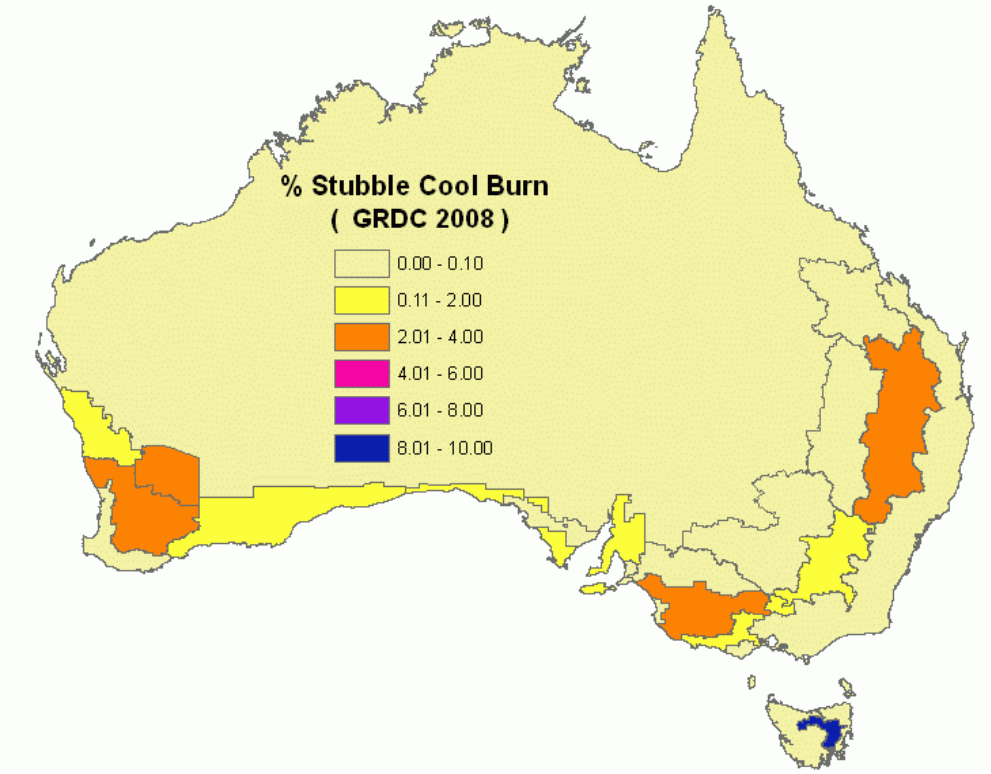


Figure 10. % of crop area where stubble was 'Cool' burnt in 2008, by AE-Zone (source GRDC, 2009)



It is apparent that very high levels of adoption of retaining stubble are now practiced across Australia, with over 90% retained in most AE-Zones. Some reasons may be considered:

- The drought conditions that have been relatively widespread through the 2000's, meaning that little crop residue has often been present, making retaining of stubble relatively easy,

though the 2008 would not have been considered abnormal in this regard, suggesting that stubble retention is now, for many, a 'normal practice.

- Retaining stubble and the use of No-till planting are closely linked, being two parts of the same system. As outlined in a previous report, the adoption of 'No-Till' has increased dramatically through the 2000's, and so to see the retention of stubble also now widespread is likely to be linked to this.
- Continued developments in machinery design to assist with stubble flow and clearance (tyned machinery), and the use of disc-based machinery that can more easily cut through stubble.

Considering the management of soil, and the desire to minimize soil erosion and maximize moisture storage, the adoption of stubble retention practices, in partnership with No-Tillage would be seen as very strong movement by grain producers to combine productivity and environmental benefits.

Crop Rotation

Crop Rotation with pasture, oilseeds, pulses etc.

The rotation of crops and pastures in sequence, either between various crop types or between crops and pastures is seen as a valuable means of assisting with weed and disease management and hence with productivity, and also with soil management issues.

Area of crop per farm

When considering the cropped area and how this represents the actual cropping characteristics of the AE-Zone, it is interesting to look at the amount of crop grown per farm in the Solutions dataset, compared to the average area of crop in the previous ABS censuses.

ABS and Solutions data at AE-Zone level

ABS data from the agricultural census is not presented at AE-Zone level, though has been manipulated to these to assist GRDC. Table 1 and Figures 1 and 2 present data from both ABS and GRDC showing average area of crop per farm.

Table 1. Average area of crop per farm (ha) from ABS and GRDC, by AE-Zone

AE-Zone	2000 (ABS)	2005 (ABS)	ABS (Avg)	GRDC (2008)
NSW Central	596	635	615	2,144
NSW NorthEast / QLD SouthEast	514	559	537	1,426
NSW NorthWest / QLD SouthWest	955	1,007	981	2,010
NSW / VIC Slopes	339	353	346	1,480
QLD Central	1,069	833	951	2,242
SA MidNorth / Lower EP	509	538	523	1,263
SA / VIC Bordertown Wimmera	343	370	356	1,168
SA / VIC Mallee	767	946	856	2,107
TAS	96	116	106	1,068
VIC High Rainfall	169	185	177	1,282
WA Central	949	935	942	2,247
WA Eastern	1,976	2,236	2,106	3,537
WA Mallee / Sandplain	1,078	1,341	1,209	3,040
WA Northern	1,828	1,878	1,853	3,489

As a general observation, area of crop per farm has increased through the 2000's, though whether this is a consequence of a similar increase in farm size, or as an increase in amount of crop per farm is difficult to determine, though perhaps a combination of both is present to some extent, at least in some of the AE-Zones where grain production dominates.

Figure 1. Average area cropped per farm in the GRDC dataset, by AE-Zone

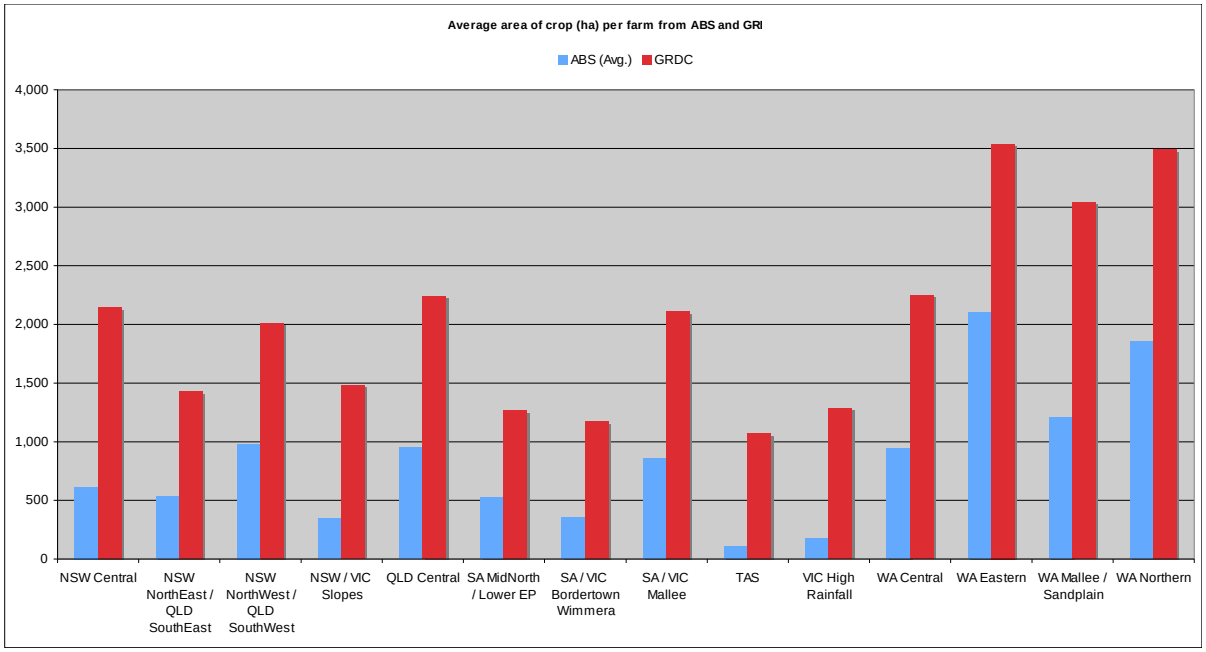
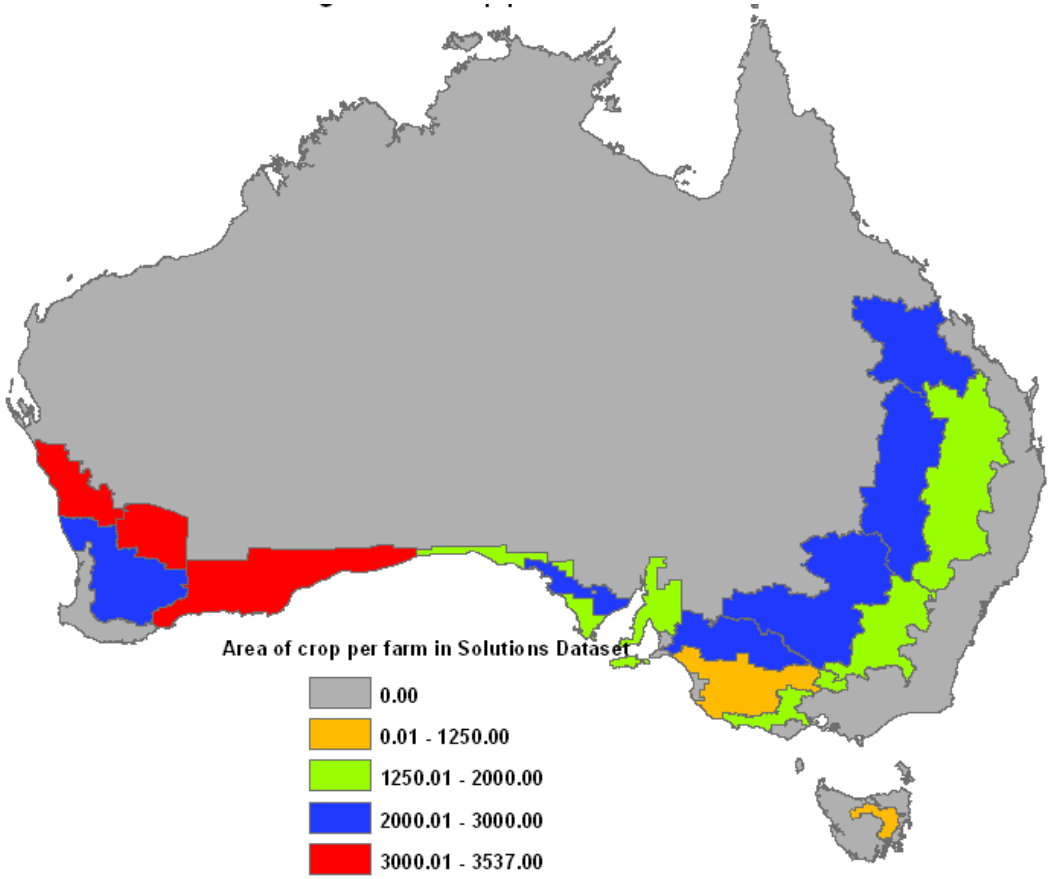


Figure 2. Average area cropped (ha) per farm in the GRDC dataset, by AE-Zone



The data presented above are from the GRDC dataset for the crop year 2008, and are known to represent generally larger grain farms. This dataset is seen to be possibly more typical of grain production, given the skewed nature of grain production in Australia.

Percentage of crop (as proportion of total farm area) per farm

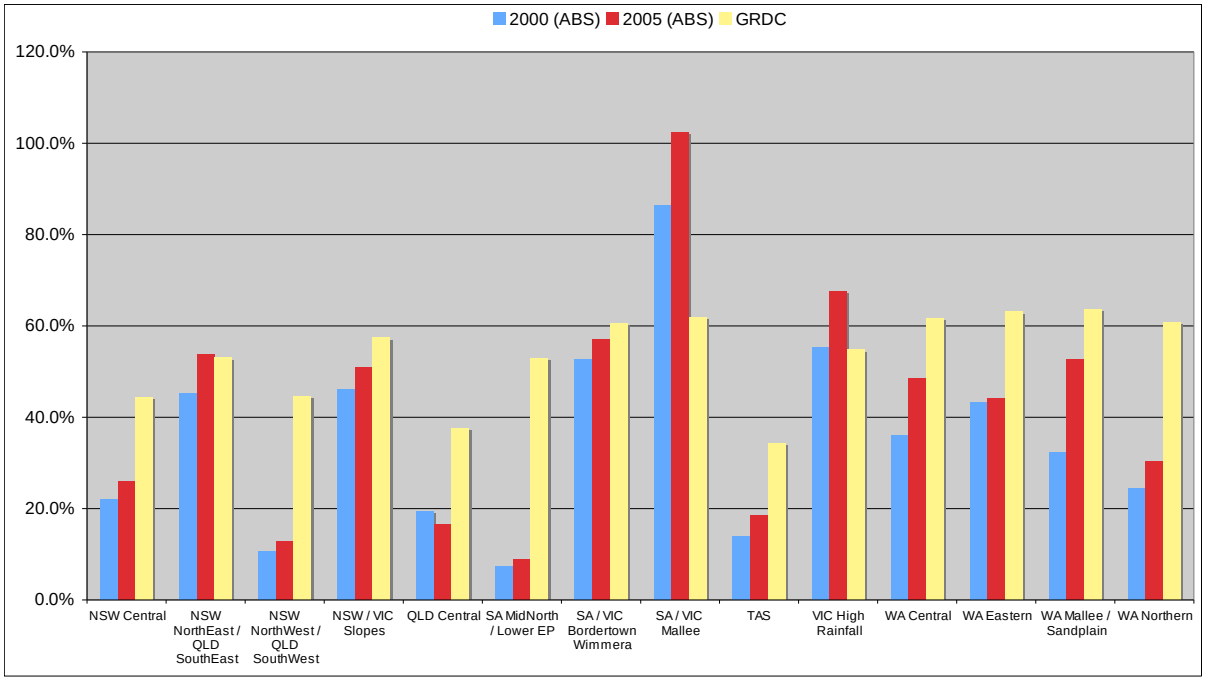
Table 2. Average % of crop as a proportion of total farmland from ABS and GRDC, by AE-Zone

AE-Zone	% Crop of farmland ABS (Avg.)	% Crop of farmland (GRDC, 2008)
NSW Central	23.85%	44.4%
NSW NorthEast / QLD SouthEast	49.25%	53.0%
NSW NorthWest / QLD SouthWest	11.60%	44.6%
NSW / VIC Slopes	48.49%	57.4%
QLD Central	18.13%	37.6%
SA MidNorth / Lower EP	8.11%	53.0%
SA / VIC Bordertown Wimmera	54.82%	60.6%
SA / VIC Mallee	94.51%	61.9%
TAS	16.09%	34.4%
VIC High Rainfall	61.16%	54.8%
WA Central	41.25%	61.7%
WA Eastern	43.74%	63.1%
WA Mallee / Sandplain	41.08%	63.6%
WA Northern	27.04%	60.9%

Table 2 (above) and Figure 3 (below) show the proportion of crop in relation to total farmland, averaged for the data for each AE-Zone, both from the ABS and GRDC.

Again, this suggests that the dataset is from the more intensive crop producers. This dataset allows some ability to answer the question as to whether increased crop area is due to increased farm size, or more crop as a proportion of the farm area. It appears that in WA, central QLD, and parts of NSW the proportion of crop to farm area has increased, signaling an increased crop intensity, though in other AE-Zones (for example, in Victoria, though see comments about these data below) this is less apparent.

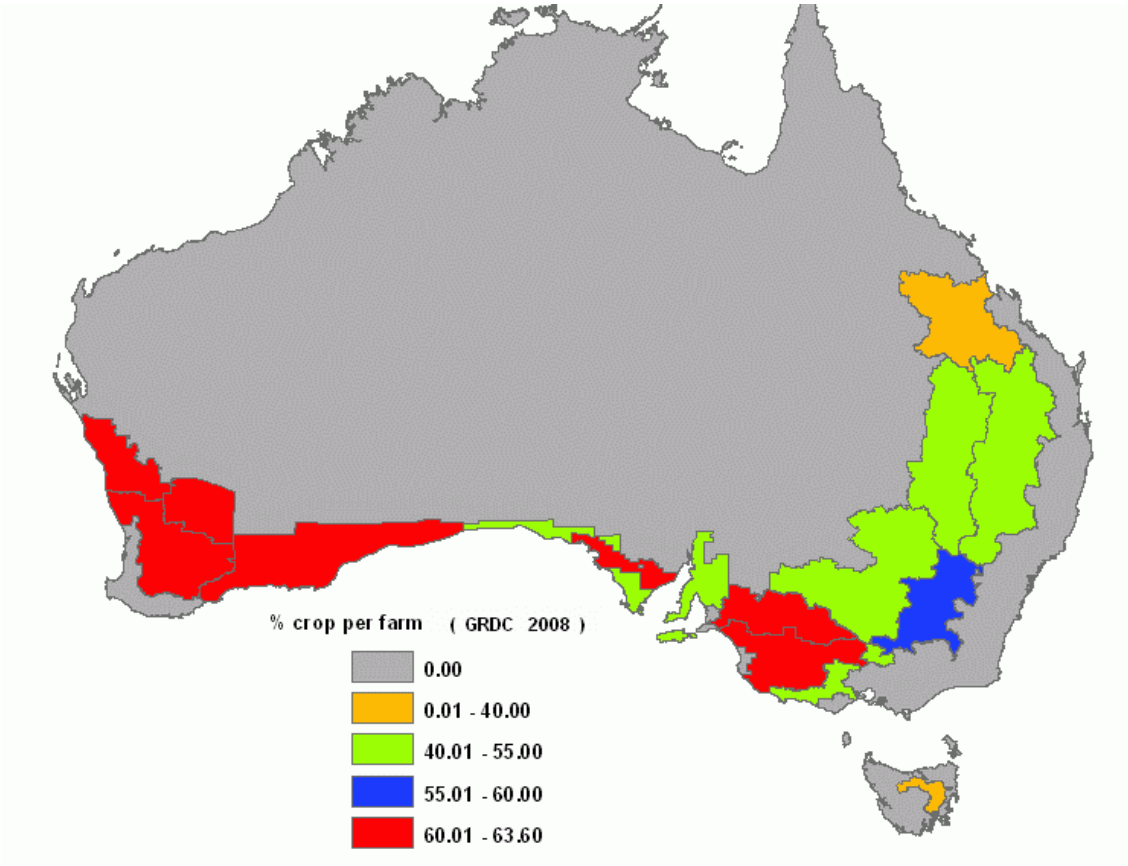
Figure 3. Proportion (%) of crop to farmland from ABS (2000 and 2005) and GRDC (2008)



There appears to be some anomaly in the ABS data concerning the SA/Vic Mallee, whereby it would be considered most unlikely to have the proportion of crop as greater than total farmland. This could be due to the methods of allocating data within ABS, error, or undefined factors. Looking at the NRM Survey data from ABS in 2007, it is possible that the proportion of crop in the mallee is actually closer to that suggested by the GRDC data, with the NRM data suggesting approximately 50% of the farmland was cropped in 2007 (see below).

Otherwise, the GRDC dataset suggests that the farms in the survey are at least as crop intensive as that suggested by ABS, or that crop intensity on farms has grown in recent years.

Figure 3. Average % of total area cropped per farm in the GRDC dataset, by AE-Zone



When one looks at the data as presented above, two aspects emerge:

- The area cropped per farm (in general) appears to have risen in pretty much all areas, though this trend is difficult to assess as continuing from the Solutions data, given the inherent bias.
- Given that it appears that the dataset from GRDC has captured a sample of the larger cropping properties in every AE-Zone, it is perhaps to be expected that these would have a higher proportion of crop compared to the overall population.

Data from the ABS NRM survey of 2007

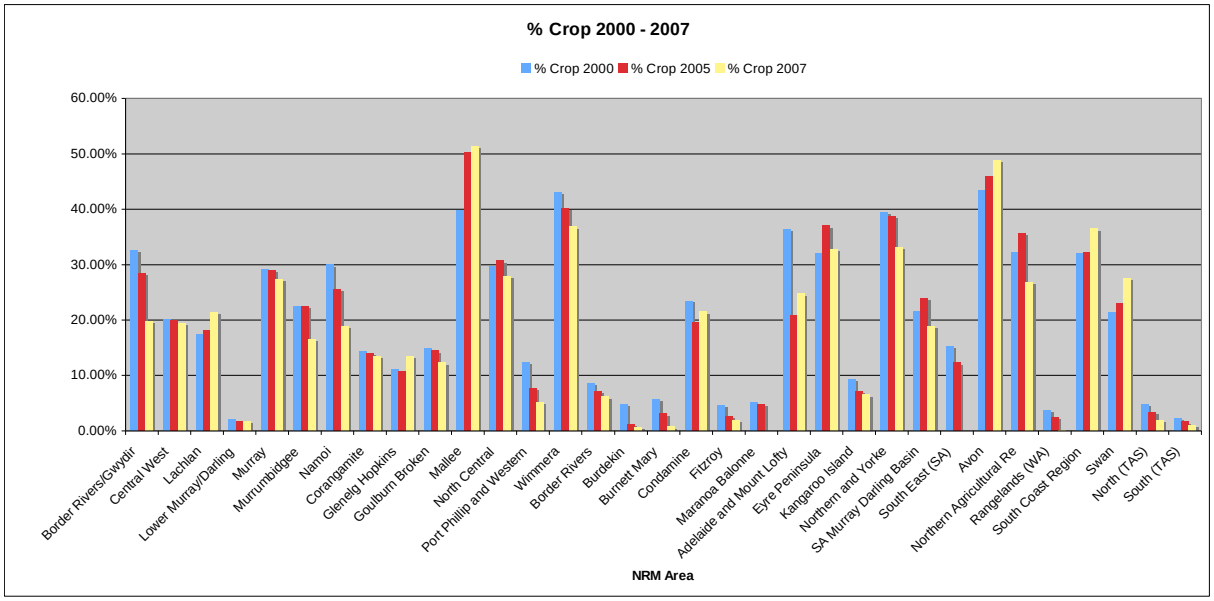
During 2007, ABS conducted a survey of farming practices as part o a national survey of management of natural resources (NRM Survey). This survey contained some questions of relevance to the data analysis work of this GRDC project, and so is included as an additional dataset of interest.

Table 3. Average % of crop as a proportion of total farmland from ABS NRM survey, by AE-Zone (2007)

Border Rivers/Gwydir	32.64%	28.41%	19.76%
Central West	20.14%	19.84%	19.43%
Lachlan	17.39%	18.14%	21.31%
Lower Murray/Darling	2.17%	1.77%	1.72%
Murray	29.20%	29.01%	27.38%
Murrumbidgee	22.47%	22.44%	16.48%
Namoi	30.01%	25.64%	18.79%
Corangamite	14.35%	13.93%	13.47%

Glenelg Hopkins	11.15%	10.65%	13.46%
Goulburn Broken	14.82%	14.41%	12.29%
Mallee	39.79%	50.24%	51.31%
North Central	29.68%	30.70%	27.89%
Port Phillip and Western	12.32%	7.60%	5.23%
Wimmera	43.11%	40.09%	36.84%
Border Rivers	8.60%	7.19%	6.11%
Burdekin	4.79%	1.24%	0.63%
Burnett Mary	5.69%	3.06%	0.74%
Condamine	23.46%	19.50%	21.48%
Fitzroy	4.66%	2.63%	1.93%
Maranoa Balonne	5.11%	4.74%	#DIV/0!
Adelaide and Mount Lofty	36.44%	20.73%	24.79%
Eyre Peninsula	31.99%	37.03%	32.76%
Kangaroo Island	9.24%	7.21%	6.50%
Northern and Yorke	39.45%	38.68%	33.21%
SA Murray Darling Basin	21.60%	23.90%	18.94%
South East (SA)	15.29%	12.28%	0.00%
Avon	43.42%	45.93%	48.80%
Northern Agricultural Re	32.22%	35.68%	26.80%
Rangelands (WA)	3.72%	2.47%	0.02%
South Coast Region	32.06%	32.25%	36.48%
Swan	21.38%	22.88%	27.56%
North (TAS)	4.80%	3.42%	1.94%
South (TAS)	2.24%	1.62%	0.96%

Figure 4. Average % of total area cropped per farm by NRM Region, using ABS Census data for 2000 and 2005, and ABS NRM Survey, 2007.



It is apparent that there is a degree of consistency between the three datasets in many of the NRM Regions in terms of the proportion of crop on farms, with the NRM Survey data tending to largely agree with the previous census data.

There are some trends apparent through time, such that the proportion of crop on farms fluctuates, though in the more specialist cropping areas the proportion of crop is around 50% or more (Solutions) somewhat higher than ABS suggests. Where mixed farming is more prevalent, the amount of crop is lower, as one would expect.

Pasture Areas:
Proportions of farmland under pasture from ABS and GRDC (2008) presented at AE-Zone level

Many grain farms in Australia are mixed enterprise, in that often livestock is also a component of the land use mix. To this end pasture areas are a feature within the grains industry. Pastures and livestock provide benefits for many farmers, assisting with providing alternatives income streams (thus assisting with financial risk management), as well as some agronomic factors, including:

- A means of increasing soil nitrogen (where legume-based pastures are used),
- A means of weed control – where livestock can be used for grazing some weeds, alternative herbicide options are often available in a pasture situation, and competition from the pasture can reduce weed numbers,
- A means of assisting with soil structure, and potentially increasing soil organic matter
- Providing a break in some crop disease cycles, by providing a non-host suite of plants that led to a reduction of many disease inoculum levels in soil.

However, many see these benefits negated by the potential impacts of grazing hard hoofed animals on the pastures, in soil erosion risk, compaction and texture breakdown. For these reasons the use of pastures in rotation with crops is often a matter for each individual farmer, driven by their sensitivity to the mix of risks and benefits, the geographical and climatic circumstances, land capability, and personal preference, coupled with the financial outlook for cropping versus meat or wool production.

Grain or crop-only farms are relatively few, and pastures are a general feature of most grain producing areas.

Data about pasture areas.

The ABS collects data on the amount of pasture on-farms as part of the usual agricultural census, in the periodic surveys they conduct, and in some special purpose surveys.

However, data on 'pastures' is often complicated by the definition of a 'pasture', since pastures can be perennial or annual-based, 'improved' (i.e. planted and managed as a dedicated pasture), or 'unimproved' (i.e. volunteer plants, or native species that simply emerge on land otherwise not managed), or several combinations of these. Additionally, landholders interpretations of questions about pastures in ABS census or surveys can be varied, with different landholders reporting the same type of pasture as different categories, or different pastures as the same, especially where regional definitions of 'pasture' vary. Further, in some areas there is uncertainty about the difference between 'native vegetation' and unimproved, extensive 'pastures', whereby livestock can make use of areas of native vegetation as 'pasture' and therefore whether these areas are to be reported as 'unimproved pasture', or 'remnant / native vegetation', or sometimes both, can cause confusion.

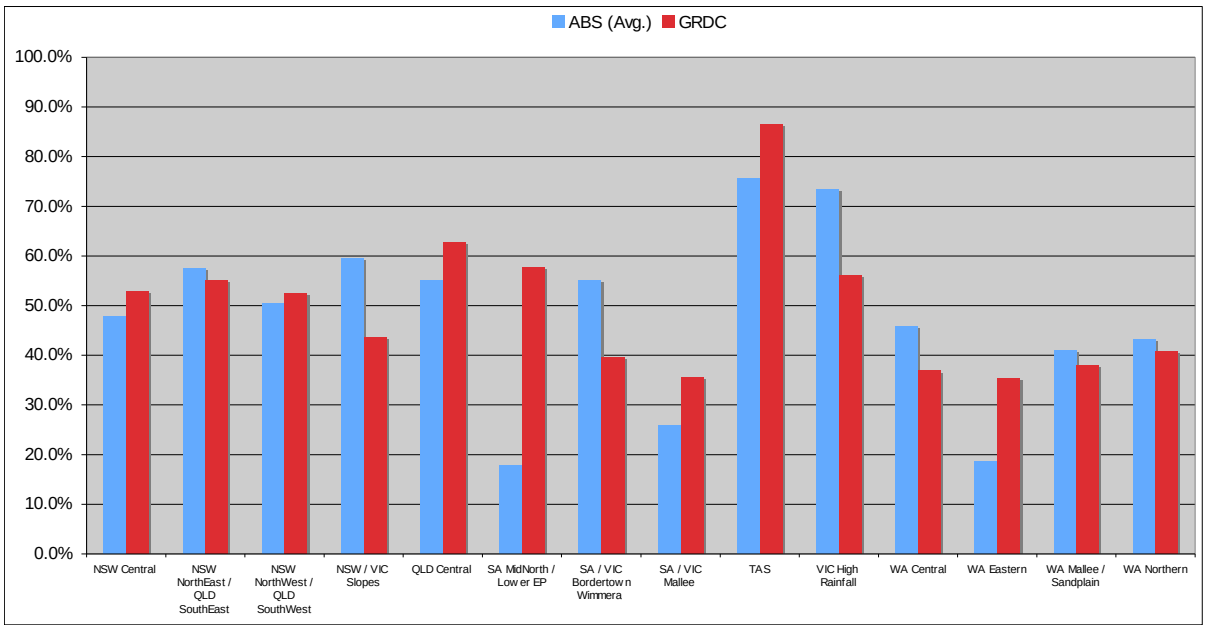
For these reasons data about pastures often fluctuates widely between censuses and is often difficult to make solid interpretations about. Data from ABS as presented below often includes a dataset of 'average of the last two censuses – 2000 and 2005' to try and cater for the variation that can be apparent between these two census years.

Table 4. Average % of pasture as a proportion of total farmland from ABS censuses (2000, 2005 and a mean of these), and from GRDC (2008) by AE-Zone.

AE-Zone	2000 (ABS)	2005 (ABS)	ABS (Avg of 2000 &	GRDC (2008)

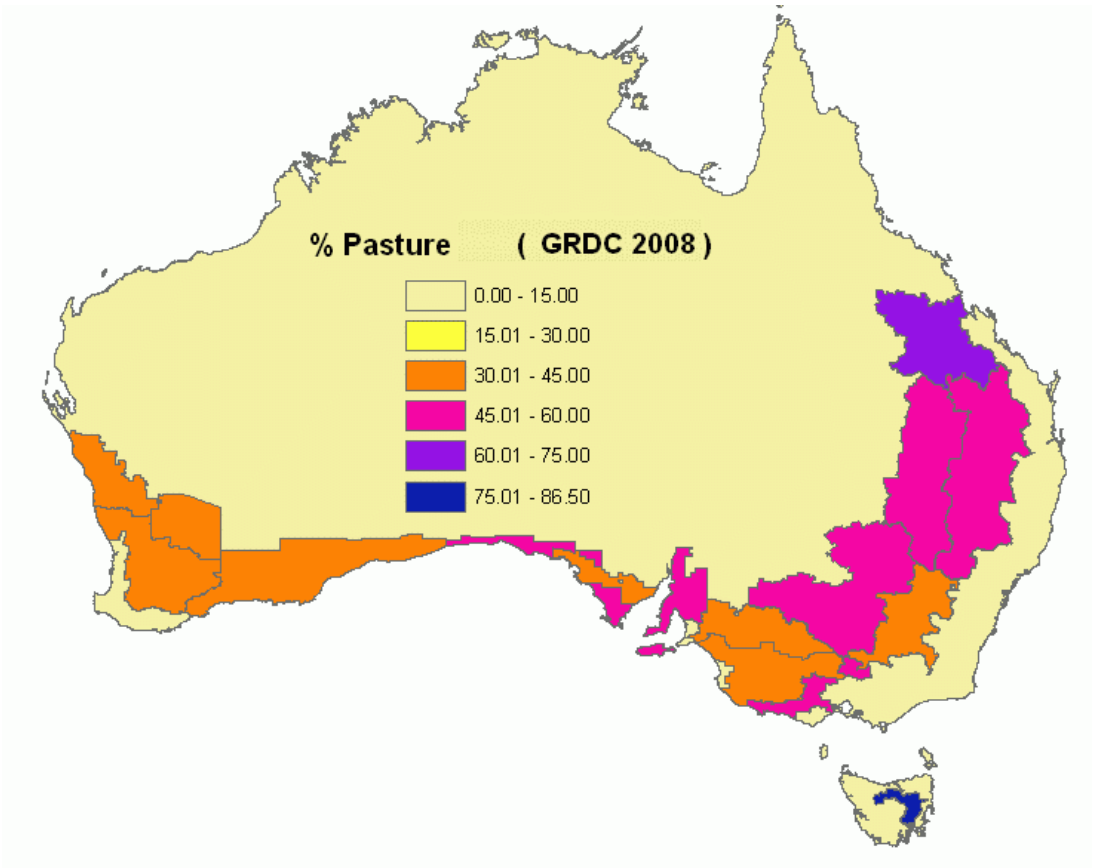
			2005)	
NSW Central	45.5%	80.5%	47.9%	52.9%
NSW NorthEast / QLD SouthEast	55.0%	68.3%	57.4%	55.2%
NSW NorthWest / QLD SouthWest	46.9%	88.9%	50.4%	52.5%
NSW / VIC Slopes	57.9%	66.4%	59.5%	43.5%
QLD Central	52.8%	89.5%	55.1%	62.8%
SA MidNorth / Lower EP	16.7%	91.4%	17.9%	57.8%
SA / VIC Bordertown Wimmera	55.1%	61.4%	55.2%	39.6%
SA / VIC Mallee	26.4%	43.3%	25.9%	35.6%
TAS	72.2%	74.3%	75.6%	86.5%
VIC High Rainfall	69.7%	74.3%	73.4%	56.0%
WA Central	39.6%	58.9%	45.8%	36.9%
WA Eastern	19.7%	41.8%	18.6%	35.3%
WA Mallee / Sandplain	36.1%	61.8%	41.0%	38.1%
WA Northern	39.4%	67.8%	43.2%	40.8%

Figure 5. Average % of total area as pasture per farm by AE-Zone, using ABS Census data (mean of 2000 and 2005 data), and GRDC Survey, 2008



One would expect farmland to be made up of essentially three components: crop area, pasture area and native or remnant vegetation areas, with these three being expected to more or less add to the total of farmland available. For reasons about the definitions of 'pasture' mentioned above, this does not always occur. Also, some farms have effectively no native vegetation present, and so the farm is split between crop and pasture. However, even then in some cases areas of 'fallow' may be described as either a pasture (if grazing of the fallow occurs) or crop area not yet planted and so the total of the components may not add to the total.

Figure 6. Average % of total area as pasture per farm by AE-Zone (GRDC, 2009)



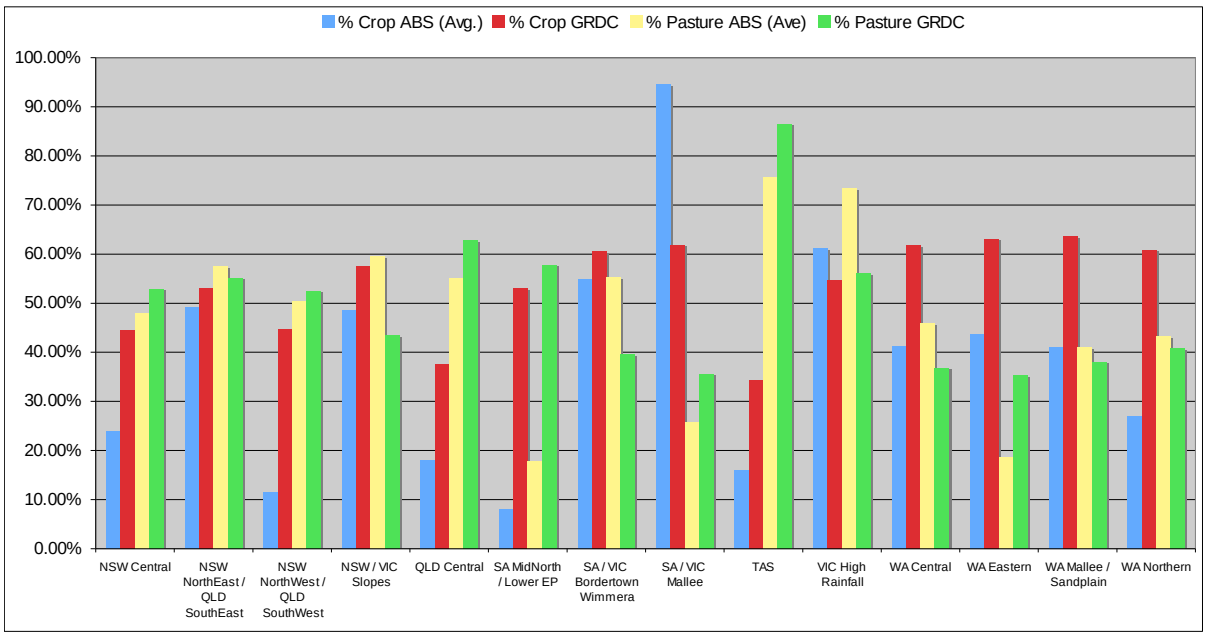
However, as a general rule, where area of crop is high, pasture is expected to be low, and *vice versa.* These data are shown in Table 5 and Figure 7, below, from both ABS and Solutions.

Table 5. Proportion (%) of farmland as crop or pasture from ABS (2000-05) and GRDC (2009) by AE-Zone

AE-Zone	% Crop of farmland ABS	% Crop of farmland GRDC (2008)	% Pasture of farmland ABS	% Pasture of farmland GRDC (2008)
NSW Central	23.85%	44.4%	47.9%	52.9%
NSW NorthEast / QLD SouthEast	49.25%	53.0%	57.4%	55.2%
NSW NorthWest / QLD SouthWest	11.60%	44.6%	50.4%	52.5%
NSW / VIC Slopes	48.49%	57.4%	59.5%	43.5%
QLD Central	18.13%	37.6%	55.1%	62.8%
SA MidNorth / Lower EP	8.11%	53.0%	17.9%	57.8%
SA / VIC Bordertown Wimmera	54.82%	60.6%	55.2%	39.6%
SA / VIC Mallee	94.51%	61.9%	25.9%	35.6%
TAS	16.09%	34.4%	75.6%	86.5%
VIC High Rainfall	61.16%	54.8%	73.4%	56.0%
WA Central	41.25%	61.7%	45.8%	36.9%
WA Eastern	43.74%	63.1%	18.6%	35.3%

WA Mallee / Sandplain	41.08%	63.6%	41.0%	38.1%
WA Northern	27.04%	60.9%	43.2%	40.8%

Figure 7. Average % of total area as crop and pasture per farm by AE-Zone (ABS and GRDC)



The data in Table 5 and Figure 7 show the 'split' between crop and pasture, and allow a comparison to be made between ABS and GRDC data. While there are anomalies, the data from the GRDC survey of 2008 shows a more 'balanced' picture, whereby crop and pasture areas mostly total (together) to a reasonably expected total for land us on the farms. The ABS data is often complicated by their datasets also having native vegetation included in the census, making the derivation of a true picture of the proportion of pasture on farms difficult to ascertain.

Crop Mix on Grain Farms

The mix of various crop types planted on grain farms gives some indication of the rotation of crops between various cereals, oilseed and pulses.

Rotating of crops is promoted as being beneficial for several agronomic reasons, including:

- For managing some crop diseases by removing the same crop as a host in sequence. Most crop types are no-hosts for other crop types,
- For allowing alternative weed control measures to be used in different crops,
- For increasing soil nitrogen levels (where pulse crops are used),
- To spread financial, labour and agronomic risks (for example frost risk, time of planting).

However, a major factor driving what crop mix is in evidence is the relative financial returns for different crops. The agronomic benefits of choosing a diverse range of crops can be severely compromised by lack of profitability of some of the otherwise desirable crop types. This operates in conjunction with the relative performance of different crops around Australia, where some crops struggle agronomically to provide sound returns where climatic, soil type or seasonal conditions make these unreliable and lower yielding.

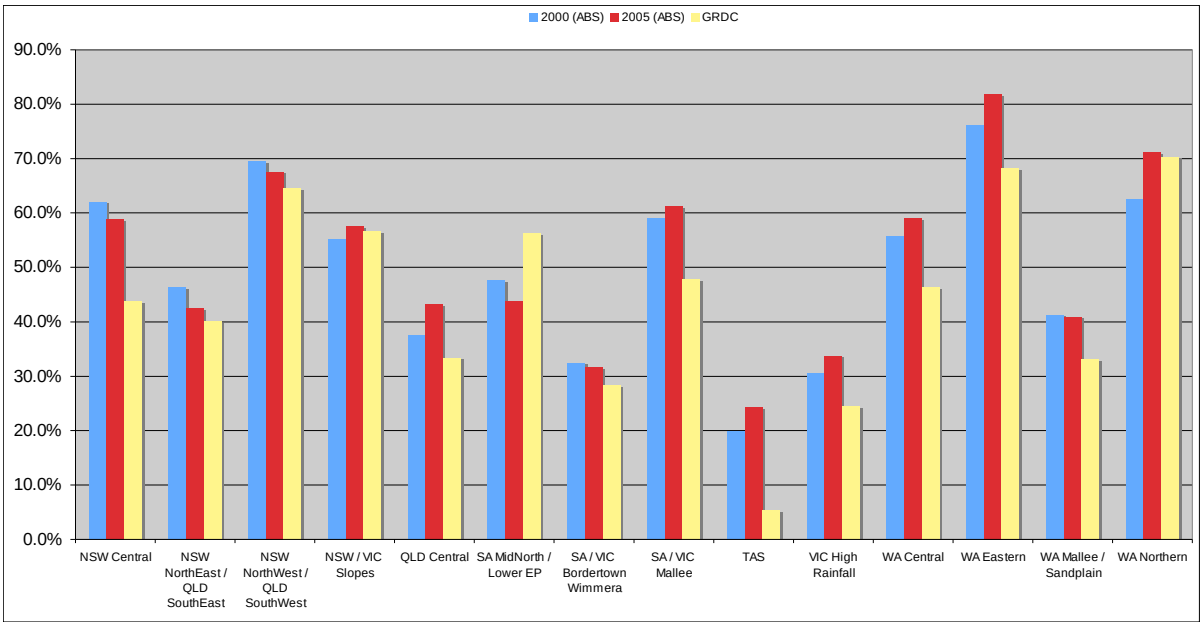
Data on the mix of crops on farms are available from ABS and the Solutions survey of 2009. These are shown in Tables 6 to 11 and Figures 8 to 20 below.

Wheat

Table 6. % Wheat as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)

AE-Zone	2000 (ABS)	2005 (ABS)	GRDC (2008)
NSW Central	62.1%	58.8%	43.8%
NSW NorthEast / QLD SouthEast	46.4%	42.5%	40.1%
NSW NorthWest / QLD SouthWest	69.5%	67.6%	64.5%
NSW / VIC Slopes	55.2%	57.6%	56.7%
QLD Central	37.6%	43.2%	33.5%
SA MidNorth / Lower EP	47.7%	43.7%	56.3%
SA / VIC Bordertown Wimmera	32.5%	31.7%	28.3%
SA / VIC Mallee	59.0%	61.3%	47.9%
TAS	19.9%	24.3%	5.4%
VIC High Rainfall	30.6%	33.8%	24.5%
WA Central	55.8%	59.1%	46.3%
WA Eastern	76.1%	81.9%	68.2%
WA Mallee / Sandplain	41.3%	41.0%	33.1%
WA Northern	62.6%	71.2%	70.3%

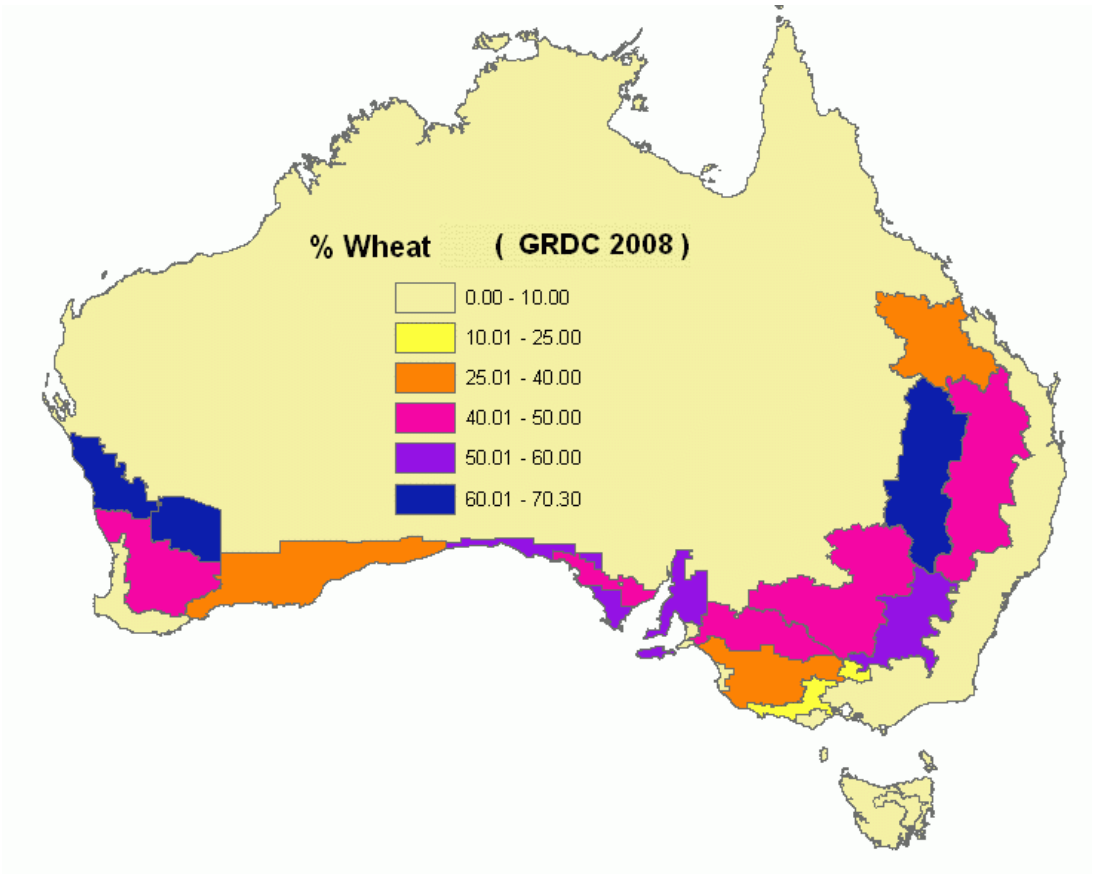
Figure 8. % Wheat as a proportion of crop per farm (ABS 2000, 2005, Solutions 2008)



The proportion of wheat would appear to have declined in many AE-Zones in recent years, though ABS data suggest some increases in WA, Victoria and central QLD. The three datasets tend to agree on the decline in NSW and parts of SA and the Mallee.

This may be driven by the recent run of poor seasons in (especially NSW), though the relatively high prices on offer in 2008 would have been expected to see an increase in wheat plantings in the GRDC dataset.

Figure 9. % Wheat as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)



Barley

Table 7. % Barley as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)

AE-Zone	2000 (ABS)	2005 (ABS)	GRDC (2008)
NSW Central	14.3%	20.4%	12.6%
NSW NorthEast / QLD SouthEast	9.6%	14.0%	6.8%
NSW NorthWest / QLD SouthWest	4.3%	13.8%	8.6%
NSW / VIC Slopes	8.8%	16.2%	17.0%
QLD Central	0.3%	1.4%	0.0%
SA MidNorth / Lower EP	30.9%	32.8%	23.3%
SA / VIC Bordertown Wimmera	26.1%	32.0%	24.3%
SA / VIC Mallee	25.2%	26.5%	18.6%
TAS	21.3%	23.2%	2.3%
VIC High Rainfall	18.1%	23.0%	12.5%
WA Central	17.8%	17.7%	14.4%
WA Eastern	4.8%	8.2%	10.8%

WA Mallee / Sandplain	33.9%	30.6%	28.7%
WA Northern	4.3%	5.9%	4.5%

Figure 10. % Barley as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)

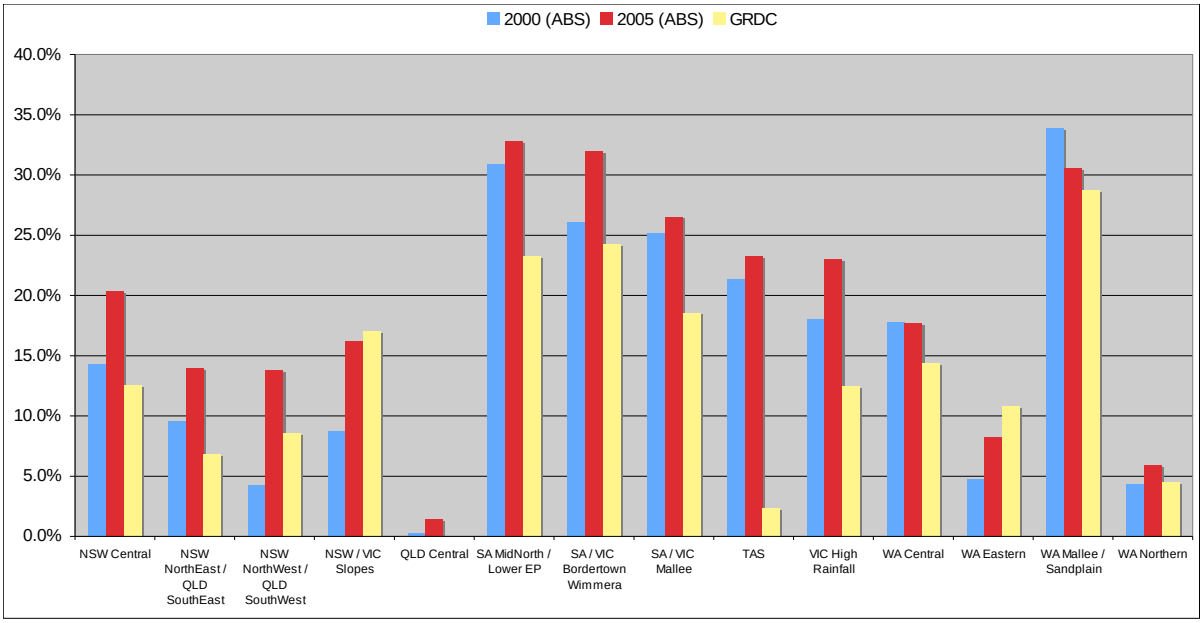
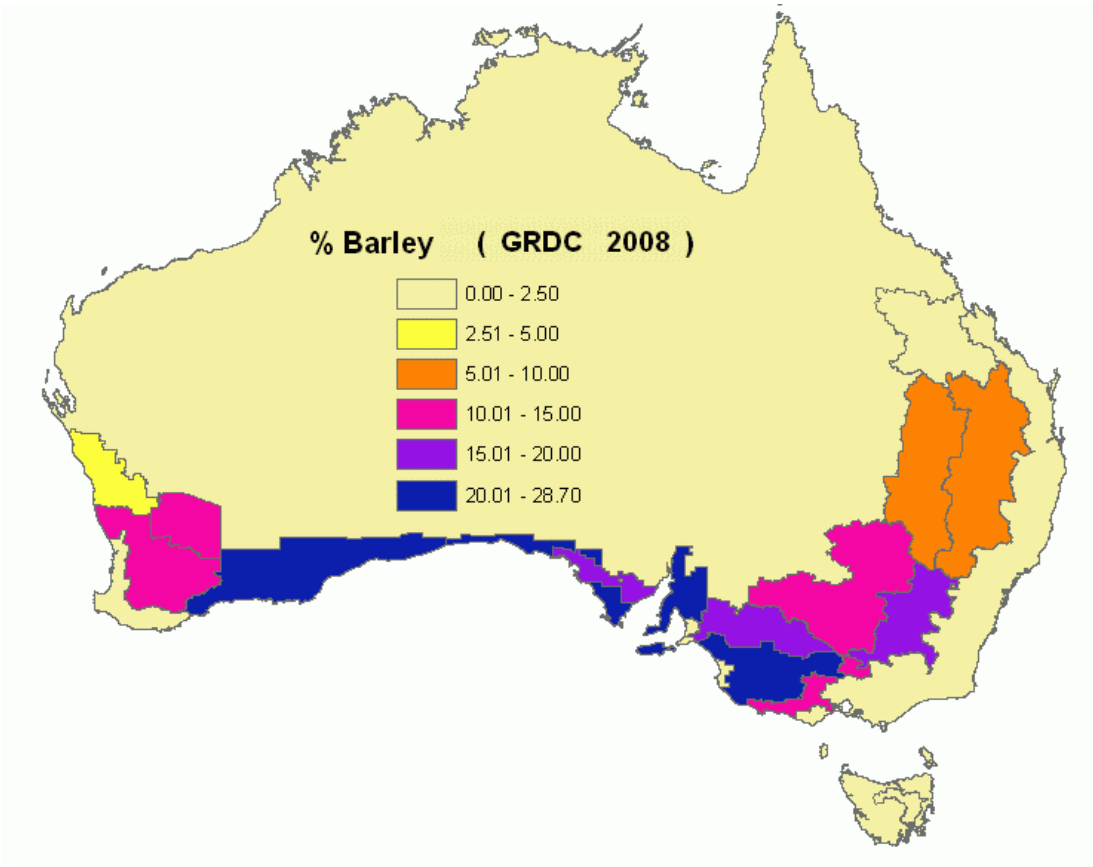


Figure 11. % Barley as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)



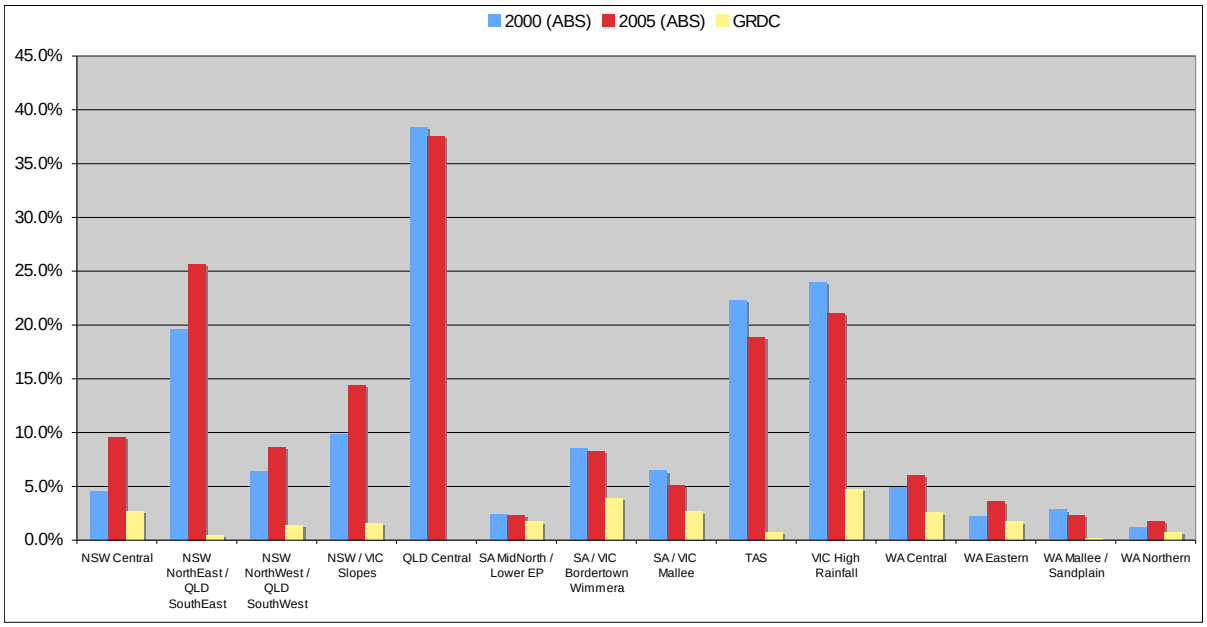
ABS data shows a relatively strong growth in barley plantings (as a proportion of crop area) between 2000 and 2005, though the GRDC survey of 2008 shows a general decline by that year.

Other Cereals

Table 8. % other cereals as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)

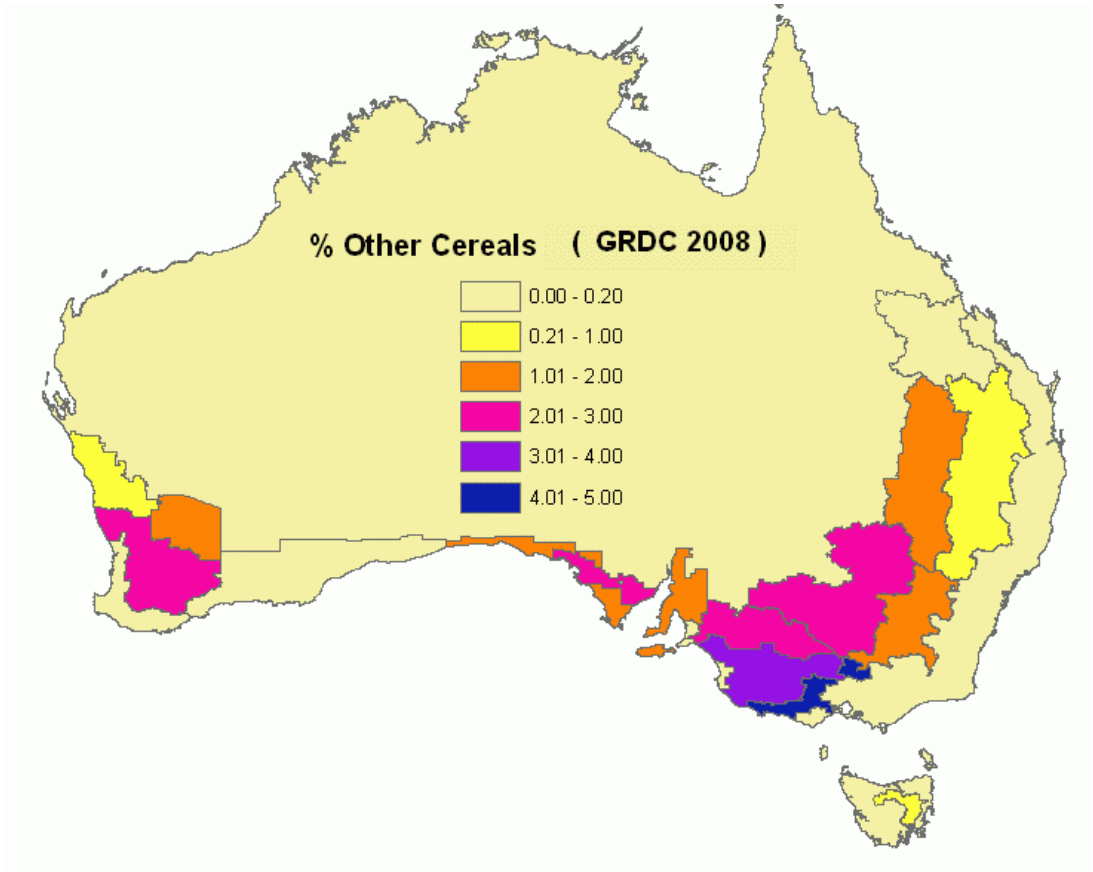
AE-Zone	2000 (ABS)	2005 (ABS)	GRDC (2008)
NSW Central	4.6%	9.6%	2.7%
NSW NorthEast / QLD SouthEast	19.6%	25.7%	0.5%
NSW NorthWest / QLD SouthWest	6.4%	8.6%	1.4%
NSW / VIC Slopes	9.8%	14.4%	1.6%
QLD Central	38.4%	37.5%	0.0%
SA MidNorth / Lower EP	2.4%	2.3%	1.7%
SA / VIC Bordertown Wimmera	8.5%	8.3%	3.9%
SA / VIC Mallee	6.5%	5.1%	2.6%
TAS	22.3%	18.9%	0.7%
VIC High Rainfall	24.0%	21.1%	4.7%
WA Central	4.9%	6.0%	2.6%
WA Eastern	2.2%	3.6%	1.7%
WA Mallee / Sandplain	2.8%	2.3%	0.2%
WA Northern/	1.2%	1.8%	0.8%

Figure 12. % Other cereals as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)



The strong indication from the Solutions dataset here is the very small proportion of other cereals in the crop mix, when compared to ABS data. "Other cereals" tends to include oats and triticale, though one suspects also sorghum in the ABS dataset for central QLD in 2000 and 2005.

Figure 13. % Other cereals as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)



Summer Crops

Table 9. % Summer crop as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)

	2000 (ABS)	2005 (ABS)	GRDC (2008)
NSW Central	1.4%	1.4%	0.1%
NSW NorthEast / QLD SouthEast	22.9%	26.2%	17.2%
NSW NorthWest / QLD SouthWest	0.8%	4.4%	4.7%
NSW / VIC Slopes	0.3%	0.5%	0.0%
QLD Central	14.6%	38.4%	36.4%
SA MidNorth / Lower EP	0.0%	0.0%	0.0%
SA / VIC Bordertown Wimmera	0.0%	0.1%	0.0%
SA / VIC Mallee	27.9%	0.0%	0.0%
TAS	41.6%	0.0%	1.2%
VIC High Rainfall	0.8%	0.2%	0.1%
WA Central	0.1%	0.0%	0.0%
WA Eastern	39.1%	0.0%	0.0%
WA Mallee / Sandplain	6.6%	0.0%	0.0%
WA Northern/	0.1%	0.0%	0.0%

Figure 14. % Summer Crop as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)

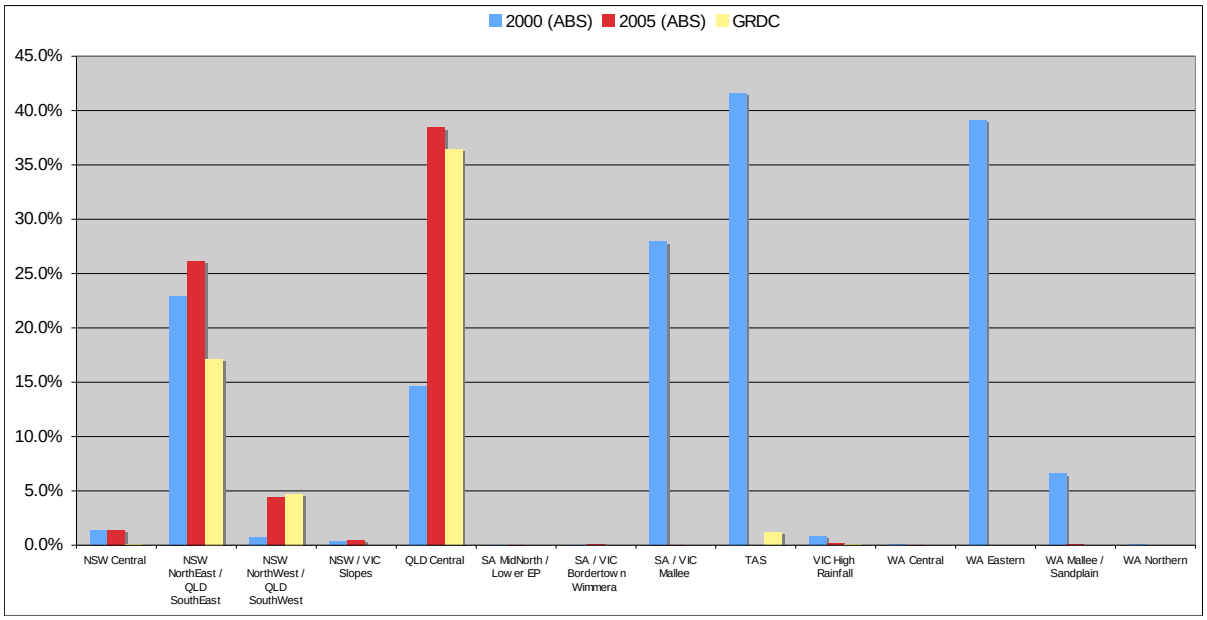
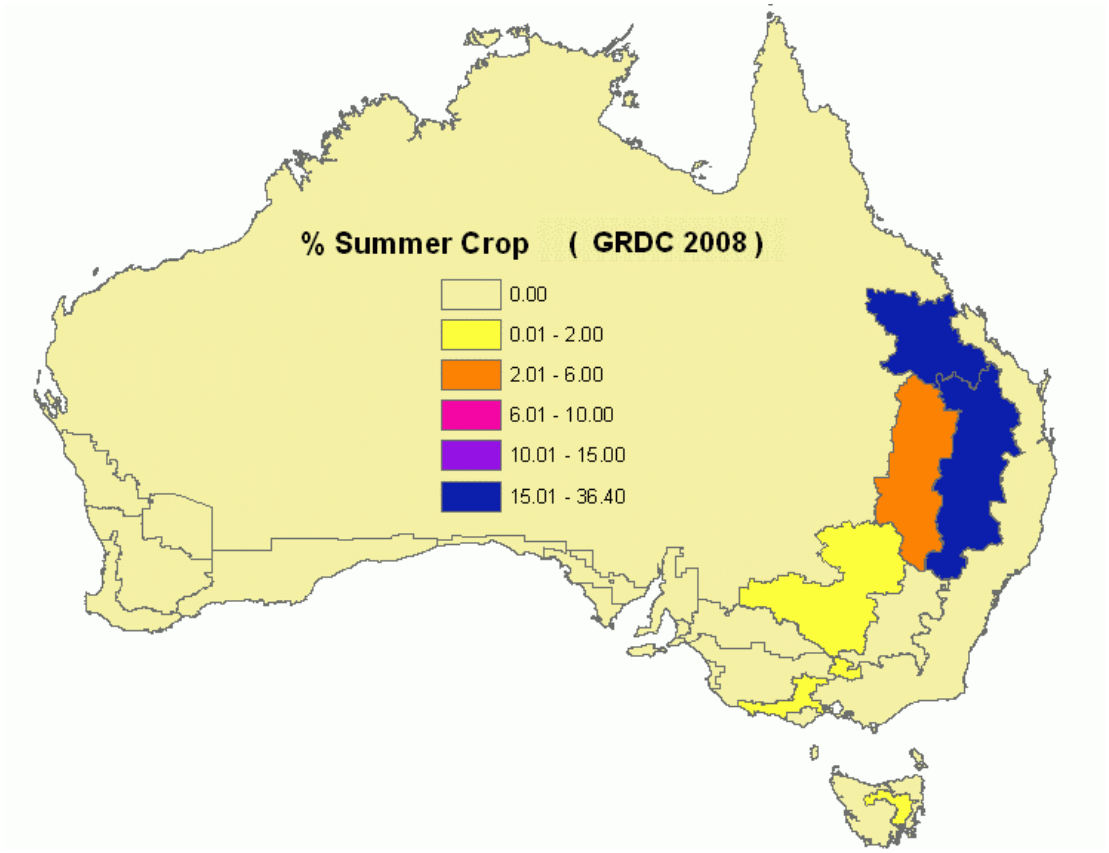


Figure 15. % Summer Crop as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)



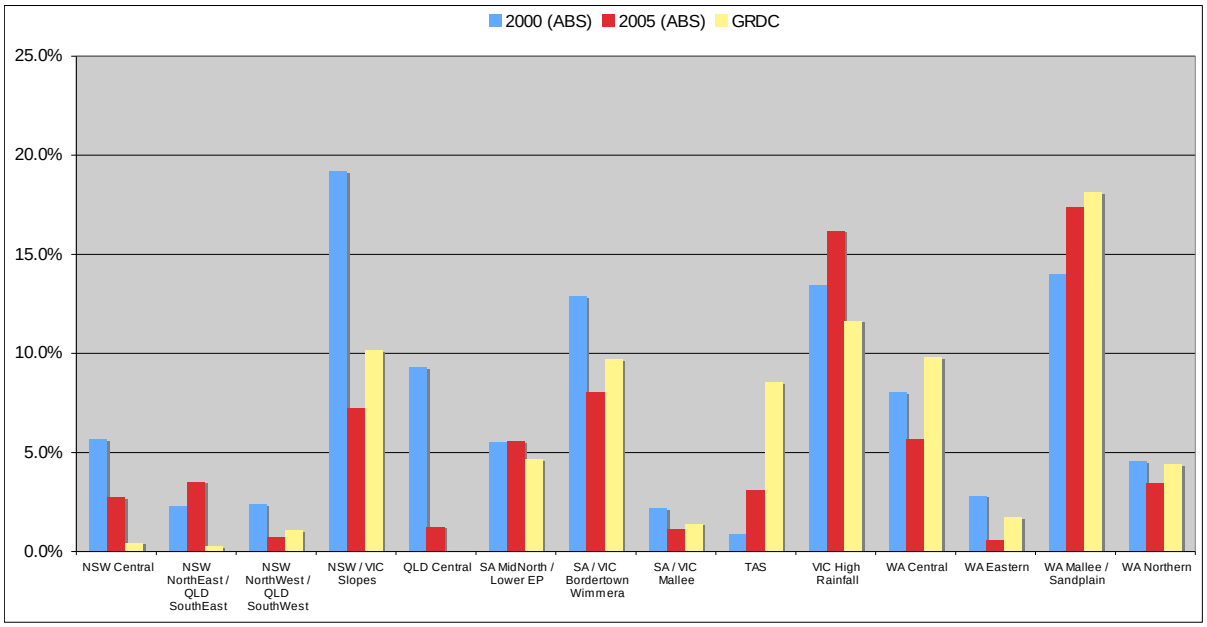
As one may expect the area and proportion of summer crop dominates in the northern grain areas, notably in northern NSW and Queensland. The areas have remained at between 20% and 30% of the crop area, though Solutions data suggests this has declined slightly in 2008.

Oilseeds

Table 10. % Oilseeds as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)

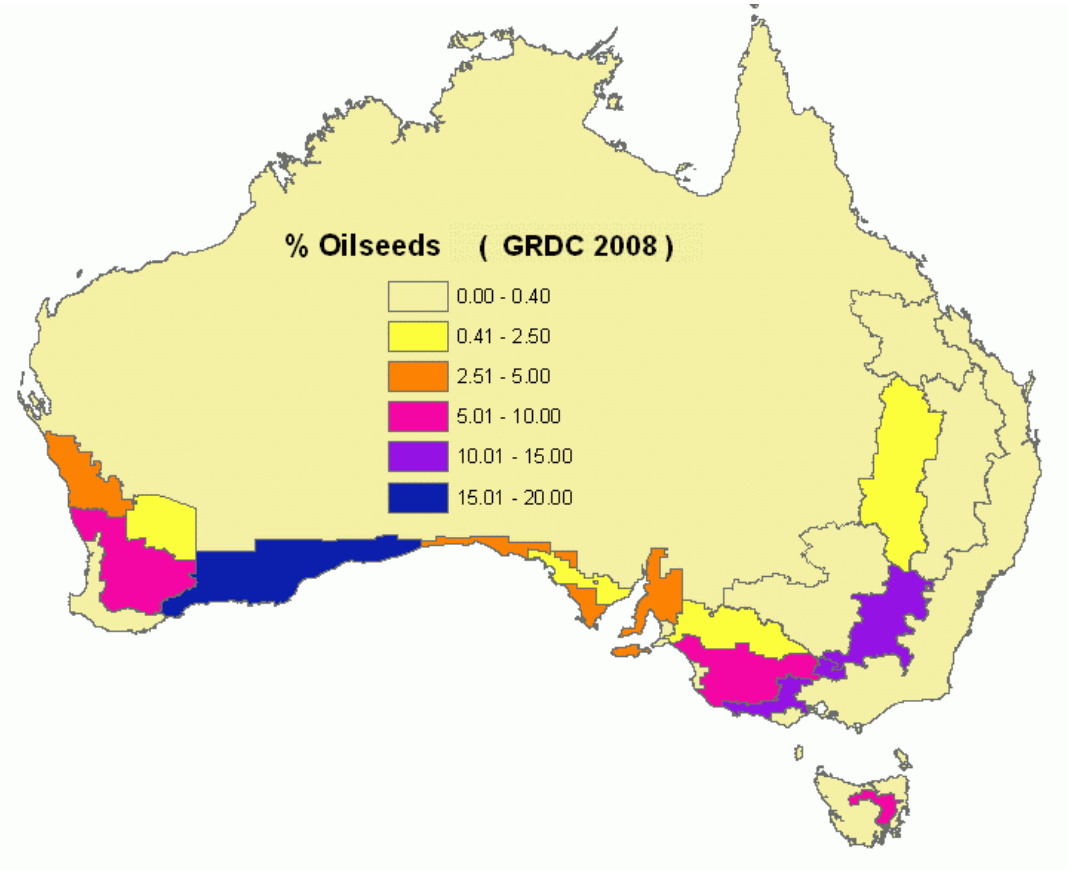
	2000 (ABS)	2005 (ABS)	GRDC (2008)
NSW Central	5.7%	2.7%	0.4%
NSW NorthEast / QLD SouthEast	2.3%	3.5%	0.3%
NSW NorthWest / QLD SouthWest	2.4%	0.7%	1.1%
NSW / VIC Slopes	19.2%	7.3%	10.2%
QLD Central	9.3%	1.3%	0.0%
SA MidNorth / Lower EP	5.5%	5.6%	4.7%
SA / VIC Bordertown Wimmera	12.9%	8.1%	9.7%
SA / VIC Mallee	2.2%	1.1%	1.4%
TAS	0.9%	3.1%	8.5%
VIC High Rainfall	13.4%	16.2%	11.7%
WA Central	8.1%	5.7%	9.8%
WA Eastern	2.8%	0.6%	1.7%
WA Mallee / Sandplain	14.0%	17.4%	18.1%
WA Northern	4.6%	3.5%	4.4%

Figure 16. % Oilseeds as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)



The proportion of oilseeds planted has shown a general downtrend since 2000, with all datasets suggesting this.

Figure 17. % Oilseeds as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)



Pulses

Table 11. % Pulses as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)

	2000 (ABS)	2005 (ABS)	GRDC (2008)
NSW Central	2.7%	1.7%	0.2%
NSW NorthEast / QLD SouthEast	7.4%	3.1%	4.7%
NSW NorthWest / QLD SouthWest	7.1%	3.7%	8.4%
NSW / VIC Slopes	3.7%	2.4%	3.0%
QLD Central	6.0%	6.9%	14.4%
SA MidNorth / Lower EP	10.3%	13.5%	6.1%
SA / VIC Bordertown Wimmera	18.4%	17.7%	6.4%
SA / VIC Mallee	6.1%	4.7%	1.5%
TAS	0.8%	3.8%	0.9%
VIC High Rainfall	2.9%	2.7%	0.0%
WA Central	12.5%	10.1%	4.6%
WA Eastern	13.1%	5.2%	2.2%
WA Mallee / Sandplain	7.1%	7.2%	3.3%
WA Northern	25.4%	16.8%	5.7%

Figure 18. % Pulses as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)

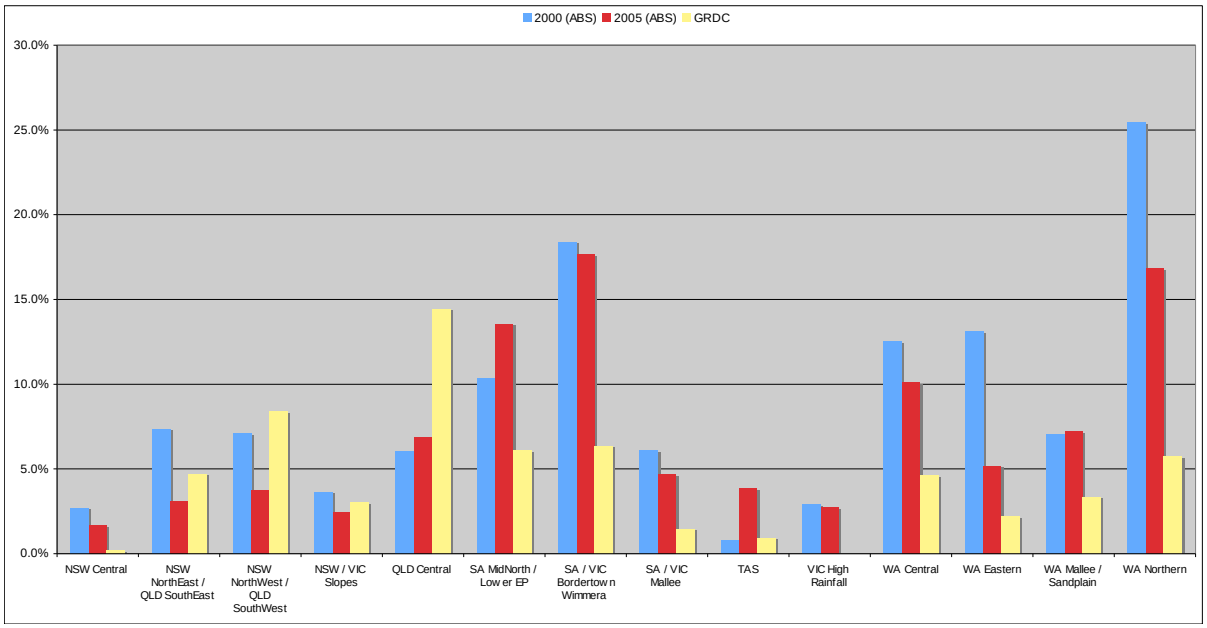
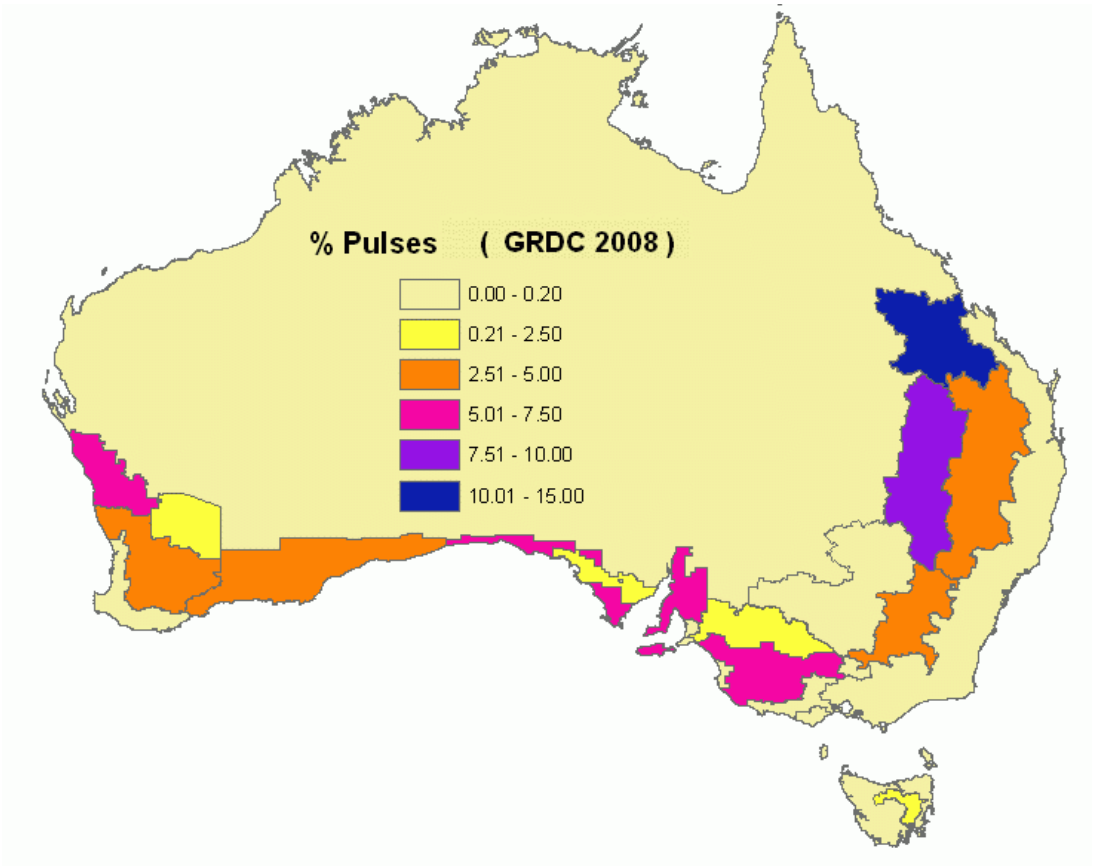


Figure 19. % Pulses as a proportion of crop per farm (ABS 2000, 2005, GRDC 2008)



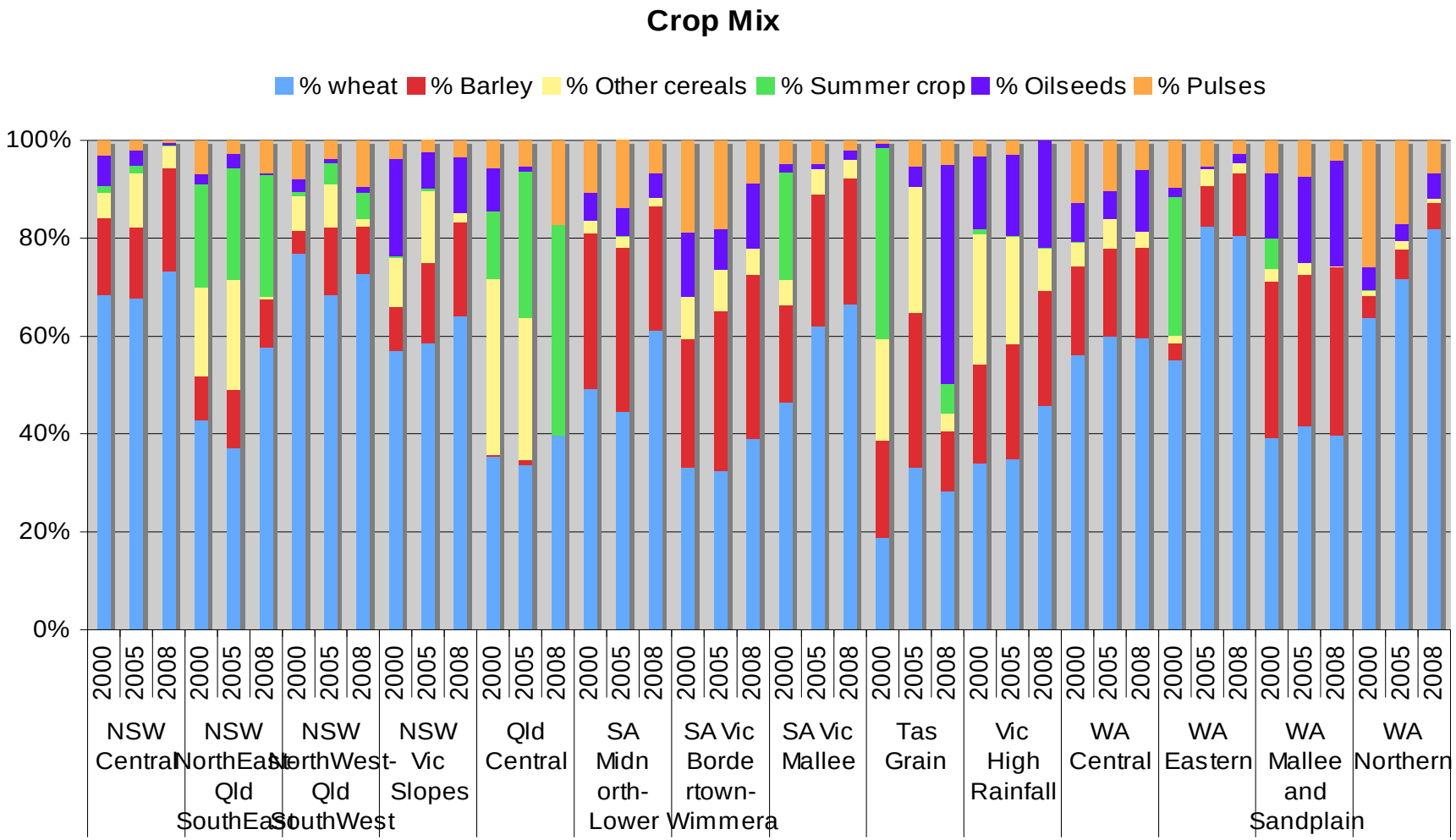
The proportion of pulses has decreased in almost all AE-Zones (except Queensland, possibly driven by soybeans and mungbeans). Pulses are now relatively minor crops, especially as indicated by the Solutions data.

Total Crop Mix

The Figure (Fig. 20) below shows the mix of crops as an amalgamated graphic, with all crops showing their relative proportions in each bar. In this, one can see the decline in pulses (and oilseeds) that has occurred through the years since 2000.

The proportions of cereals has remained steady (though differences between wheat and barley do occur) and pulses appear to have been declining more than oilseeds.

Figure 20. Crop mix (as % of total crop area), average per farm (ABS 2000, 2005, GRDC 2008)



Data from the ABS NRM Survey (2008).

As mentioned, in 2007 ABS conducted a survey of agricultural producers, which provided data amalgamated at NRM level. The survey data was published in 2008. Included in the survey were questions about crop areas. These data are presented in Tables 12 to 16, and also show declines in the proportion of pulses and oilseeds, when considered at NRM Region level.

Table 12. % Wheat as a proportion of crop by NRM Region (ABS 2000, 2005, 2007)

NRM Region	% Wheat 2000	% Wheat 2005	% Wheat 2007
Border Rivers/Gwydir	61.4%	54.8%	67.8%
Central West	79.5%	66.7%	70.7%
Hawkesbury/Nepean	26.9%	46.9%	47.3%
Lachlan	64.0%	61.8%	68.3%
Lower Murray/Darling	85.9%	89.6%	94.2%
Murray	54.6%	55.1%	62.1%
Murrumbidgee	55.7%	59.3%	62.9%
Namoi	68.6%	54.9%	68.5%
Northern Rivers	7.8%	16.1%	3.9%
Western	78.7%	68.3%	84.0%
Corangamite	32.7%	30.4%	33.3%
East Gippsland	32.3%	40.7%	76.3%
Glenelg Hopkins	39.9%	36.7%	31.7%
Goulburn Broken	36.6%	44.0%	53.2%
Mallee	51.6%	56.7%	64.8%
North Central	40.9%	42.0%	42.8%
North East (VIC)	38.6%	38.8%	59.7%
Port Phillip and Western	19.6%	19.4%	23.5%
West Gippsland	37.6%	34.4%	81.1%
Wimmera	31.1%	29.6%	39.8%
Border Rivers	64.2%	62.4%	88.0%
Burdekin	34.8%	44.1%	97.0%
Burnett Mary	25.3%	22.8%	61.6%
Condamine	31.0%	23.1%	58.7%
Fitzroy	44.7%	51.2%	95.0%
Mackay Whitsunday	39.7%	7.0%	98.2%
South East (QLD)	26.7%	14.2%	57.3%
South West (QLD)	80.8%	87.9%	40.5%
Adelaide and Mount Lofty	42.4%	38.3%	51.3%
Alinytjara Wilurara	80.2%	71.4%	70.7%
Eyre Peninsula	67.9%	67.8%	67.7%
Kangaroo Island	18.7%	24.8%	23.7%
Northern and Yorke	48.0%	42.7%	47.7%
SA Arid Lands	80.2%	64.8%	93.3%
SA Murray Darling Basin	50.9%	50.9%	55.8%
Avon	66.4%	71.2%	67.4%

Northern Agricultural Re	64.3%	71.7%	71.7%
Rangelands (WA)	50.5%	50.4%	46.6%
South Coast Region	41.6%	39.9%	36.5%
South West Region	44.5%	40.8%	34.0%
Swan	58.0%	59.2%	60.4%
North (TAS)	32.4%	36.1%	37.0%
South (TAS)	20.2%	17.9%	25.4%

Table 13. % Barley as a proportion of crop by NRM Region (ABS 2000, 2005, 2007)

NRM Region	% Barley 2000	% Barley 2005	% Barley 2007
Border Rivers/Gwydir	10.3%	16.8%	25.5%
Central West	6.6%	17.3%	15.0%
Hawkesbury/Nepean	0.0%	11.2%	2.4%
Lachlan	12.6%	20.2%	15.2%
Lower Murray/Darling	10.0%	5.9%	5.0%
Murray	17.7%	22.2%	18.6%
Murrumbidgee	13.1%	20.1%	18.2%
Namoi	7.5%	14.7%	23.7%
Northern Rivers	18.4%	24.3%	87.1%
Western	4.3%	16.9%	10.4%
Corangamite	34.4%	36.4%	45.0%
East Gippsland	6.5%	3.9%	10.7%
Glenelg Hopkins	11.1%	19.6%	30.8%
Goulburn Broken	11.7%	12.5%	13.5%
Mallee	28.6%	27.8%	29.6%
North Central	24.5%	31.8%	38.5%
North East (VIC)	1.6%	3.0%	0.7%
Port Phillip and Western	62.1%	60.8%	62.6%
West Gippsland	11.2%	25.6%	4.1%
Wimmera	26.5%	33.7%	47.5%
Border Rivers	8.1%	9.0%	10.0%
Burdekin	0.0%	0.3%	3.0%
Burnett Mary	8.4%	11.7%	24.0%
Condamine	17.9%	14.0%	35.0%
Fitzroy	0.5%	2.5%	4.7%
Mackay Whitsunday	0.4%	1.0%	0.0%
South East (QLD)	27.1%	21.8%	42.5%
South West (QLD)	4.0%	7.2%	13.3%
Adelaide and Mount Lofty	29.2%	34.2%	35.7%
Alinytjara Wilurara	16.3%	26.0%	5.2%
Eyre Peninsula	20.4%	22.1%	22.3%
Kangaroo Island	17.5%	19.8%	21.4%

Northern and Yorke	34.1%	35.6%	43.3%
SA Arid Lands	16.3%	29.7%	0.0%
SA Murray Darling Basin	31.9%	34.4%	35.7%
Avon	11.9%	14.3%	18.8%
Northern Agricultural Re	4.8%	6.1%	8.1%
Rangelands (WA)	30.1%	26.3%	28.0%
South Coast Region	29.7%	30.5%	32.1%
South West Region	26.4%	23.1%	23.8%
Swan	10.7%	11.7%	13.8%
North (TAS)	31.7%	29.7%	36.1%
South (TAS)	38.3%	45.4%	45.6%

Table 14. % Other Cereals as a proportion of crop by NRM Region (ABS 2000, 2005, 2007)

NRM Region	% Other Cereals 2000	% Other Cereals 2005	% Other Cereals 2007
Border Rivers/Gwydir	16.1%	18.5%	6.2%
Central West	4.9%	11.9%	9.6%
Hawkesbury/Nepean	73.1%	30.2%	50.3%
Lachlan	6.5%	12.9%	8.4%
Lower Murray/Darling	1.4%	3.7%	0.7%
Murray	6.7%	9.5%	6.6%
Murrumbidgee	8.1%	11.5%	8.7%
Namoi	13.2%	20.3%	5.4%
Northern Rivers	20.3%	20.4%	8.8%
Western	5.5%	9.4%	4.7%
Corangamite	15.8%	9.9%	5.2%
East Gippsland	57.3%	44.3%	6.9%
Glenelg Hopkins	22.0%	18.0%	15.0%
Goulburn Broken	31.0%	28.3%	16.7%
Mallee	5.7%	5.1%	1.8%
North Central	9.8%	10.7%	12.7%
North East (VIC)	45.3%	42.9%	21.5%
Port Phillip and Western	5.9%	5.6%	8.0%
West Gippsland	43.9%	22.1%	4.5%
Wimmera	6.2%	5.9%	5.0%
Border Rivers	19.8%	26.2%	1.5%
Burdekin	51.4%	45.5%	0.0%
Burnett Mary	53.6%	56.4%	7.8%
Condamine	39.3%	58.0%	6.3%
Fitzroy	37.7%	38.1%	0.3%
Mackay Whitsunday	55.9%	84.6%	1.8%
South East (QLD)	38.0%	52.8%	0.2%

South West (QLD)	10.8%	2.7%	46.2%
Adelaide and Mount Lofty	4.4%	3.6%	3.7%
Alinytjara Wilurara	2.6%	2.2%	24.1%
Eyre Peninsula	3.5%	1.9%	3.9%
Kangaroo Island	13.9%	18.9%	20.5%
Northern and Yorke	2.3%	2.2%	2.2%
SA Arid Lands	2.6%	4.3%	6.7%
SA Murray Darling Basin	10.5%	9.3%	4.5%
Avon	2.4%	3.2%	3.9%
Northern Agricultural Re	1.8%	2.3%	1.8%
Rangelands (WA)	2.0%	2.0%	6.2%
South Coast Region	4.9%	4.6%	3.6%
South West Region	9.6%	18.0%	25.4%
Swan	6.5%	6.3%	5.5%
North (TAS)	33.1%	25.2%	19.5%
South (TAS)	40.2%	26.5%	29.0%

Table 15. % Oilseeds as a proportion of crop by NRM Region (ABS 2000, 2005, 2007)

NRM Region	% Oilseeds 2000	% Oilseeds 2005	% Oilseeds 2007
Border Rivers/Gwydir	1.6%	5.5%	0.1%
Central West	4.7%	1.4%	3.1%
Hawkesbury/Nepean	0.0%	11.4%	0.0%
Lachlan	13.6%	3.2%	6.8%
Lower Murray/Darling	2.0%	0.2%	0.0%
Murray	17.9%	10.6%	11.4%
Murrumbidgee	18.2%	6.3%	7.8%
Namoi	3.1%	5.7%	1.4%
Northern Rivers	48.3%	38.0%	0.2%
Western	3.1%	1.0%	0.9%
Corangamite	14.6%	20.7%	16.5%
East Gippsland	1.1%	6.5%	6.2%
Glenelg Hopkins	19.9%	20.1%	21.8%
Goulburn Broken	17.4%	13.3%	15.3%
Mallee	3.7%	1.9%	1.4%
North Central	10.5%	5.6%	4.8%
North East (VIC)	11.6%	12.4%	12.4%
Port Phillip and Western	11.5%	11.9%	6.0%
West Gippsland	7.0%	13.6%	7.5%
Wimmera	12.9%	7.3%	6.4%
Border Rivers	0.4%	0.6%	0.5%
Burdekin	11.5%	3.3%	0.0%
Burnett Mary	7.0%	5.2%	0.4%
Condamine	2.5%	2.0%	0.0%

Fitzroy	9.1%	1.0%	0.0%
Mackay Whitsunday	1.3%	6.9%	0.0%
South East (QLD)	3.1%	7.2%	0.0%
South West (QLD)	0.6%	0.1%	0.0%
Adelaide and Mount Lofty	7.1%	6.1%	7.8%
Alinytjara Wilurara	0.9%	0.1%	0.0%
Eyre Peninsula	3.6%	3.5%	3.8%
Kangaroo Island	38.2%	22.4%	26.6%
Northern and Yorke	4.3%	3.9%	5.5%
SA Arid Lands	0.9%	0.1%	0.0%
SA Murray Darling Basin	2.3%	2.0%	2.3%
Avon	5.2%	2.2%	3.3%
Northern Agricultural Re	4.3%	3.5%	3.7%
Rangelands (WA)	9.1%	13.0%	11.0%
South Coast Region	16.0%	18.3%	23.9%
South West Region	11.2%	12.1%	13.4%
Swan	11.3%	10.4%	14.3%
North (TAS)	1.5%	4.4%	6.2%
South (TAS)	0.4%	2.5%	0.0%

Table 16. % Pulses as a proportion of crop by NRM Region (ABS 2000, 2005, 2007)

NRM Region	% Pulses 2000	% Pulses 2005	% Pulses 2007
Border Rivers/Gwydir	10.5%	4.4%	0.4%
Central West	4.3%	2.6%	1.6%
Hawkesbury/Nepean	0.0%	0.3%	0.0%
Lachlan	3.3%	1.9%	1.3%
Lower Murray/Darling	0.6%	0.6%	0.0%
Murray	3.2%	2.6%	1.3%
Murrumbidgee	4.9%	2.9%	2.4%
Namoi	7.6%	4.4%	1.1%
Northern Rivers	5.2%	1.1%	0.0%
Western	8.4%	4.4%	0.0%
Corangamite	2.6%	2.6%	0.1%
East Gippsland	2.8%	4.5%	0.0%
Glenelg Hopkins	7.1%	5.7%	0.7%
Goulburn Broken	3.3%	2.0%	1.4%
Mallee	10.4%	8.6%	2.4%
North Central	14.3%	9.9%	1.1%
North East (VIC)	3.0%	2.9%	5.8%
Port Phillip and Western	0.8%	2.3%	0.0%
West Gippsland	0.3%	4.3%	2.8%
Wimmera	23.3%	23.4%	1.2%
Border Rivers	7.5%	1.8%	0.0%

Burdekin	2.4%	6.8%	0.0%
Burnett Mary	5.7%	3.9%	6.2%
Condamine	9.3%	2.9%	0.0%
Fitzroy	8.1%	7.1%	0.0%
Mackay Whitsunday	2.6%	0.5%	0.0%
South East (QLD)	5.0%	3.9%	0.0%
South West (QLD)	3.9%	2.1%	0.0%
Adelaide and Mount Lofty	17.0%	17.9%	1.5%
Alinytjara Wilurara	0.0%	0.3%	0.0%
Eyre Peninsula	4.6%	4.7%	2.3%
Kangaroo Island	11.6%	14.1%	7.8%
Northern and Yorke	11.4%	15.6%	1.3%
SA Arid Lands	0.0%	1.0%	0.0%
SA Murray Darling Basin	4.4%	3.3%	1.7%
Avon	14.0%	9.1%	6.7%
Northern Agricultural Re	24.7%	16.4%	14.7%
Rangelands (WA)	8.4%	8.3%	8.2%
South Coast Region	7.7%	6.7%	4.0%
South West Region	8.2%	6.1%	3.4%
Swan	13.4%	12.3%	6.0%
North (TAS)	1.2%	4.7%	1.3%
South (TAS)	0.9%	7.6%	0.0%

Precision Agriculture

The use of various Precision Agriculture Practices, including controlled traffic, autosteer, yield mapping, variable rate fertilizer application.
Historic Public Data

No ABS data exist for the adoption levels of precision agriculture practices.

The data gathered by Solutions in 299 for the 2008 crop year are the only data available at this time. Some data may reside in some surveys carried out by No-Till or Conservation farming groups or associations, though these are not available to this project.

Data from GRDC for the 2008 (winter) crop year

The data on the various precision agriculture practices as gathered by Solutions for the 2008 crop year are presented in Table 1 and Figures 6 to 9.

1. Controlled Traffic.

Controlled traffic is where the drive and other wheels on all implements and tractors, headers etc, follow the same path each pass over the paddock. This means that wheels always travel on defined paths, leaving the soil area between wheels untraveled upon.

Controlled traffic has been to have benefits for soil compaction, soil structure, increased productivity and other soil parameters.

The GRDC survey did gather information about Controlled traffic, with this presented in Table 1 and Figures 1 to 3 below.

The data shows that adoption of controlled traffic among grain farms in the dataset represented approximately 15% of both the hectares and number of farms, with some AE-Zones showing higher level than this, for example, all AE-Zones in the northern region, and the high rainfall areas of Victoria.

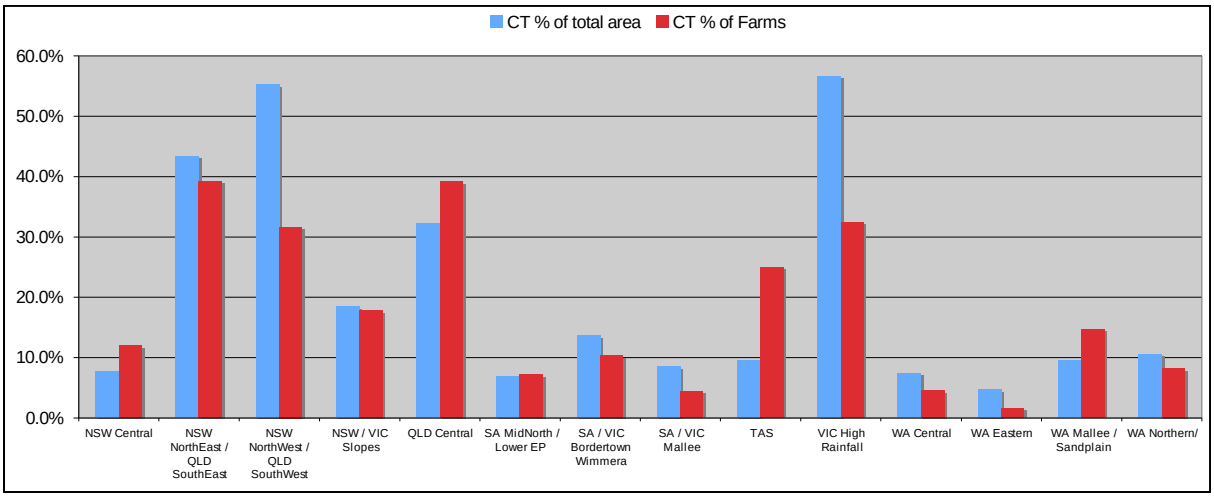
While the adoption overall was seen to be at these levels, those who were using CT were using it on a large proportion of their crop areas, (see column 4 in Table 1 below). This column compares the area of crop these growers report as being farmed using CT as compared to the average crop area of all farmers in their AE-Zone.

In every AE-Zone those farmers adopting CT are larger grain farmers than the average, and are using CT on this area of crop on their farms. This suggests that those who have adopted CT are using it pretty much on all their cropping country.

Table 1. Controlled Traffic: total area (ha) in dataset, number of farms, average area of CT per farm, % CT of total areas in dataset, % of farms using CT and % of crop using CT as compared to the average crop area on all farms as at 2008 (source: GRDC 2009)

AE-Zone	Ha per farm	% Ha total	% of Farms	% crop v's avg crop
NSW Central	1,351	7.7%	12.0%	63.0%
NSW NorthEast / QLD SouthEast	1,577	43.4%	39.2%	110.6%
NSW NorthWest / QLD SouthWest	3,447	55.2%	31.7%	171.5%
NSW / VIC Slopes	1,539	18.4%	17.7%	104.0%
QLD Central	1,850	32.3%	39.1%	82.5%
SA MidNorth / Lower EP	1,195	6.8%	7.2%	94.6%
SA / VIC Bordertown Wimmera	1,545	13.6%	10.3%	132.2%
SA / VIC Mallee	3,982	8.4%	4.4%	189.0%
TAS	405	9.5%	25.0%	37.9%
VIC High Rainfall	2,239	56.7%	32.4%	174.7%
WA Central	3,688	7.4%	4.5%	164.2%
WA Eastern	10,240	4.7%	1.6%	289.6%
WA Mallee / Sandplain	1,950	9.6%	14.7%	64.2%
WA Northern	4,531	10.6%	8.1%	129.9%
Averages		**15.6%**	**14.5%**	

Figure 1. % of total crop area and of farms in the survey using Controlled Traffic. (GRDC, 2009)



The GRDC dataset is likely to contain larger grain farms, and the benefits of CT are more evident on larger areas, perhaps providing a reason for the strong levels of adoption of CT (in this case) and other variants of PA in this survey.

Nonetheless, these data do show strong adoption of CT, especially on a per hectare basis.

Figure 2. % of total crop area in the survey using Controlled Traffic. (GRDC, 2009)

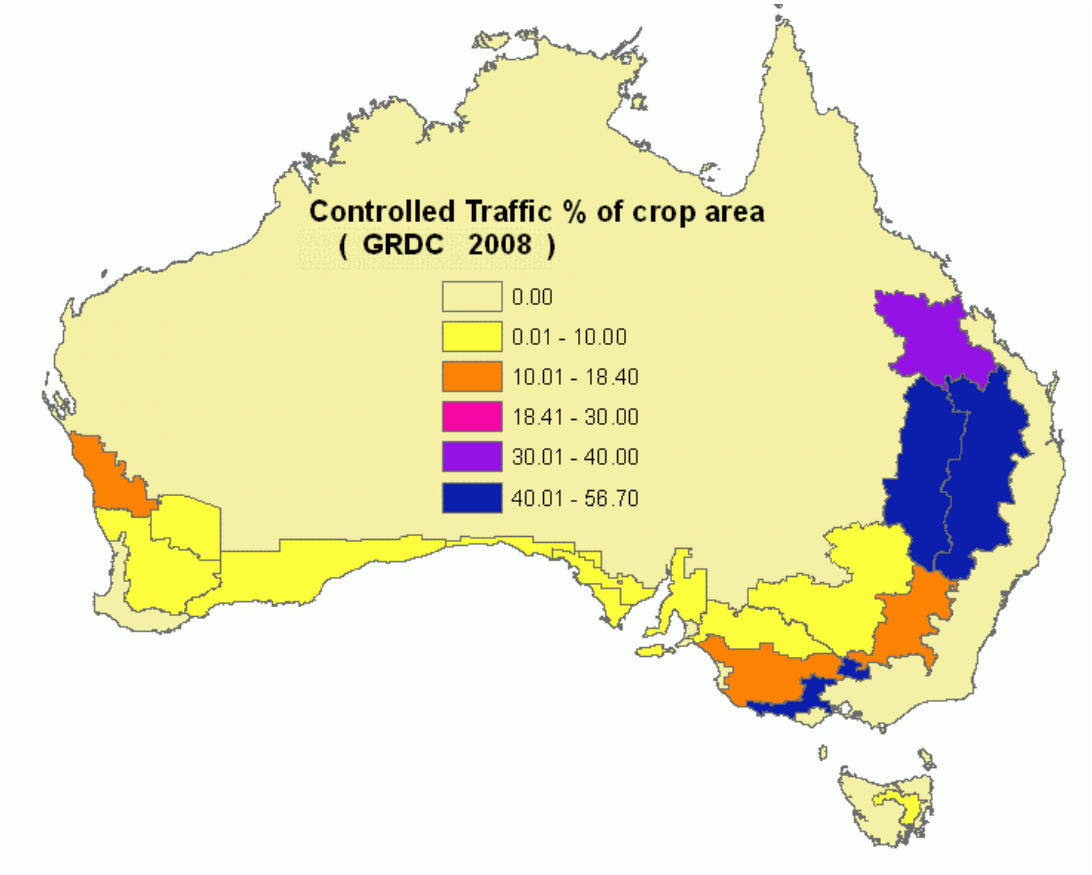
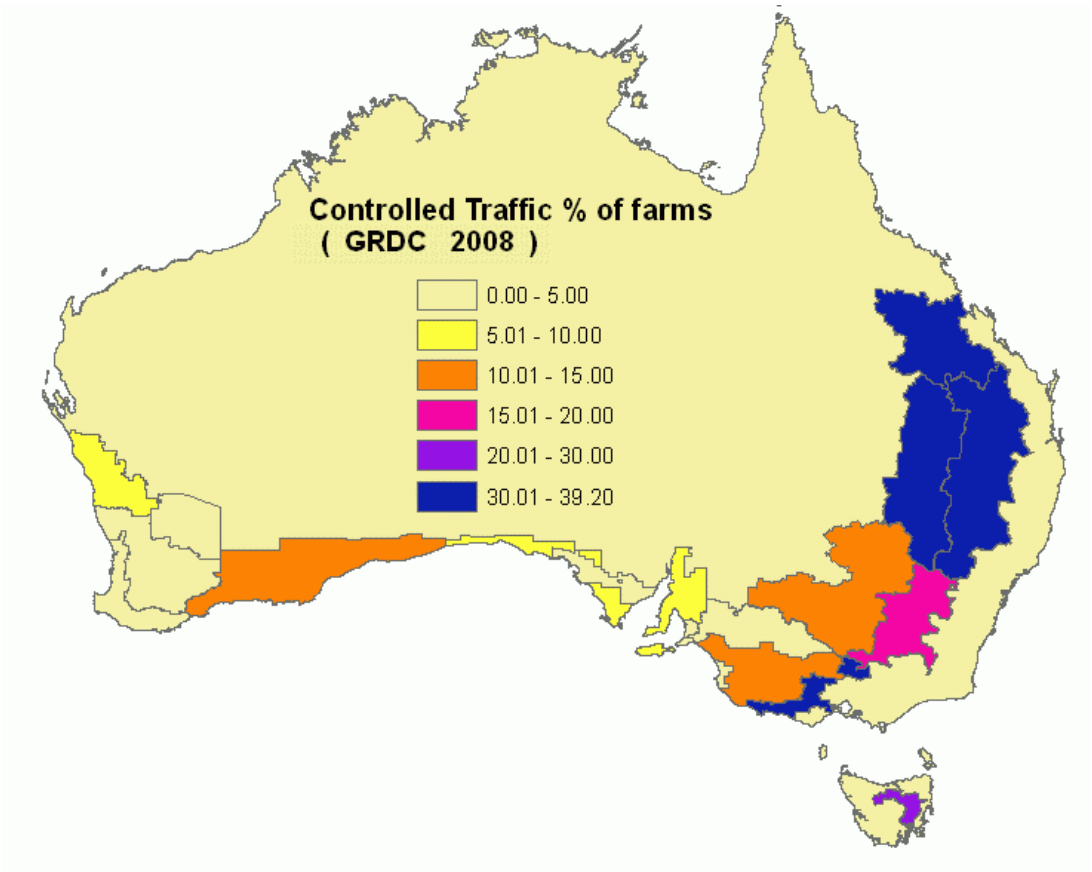


Figure 3. % of farms in the survey using Controlled Traffic. (GRDC, 2009)



2. Autosteer.

Autosteer uses GPS-based guidance to assist with guiding the tractor / header / sprayer across the cropped (or pasture) area. Autosteer is a more sophisticated level of Manual GPS guidance, where the technology steers the machine for the driver, who only has to make the turns where necessary. Autosteer can now be used to guide machinery to within 2 cm (or less) of the desired location and can be a form of controlled traffic, though this is not always the case. Controlled traffic in its purest form requires all machinery to have all wheels matched to the tracks in the field, whereas Autosteer can be used with any implement to provide accurate steering and to avoid overlapping or missed areas.

Table 2. Autosteer (AS): total area (ha) in dataset, number of farms, average area of AS per farm, % AS of total areas in dataset, % of farms using AS and % of crop using AS as compared to the average crop area on all farms as at 2008 (source: GRDC 2009)

AE-Zone	Ave ha per farm	% of total area	AS % of Farms	% crop c.f. ave crop per farm
NSW Central	2766.4	62.8%	48.0%	129.1%
NSW NorthEast / QLD SouthEast	1632.8	64.5%	56.3%	114.5%
NSW NorthWest / QLD SouthWest	2646.8	71.4%	53.3%	131.7%
NSW / VIC Slopes	1669.6	56.4%	50.0%	112.8%
QLD Central	2284.6	70.9%	69.6%	101.9%
SA MidNorth / Lower EP	1440.6	55.3%	48.5%	114.1%
SA / VIC Bordertown Wimmera	1358.4	55.4%	47.6%	116.3%
SA / VIC Mallee	2475.9	53.8%	45.6%	117.5%
TAS	300	7.0%	25.0%	28.1%
VIC High Rainfall	1934.4	77.5%	51.4%	150.9%
WA Central	3036.4	52.7%	39.0%	135.2%
WA Eastern	4319.6	53.2%	43.5%	122.1%
WA Mallee / Sandplain	3584.8	73.9%	61.8%	117.9%
WA Northern	4625.3	52.4%	39.5%	132.6%
Averages		**58.3%**	**48.1%**	

The data from the GRDC survey show the adoption of autosteer at quite high levels, considering this technology has been available only in relatively recent years. Averages show that half or more of the farms and hectares in the survey used autosteer. This is possibly higher (at least in terms of number of farms) than one may expect in the whole population, but again, indicates that larger grain farmers are seeing value in this technology.

In the main grain AE-Zones the use of autosteer is over 50%, and in some cases around 75% of the crop area.

Again, the indication is that the larger grain farms are embracing this technology, with a suggestion that autosteer is used on all the crop area of the farms where it is used, with these farms being larger than the average of the population. This is why the total areas is larger (in proportional terms) than the number of farms. That is, the larger farms are adopting this technology, and because they are larger, a greater proportion of the crop is using this technology.

Figure 4. % of total crop area and of farms in the survey using AutoSteer. (GRDC, 2009)

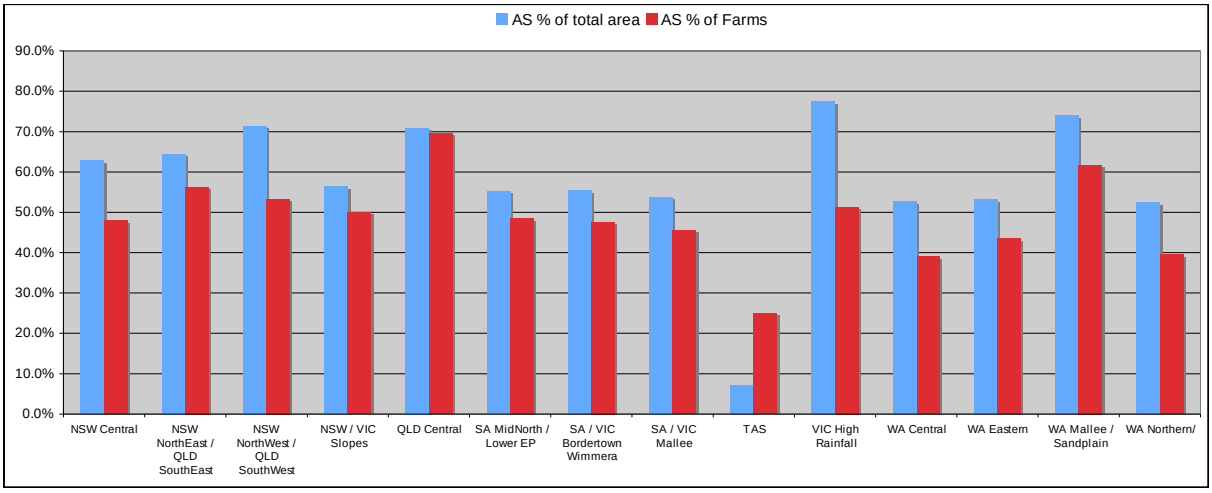


Figure 5. % of total crop area in the survey using Auto Steer. (GRDC, 2009)

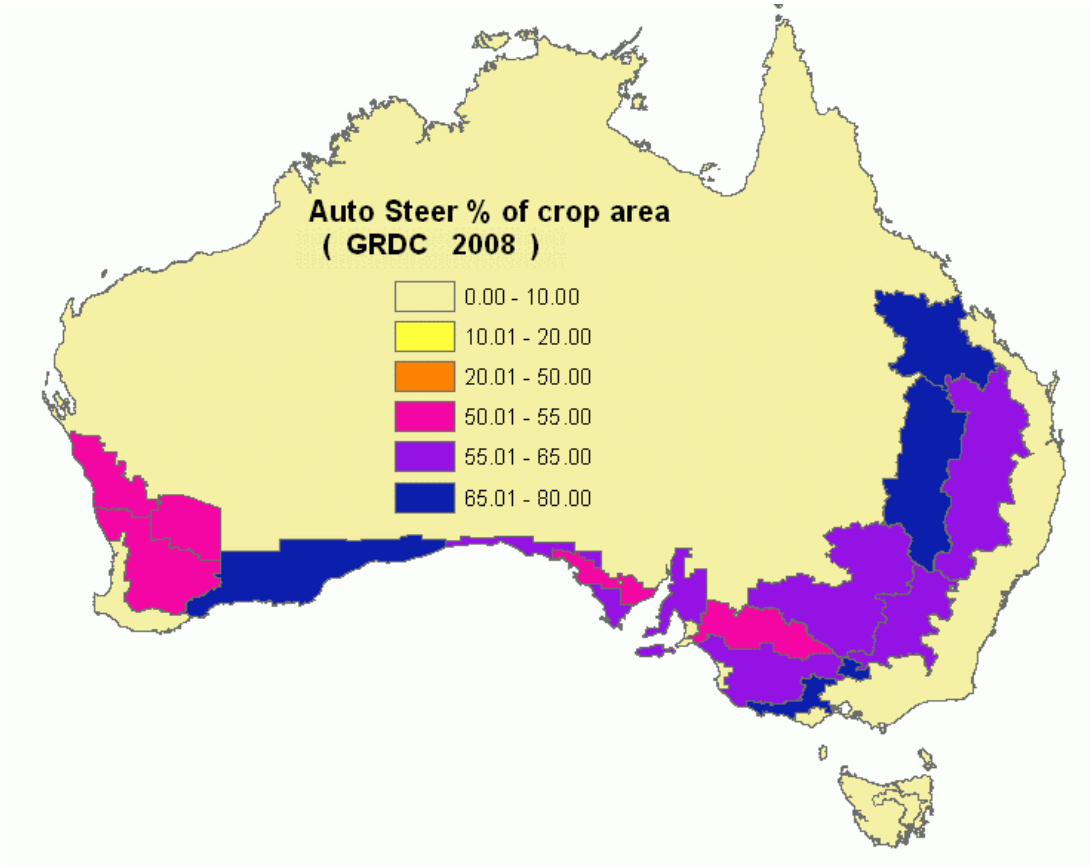
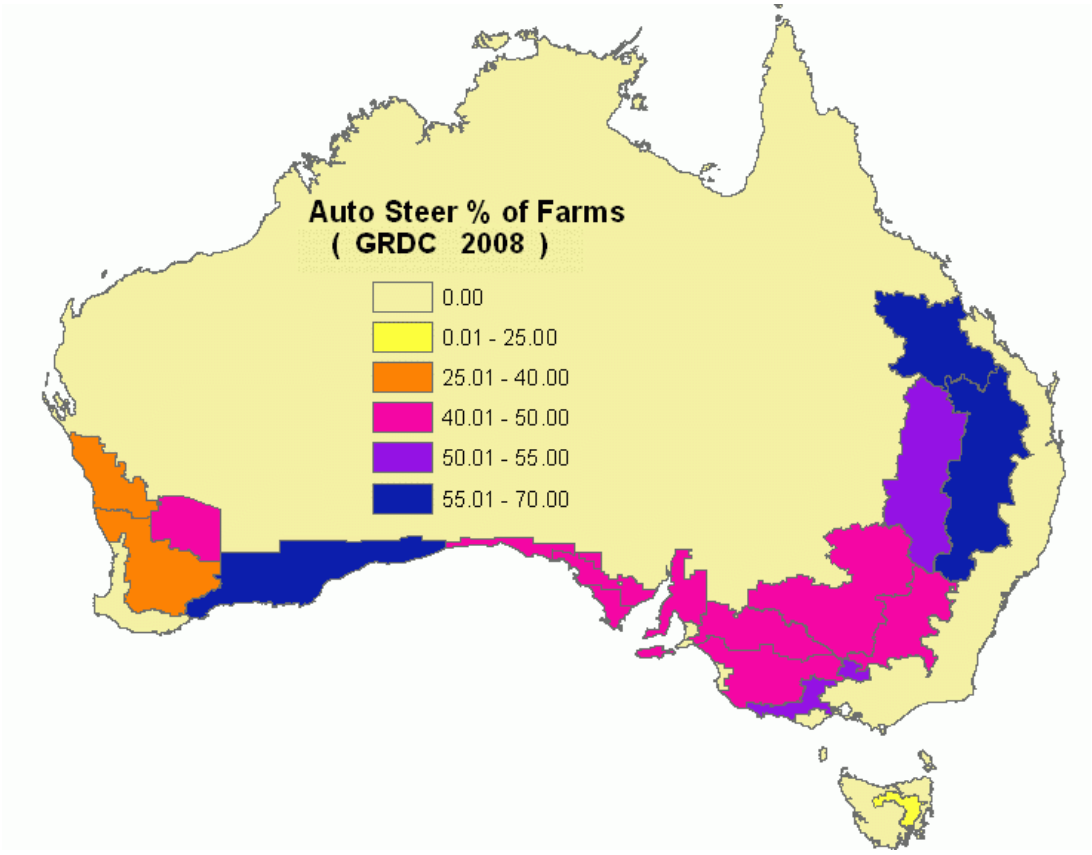


Figure 6. % of farms in the survey using Auto Steer. (GRDC, 2009)



3. Variable rate Technology as used with Fertiliser application.

One aspect of precision agriculture is the ability to use various sets of data about crop performance, soil tests and paddock history, along with other remote sensing data to determine the characteristics of various areas within a paddock. One application of this integrated approach is to be able to apply lower and higher rates of fertiliser to different areas of paddock using guidance from the data that is available.

This technology is relatively sophisticated and complex, and requires expect technical input.

The data for the use of variable rate technology as applied to the use of fertiliser is presented below (see Table 3 and Figures 7 to 9).

The use of this technology is lower than that for Autosteer, though in many AE-Zones appears little different to that for CT, at around 12% to 13%. In some AE-Zones it is as high as 20% or more of the area and number of farms, notably in the Vic / SA Mallee.

This technology is relatively new, and can be quite complex, and to see the levels of adoption at these levels is an indicator of some note.

However, as opposed to the data for CT and Autosteer, where VRT is used it is not used on areas of crop as large as for CT and Autosteer, possibly indicating farmers as still learning how best to employ this technology before using it on the whole of their crop area.

Table 7. Variable Rate Technology (VRT): total area (ha) in dataset, number of farms, average area of VRT per farm, % AS of total areas in dataset, % of farms using AS and % of crop using AS as compared to the average crop area on all farms as at 2008 (source: GRDC 2009)

AE-Zone	Ave ha per farm	% of total area	% of Farms	% crop c.f. ave crop per farm
NSW Central	1772.1	15.6%	18.7%	82.7%
NSW NorthEast / QLD SouthEast	1479.5	15.8%	15.2%	103.8%
NSW NorthWest / QLD SouthWest	1406.8	9.5%	13.3%	70.0%
NSW / VIC Slopes	1338.9	12.4%	13.7%	90.5%
QLD Central	0	0.0%	0.0%	0.0%
SA MidNorth / Lower EP	939.45	8.4%	11.3%	74.4%
SA / VIC Bordertown Wimmera	688.62	6.1%	10.3%	58.9%
SA / VIC Mallee	2825.1	28.5%	21.1%	134.1%
TAS	0	0.0%	0.0%	0.0%
VIC High Rainfall	912.67	11.5%	16.2%	71.2%
WA Central	2174.4	8.2%	8.5%	96.8%
WA Eastern	2889.9	10.5%	12.9%	81.7%
WA Mallee / Sandplain	1983.4	6.8%	10.3%	65.3%
WA Northern	3880.5	7.8%	7.0%	111.2%
Averages		**12.4%**	**13.0%**	

Figure 8. % of total crop area and of farms in the survey using Variable Rate Technology with fertiliser. (GRDC, 2009)

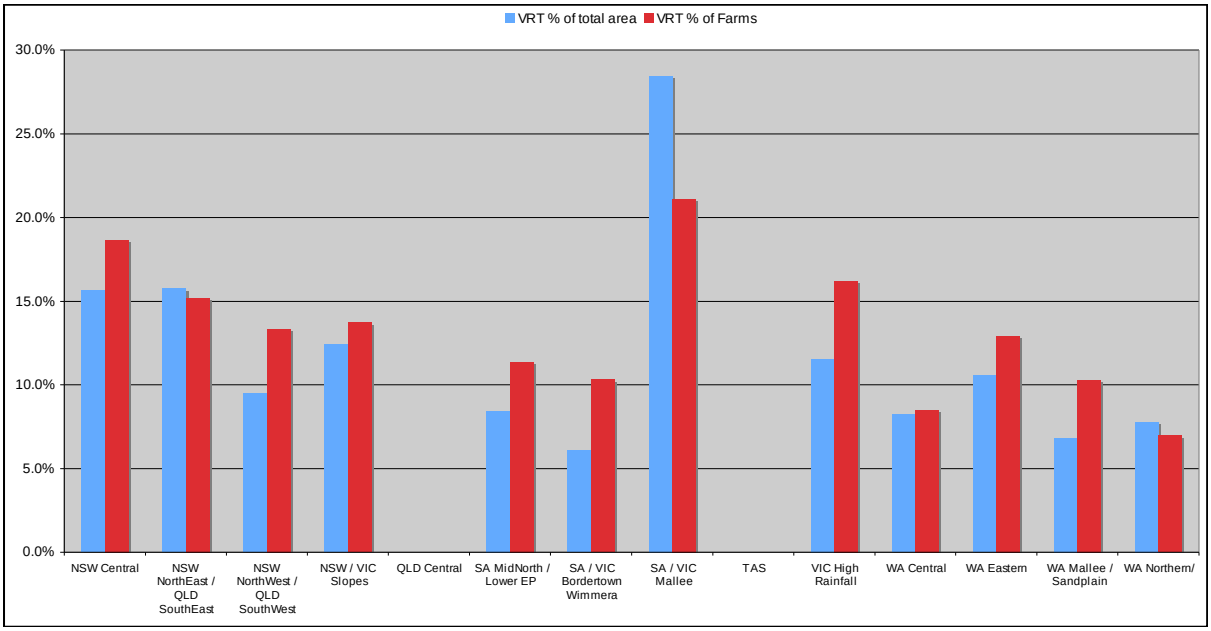


Figure 9. % of total crop area in the survey using Variable Rate Technology with fertiliser. (GRDC, 2009)

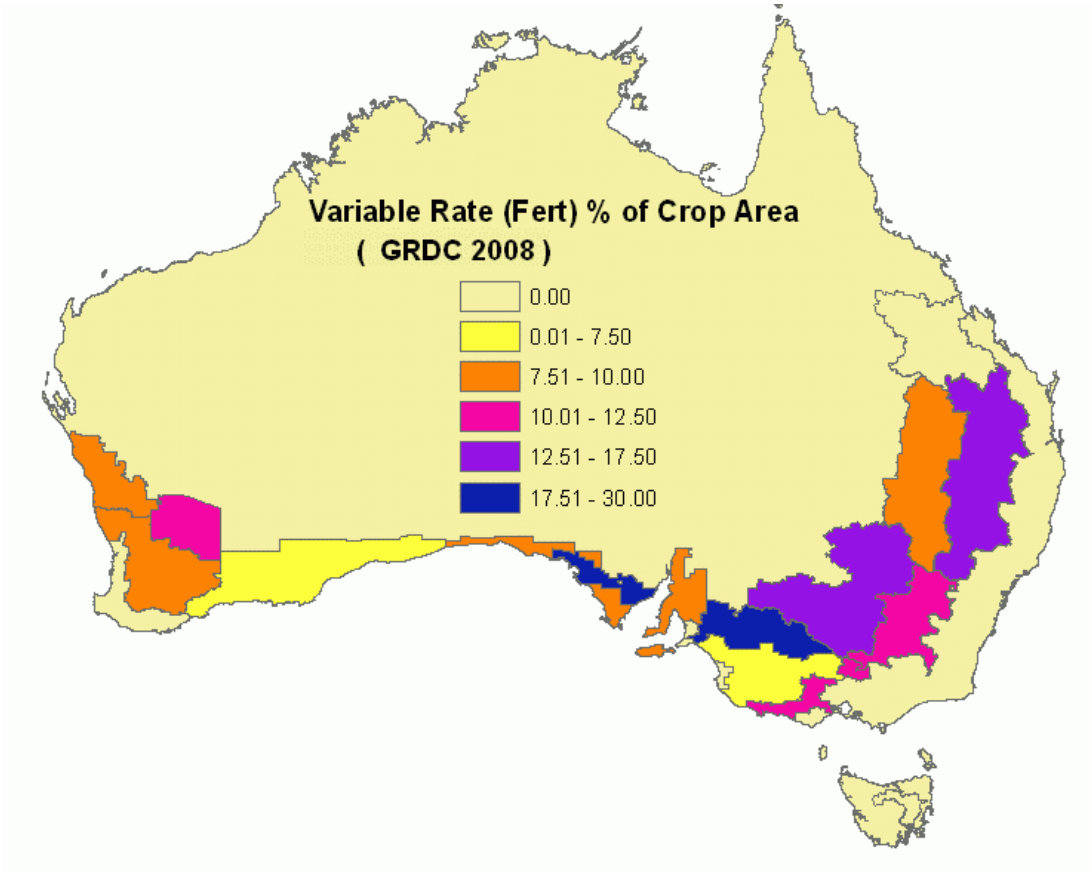
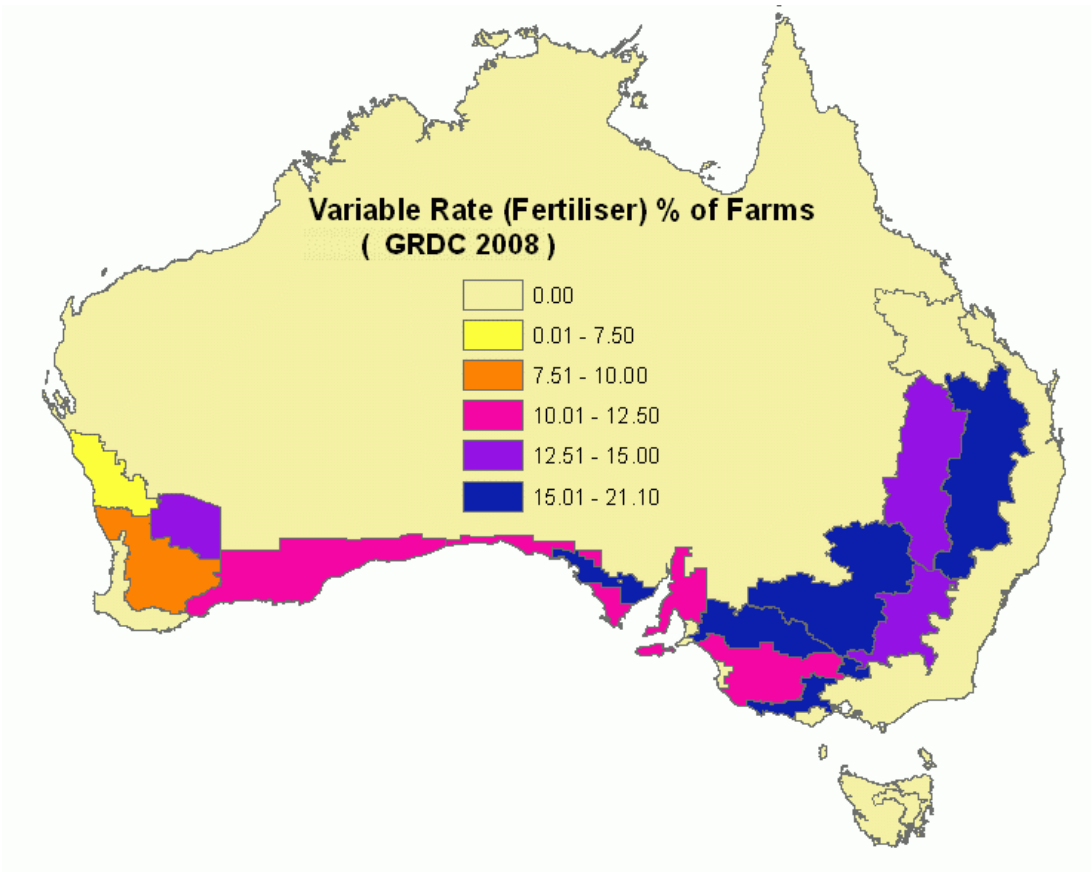


Figure 10. % of farms in the survey using Variable Rate Technology with fertiliser. (GRDC, 2009)



4. Yield Mapping.

Yield mapping can be related to variable rate technology, though can also be used for general monitoring of crop performance, and for use in making decisions about inputs, or even choice of crop for various paddocks. It can give guidance as to further investigations (e.g zoned soil tests) and for us in looking of impediments in soil or the presence of diseases or other factors across a paddock.

The data for yield mapping is presented in Table 4 and Figures 11, 12 and 13.

Table 4. Yield Mapping (YM): total area (ha) in dataset, number of farms, average area of YM per farm, % YM of total areas in dataset, % of farms using YM and % of crop using YM as compared to the average crop area on all farms as at 2008 (source: GRDC 2009)

AE-Zone	Ave ha per Farm	% of total area	% of Farms	% crop c.f. ave crop per farm
NSW Central	1832.2	13.9%	16.0%	85.5%
NSW NorthEast / QLD SouthEast	1810.7	16.9%	13.3%	127.0%
NSW NorthWest / QLD SouthWest	1763.3	8.9%	10.0%	87.7%
NSW / VIC Slopes	2202.5	24.0%	16.1%	148.8%
QLD Central	1814.3	10.6%	13.0%	80.9%
SA MidNorth / Lower EP	1864.4	25.9%	17.5%	147.6%
SA / VIC Bordertown Wimmera	1529.3	16.6%	12.7%	130.9%
SA / VIC Mallee	3311.7	15.8%	10.0%	157.2%
TAS	0	0.0%	0.0%	0.0%
VIC High Rainfall	989.2	10.4%	13.5%	77.2%
WA Central	2773.2	23.5%	19.0%	123.4%
WA Eastern	4120	22.5%	19.4%	116.5%
WA Mallee / Sandplain	3511.9	27.6%	23.5%	115.5%
WA Northern/	4141.9	30.4%	25.6%	118.7%
Averages		**20.8%**	**15.8%**	

Yield mapping is also adopted at levels similar to those of CT, at generally around 20% of the total area though slightly less in terms of number of farms.

However, the data also suggest that where it is used, the areas is often large, suggesting that there are farmers who use yield mapping where they do not use other PA techniques, for example, Autosteer. This seems to be the case in WA, the mallee, much of SA and parts of NSW.

It is also possible that where contract harvesters are used, many of these will have yield mapping capability, and so the farmers will be able to obtain yield maps where they are not using other PA techniques.

Figure 11. % of total crop area and of farms in the survey using Yield Mapping. (GRDC, 2009)

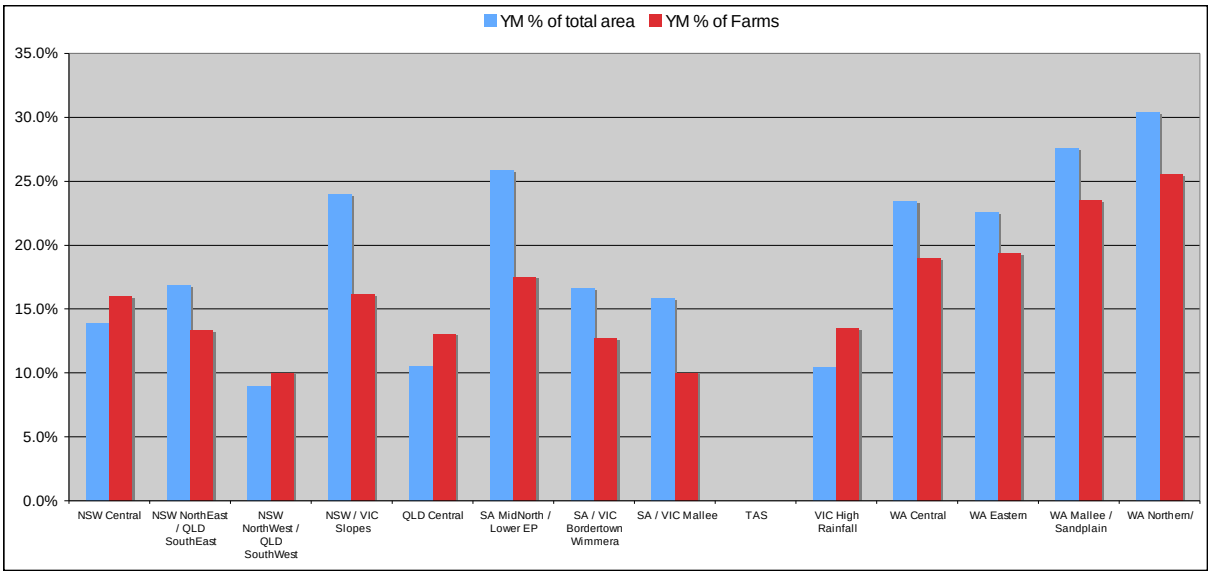


Figure 12. % of total crop area in the survey using Yield Mapping. (GRDC, 2009)

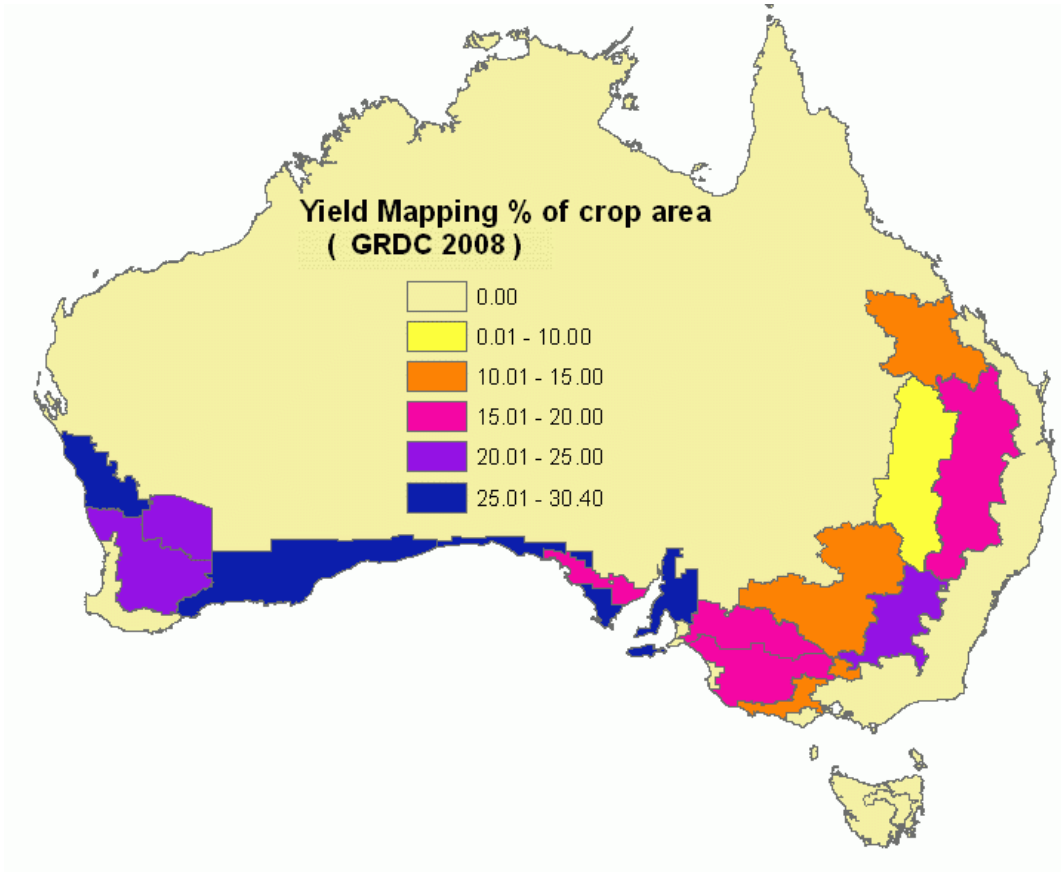
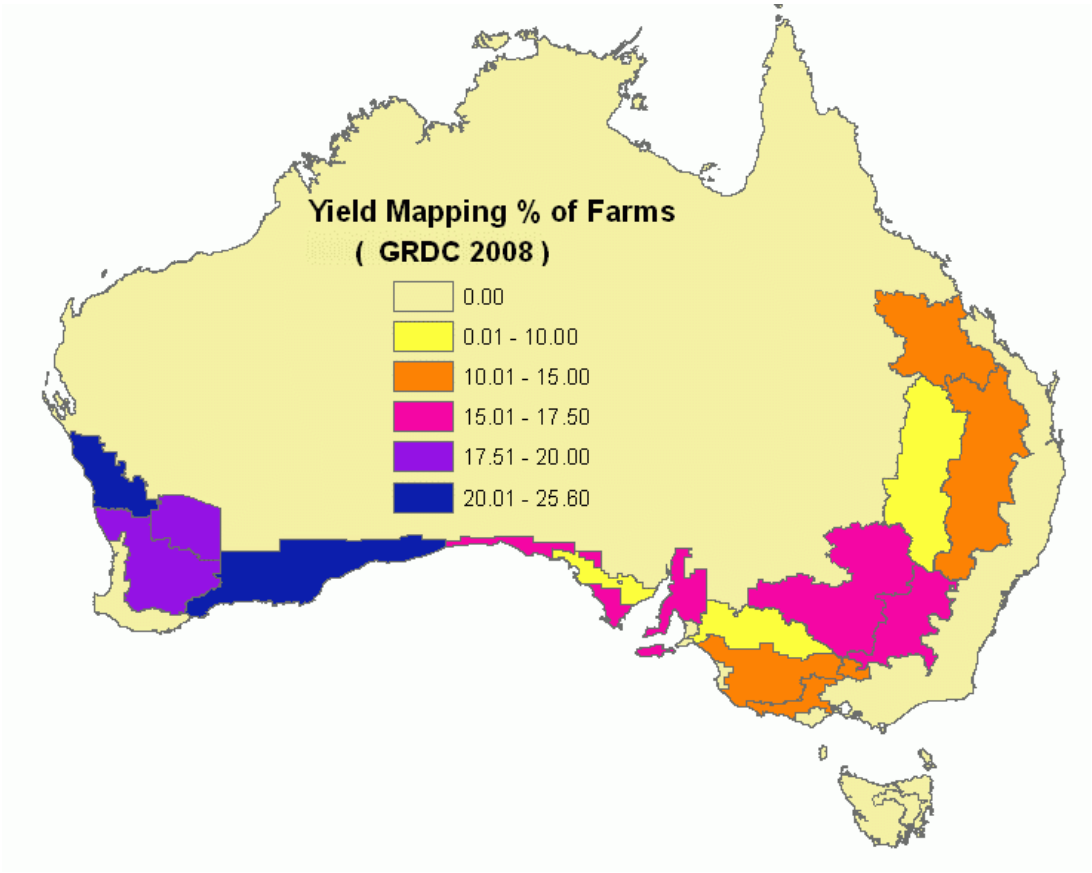


Figure 13. % of farms in the survey using Yield Mapping. (GRDC, 2009)



5. Levels of adoption between the various elements of PA.

The figure (Fig. 14) below shows one way of examining how much of the various technologies are used on the farms that use them. These data show the area of crop on the farms that have reported using one or other form of PA, as compared to the general average crop area on all farms in the relevant dataset.

Where figures are high, it indicates that the technology is used on much or all of the crop on the farms that use it, where low, that it is not used on all of the crop on the farms that use it.

When looked at this way, it appears that (in general) CT is widely used on larger farms with larger crop areas in the eastern areas of WA, the mallee, and the NSW NW / QLD SW AE-Zones.

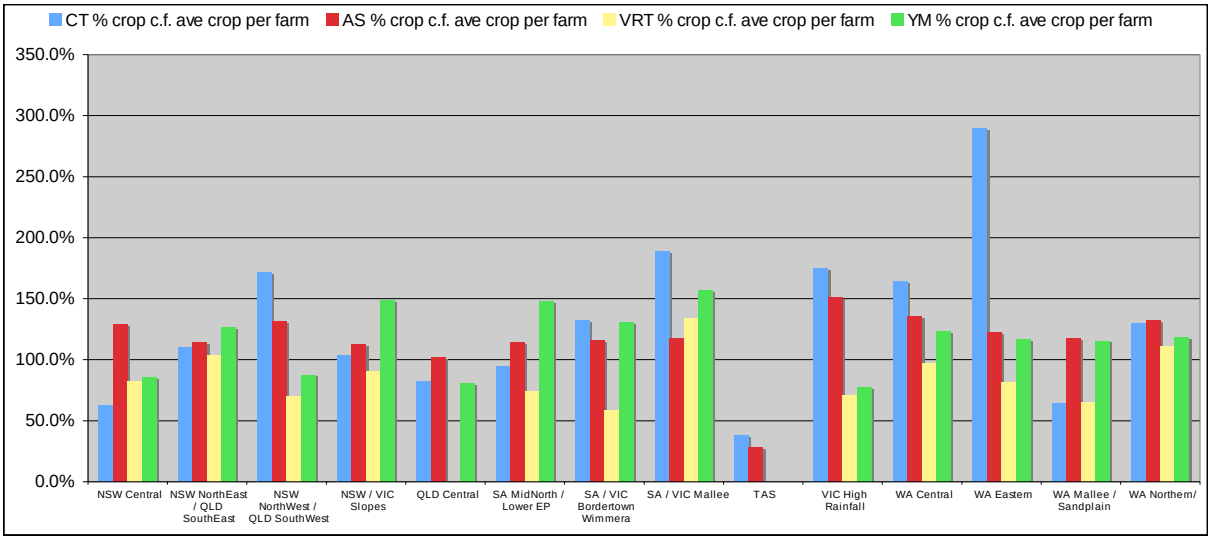
Autosteer appears relatively popular everywhere, with most or all of the crop using this where it is used.

The use of variable rate technology is just that: variable, suggesting that farmers are still learning where this is best applied, or that the adoption is not yet high.

The use of Yield mapping is also relatively high, with most of the crop being mapped on farms where this technology is available.

Nonetheless, as a general comment the adoption of the various elements of precision agriculture can be considered high, and relatively rapid.

Figure 14. % of total crop where various elements of precision agriculture are used as compared to the average of crop area in the survey dataset as a whole. (GRDC, 2009)



Integrated pest, disease and weed management

Integrated Pest, Disease and Weed Management.

The use of various elements of insect, disease and weed management, considerations of beneficial species and use of buffer zones

Historic Public Data

No ABS data exist for the adoption levels of Integrated Pest Management (IPM) practices.

The data gathered by GRDC in 2009 for the 2008 crop year are the only data available at this time. Some data may reside in some surveys carried out by other groups or bodies, though these are not available to this project.

Data from the GRDC survey for the 2008 (winter) crop year

The data on the various IPM practices as gathered by the GRDC survey for the 2008 crop year are presented in Table 1 and Figures 1 to 3

IPM Questions asked in the Solutions survey.

In the survey questions relating to the use of IPM on grain farms were:

- "Do you have a formal, Integrated weed / pest management plan such as the use of tillage, beneficial insects for your farm?"
- "And what % of your crop is managed with a formal integrated management plan?"

These allow for data about the number of farms who are using IPM in some form, and the area these represent.

The data gathered against these questions is presented below (Table 1 and Figures 1 to 5)

Almost 40% of the crop area in the sample reported using a range of IPM practices, on just over 38% of the farms.

However, when one looks at the area of crop on these farms using IPM, it appears that almost all of the crop is managed with IPM techniques on these farms. That is, where IPM is practiced, it is used on all the crop area, and perhaps some non-crop areas, for example, pastures.

Table 1. Adoption of IPM practices on grain farms: average area per farm, % this area represents of the total, % of total farms in the dataset, and area of IPM on farms as compared to the average crop area in the dataset (Source: GRDC 2009)

AE-Zone	Avg Area of IPM per farm (ha)	% of total Ha's in sample	% Farms using IPM	% of crop using IPM c.f. avg crop area
NSW Central	1,682	23.3%	29.3%	78%
NSW NorthEast / QLD SouthEast	1,533	40.1%	37.3%	108%
NSW NorthWest / QLD SouthWest	2,480	48.1%	38.3%	123%
NSW / VIC Slopes	1,587	42.4%	39.5%	107%
QLD Central	2,718	47.5%	39.1%	121%
SA MidNorth / Lower EP	1,369	50.3%	46.4%	108%
SA / VIC Bordertown Wimmera	1,212	36.2%	34.9%	104%
SA / VIC Mallee	2,393	38.1%	33.3%	114%
TAS	0	0.0%	0.0%	0%
VIC High Rainfall	786	29.8%	48.6%	61%
WA Central	2,431	49.2%	45.5%	108%
WA Eastern	3,571	37.5%	37.1%	101%
WA Mallee / Sandplain	2,786	31.5%	33.8%	92%
WA Northern	3,422	36.5%	37.2%	98%
Average	**2,081**	**39.7%**	**38.3%**	

Figure 1. Area (ha, average per farm) of IPM practiced on farms in the survey (GRDC, 2009)

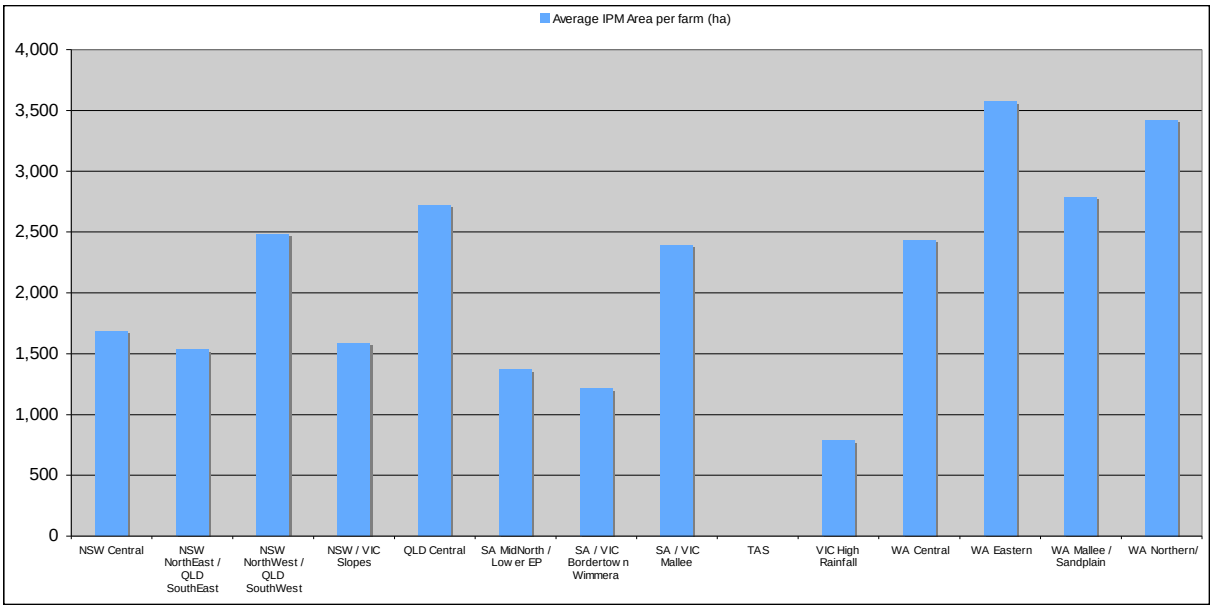


Figure 2. % of total crop area (ha) where IPM is used and % of farms using IPM (GRDC, 2009)

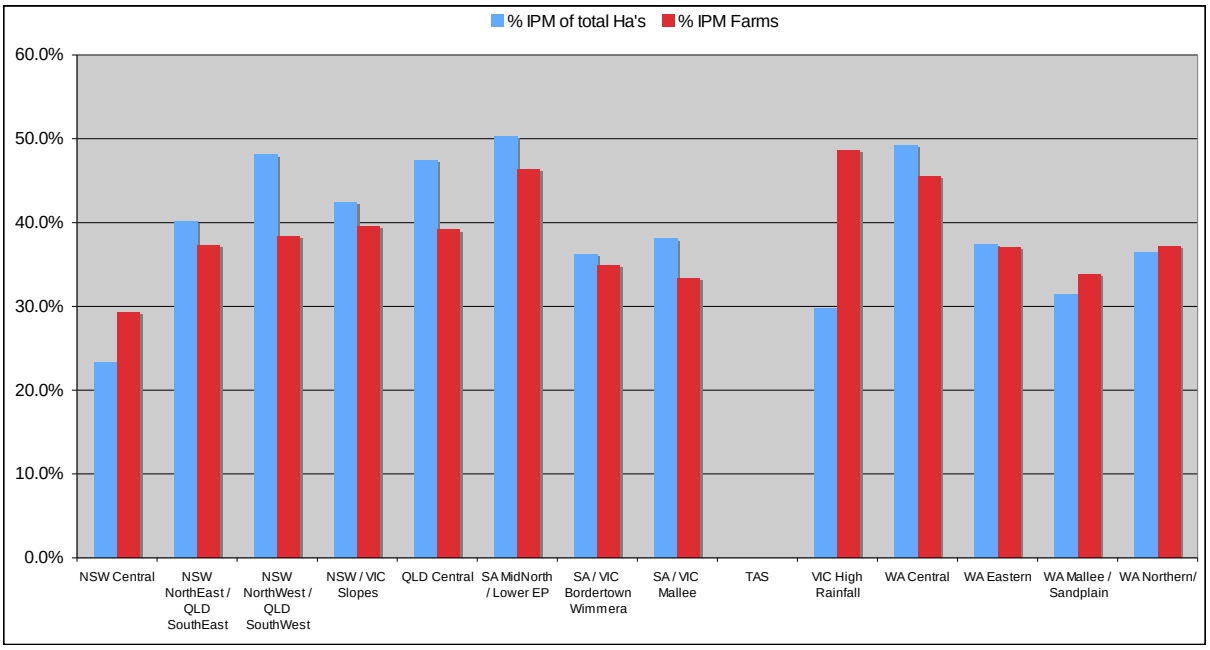


Figure 3. Are of crop where IPM is used (on farms using IPM) as compared to the average crop area in the dataset (GRDC, 2009)

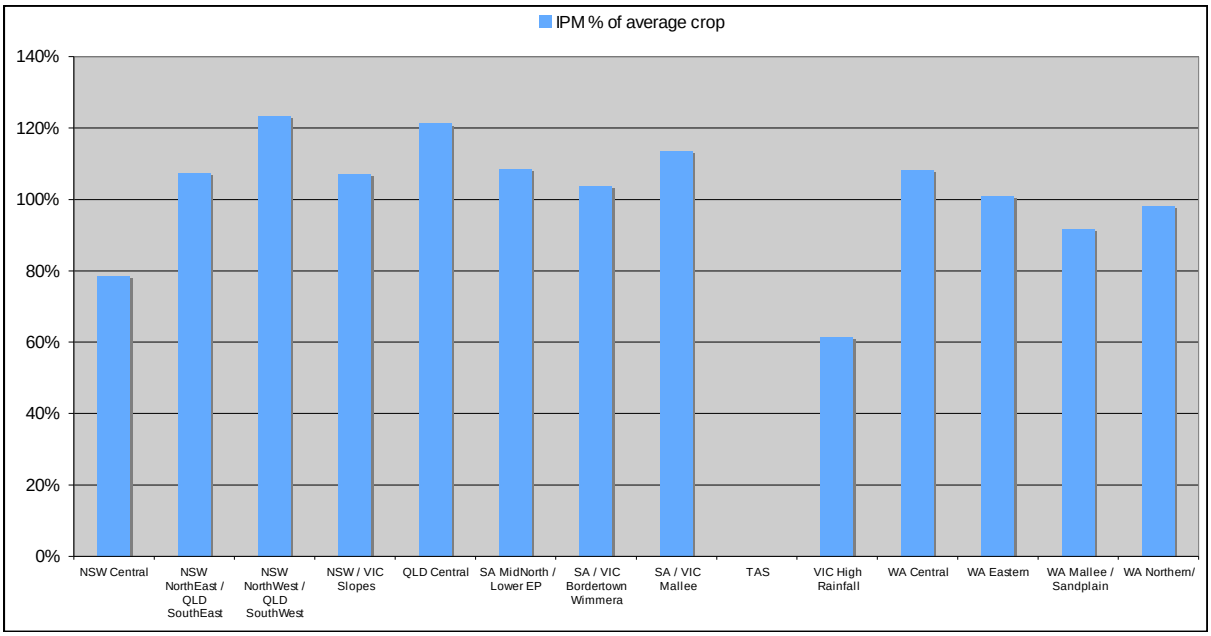


Figure 4. Area of crop (% of total) where IPM is used (GRDC, 2009)

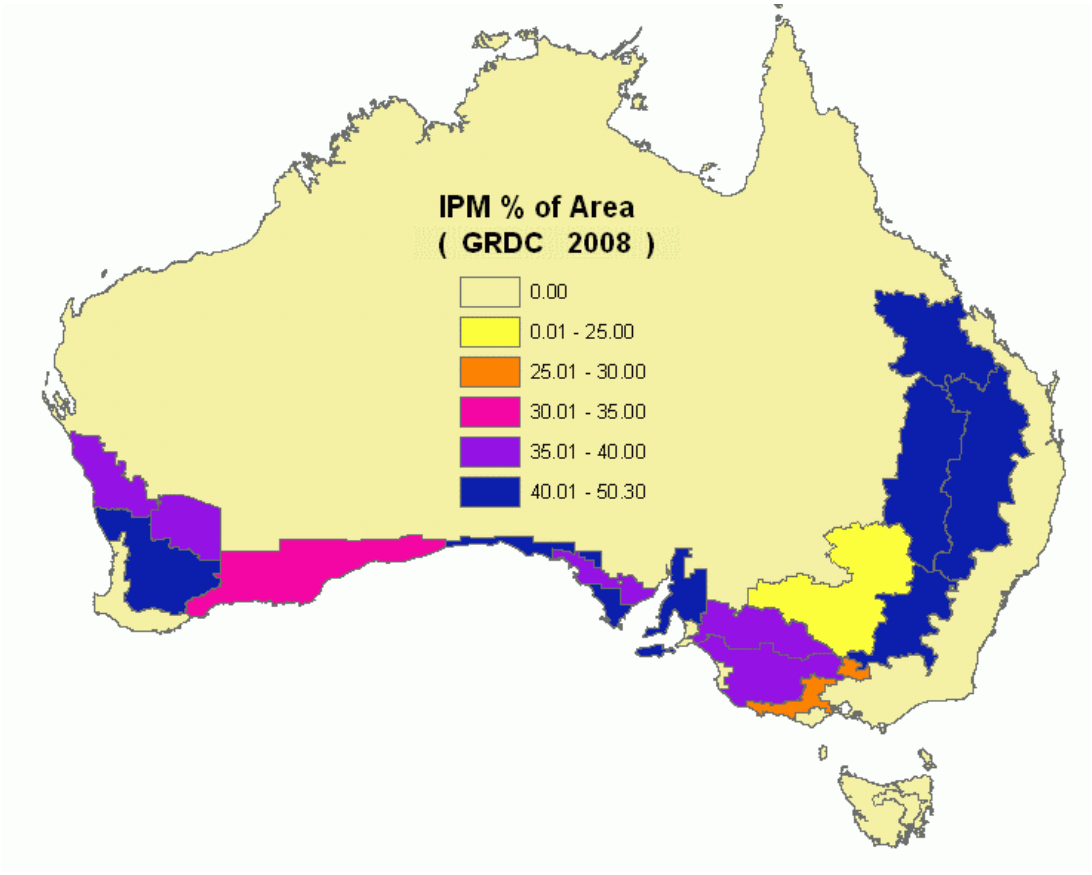
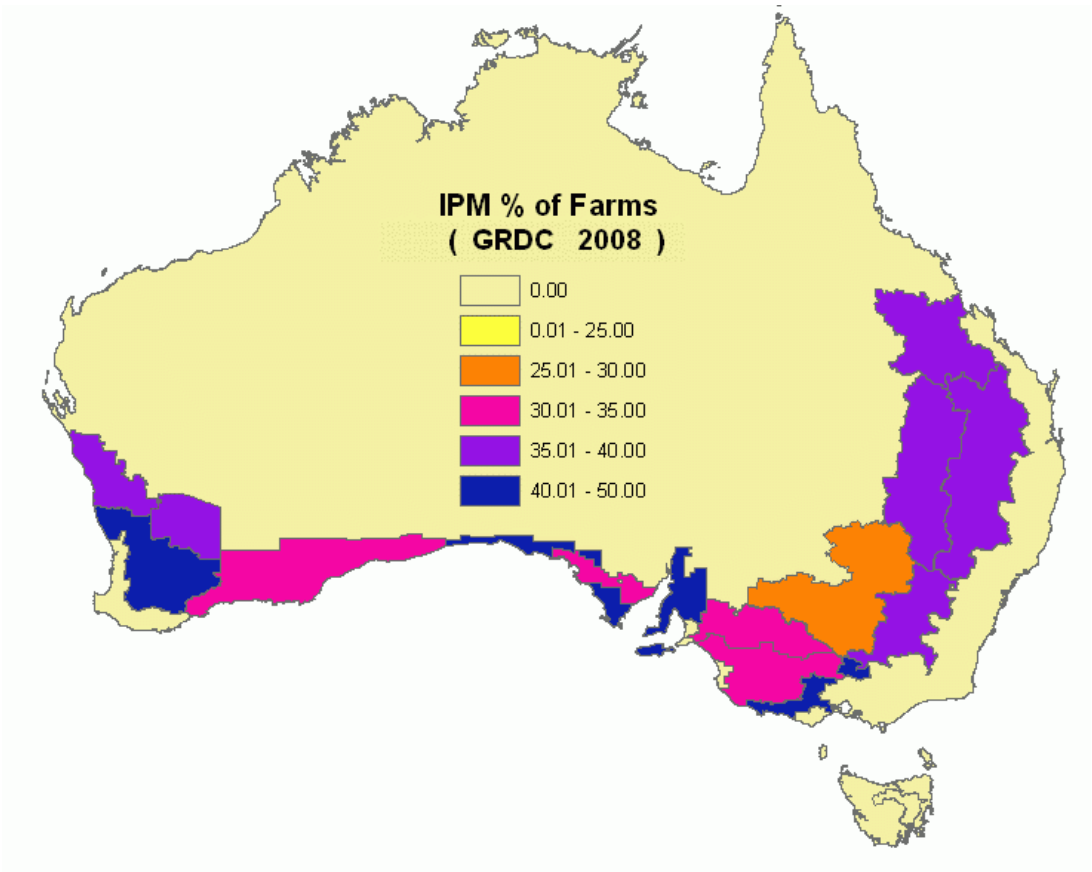


Figure 5. % of Farms using IPM (GRDC, 2009)



Nutrient Budgeting

Nutrient budgeting and soil testing in crop and pasture.

Area of soil testing, nutrient budgeting and phased use of fertiliser

Historic Public Data

No specific ABS data exist for the use of soil testing on farms. The only data of potential use from ABS is actual fertiliser used by farms on crop areas. This does not allow conclusions to be drawn about the basis for the choice of fertiliser, amount applied and timing or matching of fertiliser application to crop or soil needs.

The data gathered in 2009 for the 2008 crop year by GRDC are the only data available at this time (apart from some data within the Farming Practices Database, which are not reported here). Some data may reside in some surveys carried out by other groups or bodies, though these are not available to this project.

Data from the GRDC survey for the 2008 (winter) crop year

The data on soil testing and matching fertiliser needs to soil test results, as gathered by GRDC for the 2008 crop year are presented in Table 1, and Figures 1 to 3

Nutrient Management Questions asked in the Solutions survey.

In the survey, questions relating to the use of soil testing and fertiliser matching on grain farms were:

- "What proportion of your farm (crop area, total area) do you conduct soil testing?"
- "How often do you carry out soil testing? (annually, every two years, 3 years, or not specified)"
- "How much of your crop area do you use the results of soil tests to choose the fertiliser program for your crop?"

These allow for data about the number of farms who are using soil testing and fertiliser matching in some form, and the area these represent.

Amount of soil testing being carried out on grain farms in 2008

The data gathered against these questions is presented below (Table 1 and Figures 1 to 3)

Approximately two thirds of grain farms are using soil tests, with this representing just over three quarters of the total crop area. These figures are slightly lower in SA, and higher in NSW and WA.

When one considers the average area where soil tests were carried out, while some differences exist between AE-Zones, the average area tested exceeds the average area of crop in the dataset, suggesting that the farms doing soil tests are larger crop farms, and/or that they test all or almost all of their crop areas, or that areas of pasture are also soil tested. This suggests that soil testing is a

practice carried out on larger or more crop intensive farms, and where practices is done on all of the soils of interest.

Table 1. Adoption of Soil Testing (ST) on grain farms: average area soil tested per farm, % of farms doing soil testing, and % of the crop area tested on farms doing soil tests as compared to the average crop area in the dataset (Source: GRDC, 2009)

AE-Zone	Avg Area per farm	% of farms using ST	% of Crop Area using ST
NSW Central	3,463	65.3%	107.0%
NSW NorthEast / QLD SouthEast	1,718	62.7%	75.5%
NSW NorthWest / QLD SouthWest	2,211	51.7%	57.8%
NSW / VIC Slopes	1,489	77.4%	77.9%
QLD Central	5,076	34.8%	78.8%
SA MidNorth / Lower EP	985	53.6%	41.8%
SA / VIC Bordertown Wimmera	955	61.1%	50.0%
SA / VIC Mallee	2,091	54.4%	54.3%
TAS	3,258	75.0%	n/a
VIC High Rainfall	1,172	70.3%	64.2%
WA Central	2,818	80.0%	100.3%
WA Eastern	3,431	64.5%	62.6%
WA Mallee / Sandplain	2,935	73.5%	72.1%
WA Northern	4,339	74.4%	92.6%
Averages	**2,314**	**65.6%**	**75.7%**

Figure 1. % of farms doing soil tests and the % of crop area being tested, by AE-Zone (GRDC, 2009)

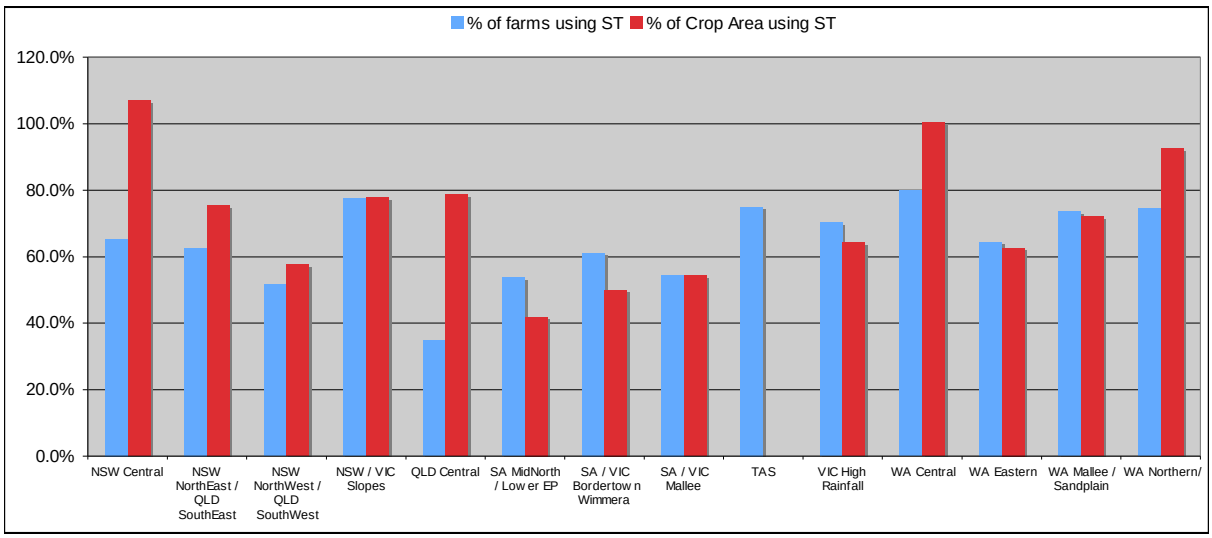


Figure 2. % of farms doing soil tests, by AE-Zone (GRDC, 2009)

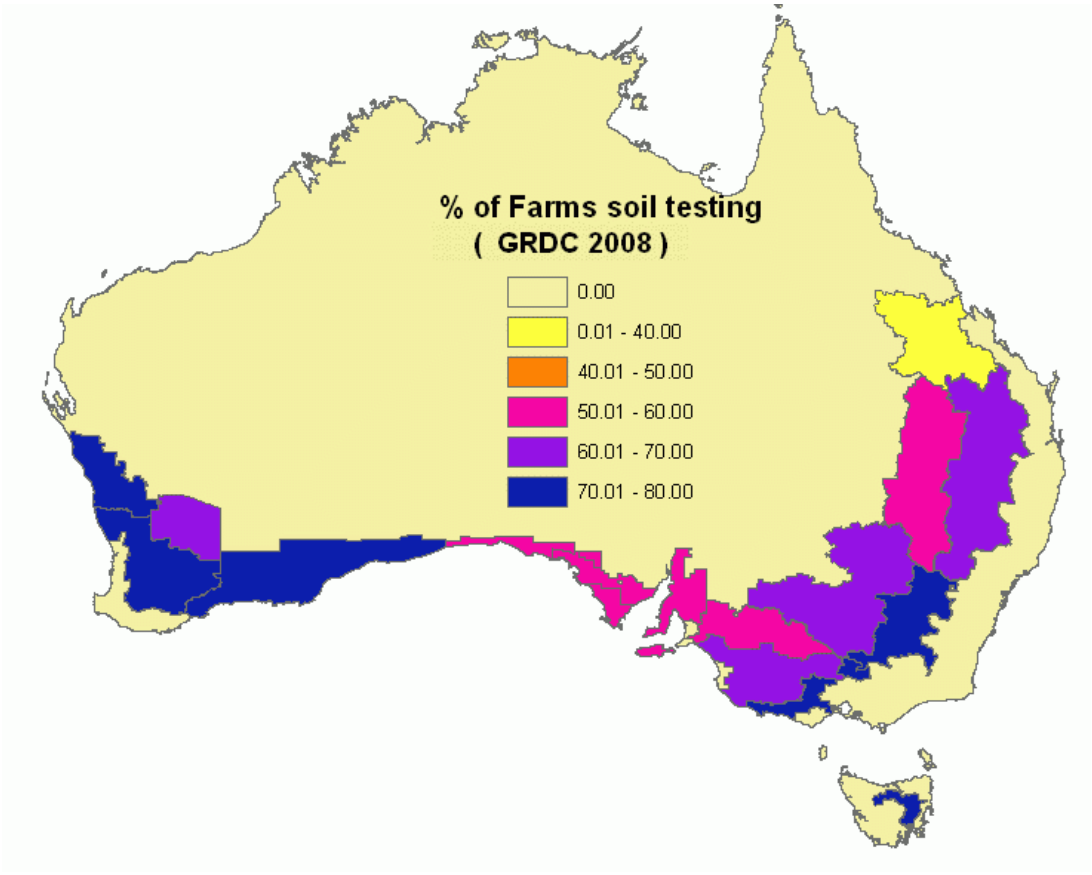
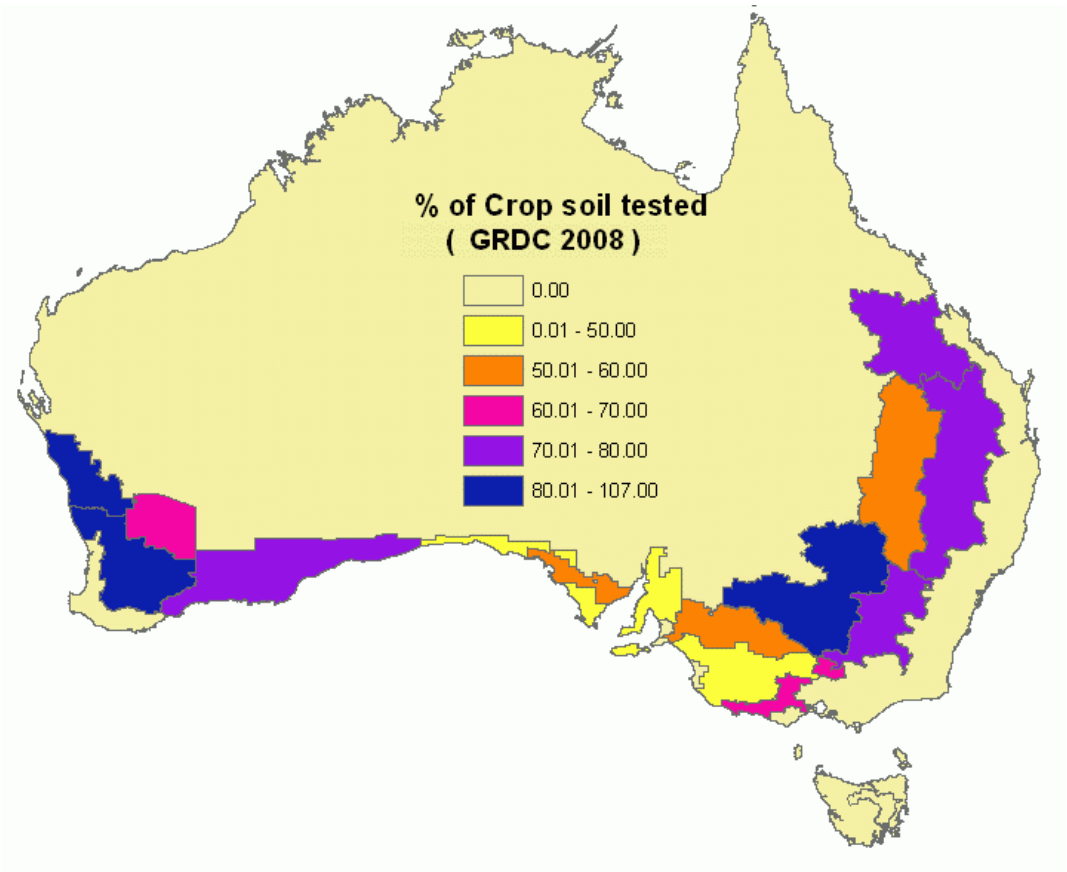


Figure 3. % of crop area being tested, by AE-Zone (GRDC, 2009)



It is apparent that soil testing is a relatively common practice in Australia, both in terms of number of farms and cropping area.

Frequency of soil testing being carried out on grain farms in 2008

Soil testing is a practice that can occur each year or less often. Questions were included to identify the regularity of soil testing, annually, each 2 years or each three years (or longer). These data are presented below.

Table 2. Adoption of Soil Testing on grain farms: average area soil tested per farm and % of farms, doing soil testing annually, 2-yearly and 3-yearly (GRDC, 2009).

AE-Zone	% ha annual	% farms annual	% ha 2 yrs	% farms 2 yrs	% ha 3 yrs	% farms 3 yrs
NSW Central	21.6%	24.5%	46.6%	22.4%	17.5%	28.6%
NSW NorthEast / QLD SouthEast	38.9%	33.3%	23.5%	25.3%	26.1%	25.3%
NSW NorthWest / QLD SouthWest	36.7%	29.0%	7.6%	16.1%	15.0%	22.6%
NSW / VIC Slopes	41.4%	36.5%	22.8%	17.7%	20.1%	24.0%
QLD Central	15.0%	37.5%	28.2%	37.5%	27.2%	12.5%
SA MidNorth / Lower EP	37.6%	38.5%	3.6%	5.8%	10.4%	13.5%
SA / VIC Bordertown Wimmera	26.1%	33.8%	21.0%	19.5%	19.5%	18.2%
SA / VIC Mallee	48.5%	33.7%	15.2%	19.4%	18.8%	23.5%
TAS	0.0%	0.0%	3.8%	33.3%	87.0%	33.3%
VIC High Rainfall	31.7%	26.9%	18.5%	26.9%	37.7%	30.8%
WA Central	31.1%	31.3%	19.8%	14.4%	24.4%	30.0%
WA Eastern	24.1%	25.0%	9.8%	10.0%	26.6%	20.0%
WA Mallee / Sandplain	33.5%	36.0%	21.5%	20.0%	30.1%	24.0%
WA Northern	27.6%	34.4%	13.4%	18.8%	18.6%	21.9%

The data suggest that the frequency of testing is relatively evenly spread, with about one third testing annually, 2-yearly or 3-yearly, with a slight dominance for annual testing. There are some differences between AE-Zones, though these are relatively minor. The Tasmanian data is anomalous due to the low numbers in the sample from there.

Figure 4. % of crop area (ha) where Soil is tested annually, every two or every three years (GRDC, 2009)

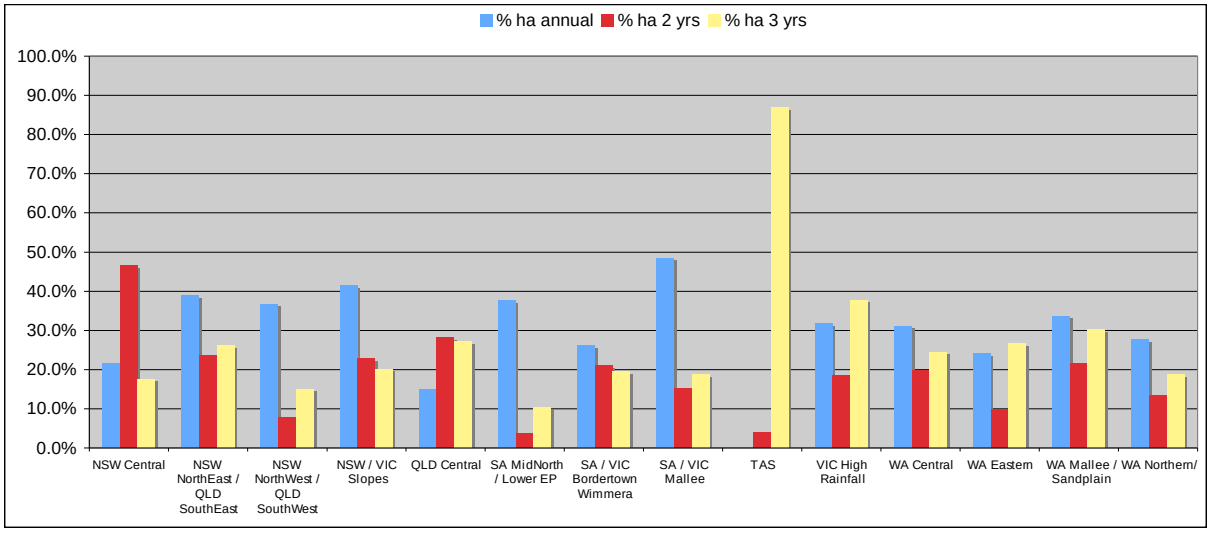


Figure 5. % of crop area (ha) where Soil is tested annually, (GRDC, 2009)

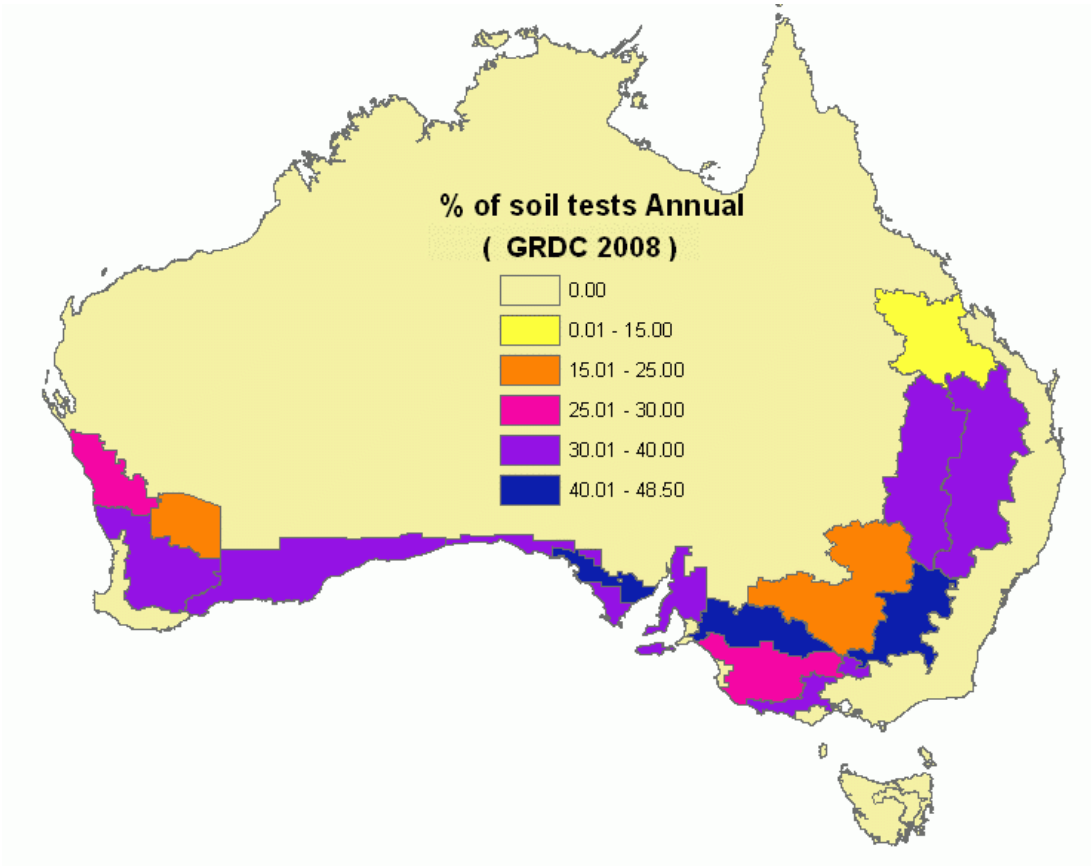


Figure 6. % of crop area (ha) where Soil is tested every two years, (GRDC, 2009)

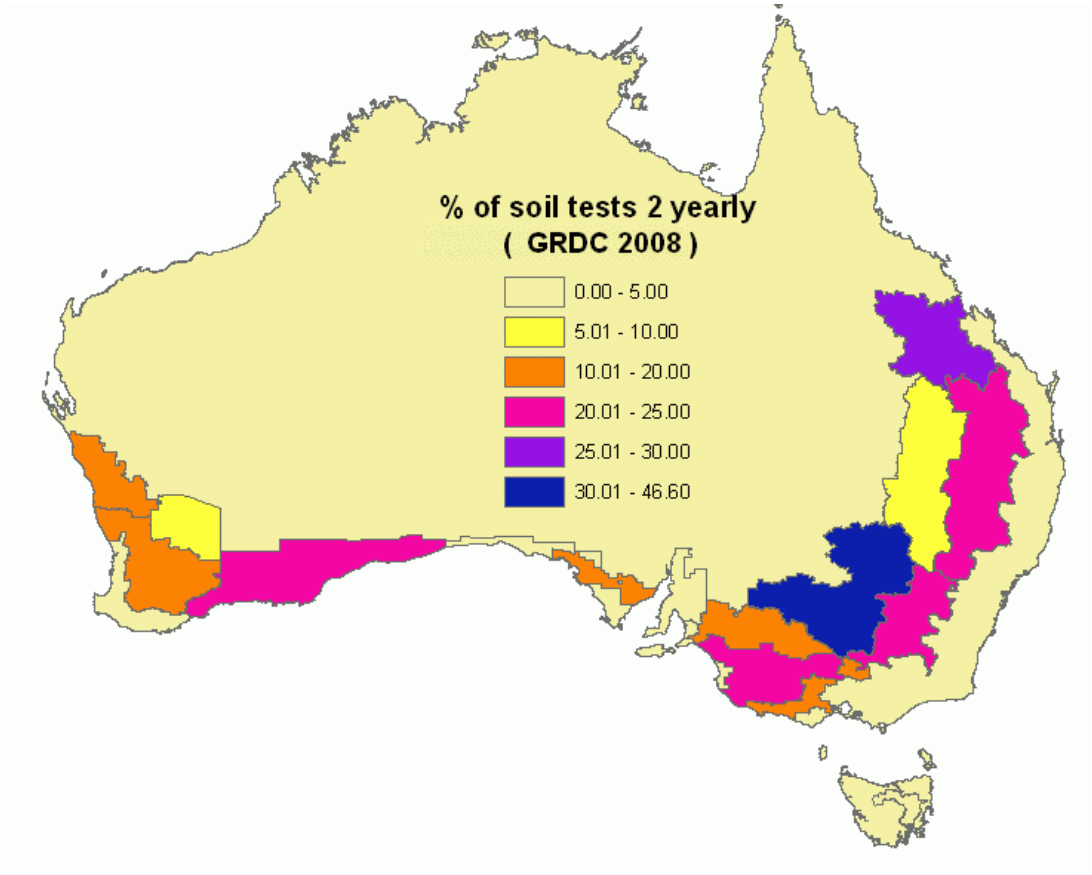
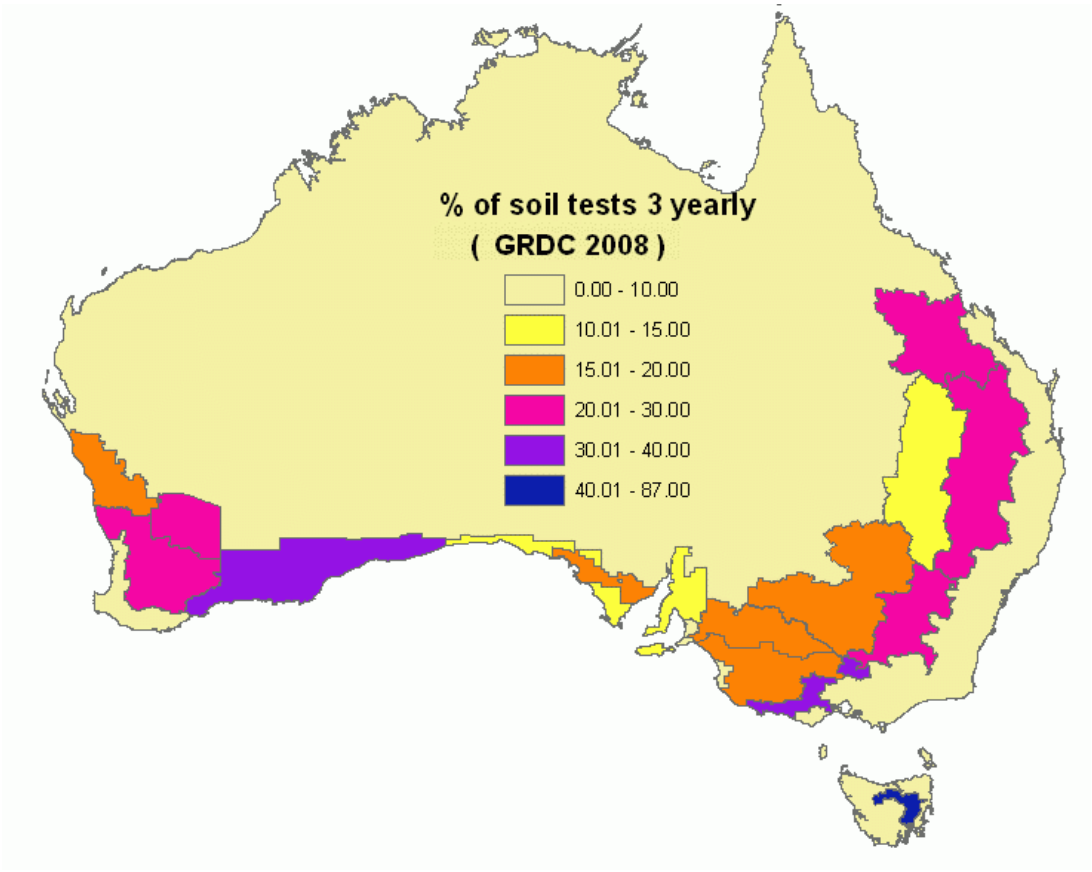


Figure 7. % of crop area (ha) where Soil is tested three years, (GRDC, 2009)



Use of Fertiliser program based on soil testing in 2008

The data below show the extent to which soil tests are used as a basis for fertiliser application, i.e., how much of the crop has a fertiliser program designed using the soil test results for guidance.

Data is presented showing the extent of the adoption of this practice in terms of the percentage of farms doing this, the area these represent and the % of crop area of these farms, expressed as a comparison with the average area of crop in the whole dataset.

These data show about 60% of farms were matching their fertiliser plans with the results from soil tests. Further, that where they do, this it is done on the majority of the crop area of the farm. Looking at the average crop area where this is done, the area where this practice is done exceeds the average crop area of the dataset, suggesting that these farms are larger in cropping terms, and are matching their fertiliser use to soil tests on most or all of their crop area.

Table 3. Use of soil testing to inform fertiliser practices, average area (ha) per farm, % of farms and % of crop where this is practiced (GRDC, 2009).

AE-Zone	Avg Area per Farm	% Farms using fert match	% crop Area using fert matching
NSW Central	4,990	56.0%	132.1%
NSW NorthEast / QLD SouthEast	2,249	57.6%	90.8%
NSW NorthWest / QLD SouthWest	2,537	40.0%	51.3%
NSW / VIC Slopes	2,298	71.8%	111.4%
QLD Central	7,599	26.1%	88.4%
SA MidNorth / Lower EP	2,238	45.4%	80.4%
SA / VIC Bordertown Wimmera	1,586	51.6%	70.0%
SA / VIC Mallee	2,877	48.3%	66.4%
TAS	3,633	75.0%	255.0%
VIC High Rainfall	2,256	59.5%	104.6%
WA Central	3,516	76.0%	118.9%
WA Eastern	4,367	54.8%	67.7%
WA Mallee / Sandplain	4,510	67.6%	101.9%
WA Northern	5,582	70.9%	113.5%
Averages	**3,223**	**58.9%**	**94.6%**

It is clear that where soil testing is carried out, it is heavily used to inform fertiliser use and tactics more or less across the cropping area in a general sense.

Figure 8. % of farms and area of crop (%) where Soil testing is used to determine fertiliser practice, (GRDC, 2009)

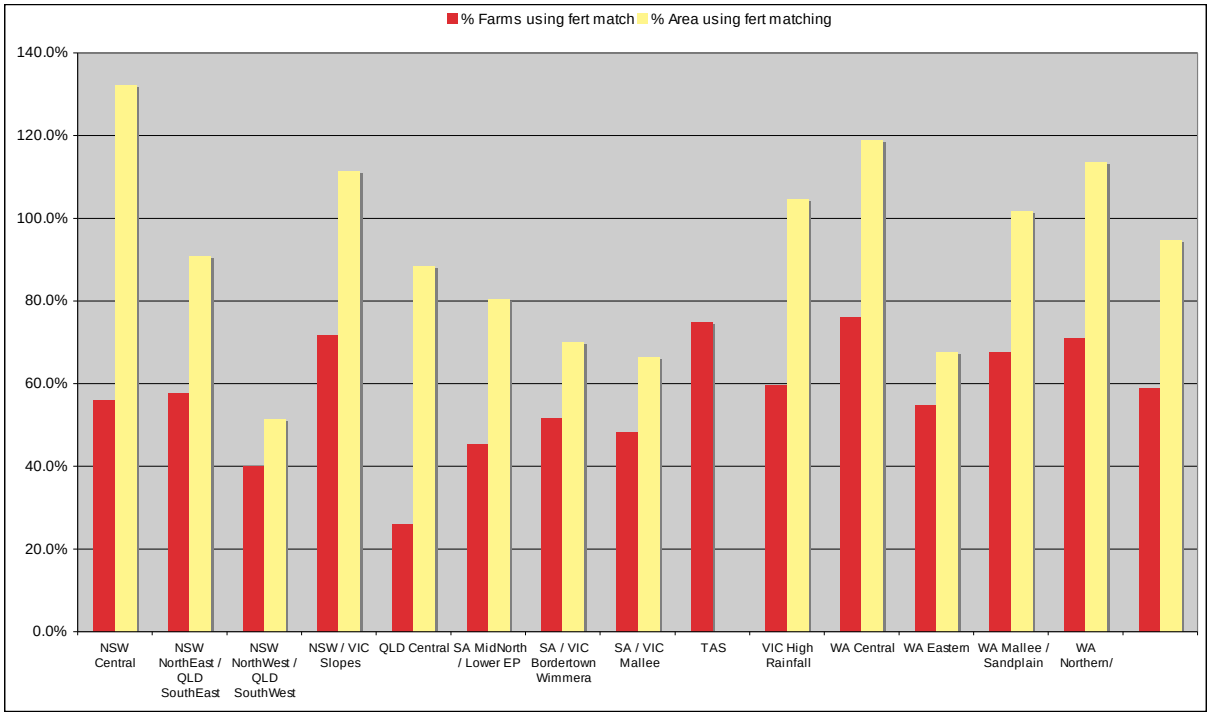


Figure 9. % of farms where Soil testing is used to determine fertiliser practice, (GRDC, 2009)

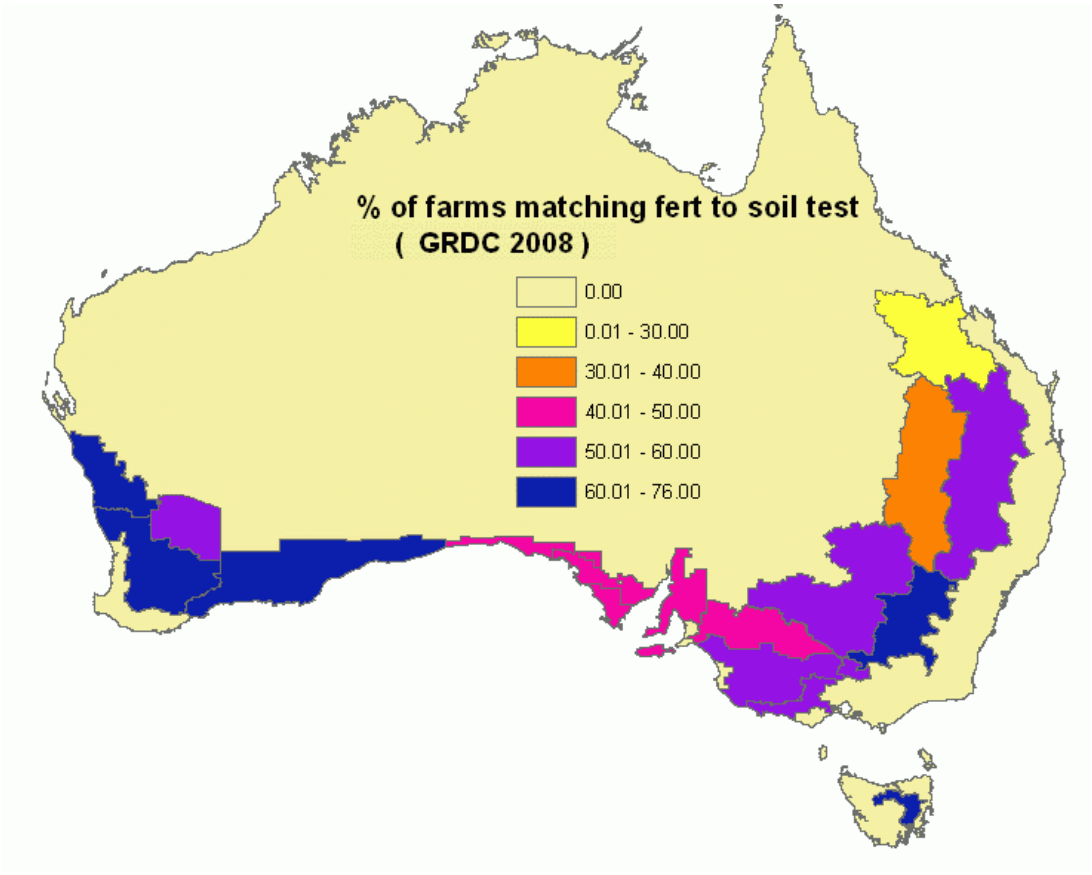
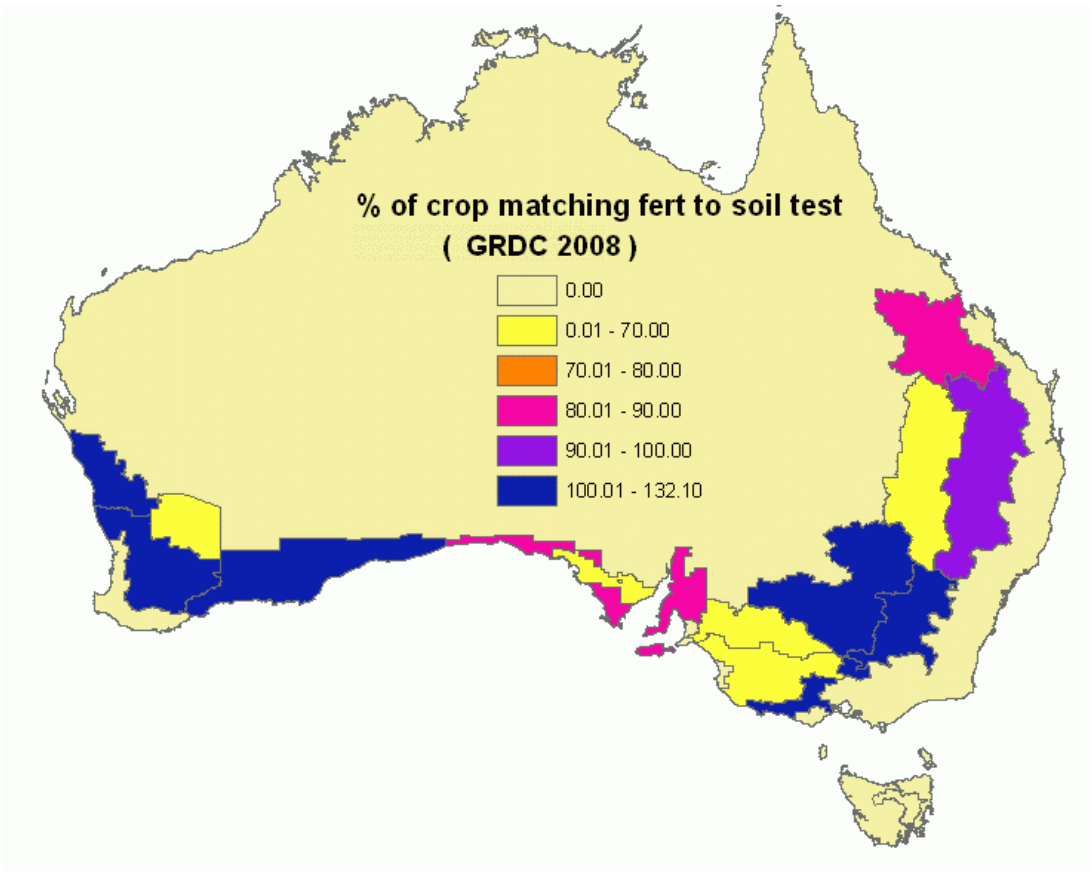


Figure 10. % of crop where Soil testing is used to determine fertiliser practice, (GRDC, 2009)



Use of Perennials

Use of Perennials in systems.

Area of perennial pasture, area of native and permanent vegetation, area of replanted and protected areas

Historic Public Data

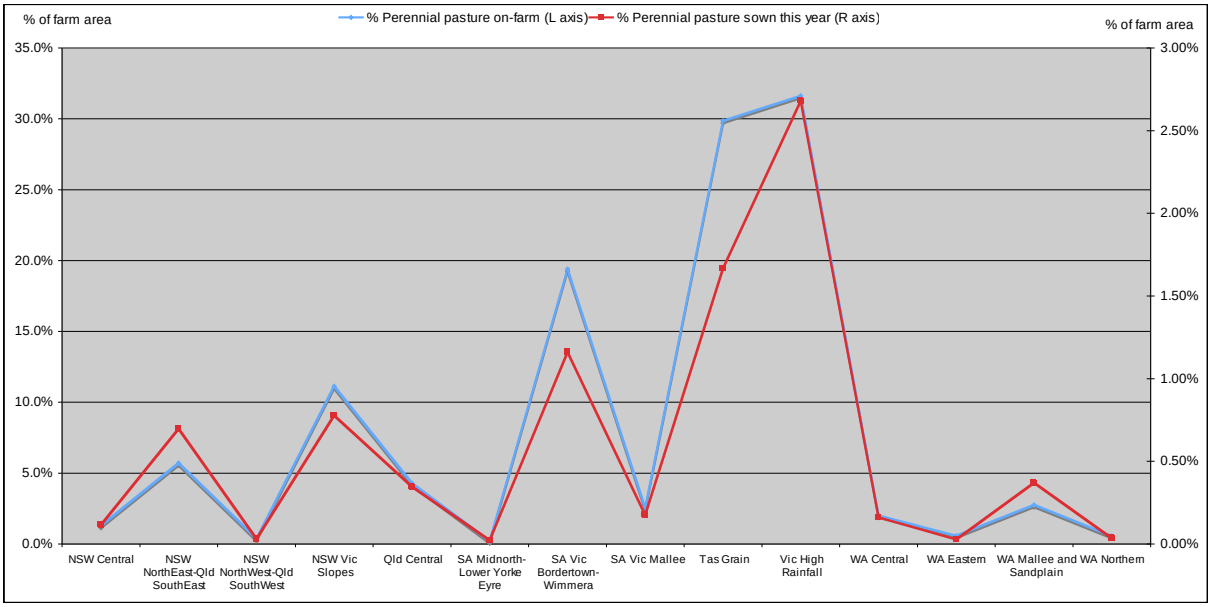
ABS data exist from previous agricultural censuses for the areas of perennial and other vegetation on farms. The agricultural census of 2000-01 asked about the area of perennial vegetation on farms, and also the area of new perennials planted on farms in that year.

The ABS census data have been manipulated to place these into AE-Zones, and are presented in Table 1 and Figures 1 and 2 below.

Table 1. % of farmland with perennial vegetation and % planted in this year (2005-06), by AE-Zone. (Source: ABS 2001)

AE-Zone	% Perennials (area of farm)	% Perennials sown (area of farm)
NSW Central	1.3%	0.12%
NSW NorthEast-QLD SouthEast	5.7%	0.70%
NSW NorthWest-QLD SouthWest	0.4%	0.03%
NSW Vic Slopes	11.1%	0.78%
QLD Central	4.3%	0.35%
SA Midnorth-Lower Yorke Eyre	0.2%	0.02%
SA Vic Bordertown-Wimmera	19.4%	1.16%
SA Vic Mallee	2.5%	0.18%
Tas Grain	29.9%	1.67%
Vic High Rainfall	31.6%	2.68%
WA Central	2.0%	0.16%
WA Eastern	0.6%	0.03%
WA Mallee and Sandplain	2.8%	0.37%
WA Northern	0.6%	0.04%

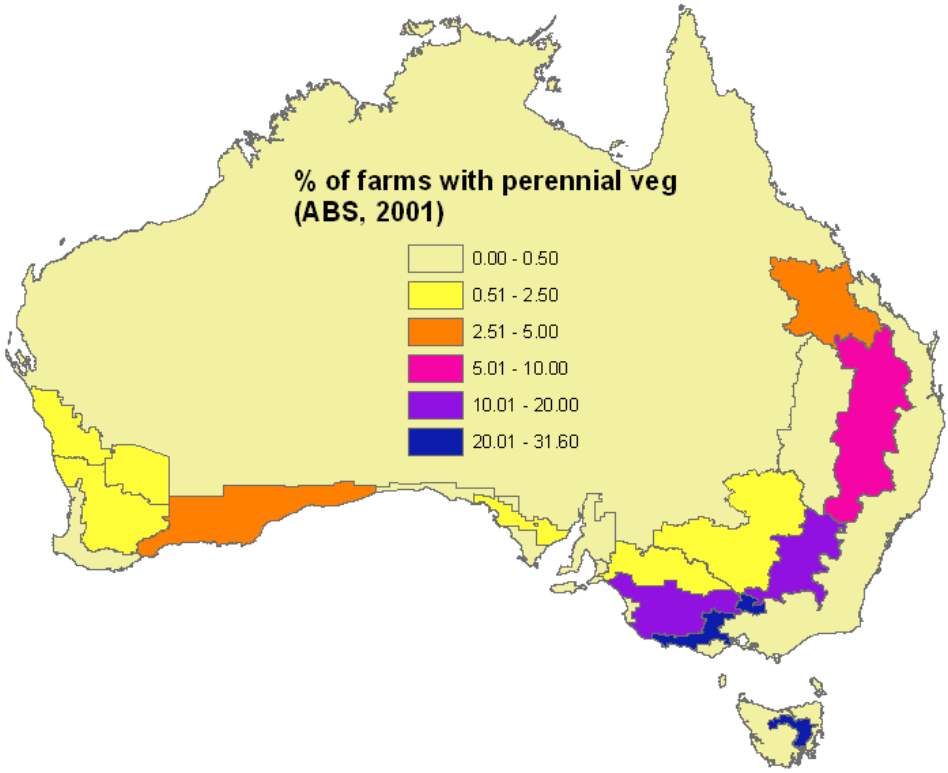
Figure 1. % of perennial vegetation present (RHS Axis) and % of perennials planted this year (LHS Axis) in 2005-6, by AE-Zone. (ABS, 2006)



One can see that the areas of perennials and the areas planted on farms in the census year follow each other closely. This is perhaps unsurprising if the area of perennials being described is perennial pasture, since where such pastures are dominant it is likely to be due to farmers planting these.

What is unclear in the data from ABS is the breakdown of the perennial vegetation, i.e. how much is perennial pasture, versus (perennial) native or remnant vegetation. From a resource management viewpoint this may not be highly important, since the benefit of perennials (e.g. soil protection, biodiversity, etc.) may be considered similar due to there being perennials in the system rather than what kind of perennial these are.

Figure 2. % of farms with perennial vegetation present in 2000, by AE-Zone. (ABS 2001)



Data from the GRDC survey for the 2008 (winter) crop year

Data on perennials on mixed grain farms was gathered in the GRDC survey of 2009, for the 2008 crop year. These data are presented in Table 2 and Figures 3 to 7

Questions asked in the GRDC survey.

In the survey, questions relating to perennial pastures on farm were:

- "What is the area of your farm that has native or sown perennial vegetation that includes pastures?"
- "How many hectares of perennials did you sow in 2008"

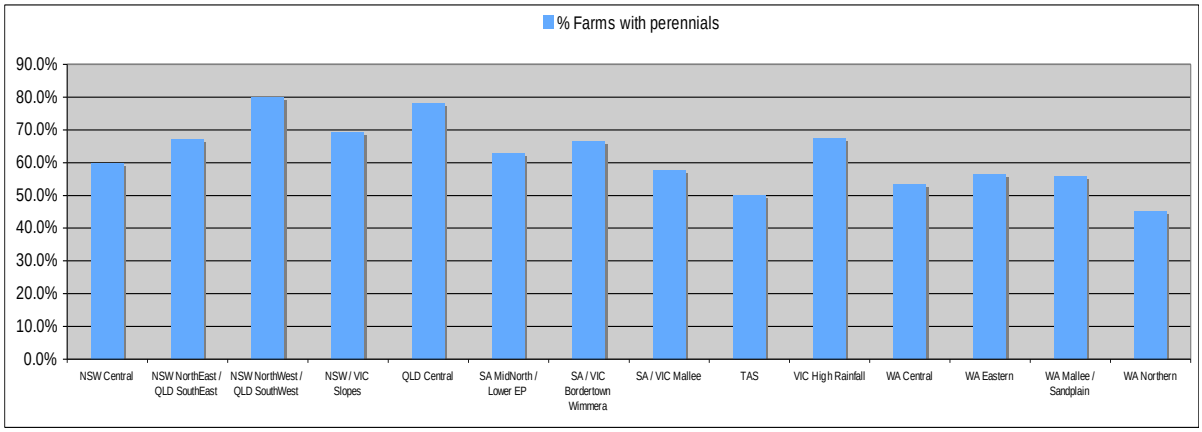
These questions allow the inclusion of native or remnant vegetation as well as sown or native perennial pastures to all be included in the total of 'perennial vegetation'. However, the second question, having included the word 'sown' is more likely to include sown perennial pasture as the dominant vegetation type that would come to mind in most farmers when asked this question.

Table 2. % of farms reporting presence of perennials, the % of the farm area with perennials and the % of farm areas planted with perennials this year (2008), by AE-Zone. (Source: GRDC, 2009)

NSW CENTRAL	60.0%	28.3%	0.34%
NSW NORTHEAST / QLD SOUTHEAST	67.1%	21.0%	0.16%
NSW NORTHWEST / QLD SOUTHWEST	80.0%	25.5%	0.01%
NSW / VIC SLOPES	69.4%	15.4%	0.12%
QLD CENTRAL	78.3%	164.0%	0.44%
SA MIDNORTH / LOWER EP	62.9%	32.6%	0.00%
SA / VIC BORDERTOWN WIMMERA	66.7%	13.9%	0.06%
SA / VIC MALLEE	57.8%	8.1%	1.18%
TAS	50.0%	39.2%	0.00%
VIC HIGH RAINFALL	67.6%	32.1%	0.22%
WA CENTRAL	53.5%	12.5%	0.54%
WA EASTERN	56.5%	10.4%	0.02%
WA MALLEE / SANDPLAIN	55.9%	11.3%	0.26%
WA NORTHERN	45.3%	15.0%	0.18%

One can see that the % of farms with perennial vegetation in Central QLD exceeds 100%, a figure that is perhaps an artifact of the survey in that many farms in central QLD do have substantial areas of native (and therefore perennial) vegetation, and it is possible that these answered the question about the area of perennials on their farms in such a way that gave areas that exceeded the total area of their farm. This can come about when one adds native / remnant vegetation and perennial pastures together to get a total perennial vegetation figure, and that many mixed farmers in this area perhaps double counted native vegetation and perennial pasture when (to them) these are essentially the same thing, leading to a total that exceeds the total farm area.

Figure 3. Average % of farms with perennial vegetation in 2008, by AE-Zone (GRDC, 2009)



The data presented in Table 2 and Figure 3 (above) show that the number of farms reporting some areas of perennials greatly exceeds that reported to ABS a few years earlier, with more than 50% of farms in most AE-Zones having areas of perennial vegetation.

These figures show (in general) that in most AE-Zones, most farms have perennials, and in some AE-Zones the area of perennial vegetation on farms can be significant, exceeding 20% of farm area in approximately half the AE-Zones.

However, these data are at odds with ABS data from earlier censuses, and reasons for this are difficult to ascribe since the questions asked by ABS in the census and those in the GRDC survey of 2008 either are or have been interpreted by growers quite differently in how they have been answered.

The general category of 'perennial vegetation' on farms is open to wide interpretation as to what it includes, and how to report. Therefore some further thought needs to be given to describing what is meant when asking such questions in the future, to ensure consistency of response and validity of making comparisons.

Nonetheless, it appears that there are healthy areas of perennial vegetation on many grain farms in Australia.

Figure 4. % of farms with perennial vegetation in 2008, by AE-Zone. (GRDC 2009)

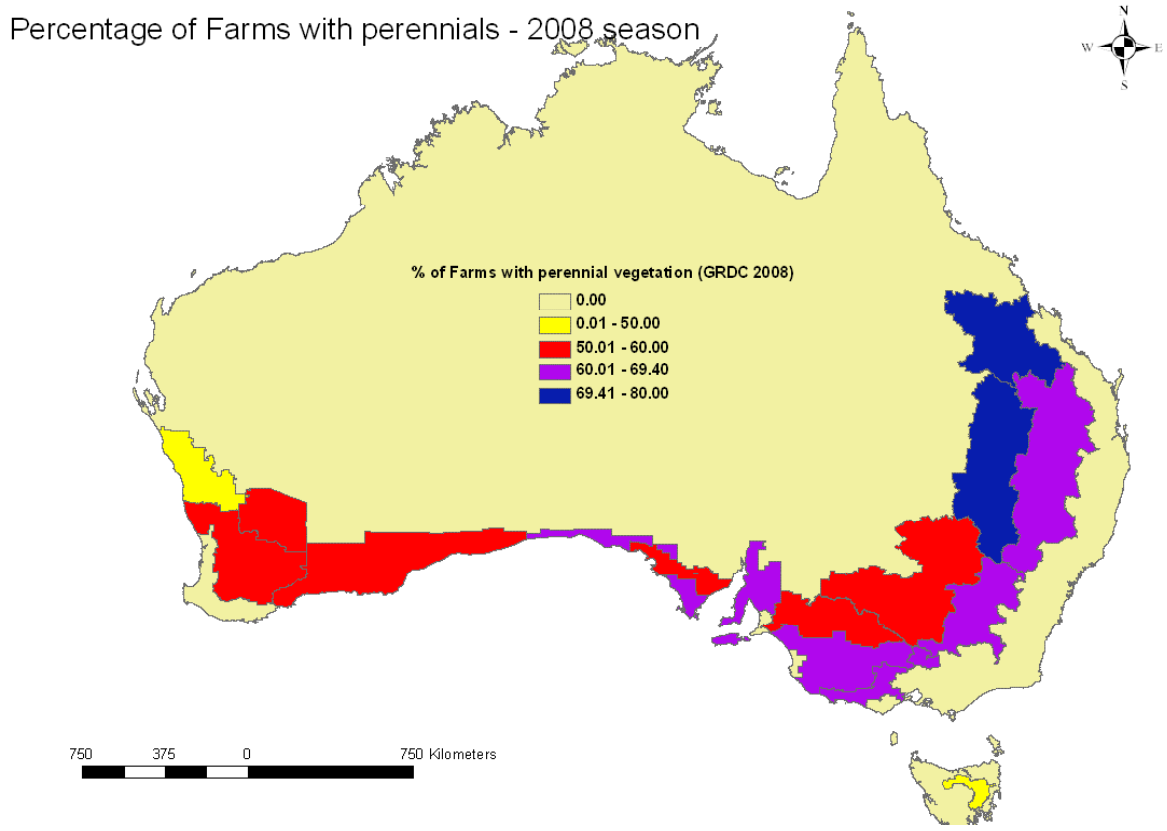
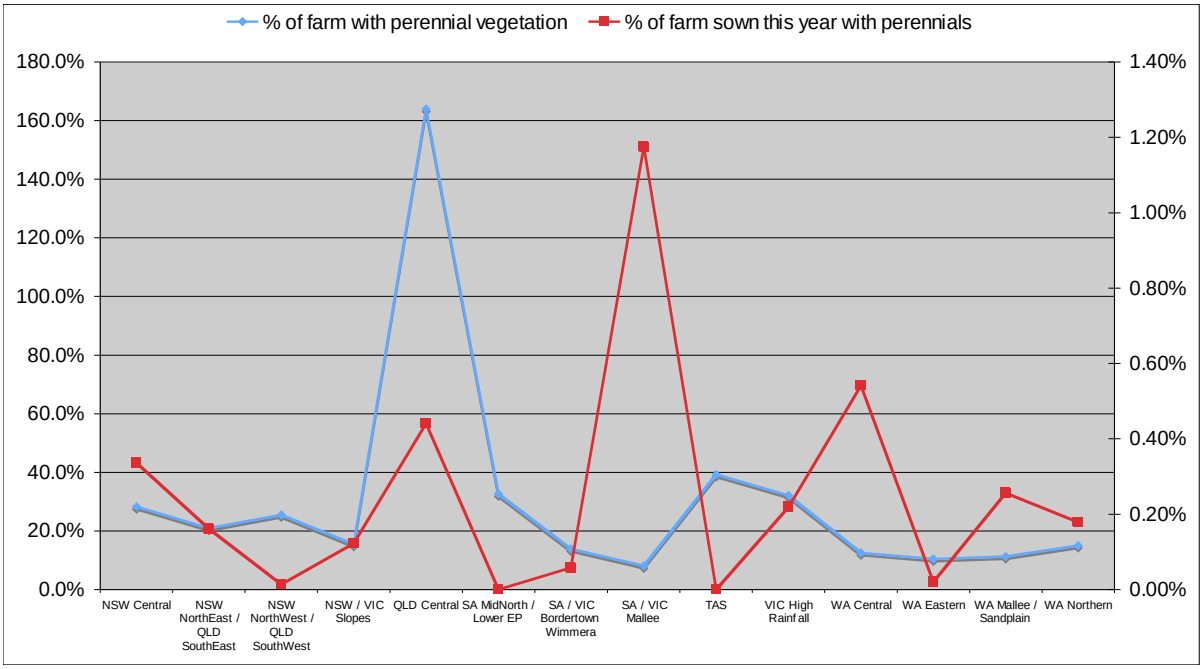


Figure 5. Average % of farm with perennial vegetation, and average % of farm area planted with new perennial vegetation in 2008, by AE-Zone (GRDC, 2009)



As opposed to the ABS data shown above, the close connection between area of perennials on farms and the area planted in the year is not as apparent, and quite divergent in some cases (for example, in the Mallee). Perhaps it is a feature of perennials, whereby farmers do not need to plant these every year for them to be present, and hence how much is planted in any one year is due to circumstances in operation in that year, for example seasonal conditions, pasture health (in the case of perennial pasture), or other factors.

Figure 6. Average % of farm area with perennial vegetation in 2008, by AE-Zone (GRDC, 2009)

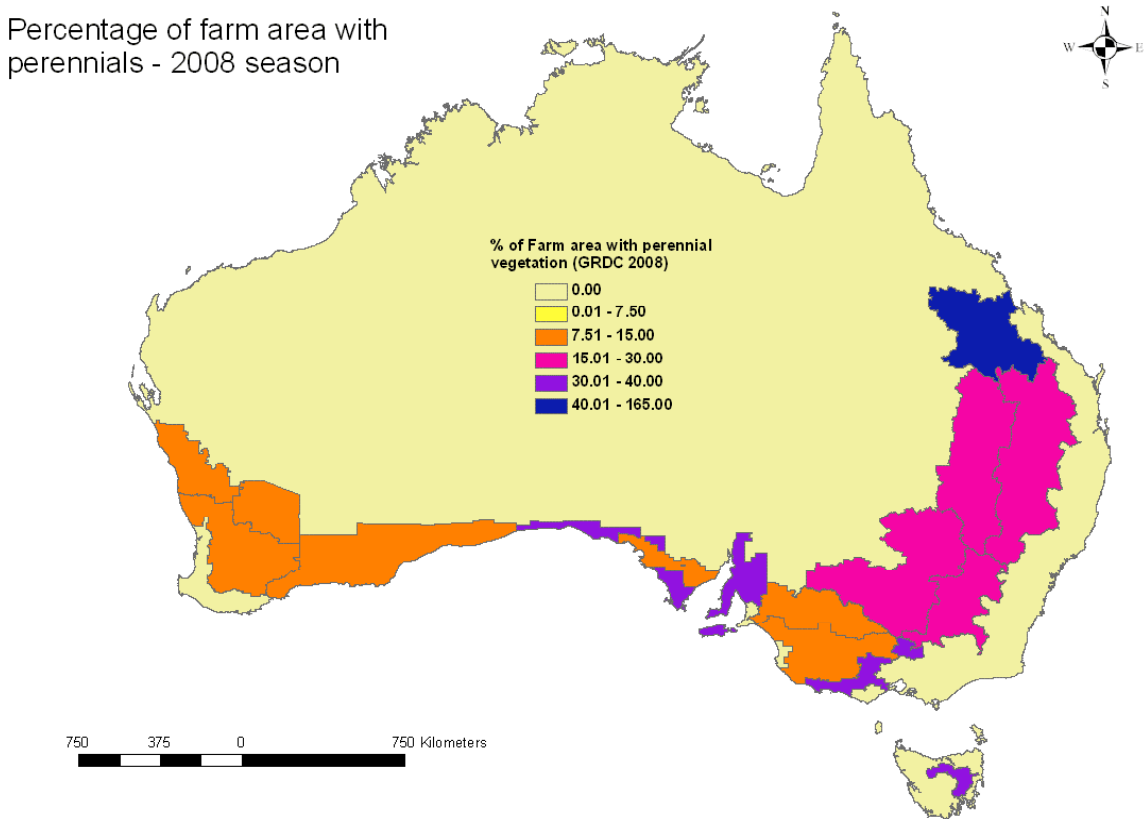
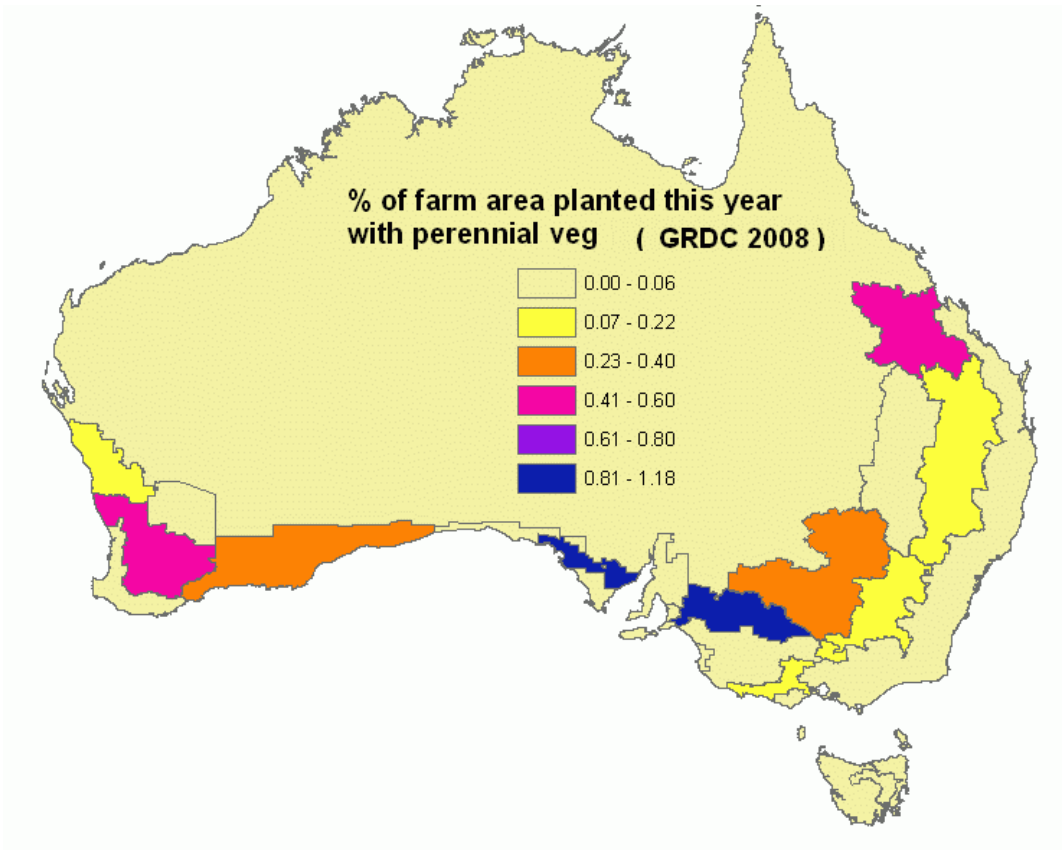


Figure 7. Average % of farm area planted with new perennial vegetation in 2008, by AE-Zone (GRDC, 2009)



Livestock Management

Numbers of both sheep can cattle carried and turned off through the year, average stocking rate, some management practices e.g. use of feed pads in drought conditions

Historic Public Data

ABS data exist from previous agricultural censuses for the numbers of cattle and sheep (and other livestock) are available. However these are of limited use in this project since these gather the total numbers of livestock on all properties, regardless of whatever other enterprises are carried out on the farms. In this way such data are unable to be applied to an analysis of how grain and mixed farmers are managing livestock, since the data are clouded by the presence of livestock-only farms.

ABS have not gathered any data about the management practices used on livestock farms, for example about whether stocking rate is adjusted in regard to feed or ground cover levels, with this practice being one now identified as important for both environmental and productivity reasons.

This report will use only the GRDC survey data of the 2008 crop year.

Questions asked in the GRDC survey.

In the survey, questions relating to livestock management on farm were:

- "Do you run cattle / sheep, if so on what proportion of your farm area – what is your average stocking rate
- Do you adjust your livestock management, stocking rate taking into account amount of feed and ground cover available – if so how much of this (% of pasture area) do you do?"

From these it is possible to manipulate the data to show some indicators of livestock management and the practices of interest, notably how many graziers are adjusting their stocking rate in recognition to feed and ground cover available.

Number of mixed grain and livestock farms

It is common knowledge that many (or most) grain producing farms also have one or more livestock enterprises, mainly either cattle or sheep, or in some cases both cattle and sheep.

The data from the GRDC survey of the 2008 season recorded data regarding livestock and the management of these. Table 1 and Figure 1 show the proportion of grain farms with cattle, sheep or both as at 2008. Figures 2, 4 and 6 shows these data in map format. Table 1 and Figures 3 and 5 show average numbers of livestock (cattle and sheep) per farm on those farms with livestock in 2008.

Table 1. Number of farms with cattle, sheep or both, and average number of cattle or sheep per farm with livestock, by AE-Zone in 2008. (Source: GRDC 2009)

AE-Zone	% Farms with Cattle	Avg No Cattle per farm	% Farms with Sheep	Avg No Sheep per farm	% Farms with both Cattle & Sheep
NSW Central	40.0%	209	61.3%	2227	22.7%
NSW NorthEast / QLD SouthEast	58.9%	580	19.0%	1921	12.0%
NSW NorthWest / QLD SouthWest	63.3%	477	53.3%	2927	31.7%
NSW / VIC Slopes	30.6%	318	75.0%	3034	20.2%
QLD Central	69.6%	1010	0.0%	0	0.0%
SA MidNorth / Lower EP	13.4%	161	75.3%	2206	8.2%
SA / VIC Bordertown Wimmera	19.8%	483	78.6%	3176	12.7%
SA / VIC Mallee	12.8%	134	73.3%	1475	6.7%
TAS	50.0%	285	100.0%	6750	50.0%
VIC High Rainfall	24.3%	544	62.2%	3789	10.8%
WA Central	7.5%	314	87.0%	5593	6.5%
WA Eastern	3.2%	55	77.4%	2561	1.6%
WA Mallee / Sandplain	33.8%	404	79.4%	5356	27.9%
WA Northern	10.5%	183	67.4%	2390	5.8%
Averages	**25.8%**	**432**	**66.6%**	**3284**	**12.3%**

Figure 1. % of farms with cattle, sheep or both in 2008, by AE-Zone. (GRDC, 2009)

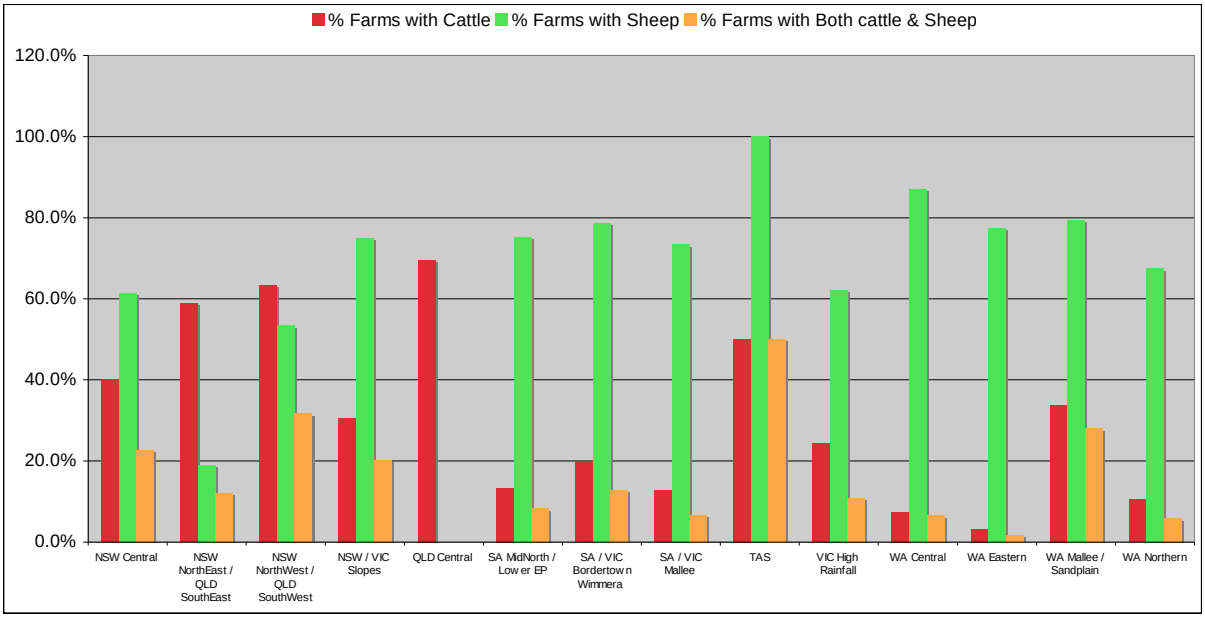


Figure 2. % of grain farms with cattle in 2008, by AE-Zone. (GRDC 2009)

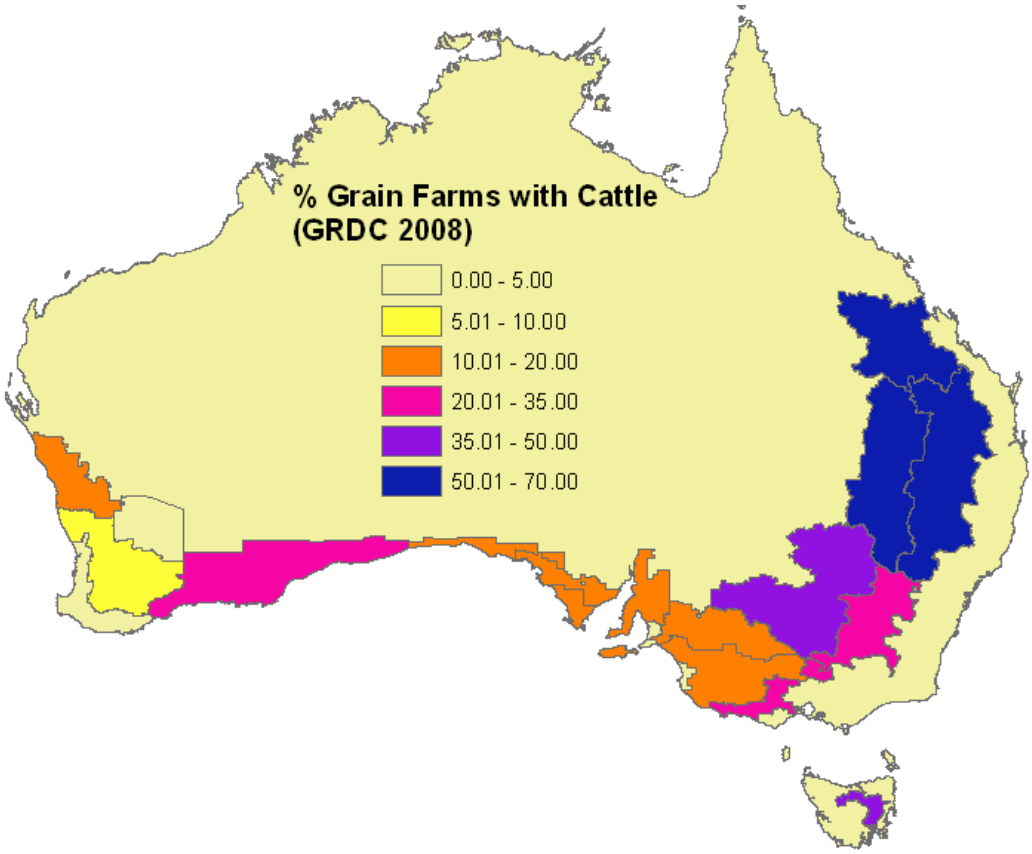


Figure 3. Average cattle numbers (head per farm) on grain farms that also have cattle in 2008, by AE-Zone. (GRDC 2009)

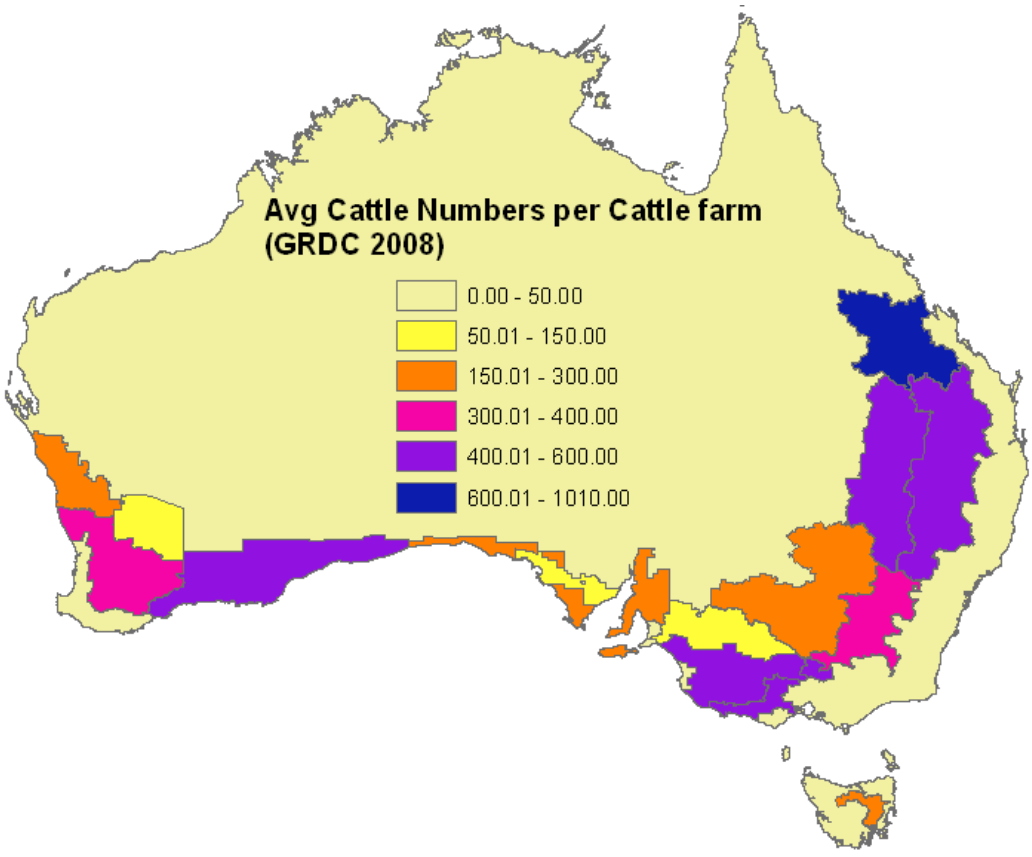


Figure 4. % of grain farms with sheep in 2008, by AE-Zone. (GRDC 2009)

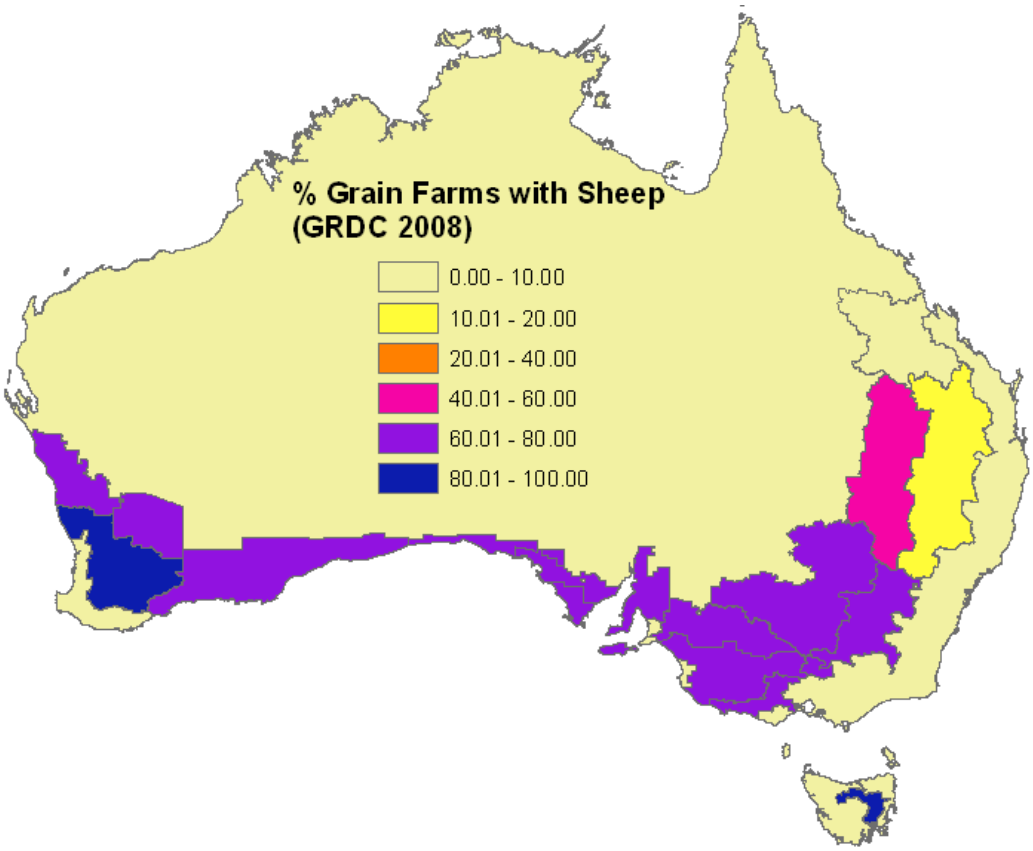


Figure 5. Average sheep numbers (head per farm) on grain farms that also have sheep in 2008, by AE-Zone. (GRDC 2009)

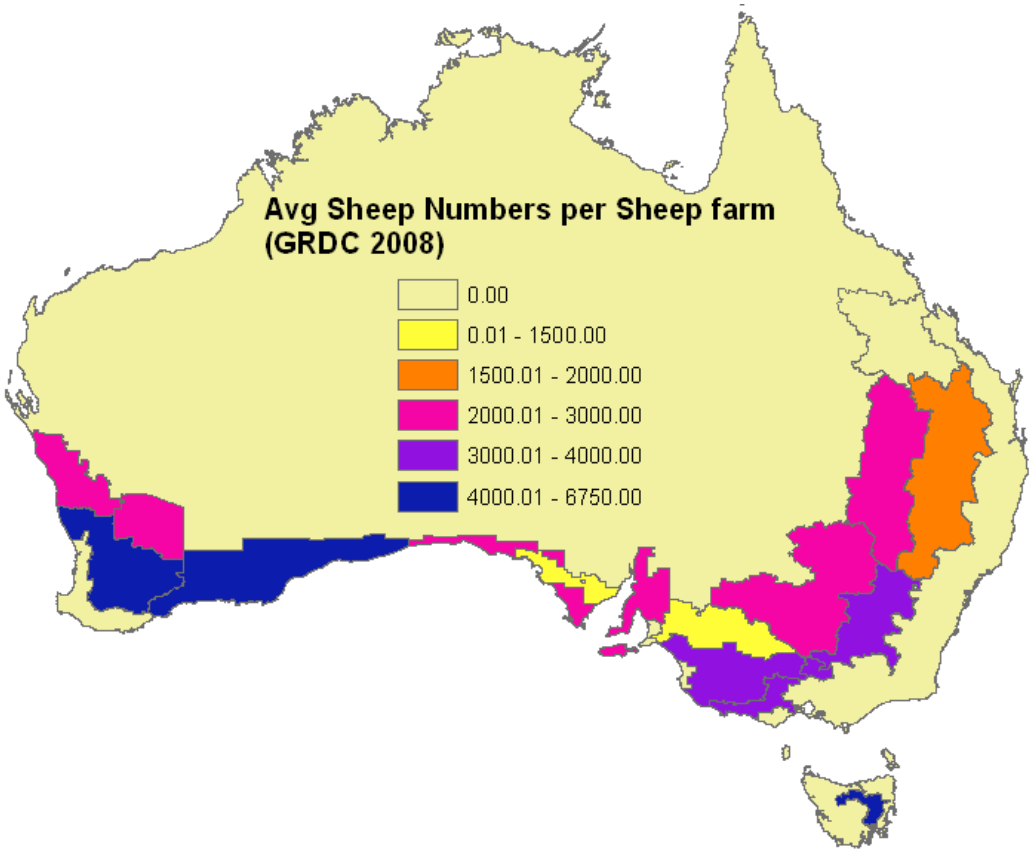
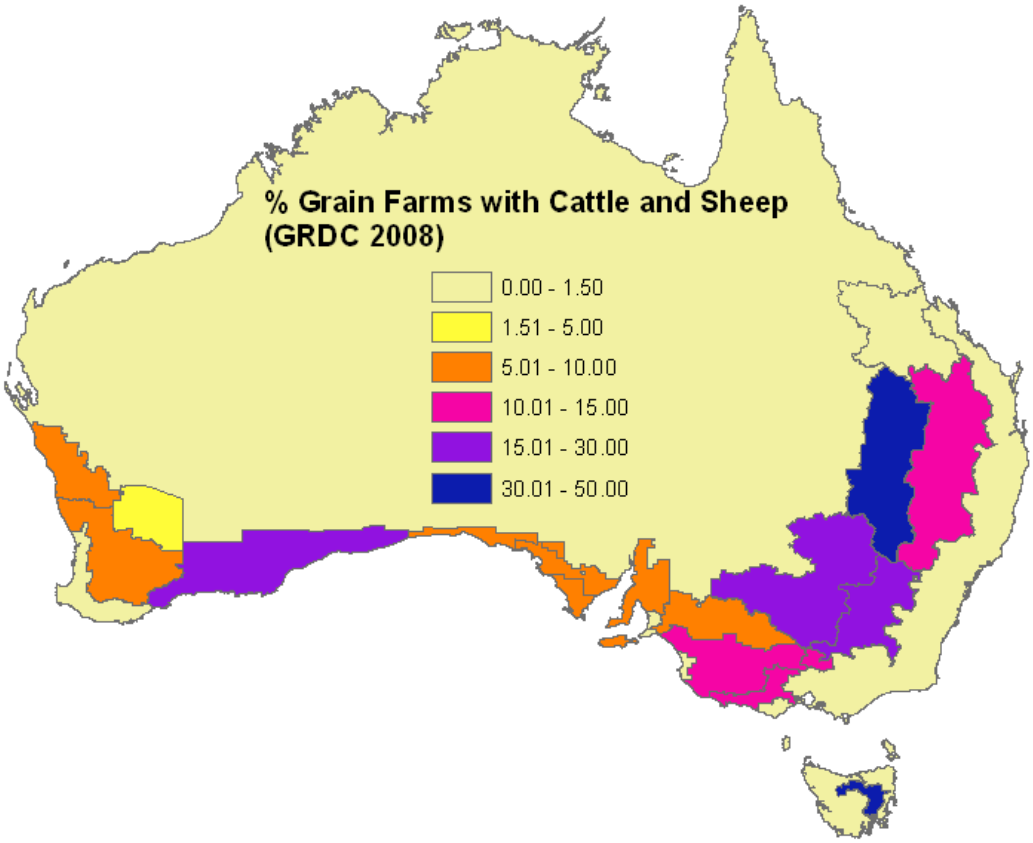


Figure 6. % of grain farms with both cattle and sheep in 2008, by AE-Zone. (GRDC 2009)



About one quarter of grain farms have cattle and two thirds have sheep, with 12% having both cattle and sheep.

Cattle dominate in Queensland and northern NSW, and sheep in all southern areas.

Cattle numbers are also higher in the northern AE-Zones and sheep numbers higher in the more extensive areas of western NSW, SA and WA. High sheep numbers are also apparent in the higher rainfall areas of Victoria and in Tasmania.

Proportion of pasture area used for grazing on mixed grain and livestock farms

Another way of looking at livestock on grain farms is to consider the proportion of pasture area on those farms with livestock. The GRDC dataset has been manipulated to show the proportion of pasture area used by those farms with cattle and sheep, or both. These data are shown in Table 2, and figures

Table 2. % of pasture area represented by those with cattle, sheep or both in 2008, by AE-Zone. (Source: GRDC, 2009)

AE-Zone	% Pasture with Cattle	% Pasture with Sheep	% Pasture shared
NSW Central	57.1%	63.9%	31.7%
NSW NorthEast / QLD SouthEast	88.7%	22.4%	17.6%
NSW NorthWest / QLD SouthWest	79.9%	60.8%	49.9%
NSW / VIC Slopes	32.6%	85.3%	22.0%
QLD Central	84.3%	0.0%	0.0%
SA MidNorth / Lower EP	9.8%	97.8%	8.1%
SA / VIC Bordertown Wimmera	27.1%	86.6%	16.6%
SA / VIC Mallee	13.4%	89.5%	8.8%
TAS	85.1%	100.0%	85.1%
VIC High Rainfall	68.9%	35.4%	7.4%
WA Central	6.3%	95.3%	5.9%
WA Eastern	2.7%	89.5%	1.7%
WA Mallee / Sandplain	43.0%	83.2%	38.5%
WA Northern	8.1%	81.3%	4.8%
Averages	**36.7%**	**72.4%**	**16.8%**

The areas of pastures used to support cattle or sheep on grain farms tend to follow a similar pattern as that seen with the number of farms and stock numbers, that is, more pasture is used for cattle in northern Australian and more for sheep in southern AE-Zones. The areas used for sheep approximate about double the areas for cattle as an overall average.

Figure 7. Average % of pasture area represented by farms with cattle, sheep or both in 2008, by AE-Zone (GRDC, 2009)

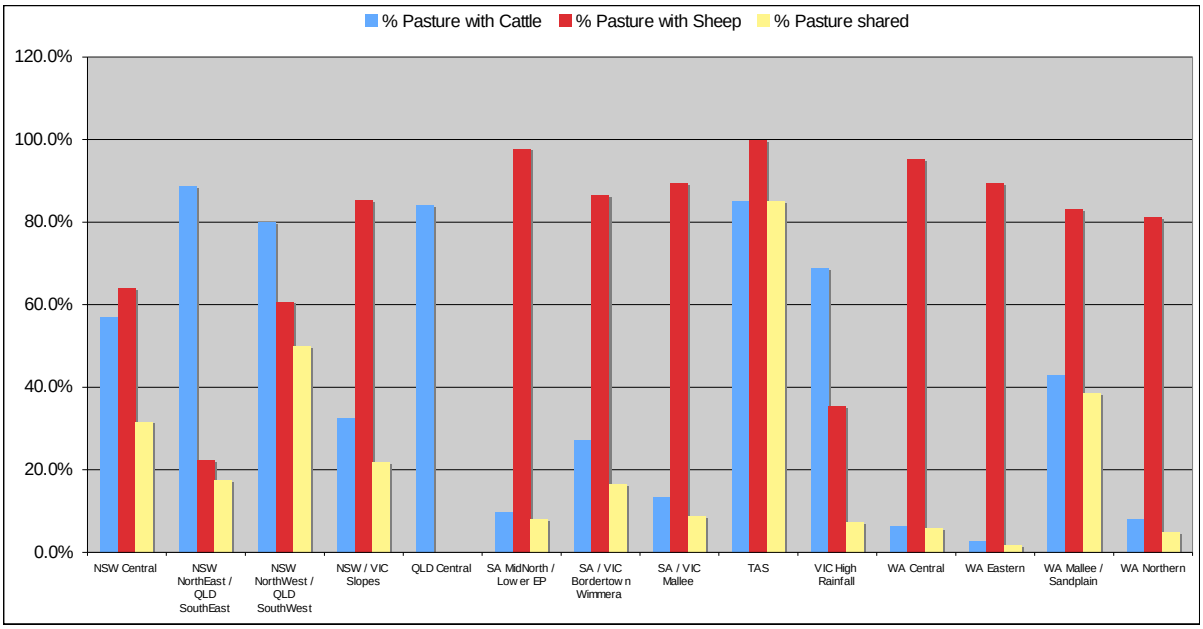


Figure 8. Average % of pasture area represented by farms with cattle in 2008, by AE-Zone (GRDC, 2009)

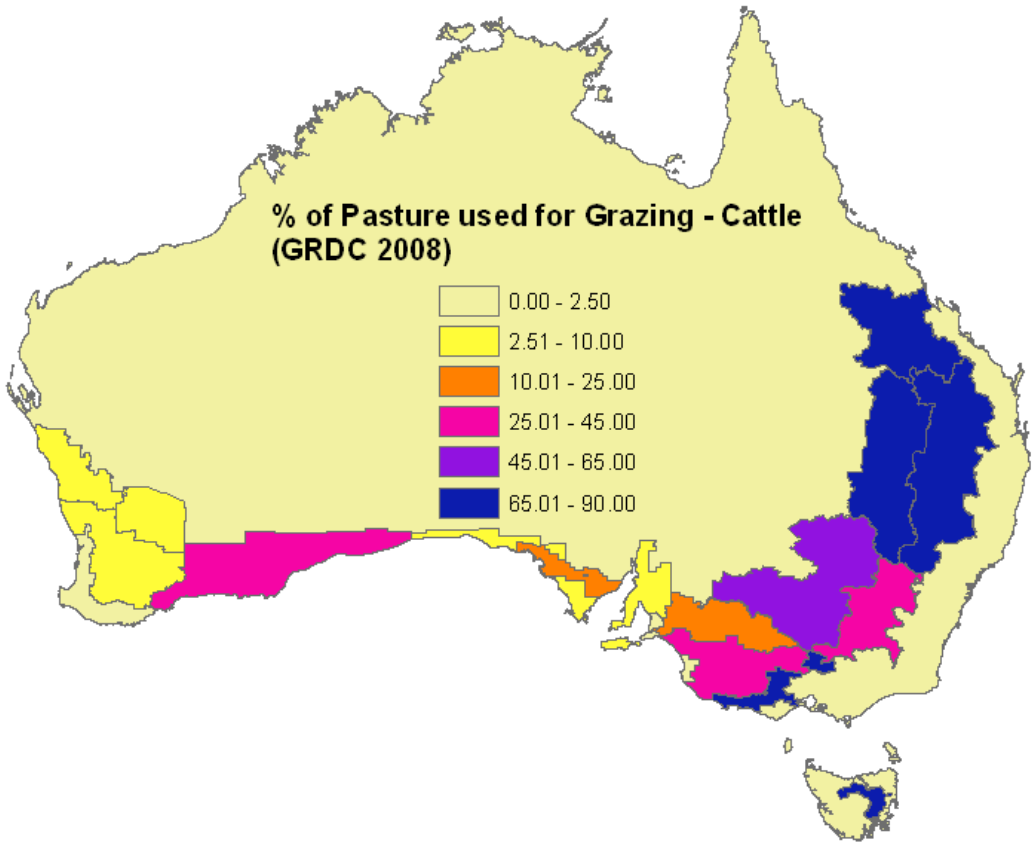
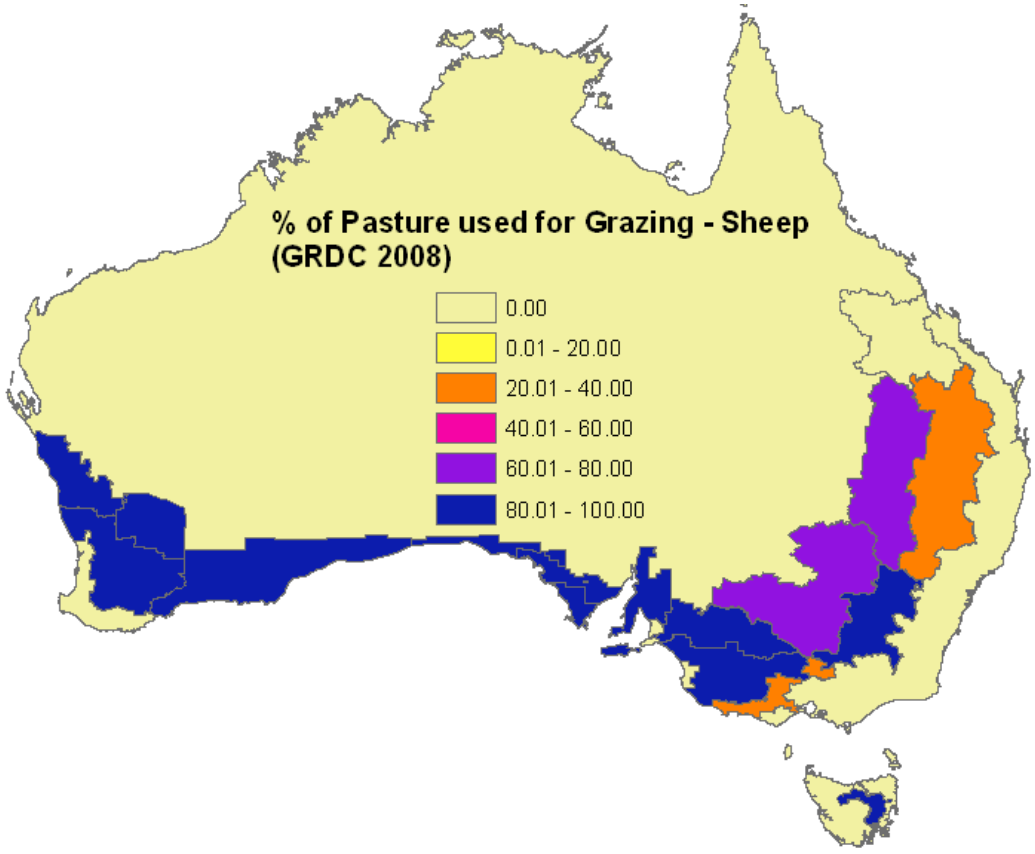


Figure 9. Average % of pasture area represented by farms with sheep in 2008, by AE-Zone (GRDC, 2009)



Proportion of mixed grain and livestock farms adjusting stocking rate for Cattle and/or Sheep to optimize ground cover

The key practice of interest in this report is how much grain farmers who also have livestock are adjusting their livestock management, mainly stocking rate, in light of the feed on offer, and the amount of ground cover present.

Analysing actual stocking rates does not provide meaningful information since without knowledge of the feed on offer, and ground cover, any stocking rate may be appropriate, too low or high.

However, the practice of adjusting stocking rate to match both feed on offer and ground cover is seen as a good practice from both productivity and environmental management viewpoints, since it considers both the livestock and the soil and pasture resource.

Table 3 and Figures 10, 11 and 12 show the data for numbers and percentages of grain farms with livestock that are adjusting stocking rates of cattle and sheep as informed by an assessment of feed and ground cover.

It is apparent that over half of all grain farms with livestock have adopted this practice, with levels over 80% in some AE-Zones, notably in northern NSW and QLD, and also on sheep farms in WA and much of the southern AE-Zones.

Table 3. % of grain farms with cattle or sheep where stocking rate is adjusted in light of feed and ground cover in 2008, by AE-Zone. (Source: GRDC, 2009)

AE-Zone	% of Cattle farms adjusting stocking rate	% of Sheep farms adjusting stocking rate
NSW Central	63.3%	78.3%
NSW NorthEast / QLD SouthEast	84.9%	83.3%
NSW NorthWest / QLD SouthWest	86.8%	84.4%
NSW / VIC Slopes	76.3%	72.0%
QLD Central	75.0%	0.0%
SA MidNorth / Lower EP	53.8%	68.5%
SA / VIC Bordertown Wimmera	64.0%	68.7%
SA / VIC Mallee	69.6%	75.8%
TAS	0.0%	0.0%
VIC High Rainfall	44.4%	65.2%
WA Central	53.3%	77.0%
WA Eastern	50.0%	75.0%
WA Mallee / Sandplain	56.5%	61.1%
WA Northern	44.4%	72.4%
	71.7%	73.1%

Figure 10. % of grain farms with cattle or sheep where stocking rate is adjusted in light of feed and ground cover in 2008, by AE-Zone. (Source: GRDC, 2009)

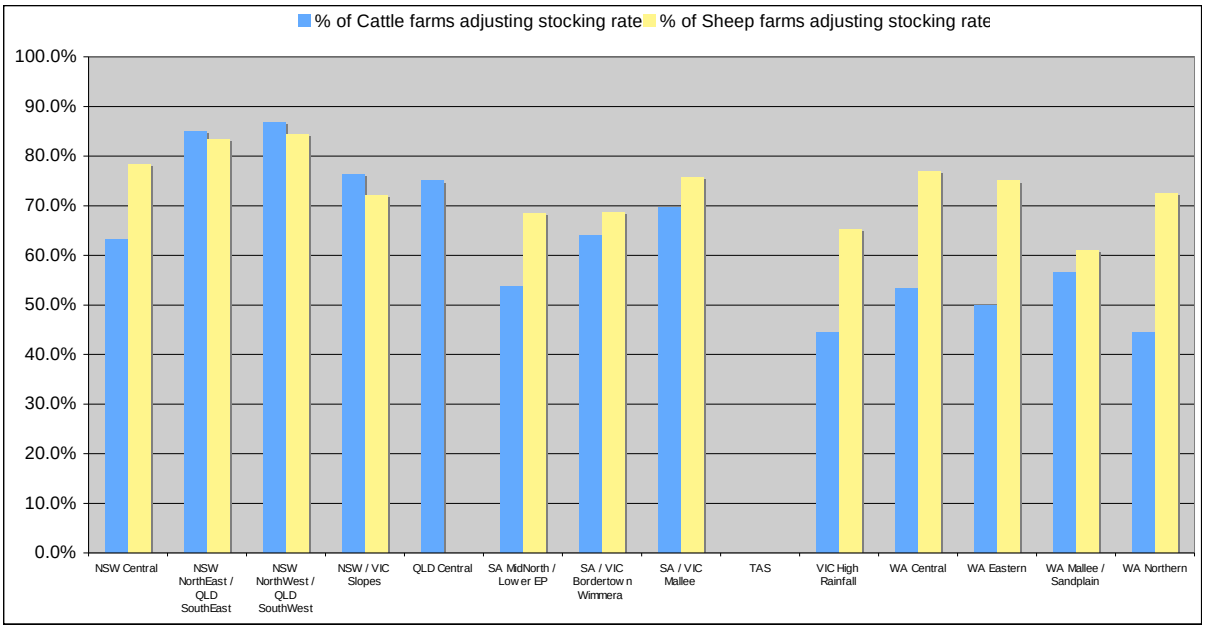


Figure 11. % of grain farms with cattle where stocking rate is adjusted in light of feed and ground cover in 2008, by AE-Zone. (Source: GRDC, 2009)

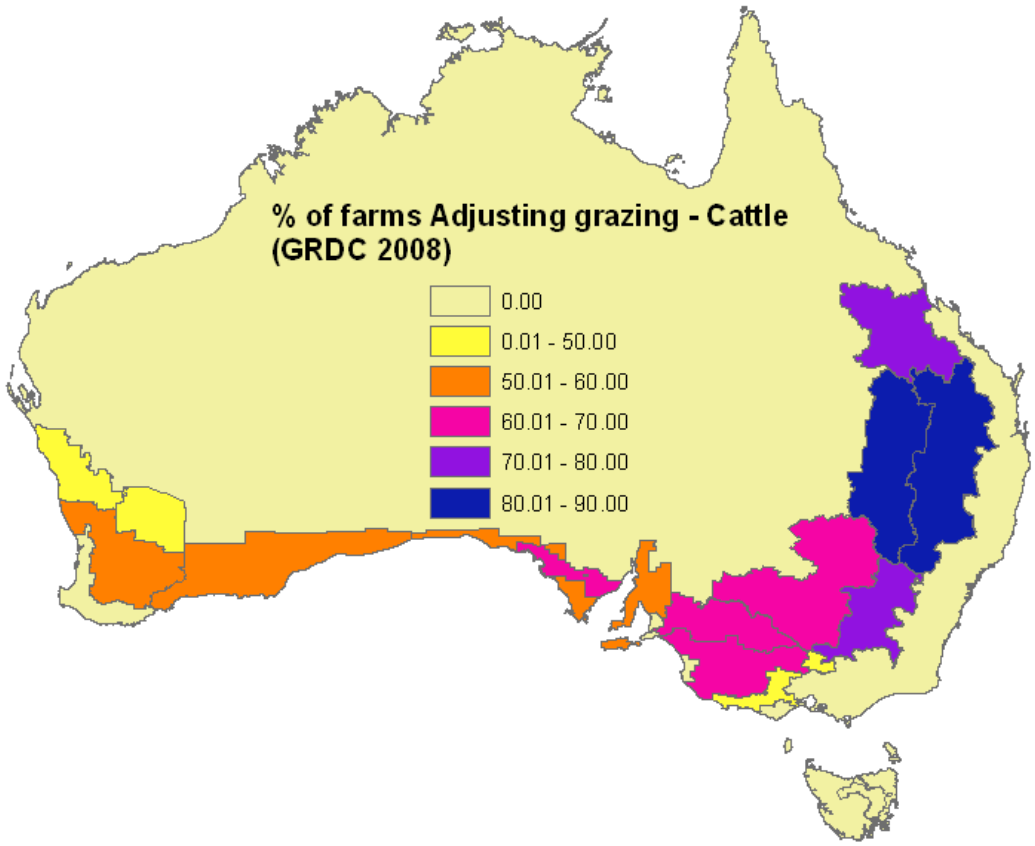
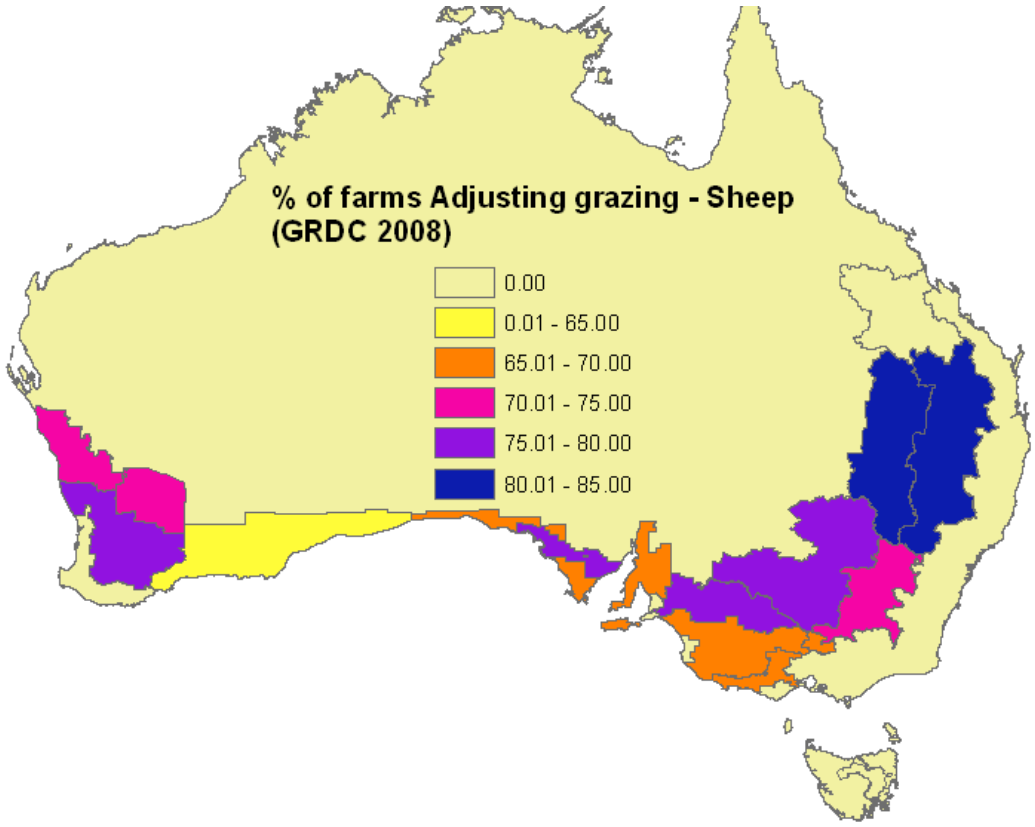


Figure 12. % of grain farms with sheep where stocking rate is adjusted in light of feed and ground cover in 2008, by AE-Zone. (Source: GRDC, 2009)



Proportion of mixed grain and livestock pasture area where stocking rate for Cattle and/or Sheep is adjusted to optimize ground cover

The above section considered the adoption of stocking rate adjustment as informed by feed and ground cover in terms of proportion of farms doing this. The data below (Table 4 and Figures 13 – 15) show data about this practice in terms of the proportion of the pasture area that this practice is used on.

Table 4. % of the pasture area on grain farms with cattle or sheep where stocking rate is adjusted in light of feed and ground cover in 2008, by AE-Zone. (Source: GRDC, 2009)

AE-Zone	% of Cattle pasture adjusting stocking rate	% of Sheep pasture adjusting stocking rate
NSW Central	81.0%	87.7%
NSW NorthEast / QLD SouthEast	85.5%	91.5%
NSW NorthWest / QLD SouthWest	70.9%	89.0%
NSW / VIC Slopes	73.9%	79.7%
QLD Central	79.3%	0.0%
SA MidNorth / Lower EP	92.4%	90.0%
SA / VIC Bordertown Wimmera	70.8%	65.3%
SA / VIC Mallee	77.4%	76.2%
TAS	0.0%	0.0%
VIC High Rainfall	8.1%	64.5%
WA Central	63.4%	81.7%
WA Eastern	63.2%	84.0%
WA Mallee / Sandplain	43.6%	45.8%
WA Northern	35.4%	79.6%
Average	**71.1%**	**78.4%**

The data show higher levels of adoption of this practice compared to only the proportion of farms, indicating that where this practice is used, it is used on all or most of the pastures used for grazing. It is also possible that these are larger farms (in terms of livestock numbers) and so are representing a larger cohort of the livestock farms, with this indicating that the larger livestock producers are adopting this practice.

The data presented in this report are a strong indicator that mixed grain and livestock farmers are adopting the practice of adjusting their stocking rate to best match the feed on offer and the ground cover on their pasture areas. Approximately three quarters of the pasture areas where livestock are present are managed using this practice.

Figure 13. % of the pasture area on grain farms with cattle or sheep where stocking rate is adjusted in light of feed and ground cover in 2008, by AE-Zone. (Source: GRDC, 2009)

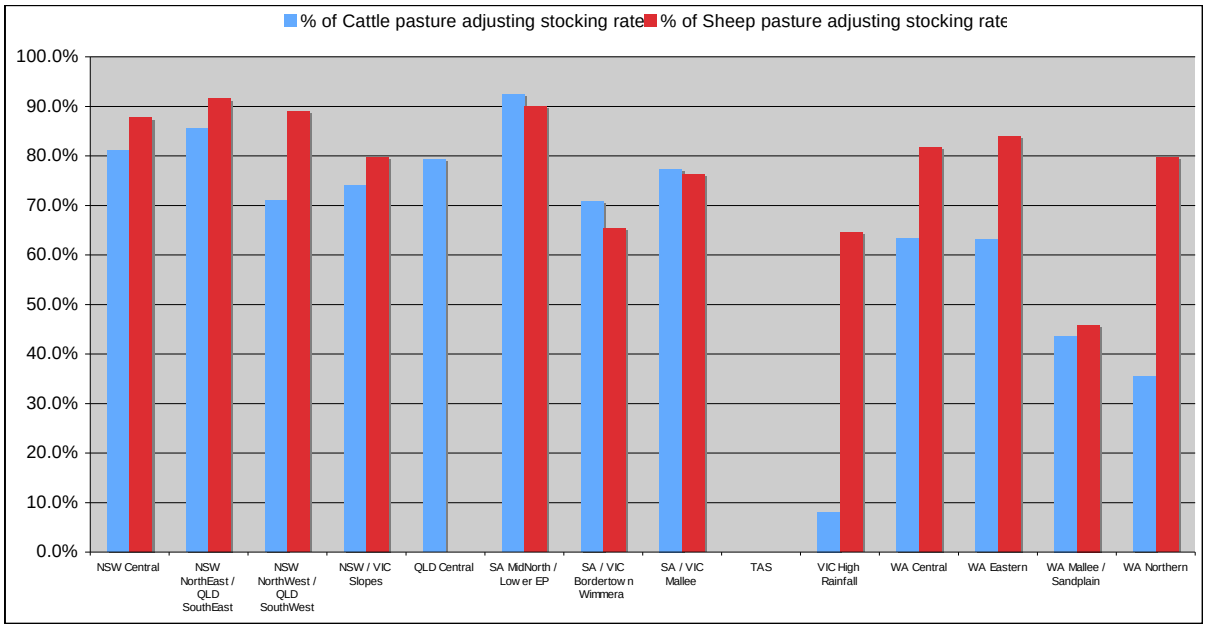


Figure 14. % of the pasture area on grain farms with cattle where stocking rate is adjusted in light of feed and ground cover in 2008, by AE-Zone. (Source: GRDC, 2009)

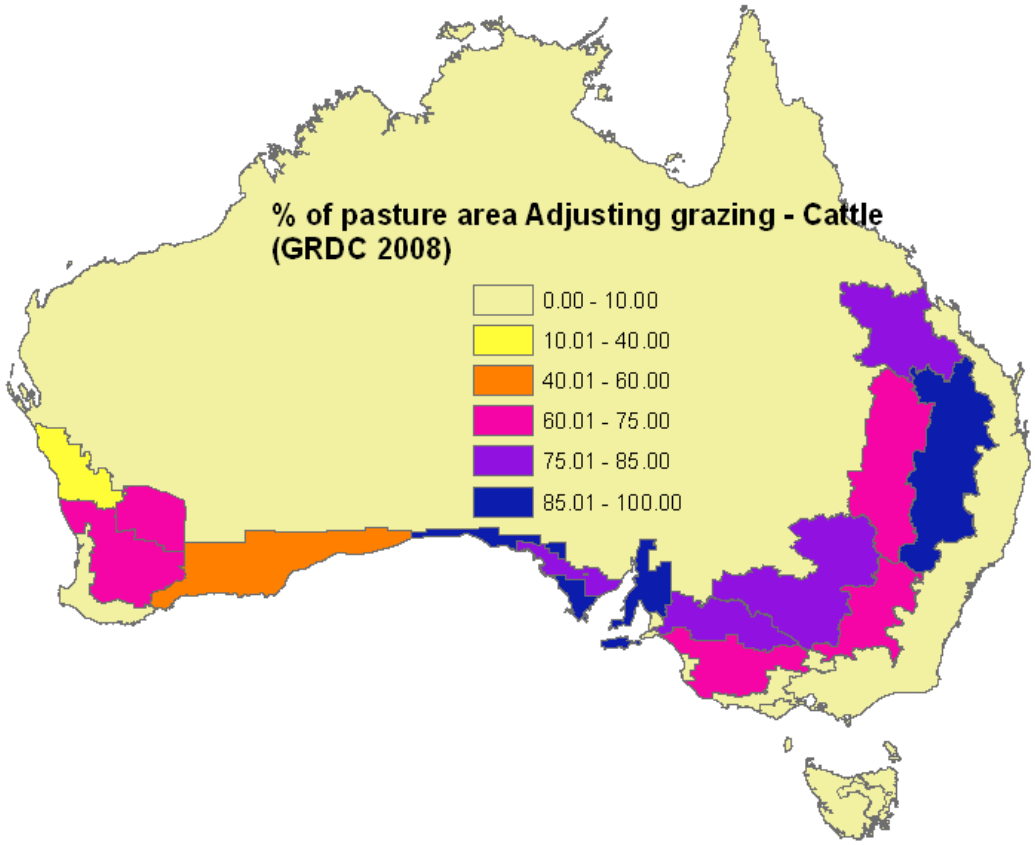
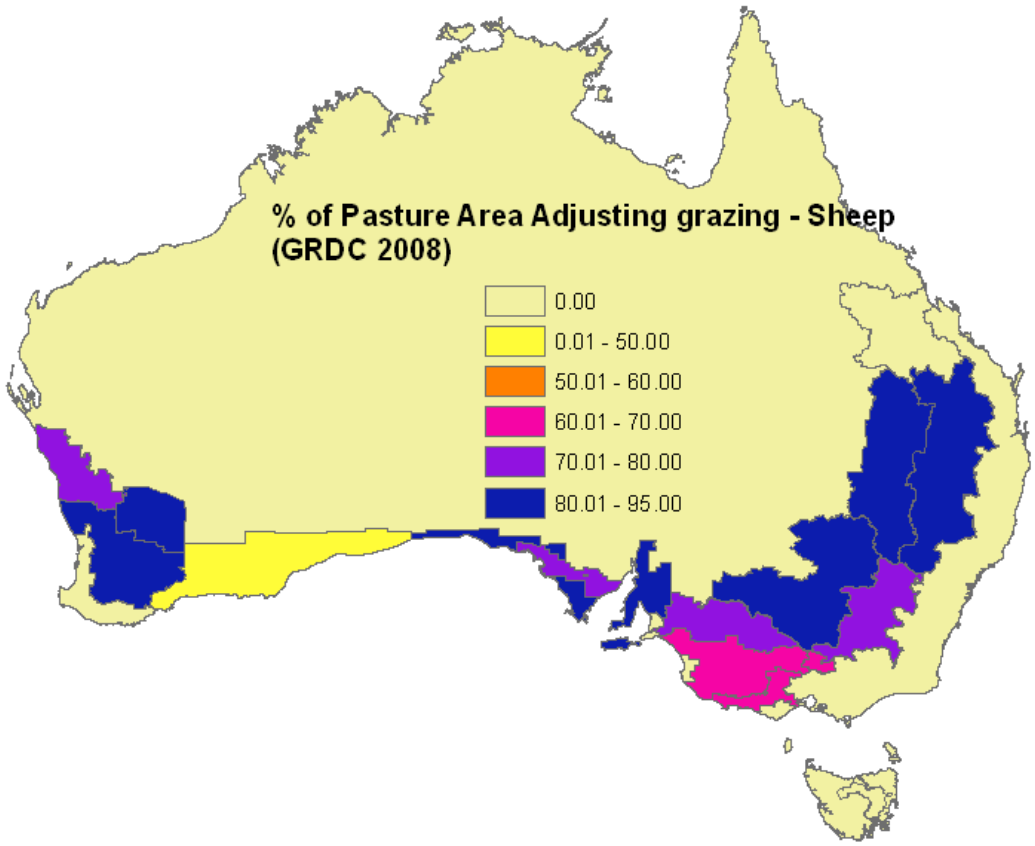


Figure 15. % of the pasture area on grain farms with sheep where stocking rate is adjusted in light of feed and ground cover in 2008, by AE-Zone. (Source: GRDC, 2009)



Average Stocking Rate

As mentioned above, stocking rate *per se* is not a practice in itself, and cannot really be used to assess livestock management, since without knowledge of the ground cover or feed on offer, stocking rate is essentially meaningless.

Nonetheless, it was possible to estimate average stocking rates as reported by grain farms with cattle or cheep in 2008. These data are presented in table 5 and Figures 16 to 19 (below).

Table 5. Average Stocking Rate (head per hectare of pasture area) on grain farms with cattle or sheep in 2008, by AE-Zone. (Source: GRDC, 2009)

AE-Zone	Cattle stocking rate	Sheep stocking rate
NSW Central	0.1	1.0
NSW NorthEast / QLD SouthEast	0.4	1.5
NSW NorthWest / QLD SouthWest	0.2	1.2
NSW / VIC Slopes	0.3	2.7
QLD Central	0.2	0.0
SA MidNorth / Lower EP	0.2	1.6
SA / VIC Bordertown Wimmera	0.5	4.2
SA / VIC Mallee	0.1	1.2
TAS	0.1	3.3
VIC High Rainfall	0.2	6.4
WA Central	0.3	4.1
WA Eastern	0.0	1.3
WA Mallee / Sandplain	0.2	3.2
WA Northern	0.1	1.0
Average	0.2	2.3

Figure 16. Average Stocking Rate (head per hectare of pasture area) on grain farms with cattle in 2008, by AE-Zone. (Source: GRDC, 2009)

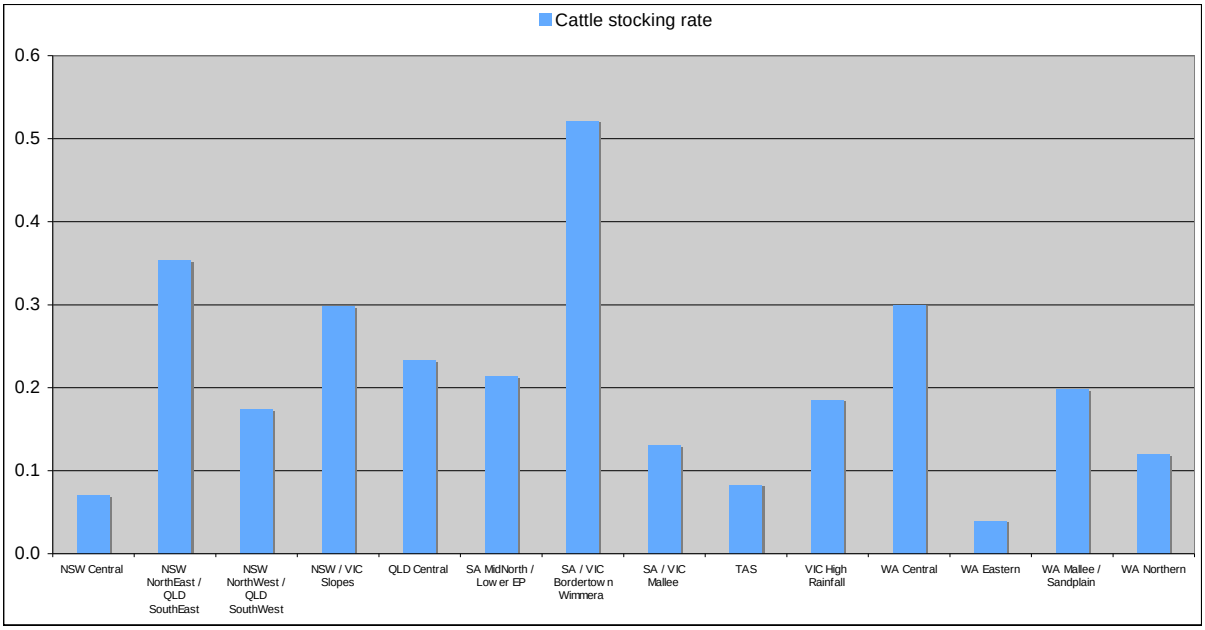


Table 17. Average Stocking Rate (head per hectare of pasture area) on grain farms with cattle in 2008, by AE-Zone. (Source: GRDC, 2009)

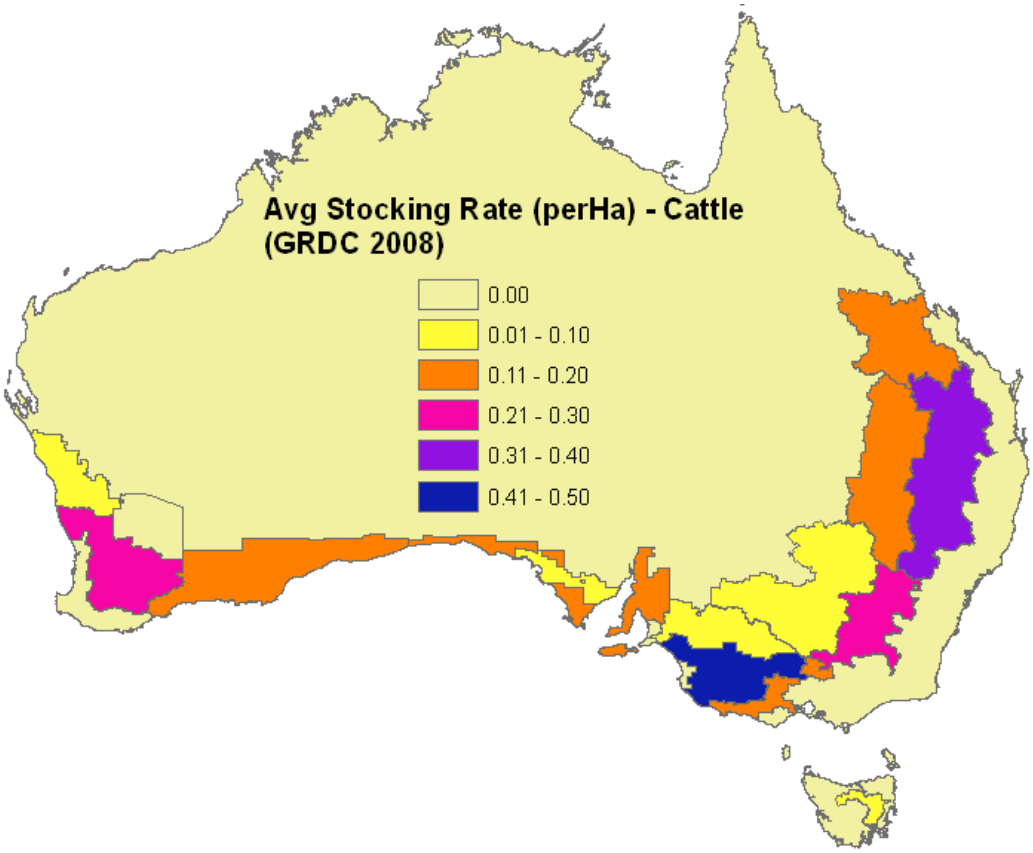


Table 18. Average Stocking Rate (head per hectare of pasture area) on grain farms with sheep in 2008, by AE-Zone. (Source: GRDC, 2009)

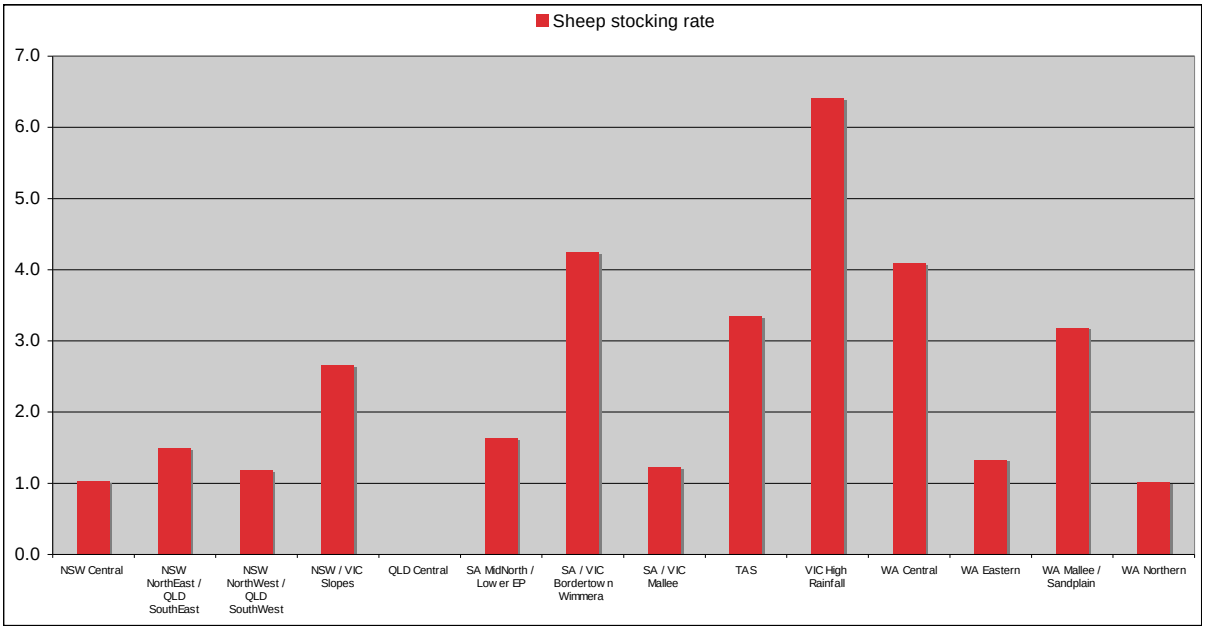
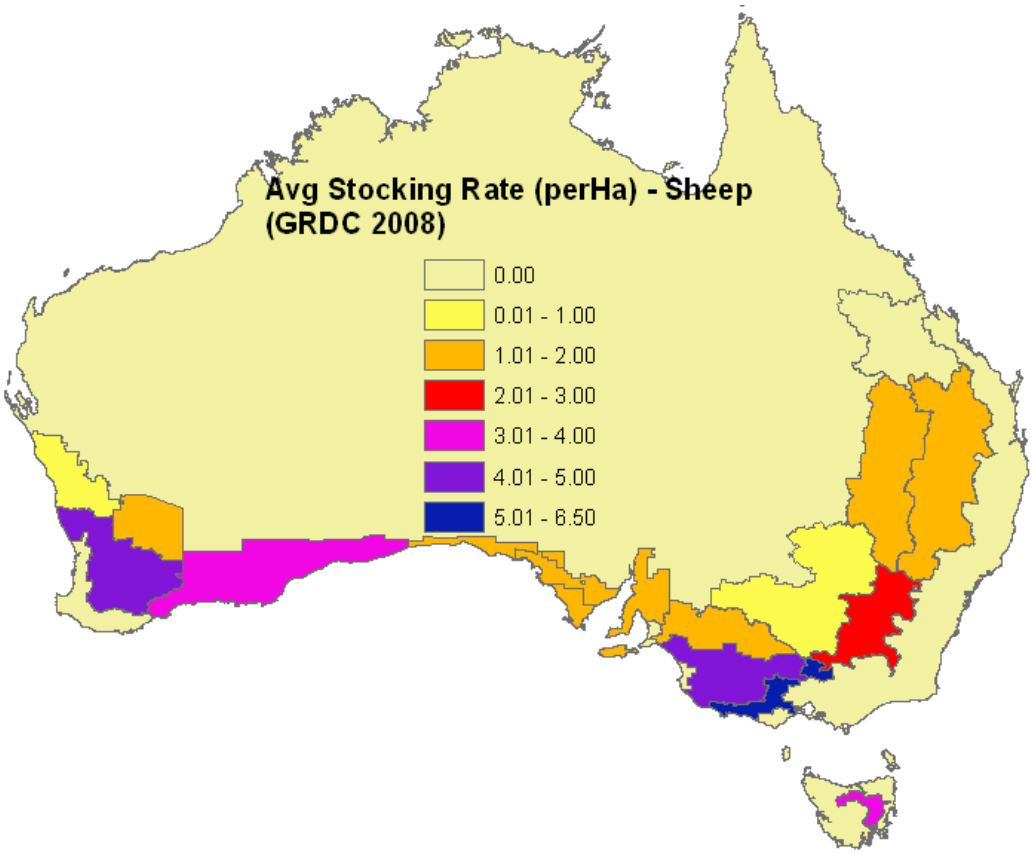


Table 19. Average Stocking Rate (head per hectare of pasture area) on grain farms with sheep in 2008, by AE-Zone. (Source: GRDC, 2009)



Managing Biodiversity

Managing biodiversity – remnant and native vegetation, riparian zone and waterway management and fencing off for protection

Areas of native and permanent vegetation, areas fenced off to protect waterways, trees and native vegetation, areas of replanted and planted new vegetation

Historic Public Data

ABS data exist from previous agricultural censuses for the areas of native vegetation on farms form both the 2000 and 2005 agricultural censuses. Additionally, data are available for areas fenced off for protection of waterways, riparian zones and the use of buffer strips on farms for those years.

The ABS census data have been manipulated to place these into AE-Zones, and are presented in below.

Area of native vegetation on farms

The ABS data for 2000-01 are considered unreliable in the context of this report, since they do not agree by some orders of magnitude with the data for the later census of 2005-06. It is possible that the wording of the questions changed in this period, and it is felt that the data for the latter census is more accurate of actual native vegetation on farms. For this reason only ABS 2005-06 data are presented here.

ABS Census Data 2005-06

The census data from 2005-06 has been manipulated to allow comparisons at AE-Zone level to be made. These data are presented in Table 1 and Figures 1 and 2.

The data generally show higher levels of native vegetation on farms in the areas where more expensive areas are operated, for example, in the western and central areas of QLD and NSW and eastern WA. As a proportion of the area of the farms one could also include the Mallee as having relatively high areas of native vegetation as well.

Table 1. Area of native vegetation (ha) on farms and average % of farmland this represents (2005-06), by AE-Zone. (Source: ABS 2006)

AE Zone	Native Vegetation on farm (avg ha per farm)	% Native vegetation
NSW Central	113	4.21%
NSW NorthEast-QLD SouthEast	47	4.66%
NSW NorthWest-QLD SouthWest	287	3.25%
NSW Vic Slopes	24	3.02%
QLD Central	226	3.97%
SA Midnorth-Lower Yorke Eyre	71	1.12%
SA Vic Bordertown-Wimmera	16	2.49%
SA Vic Mallee	46	5.43%
Tas Grain	75	11.11%
Vic High Rainfall	7	2.47%
WA Central	98	5.38%
WA Eastern	671	12.99%
WA Mallee and Sandplain	145	5.25%
WA Northern	293	4.57%

Figure 1. Area (ha) of Native Vegetation (average per farm) in 2005-06 and % of farm area this represents, by AE-Zone. (ABS 2006)

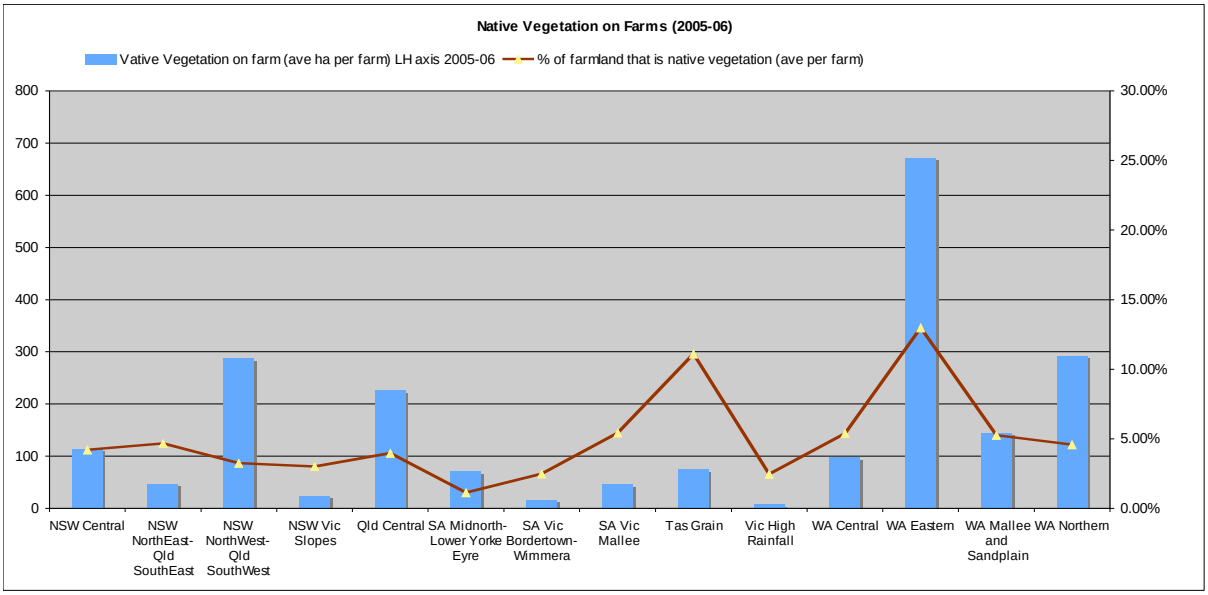
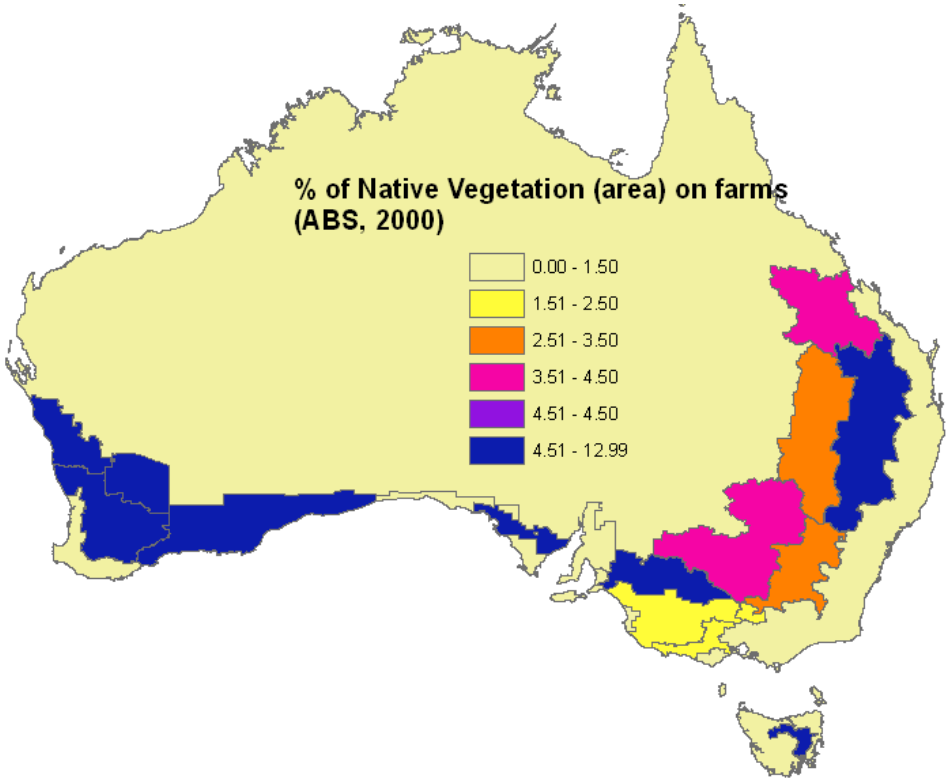


Figure 2. Average % of farmland having native vegetation in 2005-06, by AE-Zone. (ABS 2006)



GRDC data 2008
Areas, proportion and condition of native vegetation on farms in 2008.

The data from the survey of GRDC for the 2008 crop year regarding native vegetation on farms are presented in Table 2 and Figures 3 to 5 (below).

In these data, landholders were asked to describe the proportion of native vegetation on their properties as being in 'good', 'moderate' or 'poor' condition. These data are therefore subjective, and subject to the landholders' view as to what 'good', 'moderate' or 'poor' means, and hence may not reflect a more objective assessment of vegetation condition. However, it is included to give some idea of how landholders perceive their native vegetation to be.

The proportion of farmland reported as having native vegetation is roughly similar to the data form ABS of 8 years earlier, though departs from this in a few AE-Zones, with the Mallee, for example, showing a higher proportion in these data than those from ABS gathered earlier.

Additionally, the actual areas per farm in the GRDC dataset are greater, certainly in actual hectares of native vegetation, than the ABS data. This aligns with the previously observed feature of the dataset coming from larger properties in a general sense, and so one would expect larger properties to have larger areas of native vegetation, even if the proportion of the property with this vegetation is similar (in % terms) to that from older ABS census data.

As a general observation, the proportion of farm area with native vegetation seems relatively similar, with an overall average of approximately 6% of property area having native vegetation, though there are differences between AE-Zones, with central NSW and the Mallee having larger proportions under native vegetation.

The area of native vegetation on farms appears to NOT have declined in the period between the ABS census and the GRDC data collection.

Table 2. Area (percentage average percentage and areas (ha) per farm) and condition of native vegetation (NV) on farms in 2008 (Source: GRDC 2009)

AE-Zone	% N Veg of farmland	Ave area N Veg per farm	% NV Good	% NV Mod	% NV Poor
NSW Central	11.9%	1589	20.8%	57.8%	21.4%
NSW NorthEast / QLD SouthEast	5.5%	558.71	59.0%	23.0%	18.0%
NSW NorthWest / QLD SouthWest	7.3%	1158.4	44.1%	7.3%	48.6%
NSW / VIC Slopes	3.1%	317.03	33.4%	26.2%	40.5%
QLD Central	2.1%	719.75	97.0%	3.0%	0.0%
SA MidNorth / Lower EP	3.3%	329.7	75.4%	16.7%	7.9%
SA / VIC Bordertown Wimmera	3.8%	326.68	76.6%	11.4%	12.0%
SA / VIC Mallee	9.7%	1299	89.9%	5.4%	4.8%
TAS	0.4%	45			
VIC High Rainfall	1.2%	128.5	62.4%	14.5%	23.0%
WA Central	3.7%	373.46	53.8%	19.3%	26.9%
WA Eastern	6.8%	912.58	77.6%	16.8%	5.6%
WA Mallee / Sandplain	3.5%	495.04	77.5%	14.0%	8.5%
WA Northern	4.7%	925.52	68.6%	14.8%	16.6%
Averages	**5.7%**	**201**	**58.8%**	**22.0%**	**19.1%**

Figure 3. Average % of farmland having native vegetation in 2008, by AE-Zone. (GRDC 2009)

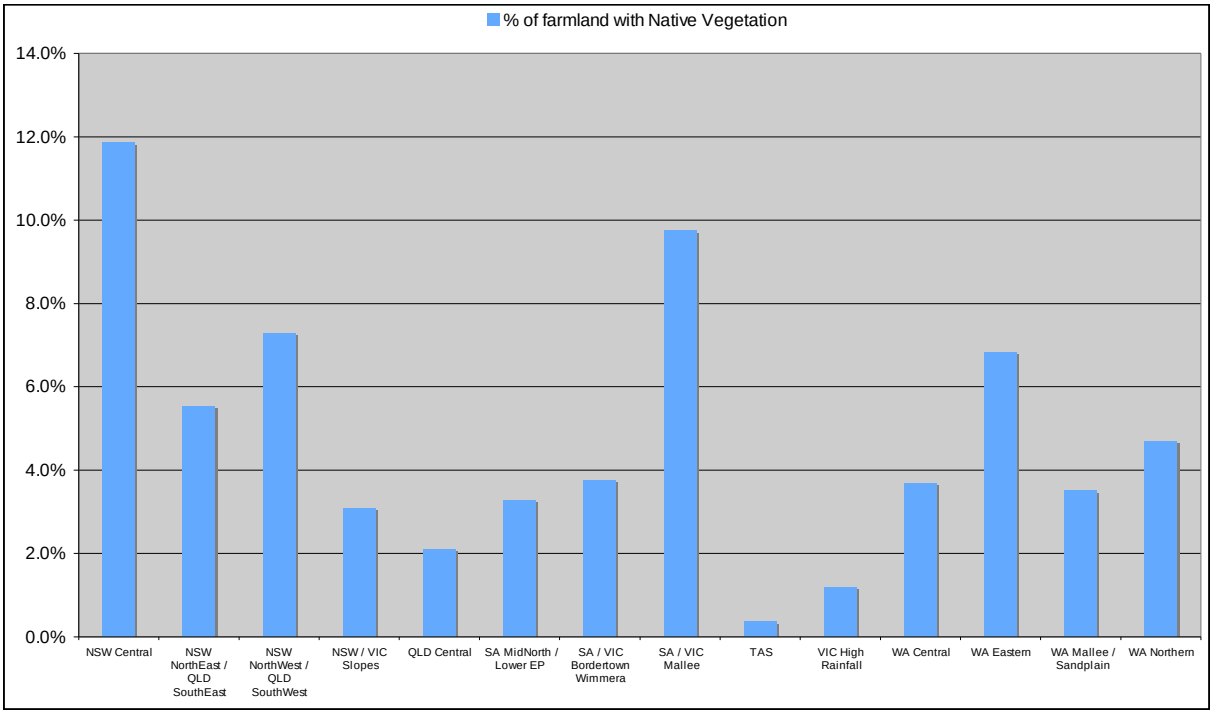


Figure 4. Average % of farmland having native vegetation in 2008, by AE-Zone. (GRDC 2009)

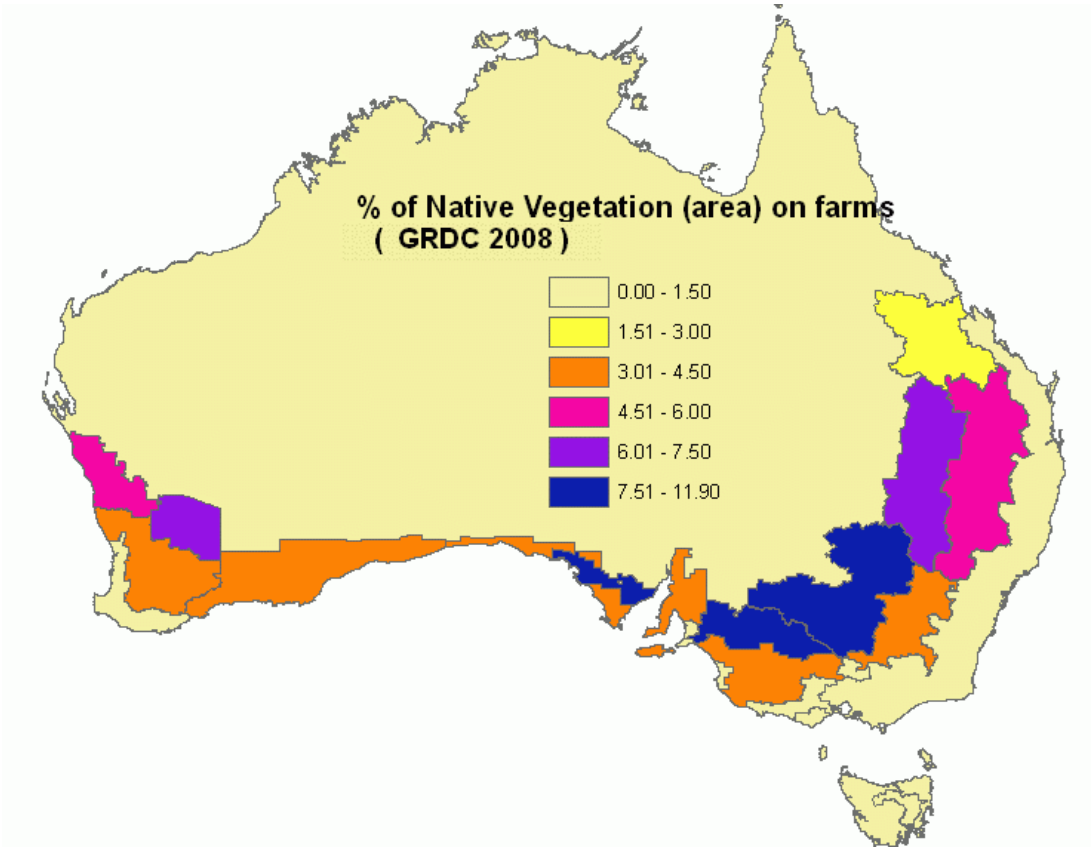
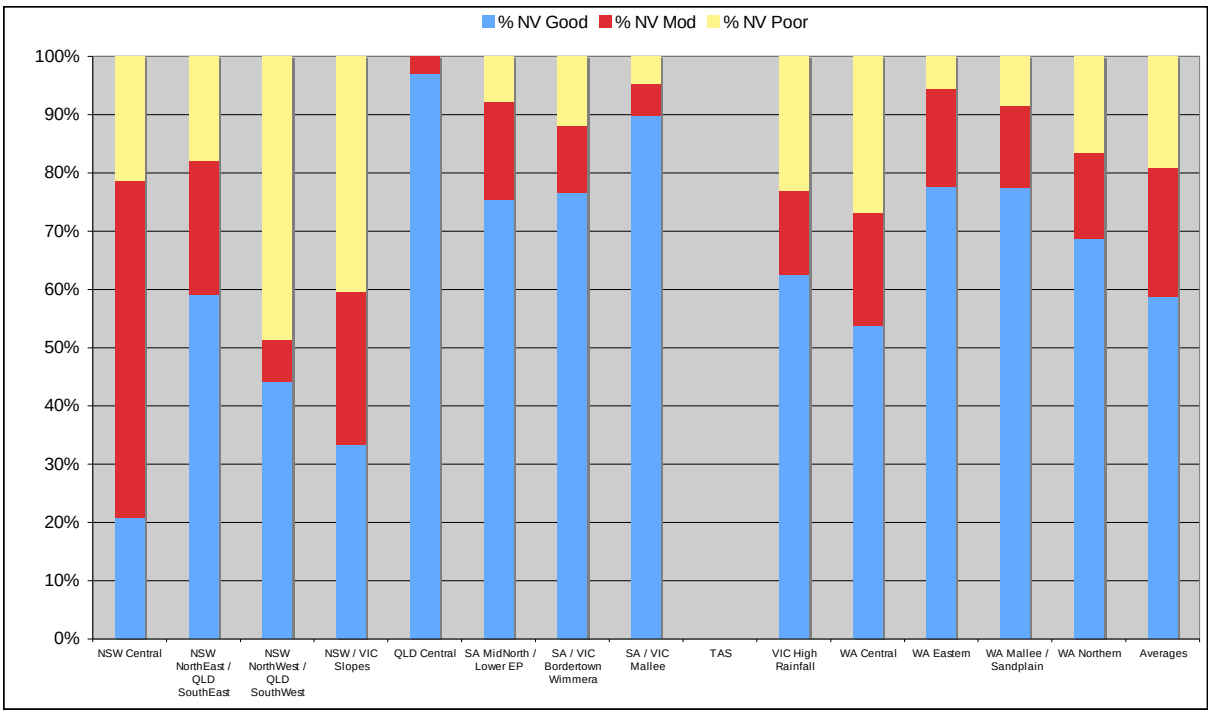


Figure 5. Condition (% of native vegetation described as 'good, 'moderate' and 'poor') on farmland in 2008, by AE-Zone. (GRDC 2009)



Considering the condition of native vegetation as assessed by landholders in 2008, the areas where 'good' native vegetation are dominant include most of WA, SA, QLD and Victoria. Poorer quality native vegetation seems to be more prevalent in NSW.

Reasons for these differences are possibly due to the subjective nature of describing native vegetation condition, and possibly involve historic, regulatory or climatic factors that are not able to be canvassed in this report.

Area fenced off or otherwise protected for various purposes related to biodiversity on farms

There are several datasets from the ABS of the census years of 2000-01 and 2005-06 of relevance for establishing the activities related to practices leading to protection of biodiversity. These include fencing off areas of to protect various areas, be these native vegetation areas, waterways, riparian zones, new tree or other plantings, and planting of new areas of permanent vegetation.

These data are presented by section below.

1. Areas fenced off to protect trees.

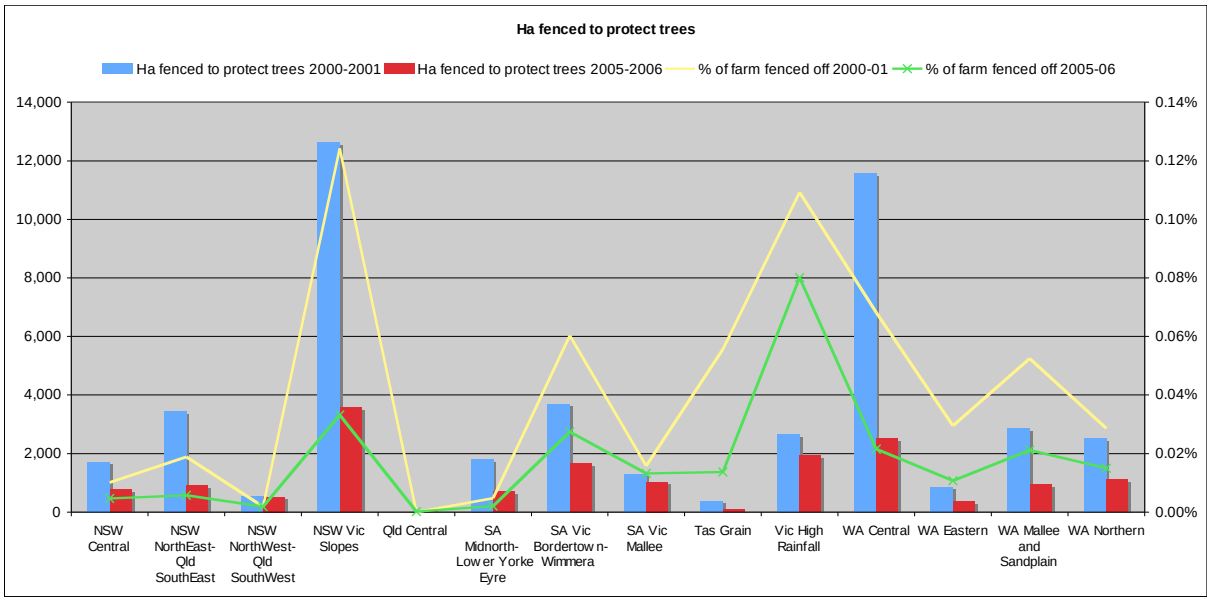
The tables and charts below show the areas (both in total area and as an average percentage per farm) fenced off to protect trees. The data of most relevance to the objectives of this report is the average percentage of farmland that is so fenced off, since this allows a comparison to be made with the data gathered by GRDC for the 2008 year.

ABS Data

Table 3. Areas (ha) and proportions of farmland (%) fenced off to protect trees, by AE-Zone in 2000 and 2005. (ABS 2001 and 2006)

AE Zone	Ha fenced to protect trees	% of farm	Ha fenced to protect trees	% of farm
	2000-2001		2005-2006	
NSW Central	1,707	0.010%	778	0.005%
NSW NorthEast-QLD SouthEast	3,435	0.019%	920	0.006%
NSW NorthWest-QLD SouthWest	536	0.002%	515	0.002%
NSW Vic Slopes	12,629	0.124%	3574	0.033%
QLD Central	1	0.000%	29	0.000%
SA Midnorth-Lower Yorke Eyre	1,791	0.005%	710	0.002%
SA Vic Bordertown-Wimmera	3,685	0.060%	1,665	0.027%
SA Vic Mallee	1,303	0.016%	1,031	0.013%
Tas Grain	382	0.056%	92	0.014%
Vic High Rainfall	2,641	0.109%	1,927	0.080%
WA Central	11,572	0.068%	2,516	0.022%
WA Eastern	855	0.029%	354	0.011%
WA Mallee and Sandplain	2,856	0.052%	948	0.021%
WA Northern	2,520	0.029%	1,123	0.015%

Figure 5. Areas (ha) and proportions of farmland (%) fenced off to protect trees, by AE-Zone in 2000 and 2005. (ABS 2001 and 2006)



The ABS data (above) shows relatively large areas fenced off to protect trees, especially in NSW / Vic slopes and central WA in 2000, and also in the SA/Vic Bordertown AE-Zones. However, by 2005 in almost all cases this had declined both in terms of absolute areas and as a proportion of farmland.

This could suggest that much of the fencing off to protect trees was done in the early 2000's, or that incentives for this had passed by 2005.

GRDC Data

There are no data for areas fenced off to protect trees within the GRDC data specifically. However, data of relevance concerning areas fenced off for other purposes are presented in the sections below.

2. Areas fenced off to protect waterways.

Many farms have areas of waterways that are now being fenced off for protection. This can also be described as areas of riparian zones, or the surrounding areas near waterways that are sensitive areas for biodiversity and are recommended to be protected from livestock grazing and other farm-based activities.

ABS Data:

Table 4. Areas (ha) and proportions of farmland (%) fenced off to protect waterways, by AE-Zone in 2000 and 2005. (ABS 2001 and 2006)

AE Zone	ha fenced to protect waterways	% of farm	ha fenced to protect waterways	% of farm
	2000-2001		2005-2006	
NSW Central	2,250	0.013%	1,554	0.009%
NSW NorthEast-QLD SouthEast	12,833	0.071%	3,783	0.024%
NSW NorthWest-QLD SouthWest	24,319	0.087%	24,417	0.090%
NSW Vic Slopes	3,724	0.037%	4,195	0.039%
QLD Central	21,808	0.158%	7,465	0.052%
SA Midnorth-Lower Yorke Eyre	2,276	0.006%	1,021	0.003%
SA Vic Bordertown-Wimmera	2,468	0.040%	1,632	0.027%
SA Vic Mallee	2,487	0.030%	2,086	0.027%
Tas Grain	612	0.089%	123	0.018%
Vic High Rainfall	2,620	0.108%	1,366	0.057%
WA Central	8,993	0.053%	4,082	0.035%
WA Eastern	53	0.002%	12	0.000%
WA Mallee and Sandplain	2,609	0.048%	1,147	0.026%
WA Northern	2,730	0.031%	14,258	0.190%

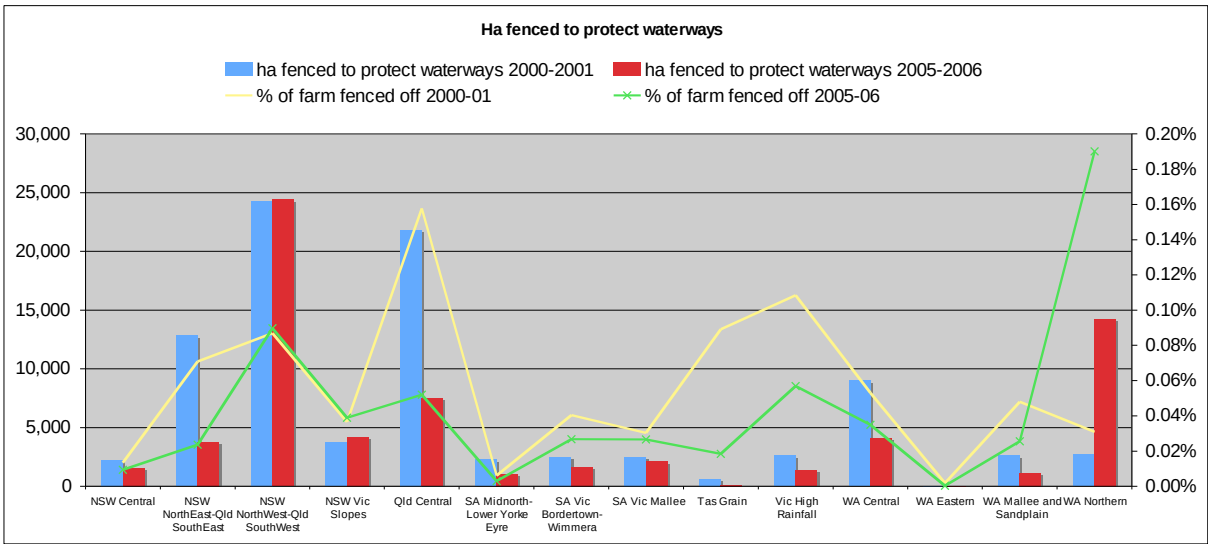
One can see there exist differences between the amount and proportion of farmland fenced to protect waterways between AE-Zone and between the years of data. One factor involved would be the propensity of waterways on properties in the different AE-Zones, for example some Zones will have more waterways running though properties than others, for example in QLD and NW, and as such one would expect more areas in these Zones to be fenced off to protect waterways, since there are more waterways to protect.

It is also possible that fencing off waterways on many properties is a one-off activity, and not one that can become a 'regular practice', and so the data can be expected to vary between one time

period and another, and that on many properties it is done once and then not again. There could sell be confusion in the landholders' minds when asked about areas fenced off, since some may consider the questions to refer to 'total areas fenced off, no matter when this was done' or others, 'areas fenced off THIS YEAR'. For the purposes of this report, it is taken that areas fenced off are in total on the farm, and not that fenced off in the year of interest.

It is therefore the proportion of the land that is fenced off that is expected to grow over time, and more landholders fence off areas through time. As such it can be puzzling to see areas fenced off (in this case for protecting waterways) decline at the later census, though this could simply be due to the above-mentioned potential for confusion among landholders.

Figure 6. Areas (ha) and proportions of farmland (%) fenced off to protect waterways, by AE-Zone in 2000 and 2005. (ABS 2001 and 2006)

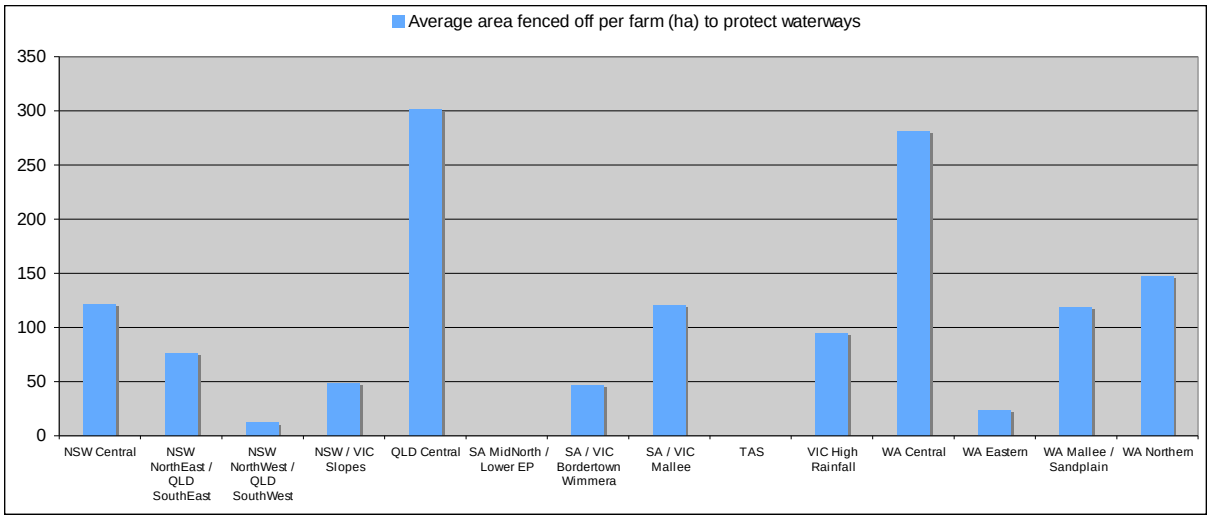


GRDC Data

Table 5. Average areas (ha per farm) and proportions of farmland (%) fenced off to protect waterways, by AE-Zone in 2008. (GRDC 2009)

AE-Zone	Avg. area (ha) fenced off per farm	Avg. % of Farm fenced off
NSW Central	121	2.52%
NSW NorthEast-QLD SouthEast	76	2.83%
NSW NorthWest-QLD SouthWest	12	0.27%
NSW Vic Slopes	49	1.90%
QLD Central	302	5.07%
SA Midnorth-Lower Yorke Eyre	0	0.00%
SA Vic Bordertown-Wimmera	47	2.42%
SA Vic Mallee	120	3.53%
Tas Grain	0	0.00%
Vic High Rainfall	95	4.06%
WA Central	281	7.73%
WA Eastern	23	0.42%
WA Mallee and Sandplain	119	2.49%
WA Northern	147	2.56%

Figure 7. Average areas (ha per farm) fenced off to protect waterways, by AE-Zone in 2008. (GRDC 2009)



The data from GRDC for the 2008 year shows a considerably greater area and proportion of farmland (expressed as average per farm) fenced off to protect waterways as compared to the ABS data. This could be due to these (GRDC) data representing the total areas fenced off **as at** 2008 and not fenced off **during** 2008.

The data do show those areas likely to have more waterways (QLD, Vic High rainfall) to have more fenced off, though the relatively high area in WA central is at variance with these.

Figure 8. Average proportion of farmland (%) fenced off to protect waterways, by AE-Zone in 2008. (GRDC 2009)

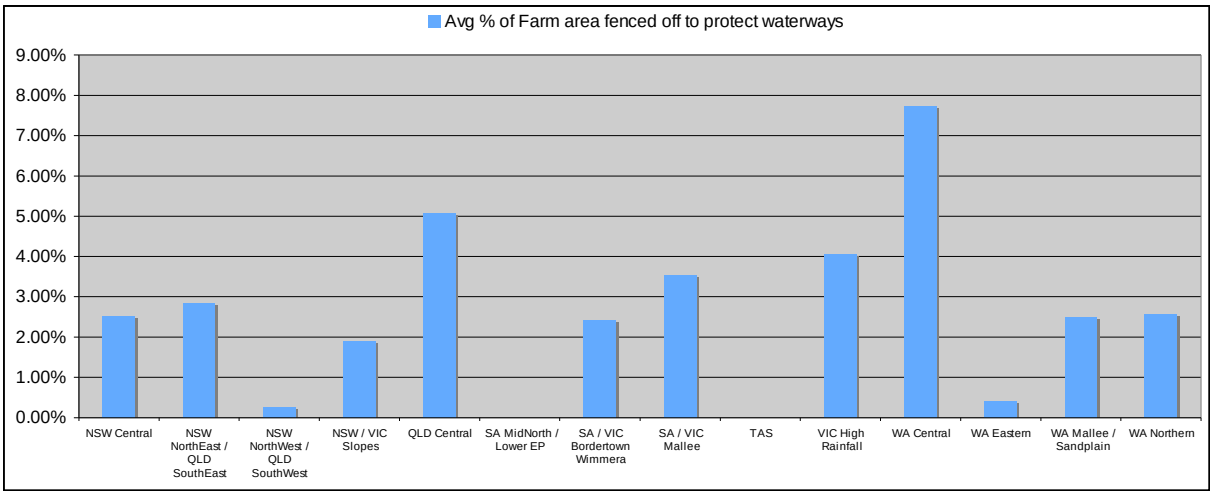
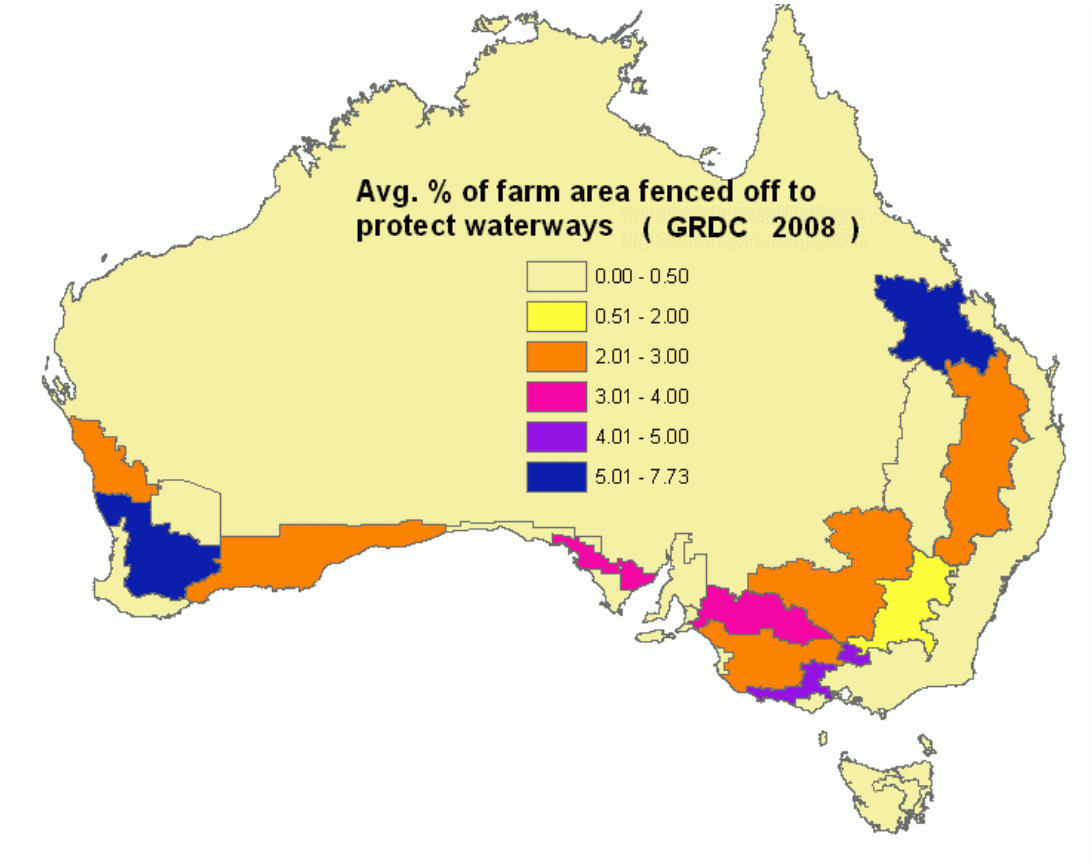


Figure 9. Average proportion of farmland (%) fenced off to protect waterways, by AE-Zone in 2008. (GRDC 2009)



3. Areas fenced off to protect native vegetation.

Fencing off areas of native vegetation may be done solely for the purpose of protecting areas of such vegetation or as part of a whole-farm strategy including waterways and other sensitive areas as well.

However, in these data this segmentation of 'areas fenced off' was included, both in ABS censuses and the data from GRDC.

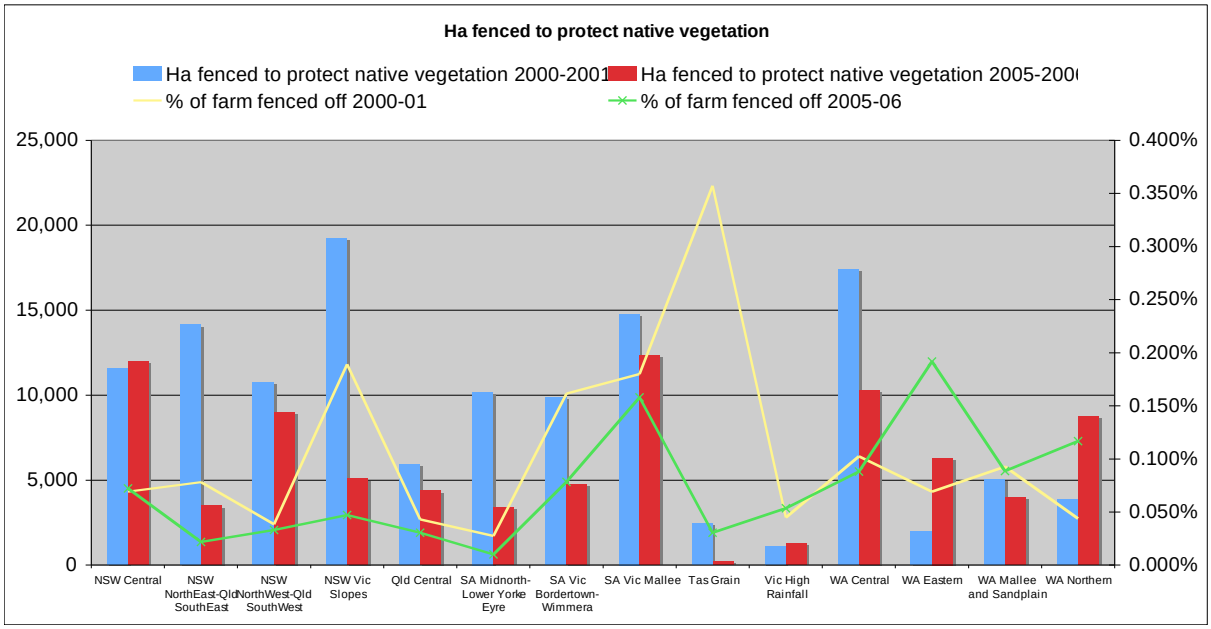
ABS Census data

Table 6. Average areas (ha per farm) and proportions of farmland (%) fenced off to protect native vegetation, by AE-Zone in 2000-01 and 2005-06. (ABS)

AE Zone	Ha fenced to protect native vegetation	% of farm	Ha fenced to protect native vegetation	% of farm
	2000-2001		2005-2006	
NSW Central	11,576	0.069%	11,992	0.072%
NSW NorthEast-QLD SouthEast	14,158	0.078%	3,491	0.022%
NSW NorthWest-QLD SouthWest	10,779	0.038%	9,010	0.033%
NSW Vic Slopes	19,244	0.189%	5,088	0.047%
QLD Central	5,932	0.043%	4,387	0.031%
SA Midnorth-Lower Yorke Eyre	10,192	0.027%	3,416	0.010%
SA Vic Bordertown-Wimmera	9,871	0.162%	4,766	0.078%
SA Vic Mallee	14,780	0.180%	12,355	0.158%
Tas Grain	2,453	0.357%	204	0.030%
Vic High Rainfall	1,083	0.045%	1,284	0.053%
WA Central	17,411	0.102%	10,306	0.088%
WA Eastern	2,004	0.069%	6,314	0.192%
WA Mallee and Sandplain	5,055	0.093%	3,986	0.089%
WA Northern	3,850	0.044%	8,764	0.117%

ABS Data shows in general well under 1% of the farmland in all AE-Zones has been fenced off to protect native vegetation as at both census dates. The areas fenced off and proportions had shown a decline between the early and later dates, suggesting that much fencing off of native vegetation had occurred by the mid 2000's. However, the above noted comment about the potential for confusion among landholders about what was meant when referring to fencing off in a year (i.e. is the area the total now fenced off, or only what was fenced off in this year), remain.

Figure 10. Average areas (ha per farm) and proportions of farmland (%) fenced off to protect native vegetation, by AE-Zone in 2000-01 and 2005-06. (ABS)



GRDC data

The data from the survey by Solutions is presented in Table 7 and figures 11 to 13 (below).

Table 7. Average areas (ha per farm) and proportions of farmland (%) fenced off to protect native vegetation, by AE-Zone in 2008. (GRDC, 2009)

AE-Zone	Avg. area (ha) fenced off for native veg. per farm	Avg. % of Farm area fenced off for native veg.
NSW Central	425.6	8.82%
NSW NorthEast / QLD SouthEast	232.25	8.64%
NSW NorthWest / QLD SouthWest	186	4.13%
NSW / VIC Slopes	69.88	2.71%
QLD Central	110	1.85%
SA MidNorth / Lower EP	163.4	6.86%
SA / VIC Bordertown Wimmera	110.77	5.74%
SA / VIC Mallee	295.5	8.68%
TAS	0	0.00%
VIC High Rainfall	59	2.52%
WA Central	216.14	5.94%
WA Eastern	280.71	5.01%
WA Mallee / Sandplain	173.45	3.63%
WA Northern	191.43	3.34%

Figure 11. Average areas (ha per farm) fenced off to protect native vegetation, by AE-Zone in 2008. (GRDC 2009)

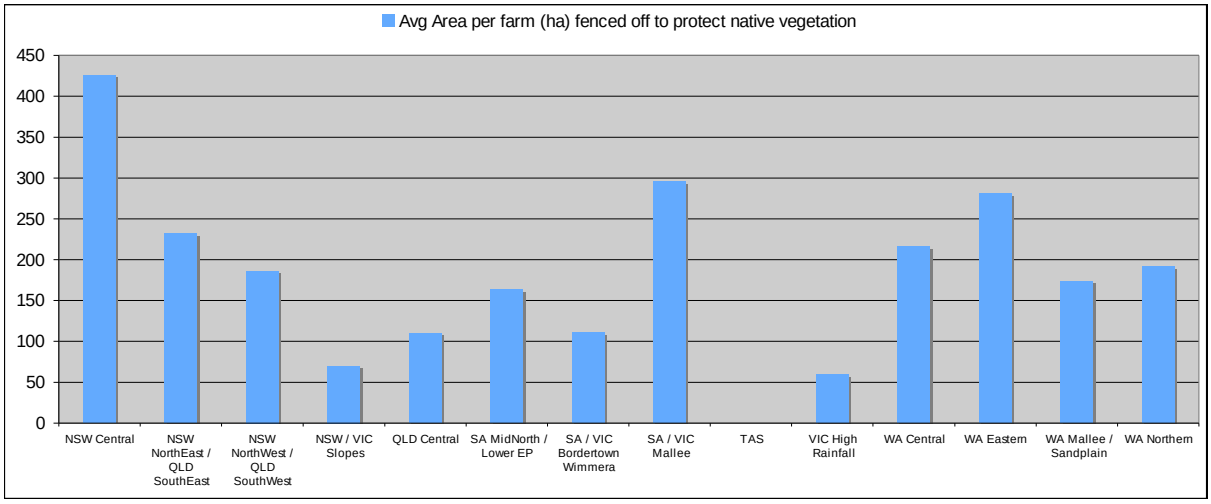
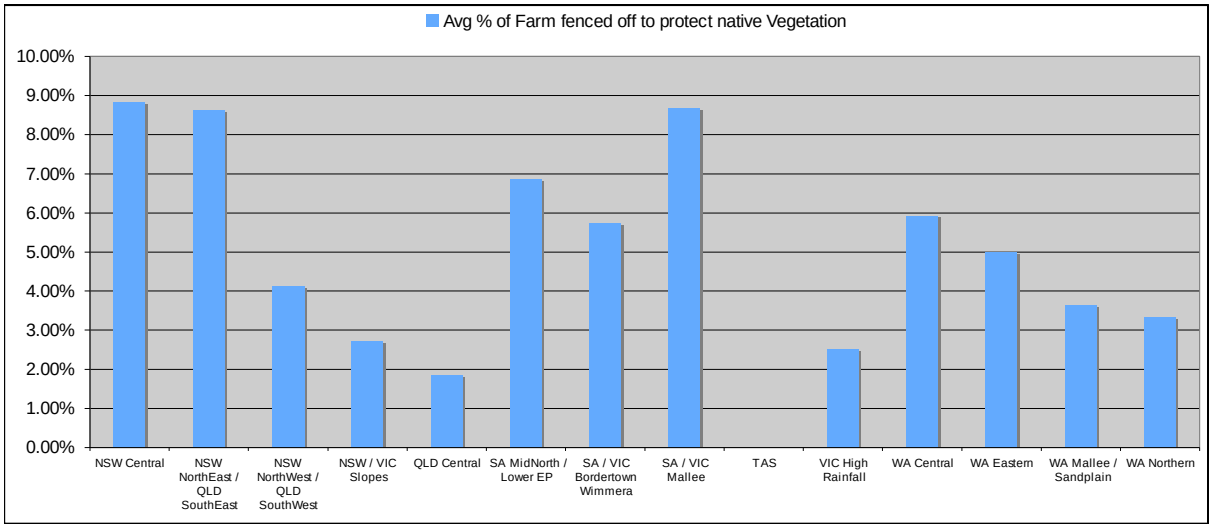


Figure 12. Average proportion of farmland (%) fenced off to protect native vegetation, by AE-Zone in 2008. (GRDC, 2009)

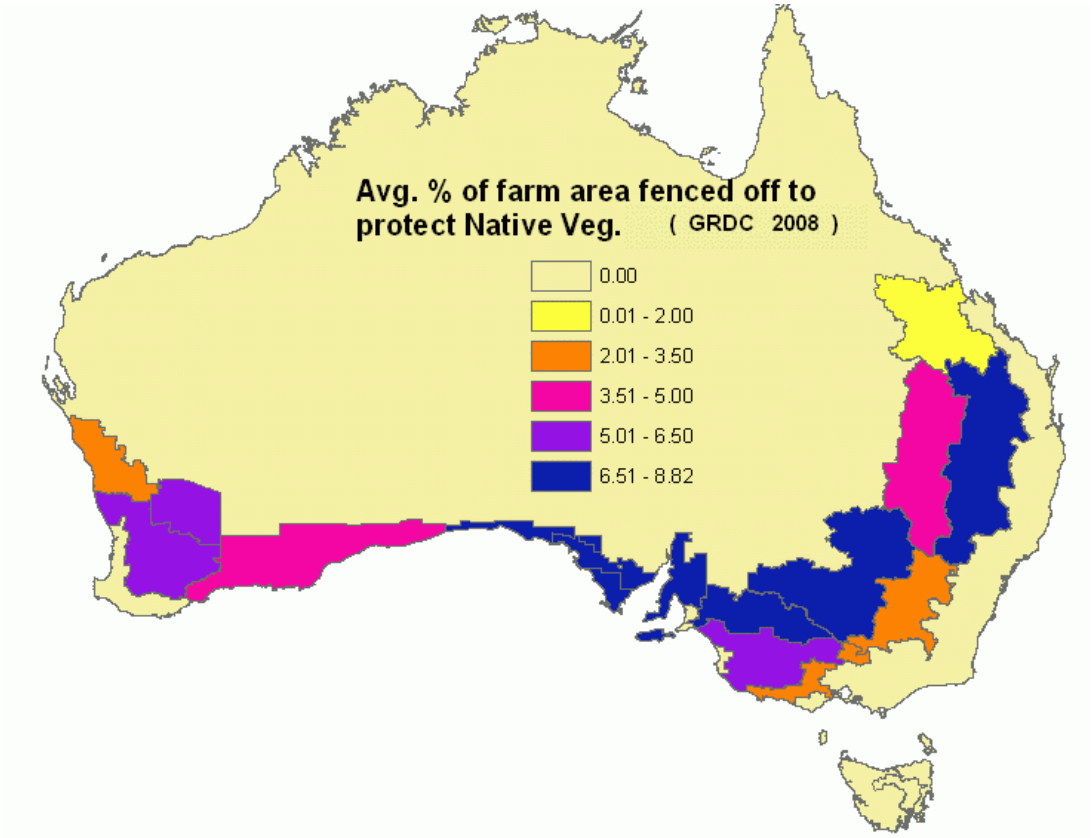


What is apparent is that the landholders in the GRDC dataset are reporting a considerably larger area and proportion of their farms as having been fenced off to protect native vegetation that that reported by both ABS censuses.

Again, this may reflect the larger properties included in the 2008 dataset, or that landholders were reporting total areas fenced off on their farms **as at** 2008, rather than only what had been fenced off in the year of 2008. The latter case is likely, and suggests that around 5% of farmland on farms is now fenced off to protect native vegetation.

When one considers the total area of native vegetation on the farms in this dataset (see Table 1) this equates roughly to all of the native vegetation areas on these farms, and in some AE-Zones exceeds what is listed as actual native vegetation. This suggests that some farmers are fencing off areas that are larger than the native vegetation they actually have.

Figure 13. Average proportion of farmland (%) fenced off to protect native vegetation, by AE-Zone in 2008. (GRDC, 2009)



4. Areas fenced off in total for protection of waterways or vegetation.

Considering the various purposes that can occur and overlaps in areas on farms that can be fenced off, both ABS and GRDC gathered data on the total area fenced off for protection of trees, waterways and native vegetation.

These data are presented in Table 8 and Figure 14 (for ABS) and Table 9 and Figures 15 to 17 (GRDC), below.

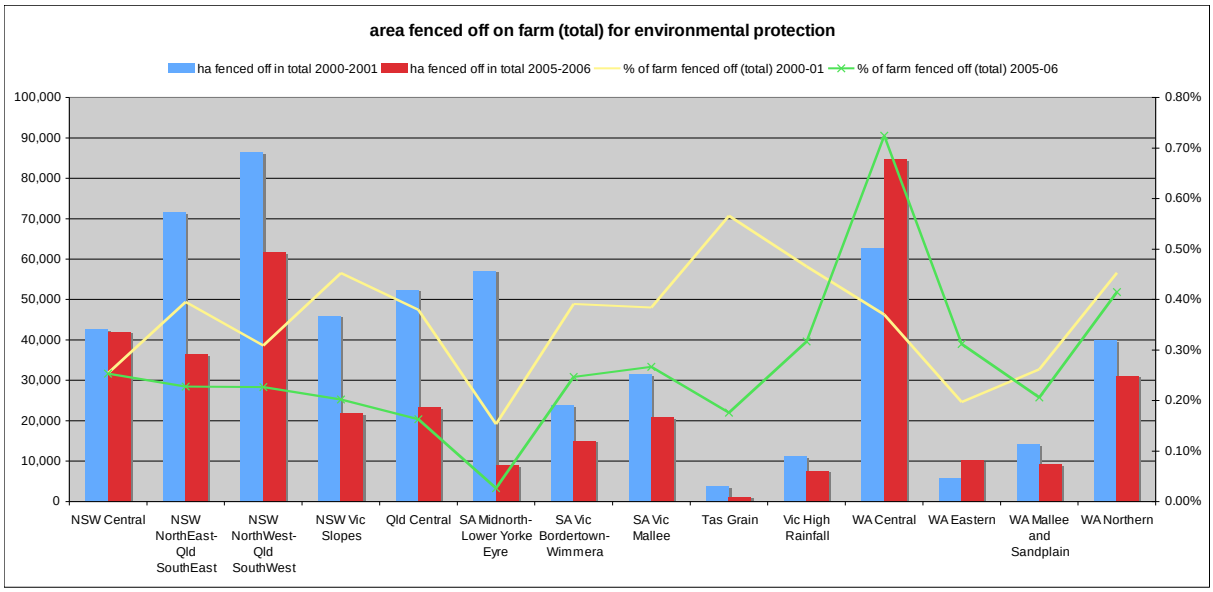
The data from ABS shows well under 1% of farmland having been fenced off for all purposes related to protection of waterways and vegetation. This is suspected to be due to the ABS questions referring to areas that had been fenced off in the year of the census, rather than total as at the year of the census.

ABS Data

Table 8. Average areas (ha per farm) and proportions of farmland (%) fenced off in total for protection of vegetation or waterways, by AE-Zone in 2000-01 and 2005-06. (ABS)

AE Zone	ha fenced off in total	% of farm	ha fenced off in total	% of farm
	2000-2001		2005-2006	
NSW Central	42,542	0.254%	42,063	0.253%
NSW NorthEast-QLD SouthEast	71,651	0.395%	36,464	0.228%
NSW NorthWest-QLD SouthWest	86,502	0.309%	61,726	0.227%
NSW Vic Slopes	46,009	0.452%	21,802	0.202%
QLD Central	52,464	0.380%	23,409	0.163%
SA Midnorth-Lower Yorke Eyre	57,151	0.154%	9,071	0.027%
SA Vic Bordertown-Wimmera	23,894	0.391%	15,018	0.247%
SA Vic Mallee	31,542	0.384%	20,840	0.267%
Tas Grain	3,887	0.566%	1,177	0.176%
Vic High Rainfall	11,255	0.466%	7,613	0.317%
WA Central	62,824	0.370%	84,766	0.725%
WA Eastern	5,719	0.197%	10,270	0.312%
WA Mallee and Sandplain	14,254	0.262%	9,264	0.206%
WA Northern	39,934	0.453%	31,126	0.415%

Figure 14. Average areas (ha per farm) and proportions of farmland (%) fenced off in total for protection of vegetation or waterways, by AE-Zone in 2000-01 and 2005-06. (ABS)



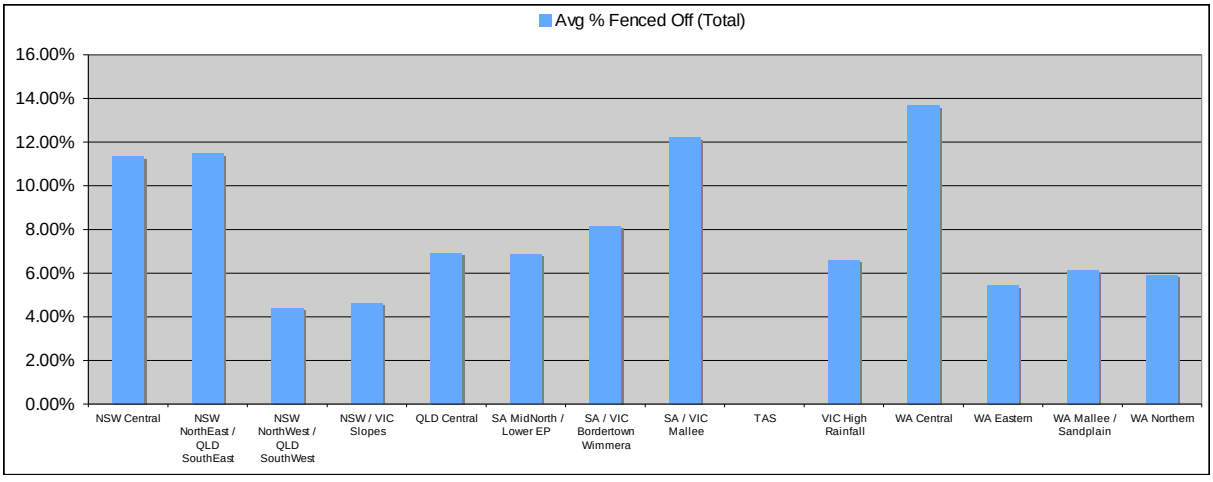
GRDC Data

The data related to total area fenced off as gathered by Solutions is presented below.

Table 9. Average proportions of farmland (%) fenced off in total for protection of vegetation or waterways, by AE-Zone in 2008. (GRDC 2009)

NSW Central	11.34%
NSW NorthEast / QLD SouthEast	11.47%
NSW NorthWest / QLD SouthWest	4.39%
NSW / VIC Slopes	4.61%
QLD Central	6.92%
SA MidNorth / Lower EP	6.86%
SA / VIC Bordertown Wimmera	8.16%
SA / VIC Mallee	12.21%
TAS	0.00%
VIC High Rainfall	6.58%
WA Central	13.67%
WA Eastern	5.42%
WA Mallee / Sandplain	6.12%
WA Northern	5.90%
Average	**7.31%**

Figure 15. Average proportions of farmland (%) fenced off in total for protection of vegetation or waterways, by AE-Zone in 2008. (GRDC)



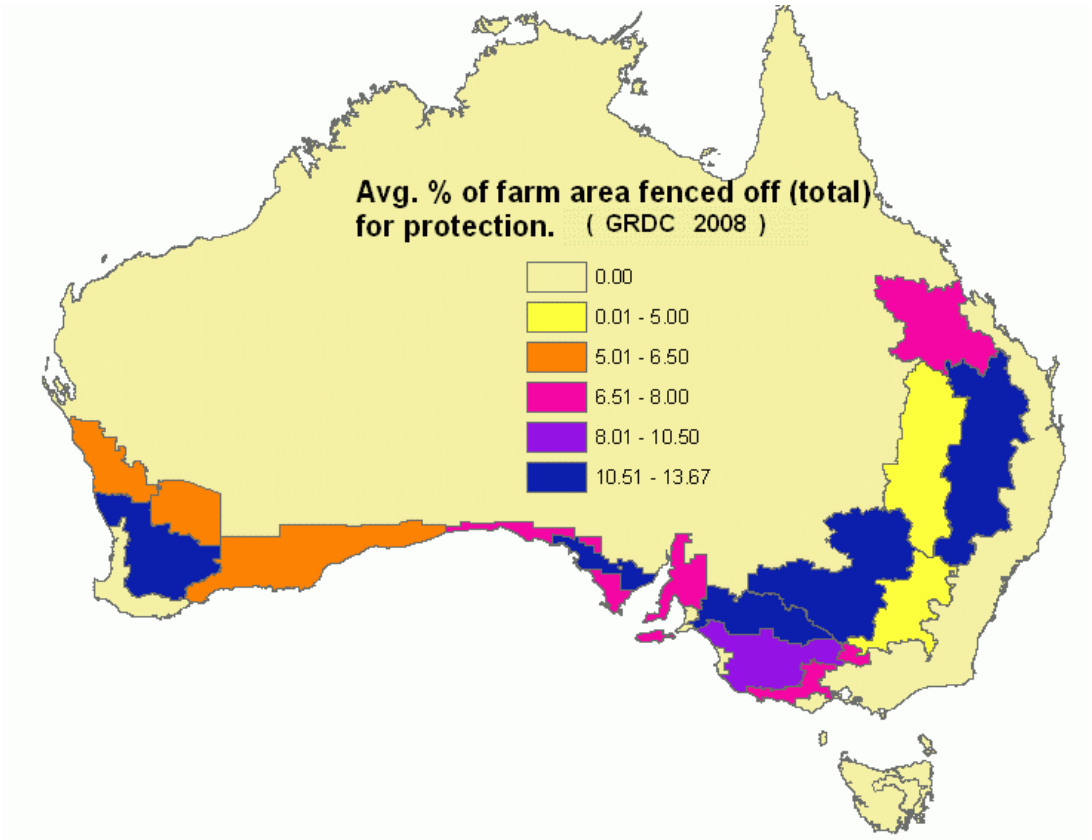
Again, it is apparent that the total area fenced off as recorded in the 2008 survey again greatly exceeds the area as reported by ABS. The areas shown in the 2008 data are suggested to be the total area fenced off on the farms (as % of farm area) **as at** 2008, and not **what was fenced off in 2008**.

These data therefore are taken to represent the total area actually now fenced off on farms (expressed as an average % of the total farmland) as at 2008.

Of interest, the overall average proportion of farmland fenced off for all purposes exceeds the general average of native vegetation on farms, and can thus be considered to cover waterways and trees on farms. It is highly likely that as at 2008, much or most of the fencing off of areas on farms for protection of trees, native vegetation and waterways has been done.

In many AE-Zones, over 10% of the total farm area has now been fenced off for such protection.

Figure 16. Average proportions of farmland (%) fenced off in total for protection of vegetation or waterways, by AE-Zone in 2008. (GRDC)



5. Areas replanted with new permanent vegetation for all purposes.

Both ABS and Solutions sought data on the area on farms that have been planted, or replanted with new, permanent vegetation.

These data are presented in Table 10 and Figure 17 (ABS) and Table 11 and Figures 12 to 14 (Solutions), below.

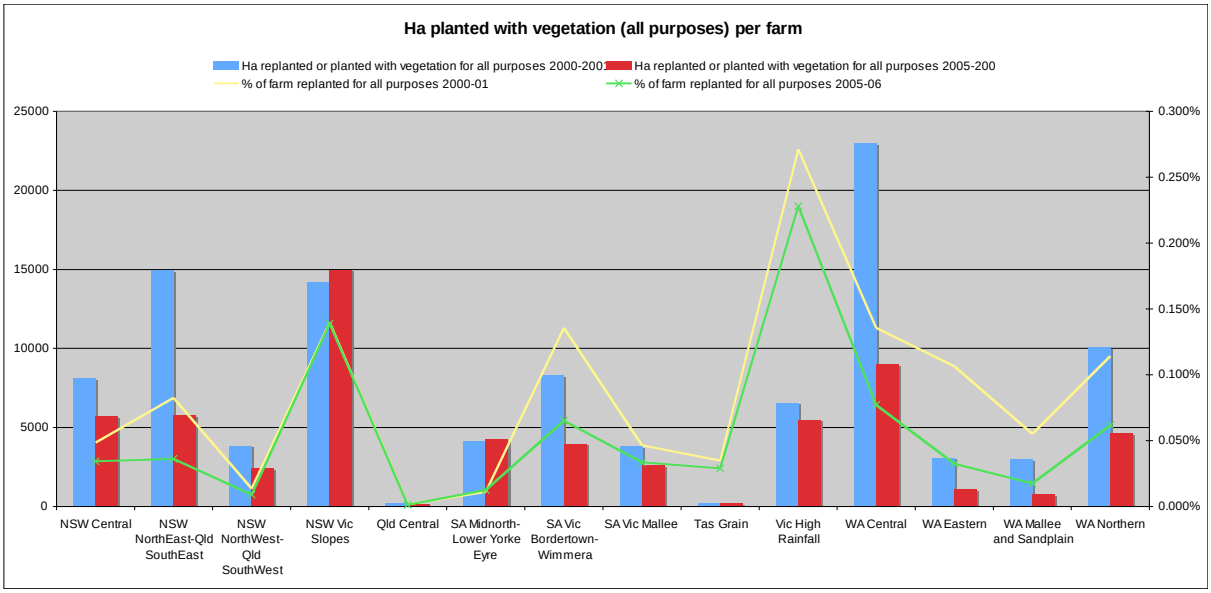
ABS Data

Table 10 and Figure 17 show the ABS data from both census years of 2000 and 2005 for the areas and proportions of farmland replanted or planted with new vegetation.

Table 10. Average area (ha) and proportions of farmland (%) replanted / planted on farms, by AE-Zone in 2000-01 and 2005-06. (ABS)

AE Zone	Ha replanted or planted with vegetation for all purposes	% of farm	Ha replanted or planted with vegetation for all purposes	% of farm
	2000-2001		2005-2006	
NSW Central	8,115	0.048%	5,702	0.034%
NSW NorthEast-QLD SouthEast	14,945	0.082%	5,785	0.036%
NSW NorthWest-QLD SouthWest	3,846	0.014%	2,438	0.009%
NSW Vic Slopes	14,188	0.140%	14,975	0.139%
QLD Central	222	0.002%	175	0.001%
SA Midnorth-Lower Yorke Eyre	4,113	0.011%	4,279	0.013%
SA Vic Bordertown-Wimmera	8,284	0.136%	3,958	0.065%
SA Vic Mallee	3,817	0.046%	2,623	0.034%
Tas Grain	239	0.035%	194	0.029%
Vic High Rainfall	6,557	0.271%	5,485	0.228%
WA Central	23,009	0.135%	9,027	0.077%
WA Eastern	3,087	0.106%	1,070	0.033%
WA Mallee and Sandplain	3,007	0.055%	785	0.017%
WA Northern	10,060	0.114%	4,622	0.062%

Figure 17. Average area (ha) and proportion (%) of farmland planted or replanted for all purposes by AE-Zone in 2000-01 and 2005-06. (ABS)



GRDC Data

The data from the GRDC 2008 survey regarding areas planted or replanted are presented below.

Table 11. Average area (ha) and proportions of farmland (%) replanted / planted on farms, by AE-Zone in 2008. (GRDC)

AE-Zone	Avg. area (re)planted	Avg. % of farm (re)planted
NSW Central	10	0.21%
NSW NorthEast / QLD SouthEast	195.17	7.26%
NSW NorthWest / QLD SouthWest	251.6	5.58%
NSW / VIC Slopes	68.3	2.65%
QLD Central	404.6	6.79%
SA MidNorth / Lower EP	6	0.25%
SA / VIC Bordertown Wimmera	36.67	1.90%
SA / VIC Mallee	12	0.35%
TAS	0	0.00%
VIC High Rainfall	0	0.00%
WA Central	42.86	1.18%
WA Eastern	16.5	0.29%
WA Mallee / Sandplain	18.63	0.39%
WA Northern	17.44	0.30%

Figure 18. Average area (ha) and proportion (%) of farmland planted or replanted for all purposes by AE-Zone in 2008. (GRDC)

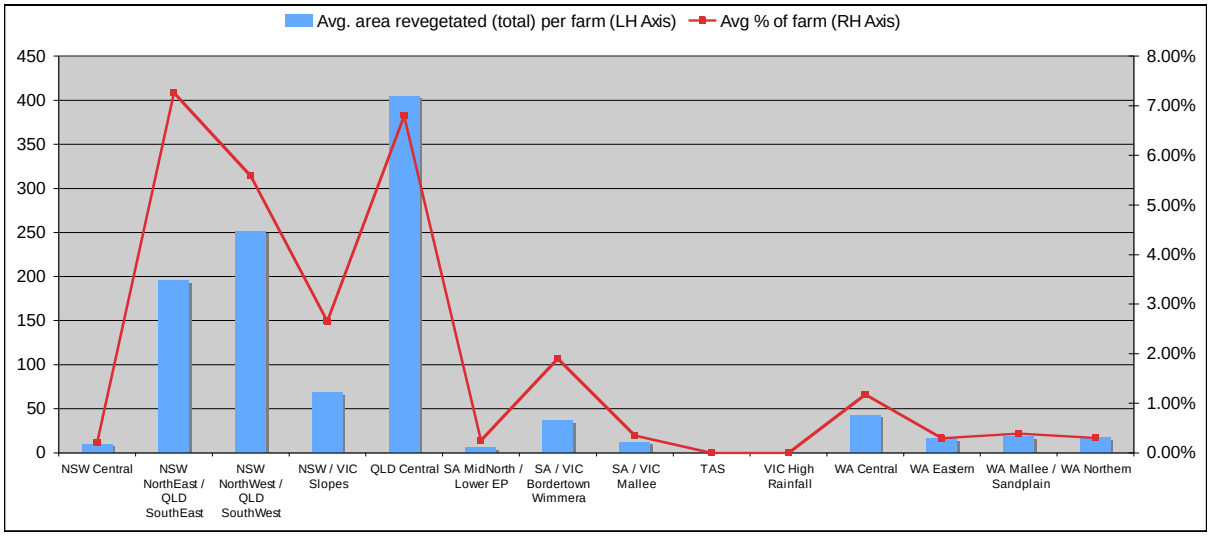
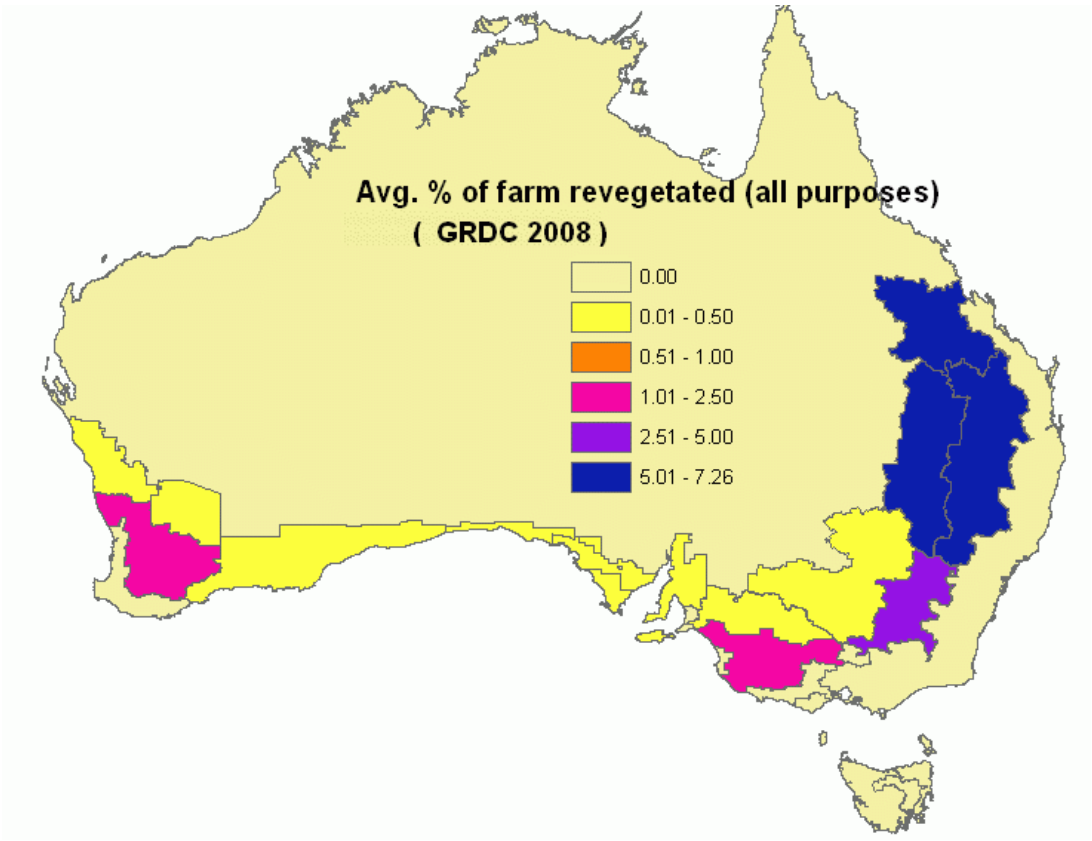


Figure 19. Average proportion (%) of farmland planted or replanted for all purposes by AE-Zone in 2008. (GRDC)



The data from 2008 show larger areas and proportions of farmland having been replanted as compared to the earlier data from ABS. Reasons for this have been previously mentioned concerning size of property in the GRDC dataset, and again, the possibility that the landholder answered the questions describing all areas that have been replanted or planted **as at 2008**, rather than **in 2008**.

Nonetheless, the majority of replanting has seen to occur in QLD and northern NSW, with relatively little being done in other AE-Zones.

Water Budgeting

Water budgeting – Soil testing pre and in-crop for Plant Available Water Content (PAW) - Water Use Efficiency.

Identification of practices that assist with optimising water Use efficiency (WUE), including crop yields, planting and harvest date and estimates of soil water at planting and in-crop.

Water Use Efficiency is an indicator of how effectively or efficiently crops use the water available (i.e. rainfall and stored soil moisture) in producing grain. It is commonly expressed in kg of grain produced per mm of available moisture. WUE can be influenced by a range of factors including several management practices available to grain producers.

Historic Public Data

Some ABS data exist from previous agricultural censuses that can be used to calculate water use efficiency (WUE) of rainfed crops.

The data includes crop yield and needs to be manipulated along with Bureau of Meteorology (BOM) data to arrive at estimates of WUE.

ABS data do not include estimates of months of fallow, soil water testing or planting and harvest dates, and as such, are unable to be used to link any of these practices to WUE.

The ABS census data have been manipulated to place these into AE-Zones, and are presented in the table below.

WUE Data from ABS

The ABS data from the 2000-01 and 2005-06 census allows an estimate of WUE to be calculated at AE-Zone level. These are however, unlikely to represent true averages of what actually was achieved on farms, since the rainfall data for use in these calculation are derived from BOM data and manipulated to give an 'overall' Growing Season Rainfall (GSR) and Plant Available Water (PAW) value for the AE-Zone.

Obviously these data will be broad averages for the whole AE-Zone, and as is well known, actual rainfall can vary markedly across relatively small geographies, and so arriving at a GSR or PAW for an AE-Zone is problematic.

WUE has only been calculated for wheat. WUE has been based on French and Schultz methodologies, which are not necessarily appropriate in the northern AE-Zones.

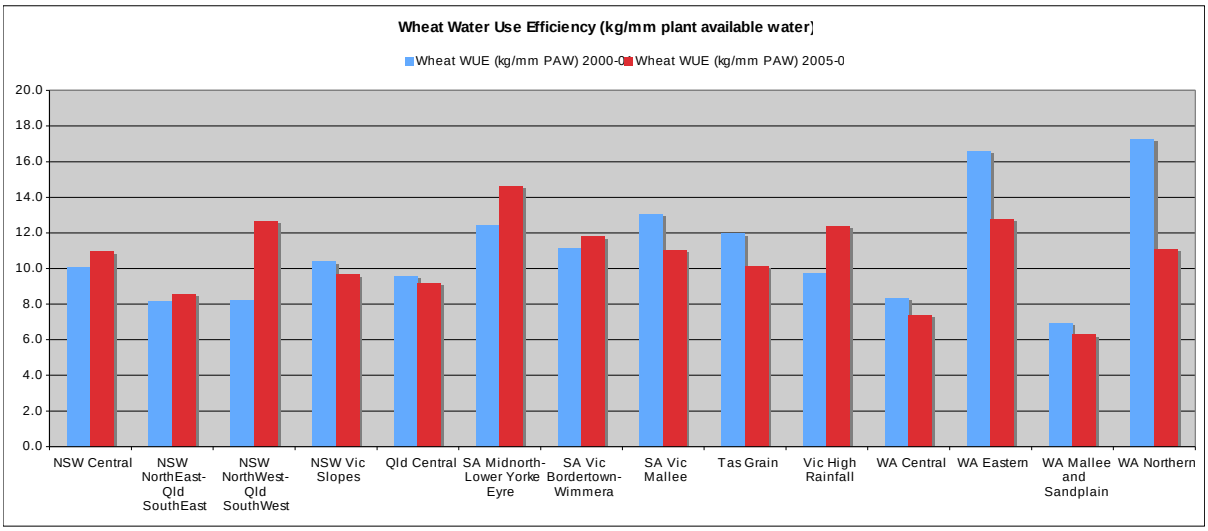
ABS Census Data 2005-06

The census data from 2000-01 and 2005-06 has been manipulated to allow comparisons at AE-Zone level to be made. These data are presented in Table 1 and Figure 1.

Table 1. Water Use Efficiency (WUE) of wheat (kg grain per mm PAW) and % of optimum WUE (Optimum = 20kg/mm PAW), by AE-Zone. (Source: derived from ABS and BOM 2001, 2006)

AE Zone	Wheat WUE (kg / mm PAW)		% of optimum (at 20kg/mm)	
	2000-01	2005-06	2000-01	2005-06
NSW Central	10.1	11.0	50%	55%
NSW NorthEast-QLD SouthEast	8.2	8.6	41%	43%
NSW NorthWest-QLD SouthWest	8.2	12.6	41%	63%
NSW Vic Slopes	10.4	9.7	52%	48%
QLD Central	9.6	9.2	48%	46%
SA Midnorth-Lower Yorke Eyre	12.4	14.6	62%	73%
SA Vic Bordertown-Wimmera	11.1	11.8	56%	59%
SA Vic Mallee	13.1	11.0	65%	55%
Tas Grain	12.0	10.1	60%	51%
Vic High Rainfall	9.7	12.4	49%	62%
WA Central	8.3	7.4	42%	37%
WA Eastern	16.6	12.8	83%	64%
WA Mallee and Sandplain	6.9	6.3	35%	31%
WA Northern	17.3	11.1	86%	55%

Figure 1. Water Use Efficiency (WUE) of wheat (kg grain per mm PAW), by AE-Zone. (Source: derived from ABS and BOM 2001, 2006)



There appears to have been some increase in WUE (in wheat) between the 2000 and 2005 years, though this is not uniform, being more apparent in SA, NSW and Victoria.

Water Management Practices (GRDC 2008).

There are many practices that can assist with optimizing WUE of crops. These include many agronomic and crop manage practices, too numerous to list here, though could be considered if looking to uncover reasons for differences between WUE between farms, areas and regions.

Within the survey carried out by GRDC two questions were included regarding the assessment of soil moisture both at planting and through the crop's life. These data are presented below in Tables 4 and 5, and Figures 10 to 13.

Assessment of soil moisture at planting to assist crop decisions

Table 4. Average % of crop where soil moisture is assessed at planting, % of farms using this practice, and % of crop these farms represent as compared with the overall crop area in the dataset, by AE-Zone (GRDC 2009)

AE-Zone	% of crop assessing PAW at planting	% of farms assessing PAW at planting	% of avg crop assessing PAW at Planting c.f. population mean
NSW Central	22.8%	20.0%	112.3%
NSW NorthEast / QLD SouthEast	32.6%	34.2%	95.3%
NSW NorthWest / QLD SouthWest	52.5%	31.7%	163.2%
NSW / VIC Slopes	22.1%	28.2%	78.1%
QLD Central	6.2%	8.7%	71.4%
SA MidNorth / Lower EP	6.6%	7.2%	91.4%
SA / VIC Bordertown Wimmera	6.0%	13.5%	44.5%
SA / VIC Mallee	7.5%	12.2%	60.9%
TAS	0.0%	0.0%	0.0%
VIC High Rainfall	1.5%	8.1%	18.4%
WA Central	2.9%	4.0%	71.5%
WA Eastern	2.1%	4.8%	43.8%
WA Mallee / Sandplain	0.0%	0.0%	0.0%
WA Northern	4.9%	9.3%	52.4%

Figure 10. Average % of crop where soil moisture is assessed at planting, % of farms using this practice, and % of crop these farms represent as compared with the overall crop area in the dataset, by AE-Zone (GRDC 2009)

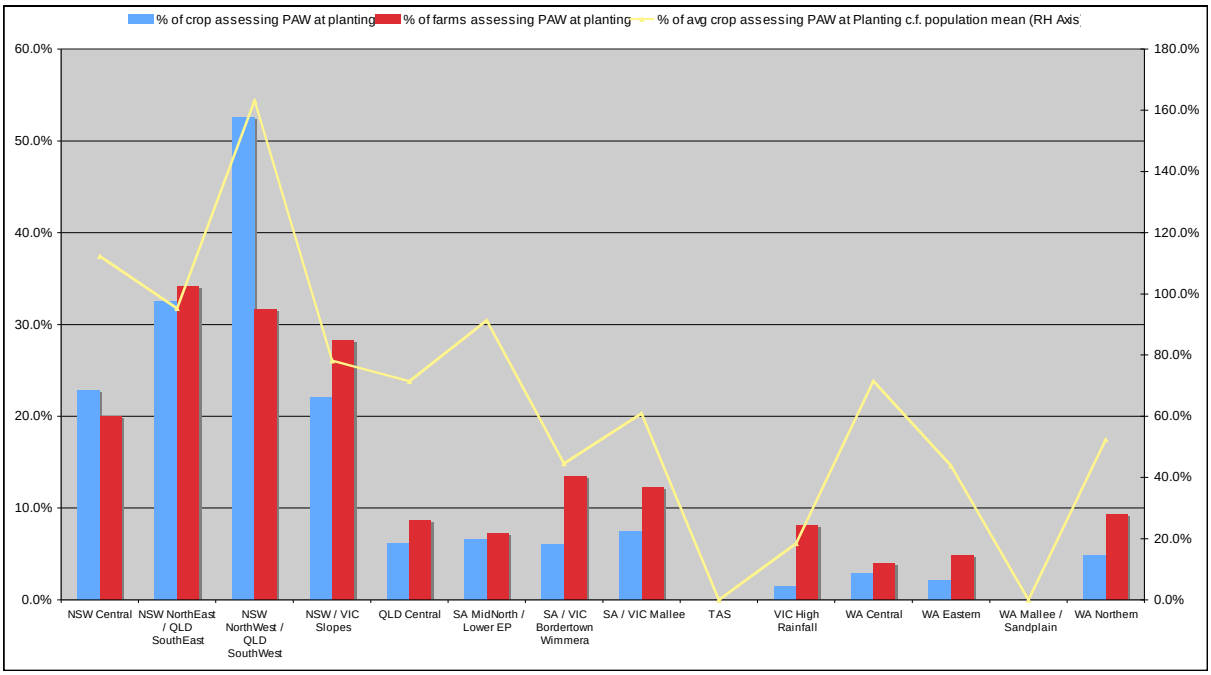
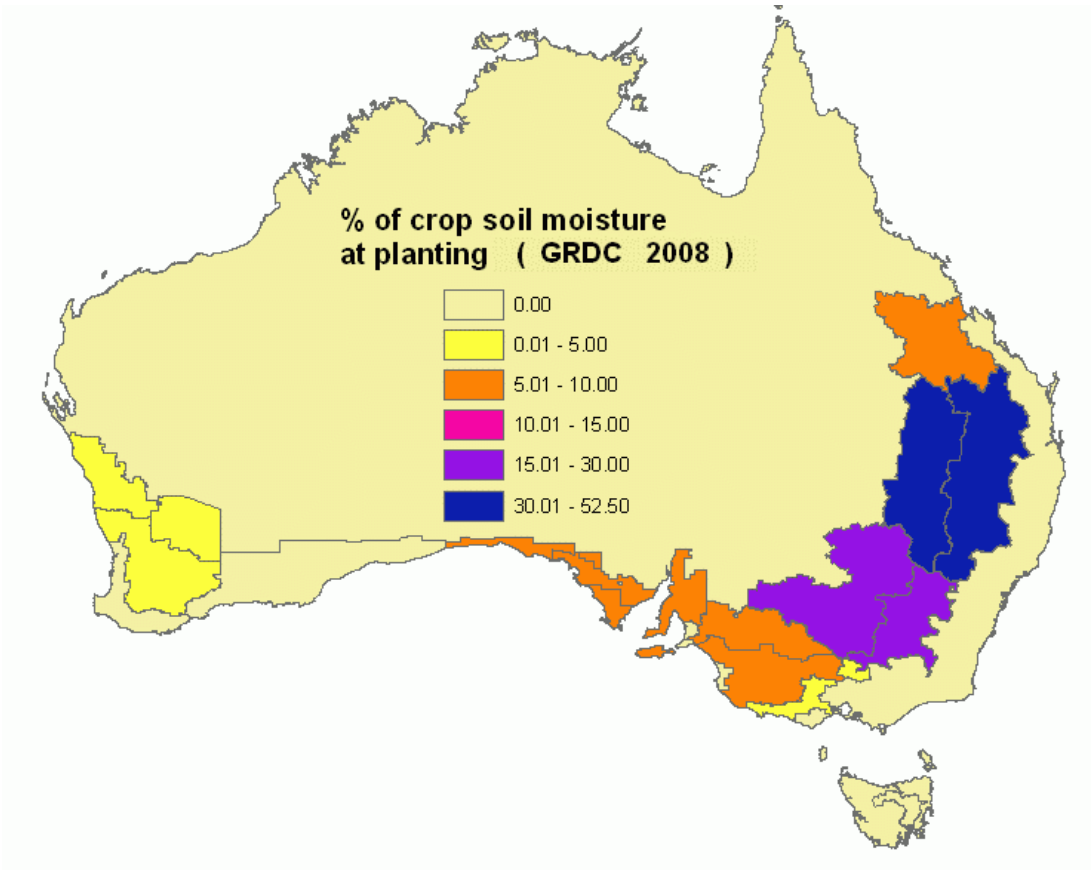


Figure 11. Average % of crop where soil moisture is assessed at planting, by AE-Zone (GRDC 2009)



From the data above it appears that assessing soil moisture at planting is considerably more highly practices in NSW and southern QLD than elsewhere, with WA not using this practice to any extent.

This is likely sue to the nature of soil s and the climate, such that in NSW and QLD soils are well known to store moisture from rainfall received prior to the crop being planted, and an assessment of

pre-plant soil moisture is much more a standard practice in these soils. In SA and WA by comparison, the soils do not store as much moisture and rainfall tends to be received through the growing season, and so the need to an assessment of soil moisture at planting is both less needed, and less useful, since the 'break of season' determines planting activities considerably more than soil moisture available at the desired time.

It is perhaps then less surprising that assessing soil moisture at planting is practiced where this is of value, and less so where it is not.

Assessment of soil moisture through the season to assist crop decisions

Table 5 shows the data from GRDC for this practice.

The practice of assessing soil moisture through the crop season is one that can assist with strategic decisions including the application of in-crop fertiliser (notably nitrogen) and some pesticide or herbicide applications. In partnership with knowledge of soil moisture at planting this can assist with these and other crop management practices and give confidence for some strategic marketing decisions.

Table 5. Average % of crop where soil moisture is assessed at planting, % of farms using this practice, and % of crop these farms represent as compared with the overall crop area in the dataset, by AE-Zone (GRDC 2009)

AE-Zone	% of crop assessing PAW in crop	% of farms assessing PAW in crop	% of avg crop assessing PAW in crop c.f. population mean
NSW Central	14.2%	14.7%	95.3%
NSW NorthEast / QLD SouthEast	25.7%	22.8%	112.7%
NSW NorthWest / QLD SouthWest	23.0%	20.0%	113.1%
NSW / VIC Slopes	21.1%	29.0%	72.5%
QLD Central	0.0%	0.0%	0.0%
SA MidNorth / Lower EP	5.4%	5.2%	103.8%
SA / VIC Bordertown / Wimmera	4.7%	10.3%	45.9%
SA / VIC Mallee	3.6%	5.6%	63.9%
TAS	0.0%	0.0%	0.0%
VIC High Rainfall	7.8%	10.8%	72.3%
WA Central	3.7%	3.5%	104.3%
WA Eastern	1.5%	3.2%	45.4%
WA Mallee / Sandplain	2.1%	1.5%	138.2%
WA Northern	5.2%	8.1%	64.5%

Figure 12. Average % of crop where soil moisture is assessed in-crop, % of farms using this practice, and % of crop these farms represent as compared with the overall crop area in the dataset, by AE-Zone (GRDC 2009)

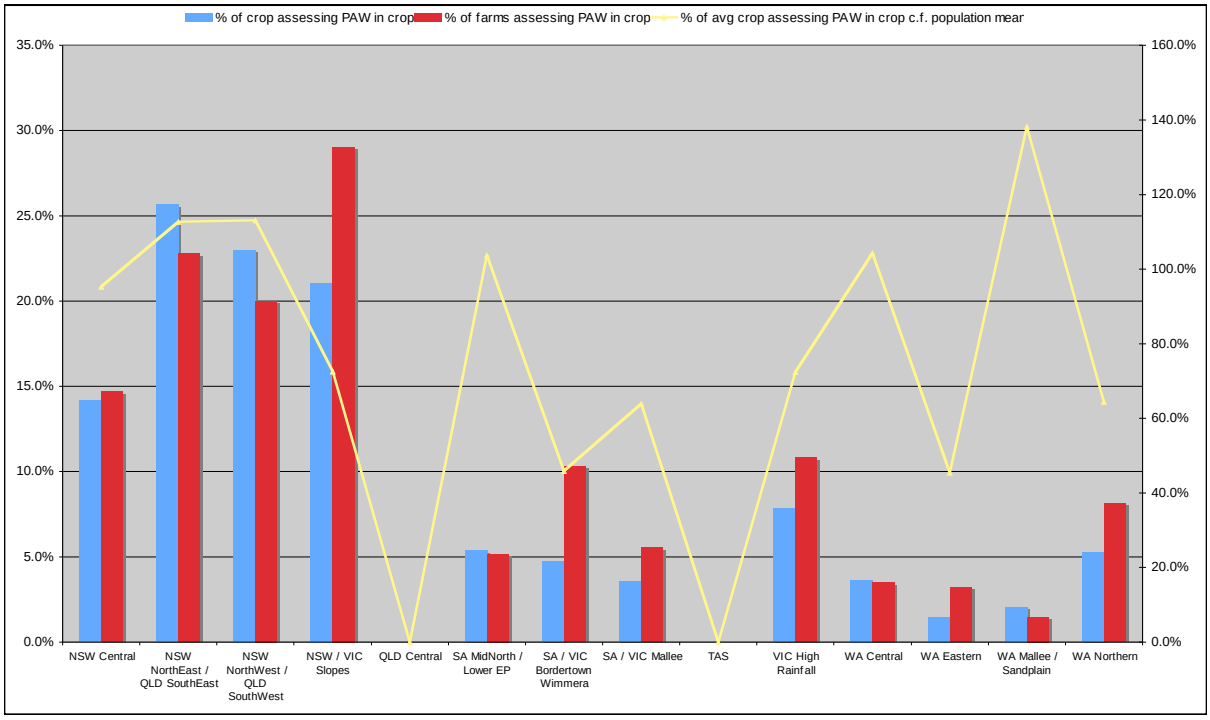
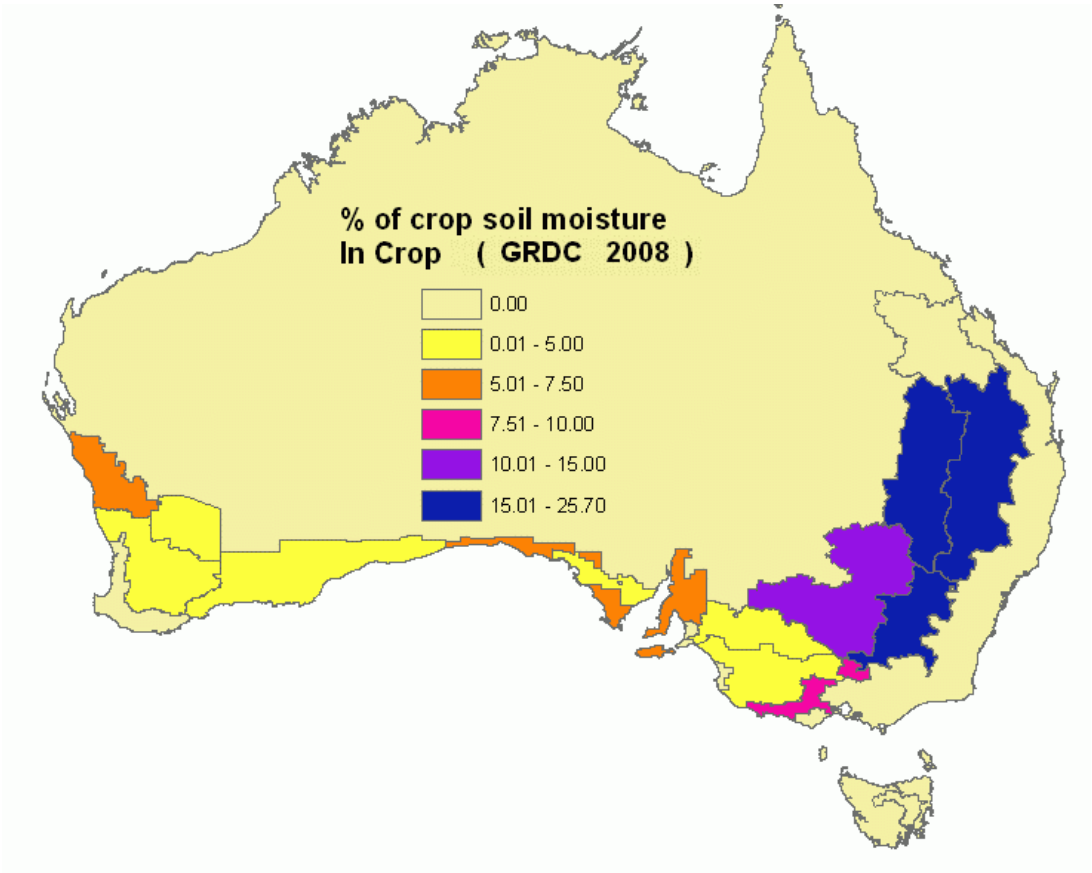


Figure 13. Average % of crop where soil moisture is assessed in-crop, by AE-Zone (GRDC 2009)



Again, the stand out observation is the use of in-crop soil moisture monitoring in NSW (and Victorian slopes), though the data for central QLD was unable to be used in this analysis.

In keeping with the at-planting soil moisture data, it is apparent that were these practices are used they are used on much or all of the crop on these farms (yellow line) where the average area exceeds the general average for the dataset, indicating that the farms where the practice is used are larger than average, and the practice is used on the whole crop area on these farms.

In WA both pre-plant and in-crop soil moisture testing is relatively low, though some are doing this. Knowing the WA seasonal situation where in-crop rainfall is the dominant factor in crop growth for decision making this is not surprising.

Appendix 1: Historic Baseline Information of the 11 major farming practices

GRDC Needs

The GRDC and associated agencies in the grains industry have identified a number of key management practices, considered important in driving productivity, sustainability and environmental effects on grain farms.

This document presents some baseline data from the Australian Bureau of Statistics (ABS) Agricultural Censuses of 2000-01 and 2005-06, and from a national survey conducted by Solutions Market Research (Solutions) for the cropping year of 2008. These datasets have been extracted and analysed by the Farming Practices Project. It has also obtained rainfall data from the Bureau of Meteorology, where needed, and used mapping software in the presentation of some of the results.

11 Key Management Practices

The GRDC and MLA have identified the following sustainable farm practices that are to be targeted in a Mixed Farming Systems Program to achieve on-farm impact.

These practices will be prioritised and refined through a regional planning phase where each region across the mixed farming zone will be required to target more than 4 of the following practices in the new Mixed Farming Systems Program to achieve change on farm.

The practices can be listed as follows:

1. Land use - land use to land class. The actual use of land on the farm, and how well this relates to land capability as described by land class
2. Reduced or no-tillage. The use of minimum, zero- or no-tillage systems for crop and pasture establishment
3. Stubble retention. The level of retention of crop and pasture residues following harvest or grazing. This frequently goes in hand with the tillage regime in place on the farm, and combined have a major impact on soil cover and erosion susceptibility.
4. Crop rotation with pastures, oilseeds and pulses. The rotation of crops and pastures in sequence, either between various crop types or between crops and pastures is seen as a valuable means of assisting with weed and disease management and hence with productivity, and also with soil management issues.
5. Controlled traffic/ precision agriculture. These relatively recent developments also have a growing importance in productivity, efficient use of inputs, soil management and erosion control.
6. Integrated weed/pest/disease management in crops and pasture. The use of a broad range of disease, weed and insect pest control methods is beneficial for biodiversity, to avoid resistance to pesticides and has environmental benefits.
7. Nutrient budgeting and soil testing in crop and pasture. Nutrient supply (frequently in the form of fertilizer use) is a major consideration for productivity, sustainability, environmental management

and financially. The use of fertilisers as efficiently as possible assists with all these, and the use of soil testing alongside nutrient budgeting is a crucial practice in this regard.

8. Use of perennials in systems. Perennials (usually pasture species) either in rotation with annual crops and pastures, in a phased fashion or in permanent blocks on a farm have important implications for integrated pest management, assistance with managing biodiversity, soil management, and in some areas assistance with management of salinity
9. Stocking rate/intensity. Stocking rates and grazing management have ramifications for productivity, soil cover and hence soil erosion issues.
10. Managing biodiversity - remnant vegetation, riparian zone, buffer strips - area-wide farming in landscapes IPM. This suite of activities or practices have strong impacts on this major environmental issue
11. Water budgeting – Soil testing pre and in-crop (PAWC). In the cropping industry efficient use of the rainfall that is received has a direct impact on crop productivity, and may have some indirect effects on soil management, and salinity in some areas.

Encouraging increased levels of adoption of these practices remains an objective of the investments within the grains industry. This is because these practices have been identified as being beneficial for both productivity and sustainability.

Measurement of farming practices – establishing historic Baseline data.

The preceding section describes the major practices of interest.

Having knowledge of the level of adoption by growers of these practices and use within farming systems is seen as a valuable means of tracking progress and for assessing the successes of research investments.

Having baseline data about the practices of interest, likewise, is part of the process of evaluating progress, since having baseline data allows for a better assessment of progress, and establishes the basic levels of the practices which, as projects proceed, more recent data can be gathered and used for comparisons.

Data about the use of various practices on farms can come from a variety of sources. Historically a major source has been the Australian Bureau of Statistics (ABS), where the agricultural census could gather valuable data about the various practices in use on farms, as well as the basic information about enterprises, crop, pasture and livestock production and other basic data. The agricultural census was collected every year till 1996, and has been done 5-yearly since then. The census of 2001 contained a range of questions related to several of the practice of interest, including tillage, residue management, fertilizer use and area of vegetation planted, replanted or fenced off.

However, the census of 2006 contained very few questions related to practices, and future ones are less likely to.

Therefore, only ABS data from the 2000-01 census is of wide use and value for baseline data analysis and presentation, with the data from 2006 of much more limited.

More recent data, especially for use in assessing progress by growers in adoption of the various practices of interest has been difficult to gather. The Farming practices Data Gathering and Reporting system, a project of GRDC, was set up for such data gathering, though being based on voluntary participation by growers has found it difficult to gather data from a side selection of growers, let alone be able to be statistically representative of the total population.

Considering this, in late 2009 GRDC commissioned a market research company (Solutions Market Research) to contact a national subset of grain producers and gather data about their farm

operations and practices directly from these. The survey was based on the operations on the farms for the 2008 (winter) cropping year.

Considering the 11 key practices identified by GRDC and MLA, the following baseline data has been extracted from ABS data and Solutions and manipulated for presentation.

The sections in this initial report describe a summary of the overall datasets in terms of gross measures that indicate overall characteristics of each dataset. This report is not about individual practices, but more about farm numbers, farm size, cropped areas and other features of an overall nature, that assist in understanding the characteristics of the ABS and, in particular, the GRDC 2008 datasets.

Table 1. Summary of data and practices relationships for use in data gathering and reporting.

Key Practice	Data collected to assist reporting and analysis
Land use - land use to land class.	Areas of crop and pasture (annual and perennial), areas of native vegetation and areas fenced off, planted or otherwise protected.
Reduced or no-tillage.	Area of various tillage practices
Stubble retention.	Areas of various stubble management practices, area of how much soil cover at specific times of the year (for example, How much of your farm is x% soil cover at March 30)
Crop rotation with pastures, oilseeds and pulses.	Areas of each crop type, each pasture type
Controlled traffic/ precision agriculture.	Areas of controlled traffic, precision agriculture, remote sensing (e.g. EM38 surveys), variable rate technology
Integrated weed/pest/disease management in crops and pasture.	Several questions about the various elements of insect and weed management, considerations of beneficial species and use of buffer zones etc. All are area-based.
Nutrient budgeting and soil testing in crop and pasture.	Area of soil testing, and how often are tests done, at both shallow and depth. Area of nutrient budgeting and phased use of fertiliser
Use of perennials in systems.	Area of perennial pasture, area of native and permanent vegetation, area of replanted and protected areas
Stocking rate/intensity.	Numbers of both sheep can cattle carried and turned off through the year, average stocking rate, some management practices e.g. use of feed pads in drought conditions
Managing biodiversity - remnant vegetation, riparian zone, buffer strips - area-wide farming in landscapes IPM.	Areas of remnant and native vegetation, area of replanted and newly planted vegetation, area fenced off to protect waterways etc
Water budgeting – Soil testing pre and in-crop (PAWC).	Rainfall received by month, crop yields and protein, planting and harvest date, estimate of soil water at planting, months of fallow

Methodology

The study was organized to assist with the data requirements for GRDC by complying with previous farming practice data collections and with regard to potential uses:

- Noting the methods and questions used in previous ABS census data,

- Constructing questions that allow data to be gathered to assist with supplying information about the 11 key practices as listed above,
- Given the survey was intended to provide quantitative data, a focus on questions that provided answers of area of the various practices carried out on farms rather than simple 'yes / no' questions,
- Identification of farms to allows data to be amalgamated to AE-Zone level, though having an ability to be extracted at shire or Statistical Local Area (SLA) level where needed,
- To attempt to cover the grains industry as well as possible, with a dataset that could be seen to be broadly representative.

The survey was developed in consultation with the needs for farming systems, Grain and Graze and other projects where an objective is researching, extending or modifying the various elements of farming practices in the grains industry. It considered the questions that had previously been used by public data gathering activities (for example, ABS) and other industry activities, (for example those used in the Farming Practices Database Project).

There is strong interest in farming practices for indicating matters of productivity and environmental management in the grain and mixed farming industries. These are based on established research that links several practices to increased productivity and environmental management.

Questions

A questionnaire was assembled based on the existing questions in use by ABS and the Farming Practices Data Project. The questions were tested to ensure they covered the data needs for the 11 key practices as identified and that they elicited quantitative answers for use in databases and for analytical purposes. To this end questions were intended to provide 'how much' of the various practices are used by the farmers interviewed, as much as possible in area (hectare) terms.

Qualitative responses (i.e. the 'why', 'what is your opinion' 'what would it take for you to…') were not sought. It was felt that such questions would require considerable additional time, a different questioning technique, and be best considered in separate surveys or other activities. Details of the motives, and reasons for high or low adoption of various practices is of high interest, and it is felt that elucidating these would be best as a focus of a dedicated activity, separate to this quantitative-based data gathering activity.

Some identification questions were included to assist with locating the farm into the appropriate SLA and therefore AE-Zone. Following these basic questions about farm size, enterprise mix and some demographics were included. The balance of the questionnaire was then about the use of the various farming practices on the farm. The questionnaire was restricted to 15 minutes in length.

Data was prepared by Solutions into spreadsheet format with question coding and the data aligned, before being sent to the Farming practices database project for processing, interpreting and presenting.

The detailed list of questions are attached as Appendix 1 and the end of this document

Regional spread

The survey was carried out so as to provide a relatively even spread of farms in each AE-Zone, and though this is not statistically perfect it does provide a relatively good spread in all Zones.

Growers were contacted randomly from the database compiled for each SLA and hence AE-Zone.

Data collection

Only farms with grain production were targeted from the Solutions database, whether these also carried livestock or not.

The criteria used to select farms to approach were:

- Grain Specialists (>75% income from grain) – minimum farm size: 500 ha
- Grain / Livestock (between 25% and 75% of income from both grain and livestock) – minimum farm size: 1,000 ha
- Must also have grown crops in 2008

A phone interview was used due to the higher response rates usually achieved with this method compared to mail-out surveys and to reduce self selection bias (e.g. where characteristics of respondents are biased towards those with an interest in the subject).

The surveying began in October 2009 and all callbacks were completed by early November 2009. Data were collected from a primary cropping decision maker in each household.

A total of 5757 farmers were approached. 1530 required a call back, and 2918 refused to take part. This relatively high figure of refusals is thought to be due to the timing of the survey period (October to early November 2009) coinciding with harvest in several areas.

1309 full sets of data were completed. On further analysis by the Farming Practices Database 9 of these were discarded due to some data appearing to be very out of expectation.

This gave a final dataset of 1300 farms across all 14 AE-Zones.

The data has a confidence level of 95%, giving a confidence interval of +/- 2.6%.

Data Presentation

The Solutions data was imported into the Farming Practices Database, various manipulations and calculations carried out to ensure conformity with the database, and for ease of amalgamation to AE-Zone level. Each record was checked for validity, errors and simple keying mistakes.

Data has been presented in most cases amalgamated to AE-Zone level.

For comparative purposes, ABS census data has also been accessed. This has also been manipulated to AE-Zone level. Where necessary, additional data sources (for example rainfall data) have been accessed and also manipulated to provide data at AE-Zone level.

In some cases ABS data is available for some practices of interest from a survey conducted in 2007. These data are only available at NRM body level, and are not amenable to amalgamating to AE-Zones. In these cases these data are presented for comparative purposes, though are less able to be used for direct comparisons.

Data are presented in tabular, graphic and map format.

Data of historic and current baselines for the practices of interest, from the censuses of 2000, 2005 and survey data from the 2008 crop year.

1. Basic data.

Data in this report is presented amalgamated to Agro-Ecological Zone (AE-Zone) level. There are 14 AE-Zones in the cropping areas of Australia, as defined in previous work for the GRDC.

Each AE-Zone is comprised of a series of local government areas, or shires. The data from the survey of 2009 (for the 2008 crop year) does note which shire each property is in, and so while the data presented here is amalgamated to AE-Zone level, data for each of these shires is available to interested parties, so that these parties can use data at shire level if they desire.

Data throughout this report (and other reports concentrating on each set of the Practices of interest) is presented in tabular and graphic form, as well as on maps showing AE-Zone boundaries. Data for shire-level examination would be available in table format only (i.e. as excel spreadsheets).

Numbers of farms, growers and basic crop statistics.

1.1 Number of grain holdings in the dataset

Data presented in Table 2 and Figures 1 and 2 (below) show the coverage of the 2009 GRDC dataset in terms of number of grain producing farms and areas of crop and other enterprises these farms represent.

To consider the coverage of this work, as well as providing a means of comparison with existing population data, the 2008 data is presented alongside data from the ABS censuses of 2000-01 and 2005-06. Additionally, a series of data showing the average of the ABS data from these two censuses is presented to provide a single comparative set of figures that should give a reasonable estimate of the total population for use in considering the more recent GRDC data.

Table 2. Number of grain holdings (from ABS) for 2000-01 and 2005-06, average of these, number of survey responses from The GRDC survey in 2009, and the % these represent of the ABS average, by AE-Zone

AE-Zone	No. of Grain holdings (ABS)			No. in survey	% surveyed c.f. ABS average
	2000-01	2005 - 06	ABS (Avg.)	GRDC (08)	GRDC %
NSW Central	2,924	2,696	2,810	75	2.67%
NSW NorthEast / QLD SouthEast	5,959	5,176	5,568	158	2.84%
NSW NorthWest / QLD SouthWest	1,382	1,299	1,341	60	4.48%
NSW / VIC Slopes	6,849	7,255	7,052	124	1.76%
QLD Central	636	504	570	23	4.04%
SA MidNorth / Lower EP	3,885	3,707	3,796	97	2.56%
SA / VIC Bordertown Wimmera	4,992	4,549	4,771	126	2.64%
SA / VIC Mallee	3,654	3,312	3,483	180	5.17%

TAS	373	311	342	4	1.17%
VIC High Rainfall	1,824	1,950	1,887	37	1.96%
WA Central	4,710	3,810	4,260	200	4.69%
WA Eastern	599	589	594	62	10.44%
WA Mallee / Sandplain	834	723	779	68	8.73%
WA Northern/	962	904	933	86	9.22%
Totals (average %)	**39,583**	**36,785**	**38,184**	**1,300**	**3.40%**

Table 2 (above) shows the number of grain properties from ABS censuses, plus the number of grain growers interviewed in the work for GRDC in 2009. ABS data is likely to overestimate the number of actual 'serious' grain producers, since the categorization of 'grain property' used by ABS is based on a relatively low value of grain production per farm.

The approximate figure used by many in the industry is below 30,000, possibly around 27,000.

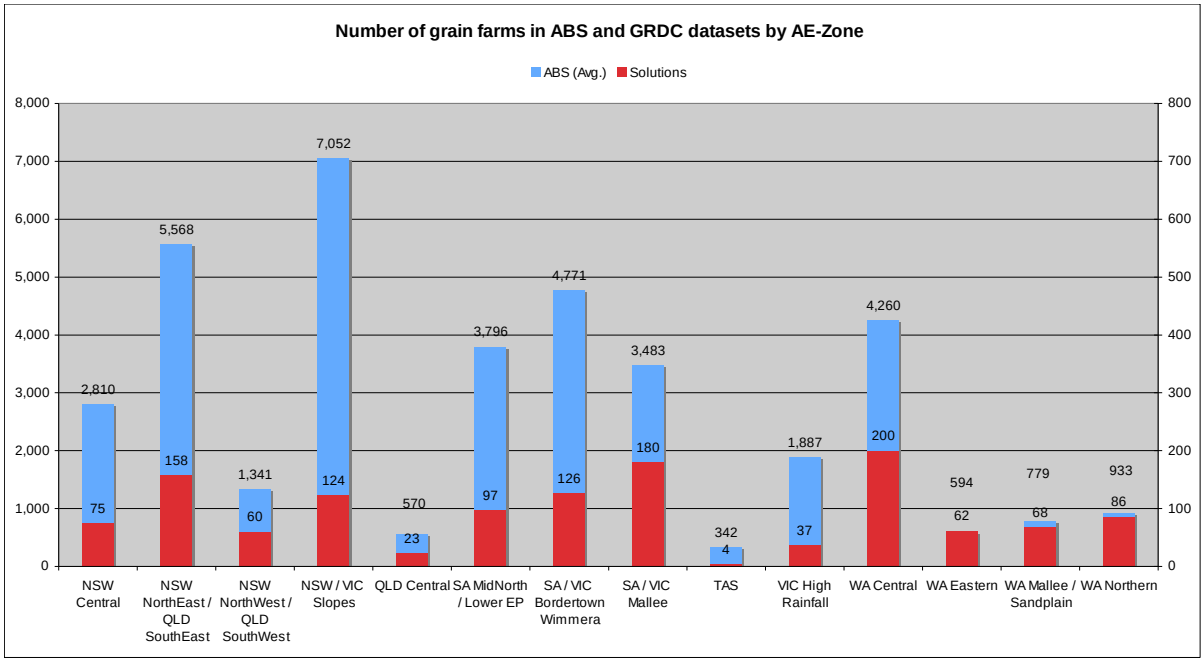
The survey of 2009 was able to provide data for 1300 grain properties, with this representing 3.4% of the ABS 'average' grower number, though based on 27,000 properties; this would be approximately 4.8%. As a rough approximation, one could say **the survey of 2009 provided data for close to 5% of the grain farms in Australia**.

A further observation is that the proportion of properties in the dataset as compared to total property numbers in each AE-Zone varies. In some AE-Zones the 2009 data represents fewer than 2% of grain farms, while in one case more than 10% of properties participated.

The number of properties in the dataset as compared to the notional total in each AE-Zone is not necessarily the main consideration in having a representative dataset, since the industry is characterized by a strong skewing of data, whereby a strong minority of farms tend to produce a large majority of the grain. Hence, an examination of the cropped areas represented in the dataset is a valuable adjunct to a consideration of the number of farms participating.

To further illustrate the nature of the grains industry in Australia, it is understood that approximately 50% of farms produce only (in total) approximately 10% of the tonnage, and therefore the remaining 50% produce the balance (approximately 90% of the tonnes).

Figure 1. Average number of grain holdings (from ABS) for 2000-01 and 2005-06 and number of survey responses from GRDC by AE-Zone



One can see in Fig. 1 that the number of farms surveyed in the various AE-Zone varies between the AE-Zones. As a percentage of the average ABS-based number of grain farms in these AE-Zones, the GRDC 2008 dataset covers from less than 2% to over 10% of grain farms (see Table 2 above).

1.2 Areas in Dataset.

As mentioned, another way of assessing the coverage of the survey work is to consider what proportion of the farmland; crop or other land use areas have been included in the dataset. These data are presented in tables 3 to 5, and figure 2 below, and show the crop, pasture and native vegetation areas included in both the earlier ABS data and that from 2008.

1.2.1 Farm Size

Average farm size in the two datasets are presented in Table 3 and Figures 2 and 3 (below).

Table 3. Average farm size (ha per farm) from ABS and GRDC and the % the GRDC 2008 dataset represents of the ABS average, by AE-Zone

AE-Zone	Ave area of farm				Farm size as % of ABS
	2000 (ABS)	2005 (ABS)	ABS (Avg)	GRDC	GRDC
NSW Central	2,712	2,447	2,579	4,824	178%
NSW NorthEast / QLD SouthEast	1,137	1,042	1,090	2,689	236%
NSW NorthWest / QLD SouthWest	9,082	7,821	8,452	4,508	50%
NSW / VIC Slopes	734	695	715	2,577	351%
QLD Central	5,478	5,009	5,244	5,957	109%
SA MidNorth / Lower EP	6,921	5,987	6,454	2,383	34%
SA / VIC Bordertown Wimmera	652	649	650	1,928	296%
SA / VIC Mallee	888	924	906	3,406	383%
TAS	690	628	659	3,109	450%
VIC High Rainfall	305	274	290	2,342	768%
WA Central	2,639	1,928	2,284	3,641	138%
WA Eastern	4,558	5,073	4,815	5,606	123%
WA Mallee / Sandplain	3,341	2,547	2,944	4,780	143%
WA Northern/	7,527	6,181	6,854	5,731	76%

These data indicate a divergence in average farm size between ABS and GRDC datasets. The divergence is less marked in WA than in the southern states, though this pattern is not consistent. Nonetheless, it would appear that the GRDC dataset covers farmers who are at least or larger than average in size. This is a simple observation, though does not necessarily mean that the dataset is therefore unrepresentative, since the objective was to cover a set of farms that are more typical of grain producers as the industry is comprised, that is, generally larger farms of more specialist producers.

The GRDC dataset is possibly seen to actually represent the nature of the industry, as exampled above, whereby the dataset is likely to reflect the practices carried out on the 90% or so of the area of the crop, as farmed by 50% of the grower population, since in the dataset the average farm is considerably larger than the statistical mean of the ABS data, in keeping with the industry demographics as described. What is likely to be apparent in the dataset is a representation of the 50% of farms who account for the vast majority of the area farmed and tonnes produced. This can assist in explaining why, in the dataset a relatively small number of farms in the dataset represent a considerably larger area and tonnage of production.

Another observation in the data is that ABS data suggests that in the period between 2000 and 2005, average farm size has not changed very much in almost all AE-Zones, and in many cases some reduction has been evident.

One could not draw a conclusion that since 2005-06 farm size has increased by considering the average farm size as represented by the GRDC dataset, since many other indicators suggest this

dataset represents larger farms in any case, and while perhaps not representing a perfect statistically valid sample of the total population, does comprise a dataset that is more in keeping with the characteristics of the industry sector of most interest.

The data do, however, confirm that as one moves west in the eastern states, and east in WA, average farm size increases.

Figure 2. Farm size (average per farm) from ABS (avg. of 2000 and 2005) and from GRDC 2008, by AE-Zone

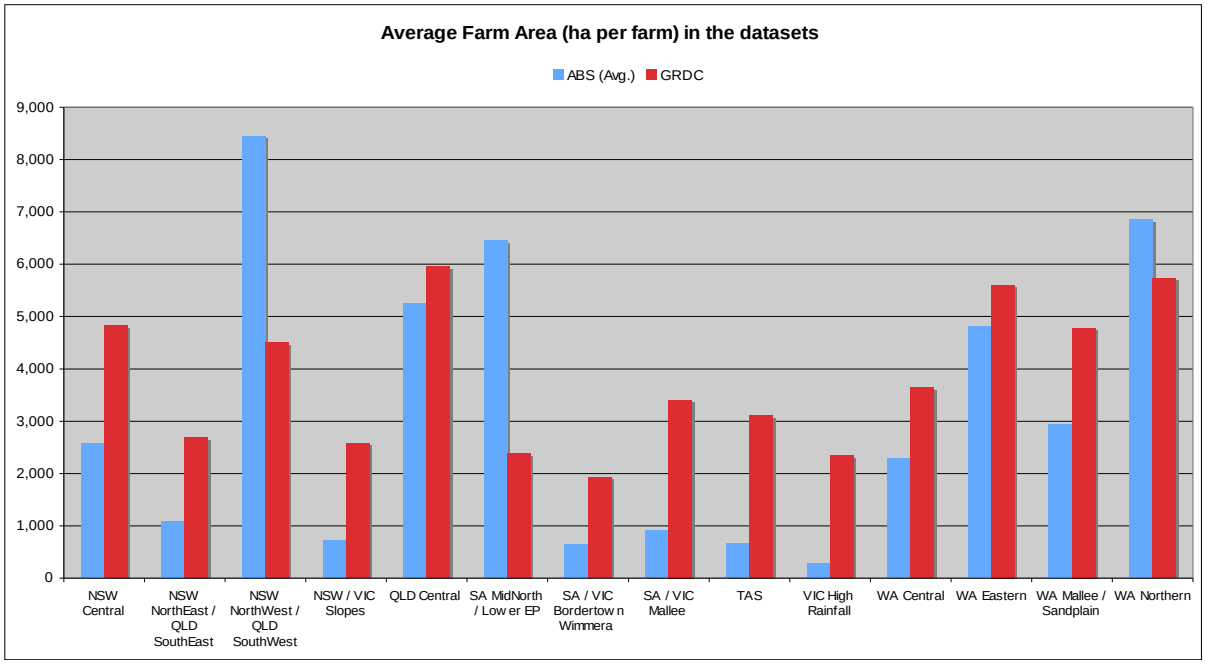
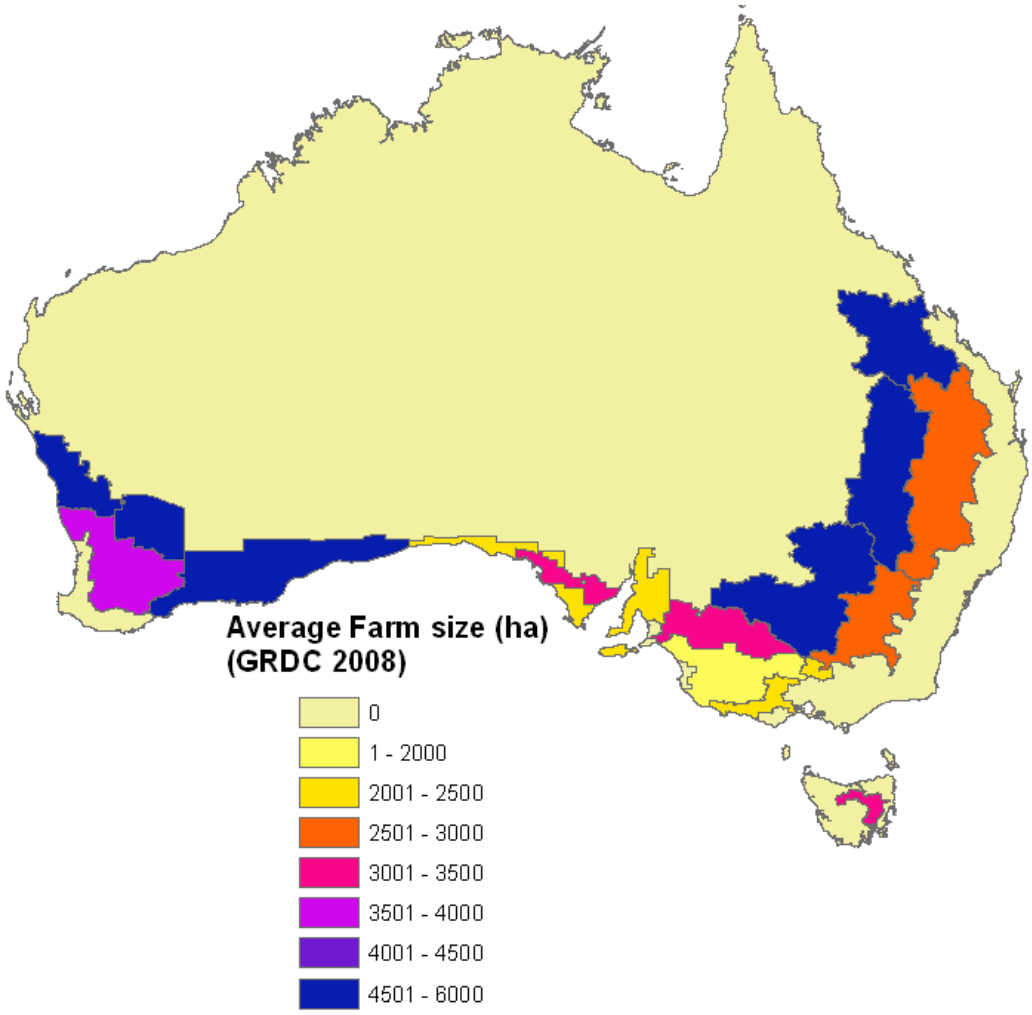


Figure 3. Farm size (average per farm) GRDC 2008, by AE-Zone



1.2.2 Crop Areas:

Total area of crop as represented in the GRDC data is shown in comparison to ABS data in Table 4.

These data are another way of assessing just what the GRDC data represent, in terms of the grains industry, an, taken in conjunction with the data on farmland and number of farms allows some assessments and commentary to be made.

Table 4. Total areas of cropland (from ABS) for 2000-01 and 2005-06, average of these, plus total areas of crop from the GRDC survey for 2008, and the % these represent of the ABS average (2000 and 2005), by AE-Zone

AE-Zone	Cropland (total ha in dataset)				
	2000 (ABS)	2005 (ABS)	ABS (Avg)	GRDC (2008)	GRDC % c.f. ABS Avg.
NSW Central	1,741,431	1,711,272	1,726,351	158,620	9.19%
NSW NorthEast / QLD SouthEast	3,064,333	2,894,397	2,979,365	225,313	7.56%
NSW NorthWest / QLD SouthWest	1,319,277	1,307,662	1,313,470	118,610	9.03%
NSW / VIC Slopes	2,325,143	2,564,509	2,444,826	183,494	7.51%

QLD Central	679,607	419,967	549,787	51,557	9.38%
SA MidNorth / Lower EP	1,976,118	1,994,626	1,985,372	122,520	6.17%
SA / VIC Bordertown Wimmera	1,710,324	1,684,871	1,697,598	147,210	8.67%
SA / VIC Mallee	2,803,279	3,132,179	2,967,729	377,194	12.71%
TAS	35,949	35,987	35,968	4,273	11.88%
VIC High Rainfall	307,773	361,705	334,739	47,434	14.17%
WA Central	4,467,977	3,562,878	4,015,427	449,325	11.19%
WA Eastern	1,183,575	1,317,130	1,250,353	219,264	17.54%
WA Mallee / Sandplain	899,293	969,261	934,277	203,646	21.80%
WA Northern	1,758,458	1,698,161	1,728,310	300,008	17.36%
Totals	**24,272,536**	**23,654,605**	**23,963,571**	**2,608,468**	**10.89%**

The total area of crop as represented in each AE-Zone in the GRDC dataset is greater than the proportion of either total farms or total farmland in the dataset, as compared with ABS data from a few years earlier. As mentioned, the total number of grain farms in the 2008 dataset is around 5%, while looking at the table above the area of crop these represent is over 10%.

This simply indicates that the GRDC dataset is from generally larger grain producing farms than the overall average. This is discussed further below.

Figures 4, 5 and 6 (below) show the percentage of grain farms and of grain area these represent in the GRDC dataset, and shows these to be larger grain producers than the overall ABS statistical average.

Figure 4. Percentage of farms and cropped area represented by the GRDC dataset by AE-Zone

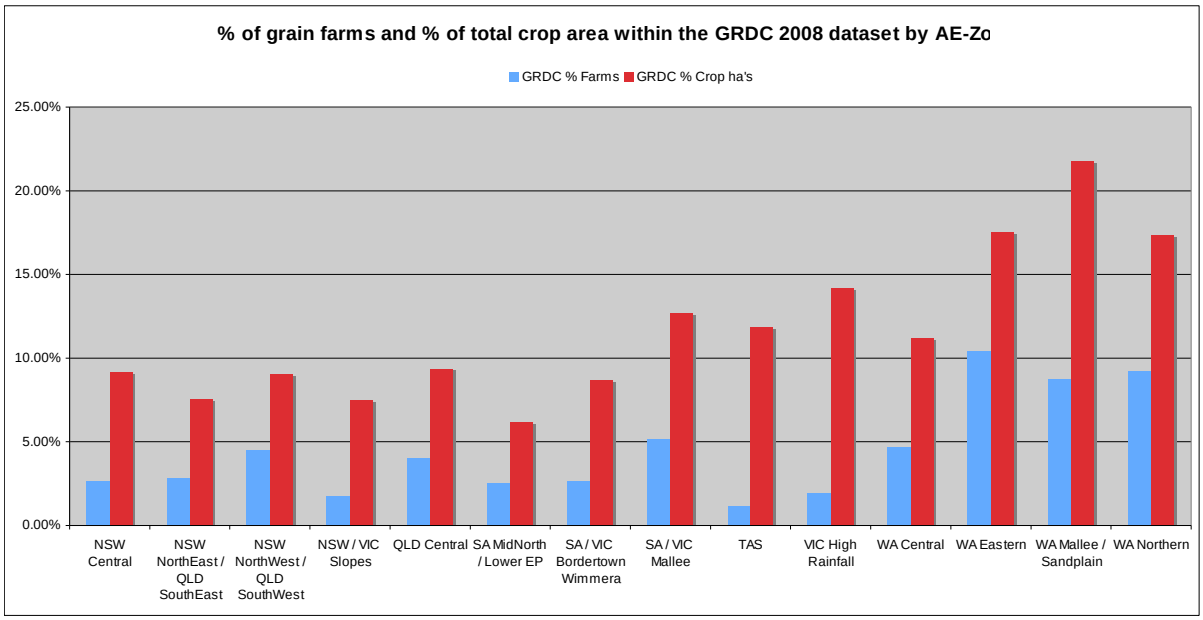


Figure 5. Percentage of total grain farms represented by the GRDC dataset by AE-Zone

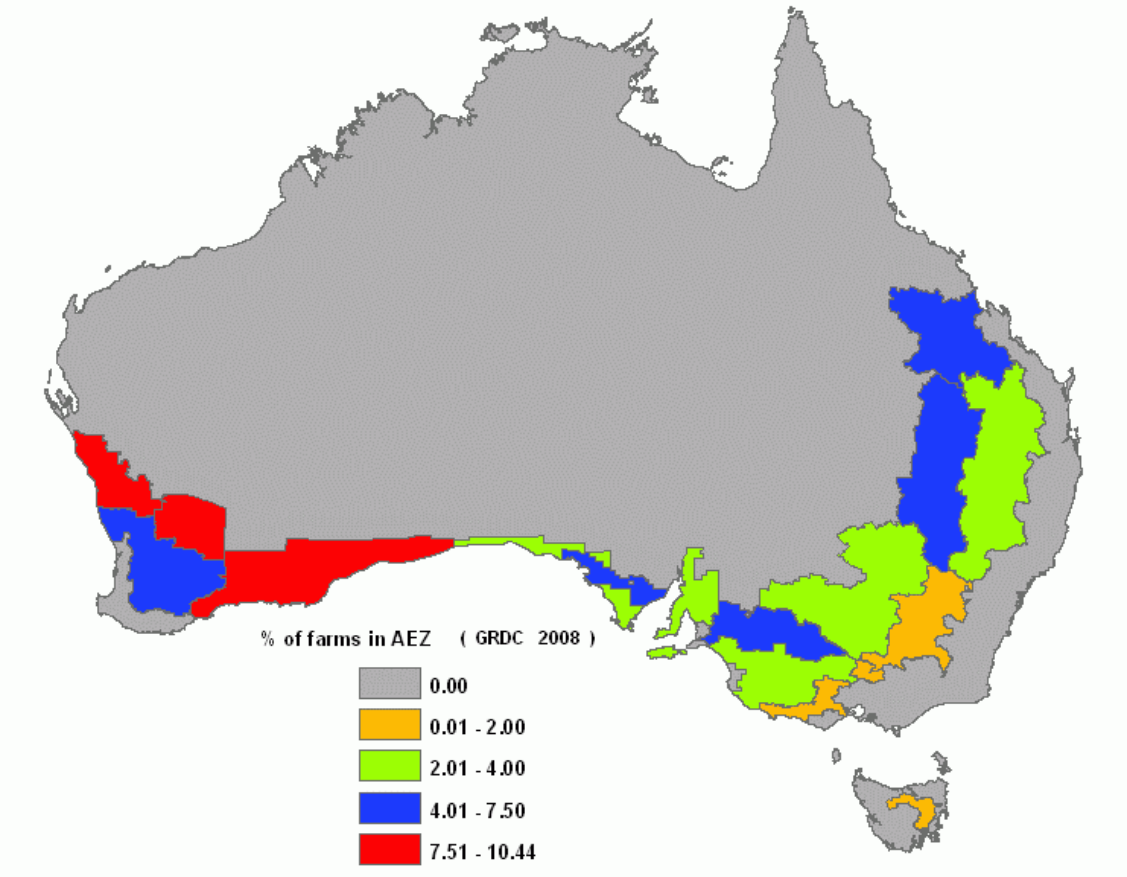
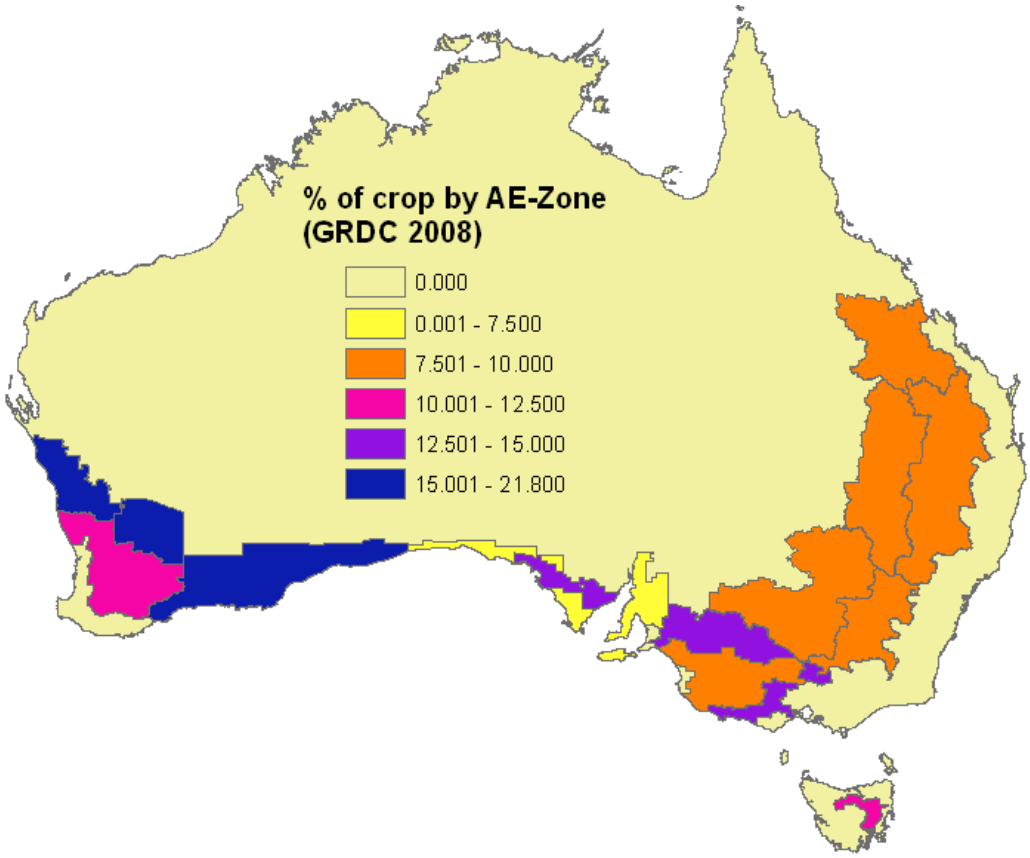


Figure 6. Percentage of total crop represented by the GRDC dataset by AE-Zone



The data in Table 4 show that the GRDC dataset from 2008 covers approximately 11% of the national crop area, based on the average of crop areas as reported by ABS from the previous two national censuses.

This would suggest that the 2009 survey of the 2008 crop has covered a selection of growers that are larger than the overall average, though may represent something closer to the general grain farms, especially those producing the majority of grain. The grain producing population is one where a relatively small proportion tend to represent the majority of total crop production whereby, for example, previous analyses of ABS data suggest that 16% of growers produce over 50% of the grain, and another analysis suggested that 50% of growers produce only 10% of the total grain in Australia. As such, while the GRDC data do not represent a truly statistically representative sample, based on grower numbers versus crop area, it may represent a reasonable reflection of the majority of grain production. The data could possibly also reflect the characteristics of the demographics within the industry, for example, where a grower in the lowest 10% of crop producers (by size) would produce perhaps only 10% (some suggest as low as 1%) of that for a typical grower in the top 10% of the population.

With these features of the industry in mind, the dataset from the survey of 2009 can perhaps be said to give some approximation to the management practices used on a 'typical' 10% or so of the area of crop production in Australia.

Considering the same data presented in Figure 2, it is apparent that varying proportions of farms are represented in the GRDC 2008 dataset between the AE-Zones, whereby in some AE-Zones well over 10% of the crop area is represented and in others less than 10% appears. Some variation between AE-Zones would be expected, though it does appear that the proportion of WA farms presented is greater than those for the other AE-Zones. This is likely to be due to the demographics within the

industry, where the largest grain farms are in WA, and so for a similar percentage of farms, surveyed, a greater proportion of crop area would appear in WA AE-Zones.

It will be for users of these data and analyses to determine whether they use the data from the GRDC survey or some average from the censuses from ABS. In many cases, the data from GRDC of 2008 will be expected to show somewhat higher adoption of some management practices, based on the suggestion that larger grain producers are often more likely to have adopted more advanced practices (though this may not always be true).

Given the above comments, and that the GRDC dataset is potentially for use by farming systems groups and others to establish baseline levels of several practices of interest, it may provide baselines perhaps closer to what might be considered typical, or understood to be current, in the industry as at 2008.

1.2.3 Area of crop per farm

When considering the cropped area and how this represents the actual cropping characteristics of the AE-Zone, it is interesting to look at the amount of crop grown per farm in the GRDC dataset, compared to the average area of crop in the previous ABS censuses. These data are presented in Table 5 and Figures 7 and 8.

Table 5. Average area of crop per farm (ha) from ABS and GRDC, by AE-Zone

AE-Zone	Ave area of crop per farm (ha)			
	2000 (ABS)	2005 (ABS)	ABS (Avg.)	GRDC 2008
NSW Central	596	635	615	2,144
NSW NorthEast / QLD SouthEast	514	559	537	1,426
NSW NorthWest / QLD SouthWest	955	1,007	981	2,010
NSW / VIC Slopes	339	353	346	1,480
QLD Central	1,069	833	951	2,242
SA MidNorth / Lower EP	509	538	523	1,263
SA / VIC Bordertown Wimmera	343	370	356	1,168
SA / VIC Mallee	767	946	856	2,107
TAS	96	116	106	1,068
VIC High Rainfall	169	185	177	1,282
WA Central	949	935	942	2,247
WA Eastern	1,976	2,236	2,106	3,537
WA Mallee / Sandplain	1,078	1,341	1,209	3,040
WA Northern	1,828	1,878	1,853	3,489

Figure 7. Average area cropped per farm in the ABS (2005-06) and GRDC (2008) datasets, by AE-Zone

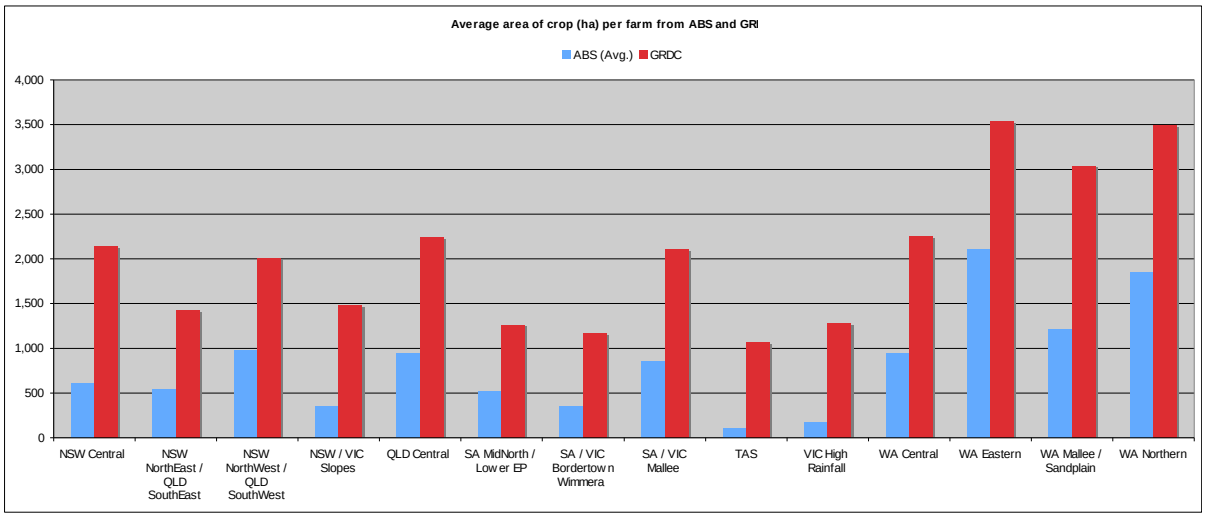
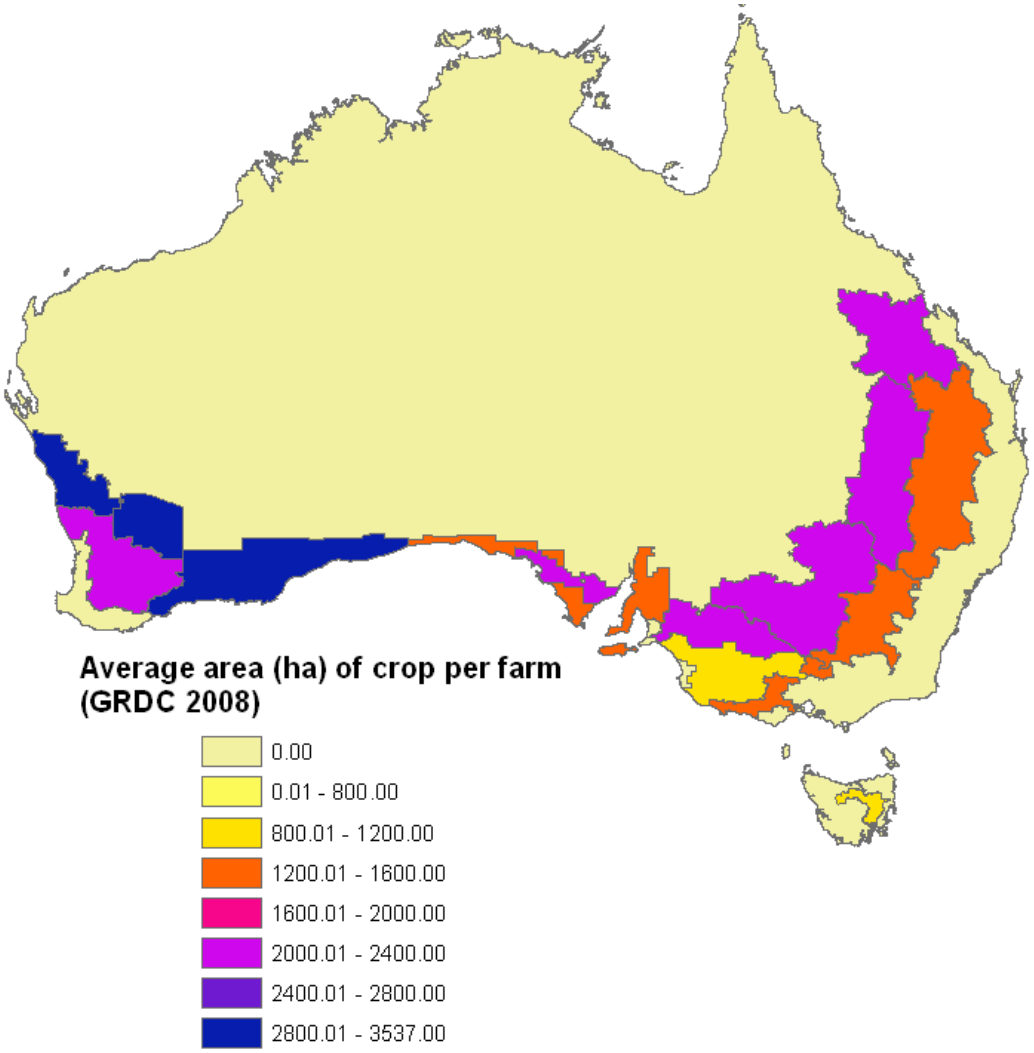


Figure 8. Average area cropped per farm in the GRDC dataset, by AE-Zone



The data presented above only reinforce the previously stated observation that the dataset shows what are generally larger or more intensive grain producers, with this perhaps being reasonable given the skewed nature of grain production in Australia.

1.2.4 Percentage of crop (as proportion of total farm area) per farm

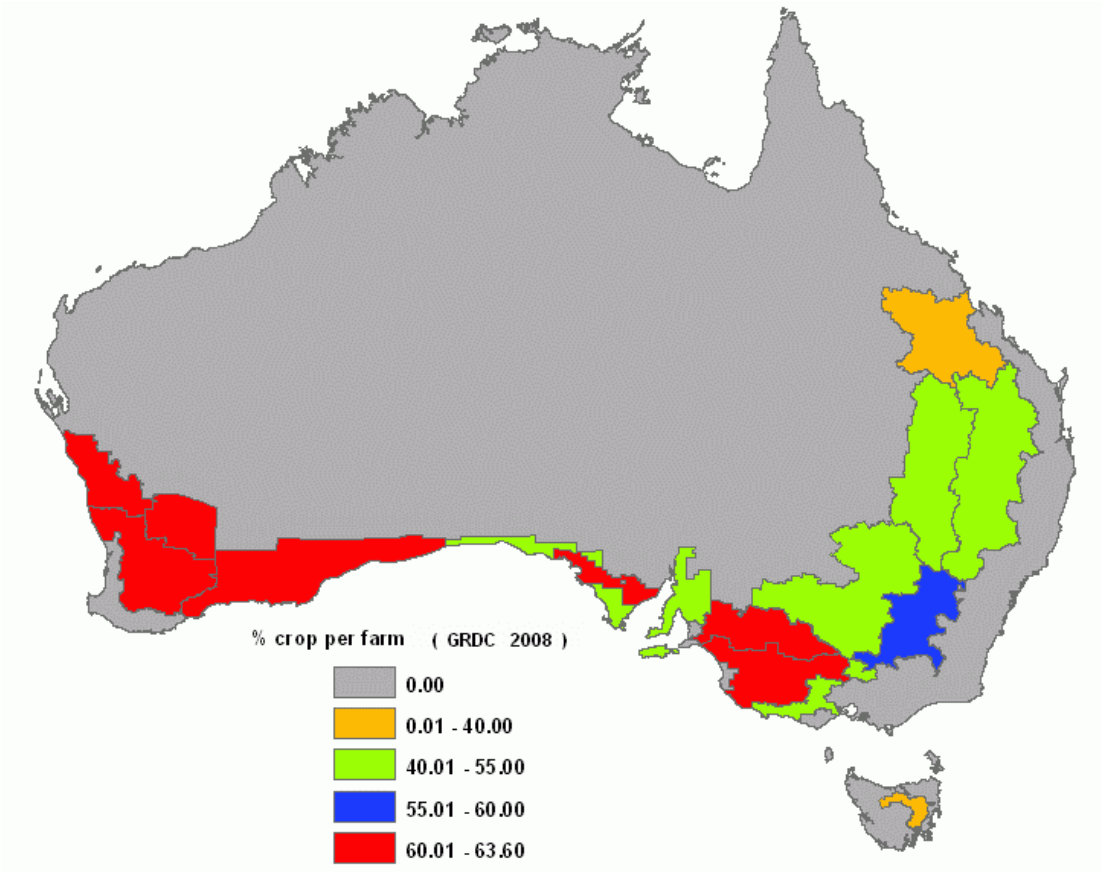
Table 6. Average % of crop as a proportion of total farmland from ABS and GRDC, by AE-Zone

AE-Zone	% Crop of farmland ABS (Avg. of 2000 and 2005)	% Crop of farmland (GRDC 2008)
NSW Central	23.85%	44.4%
NSW NorthEast / QLD SouthEast	49.25%	53.0%
NSW NorthWest / QLD SouthWest	11.60%	44.6%
NSW / VIC Slopes	48.49%	57.4%
QLD Central	18.13%	37.6%
SA MidNorth / Lower EP	8.11%	53.0%
SA / VIC Bordertown Wimmera	54.82%	60.6%
SA / VIC Mallee	94.51%	61.9%
TAS	16.09%	34.4%
VIC High Rainfall	61.16%	54.8%
WA Central	41.25%	61.7%
WA Eastern	43.74%	63.1%
WA Mallee / Sandplain	41.08%	63.6%
WA Northern	27.04%	60.9%

Table 6 (above) and Figure 9 (below) show the proportion of crop in relation to total farmland, averaged for the data for each AE-Zone, both from the ABS and the GRDC survey for 2008.

Again, this suggests that the GRDC dataset is from the more intensive crop producers and that cropped area as a percentage of farm area has increased since the ABS censuses of 2000 and 2005.

Figure 9. Average % of total area cropped per farm in the GRDC dataset, by AE-Zone



1.2.5 Pasture Areas:

Table 7. Area Pasture (from ABS) for 2000-01 and 2005-06, average of these, Pasture area from the GRDC survey of 2009, and the % these represent of the ABS average, by AE-Zone

AE-Zone	Pasture areas (ha total)					
	2000 (ABS)	2005 (ABS)	ABS (Avg)	GRDC (2008 data)	GRDC % v's avg. of 2000 & 2005	GRDC % v's ABS 2000
NSW Central	7,627,869	13,387,830	10,507,849	155,699	1.48%	2.0%
NSW NorthEast / QLD SouthEast	9,974,884	10,941,273	10,458,079	172,033	1.64%	1.7%
NSW NorthWest / QLD SouthWest	13,143,288	24,211,403	18,677,346	130,227	0.70%	1.0%
NSW / VIC Slopes	5,887,163	7,160,667	6,523,915	122,225	1.87%	2.1%
QLD Central	7,294,939	12,870,931	10,082,935	82,275	0.82%	1.1%
SA MidNorth / Lower EP	6,209,068	31,103,503	18,656,285	100,534	0.54%	1.6%
SA / VIC Bordertown Wimmera	3,365,399	3,738,518	3,551,959	85,494	2.41%	2.5%
SA / VIC Mallee	2,166,190	3,385,813	2,776,001	174,457	6.28%	8.1%
TAS	495,614	497,485	496,550	8,070	1.63%	1.6%
VIC High Rainfall	1,683,986	1,786,388	1,735,187	38,031	2.19%	2.3%
WA Central	6,734,538	6,891,265	6,812,901	248,230	3.64%	3.7%
WA Eastern	570,778	1,375,190	972,984	102,953	10.58%	18.0%
WA Mallee / Sandplain	1,966,608	2,777,783	2,372,196	109,128	4.60%	5.5%
WA Northern	3,469,758	5,083,968	4,276,863	168,294	3.93%	4.9%
Totals	70,590,083	125,212,017	97,901,050	1,697,650	1.73%	2.4%

The above Table (Table 7) shows two percentages for the dataset from the 2008 crop year, with the comparisons with the data from the ABS census for 2005-06 showing a considerably higher area of pasture reported for the census year at that time. There are likely reasons for this apparent discrepancy between these census years, though these are not discussed here.

In any case, the dataset from the 2008 crop year shows well under 5% of the farmland in this survey as being pasture, in whatever way 'pasture' is described.

This would lend weight to the observation that this dataset tends to comprise farms that are more crop-intensive, with pastoral or grazing operations being minor in terms of area of these farms.

At the same time, there are some AE-Zones where one would expect areas of 'pasture' to be high, noting those of the mallee and eastern wheat belt of WA as examples, with the survey data from 2008 supporting this understanding.

1.2.6 Native Vegetation:

Table 8. Area of Native Vegetation (from ABS) for 2000-01 and 2005-06, average of these, Native Vegetation area from GRDC in 2009, and the % these represent of the ABS average, by AE-Zone

AE-Zone	Native vegetation (ha)				%	%
	2000 (ABS)	2005 (ABS)	ABS (Avg)	GRDC 2008	GRDC %	GRDC % v's 2005
NSW Central	7,313,301	700,849	4,007,075	42,904	1.07%	6.1%
NSW NorthEast / QLD SouthEast	4,473,964	746,494	2,610,229	23,466	0.90%	3.1%
NSW NorthWest / QLD SouthWest	11,382,067	885,840	6,133,953	19,693	0.32%	2.2%
NSW / VIC Slopes	1,318,248	325,877	822,062	9,828	1.20%	3.0%
QLD Central	4,908,777	570,355	2,739,566	2,879	0.11%	0.5%
SA MidNorth / Lower EP	2,443,938	382,870	1,413,404	7,583	0.54%	2.0%
SA / VIC Bordertown Wimmera	1,077,235	151,400	614,318	9,147	1.49%	6.0%
SA / VIC Mallee	3,175,531	424,612	1,800,072	59,755	3.32%	14.1%
TAS	156,239	74,387	115,313	45	0.04%	0.1%
VIC High Rainfall	439,550	59,371	249,461	1,028	0.41%	1.7%
WA Central	3,352,339	629,339	1,990,839	26,889	1.35%	4.3%
WA Eastern	1,149,015	427,575	788,295	23,727	3.01%	5.5%
WA Mallee / Sandplain	2,580,623	236,202	1,408,413	11,386	0.81%	4.8%
WA Northern	1,205,997	342,933	774,465	23,138	2.99%	6.7%
Totals	**44,976,826**	**5,958,103**	**25,467,465**	**261,468**	**1.03%**	**4.4%**

Table 8 (above) shows a similar seat of data for the areas of native vegetation on farms. Again, there is a very large difference in areas reported as 'native vegetation' on farms between the two ABS census years that are (again) not the subject of this report. Though one would note the difference in native vegetation and pasture areas reported in each census are such that they tend to 'balance' (at least to some degree) each other, whereby the huge increase in 'pasture' in the 2005-06 census is somewhat offset by the large decrease in 'native vegetation' in that census year.

In any case, the dataset from the GRDC survey of 2009 shows under 5% of total area of native vegetation as compared to whichever figure from ABS is the true total on farms in the AE-Zones of Australia. This again suggests that this dataset has found the larger or more specialist grain producers in the subset of the population represented by survey participants.

An analysis of the proportions of crop, pasture and native (or remnant) vegetation on farms will be presented in a separate report, where land use is considered. The inclusion of cropped areas here is to provide guidance as to the nature of the datasets being examined and presented in this series of reports.

Appendix 2: Questions used in GRDC Survey 2009

Q1. Good evening [03title] [05first] [06surname], my name is ____ from Solutions Research. We are conducting a study for the Grains Research and Development Corporation (GRDC) on Farming Practices with grain producers. This will assist research and product development to meet your future needs This is strictly a research project and we are not selling anything. Naturally all responses and opinions you share are held in the strictest of confidence and are used for statistical purposes only. The survey will take around 15 minutes. Would you be able to help with this study?

Q2. Thanks for your help; your time is greatly appreciated. Firstly we need to classify property types so that we can be sure have interviewed a representative cross section of rural producers. Thinking of all your on-farm income, that is, only income from your property, over the last 3 full financial years, on average roughly what percentage of income came from the following activities?

Beef Cattle
Sheep including Wool & Prime Lambs
Dairy
Winter Cereal Grain crops (eg. Wheat, Barley, Oats, Triticale)
Winter Legume Crops (eg Lupins, Chickpeas, Lentils, Beans, Peas etc)
Winter Oilseeds (eg Canola, Mustard etc)
Summer Cereals (eg Sorghum, Maize and Corn etc)
Summer Legumes (eg Soybeans, mungbeans)
Summer Oilseeds (eg Sunflowers)
Sugar Cane
Cotton
Rice
Horticultural / Vegetable Crops
Other Crops
Other Livestock

Q4. State

NSW
VIC
QLD

SA
WA
TAS
NT

Q5. Farm Type Question Crops, Livestock

Grains
Grain/Livestock
Beef and Sheep
Beef
Sheep
Dairy
Sugar Cane
Cotton
Horticulture
QNA

Q6. Questions - AE Zones

NSW Central
NSW NorthEast / QLD SouthEast
NSW NorthWest / QLD SouthWest
NSW / VIC Slopes
QLD Central
SA MidNorth / Lower EP
SA / VIC Bordertown Wimmera
SA / VIC Mallee
TAS
VIC High Rainfall
WA Central
WA Eastern
WA Mallee / Sandplain
WA Northern

Q7. What crops did you sow between the 1st of January and the 31st of December 2008?

Wheat - bread
Wheat - Durum
Barley - feed
Barley - malt
Oats
Triticale
Cereal Rye
Canola
Mustard
Linola
Sorghum
Maize / Corn
Sunflowers
Chick Peas
Field Peas

Lentils
Lupins
Faba Beans
Broad Beans
Vetch
Soy Beans
Mung Beans
Cotton
Cow peas
Azuki beans
Navy beans
Lima beans
DID NOT GROW CROPS

Q8. And what is the total area of your property, including all leased land and any unused land?

Q11. Now thinking back to 2008, excluding any share farming arrangements, what percentage of your property was

used for cropping
Pasture (improved and unimproved)
Native and / or remnant vegetation
Roadways. buildings etc

Q12. How many months of fallow did you have prior to planting Bread Wheat in 2008?

Q13. How many hectares of Bread Wheat did you plant in 2008?

Q14. And in what month (s) did you plant your Bread Wheat in 2008?

Q15. How many hectares of Bread Wheat did you harvest that you sowed in 2008?

Q16. And in what month (s) did you harvest your Bread Wheat that you sowed in 2008?

Q17. What was the average yield of the Bread Wheat that you sowed in 2008?

Q18. What was the average Grain Protien of the Bread Wheat that you sowed in 2008?

Q19. And what fertilisers did you apply to your Bread Wheat that you sowed in 2008?

Q20. And what was the average rate of Fertiliser that you applied to your Bread Wheat?

Q21. How many months of fallow did you have prior to planting Durum Wheat in 2008?

Q22. How many hectares of Durum Wheat did you plant in 2008?

Q23. And in what month (s) did you plant your Durum Wheat in 2008?

Q24. How many hectares of Durum Wheat did you harvest that you sowed in 2008?

Q25. And in what month (s) did you harvest your Durum Wheat that you sowed in 2008?

Q26. What was the average yield of the Durum Wheat that you sowed in 2008?

Q27. What was the average Grain Protein of the Durum Wheat that you sowed in 2008?

Q28. And what fertilisers did you apply to your Durum Wheat that you sowed in 2008?

Q29. And what was the average rate of [LQ28] that you applied to your Durum Wheat?

Q30. How many months of fallow did you have prior to planting Feed Barley in 2008?

Q31. How many hectares of Feed Barley did you plant in 2008?

Q32. And in what month (s) did you plant your Feed Barley in 2008?

How many hectares of Feed Barley did you harvest that you sowed in 2008?

Q33.

Q34. And in what month (s) did you harvest your Feed Barley that you sowed in 2008?

Q35. What was the average yield of the Feed Barley that you sowed in 2008?

Q36. What was the average Grain Protien of the Feed Barley that you sowed in 2008?

Q37. And what fertilisers did you apply to your Feed Barley that you sowed in 2008?

Q38. And what was the average rate of [LQ37] that you applied to your Feed Barley?

Q39. How many months of fallow did you have prior to planting Malting Barley in 2008?

Q40. How many hectares of Malting Barley did you plant in 2008?

Q41. And in what month (s) did you plant your Malting Barley in 2008?

Q42. How many hectares of Malting Barley did you harvest that you sowed in 2008?

Q43. And in what month (s) did you harvest your Malting Barley that you sowed in 2008?

Q44. What was the average yield of the Malting Barley that you sowed in 2008?

Q45. What was the average Grain Protien of the Malting Barley that you sowed in 2008?

Q46. And what fertilisers did you apply to your Malting Barley that you sowed in 2008?

Q47. And what was the average rate of [LQ46] that you applied to your Malting Barley?

Q48. How many months of fallow did you have prior to planting Oats in 2008?

Q49. How many hectares of Oats did you plant in 2008?

Q50. And in what month (s) did you plant your Oats in 2008?

Q51. How many hectares of Oats did you harvest that you sowed in 2008?

Q52. And in what month (s) did you harvest your Oats that you sowed in 2008?

Q53. What was the average yield of the Oats that you sowed in 2008?

Q54. What was the average Grain Protien of the Oats that you sowed in 2008?

Q55. And what fertilisers did you apply to your Oats that you sowed in 2008?

Q56. And what was the average rate of [LQ55] that you applied to your Oats?

Q57. How many months of fallow did you have prior to planting Triticale in 2008?

Q58. How many hectares of Triticale did you plant in 2008?

Q59. And in what month (s) did you plant your Triticale in 2008?

Q60. How many hectares of Triticale did you harvest that you sowed in 2008?

Q61. And in what month (s) did you harvest your Triticale that you sowed in 2008?

Q62. What was the average yield of the Triticale that you sowed in 2008?

Q63. What was the average Grain Protien of the Triticale that you sowed in 2008?

Q64. And what fertilisers did you apply to your Triticale that you sowed in 2008?

Q65. And what was the average rate of [LQ64] that you applied to your Triticale?

Q66. How many months of fallow did you have prior to planting Cereal Rye in 2008?

Q67. How many hectares of Cereal Rye did you plant in 2008?

Q68. And in what month (s) did you plant your Cereal Rye in 2008?

Q69. How any hectares of Cereal Rye did you harvest that you sowed in 2008?

Q70. And in what month (s) did you harvest your Cereal Rye that you sowed in 2008?

Q71. What was the average yield of the Cereal Rye that you sowed in 2008?

Q72. What was the average Grain Protien of the Cereal Rye that you sowed in 2008?

Q73. And what fertilisers did you apply to your Cereal Rye that you sowed in 2008?

Q74. And what was the average rate of [LQ73] that you applied to your Cereal Rye?

Q75. How many months of fallow did you have prior to planting Sorghum in 2008?

Q76. How many hectares of Sorghum did you plant in 2008?

Q77. And in what month (s) did you plant your Sorghum in 2008?

Q78. How many hectares of Sorghum did you harvest that you sowed in 2008?

Q79. And in what month (s) did you harvest your Sorghum that you sowed in 2008?

Q80. What was the average yield of the Sorghum that you sowed in 2008?

Q81. What was the average Grain Protien of the Sorghum that you sowed in 2008?

Q82. And what fertilisers did you apply to your Sorghum that you sowed in 2008?

Q83. And what was the average rate of [LQ82] that you applied to your Sorghum?

Q84. How many months of fallow did you have prior to planting Maize / Corn in 2008?

Q85. How many hectares of Maize / Corn did you plant in 2008?

Q86. And in what month (s) did you plant your Maize / Corn in 2008?

Q87. How many hectares of Maize / Corn did you harvest that you sowed in 2008?

Q88. And in what month (s) did you harvest your Maize / Corn that you sowed in 2008?

Q89. What was the average yield of the Maize / Corn that you sowed in 2008?

Q90. What was the average Grain Protien of the Maize / Corn that you sowed in 2008?

Q91. And what fertilisers did you apply to your Maize / Corn that you sowed in 2008?

Q92. And what was the average rate of [LQ91] that you applied to your Maize / Corn?

Q93. How many months of fallow did you have prior to planting Canola in 2008?

Q94. How many hectares of Canola did you plant in 2008?

Q95. And in what month (s) did you plant your Canola in 2008?

Q96. How many hectares of Canola did you harvest that you sowed in 2008?

Q97. And in what month (s) did you harvest your Canola that you sowed in 2008?

Q98. What was the average yield of the Canola that you sowed in 2008?

Q99. What was the average Oil Content of the Canola that you sowed in 2008?

Q100. And what fertilisers did you apply to your Canola that you sowed in 2008?

Q101. And what was the average rate of [LQ100] that you applied to your Canola?

Q102. How many months of fallow did you have prior to planting Mustard in 2008?

Q103. How many hectares of Mustard did you plant in 2008?

Q104. And in what month (s) did you plant your Mustard in 2008?

Q105. How many hectares of Mustard did you harvest that you sowed in 2008?

Q106. And in what month (s) did you harvest your Mustard that you sowed in 2008?

Q107. What was the average yield of the Mustard that you sowed in 2008?

Q108. What was the average Oil Content of the Mustard that you sowed in 2008?

Q109. And what fertilisers did you apply to your Mustard that you sowed in 2008?

Q110. And what was the average rate of [LQ109] that you applied to your Mustard?

Q111. How many months of fallow did you have prior to planting Linola in 2008?

Q112. How many hectares of Linola did you plant in 2008?

Q113. And in what month (s) did you plant your Linola in 2008?

Q114. How many hectares of Linola did you harvest that you sowed in 2008?

Q115. And in what month (s) did you harvest your Linola that you sowed in 2008?

Q116. What was the average yield of the Linola that you sowed in 2008?

Q117. What was the average Oil Content of the Linola that you sowed in 2008?

Q118. And what fertilisers did you apply to your Linola that you sowed in 2008?

Q119. And what was the average rate of [LQ118] that you applied to your Linola?

Q120. How many months of fallow did you have prior to planting Sunflowers in 2008?

Q121. How many hectares of Sunflowers did you plant in 2008?

Q122. And in what month (s) did you plant your Sunflowers in 2008?

Q123. How many hectares of Sunflowers did you harvest that you sowed in 2008?

Q124. And in what month (s) did you harvest your Sunflowers that you sowed in 2008?

Q125. What was the average yield of the Sunflowers that you sowed in 2008?

Q126. What was the average Oil Content of the Sunflowers that you sowed in 2008?

Q127. And what fertilisers did you apply to your Sunflowers that you sowed in 2008?

Q128. And what was the average rate of [LQ127] that you applied to your Sunflowers?

Q129. How many months of fallow did you have prior to planting Winter Pulses in 2008?

Q130. How many hectares of Winter Pulses did you plant in 2008?

Q131. And in what month (s) did you plant your Winter Pulses in 2008?

Q132. How many hectares of Winter Pulses did you harvest that you sowed in 2008?

Q133. And in what month (s) did you harvest your Winter Pulses that you sowed in 2008?

Q134. What was the average yield of the Winter Pulses that you sowed in 2008?

Q135. And what fertilisers did you apply to your Winter Pulses that you sowed in 2008?

Q136. And what was the average rate of [LQ135] that you applied to your Winter Pulses?

Q137. How many months of fallow did you have prior to planting Summer Pulses in 2008?

Q138. How many hectares of Summer Pulses did you plant in 2008?

Q139. And in what month (s) did you plant your Summer Pulses in 2008?

Q140. How many hectares of Summer Pulses did you harvest that you sowed in 2008?

Q141. And in what month (s) did you harvest your Summer Pulses that you sowed in 2008?

Q142. What was the average yield of the Summer Pulses that you sowed in 2008?

Q143. And what fertilisers did you apply to your Summer Pulses that you sowed in 2008?

Q144. And what was the average rate of [LQ143] that you applied to your Summer Pulses?

Q145. How many months of fallow did you have prior to planting your Cotton in 2008?

Q146. How many hectares of Cotton did you plant in 2008?

Q147. In the sowing of your crops in 2008, what percentage, was sown using

Zero Tillage (< 10% soil disturbance, e.g. disc planters)
No Tillage (< 30% soil disturbance, e.g. knife points)
Direct Drill (One pass at sowing, with full cut planting)
One or two cultivations prior to planting operation
Reduced Tillage (One cultivation before sowing but less soil disturbance than conventional at sowing.)
More than two cultivations prior to sowing

Q148. Precision Agriculture In 2008, what percentage of your crop did you use Controlled Traffic / Tramlines?

Q149. In 2008, what percentage of your crop did you use Autosteer GPS systems?

Q150. In 2008, what percentage of your crop did you use Yield mapping or similar technology?

Q151. Thinking about stubble practices, for you crops sown in 2008, what percentage of your stubble was...

Intact at Planting – standing, no grazing
Not Standing (eg Grazed, Slashed, Mulched, Incorporated)
Cool Burn
Hot Burn
Burning of windrows for weed management
Stubble Raking / Windrow Burning – whole paddock
Stubble Baled

Q152. Now thinking about Soil Conditioners, prior to sowing your crops in 2008, did you apply any

Lime
Gypsum
Dolomite
None (DO NOT READ OUT)

Q153. How many tonnes of [LQ152] did you apply?

Q154. And how many hectares did you apply [LQ152] to?

Q155. Do you routinely undertake nutrient soil tests?

Yes

No

Q156. And what percentage of your arable land has soil testing?

Q157. And on average, how often do you soil test any given paddock?

Yearly

Every 2 years

Every 3 years

Q158. And of your arable land, what percentage of it, has its fertiliser use based on soil tests or other predictive tools?

Q159. What percentage of your arable land has fertiliser applied using variable rate technology

Q160. What percentage of your arable land has been characterised, or tested to determine soil features (i.e. bulk density, texture, sodicity, salinity, rooting depth, water holding capacity etc)

Q161. And what percentage of your crop is planted to match crop type or variety with land capability?

Q162. What percentage of your cropping area do you measure soil water holding capacity before sowing?

Q163. What percentage of your cropping area do you measure soil water holding capacity throughout the season?

Q164. Do you have a formal integrated weed / pest / management plan, such as the use of tillage, beneficial insects for your farm?

Yes

No

Q165. And what percentage of your crop in managed with a formal integrated management plan?

Q166. Does your integrated management plan incorporate the following

Weed Management (e.g. with herbicide resistance in mind)

Insect Pests Management (e.g. with beneficial insects and predators in mind)

Diseases Management (e.g. rust, root diseases)

Q167. What is the capacity of your permanent on-farm storage for grain?

Tonnes

Bushels

Don't Know

Q168. Approximately, how many litres of diesel fuel do you use a year in your cropping operation?

Q169. Did you run any commercial grazing livestock last year?

Yes

No

Q170. And what type of livestock did you run?

Beef cattle

Dairy cattle

Sheep (wool and prime lambs)

Goats

Deer

Q171. And what was the average number of [LQ170] that you ran last year?

Q172. And what was the average stocking rate for your [LQ170] last year?

Q173. Do you adjust your [LQ170] stocking rate considering feed on offer, ground cover etc?

Yes

No

Q176. Thinking about the native vegetation on your farm, how many hectares would you say are in [LQ175] condition?

Q177. Now thinking about 2008, what area of your property did you revegetate?

Q178. And what was the area of native / remnant vegetation that was fenced off, or stock excluded, to protect remnant vegetation

Q179. And what was the area of native / remnant vegetation that was fenced off to protect

waterways and riparian areas.

Q180. And what is the area of native / remnant vegetation that may be used for future biomass crops / tree crops?

Q181. What is the area of your farm that has native or sown perennial vegetation, including pastures?

Q182. How many hectares of perennials did you sow in 2008?

Q183. And what types of perennials did you sow in 2008?

Lucerne
Saltbush
Medics
Perennial Phalaris

Q184. And how long on average, do you maintain your perennials?

1 year
2 years
3 years
4 years
5 years

Q188. And what is the name of your nearest Rainfall Station?

Don't Know

Q189. Could you tell me into which of the following age groups you fall?

18 - 24
25 - 34
35 - 44
45 - 54
55 - 64
65 and over
Refused (DO NOT READ OUT)

Q190. Has anyone involved with managing the farm completed a university degree or diploma?

Q191. Thinking of all your sources of on-farm income over the last 3 full financial years, on average what was the annual gross on-farm income of your business? (i.e. the average annual income derived from your farm BEFORE operating expenses and tax are taken out). Would you say it was ...

Under $100,000
$100,000 - under $200,000
$200,000 - under $500,000

$500,000 - under $1m
$1m to under $5m
$5m or more
Refused/Prefer not to say (DO NOT READ OUT)
Don't know (DO NOT READ OUT)