Final report

Adaptation to Climate Change in Southern Livestock Program, South Australia SLA 2030

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Abstract

The Climate Change Adaptation in the Southern Australian Livestock Industries program focused on the mitigation of greenhouse gases and climate change adaptation options at a farm systems level. During this three-year project, 325 livestock producers were directly engaged to look at the impacts and potential adaptations of climate change on livestock enterprises by 2030. The livestock producers were engaged at workshops and seminars at seven locations run in the southeast, Fleurieu Peninsula, Mid North and Eyre Peninsula regions of South Australia. Generally, by 2030 the impacts of climate change on livestock and pasture production in Southern Australia is most likely to include be shorter growing seasons, greater variability in pasture growth, reduced pasture quality, increased variability in farm gross margins, reduced livestock production from high heat days, reduced wool quality. However through appropriate management interventions addressing seasonal variability and strategic long term planning, farm profits can be maintained or improved.

Executive summary

Background

This sub-program of the Climate Change Adaptation in the Southern Australian Livestock Industries program focused on the mitigation of greenhouse gases and climate change adaptation options at a farm systems level. Supplementary feed requirements were an aspect of management likely to be compromised with later lambing or calving and higher stocking rates. This project established modelling capacity across a range of Industry research, development, and extension (RD&E) providers that will assist industry in evaluating adaptation options in more detail across a range of agro-climatic regions.

Objectives

- By 2011, a knowledge base established to underpin ongoing engagement with livestock producers in South Australia, and to facilitate further research, development, and extension in climate change adaptation.
- By 2011, 1400 livestock producers across SA are aware of the key research outcomes of the program through a combination of field days, workshops, media and written material and use of the SARDI climate support program.
- By 2012, a program of on farm trailing of key recommendations within each of the agro-climatic regions of Southern Australia will be defined for implementation during the period 2012-2015 via the MLA Producer Demonstration Sites (PDS) programs and similar programs supported by other RDE providers.
- An improved modelling capacity established across a range of Industry RD&E providers that will assist industry in evaluating adaptation options in more detail across a range of agro-climatic regions.

Objectives one, two and four were achieved and objective 3 was achieved after modification to action an on ground project.

Methodology

To engage producers in South Australia four methods were utilised to explore the impacts of climate change to 2030:

- Climate change projections using four Global Climate models and the pasture production model GrassGro model;
- A sensitivity analyses using the Sustainable Grazing Systems (SGS) model (looking at temperature increases and rainfall decreases);
- Trends using GrassGro and time in history where it was known to be hotter and drier (e.g. 1995-2005;
- Spatial analyses looking at alternative locations where it is known to be hotter and drier and looking at management approaches in these regions.

Results/key findings

During this three-year project, 325 livestock producers were directly engaged to look at the impacts and potential adaptations of climate change on livestock enterprises by 2030. The livestock producers were engaged at workshops and seminars at seven locations run in the south-east, Fleurieu Peninsula, Mid North, and Eyre Peninsula regions of South Australia.

Generally, across SA by 2030 the impacts of climate change on livestock and pasture production is most likely to be:

- Shorter growing seasons
- Greater variability in pasture growth
- Reduced pasture quality
- Increased variability in farm gross margins
- High heat days will reduce livestock production
- Wool quality reduced

Benefits to industry

Thirty base enterprises have been set up in GrassGro making this a valuable resource for now and in the future. This data could be used to do any number of analyses including total carbon emissions. The GrassGro model can be used in tandem with the AusFarm model to do some of this analysis. Some of this work can be completed in South Australia, however it could adopted to other states using their base runs.

Future research and recommendations

There is scope on most farms to improve pasture utilisation and grazing systems and thus profit. This approach should also reduce methane emissions, as in theory, better pastures and utilisation, animals will reach target weight quicker and be removed from property sooner, reducing net methane emissions on farm. Any case study or project that can demonstrate this with case studies in conjunction with modelling would be a valuable initiative.

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1. Background

This sub-program of the Climate Change Adaptation in the Southern Australian Livestock Industries program focused on the mitigation of greenhouse gases and climate change adaptation options at a farm systems level. Supplementary feed requirements were an aspect of management likely to be compromised, with later lambing or calving and higher stocking rates. This project established modelling capacity across a range of Industry research, development, and extension (RD&E) providers that will assist industry in evaluating adaptation options in more detail across a range of agro-climatic regions.

2. Objectives

- By 2011, a knowledge base established to underpin ongoing engagement with livestock producers in South Australia, and to facilitate further research, development, and extension in climate change adaptation.
- By 2011, 1400 livestock producers across South Australia are aware of the key research outcomes of the program through a combination of field days, workshops, media and written material and use of the SARDI climate support program.
- By 2012, a program of on farm trailing of key recommendations within each of the agro-climatic regions of Southern Australia will be defined for implementation during the period 2012-2015 via the MLA Producer Demonstration Sites (PDS) programs and similar programs supported by other RDE providers.
- An improved modelling capacity established across a range of Industry RD&E providers that will assist industry in evaluating adaptation options in more detail across a range of agro-climatic regions.

Table 1 below, lists the project objectives as per contract and their status at the end of the project.

Table 1: Project objectives as per contract and their status.

Objective	Status at Project End
1. By 2011, a knowledge base will be established to underpin ongoing engagement with livestock producers in South Australia, and to facilitate further research and development and extension in climate change adaptation.	**Achieved**
2. By 2011, 1400 livestock producers across SA will be aware of the key research outcomes of the program through a combination of field days, workshops, media and written material and use of the SARDI climate support program.	**Achieved**
3. By 2012, a program of on farm trialing of key recommendations within each of the agro-climatic regions of Southern Australia will be defined, for implementation during the period 2012-2015 via the MLA Producer Demonstration Sites (PDS) program and similar programs supported by other RDE providers.	**Modified to action on ground project**
4. An improved modelling capacity will be established across a range of Industry RD&E providers that will assist industry in evaluating adaptation options in more detail across a range of agro-climatic regions.	**Achieved**

2.1 Project Activities

The contracted requirements of the project activities in South Australia and their status at the conclusion of this project are listed below in Table 2.

Table 2: Contracted requirements of the project in SA and their status.

Activity	Contracted requirement	Status at Project End
1. Regions modelled	3	4
2. Locations modelled	6	7
3. Enterprises modelled		NA
4. Producer workshops held	6	10
5. Other awareness events held (e.g. seminars)	8	12
6. Producers directly engaged		322
7. Communication products produced	2 TO 3	33
8. Producers aware of the key project findings?	1400	2819
9. **Adaptations modelled**		NA

3. Methodology

3.1 Heading

In order to engage producers in South Australia we utilised four methods to explore the impacts of climate change to 2030 including:

- Climate change projections using four Global Climate models and the pasture production model GrassGro model (Moore and Donnelly et al 1997);
- A sensitivity analyses using the Sustainable Grazing Systems (SGS) model (Johnson, Lodge et al. 2003) (looking at temperature increases and rainfall decreases);
- Trends using GrassGro and time in history where it was known to be hotter and drier (e.g. 1995-2005;
- Spatial analyses looking at alternative locations where it is known to be hotter and drier and looking at management approaches in these regions.

The GrassGro model uses pasture species in the region, a selected soil from the region and rainfall and temperature from the region. The historical period from a range of base periods like 1970-1999 and 2000-2008 was used as a comparison for future pasture production to 2030. The 1995 to 2005 period was also selected for a trend analyses. It was chosen because it is one that producers can remember had a highly variable climate and they can relate to it in terms of the management practices they employed to deal with the variability. Climate change data used in GrassGro was downscaled using the “Weather Maker” modelling program (CSIRO 2009). The four Global Climate models were chosen from a possible 23 due to their performance in southern Australia. The models include Geophysical Fluid Dynamics Laboratory (GFDL) (USA 1), ECHAM (German), Community Climate System Model (CCSM) (USA 2), and Hadley Centre Global Environment Model (HadGEM) (UK).

The sensitivity analyses was performed to examine the impact of incremental temperature and rainfall changes on pasture growth. The SGS pasture model (Johnson, Lodge et al. 2003) was used for the analyses and run by Brendan Cullen (University of Melbourne). We used temperature increases from 0 to 2°C above baseline, rainfall declines of 0 to 20% from the baseline and carbon dioxide concentration of 450 ppm in all scenarios.

About 150 producers were shown the impacts of climate change using the four approaches above. Producer input was essential to ensure the enterprises investigated were relevant; the modelled base runs were accurate. These 150 producers were also consulted as to the potential adaptations we should test.

The adaptations were tested where viable using the GrassGro model. These adaptations were shown to a further 150 odd producers and discussed. Climate trends and alternative locations were also used to discuss adaptations. The livestock producers looked at the most viable adaptations and listed which adaptations they would most likely implement due to their practically and viability. The locations, enterprises and adaptations are shown in Table 3 below.

Table 3: Locations, enterprises and adaptations tested in South Australia

Location	Enterprise	Adaptations tested
Keith (upper south east)	Self-replacing large (57kg ref wgt) wool merino	• Stocking rate 3 .5, 4.5 and 5.5 ewes/ha • Lambing mid may, mid-June and mid-July • Wean 16 weeks • Annuals pasture only, perennial pasture only, mix of pasture • Various soil types from the region
Keith	Cross Bred Ewes (Border Leicester x Merino)	As above
Keith	Self-replacing Angus Cow Herd	• Stocking rate 0.4, 0.6 and 0.8 cows/ha • Calving mid Feb, Apr and July • Wean 29 weeks • Annuals pasture only, perennial pasture only, mix of pasture • Various soil types from the region
Lucindale (mid south east)	Merino Ewe Fine Wool – Self Replacing	• Stocking rate 5.5, 7 and 8.5 ewes/ha • Lambing mid-March, early June and mid July • Annuals pasture only, perennial pasture only, mix of pasture • Various soil types from the region
Lucindale	Hereford Beef Cows	• Stocking rate .8, 1 and 1.2 cows/ha • Calving April, July and Feb • Stocking rate 0.85, 1 and 1.5 cows/ha • Calving April, July and Feb • Annuals pasture only, perennial pasture only, mix of pasture • Various soil types from the region
Millicent	Sheep cross – Meat. Border leister/Merino Ewe x Poll Dorset Ram	• Stocking rate 5.5, 7 and 8.5 ewes/ha • Lambing March, June and August • Annuals pasture only, perennial pasture only, mix of pasture • Various soil types from the region
Millicent	British x Friesian cow breeding self-replacing herd	• Stocking rate 0.85, 1 and 1.5 cows/ha • Calving April, July and Feb • Annuals pasture only, perennial pasture only, mix of pasture • Various soil types from the region

<table>
<tr><td>Millicent</td><td>Cross Bred Cows

Buy replacements</td><td>Stocking rate 0.85, 1 and 1.5 cows/ha
Calving April, Aug and Feb
Annuals pasture only, perennial pasture only, mix of pasture
Various soil types from the region</td></tr>
<tr><td>Fleurieu</td><td>Angus Cow Vealers vs Angus Cow Weaners

Self-replacing</td><td>0.7, 1 and 1.3cows/ha
Calving mid Mar, Apr and May.
Wean calves at 42 weeks
Mate heifers at 15 months
Feed hay in paddock to maintain weight of average animal and ground cover
All steers and surplus heifers sold or 350 kg or 44 weeks (vealers only). Weaners sold at 19 months.</td></tr>
<tr><td></td><td>Angus Steer trading</td><td>Cows 550 kg standard reference weight
Yearlings 360kg, 2-3yo 515kg, 3-4yo609kg
Stocking rate 3, 3.5 & 4/ha
Buy Feb, replace Feb following year
Feed hay in paddock to maintain conditions score of 2.5
Sell 16 months</td></tr>
<tr><td>Eyre Peninsula</td><td>Merino</td><td>Native Grass vs Cocksfoot pasture
Hilly hard shallow soil vs Deeper soil
Weight of mature ewe in average condition 60 kg. Buy in ewes
Wool 21 micron
4.5, 5.5 and 6.5 ewes/ha
Lambing mid May, Jun and July.
Wean lambs at 14 weeks
Feed Barley in paddock to maintain condition score targets Also feed when total dry matter falls below 500 kg/ha
All surplus ewes and wethers sold at 20 weeks if 52kg, or at 29 weeks.</td></tr>
<tr><td></td><td>Merino x terminal sire</td><td>Native grass vs Cocksfoot pasture
Hilly hard shallow soil vs deeper soil with gravel
Weight of mature ewe in average condition 50 kg. Buy in ewes
Wool 19 micron
7, 8 and 9 ewes/ha inc. weaners and hoggets
Lambing mid May, Jun and July.
Wean lambs at 16 weeks
Feed Barley in paddock to maintain condition score targets Also feed when total dry matter falls below 500 kg/ha
All wethers sold at 20 weeks to 29 weeks</td></tr>
<tr><td>Mid North</td><td>Self-replacing Merino</td><td>Booborowie low fertility hill soils vs Booborowie flats red brown earth
Lambing April, June, August
Weaning 12 and 16 weeks,
Stocking rate 3, 4 and 6/ha.</td></tr>
</table>

4. Results

4.1 Key Results

4.1.1 Impacts of climate change on enterprises tested

Generally, across SA by 2030, the impacts of climate change on livestock and pasture production is most likely to be:

- Shorter growing seasons
- Greater variability in pasture growth
- Reduced pasture quality
- Increased variability in farm gross margins
- High heat days will reduce livestock production
- Wool quality reduced

The following adaptations will help maintain or improve profit by 2030 and they are the most likely to be implemented after presentation and discussion with producers.

Minimise the need for supplementary feed by:

- Optimising lambing and calving times
- Review age at first joining
- Reviewing stocking rates
- Reviewing sale times
- Core Breeding and more trading

Flexibility to adjust numbers as season progresses Increase flexibility in their systems by;

- Varying sale times/rules, confinement feeding, movement, more animal trading (core breeding), self-replacing system, agistment

Better pasture utilisation by grazing management systems

- Controlled, cell, rotational, confinement, movement
- Larger mobs for shorter periods of time
- Match livestock feed demand to pasture production
- Maintain high pasture quality by adequate fertiliser
- Maintaining pasture in growth stage 2

4.1.2 Specific results

Below are some specific examples of adaptations tested and explored. Further results and examples are available on the web site including presentations delivered at workshops.

Stocking rate and lambing or calving date

In many cases, GrassGro suggested later lambing or calving compared to district practice would be more profitable (see Fig. 2 example). In tandem with these results, increased stocking rate helps improve feed efficiency and improves Gross Margins. However there are trade-offs between lambing or calving later, increased stocking rate as it creates other management issues. For example lambing in the middle of winter means that adequate feed needs to be maintained for expectant ewes and shelter provided for lambs. Furthermore, ground cover is often exploited as a result of more animals on the ground (see Fig.3 example). However, stock movement and supplementary feeding can maintain ground cover and setting up adequate sale rules when pasture condition is compromised.

Figure 2: GrassGro box plots showing the difference in profit using a Self-replacing large wool merino sheep enterprise at Keith on a Loamy Sand over Deep Bleached Sand on Lucerne Annual Grass and Capeweed. Adaptations of varying stocking rates and lambing dates were tested.

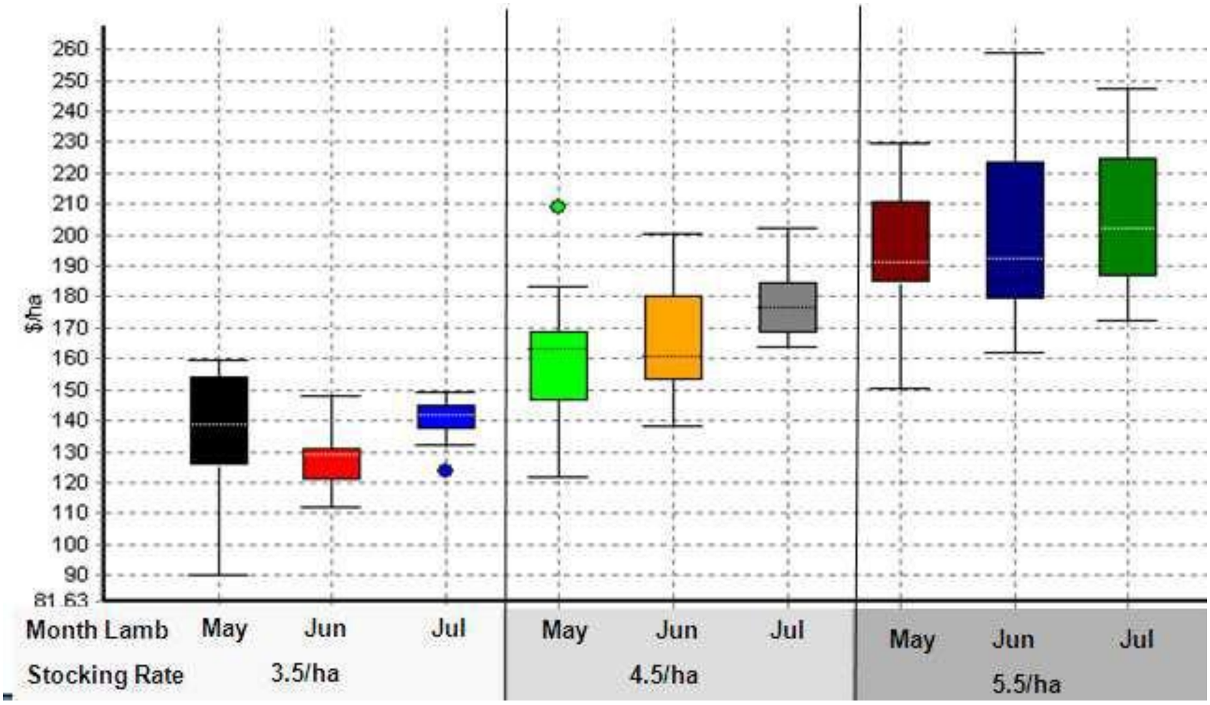
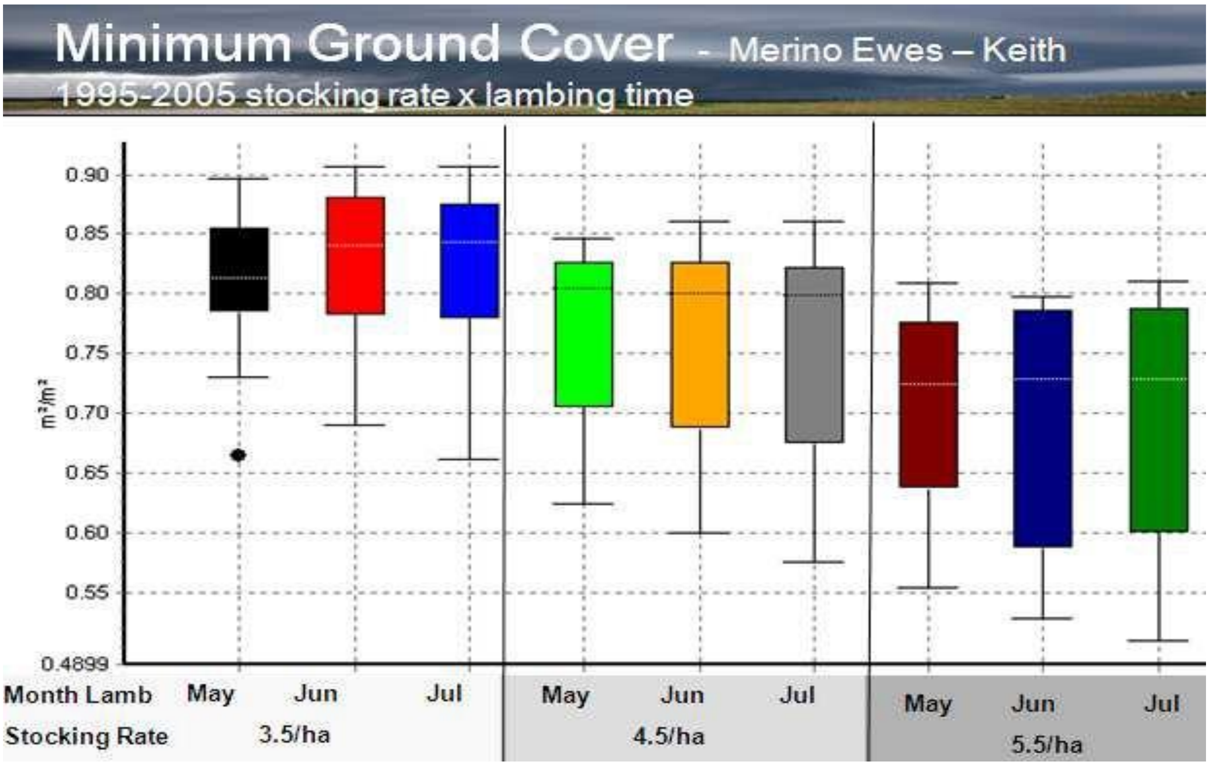


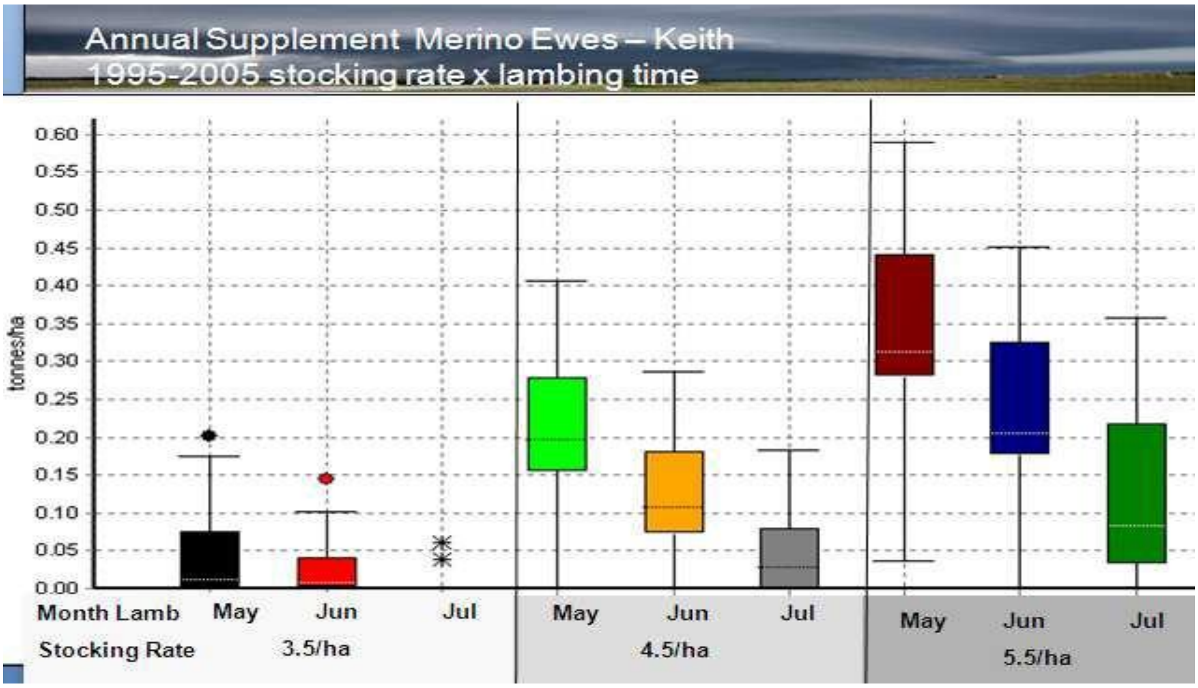
Figure 3: GrassGro box plots showing the ground cover at varying stocking rates and lambing times on Self-replacing large wool merino sheep enterprise at Keith on a Loamy Sand over Deep Bleached Sand on Lucerne Annual Grass and Capeweed.



As a general rule in SA, Natural Resource officers suggest that you should aim to maintain 70% ground half of the time. Thus we are looking for the median line to be above 70m^2/m^2
Although the increased stocking rate and later lambing does result in less ground cover, it still shows that it is above the median for more than 70% of the time above. However in other examples not shown here, our GrassGro simulations demonstrated that ground cover is not maintained at higher stocking rates. This can be overcome by stock movement (as mentioned in adaptations).

Another aspect of management likely to be compromised with later lambing or calving and higher stocking rates is supplementary feed requirements. Logically, more supplementary feed is required especially in drier years, with higher stocking rates. Again, some of this can be reduced with stock movement and aiming to maintain pasture in growth stage 2. However, in many cases we have been able to maintain higher profits despite increased hand feeding requirements (as shown in Fig. 1 and Fig. 3). In Fig. 4, whole barley was fed to the Merino ewes. It was priced at $180.00 per tonne.
The trade-offs for supplementary feeding include; availability, extra labour costs, time constraints, initial increased costs and need for extra cash flow. Each farmers enterprise set up is different and attitude to risk, thus depending upon the farmer’s priorities and risk attitude, extra supplementary feed may not be deemed viable.

Figure 4: GrassGro box plots showing supplementary feed at varying stocking rates and lambing times on Self-replacing large wool merino sheep enterprise at Keith on a Loamy Sand over Deep Bleached Sand on Lucerne Annual Grass and Capeweed.



Annuals alone vs annual perennial mix

Further south at Lucindale in SA, many producers are upgrading their paddocks to include more Lucerne and perennial pastures. As this is at reasonable costs, producers wanted to look at the profitability of improving pastures long term. Therefore, we looked at a range of enterprises on annual and perennial mixed pastures versus just annual pasture alone. We also compared the same enterprise on annual pastures alone (Table 4a and b)

Table 4a: A self-replacing fine wool merino ewe enterprise at Lucindale on annual perennial mix. Compare with the same enterprise on an annual pastures alone (Tab 4b).

Location: Lucindale Enterprise: Fine Wool - Self replacing Merio Ewes Soil type: Sandy loam on clay loam: Sub clover and Phalaris

	1970-1999	2000-2008	2030 Climate GFDL		2030 Climate Echam		2030 Climate CCSM		2030 Climate Had	
			Scenario 1	% change compared to 1970-1999	Scenario 2	% change compared to 1970-1999	Scenaro 3	%change compared to 1970-1999	Scenario 4	% change compared to 1970-1999
Rainfall (mm/pa)	588	512	501	-15	529	-10	548	-7	573	-3
Temperature (°C average Max)	21	21	21	0	21	0	22	5	21	0
Temperature (°C average Min)	9	9	10	11	9	0	10	11	10	11
Pasture (kg DM/Ha/yr) annual perennial mix	7756	8135	7739	0	8232	6	9118	18	9488	22
Stock Rate (DSE/Ha)	12.5	12.1	12.3	-2	12.5	2	12.7	2	12.9	3
Profit ($/ Ha)	310	281	301	-3	310	0	334	8	348	12
Profit change compared to 2000 - 2008				7		10		19		24

2030 Climate Scenario 1-GFDL (USA 1) 2030 Climate Scenario 2-ECHAM (German) 2030 Climate Scenario 3-CCSM (USA2) 2030 Climate Scenario 4 – HAD (English)

Table 4b: A self-replacing fine wool merino ewe enterprise at Lucindale on annual pasture alone. Compared with the same enterprise on an annual and perennial pastures (Tab 4a)

Location: Lucindale Enterprise: Fine Wool - Self replacing Merio Ewes Soil type: Sandy loam on clay loam: Sub clover and annual weeds

	1970-1999	2000-2008	2030 Climate GFDL		2030 Climate Echam		2030 Climate CCSM		2030 Climate Had	
			Scenario 1	% change compared to 1970-1999	Scenario 2	% change compared to 1970-1999	Scenaro 3	%change compared to 1970-1999	Scenario 4	% change compared to 1970-1999
Rainfall (mm/pa)	588	512	501	-15	529	-10	548	-7	573	-3
Temperature (°C average Max)	21	21	21	0	21	0	22	5	21	0
Temperature (°C average Min)	9	9	10	11	9	0	10	11	10	11
Pasture (kg DM/Ha/yr) annual only	9172	8149	8169	-11	8925	-3	9348	2	9910	8
Stock Rate (DSE/Ha)	11.9	11.8	12.9	8	12.2	-5	11.8	-1	12.4	4
Profit ($/ Ha)	264	264	295	12	294	11	263	0	310	17
Profit change compared to 2000 - 2008				12		11		0		17

2030 Climate Scenario 1-GFDL (USA 1) 2030 Climate Scenario 2-ECHAM (German) 2030 Climate Scenario 3-CCSM (USA2) 2030 Climate Scenario 4 – HAD (English)

Tables 4a and 4b show that the most pasture in kg/ha/yr is produced on the annual pasture alone. However, the more profitable Merino ewe enterprise is on the annual perennial mix. The results suggest that this is because a higher stocking rate (dse) was maintained on the annual perennial mix due to more pasture being available over summer (longer term).

Furthermore, although a higher pasture yield was established on the annuals alone, the pasture utilisation rate was lower. The added benefit of the perennial is to maintain the ground cover, tap deep-water reserves in drier times and improve sustainability longer term.

Enterprise structure.

Due to the declining autumn rainfall trend in South Australia, most livestock producers have introduced more flexibility in their enterprise structure to allow for variable livestock numbers according to the season. Many producers also agree that increased animal trading (see figure 10) is a good option for managing climate variability and change. For this reason we tested a range of enterprise structures, some more flexible than others. Table 5 below shows an Angus cow vealer and weaner system compared to a steer trading system at Inman Valley in SA's Fleurieu Peninsula. The table below shows the GrassGro outputs for 1995 to 2005 rainfall as this was a period of hotter and drier times even in comparison to 2030 rain.

Table 5: GrassGro outputs showing a comparison of enterprise structures at Inman Valley in SA's Fleurieu peninsula.

	Angus cow vealer	Angus cow weaner	Angus Steer trading
cows	550 kg	550 kg	550 kg
Conception	95%	95%	Na
calving	Mar-11	Mar-11	Na
wean	Jan-01	Jan-01	Buy February 1 180 kg LW
sale	Jan-15	Oct-15	January 15
Soil	300 mm acid sandy loam over sandy clay loam containing gravel		
Pasture	Sub clover, annual weeds, cocksfoot and phalaris	Sub clover, annual weeds, cocksfoot and phalaris	Cocksfoot and phalaris
Stocking rate	1 cow/ha Including heifers	1 cow/ha Including heifers	3 Steers/ha
steer sale LW	345 kg	508 kg	371 kg
GM	$242/ha	$314/ha	$792 kg/ha
Supplement (hay $140/t)	$65/ha	$86/ha	$79/ha
DSE/ha	13	15.6	19.5
Pasture use	42%	49%	57%
Pasture yield	8400 kg/ha	8500 kg/ha	9740 kg/ha
kg/ha meat sold	134 kg/ha LW	187 kg/ha LW	552 kg/ha
Kg/ha meat produced	229 kg/ha LW	282 kg/ha LW	552 kg/ha

Temperature and rainfall sensitivity

Brendan Cullen (University of Melbourne) performed a sensitivity analyses at our request to examine the impact of incremental temperature and rainfall changes on pasture growth. The SGS pasture model (Johnson, Lodge et al. 2003) was used for the analyses. We used temperature increases from 0 to 2°C above baseline, rainfall declines of 0 to 20% from the baseline and carbon dioxide concentration of 450 ppm in all scenarios. For this exercise, we considered four representative location in SA (Fig.5) and the results of two are demonstrated in Figs 6 and 7.

Figure 5: Average annual pasture production using the SGS pasture model for the baseline 1970 to 2010. The growth at Morchard is low due to low annual average rainfall and frosts in winter. Growth is shown in Kg of dry matter/ha/day.

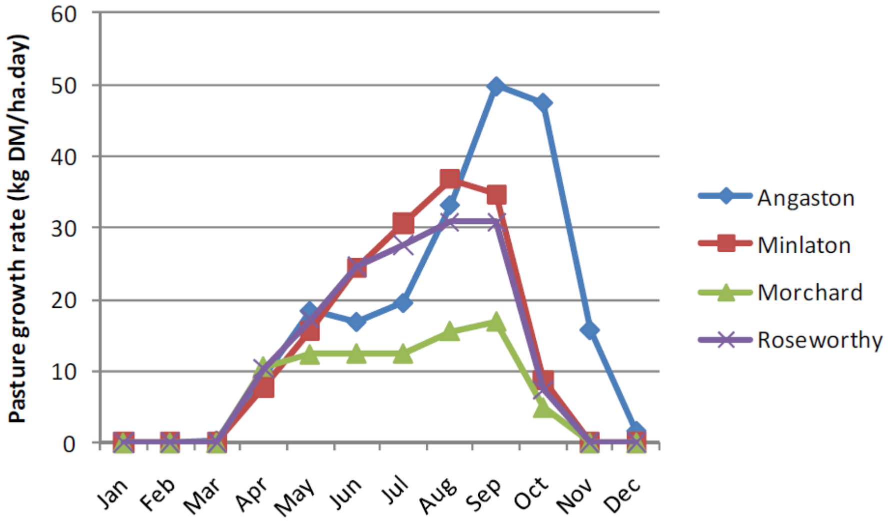
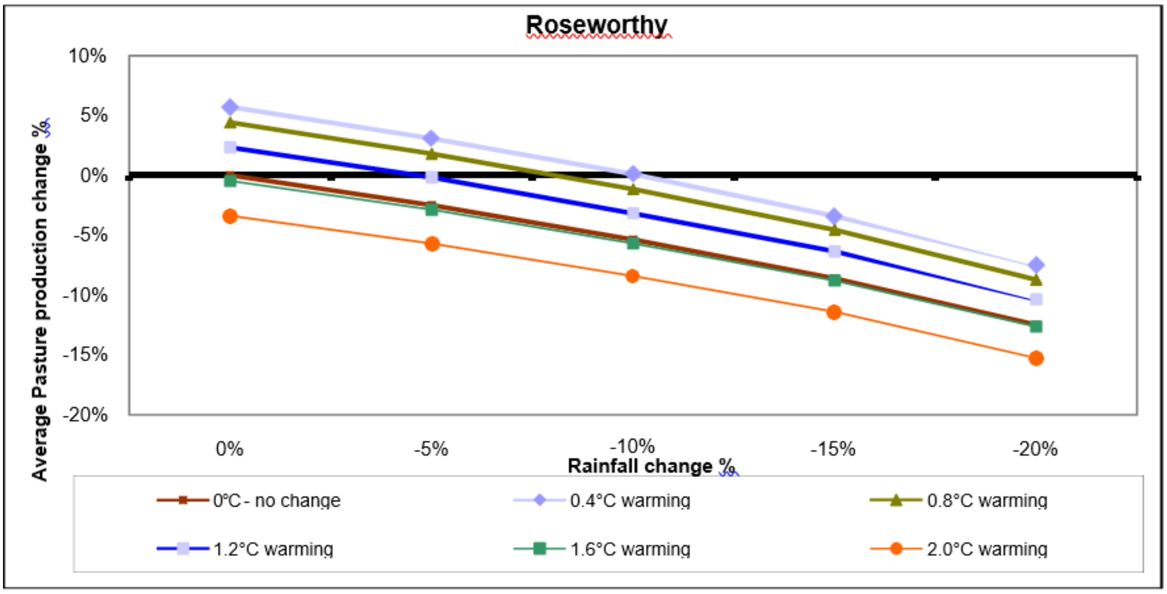


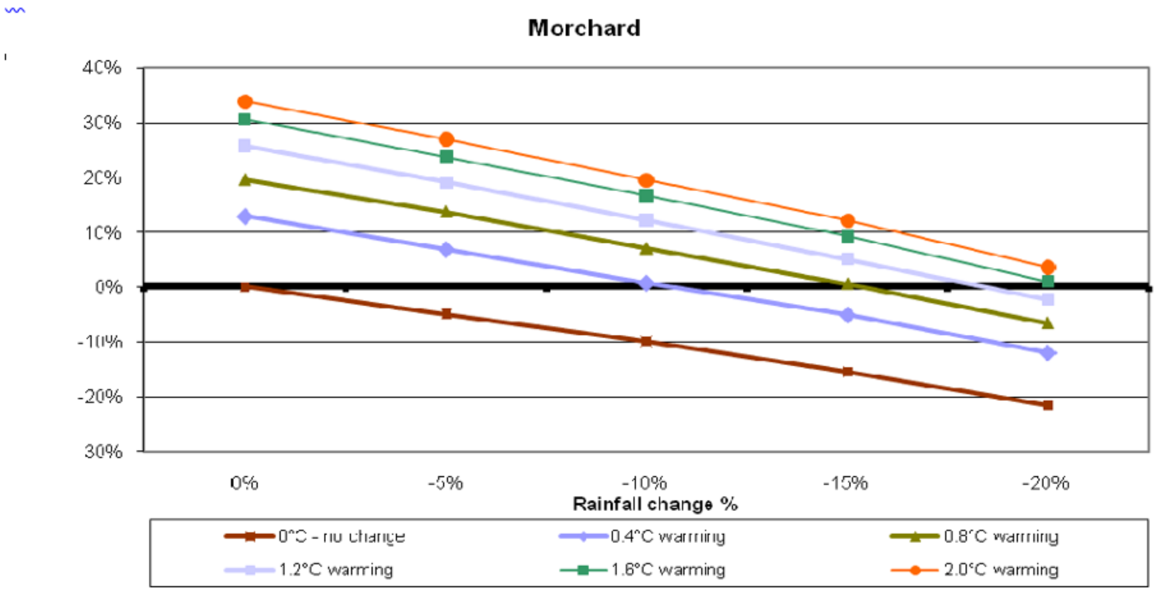
Figure 6: Pasture growth simulations using SGS pasture model for a sandy loam over clay soil at Roseworthy. The pasture composition includes 75% early annual grass and 25% medic. Production is a displayed as a percentage change from the baseline modelling. All future climate change runs use CO2 levels of 450 ppm.



The modelling indicates that at Roseworthy (Fig. 6) pasture production will decrease by no more than 10% with a rainfall reduction of up to 10% and temperature increase of up to 2 °C (NB: CO_2 concentration was set to 450 ppm). For a 20% reduction in rainfall, pasture production at Roseworthy is predicted to decrease by between 7 and 20% depending upon the temperature increase. The response to increased temperature and decreased rainfall for Roseworthy were similar to that expected in Angaston and Minlaton.

The pastures at Morchard in the far north region were affected by frosts in winter (pers. comm. Daniel Schuupan, livestock consultant, PIRSA Rural Solutions, May 2011) and so growth is usually reduced and slow in winter (Fig.7). Consequently, the modelled pasture growth at Morchard responds quite differently than the other three locations as higher temperatures increase growth even with relatively high reductions in rainfall. The SGS model predicts that an average temperature rise of 2°C (with no rainfall decline) would increase pasture growth by about 30% and for a 20% reduction in rainfall there would be no long term change to pasture production. The modelling also shows that if there were no temperature increase and a rainfall decline of 20 % there would be a reduction in production by up to 20%. This result indicates that the increase in temperature that we are locked into by 2030 will enhance pasture growth even with a rainfall decline at Morchard. However, this is modelled data only and needs further research.

Figure 7: Pasture growth simulations using SGS pasture model for a brown calcareous earthy soil at Morchard in the Southern Flinders sub-region. The pasture composition includes 75% early annual grass and 25% medic. Production is a displayed as a percentage change from the baseline modelling. All future climate change runs use CO_2 levels of 450 ppm.



The important fact to note from Figs 5 and 6 is that although some increases in temperature will increase growth, rainfall will be the critical limiting factor in both cases. Total dry matter from grazed pasture is more sensitive to temperature than cereals because after it has been grazed, temperature is a major determinant of the growth rate.

Benefits

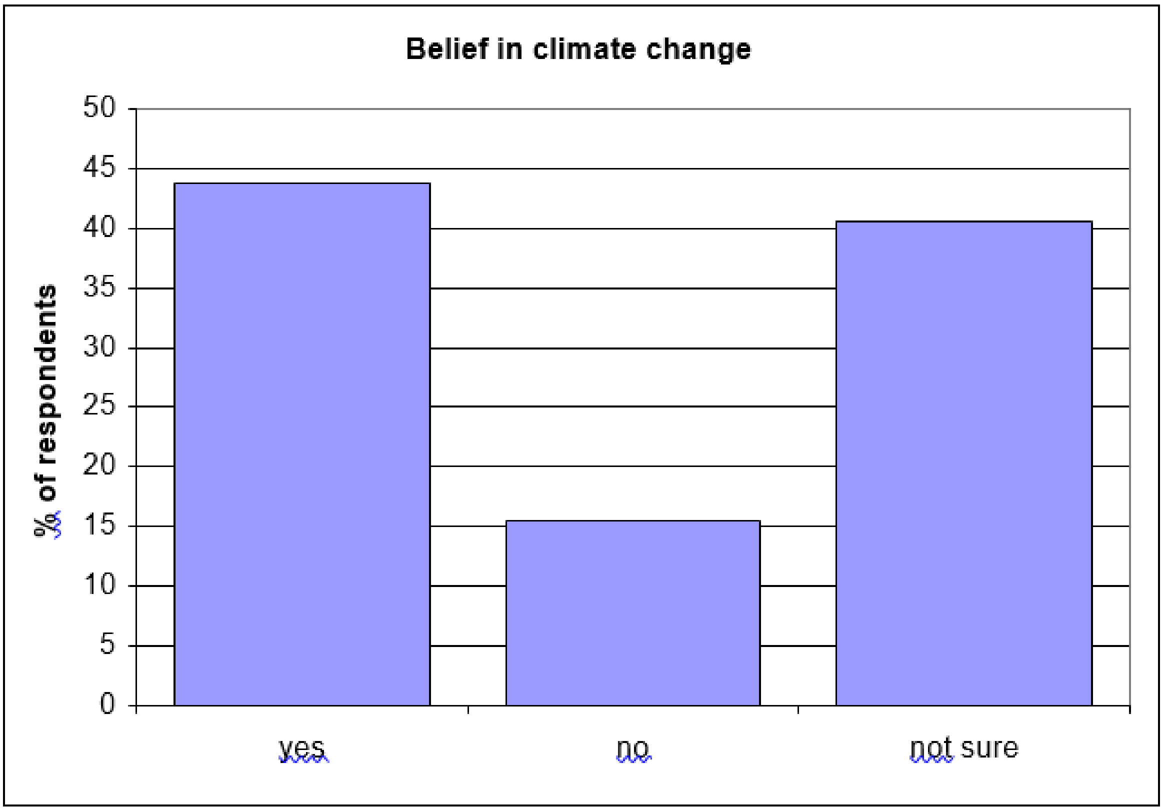
Many livestock enterprises in SA have the potential to increase profits by harder grazing and grazing management strategies. Whilst 2030 has the potential to reduce gross margins under current grazing management strategies, with increased flexibility and grazing management options as discussed under adaptation strategies, there is no reason why most enterprises cannot at least maintain or increase productivity and profits by 2030.

Implications of project findings

A survey on the attitude of livestock producers to climate change, adaptation and management was handed out at most workshops. We have selected the key results and have discussed these in Figs. 8 to 12.

Fig. 8 shows that only around 45% of respondents believe in climate change with 40% not sure. This could have potentially been a barrier to discuss impacts or adaptations of climate change with producers. This is one of the reasons why we chose to use trends in history where it was hotter or drier to discuss management changes to cope with seasonal variability. All producers agreed that they have experienced periods where it was hotter or drier such as the 1995-2005 period. They said they had to make some sudden drastic changes to their management in order to cope with this variability including flexibility and others mentioned in our adaptations list.

Figure 8: The percentage of respondents that believe in climate change



Most producers agree that if you are managing climate variability (such as heat stress, late breaks to the season or dry springs) you are becoming more robust and flexible to cope with longer term climate change, whether it exists or not (like an average increase of overall temp and drop in rain).

After all, it is the extremes in variability that make the long-term average temperature increase or rain decrease. Thus 27% of producers said that managing seasonal climate variability is the best way to manage climate change. As shown in figure 9.

Figure 9: The time scale most respondents think should be used to plan for climate change

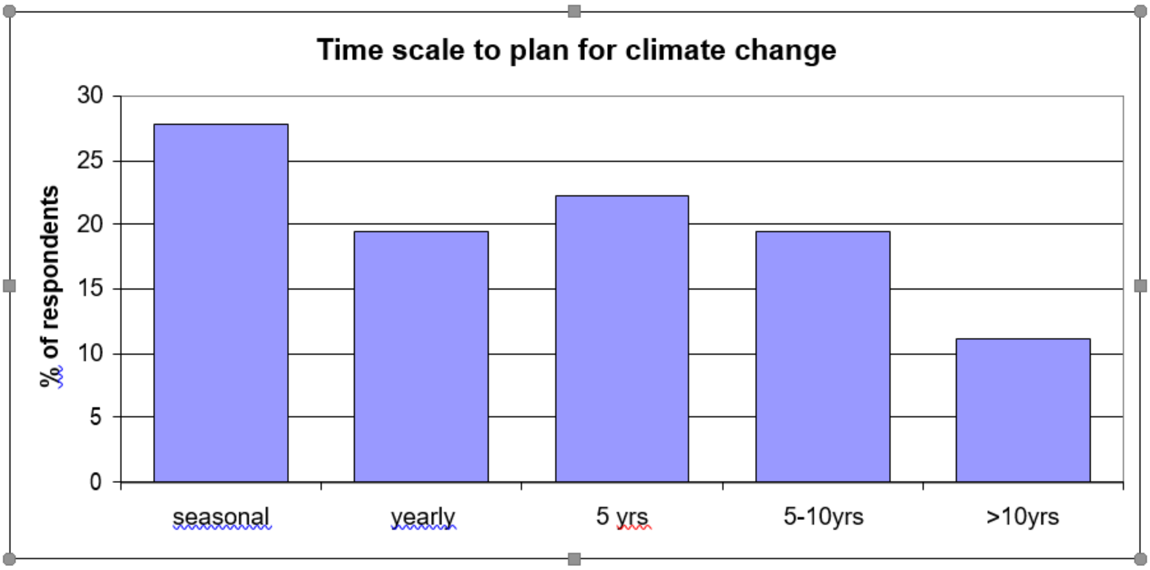


Fig. 10 shows that nearly 45% of respondents agree that climate change will occur, a similar amount of respondents indicated that they agree it will make it harder to run their farm enterprise.

I think this is consistent with our result as we suggest that by 2030 there is no reason why profits cannot be maintained or increased, however, it will require greater flexibility and grazing management strategies requiring more labour and input. This is consistent with Fig. 11, as the majority of respondents suggest that more animal trading and the use of drought lots will be important to manage climate change.

Figure 10: Percent of respondents indicating if they agree that climate change will occur and make it harder to run their farm enterprise.

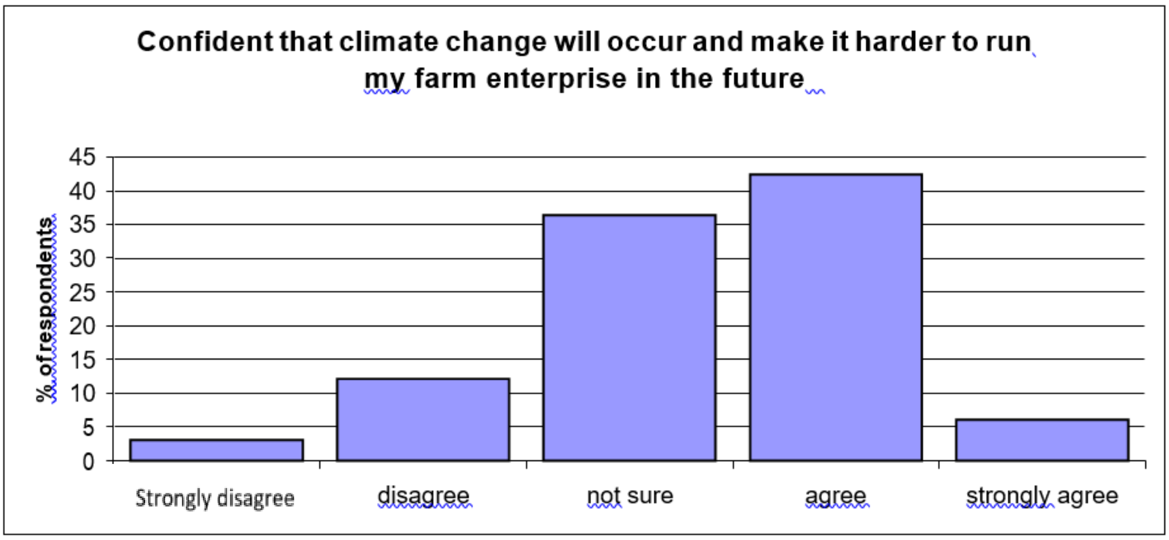
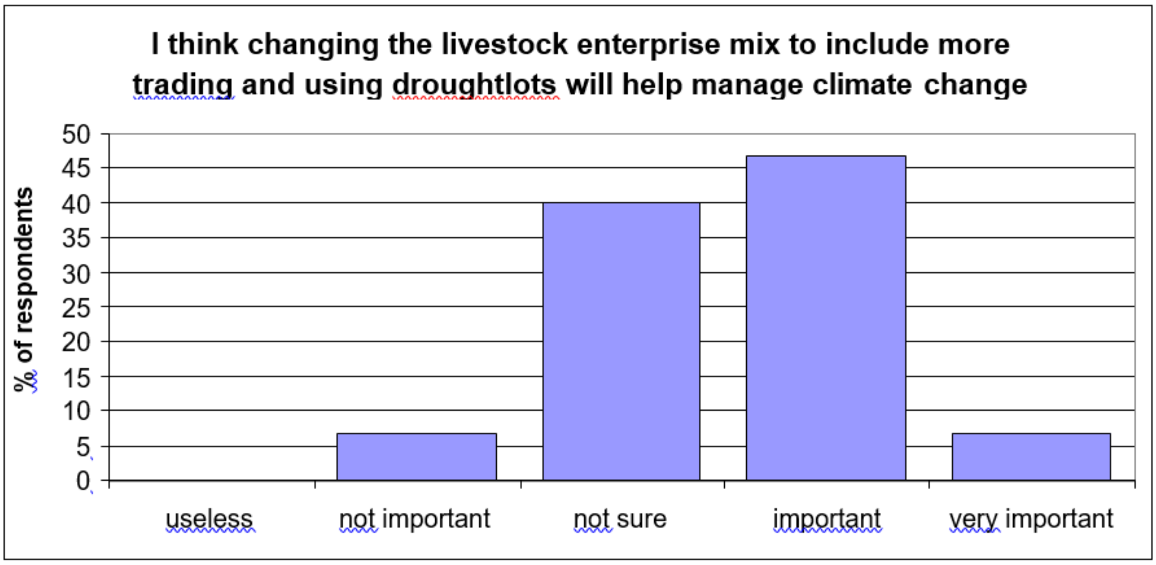
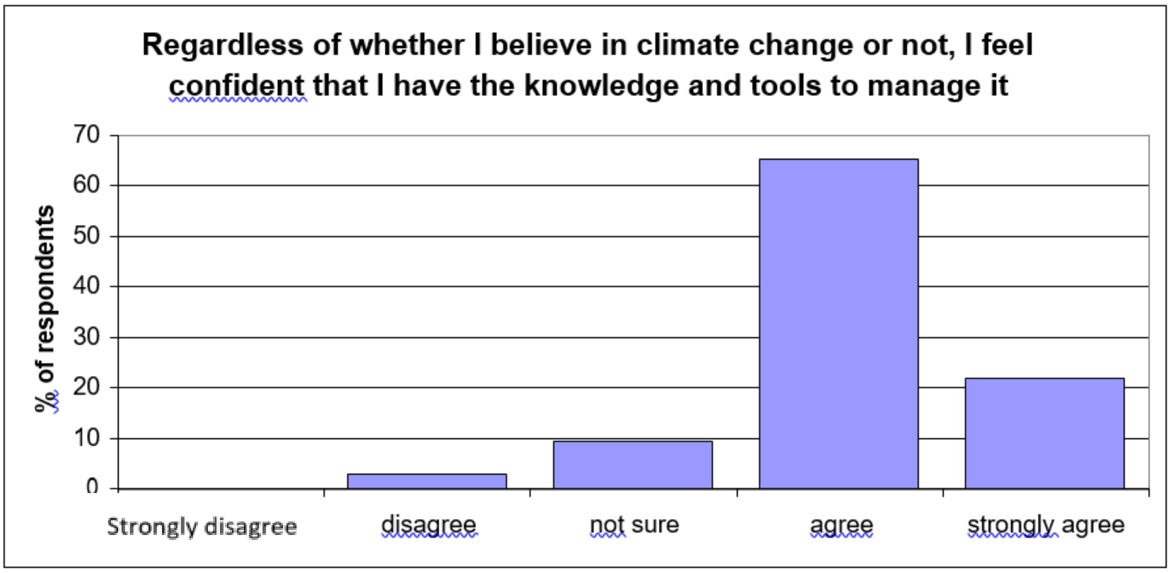


Figure 11: Percent of respondents that think changing livestock enterprise mix to include more trading and using droughtlots will help manage climate change.



Many producers have comfortably managed seasonal variability and have increased confidence to manage climate change. Therefore, although only 45% said they agree with climate change, 80% agree or strongly agree that they have the tools to manage climate change regardless of if it will occur or not (Fig. 12).

Figure 12: Percent of respondents that feel they have the tools and knowledge to manage climate change



5. Conclusion

In South Australia, the project was resourced at 0.2 FTE and a consultant at 0.05 FTE as these staff were more skilled in using GrassGro, this limited capacity. Other producers were aware of GrassGro. However, there is an opportunity to train more users to work with GrassGro and help producers to manage climate change and variability. If GrassGro was used in a tactical sense to manage climate variability, it will help producers become more flexible, and this is an adaptation tool for climate change.

During this three-year project, 325 livestock producers were directly engaged to look at the impacts and potential adaptations of climate change on livestock enterprises by 2030. The livestock producers were engaged at workshops and seminars at seven locations run in the south-east, Fleurieu Peninsula, Mid North, and Eyre Peninsula regions of South Australia.

5.1 Key findings

Generally, across SA by 2030 the impacts of climate change on livestock and pasture production is most likely to be

- Shorter growing seasons
- Greater variability in pasture growth
- Reduced pasture quality
- Increased variability in farm gross margins
- High heat days will reduce livestock production
- Wool quality reduced

Supplementary feed requirements are an aspect of management likely to be compromised with later lambing or calving and higher stocking rates. Logically, more supplementary feed is required especially in drier years, with higher stocking rates. Due to the declining autumn rainfall trend in South Australia, most livestock producers have introduced more flexibility in their enterprise structure to allow for variable livestock numbers according to the season. Pasture growth simulations using the Sustainable Grazing System pasture model found increases in temperature will increase growth, rainfall will be the critical limiting factor in both cases. Total dry matter from grazed pasture is more sensitive to temperature than cereals because after it was grazed, temperature was a major determinant of the growth rate. Many livestock enterprises in SA have the potential to increase profits by harder grazing and grazing management strategies. Whilst 2030 has the potential to reduce gross margins under current grazing management strategies, with increased flexibility and grazing management options as discussed under adaptation strategies, there is no reason why most enterprises cannot at least maintain or increase productivity and profits by 2030.

5.2 Benefits to industry

Thirty base enterprises were set up in GrassGro and this is a valuable resource. This data could be used to do any number of analyses including total carbon emissions. The GrassGro model can be used in tandem with the AusFarm model to do some of this analysis. Some of this work can be completed in South Australia, however it could adopted to other states using their base runs.

Table 6 illustrates how many producers were made aware of project outcomes. This is based on the project committee estimations deeming that communication such as workshops, seminars, presentations at field days will be rated at 100% awareness (provided they focus specifically on the key findings of the project); a figure of 5% awareness will be accounted from circulation of indirect written communication (e.g. industry magazines, dedicated articles in other mags and rural newspapers etc.), a figure of 5% awareness would be used accounted from use of possible website hits (downloads of articles, not just page hits) and radio interviews that talk about key findings. Basic articles and radio interviews at only % but where key project outcomes were discussed then it was counted it as 5%.

Table 6: Communication activities over the life of the project.

Newspaper Articles	Title	Date	Circulation	% counted	Actual Delivery
Naracoorte Herald	Profit workshop for farmers (in Agritalk)	14/10/2010	3300	1	33
Port Lincoln Times	Positive impacts for livestock	31/03/2011	6311	1	63
The Stock Journal	GrassGro model points to shortened seasons	15/12/2011	13302	5	665
Port Lincoln Times	Climate change focus at forum	29/03/2012	7000	1	140
The Bunyip	Farmers to hear climate solutions	8/12/2012	9500	1	95
The Stock Journal	SE Climate Trials	2/02/2012	13302	1	133
Murray Valley Standard	Producers to learn about climate change	10/11/2012	3941	1	39
Port Lincoln Times	Vital Speakers at Field day	15/03/2012	6311	1	63
Plains Producer	Livestock and climate	5/02/2012	4000	1	40
Radio					
ABC North and West SA		26/10/2011	2000	1	20
ABC - South East SA		26/10/2011	2000	1	20
ABC - Riverland SA		26/10/2011	2000	1	20
ABC - Country hr, north and west SA		16/03/2012	6000	5	300
ABC - Riverland SA		17/02/2012	2000	1	20
Reports					
Central local government region integrated climate change vulnerability assessment - 2030.	Impact of climate change on livestock, pasture and wool in central local government region	Nov-2011	2000	10	200
Eyre Peninsula, Farmins systems book	Grazing systems management into 2030	13/02/2012	700	90	630
Direct communication					
Conferences					
CCRISPI		Feb-2011	300	5	15
Workshops					
Keith		Jul-2010	20	100	20
Lucindale		Jul-2010	15	100	15
Furner		Jul-2010	15	100	15
Keith		Oct-2010	12	100	12
Furner		Oct-2010	15	100	15
Fleurieu		Feb-2011	35	100	35
Booborowie		Mar-2011	30	100	30
Seminars					
Freeling		Mar-2011	45	100	45
Koppio		Mar-2011	10	100	10
Roseworthy		May-11	15	100	15
Waite		Feb-12	10	100	10
Wilalooka		Feb-12	25	100	25
Roseworthy		Feb-12	25	100	25
Lucindale		Mar-12	10	100	10
Cummins		Mar-12	40	100	40
Total producers aware					**2819**

6. Future research and recommendations

There is scope on most farms to improve pasture utilisation and grazing systems and thus profit. This approach should also reduce methane emissions, as in theory, better pastures and utilisation, animals will reach target weight quicker and be removed from property sooner, reducing net methane emissions on farm. Any case study or project that can demonstrate this with case studies in conjunction with modelling would be a valuable initiative.

7. References

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