final report

Project Code: B.SBP.0076

Prepared by: Julia Smith
Department of Agriculture and Food Western Australia

Date published: October 2012

PUBLISHED BY
Meat and Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

Adaptation to Climate Change in the Southern Livestock Industries (Western Australia component)

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

1. Executive Summary and Key Findings (1 page maximum)

Two groups in WA [Kojonup and Ravensthorpe] expressed interest in being involved in the CCSALI project after initial approaches were made via coordinators for the Southern DIRT [Kojonup] and RAIN [Ravensthorpe] groups.

The Kojonup area was chosen as a typical sheep-wool belt with good "forest" soils, while the Ravensthorpe / Jerramungup district represents coastal sand plains. Initial producer meetings to describe a 'district average' farming system occurred with Southern DIRT and RAIN groups in late June 2011. For most producers, a Merino-Poll x Dorset lamb production system was the most appropriate enterprise to model. A self replacing Merino enterprise for a participating producer from Hopetoun was also modelled.

Modified climatic conditions using predicted climatic data to 2030 were inserted into the 'Base' GrassGro models. In essence, the model outputs showed:

- Quite varied results across the two locations modelled - Kojonup (positive) and Ravensthorpe (negative).
- On balance, for both locations, there is predicted to be increased rainfall variability and increased temperature. This will result in faster winter pasture growth rate but shorter growing seasons.
- Increased CO_2 and temperature will result in an increase in legume content. While this will be positive for animal production, the rate of decline of dry pasture residues over summer may increase, resulting in wind erosion and groundcover limits being reached quicker.
- As a result, confinement feeding is likely to be an essential component of a sustainable grazing system for producers in these areas.

The modelling predictions were presented to the Kojonup and Ravensthorpe groups in Sep 2011. Further GrassGro modelling to explore the effect of adaptations has continued for both districts.

Refinement of glitches in Grassgro outputs [overestimation of both feed on offer (FOO) and ewe condition score compared to measured results from closed-system farmlets at Mt Barker WA] have been examined by Andrew Moore and Mike Freer at CSIRO.

There has been very strong interest in this project and enthusiastic discussion with producers at the meetings. The face-to-face contact with the programme modeller [Dr Andrew Moore] was considered by producers to be a real positive.

Four global circulation models were used. Of these, GFDL (USA 1) had the largest negative effect on gross margins in both locations.

2. Statement against Objectives and Activities

a) Project objectives

Objective	Status at Project End
1. By 2011, a knowledge base will be established to underpin ongoing engagement with livestock producers in Western Australia (WA), and to	**A small knowledge base has been established with key groups in the Kojonup and Ravensthorpe areas.**

facilitate further research, development and extension in climate change adaptation.	**[Please note: Because WA was a late addition to the project - only joining the national team in Oct 2009 - progress is behind that of the other states. However, expansion of this knowledge base is planned via workshops to be held in July-Sep 2012.**
2. By 2012, 1,000 livestock producers across WA's Southern Agricultural Region will be aware of the key research outcomes of the program through a combination of field days, workshops and written material.	**Currently approximately 700 producers are aware of the key research outcomes as a result of producer workshops and written material.**
3. By 2012, a program of on-farm trialling 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.	**No specific trialling has occurred to date, but it should be noted that many of the adaptations to climate change are currently being employed by producers to cope with erratic seasonal variation (eg feedlotting capability, establishment of perennial pastures). That these adaptations are deemed to be economic in the present day bodes well for the adoption of tactics to deal with a changing climate towards 2030.**
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	**This was achieved with Grassgro training provided by Dr Andrew Moore to three DAFWA staff in Sep 2011.**

b) Project activities

Activity	Contracted requirement	Status at Project End
1. Regions modelled	**2**	**2**
2. Locations modelled	**2**	**4**
3. Enterprises modelled	**4**	**4**
4. Producer workshops held	**2**	**4**
5. Other awareness events held (e.g. seminars)	**2**	**0** [Presentations of results to producers are planned for Jul-Sep 2012; see comment in Objective 1 above]
6. Producers directly engaged	**8**	**10**

7. Communication products produced	**2**	**4**
8. Producers aware of the key project findings?	**1000**	**700** [note: this will increase after planned presentations to producers in Jul-Sep 2012]
9. **Adaptations modelled**	**2**	**2**

3. Background / Context

WA was a late addition to the Climate Change Adaptation in the Southern Australian Livestock Industries [CCSALI], joining the national team in Oct 2009, so progress was consistently behind that of the other states.

In brief:

- In April 2011, Coordinators for the Southern DIRT [Kojonup], RAIN [Ravensthorpe] and North Stirling Pallinup Natural Resources [Borden/Ongerup] groups were canvassed for expressions of interest in being involved in the CCSALI project.
- Kojonup and Ravensthorpe groups expressed interest in May 2011
- 'Average' farming systems for these districts were defined in June 2011 and modelled using GrassGro
- Dr Andrew Moore (CSIRO, Canberra) visited Albany on Sep 2011, and inputs and outputs for 'Base' GrassGro models - using climatic data to 2000 - for the selected locations were reviewed
- Modified climatic conditions using predicted climatic data to 2030 were inserted into these 'Base' models and the effects discussed and summarised
- Grassgro runs were presented to the Kojonup and Ravensthorpe groups on September 6-7, 2011
- GrassGro modelling to explore the effect of adaptations was continued for both districts
- Refinement of glitches in Grassgro outputs [overestimation of FOO and ewe condition score compared to actual measured results from closed-system farmlets at Mt Barker WA] have been examined by Andrew Moore and Mike Freer.

There has been very strong interest in this project and enthusiastic discussion with producers at the meetings. The face-to-face contact with the programme modeller was considered by producers to be a real positive.

4. Methodology

The methodology for this project is largely described in Section 3 above. Other key points include:

Enterprises Modelled: For most producers, a Merino-Poll x Dorset lamb production system was the most appropriate enterprise to model. A self replacing Merino enterprise for a participating producer from Hopetoun was also modelled.

Workshops: Workshops to present the results from both the 'base' runs and modified climatic runs were held in Sep 2011 at Kojonup and Ravensthorpe. Seasonal issues with sheep management

meant some producers were not able to attend these meetings but we had 3 of 4 producers at Kojonup and 6 of 6 producers at Ravensthorpe.

Awareness Events

At the suggestion of producers from both groups, we propose to make presentations (over the period July to September 2012) to Sheep Industries Leadership Council, Great Southern DIRT, South Coast NRM, Grain & Graze, Landmark, Bob Hall & Ashley Herbert advisory groups, Topcrop groups, and various other grower groups to highlight the project and its achievements.

In addition to one-page articles in newsletters associated with the proposed modelling districts, results from Grassgro runs have been published in the Ovine Observer, a newsletter with a 1000-strong readership. ABC radio interviews publicising the project and its results are planned for Sep 2012.

5. Key results

a) Overview - summary of the key findings

Modified climatic conditions using predicted climatic data to 2030 were inserted into the 'Base' GrassGro models for Kojonup and Ravensthorpe. Accepting that the last decade better reflects future climate, data are presented for 2000-2009 in addition to the long-term 1975-1999 data.

In essence, the model outputs showed quite varied results across the two locations modelled – for Kojonup, the predictions were generally positive, but negative for Ravensthorpe.

In brief:

- Kojonup recorded a lower annual rainfall during the past decade compared to the previous 30 years, but except for Scenario 1 [GFDL], rainfall is predicted to increase [see table 1]. The converse was true for Ravensthorpe, with an increase in rainfall between 2000-2009 but predicted decreases in annual rainfall in all but the HAD model [Scenario 4] [see table 2]
- For both sites, there was only a marginal difference in the average min/max temperature during 1970-1999 and 2000-20009, but for all modelled Scenarios, temperature is predicted to increase by 2030.
- Increased CO_2 and temperature will result in an increase in legume content. While this will be positive for animal production, the rate of decline of dry pasture residues over summer may increase, resulting in wind erosion and groundcover limits being reached quicker. This will have ramifications for runoff from non-wetting undulating forest soils in the Kojonup district, and wind erosion sandy soils along the coastal sand plains around Ravensthorpe/Esperance. As a result, confinement feeding is likely to be an essential component of a sustainable grazing system for producers in these areas.
- At current district average stocking rates [6.5 and 2.5 DSE/ha for Kojonup and Ravensthorpe, respectively], there was an 8% and 5% decrease in profit for Kojonup and Ravensthorpe, respectively, due to the change in climate in the decade 2000-2009 compared to 1970-1999. For Kojonup, all scenarios except Scenario 1 [GFDL) showed profit increasing for the period out to 2030. For Ravensthorpe, profit declined significantly in GCM scenarios 1 and 3, with only marginal increases predicted in the other models out to 2030.

b) Specific results –

Table 1: Modelling of enterprise comparing periods 1970-99, 2000-09 and 4 climate scenarios in 2030.

Location: Kojonup **Enterprise:** Merino x Poll Dorset lamb production

	1970–1999	2000-2009	2030 Climate Scenario 1	2030 Climate Scenario 2	2030 Climate Scenario 3	2030 Climate Scenario 4
Rainfall (mm/pa)	503	451	375	518	493	511
Temperature (°C average max)	21.6	21.9	22.6	22.5	22.8	22.5
Temperature (°C average min)	9.4	9.0	10.1	10.2	10.5	10.4
Stock Rate (DSE/Ha)	6.5	6.5	6.5	6.5	6.5	6.5
Profit ($/ Ha)	205	189	164	286	226	282
Profit change compared to 1970-99 (%)		- 7.8%	- 20%	+ 39.5%	+ 10.2%	+ 37.6%
Profit change compared to 2000-09 (%)			- 13.2%	+ 51.3%	+ 19.6	+ 49.2%

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

Table 2: Modelling of enterprise comparing periods 1970-99, 2000-09 and 4 climate scenarios in 2030

Location: Ravensthorpe **Enterprise:** Merino x Poll Dorset lamb production

	1970–1999	2000-2009	2030 Climate Scenario 1	2030 Climate Scenario 2	2030 Climate Scenario 3	2030 Climate Scenario 4
Rainfall (mm/pa)	427	447	328	436	396	492
Temperature (°C average max)	22.6	22.6	23.8	23.5	23.8	23.5
Temperature (°C average min)	10.4	10.4	11.2	11.1	11.5	11.2
Pasture (kg DM/Ha/yr)						
Stock Rate	2.5	2.5	2.5	2.5	2.5	2.5

(DSE/Ha)						
Profit ($/ Ha)	105	100	10	101	62	110
Profit change compared to 1970 - 1999 (%)		-4.7%	-90.5%	-3.8%	-40.9%	4.8%
Profit change compared to 2000 - 2009 (%)			-90.0%	1.0%	-38.0%	10.0%

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

c) Summary of adaptations examined and potential impact / benefit

The effects on profit of various adaptations employed with long-term climatic data and Climate Scenario 2 in 2030 are shown in Table 3. Because mating time and stocking rate are key profit drivers, they were the main adaptations modelled and presented here.

For Kojonup (Table 3a), in 2030, the biggest increase in profit occurred by maintaining current practices, with little to be gained by mating a month earlier, reducing the stocking rate (SR) by 0.5 DSE/ha or increasing the SR by 0.5 DSE/ha.

Table 3a: Adaptations modelled for a Merino x Poll Dorset lamb production enterprise in Kojonup comparing long-term climatic data [1970-1999] and climate Scenario 2 in 2030

KOJONUP: Adaptations modelled	Profit ($/ Ha) 1970–1999	Profit ($/ Ha) 2030 Climate Scenario 2
Business as usual (no change)	**205**	**286**
Change mating time (14 Feb to 14 Jan)	**205**	**262**
Change stocking rate from 6.5 to 6	**198**	**244**
Change stocking rate from 6.5 to 7	**203**	**233**

For Ravensthorpe (Table 3b), in 2030 delaying mating by one month and decreasing SR resulted in significant decreases in profit, with the only marginal increase in profit occurring if SR was increased from 2.5 to 3.0 DSE/ha.

Table 3b: Adaptations modelled for a Merino x Poll Dorset lamb production enterprise in Ravensthorpe comparing long-term climatic data [1970-1999] and climate Scenario 2 in 2030

RAVENSTHORPE: Adaptations modelled	Profit ($/ Ha) 1970–1999	Profit ($/ Ha) 2030 Climate Scenario 2
Business as usual	105	**101**

Change mating time (29 Dec to 29 Jan)	**95**	**86**
Change stocking rate from 2.5 to 2	**89**	**75**
Change stocking rate from 2.5 to 3	**122**	**104**

6. Implications of project findings

Both sites had small but consistent increases in mean minimum and maximum temperatures across all of the four GCM's used, with the largest increase being 1.2ºC. This will have implications for the growing season at these locations as increased temperature can affect bud formation and flowering and thus yield and quality of crops. For temperature-sensitive crops such as canola – a mainstay of cropping rotations in Kojonup area - this could lead to faster maturing which could result in reduced yield and quality. There may well be similar affects on temperature-sensitive pasture species.

The increased CO_2 will result in an increase in legume content. This could increase the rate of decline of dry pasture residues over summer as clover residues break down quicker than grassy pastures during senescence. As a consequence, wind erosion and groundcover limits will be reached quicker, necessitating the need for confinement feeding as an essential component of a sustainable grazing system for producers in these areas.

When presented with the GrassGro-run results, producers on the whole seemed quite positive. While the variation in predicted rainfall from the 4 GCMs demonstrated the independence of the models, the lack of consistency was troubling for many producers, and led to a degree of scepticism about the value of the GCM models. On the other hand, the models demonstrated several scenarios that included extremes, and this proved useful in discussions about coping with climate variability. Producers are already routinely coping with erratic seasons, and predictions suggesting this variability would continue into the future added strength to their resolve to adapt by adopting improved sustainable tactics in their enterprise.

7. Future RD&E needs

1. The inconsistency between the GCM predictions made it difficult to 'sell'. Given WA is so different from Eastern Australia, is it possible to identify GCM's that give a clear consistent message for WA?
2. The ability for GrassGro to manage crop residues would be an advantage as cropping is fundamental to most WA enterprises.

8. Published papers and extension communication products

The following publications were prepared and distributed during the project

- **Ovine Observer March 2011***: Southern livestock adaptation project, WA*
- **Ovine Observer June 2012**: *Understanding climatic modelling and its impact on the southern livestock industry.*
- **Wagin Woolarama handouts**:
  - *Understanding climatic modelling and its impact on the southern livestock industry;*

- *Details, costs and prices used in the Kojonup 'Base' run;*
- *Future climate predictions for the Kojonup 'Base' run*