Final report

Whole Farm Systems Analysis of Climate Change Impacts on the Southern Grazing Industries

Project code: B.SFP.0078

Prepared by: Peter Ball
Tasmanian Institute of Agriculture

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Meat and Livestock Australia Limited
PO Box 1961
NORTH SYDNEY NSW 2059

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Abstract

This project formed part of the Climate Change Adaptation in the Southern Australian Livestock Industries program focused on the mitigation of greenhouse gases and climate change adaptation options for the dairy industry. Regional consultations were undertaken with farmers and industry representatives to present the modelling results of the Program and gather regionally specific feedback on likely adaptation and mitigation options.

Executive summary

Background

This project was collaborative in its approach to addressing the climate adaptation and greenhouse gas (GHG) mitigation options for the dairy industry and southern grazing industries within the Climate Change Adaptation in the Southern Australian Livestock Industries (CCASALI) program. This sub project (B.SBP.0077) was undertaken by Tasmanian Institute of Agriculture (TIA).

Objectives

These three objectives of this project were achieved:

- By 2011, a knowledge base will be established to underpin ongoing engagement with livestock producers in Tasmania, and to facilitate further research, development and extension in climate change adaptation.
- By 2012, 200 livestock producers across Tasmania will be aware of the key outcomes of the program through a combination of field days, workshops and written material
- 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

The fourth objective was under development as discussed in the recommendations.

- 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

Methodology

- Livestock impact modelling was conducted for selected Tasmanian regions using locally relevant enterprises as indicative systems. Modelling was conducted using GrassGro, with weather data derived from the Climate Futures Tasmania project.
- Modelling was conducted across four climate models using the A2 emissions scenario. The 2030 climate was characterised by mean responses over the forecast period 2015-2044. The current situation was characterised by mean responses over the 1970-1999 historical data period.
- Producers were engaged in workshops with discussion/ productivity groups, and awareness was further extended at producer field-days and seminars. The awareness of climate change impact was included within a range of activities conducted in the MLA More Beef from Pastures program.

Results/key findings

The effects of climate change to the 2030 horizon on Tasmanian livestock systems were forecast to be generally benign. The key modelling outcome was that pasture production is indicated to broadly increase in this timeframe or remain similar with improved seasonal supply.

This outcome is indicated for many key production areas within the state. Some areas in the central highlands and southern midlands may not realise this benefit.

Generally it appears that increased temperatures and reduced frost frequency may improve pasture growth. This alongside a largely neutral or improved rainfall leads to forecasts of improved or similar pasture production. In the absence of any substantially increased seasonal feed deficit notably in summer, animal production is forecast to increase in many regions.

The key adaptation facing many regions seems to be making use of improved opportunity for more effective utilisation of the pasture resource, with increasing stocking rate used to capture this opportunity within systems similar to those already being operated.

Benefits to industry

Issues of local interest include a commitment to long term bio-economic monitoring across a range of enterprises and climatic zones. Such monitoring will assist in developing the case for adaptive change and in validating the basis for modelled comparisons with selected adaptations. Adaptations that have indicative benefit now and into the near future may be included in demonstration or case study analyses.

In contrast to the other Southern states, the future forecasts for Tasmania are generally positive. As we approach 2030 and beyond, and if the current climate forecasts are born out, Tasmania with its water supply and climate security may become an even more attractive hub for agricultural development. If this occurs, there will naturally be much emphasis placed on new ways of using the climate effectively perhaps with many new and exciting crops.

However, the potential gains from more effective and productive livestock industries should not be overlooked. The momentum of large, already established industry (lamb, beef, dairy, wool), that has the requisite infrastructure and reason for being already in place, could be a powerful force indeed. Industry support to adapt, build and capture the benefit on offer, may be a wise investment.

Future research and recommendations

Improved modelling capacity, particularly with respect to pasture responses may be a valuable development. This may encompass new species parametrisation and improved modelling of within sward competition. Trends of increasing animal production and carrying capacity, and perhaps reduced variability of pasture performance may give producers greater confidence to adopt mechanisms for increasing overall pasture utilisation.

One key question to be addressed though is at what point will producers feel assured enough to seek this opportunity?

Part of the adaptive process may be significantly improved attention to performance monitoring. This may provide the evidence and assurance for reasoned adaptive changes that seek to make hay while the sun shines, so to speak, and bank the opportunity that improved pasture growth may offer.

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1. Background

This project is collaborative in its approach to addressing the climate adaptation and GHG mitigation options for the dairy industry and southern grazing industries within the Climate Change Adaptation in the Southern Australian Livestock Industries (CCASALI) program. This sub project (B.SBP.0077) was undertaken by Tasmanian Institute of Agriculture (TIA).

2. Objectives

2.1 Project Objectives (as per contract)

Table 1: Project Objectives and Status

Objective	Status at Project End
1. By 2011, a knowledge base will be established to underpin ongoing engagement with livestock producers in Tasmania, and to facilitate further research, development and extension in climate change adaptation	Achieved. GrassGro modelling capacity has been developed within TIA. Further staff will be trained as a consequence of this capacity. This modelling has developed the understanding of climate impact beyond the simplistic effects on pasture growth and average responses alone. This climate impact and modelling experience is available for more effective systems analysis in RDE development of livestock systems.
2. By 2012 200 livestock producers across Tasmania will be aware of the key research outcomes of the program through a combination of field days, workshops and written material.	Achieved. Over 200 producer participants were directly engaged with the projects outcomes in workshops and seminars discussing regional climate impact. Written material in rural press pages, newsletters and at awareness events has extended awareness to approximately 600 producers.
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.	Under development. The program is developing a series of recommendations. An issue of local interest may be a commitment to long term bio-economic monitoring across a range of enterprises and climatic zones which will assist in developing the case for adaptive change. Such monitoring will assist in validating the basis for modelled comparisons with selected adaptations. In addition adaptations that have indicative benefit now as well as into the near future may be also be included in such monitoring. Mitigation outcomes that arise will also required systems analysis from both modelling and adoption perspectives.

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. GrassGro modelling capacity has been developed within TIA.

2.2 Project Activities

Table 2: Project Activities

Activity	Contracted Requirement	Status at project end
1. Regions modelled	1	1
2. Locations modelled	6	7
3. Enterprises modelled		NA
4. Producer workshops held	3	9
5. Other awareness events held (e.g. seminars)	15	8
6. Producers directly engaged	60	201
7. Communication products produced		NA
8. Producers aware of the key project findings?	200 (revised by the project to 400)	600
9. Adaptations modelled		NA

3. Methodology

Livestock impact modelling was conducted for selected Tasmanian regions using locally relevant enterprises as indicative systems. Modelling was conducted using GrassGro, with weather data derived from the Climate Futures Tasmania project.

Modelling was conducted across four climate models using the A2 emissions scenario. The 2030 climate was characterised by mean responses over the forecast period 2015-2044. The current situation was characterised by mean responses over the 1970-1999 historical data period.

Producers were engaged in workshops with discussion/ productivity groups, and awareness was further extended at producer field-days and seminars. The awareness of climate change impact was included within a range of activities conducted in the MLA More Beef from Pastures program.

Table 3: Producer areas

Location	Beef Cattle	Sheep - wool	Sheep - prime lamb
King Island	X		
Flinders Island	X		X
Ringarooma	X		
Bothwell	X	X	
Cressy			X
Smithton	X		
Oatlands		X	

4. Results

4.1 Key Results

4.1.1 Overview- summary of the key findings

In Tasmania the effects of climate change to the 2030 horizon are forecast to be generally benign or similar to the current situation. The key modelling indicates that pasture production may broadly increase in this timeframe or at least remain similar with some smoothing of seasonal deficit leading to opportunity for increased pasture utilisation above the baseline comparison.

This outcome is indicated for many key production areas within the state. Some areas in the central highlands and southern midlands may not realise this benefit.

Generally increased winter temperatures and reduced frost frequency may improve winter pasture growth. This alongside a largely neutral of slightly improved rainfall leads to consequent forecasts of improved or similar pasture production. Where there is no substantial increase in summer feed deficit, animal production is forecast to increase or supplementary feed requirements decrease, leading to increased gross margin and increased opportunity for greater pasture utilisation.

Some forecast weather data suggest slightly less variable annual rainfall and more uniform seasonal responses. However this should be probably be approached with caution, as such detailed appreciations of variability may be beyond the skill of the climate modelling.

The key adaptation facing many regions seems to be the action required for more effective utilisation of the pasture resource, with increasing stocking rate used to capture this opportunity within the systems already being operated.

A further business adaptation may be a more rigorous approach to seeking the continuous improvement of these systems and evaluating the opportunity for increased productivity and profit. This can be well founded the best practice recommendations already encapsulated within programs such as More Beef from Pastures and Making More from Sheep.

Trends of increasing animal production and carrying capacity, and reduced variability of performance within the optimisation of stocking rate, may give producers greater confidence to adopt mechanisms for increasing overall pasture utilisation.

One key question is that if the new climate offers improvement, how and when will producers come to effectively realise and benefit from it? At what point will producers feel assured enough to seek this opportunity?

Part of the adaptive mechanisms may be significantly improved attention to performance monitoring. Improved systems monitoring may provide the evidence and assurance for reasoned adaptive change that seeks to make hay while the sun shines as it were, and bank the opportunity that any improved pasture growth may offer.

4.1.2 Specific results Current Situation

Table 4: King Island – Trade Steers V2030 at 17.5 DSE/ha

	1970-1999	2030 Climate GFDL		2030 Climate Echam		2030 Climate CSIRO3.5		2030 Climate HAD	
		Scenario 1	% change compared to 1970-1999	Scenario 2	% change compared to 1970-1999	Scenario 3	% change compared to 1970-1999	Scenario 4	% change compared to 1970-1999
Rainfall (mm/pa)	873	887	2	916	5	856	-2	907	4
Temperature (°C average Max)	16.8		4		2		4		4
Temperature (°C average Min)	10.6		11		6		8		8
Pasture (kg/DM/Ha/yr)	10667		3		11		4		7
Stock Rate (DSE/Ha)	17.5		0		0		0		0
Live-weight production (kg/ha/yr)	870		2		3		3		5
Gross Margin ($/Ha)	460		10		18		8		13

2030 Climate Scenario 1 – GFDL (USA); 2030 Climate Scenario 2 – ECHAM (German); 2030 Climate Scenario 3 – CSIRO3.5; 2030 Climate Scenario 4 – HAD (English)

Table 5: King Island – Trade Steers V2030 at 21.5 DSE/ha

	1970-1999	2030 Climate GFDL		2030 Climate Echam		2030 Climate CSIRO3.5		2030 Climate HAD	
		Scenario 1	% change compared to 1970-1999	Scenario 2	% change compared to 1970-1999	Scenario 3	% change compared to 1970-1999	Scenario 4	% change compared to 1970-1999
Rainfall (mm/pa)	873	887	2	916	5	856	-2	907	4
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2030 Climate Scenario 1 – GFDL (USA); 2030 Climate Scenario 2 – ECHAM (German); 2030 Climate Scenario 3 – CSIRO3.5; 2030 Climate Scenario 4 – HAD (English)

4.1.3 Summary of adaptation examined and potential impact/benefit (regions especially)

The rationale taken in exploring adaptations was to investigate adaptations that are likely to make sense now and retain this benefit or offer improvement into the future. These included increasing stocking rate, tactical stocking rate management to match feed supply and demand, increasing legume content and changing primary grass species.

Increased stocking rate appeared the most effective mechanism for taking advantage of potential improvement in pasture production and seasonal feed on offer and translate this into increased gross margin. Current industry best practice approaches to feed-base and livestock management are likely to continue to provide the means of supporting this improvement or eroding it in their absence.

In regions with a positive 2030 response, early turn-off of animals at a lighter sale weight indicated some potential increase in total productivity. Measures of profit however are vulnerable to market acceptability of sale weight and consequent market value per unit live- weight. Customer and processing factors may over-ride productivity alone.

In some locations, increased pasture legume composition also improved productivity now and into 2030. Generally increased legume performance was suggested in the higher rainfall zone, which in turn has benefits for both pasture and animal performance.

Changing pasture species from ryegrass to cocksfoot offered no increase where ryegrass was already well adapted in the modelled regions.

Other Tasmanian modellers have indicated potential increases with the use of C4 grasses out to 2080. In my view it would be wise to take this indication with caution. Currently C4's offer little to our grazing systems other than as occasional poorly performing weed in more temperate improved pastures. This option was not available in GrassGro, which in itself may indicate a lack of confidence in the species parametisation available.

Where ryegrass is less adapted, a change to cocksfoot was slightly positive in terms of productivity and gross margin compared to ryegrass. However, there were some increases in measures of sustainability, with cocksfoot improving ground cover and also slightly reducing gross margin variance.

In these drier central/southern areas the 2030 climate showed a slight reduction in profitability despite generally improved total rainfall and total pasture production This appeared to be due to increased periods of feed deficit and supplementary feeding. In this less temperate region increased winter feed on offer was not observed in the model. This overall performance reduction was marginally less evident with the adoption of cocksfoot and the variability of gross margin response was also reduced. However, the 2030 gross margin still declined slightly relative to the current situation.

In the above situation, reducing stocking rate reduced mean gross margin across the board, but periods of supplementary feeding remained to maintain the reduction in productivity forecast for the 2030 climate. Time of sale and target weight at sale also had limited ameliorating effect.

Changes in grass species from perennial to annual in low rainfall zones offered a variable response ranging from no gross margin improvement to some improvement. This improvement in mean return however was accompanied by increased variance and reduced ground cover increasing sustainability related risk inherent in a less stable annual system.

Changing enterprise to wethers or adopting feed supply tools like fodder crops or dual-purpose cereals off other systems approaches that may ameliorate the 2030 reduction in these regions.

5. Conclusion

The effects of climate change to the 2030 horizon on Tasmanian live-stock systems are forecast to be generally benign. The key modelling outcome is that pasture production is indicated to broadly increase in this timeframe or remain similar with improved seasonal supply.

This outcome is indicated for many key production areas within the state. Some areas in the central highlands and southern midlands may not realise this benefit.

Generally it appears that increased temperatures and reduced frost frequency may improve pasture growth. This alongside a largely neutral or improved rainfall leads to forecasts of improved or similar pasture production. In the absence of any substantially increased seasonal feed deficit notably in summer, animal production is forecast to increase in many regions.

The key adaptation facing many regions seems to be making use of improved opportunity for more effective utilisation of the pasture resource, with increasing stocking rate used to capture this opportunity within systems similar to those already being operated.

5.1 Key findings

Overall the picture for many Tasmanian livestock enterprises looks benign or relatively neutral.

This view is of course predicated on the assumption that the interaction of 2 models, one seeking to create likely future weather and the other responding with consequent pasture and livestock production, realistically reflects the future production environment. Pasture species interaction in competitive and sometimes weedy pastures, alongside rainfall prediction skill, probably introduce the greatest means of reduced confidence in this.

In general it is hard to believe that there will be significant pre-emptive action by producers in response to these findings or other climate change discussions. There is a healthy scepticism regarding modelling in general and climate modelling in particular.

The confidence to make changes that capture any benefits that do manifest will be a cornerstone issue. Here this effectively means the confidence of producers to manage stocking rate in response to increases in feed supply where they occur. This will be assisted by significantly more rigorous approaches to monitoring production and financial performance.

These measures may assist in determining if positive change is occurring, or alerting producers to the consequences of negative change. A critical issue becomes one of the timeframe in which these realisations are made and what action they initiate.

An adaptation of some consequence arising from this project will be the improved decision support capacity that can assist the reasoned examination of change and forecasting, by

employing more rigorous analytical approaches such as the systems modelling offered by GrassGro.

Seeking to build more robust live-stock businesses by implementing the practices that already offer improvement, by realising the value of key business and system information, and by seeking informed evaluation of improvement paths, offer practical ways forward.

5.2 Benefits to industry

Many producers regard climate change as a bandwagon, with timeframes beyond their current management concern and perhaps beyond the lifespan of their businesses. Practical mechanisms for building adaptive capacity and adopting approaches that make sense now, beat scary future messages in any climate period.

When contrasted against the remaining Southern states, the future forecasts for Tasmania are positive indeed. As we track toward 2030 and beyond, and if the current climate forecasts are born out, Tasmania with its water supply and climate security may become an even more attractive hub for agricultural development. If this occurs, there will naturally be much emphasis placed on new ways of using the climate effectively with many new and exciting crops. However the potential gains from more effective and productive livestock industries should not be overlooked. The momentum of large, already established industry (lamb, beef, dairy, wool), that has the requisite infrastructure and reason for being already in place and is improving productivity and profit, could be a powerful force indeed. However industry support may be required to adapt and capture the benefits on offer.

6. Future research and recommendations

The program is developing series of recommendations. Issues of local interest include a commitment to long term bio-economic monitoring across a range of enterprises and climatic zones. Such monitoring will assist in developing the case for adaptive change and in validating the basis for modelled comparisons with selected adaptations. Adaptations that have indicative benefit now and into the near future may be included in demonstration or case study analyses.

The integration of any mitigation practices that become feasible will an important line of development and research activity.

Improved modelling capacity, particularly with respect to pasture responses may be a valuable development. This may encompass new species parametrisation and improved modelling of within sward competition.

6.1 Published papers and extension communication products

Final communication references are under development.

Contribution has been made to papers presented Australasian Agronomy conference (1) and the Grasslands Society of Southern Australia Conference (2). Awareness stories have been communicated in rural press articles and newsletters (3). A further 2 are being prepared.

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