Dairy Businesses for Future Climates

GIPPSLAND - Research Findings 2016

The profitability of dairy farm businesses in this research was negatively affected by the 2040 climate change scenarios modelled. Three real base farms (including one in Gippsland) and three development options at each site were tested and all were predicted to have a reduction in profit.

Farmers interviewed were generally confident to adapt to incremental climate change based on their past experiences of managing variable seasons.

- Skilled farm managers are essential to the future success of the dairy industry. Training and skills support for farmers to manage future climate challenges will be required.

Dairy farm managers will need to continue to adapt their farm systems to manage risks presented by future climate.

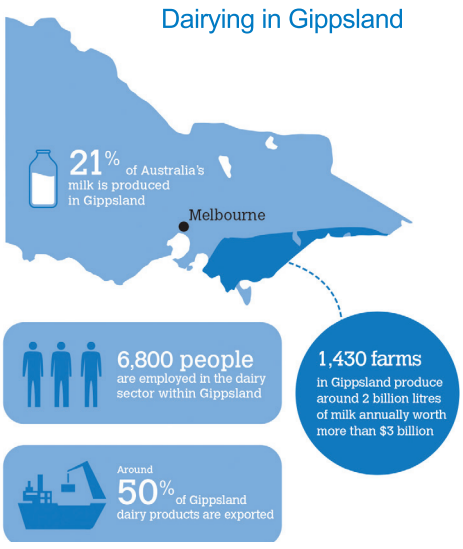
- The growing season for pastures will shift under 2040 climate change scenarios creating feed challenges.
- Year to year climate variability will continue to be a challenge to dairy farm businesses.
- Milk price is likely to have a greater impact on business performance than climate change.

The adaptive or simplified farm production systems tested are realistic alternatives to the long term trend of intensification for dairy businesses in future climates.

- Milk payment systems may alter the attractiveness and returns of different production systems in the future.

What was the aim of the national research?

The Australian dairy industry has been on an intensification pathway over recent decades, utilising higher levels of inputs to produce more milk. This pathway has been questioned in light of projections for warmer and more variable future climates. This research set out to explore how three individual dairy farm systems in Gippsland, South Australia and Tasmania might perform under predicted climate changes (out to 2040) and how they could adapt to a changing climate.

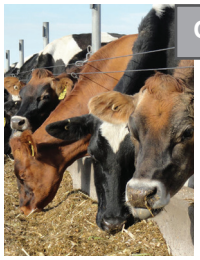


How was the research carried out in Gippsland?

- A Gippsland case study dryland dairy farm located at Moe in central Gippsland was studied as a representative (base) farm with the intention that other farms in the region could relate to the research findings.
- Three development options for the base farm in a high, medium and low climate change scenario were modelled in a '2040' climate by an economist and biophysical modellers.
- Social researchers conducted interviews with dairy farmers and hosted three focus groups to explore the social impacts on farm production from a changed climate and explore the development options. Farmers were surveyed on their experiences of extreme weather events in the region.
- A Gippsland Working Group made up of farmers and a farm consultant guided the research.

What was the base farm system and what development options were explored?

The base farm is a pasture based system with a spring calving herd of 350 cows. Three development options, representing different farm systems were defined for modelling by the local Working Group.

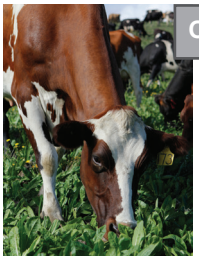


Option 1 - INTENSIFY

Pasture grazing at a higher stocking rate

Additional supplementary feeding

Split calving

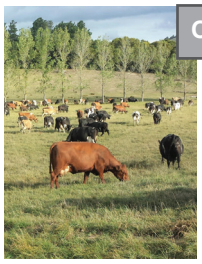


Option 2 - ADAPT

Fewer cows

Greater milk production per cow

Autumn calving



Option 3 - SIMPLIFY

Aimed to reduce purchased feed

Optimise pasture use at a lower stocking rate

Autumn calving

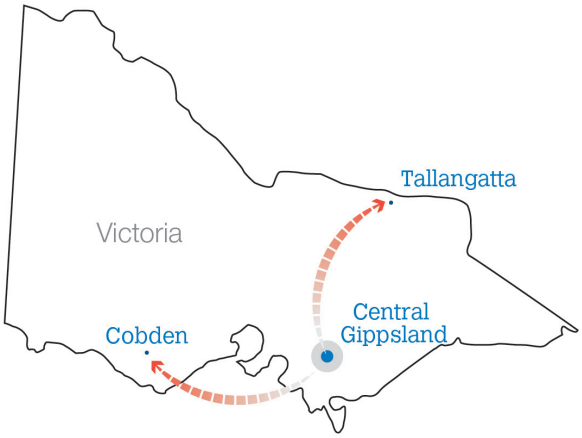
Details of the base farm and each of the options in the historic and 2040 high change scenario system are outlined in the table below.

KEY FEATURES Base Farm and 3 development options modelled in Gippsland	Herd Size	Cow Live Weight (kg)	Peak Calving	Stocking Rate (cows/ha)	Grain Fed (tonnes/cow)	Production per yr kg Milk Solids per cow (today/2040)	Pasture consumed tonnes DM/ha (today/2040)
Base Farm – current system	350	475	Spring	3.2	1.1	395 / 392	9 / 8.1
Intensify – increase stocking rate	500	550	Split 50% mid April 50% mid Aug	4.5	2	531 / 515	9.7 / 8.6
Adapt – more milk per cow	250	550	Autumn	2.3	1.8	512 / 518	8.7 / 8.5
Simplify - self reliant	200	475	Autumn	1.9	0.5	449 / 448	7.8 / 7.8

How different is a 2040 Gippsland climate predicted to be?

- In 2040, modelling suggests that the climate in Central Gippsland will have warmed by 1.4°C with rainfall declines up to 12% (current annual rainfall average at the base farm is 940mm).
- This would be similar to the current climate at Cobden in south west Victoria (though warmer), or Tallangatta in north east Victoria (without the temperature extremes).
- Rainfall events are predicted to vary from year to year and to occur in fewer, larger events, with longer dry spells in between.
- Extreme weather events are predicted to continue under a changing climate – intense rainfall, drought, bush fires and wind events were identified as concerns to Gippsland farmers surveyed in this research.
- In 2040, March will have maximum temperatures similar to January today. In 2040, November will have maximum temperatures similar to December. Some might say that summer is getting 'bigger'.

Dairy Business for Future Climates
Case Study Farm - Central Gippsland, Victoria

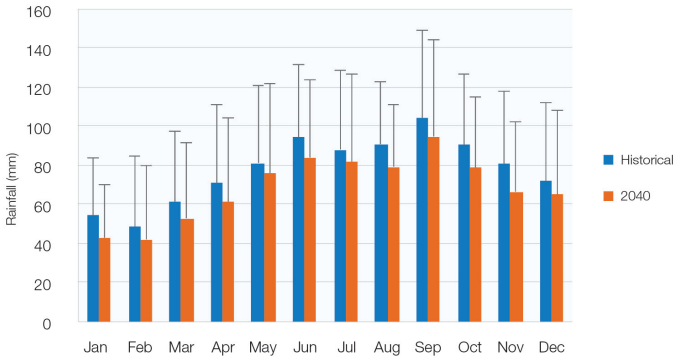


In 2040 under the high climate change scenario, Moe will be more like Tallangatta (without the temperature extremes) or Cobden (but slightly warmer).

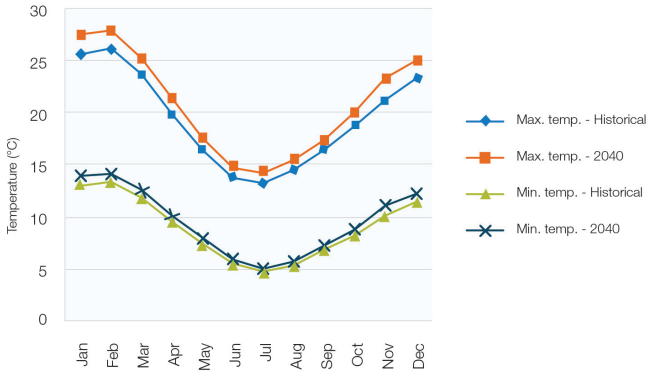
How different is a 2040 Gippsland climate predicted to be? [cont]

Central Gippsland, Victoria

Historical and 2040 modelled rainfall (high climate change scenario) at Central Gippsland, Victoria



Historical and 2040 modelled maximum and minimum temperature (high climate change) at Central Gippsland, Victoria



The above graphs show the historical average rainfall distribution in Central Gippsland (blue columns) and the modelled rainfall distribution (red columns) in a 2040 high climate change scenario.

The graph shows a reduction in rainfall for every month of the year. It also indicates increasing year-to-year variability in rainfall (note that the size of the error bars (grey lines) relative to the columns is relatively larger in the 2040 scenario). Minimum and maximum temperatures will be higher in 2040.

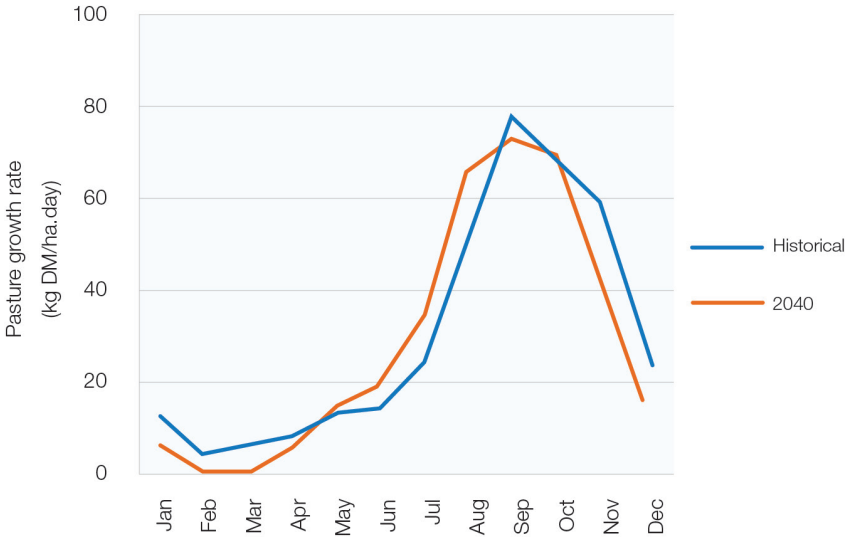
The 2040 scenario was based on climate projections from the best performed climate models across southern Australia.

How different will pasture production and utilisation be in 2040?

- Gippsland's dairy farms rely on pasture production (predominantly rye grass), pasture consumed by cows is a key profit driver.
- Modelling showed that pasture growth rates from May to September on the base farm (winter and early spring) were likely to be higher in the 2040 climates but lower during the remainder of the year. This results in a lower proportion of pasture being directly grazed and more conserved and fed back to cows.
- Pasture utilisation was highest and most variable in the *Intensify* option, and lowest and least variable in the *Simplify* option.
- The base farm and *Intensify* options had approximately 10% lower pasture consumed in the 2040 high climate change scenario than the historic climate.

Central Gippsland, Victoria

Monthly average pasture growth rates for a perennial ryegrass pasture in the historical and 2040 High climate scenarios at Gippsland



"The biggest challenges come when we get a tough season (weather-wise) together with a low milk price."
(Dairy farmer, Gippsland)

What does a changing climate mean for dairy farms in Gippsland?

- Climate variability already experienced will continue and rainfall variability may be increased. Climate variability can have a greater impact on financial returns compared to the general trend in climate change alone.
- If climate change follows the high change trajectory, less pasture will be grown on farm and on average, profitable years will become less frequent. Farmers will need to adapt further to manage greater risk (eg. stock comfort, feed buffers, water security) and have financial plans in place to buffer low production in some years.
- Pasture utilisation, feed costs and milk prices will continue to have dominant influences on farm businesses in the 2040 climates.
- Assuming the same milk price for each option (which is not the case with current milk payment structures), in the 2040 high climate change scenario, none of the farm development options modelled increased their profit but the options were affected differently.

The *Intensify* option was most impacted, followed by the base farm then *Simplify*, with *Adapt*, least impacted. The key to understanding the different impacts are the changes to the seasonal pattern of pasture production.

The following table outlines the impacts on the farm options that were explored.

Base Farm	The contracted pasture growing season and increased winter growth in 2040 will reduce pasture utilisation.
Intensify	Pasture utilisation is highly variable between years, and exposed to warmer and drier climate in the 2040 high climate change scenario. A heavy reliance on purchased feed will increase further in the high 2040 climate change scenario.
Adapt	Autumn calving capitalises on the changed pasture growth pattern in the 2040 high climate change scenario. Slightly less profitable than the base farm in the historic climate, the most profitable option in the 2040 high climate change scenario.
Simplify	Pasture utilisation is predicted to be lower than the base farm in the historic climate, but autumn calving capitalises on the changed pasture growth pattern in 2040 high climate change scenario. While less profitable in the historic climate it has similar profitability to the base farm in the 2040 high climate change scenario.

"With the fodder, you're relying on the outside to implement this (intensify system) well and we've just got too many outside factors that impact on that bought in feed cost."
(Dairy farmer, Gippsland)

What are the opportunities and trade-offs with each development pathway?

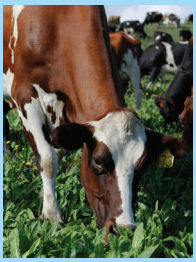
This research did not find a clear 'winner' in the form of the most resilient farming system for the future. All of the development options explored had positive and negative aspects.

The following tables provide a summary of the opportunities, vulnerabilities and dependencies of each development option as identified by farmer participants in this study.

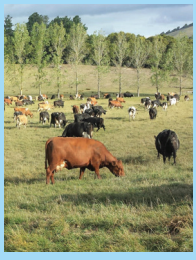
Opportunities and trade-offs for an intensification pathway

Intensify 2040	Opportunities	Vulnerabilities	Dependencies
	▪ Capacity to take advantage of economies of scale and favourable operating conditions, i.e. high milk prices, low feed prices ▪ Employment opportunities, these systems demand more staff ▪ Investment in a permanent feed-pad can add operational flexibility in response to variable seasonal conditions ▪ Increased manufacturing capacity in regions as a result of greater milk production	▪ May be exposed to greater variability (high and lows) in profit making over the mid to long term under variable climate conditions ▪ Significant investment in infrastructure may result in 'lock-in' effects, reducing flexibility of farm system ▪ Possible risks to personal and family health due to increased stress levels ▪ Greater effluent concentrations	▪ May be attractive to dairy manager/ owner who operates a mature dairy business ▪ Requires high equity levels and/or the ability to take financial risks ▪ Reliant on accessing skilled staff ▪ Reliant on knowledge of global situation – milk and fodder prices, climate patterns ▪ Reliant on affordable grain supply

Opportunities and trade-offs for an adaptive pathway

Adapt 2040	Opportunities	Vulnerabilities	Dependencies
	▪ Flexibility in adjusting farm system to maximise seasonal conditions, eg. weather, input costs ▪ Maximises per cow production	▪ Sound decision making and planning abilities to adjust operations seasonally to take advantage of conditions ▪ Adaptive management requires constant scanning of seasonal and global parameters	▪ Reliant on accessing skilled staff ▪ Need to have self-efficacy in seeking knowledge to supplement knowledge gaps ▪ Reliant on knowledge of global situation – milk and fodder prices, climate patterns ▪ Reliant on affordable grain supply

Opportunities and trade-offs for a simplified (de-intensification) pathway

Simplify 2040	Opportunities	Vulnerabilities	Dependencies
	▪ Operating a less complex system, i.e. less stress on business managers, families and staff ▪ Possibly less labour required and less demand for advisory services ▪ Possibility of stabilising annual profit making over the mid to long term by generating a consistent income	▪ Greater reliance on making own decisions ▪ Reduced capacity to take advantage of favourable operational conditions, i.e. high milk price, low feed costs ▪ May limit farming succession if not able to financially support additional family members or share farmer ▪ Potential loss in agricultural advisory services due to reduced demand	▪ Need high level skills in pasture management, budget management and general farm operations ▪ Likely to be viable only if servicing a relatively low debt with medium to high equity levels ▪ Likely to be an attractive option for a farmer transitioning towards retirement

Does it matter whether the change is implemented at the start of a wet or dry period*?

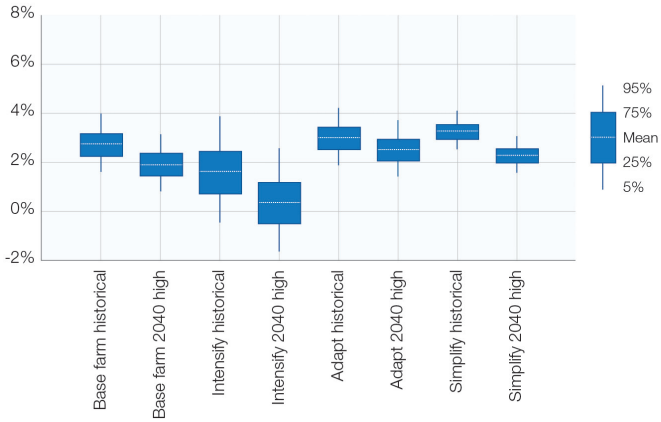
The modelling results indicate a marked difference between the profitability of the *Intensify* option if it is implemented at the start of a 'wet' or 'dry' period (see graphs below). The bigger the box in the graph, the more variability is likely. If the Intensify option is implemented at the start of a 'dry' period, it is a much less attractive option (in terms of average profitability) than if it is implemented at the start of a 'wet' period.

Under the historic climate, the *Intensify* option shifts from having the highest average profitability of all the options in the 'wet' period, to having the lowest average profitability in the 'dry' period. This is due to a higher reliance on purchased feed and increased debt as a result of capital development and machinery purchases. For the *Simplify* and *Adapt* options there is little difference between implementing them at the start of a 'wet' or 'dry' period.

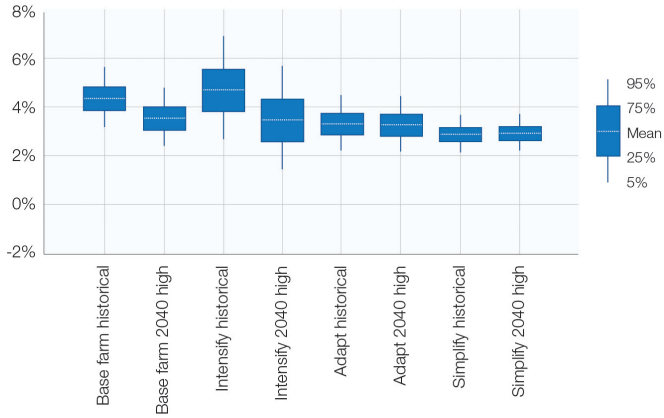
** a wetter decade (average 1100 mm/year) & drier decade (average 815 mm/year) were used to allow modelling of the farm development options under different conditions.*

Central Gippsland, Victoria

Internal rate of return in dry period Central Gippsland, Victoria



Internal rate of return in wet period Central Gippsland, Victoria



The above graphs show the internal rate of return (IRR real) for the central Gippsland farm business if each option was implemented at the start of a 'wet 10-year period' (similar rainfall to 1986/87 – 1995/96 and below average supplementary feed prices) and the start of a 'dry 10-year period' (similar rainfall to 2000/01 – 2009/10 and above average supplementary feed prices).

The IRR represents the average annual earning rate of each investment over each decadal period (in real terms i.e. excluding inflation). The bigger the box in the graph, the more year-to-year variability is likely (or predicted). The boxes cover 50% of the variability that is predicted, while the lines (or whiskers) cover 90% of the variability that is predicted.

How Are Farmers Adapting To Climate Change?

- Increasing the amount of shade and shelter for stock during extreme weather events
- Increasing on farm water storages
- Recycling water in the dairy shed to reduce water usage
- Growing summer crops to fill the feed gap during dry times
- Carrying larger fodder reserves from year to year
- Installing a feed pad for flexibility in feeding animals
- Upgrading irrigation systems
- Installing fans and/or sprinklers in and around the dairy for cow and people comfort
- Adjusting the farm system eg. calving pattern change
- Improving business management skills to manage income variability
- Accessing longer range weather forecasts
- Seeking information about global market conditions

What financial risk is associated with transitioning to the development options?

The *Intensify* option combines increased farm system variability (business risk) with increased financial risk (due to increased borrowings for infrastructure and machinery). This combination leads to significantly greater risk overall. A large proportion of the extra assets are depreciating assets.

Moving from the base farm, a slightly different mix of resources may be required for the *Adapt* option. The operating profit of the *Adapt* option is slightly lower than the base farm on average in the historic climate, this is likely to be offset by a reduction in variability in operating profit. This option appealed to some farmers participating in this project due to the opportunity to adjust tactically from season to season whilst avoiding a 'lock in' to an intensive system.

Overall debt would be reduced slightly with the *Simplify* option by selling some cows, there is less exposure to financial risk compared to the base farm with no additional depreciating assets. This option does not generate enough operating profit to service a high level of debt. There is little variability in operating profit between years. This option would be very low risk with a medium/high equity level. For some farmers participating in this project it represented a desirable business development option due to relatively lower stress levels (compared to a more intensive system).

Which development option is the most risky?

- The *Intensify* option is likely to be the most risky as it is predicted to have the greatest variation in average profitability of all the options. Large profits can be made when milk prices are high and feed is relatively cheap, but large losses are likely if milk price is low and feed is expensive. A successful manager of this type of system would monitor operating conditions closely and make adjustments between years to suit conditions.
- The *Simplify* option had the least predicted variation in profitability. Hence, there will be less pressure to make adjustments in unfavourable operating conditions. This option would generally be regarded as a low risk option, but the ability to capitalise on favourable operating conditions may be limited, as may the scope for growth of the business.
- The *Adapt* option has a little less variation in profitability and is more suited to the 'dry' periods than the base farm.

Will milk price have an impact on farm development into the future?

Variation in milk price is predicted to have a much greater effect on the variation in profitability than the 2040 climate change projections. A change in milk price of $0.30/kg MS has a larger impact on profitability than the 2040 high climate change scenario.

The results presented on the graphs (on page 6) include milk price variability, but the average and range are assumed to be the same for all options. It would be expected that the options with more milk produced outside of the spring months, and those with a larger quantity of milk production, are likely to receive a higher milk price than the base farm (however, the seasonal incentives may change if the predominant calving pattern changes).

The *Intensify* (split calving and more milk produced) and *Adapt* (autumn calving) options would be expected to receive a higher milk price than the base farm in the current operating environment. This would lead to a substantial increase in the profitability of these options.

If constant milk price is assumed ($5.25), the base farm was the most profitable option in the historic climate. In the 2040 high climate change scenario, the *Adapt* option had highest profitability, followed by *Base* and *Simplify* while *Intensify* was least profitable.

In the historic climate, a milk price that was $0.30/kg MS higher for the Intensify option than the base farm would result in higher profitability for the Intensify option in either 'wet' or 'dry' periods. In this situation the additional average return might well be worth the extra risk of adopting this option.

If the autumn calving pattern in the *Adapt* option results in a $0.15/kg MS higher milk price than the base farm, the *Adapt* option has similar profitability to the base farm in the historic climate and a higher profit in the 2040 high climate change scenario. If the autumn calving pattern in the *Adapt* option results in a $0.30/kg MS higher milk price than the base farm, the *Adapt* option is likely to be more profitable in both the historic and 2040 high climate change scenario.

Similarly, if the autumn calving pattern in the *Simplify* option results in a $0.30/kg MS higher milk price than the base farm, the *Simplify* option is likely to be more profitable in both the historic and 2040 high climate change scenario. Given that there is a substantial reduction in the overall milk production under the *Simplify* option, an increase of this magnitude is less likely.



Dairy Businesses for Future Climates

What about Greenhouse gas emissions?

Greenhouse gas (GHG) emissions intensity was analysed for the base farm and three development options, now and in 2040. The difference between all farm systems in the historic climate and 2040 was slight but all increased in emissions intensity. Given the small differences that modelling shows across the options, there is no signal to suggest that one option should be favoured above any other due to GHG emissions intensity.

What are the limitations of the modelling approach?

Some of the modelling assumptions of this research include:

- Development options were imposed directly rather than sequentially. In reality each adaptation could be imposed gradually over time, e.g. for the *Intensify* option a farmer may first purchase a feed-pad, second construct a calving shed etc., as allowed by borrowing constraints.
- Climate change scenarios followed the trajectory of high greenhouse gas emissions as predicted by the IPCC (RCP8.5), with atmospheric carbon dioxide levels in 2040 of 489 ppm.
- The economics and risk analysis assume the options are implemented in the same way each year regardless of the seasonal conditions and milk price etc. It is too difficult to build the responsive tactical adaptation into the models.
- 'One-off' extreme events such as large floods and bushfires can be very costly to farm businesses and are difficult to represent in modelling.

Conclusion

Financial, personal, and environmental considerations were all important in farmers' evaluation of the development options. Farmers were generally confident to adapt to projected climate changes based on their experiences over the past decade.

The financial performance of *Intensify* options were superior in historical wet decades but were more impacted by climate variability and change than *Simplify* options, and were considered more stressful and threatened by public concerns about animal welfare and environmental issues. *Adapt* options showed some potential to mitigate financial impacts of climate change.

Results highlighted that farming systems changes to align with projected changes in climate (such as *Adapt* options) or to simplify the system are realistic alternatives to the long term trend for intensification for dairy businesses in future climates. This is due to the risks associated with an intensive system compared to an adaptive system.

Other fact sheets in this series

Dairy Businesses for Future Climates *National Information Sheet*

Dairy Businesses for Future Climates *South Australia Information Sheet*

Dairy Businesses for Future Climates *Tasmania Information Sheet*

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Link - http://dairyclimatetoolkit.com.au/adapting-to-climate-change/adapting-the-dairy-industry

Dairy Australia

Research was undertaken between June 2013 and May 2016. The research was conducted on three farms in south eastern Australia, one of these being in central Gippsland. The decision to change a farming system is contextual – an industry wide response is not appropriate.

Australian Government