Dairy Businesses for Future Climates

SOUTH AUSTRALIA - 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 South Australia) 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.

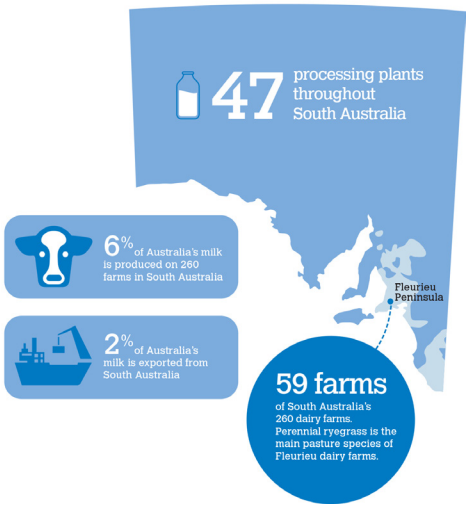
The adaptive or simplified farm production systems tested are realistic alternatives to the long term trend of intensification for dairy businesses in future climates.

- 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 (SA) and Tasmania might perform under predicted climate changes (out to 2040) and how they could adapt to a changing climate.

Dairying on the Fleurieu Peninsula

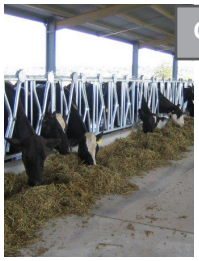


How was the research carried out in SA?

- A dryland case study dairy farm located on the Fleurieu Peninsula was selected 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.
- A South Australian (SA) Working Group made up of farmers guided the research.
- Social researchers conducted interviews with dairy farmers and hosted focus groups to explore the social impacts on farm production from a changed climate and discuss the development options. Farmers were surveyed on their experiences of extreme weather events in the region.

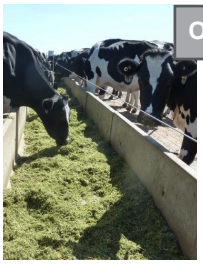
What was the base farm system and what development options were explored?

The base farm is a pasture based system with an autumn (May-June) calving herd of 350 cows. Three development options, representing different farm systems were defined for modelling by the local Working Group.



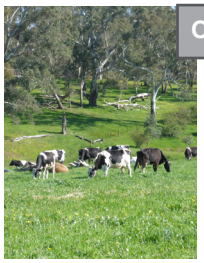
Option 1 - INTENSIFY

Total Mixed Ration (TMR)
A fully ration fed herd of 400 larger cows calving year round to target premiums for flat supply. It was assumed some land was sold to fund the development of the barn and purchase of machinery.



Option 2 - ADAPT

Partial Mixed Ration (PMR)
A 400 cow split calving herd with higher milk production per cow and more pasture consumed, through additional grain feeding, development of a basic feedpad, and more nitrogen fertiliser.



Option 3 - SIMPLIFY

A smaller herd of 290 cows focused on optimising grazed pasture with less fodder and a reduction in grain feeding. The herd is autumn calving.

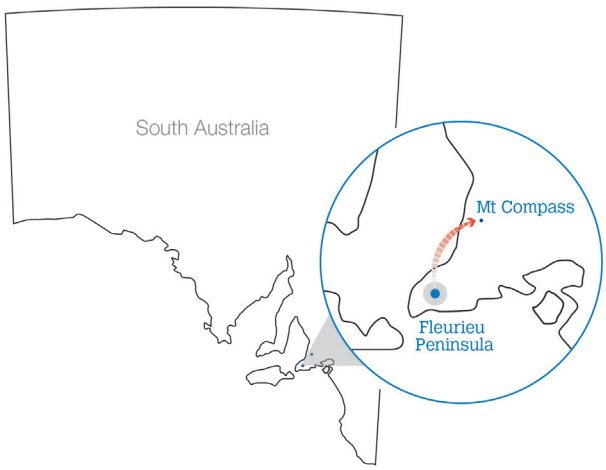
Details of the base farm and each of the options in the historic and 2040 high change scenario system are outlined in the table below.

	Herd Size	Cow Live Weight (kg)	Peak Calving	Stocking Rate (cows/ha)	Grain Fed (Tonnes DM / cow)	Production per yr kg Milk Solids per cow (today/2040)	Pasture consumed Tonnes DM/ha (today/2040)
Base Farm - current system	350	550	Autumn	1.7	1.6	526 / 520	7.6 / 7.3
Intensify – TMR	400	600	Year-round	n/a	3.0	700 / 700	8.1 / 7.3
Adapt – PMR	400	550	Split 50% mid April 50% mid Aug	1.9	2.2	561 / 553	8.1 / 7.3
Simplify - self reliant	290	520	Autumn	1.4	1.0	473 / 471	7.4 / 7.1

How different is a 2040 Fleurieu climate predicted to be?

- In 2040, under a high climate change scenario, it is expected that the climate at Parawa will be more like Mt Compass is now and a little warmer.
- On average conditions will be drier and warmer. Modelling suggests that the climate at Parawa will have warmed by 1.0°C with rainfall declines up to 12% (current annual rainfall average at the base farm is 940 mm).
- 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 South Australian farmers surveyed in this research.
- In 2040, maximum temperatures in March are expected to be similar to February now, and November similar to December now. This indicates that the period of summer-like conditions are getting longer.

Dairy Business for Future Climates
Case Study Farm - The Fleurieu Peninsula, SA

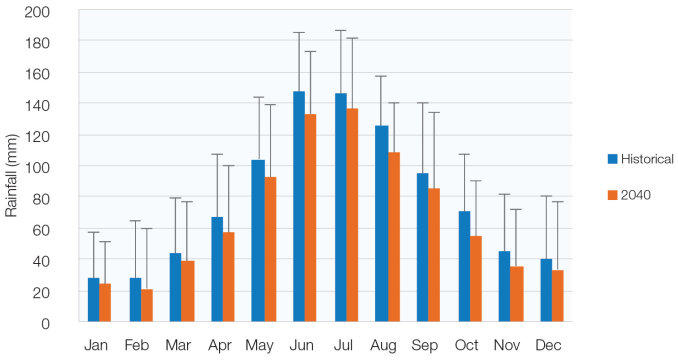


In 2040 under the high climate change scenario, Parawa's climate will be more like Mt Compass is now (and a little warmer)

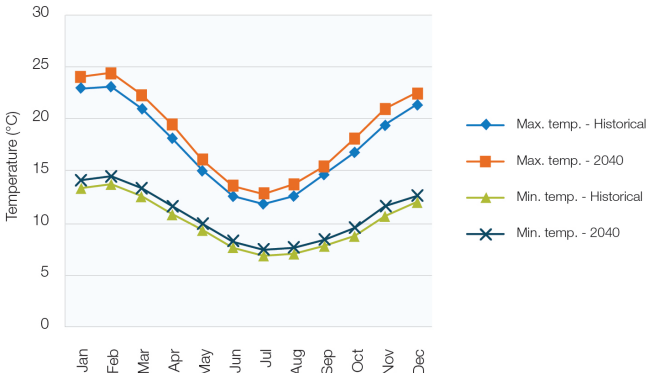
How different is a 2040 Fleurieu climate predicted to be? [cont]

The Fleurieu Peninsula, South Australia

Historical and 2040 modelled rainfall (high climate change scenario) at Fleurieu Peninsula, South Australia



Historical and 2040 modelled maximum and minimum temperature (high climate change) at Fleurieu Peninsula, South Australia



The above graphs show the historical average rainfall distribution on the Fleurieu Peninsula (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.

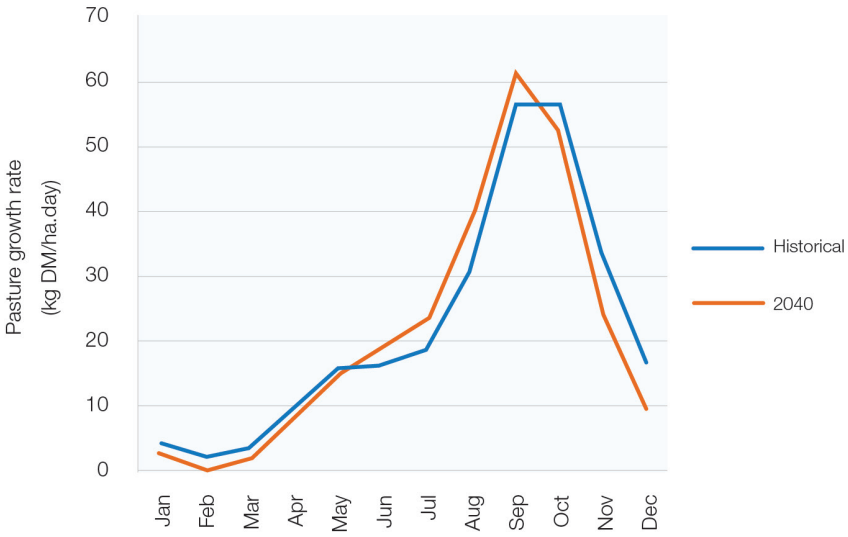
The 2040 scenario was based on climate projections from the best performed climate models across southern Australia.

How different will pasture production and utilisation be in 2040?

- Dairy farms on the Fleurieu Peninsula rely on pasture production. Pasture consumed by cows is a key profit driver.
- Pasture growth rates are predicted to be higher from June to September in the 2040 climates, but lower during the remainder of the year. As a result less pasture was directly grazed and more was conserved and fed back.
- Pasture utilisation was highest and most variable in the *Intensify-TMR* and *Adapt-PMR* options and lowest and least variable in the *Simplify* option.
- Under the high climate change scenario, average pasture utilisation was predicted to decrease in 2040, with a 5% reduction predicted for the Base and *Simplify* options and a 10% reduction for the *Intensify* and *Adapt* options.
- Year-to-year variation in pasture production was also predicted to increase.

The Fleurieu Peninsula, South Australia

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



"I guess the biggest risk (associated with the TMR option) is that if the commodities change, milk price comes down and hay and grain go through the roof, you're at the mercy of the commodities really." (SA Dairy Farmer)

What does a changing climate mean for dairy farms in South Australia?

- 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. Increasing year-to-year variability will be an additional challenge.
- A drier climate across the state is also expected to increase the cost of bought in grain and hay as the cropping areas of the state are impacted by the changing climate.
- A hotter drier climate is expected to increase the amount of high risk fire weather and the fire season is expected to start earlier and have less time in spring for prescribed burning to reduce fire risk.
- Dairy production systems in South Australia are likely to remain diverse due to differences in climate, attitude to risk, stage of life, locations, financial stability etc.
- Under the 2040 high climate change projections, profitability declined for all options but to different extents.

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

Base Farm	The shortened growing season is predicted to lead to reduced pasture consumption and reduced profit in 2040.
Intensify TMR	If the *Intensify* option is implemented at the start of a 'dry' period, it is a much less attractive option than if it is implemented at the start of a 'wet' period. This is mainly due to a higher reliance on purchased feed. 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. The higher milk price that would be expected for the flatter supply and larger scale under the *Intensify* option may increase the average profitability enough to justify the extra risk in the 2040 high climate change scenario.
Adapt PMR	The 2040 high climate change scenario had a substantial impact on the profitability of the *Adapt* – PMR option, it was also a much less attractive option if it is implemented at the start of a 'dry' period, than if it is implemented at the start of a 'wet' period. Given that the variability is also higher than the base farm, the *Adapt* option appears to be less economically attractive, unless the milk price received is higher than the base farm. However, if the larger scale and flatter supply of the split calving pattern results in a $0.15/kg MS higher milk price than the base farm, the *Adapt* - PMR option has a slightly higher internal rate of return than the base farm in both 'wet' and 'dry' periods.
Simplify	The *Simplify* option appears to offer similar average profitability to the base farm in the 2040 high change climate scenario with substantially less risk. The 2040 high climate change appears to have less negative impact on the *Simplify* option than the base farm. The *Simplify* option may be a relatively attractive option in the 2040 High Climate Change scenario, for a risk averse farmer. However, the *Simplify* option will not lend itself to capitalising on high milk prices, and low supplementary feed prices. This option is unlikely to service a high level of debt.

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

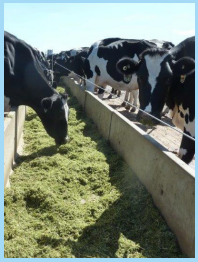
This research did not find a clear 'winner' in the form of the most resilient farming system for the future. All of the development options explored had positive and negative aspects.

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

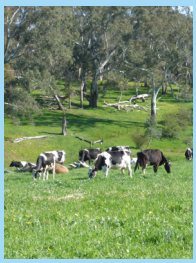
Opportunities and trade-offs for an intensification pathway

Intensifiy 2040	Opportunities	Vulnerabilities	Dependencies
	▪ Greater capacity to take advantage of favourable operating conditions i.e. high milk prices, low feed prices ▪ Employment opportunities: these systems demand more staff with higher skills ▪ Investment in a permanent feed-pad can add operational flexibility in response to variable seasonal conditions	▪ Potential for 'lock-in' effects from investing in expensive infrastructure ▪ Risks to personal and family health due to potentially high stress levels ▪ Greater effluent concentrations and output to manage ▪ May be exposed to greater variability (high and lows) in profit making over the mid to long term under variable climate conditions	▪ Requires high equity levels and/or the ability to take greater financial risks ▪ Stability in milk prices, relatively low feed costs and grain supply ▪ Reliant on accessing skilled staff ▪ Reliant on knowledge of global situation – milk and fodder prices, climate patterns

Opportunities and trade-offs for an adaptive pathway

Adapt 2040	Opportunities	Vulnerabilities	Dependencies
	▪ Flexibility in directing business trajectory towards intensifying or simplifying ▪ Flexibility in adjusting farm system to maximise seasonal conditions eg. weather, input costs ▪ Feasible family business model	▪ Sound decision making and planning abilities to adjust operations seasonally to take advantage of conditions ▪ Constant scanning of seasonal and global parameters ▪ Less opportunities to capitalise on favourable conditions compared to a full intensification pathway	▪ 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 ▪ Less labour required and less demand for advisory services ▪ Possibility of stabilising annual profit making over the mid to long term	▪ 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 an attractive option for a farmer transitioning towards retirement ▪ This option is unlikely to be able to service a high level of debt

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

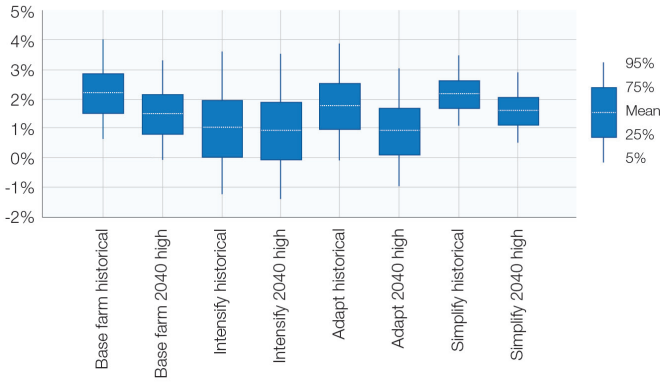
The modelling of 'wet' and 'dry' periods demonstrated the relative stability of the Fleurieu Peninsula as a dairying region. With the 'wet' period having an average annual rainfall of 951mm and the 'dry' period had an average annual rainfall of about 919mm there were still impacts on the profitability of the different systems.

The prices for supplementary feed were assumed to be higher in 'dry' periods than 'wet' periods.

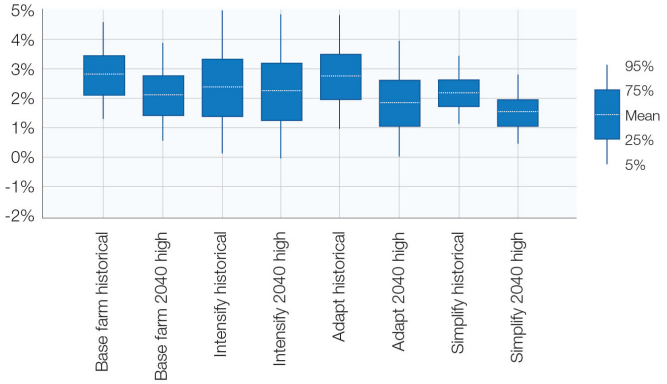
** a wetter decade (average 951 mm/year) & drier decade (average 919 mm/year) were used to allow modelling of the farm development options under different conditions.*

The Fleurieu Peninsula, South Australia

Internal rate of return in dry period Fleurieu Peninsula, South Australia



Internal rate of return in wet period Fleurieu Peninsula, South Australia



The above graphs show an Internal rate of return (IRR real) for the Fleurieu 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.

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

The *Intensify - TMR* 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. The potential for wealth creation in the longer-term is likely to diminish with the *Intensify-TMR* option. Assets that are likely to gain value over time (land) have been sold to fund the purchase of infrastructure (barn, feeding facilities etc) and machinery, which will decrease in value over time. The machinery could be resold at the market price, but the barn and feeding facilities can only be sold with the property and is unlikely to add significantly to the sale price of the property.

There is little change in requirements for financial capital with the *Adapt - PMR* option from the base farm. It involves a little more debt and a slightly different mix of resources. The operating profit is more variable and when combined with additional debt this increases the overall risk. This option will appeal to farmers that want the opportunity to adjust feeding systems from year to year whilst avoiding a 'lock in' major capital investment. However, the management skills required to run this system effectively are significant.

The overall amount of debt would be reduced slightly with the *Simplify - self reliant* option, so there is less exposure to financial risk. There were no additional depreciating assets. The *Simplify* option has little variability in operating profit between years this option so would be a very low risk alternative for managing climate change with a medium/high equity level.

Which development option is the most risky?

The *Intensify - TMR* option has by far the greatest variation in 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. In this regard the *Intensify* option could be considered the most risky. A successful manager of this type of system is likely to monitor operating conditions closely, manage the risk associated with changes in milk and supplementary feed prices, and make adjustments between years depending on conditions.

The *Intensify - TMR* 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.

The *Simplify* option had the least variation in profitability so 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 management challenges for the *Simplify* option are likely to be related to maintaining pasture quality with the lower stocking rate.

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

In general, the current variation in milk price would be a greater source of variability in profit than the 2040 climate change projections. A change in milk price of $0.30/kg MS has a larger impact on IRR than the 2040 high climate change scenario.

If the same milk price ($5.40/kg milk solids) was used for all options under the historic climate the base farm and all three options all had similar annual operating profits (Earnings Before Interest and Tax – EBIT). However, there are different amounts of capital invested in the options and those with additional capital invested require a higher operating profit to be attractive investments.

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.

The *Intensify - TMR* option is highly sensitive to milk price, and higher milk price would be expected for the flatter supply and larger scale. In the historic climate and the 2040 high climate change, a milk price that was $0.30/kg MS higher ($5.70/kg MS) for the *Intensify - TMR* option than the base farm is predicted to result in a higher average IRR in either wet or dry periods. In this situation the additional average return might be viewed as worth the extra risk. In the historic climate, a milk price that was $0.15/kg MS higher ($5.55/kg MS) for the *Intensify - TMR* option than the base farm was predicted to result in a higher average IRR in the wet periods, but not the dry periods. In this situation the additional average return with the *Intensify* option generally would not be considered worth the extra risk.

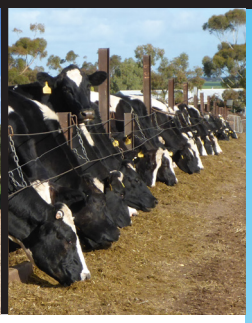
A higher milk price would be expected for the larger scale and flatter supply of the split calving pattern in the *Adapt - PMR* option. If this results in a $0.15/kg MS higher milk price than the base farm, the *Adapt - PMR* option has a slightly higher IRR than the base farm in the historic climate and 2040 high Climate Change scenario, in both wet and dry periods.

Given that there is a substantial reduction in the overall milk production under the *Simplify* option, an increase in milk price is unlikely.

How Are Farmers Adapting To Climate Change?

- Increasing the amount of shade and shelter for stock during extreme weather events
- 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





Dairy Businesses for Future Climates

What about Greenhouse gas emissions?

Greenhouse gas emissions intensity was modelled for the base farm and the three development options, now and in 2040. The differences in emissions intensity between now and 2040 were slight. Given the small differences in emission intensity across the options, there is no clear signal that any option should be favoured on this basis.

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 system 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 *Gippsland 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

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

Dairy Australia

Australian Government