Dairy Businesses for Future Climates

TASMANIA - 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 North West Tasmania) 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.

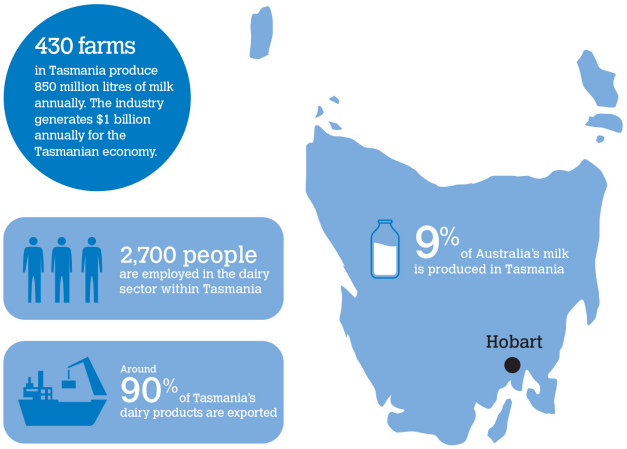
The adaptive or simplified farm production systems tested are realistic alternatives to the long term trend of intensification for dairy businesses in future climates.

- 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.

Dairying in Tasmania

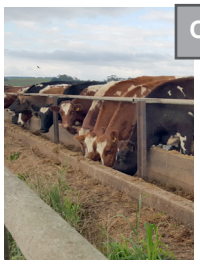


How was the research carried out in Tasmania?

- A Tasmanian case study irrigated dairy farm located at Myalla in the North West 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 Tasmanian Working Group made up of farmers 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 465 cows. The total farm area is 150 hectares, 100 hectares is currently under irrigation. Three development options, representing different farm systems were defined for modelling by the local Working Group.



Option 1 - INTENSIFY

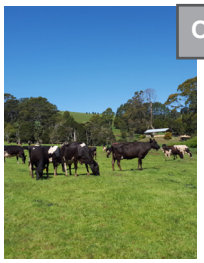
600 cross bred cows at higher stocking rate

50 ha additional irrigation with additional supplementary feeding and infrastructure (feedpad) investment

Option 2 - ADAPT

500 cross bred cows

50 ha additional irrigation and off-farm agistment for winter wets



Option 3 - SIMPLIFY

350 cross bred cows

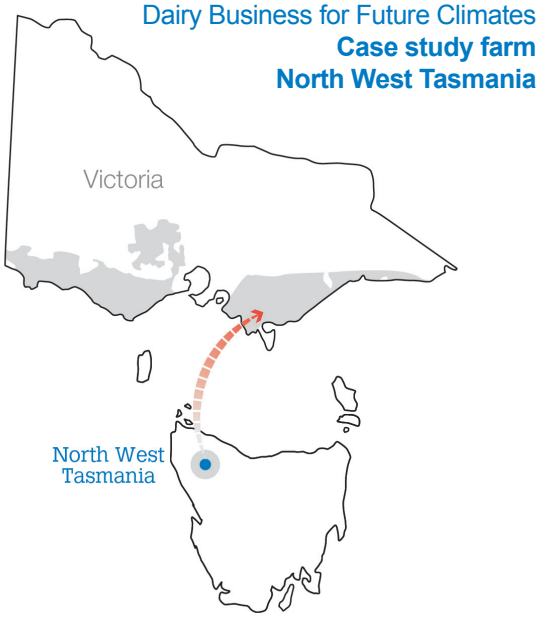
Less purchased inputs, optimise pasture use with a lower stocking rate

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	450	500	August	3.0	1.1	496 / 489	12.4 / 12.1
Intensify	600	500	August	4.0	2.0	540 / 531	13.6 / 13.6
Adapt	500	500	August	3.3	1.0	513 / 501	13.9 / 13.6
Simplify	350	500	August	2.5	0.5	442 / 434	11.2 / 10.9

How different is a 2040 North West Tasmanian climate predicted to be?

- In 2040 under the high climate change scenario modelling suggests that the climate at Myalla will have warmed by 0.8°C with rainfall declines up to 6% (current annual rainfall average at the case study farm is 995 mm).
- In 2040 under the high climate change scenario, Myalla will have similar temperatures to those currently occurring in Southern Victoria.
- 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, winter wets, drought, bush fires and wind events were identified as concerns to Tasmanian farmers surveyed in this research.

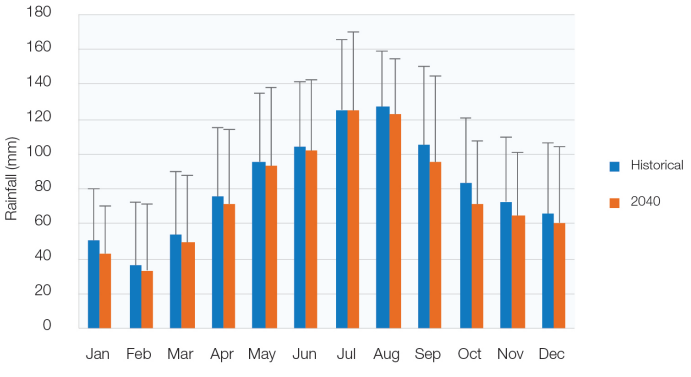


In 2040 under the high climate change scenario, Myalla will have similar temperatures to that of Southern Victoria.

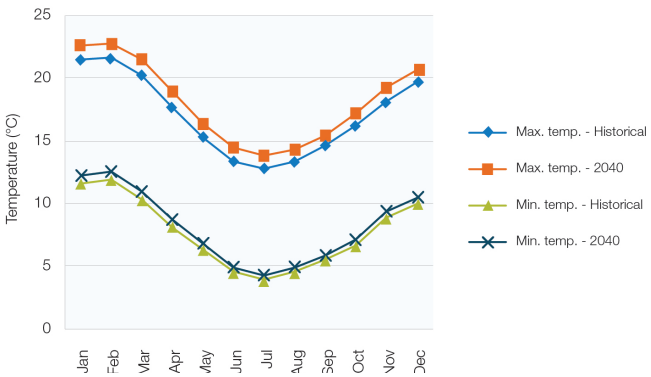
How different is a 2040 North West Tasmanian climate predicted to be? [cont]

North West Tasmania

Historical and 2040 modelled rainfall (high climate change scenario) at North West Tasmania



Historical and 2040 modelled maximum and minimum temperature (high climate change) at North West Tasmania



The above graphs show the historical average rainfall distribution in North West Tasmania (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.

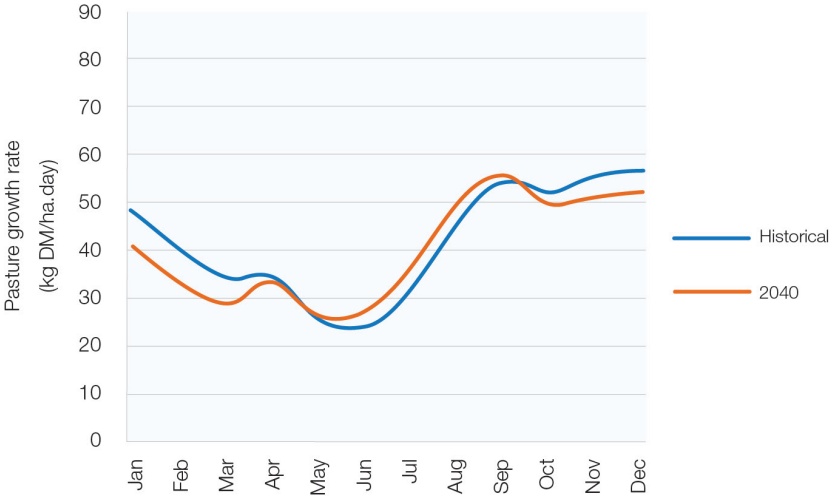
The 2040 scenario was based on climate projections from the best performed climate models across southern Australia.

How different will pasture production and utilisation be in 2040?

- Tasmania's dairy farms rely on pasture production (predominantly rye grass); pasture consumed by cows is a key profit driver.
- Pasture growth rates are predicted to be higher between May and September in a 2040 climate but lower over the remainder of the year.
- The *Simplify* option had a median historical pasture utilisation of close to 11 t DM/ha compared with the current farm system of around 12.5 t DM/ha. Pasture utilisation of the *Adapt* and *Intensify* options was similar since the whole farm area was irrigated (150 ha) compared with 100 ha under irrigation in the base farm and *Simplify* options. Median historical pasture utilisation of the *Adapt* and *Intensify* options was around 14 t DM/ha.
- Year-to-year variation in pasture production was also predicted to increase.

North West Tasmania

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



"Most people wouldn't imagine Tasmania can get so dry, but this season has made us have to rethink our feed budgets big time. Let's hope we don't get another of these." (Tasmanian Dairy Farmer)

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

- 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 climate.
- Dryland farms that currently rely on summer pasture/crop growth may face difficulties in the future as warmer and drier climate scenarios are predicted to change the seasonal pattern of pasture production.
- The environment beyond the farm gate will influence farm development pathways - industry reputation, market demand for dairy products, agriculture and environmental policies, workforce access and regional economics and development.

Assuming the same milk price for each option (which is not the case with current milk payment structures), in the 2040 high climate 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	Investment in additional 50 ha irrigation allows pasture growth to be maintained, but this relies on additional irrigation water being available at a relatively cheap price. A heavy reliance on purchased feed will increase further in the high 2040 climate change scenario. This option has increased debt with more infrastructure investment eg. feedpad.
Adapt	Investment in additional 50 ha irrigation allows pasture growth to be maintained, but this relies on additional irrigation water being available at a relatively cheap price. This option relies on quality agistment services. Equally profitable to the base farm in the historic climate and 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 herd size is reduced. Without additional irrigation and with reduced grain inputs, per cow production is less.

"For the first time we've thought about installing sprinklers in the yard for afternoon milkings, it gets very hot for the cows." (Tasmanian Dairy Farmer)

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.

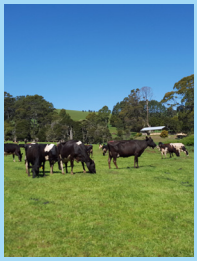
Opportunities and trade-offs for an intensification pathway

Intensifiy 2040	Opportunities	Vulnerabilities	Dependencies
	▪ Capacity to take advantage of 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 ▪ Risks to personal and family health due to potentially high stress levels ▪ Greater effluent concentrations	▪ Requires high equity levels and/or the ability to take financial risks ▪ Reliant on accessing staff with specialised skill sets ▪ Reliant on knowledge of global situation – milk and fodder prices, climate patterns ▪ Reliant on affordable grain supply ▪ Reliant on affordable and additional irrigation water

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 ▪ Increases 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 ▪ Increased risk of pugging in wet winters with more of the farm being irrigated	▪ 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 ▪ Reliant on affordable and additional irrigation water ▪ Reliant on quality local agistment services

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	▪ 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*?

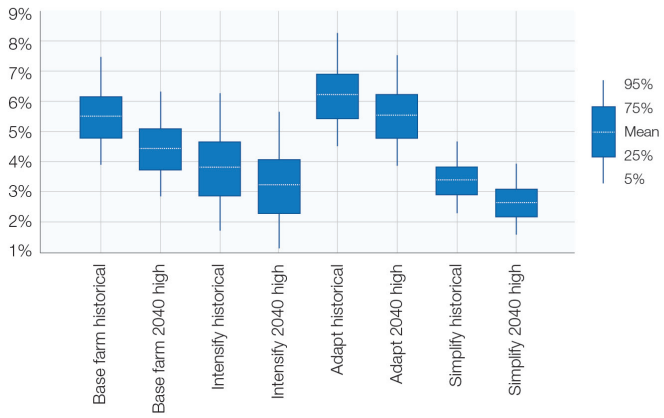
The modelling results indicate a marked difference between the profitability of the *Intensify* option if it is implemented at the start of a 'wet' or 'dry' period (see graphs below). The bigger the box in the graph, the more variability is likely. If the Intensify option is implemented at the start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

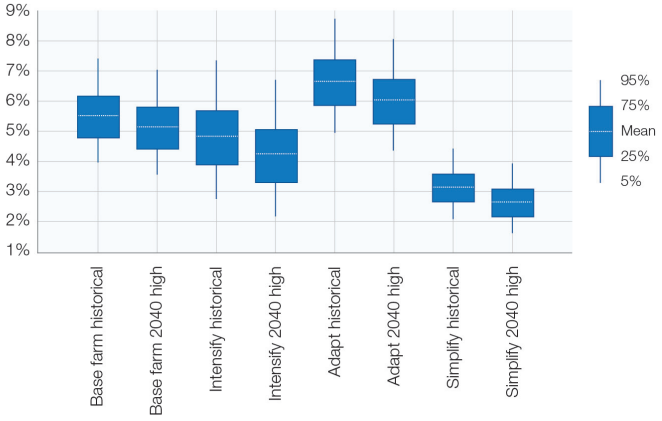
** a wetter decade (average 1100 mm/year) & drier decade (average 815 mm/year) were used to allow modelling of the farm development options under different conditions.*

North West Tasmania

Internal rate of return in dry period North West Tasmania



Internal rate of return in wet period North West Tasmania



The above graphs show the internal rate of return (IRR real) for the North West Tasmania 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 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* 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 substantially more than the base farm and should easily service the additional interest payments, resulting in a short period to 'break even'. 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 for Tasmania is the most risky?

The *Intensify* option has the greatest variation in IRR of all the options and relies on the availability of additional irrigation water. 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 and make reasonably significant adjustments between years depending on the conditions (which were not conducted in this analysis).

The *Adapt* option has a higher average return than the base farm without a significant increase in variability. This is likely to make this option attractive. No assumptions were made about higher pasture losses due to pugging damage in wet years, so actual results may be lower depending on intensity of each rainfall event, stocking rate, paddock size and soil type.

The *Simplify* option had the least variation in profitability. 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. It is dependent on availability of irrigation water at a relatively low cost.

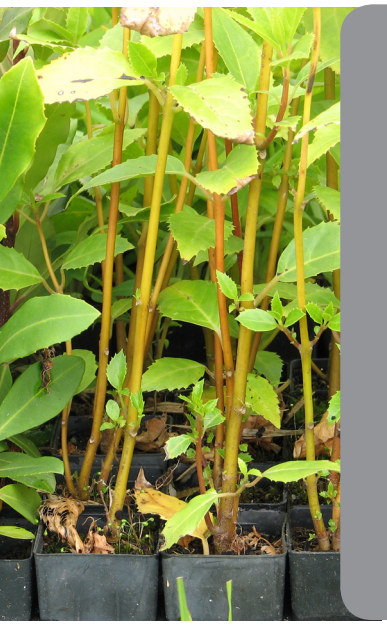
Peak debt for the *Simplify* and *Adapt* options was not markedly different to the base farm. The *Intensify* option has a substantially higher peak debt ($800,000-$950,000 greater) and longer period to 'break-even' than the other options. There is significant financial risk associated with this option if the initial equity position is low.

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 the average milk price of $0.30/kg MS has a larger impact on IRR than the 2040 high climate change scenario for all options. For some options, a change in the average milk price of $0.15/kg MS has a larger impact on IRR than the 2040 high climate change scenario. (Milk prices for this farm have varied between about $4.75 to $6.80 in the last 5 years).

The *Intensify* option is highly sensitive to milk price. If a higher milk price (eg $5.55/kg MS average) is assumed for this option, with a larger quantity of milk produced, the *Intensify* option becomes a more attractive investment. A milk price that was $0.15/kg MS higher ($5.55/kg MS) for the *Intensify* option than the base farm is predicted to result in a higher average IRR for the *Intensify* option than the base farm in the wet periods, but not the dry periods. In general, the Intensify option would require a milk price premium of more than $0.15/kg MS to be considered worth the extra risk.

It would be expected that there would be moderate difference in milk price between the base farm and the *Adapt* option. Given that there is a substantial reduction in the overall milk production under the *Simplify* option, a decrease in milk price from the base farm is likely.



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



Dairy Businesses for Future Climates

What about Greenhouse gas emissions?

Greenhouse gas emissions (GHG) 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; there was a small increase in emissions intensity for the *Simplify* option because of less milk production per cow. 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:

- Farmers would generally aim for a set level of milk production per year (Table 1); if pasture growth was inadequate the gap would be filled by purchased feed.
- 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 favourable climatic conditions but was more impacted by climate variability and change than *Simplify* options, and were considered more stressful and threatened by animal welfare and environmental issues. *Adapt* options showed some potential to mitigate financial impacts. Results highlighted that systems changes to align with projected changes in climate (such as *Adapt* options) or simplify the production system are realistic alternatives to the long term trend for intensification for dairy businesses in future climates.

For Tasmania, irrigation will be important for maintaining growth through dry seasons. Dryland farms that currently rely on summer pasture/crop growth may face challenges in the future as warmer and drier climate scenarios are predicted to change the seasonal pattern of pasture production.

This project was funded by the Australian Government and Dairy Australia.
Researchers included Matthew Harrison and Richard Rawnsley (Tasmanian Institute of Agriculture), Brendan Cullen, Margaret Ayre, Nicole Reichelt, Steven Waller, Ruth Beilin and Ruth Nettle (University of Melbourne), Daniel Armstrong (D-Arm Consulting). Local context and facilitation provided by Rachel Brown and the Tasmanian Working Group.

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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 in North West Tasmania. The decision to change a farming system is contextual – an industry wide response is not appropriate.

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 *Gippsland Information Sheet*

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