Case study 1:

# Adaptation options for a **dry-land farm in Capella**

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# Case study 1: Adaptation options for a dry land farm in Capella

This case study—Adaptation options for a dry land farm in Capella, Central Queensland—aims to highlight the impacts of climate change on production. The University of Southern Queensland provided a multi-model ensemble—combining the Agricultural Production Systems Simulator (APSIM) and the Decision Support System for Agrotechnology Transfer (DSSAT)—to established crop performance under three different climate scenarios across three time frames. Three climate scenarios were used: Representative Concentration Pathway (RCP) 2.6—low emissions scenario; RCP 4.5—intermediate emissions scenario; and RCP 8.5—high emissions scenario. The results were averaged and applied to understand the impacts on the farm, and to assess any on-farm adaptation measures that could help to reduce the simulated impacts.

## Farm profile

The cropping farm is located close to Capella, in the Fitzroy Basin Association (FBA) Natural Resource Management (NRM) region. The 4,000 hectare dry land farm focuses on sorghum, sunflowers, wheat and chickpeas. The farm manages weather conditions as best as possible, and uses zero till and controlled traffic to maximise stored moisture. The farm is summer cropping dominated, with roughly 70 percent of its focus in summer and 30 percent in winter. In 'normal' years this enables the farm to take advantage of the summer dominated rain. The FBA region comprised approximately 865,000 hectares of cropping (Australian Bureau of Statistics, 2014).

## Weather statistics

**Table 1: Mean maximum and minimum temperature, and rainfall in Emerald, 50km from Capella**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean maximum temperature (°C) | 34.6 | 33.6 | 32.8 | 29.9 | 26.4 | 23.4 | 23.4 | 25.5 | 29.1 | 31.8 | 33.4 | 34.3 | 29.9 |
| Mean minimum temperature (°C) | 22.2 | 22.0 | 20.4 | 17.0 | 13.1 | 10.3 | 9.1 | 10.0 | 13.5 | 17.1 | 19.5 | 21.4 | 16.3 |
| Mean Rainfall (mm) | 85.5 | 87.2 | 57.4 | 29.1 | 19.0 | 31.4 | 17.1 | 21.3 | 27.2 | 44.0 | 52.7 | 86.2 | 555.5 |

A major risk for this farm businesses is drought. The region is in drought with 2018 recording a total annual rainfall of 430.8mm.

**Table 2: Mean rainfall for Central Queensland in 2018**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2018 total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean Rainfall (mm) | 16.6 | 231.0 | 4.0 | 6.2 | 10.8 | 20.4 | 2.4 | 6.6 | 0.4 | 104.0 | 9.2 | 19.2 | 430.8 |

## Climate change projection summaries for Australia

The following climate changes for Australia are predicted with very high confidence:

- rising average temperatures will continue in all seasons
- more hot days and warm spells
- rising mean sea level
- rising height of extreme sea-level events.

The following changes are predicted with high confidence:

- fewer frosts
- increased intensity of extreme rainfall events
- a harsher fire-weather climate.

The following changes are predicted with medium confidence:

- lower average winter and spring rainfall
- changes in summer and autumn rainfall, but unclear.

On annual and decadal bases, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

## Predicted impacts—crop modelling outputs

There are some limitations and assumptions in predicting the impacts of climate change on production. Modelled outputs on crop performance are based on many assumptions and may not be representative of what will happen on farm. The results indicate what could happen with the farming system under different future predicted climate scenarios. Results do not consider any future adaptation that might occur on the farm. Although the modelled runs have been distilled down to percentage change, there is a lot of variation in the modelled outcome that cannot be represented in this simple case study. Models are for climate change scenarios and do not consider weather variability. Cells with red text indicate a reduction in yield over the 2013–2018 average.

**Table 3: Modelled percentage change in sorghum yield**

| Timeframe | Model runs | Climate scenario RCP 2.6 | Climate scenario RCP 4.5 | Climate scenario RCP 8.5 |
|---|---|---|---|---|
| 2030–2049 | 720 | -18.50 | -16.36 | -26.27 |
| 2050–2069 | 720 | -12.94 | -7.61 | -23.03 |
| 2070–2099 | 720 | -14.13 | -19.34 | -38.68 |

**Table 4: Modelled percentage change in wheat yield**

| Timeframe | Model runs | Climate scenario RCP 2.6 | Climate scenario RCP 4.5 | Climate scenario RCP 8.5 |
|---|---|---|---|---|
| 2030–2049 | 1200 | -8.78 | -10.41 | -4.99 |
| 2050–2069 | 1200 | 8.53 | -3.47 | 4.44 |
| 2070–2099 | 1200 | -7.25 | -13.38 | -23.58 |

Since 2013, the farm has rotated between chickpeas, sorghum, sunflower and wheat. sorghum and wheat.Between 2013-2018, wheat had an average yield of 2.1 tonnes per hectare and sorghum an

average yield of 2.7 tonne per hectare. Modelling for the three scenarios shows yields decreasing in nearly all timeframes.

**Table 5: Modelled change to sorghum and wheat yield in tonnes per hectare (t/ha)**

| Time | Climate scenario RCP 2.6 | | Climate scenario RCP 4.5 | | Climate scenario RCP 8.5 | |
|---|---|---|---|---|---|---|
| Produce | Sorghum (t/ha) | Wheat (t/ha) | Sorghum (t/ha) | Wheat (t/ha) | Sorghum (t/ha) | Wheat (t/ha) |
| 2013–2018 | 2.7 | 2.1 | 2.7 | 2.1 | 2.7 | 2.1 |
| 2030–2049 | 2.2 | 1.92 | 2.25 | 1.88 | 1.98 | 1.99 |
| 2050–2069 | 2.35 | 2.27 | 2.49 | 2.03 | 2.08 | 2.19 |
| 2070–2099 | 2.32 | 1.95 | 2.18 | 1.82 | 1.66 | 1.60 |

## Adaptation potential

As outlined in the East Coast North Sub-cluster Action Plan, the farm has some options to reduce the impacts of climate change. Yield decrease is a typical impact and will affect business profitability over time. For this business, there are two main paths for climate change adaptation.

### 1. Business resilience to manage reduced yields and income

Options for the farm include:

- talk to insurance providers or brokers and industry representatives about insurance options (find out more about insurance at www.qff.org.au/projects/insurance)
- get involved with projects to improve understanding of insurance and the development of insurance markets for producers
- connect with the Queensland Rural and Industry Development Authority and the Regional Investment Corporation to leverage concessional loans for adaptation
- develop a rolling budget, with the 'Rules of thumb' setting out expectations for a ten-year yield prediction and translate the outlined climate risk into crop expectations over a decade, which can be useful for farm management decision making.

### 2. Increase awareness of the impacts of climate change, work with extension officers and implement research and development, to reduce the potential yield decrease

Options for the farm include:

- complete an industry BMP, evaluate score and implement recommendations
- participate in extension projects which deliver services on best practices on environmental issues in your area and sector, and seek further details from local industry bodies or the NRM
- include climate risks in on-farm decision making and investments
- participate in on-farm trials, field days and workshops to build and share knowledge
- seek advice and support from agronomists, local universities, industry groups or NRM organisations on specific management practices that can mitigate climate change impacts on crops.

## Conclusion

The crop modelling output shows that there is likely to be an impact on yield for the farm. Climate change impacts need continued management over time and the farm needs to incorporate the latest information and advice. This case study details parts of the East Coast North Sub-cluster Action Plan that could be considered and utilised on farm. Ultimately, the responsibility is on farmers to understand their risks and take suitable actions to minimise the risk.