Communicating Climate Change
Module 4
An initiative of the National Agriculture and Climate Change Action Plan
August 2008

Wheat and sheep production in a changing climate: western Victoria

Australia's wheat-sheep production zone covers 35 million hectares in southern and eastern Australia. Its 15 700 wool-producing farms contain 55% of the nation's sheep. Annual rainfall in the zone is 300–600 mm.

Climate change threatens the productivity of Australia's wheat and sheep industries. It reduces the value of historical climate knowledge and increases uncertainty about the bounds of future climates, making farming decisions more complex.

While Australian farmers are already adapting to a highly variable climate, adapting to significant climate change is a challenge. Here we provide a case study of the Wimmera-Mallee region in Victoria.

Key facts

- By 2030, the Wimmera-Mallee region is likely to experience an increase in temperature of at least 0.6°C and a decrease in rainfall of at least 2% (compared to 1980–99 averages). By 2070, temperatures could be 1.5–3°C higher and rainfall could be 5–20% lower.
- Predicted wheat yields in the Wimmera-Mallee region for 2050 range between an increase of 6% and a decrease of 10%.
- Climate change is likely to have some negative impacts on the Victorian wool and sheep meat industry. These include lower wool production, more heat stress, less reproduction, and lower growth rates.
- Adaptation strategies are available to help wheat and sheep producers offset the negative impacts of climate change. Improving management practices could increase predicted wheat yields by 15% or more. These strategies will be less effective if temperatures rise faster than expected.

Wimmera-Mallee case study

The Wimmera-Mallee region

The Wimmera-Mallee region (Figure 1) occupies 3% of the Murray-Darling Basin. The population of nearly 50 000 is mostly located in the major centres of Horsham, Stawell and Ouyen along the Wimmera and Avon Rivers and represents 2.5% of the Basin's total population.

Land use in the Wimmera-Mallee region is primarily broadacre cropping of cereals, pulses and oilseeds, with dryland livestock grazing in the south. Australian Premium White is the predominant wheat quality produced, and average regional yields are about 2.1 tonnes per hectare. The dominant livestock industry in the southwest of the region is sheep for wool and meat production.

A cooperative venture between

MANAGING CLIMATE VARIABILITY R&D PROGRAM
mla MEAT & LIVESTOCK AUSTRALIA
BCG shared solutions
Australian Government
Department of Agriculture, Fisheries and Forestry
Bureau of Meteorology
Bureau of Rural Sciences

Figure 1: The Wimmera-Mallee region, Victoria

Climate change projections

Australia and the globe are experiencing rapid climate change. Average temperatures in Australia have risen about 1°C since the middle of the 20th century. We had one of the most severe droughts on record in 2002–2007. Prolonged high temperatures have increased evaporation rates, dehydrated soils, and increased stress on crops, animals and vegetation.

Projections are for continued warming, less rainfall and more intense drought episodes across the temperate regions of Australia throughout the coming decades. This will affect wheat and sheep production. Anticipating and dealing with these changes in climate is critical to protect our agricultural industries.

By 2030, temperatures in the Wimmera-Mallee region are projected to increase by at least 0.6°C, while rainfall could decrease at least 2% below current annual averages (1980–99).

By 2070, temperatures in the region could increase by 1.5°C under a low carbon emission scenario, or 2.5°C under a high carbon emission scenario. Rainfall could decrease by 5–10% under a low emission scenario, or by 10–20% under a high emission scenario.

For more information on climate change projections for specific regions of Victoria, see the fact sheet for Module 3: Glimpsing Victoria's Future Climate.

Impact of climate change on wheat production

If atmospheric carbon dioxide reaches a concentration of 550 parts per million (ppm) by 2050 (it was 379 ppm in 2005), wheat yields for the Wimmera-Mallee region could rise by 28% as a result of increased photosynthesis and water-use efficiency. However, increased levels of carbon dioxide will be offset if temperatures rise and rainfall declines correspondingly. The best estimate for climate change in the region predicts a range of wheat yields between plus 6% and minus 10% (where carbon dioxide = 550 ppm; temperature = +2 to +2.5°C; rainfall = -5 to -10%).

Wheat quality in the region could decline as a result of climate change. Models predict that an increase in carbon dioxide concentration to 550 ppm will lead to a 3% fall in wheat protein content. An additional fall in protein of 31% below the long-term average is predicted if temperatures increase by 2.5°C. Decreasing rainfall, increasing carbon dioxide levels and higher temperatures could result in an overall decrease in wheat quality of 34% by 2050.

Impact of climate change on wool production

Climate change and variability is likely to impact on the Australian wool industry. Growth of pasture and fodder crops in Victoria could increase by 2030 under higher carbon dioxide concentrations. However, this increase may be offset by lower nutrient content and less rainfall. The strain on water resources will continue and water supplies will decline because of increased evaporation, reduced runoff into storages, and decreased and more variable rainfall.

A major concern for the wool industry will be reduced wool production and quality in some marginal areas where pasture growth is reduced. Nevertheless, there might be increased productivity in areas of high rainfall. Increased heat and water stress will reduce rates of animal reproduction and growth. Changes in climate could well change the spectrum of pests and diseases that affect sheep. Reduced rainfall and increased variability are likely to increase the risk of land degradation.

Competition from other agricultural industries (particularly for cropping and water/land resources) will be a significant concern for the wool industry. The future is brighter for some of our international competitors. In Canada and the Ukraine, where low temperatures currently limit the extent of the cropping zone, higher temperatures caused by climate change are extending the growing season and increasing crop yields. In New Zealand and China, sheep producers are likely to be advantaged as warmer and wetter regional conditions extend their grazing zones.

Adaptation strategies and opportunities

Many adaptation strategies are available to offset the projected impacts of climate change in Australia. These strategies involve modifying current practices to offset risk associated with climate variability. If widely adopted, they have the potential to offset negative climate change impacts and take advantage of positive ones. In the wheat industry alone, relatively simple adaptations may be worth $100–500 million each year.

The most promising crop-management practices include:

- zero-tillage to reduce soil moisture loss and to protect the soil in areas of increased rainfall intensity
- using seasonal forecasts to manage production risks
- extending fallows to effectively capture and store soil moisture
- planting later in the season when there is enough water in the soil profile
- widening row spacing, or skip-row planting
- lowering plant density
- staggering planting times
- developing efficient on-farm irrigation management
- monitoring and responding to emerging pests
- assessing fertiliser inputs

Implementing these adaptation strategies in the Wimmera-Mallee region could provide several benefits:

- Wheat yields could increase by 5–22% if planting windows are modified to account for rising temperatures.
- Yield losses could be offset through improved residue management and longer fallows.
- Wide-row and skip-row plantings can increase yield stability, particularly in poor rainfall areas, although they may reduce ground cover and water storage and increase runoff and soil loss.
- Higher temperatures are expected to reduce the risk of frost throughout the season.

- Reducing the incidence of frost may allow for earlier planting and lead to increased yields if there is enough soil moisture.

Selecting the best adaptation option is a difficult exercise because regional climate change projections are still so uncertain. Nevertheless, early adaptation strategies have the highest potential to reduce the negative impacts of climate change.

Sources

ABARE 2008, *Australian Commodities 08*: http://www.abare.gov.au/publications_html/ac/ac_08/ac_08.html

Australian Wool Innovation Limited: http://www.wool.com.au

Bureau of Rural Sciences 2006, *Science for Decision Makers: Climate Change: Adaptation in Agriculture*: http://www.affashop.gov.au/product.asp?prodid=13352

Crimp, S, Howden, M, and Gaydon, G 2008, *On-farm management in a variable and changing climate: A participatory approach to adaptation*: http://www.bcg.org.au/cb_pages/images/climate%20risk%20management%20-%20Steve%20Crimp.pdf

CSIRO, Bureau of Meteorology and Australian Greenhouse Office, *Climate Change in Australia*: http://www.climatechangeinAustralia.com.au

CSIRO 2008, *An Overview of Climate Change Adaptation in the Australian Agricultural Sector – Impacts, Options and Priorities*: http://www.csiro.au/files/files/plhg.pdf

CSIRO 2008, *Murray-Darling Basin Sustainable Yields Project*: http://www.csiro.au/content/pt9n.html

Department of Agriculture, Fisheries and Forestry 2007, *At a Glance. Australia - Our Natural Resources*: http://www.daff.gov.au/brs/publications/series

Grace, P 2006, *Farming in a Changing Environment*, Institute of Sustainable Resources, Queensland University of Technology: http://www.isr.qut.edu.au/publications/public/rm_5.jsp

Harle, KJ, Howden, SM, Hunt, LP and Dunlop, M 2004, *The Potential Impacts of Climate Change on Wool Growing in 2029*, a research brief conducted by CSIRO Sustainable Ecosystems for Future Woolscapes: http://www.wool.com.au/.../attachments/Wool_production/Natural_resources/lww_climate_change.PDF

Meat & Livestock Australia: http://www.mla.com.au

Further information

For more information or to provide feedback on the content of this fact sheet, contact John Gray at the Bureau of Rural Sciences:

Phone: +61 2 6272 5381, email: john.gray@brs.gov.au