

Adapting to Climatic Change:

Potential future water management strategies for
Riverina broad-acre irrigators
and the impacts on biodiversity and production.



Growers in the Riverina get smart, not scorched, with climate change.

94% of Riverina rice growers* consider that understanding climate change effects will assist them in the future management of their farms.

** Results from a climate change workshop survey conducted by RGA/CSIRO in February 2008*





Project Outline

Climate change poses challenges for agriculture in Australia on both the farming and policy front. If projected changes to climate eventuate we are likely to see even more variable climatic conditions. Australian farmers are resilient and used to adapting to change, farmers can treat climate change as one more challenge to manage.

The Ricegrowers' Association of Australia (RGA), along with others, are supporting farmers to adapt through providing information and undertaking research. The RGA has partnered with CSIRO Sustainable Ecosystems to look at some of the implications of climate change for the Ricegrowers of the Riverina.

In 2008 the RGA and CSIRO undertook a research project looking at future climate scenarios and water management strategies for Riverina broad acre irrigators. The project was jointly funded by the Federal Government through the National Agriculture and Climate Change Action Plan Implementation Program, CSIRO and RGA.

The project aimed to:

- Evaluate the impact of projected climate change scenarios on current farming systems
- Together with growers, consider a range of possible farming system adaptation options and for future evaluation of their long-term viability using simulation modelling
- Evaluate the biodiversity implications of potential changes

Project methods:

1. Climate Change scenarios were developed for Riverina regions using projections from General Circulation Models (GCM). Irrigators were then provided with this information through a series of workshops and via extension material.
2. Based on these scenarios, irrigators at the workshops brainstormed possible on-farm adaptation options and future research needs.
3. Irrigators were surveyed before and after workshops about their views on climate change.
4. Previous research was reviewed to pull together current knowledge about climate change impacts on rice-based farming systems and adaptation options.
5. A rice-modelling capability was added to the ASPIM farming systems model and APSFarm whole-of-farm modelling framework. This will enable future research into adaptation options identified in the workshop.
6. Existing knowledge on biodiversity in the Riverina was reviewed to assess the possible effects of changed irrigation practices and suggest strategies to deal with these effects. This also helped identify further research needs.

Climate Change on YOUR Farm

Firstly, what is climate change?

Climate change is a term used to describe significant long-term changes to our climate. Often the term is linked to the “greenhouse effect” and “global warming” (see explanation below). This warming influences aspects of our climate that are most important to farming; including average temperatures, rainfall amount/distribution and evaporation.

Scientists have been using historical climatic patterns to create models that predict our future climate.

Climatic trends for the Riverina based on historical data since 1957:

- **Temperatures have risen.** This included maximums and minimums for all seasons.
- **Annual Rainfall totals have not changed significantly,** however there has been a slight decrease in autumn rain and an increase in summer rain.
- **Pan evaporation has increased in all seasons.**
- **There has been no significant changes in frost patterns in the Riverina** (other NSW regions have had changes).
- **Water allocations have decreased in all regions.**



Reliable weather data dates back to 1957!

The Greenhouse Effect

Certain gases in the atmosphere trap a portion of the sun's rays, keeping our climate warm and stable. This is a natural phenomenon.

Global Warming

Since industrialisation, human activities have increased the concentration of gases such as carbon dioxide, methane and nitrous oxide which has led to more heat being trapped, increasing the earth's temperature.



Regional Forecasts 2070

As part of the project, CSIRO modeled climate change scenarios for three Riverina regions for 2070. Data came from weather stations in Darlington Point, Deniliquin, and Griffith to link to the workshops in Coleambally, Wakool and Whitton respectively.

The information on the right represents forecasts for the three locations by 2070 based on two climate change scenarios, mild and severe for the wheat and rice growing seasons.

Water Allocation Forecasts for 2030

The Murray Darling Sustainable Yields Project completed by the CSIRO estimates the following changes in average annual water allocations

Murrumbidgee 2% - 16% decrease

Murray 4% - 23% decrease

(based on mild and severe climate change scenarios)

Source: www.csiro.au/mdbsy.html



Coleambally

(default weather station Darlington Point)

Rice Season forecasts

Average Temperature (change)

mild	+0.6°C
severe	+2.1°C

High rice flowering temperatures

Chance of heat damage

current	2.4%
forecast	7.1%

Low rice flowering temperatures

Chance of cold damage

current	28.6%
forecast	16.7%

Rainfall (average)

current	161mm
mild	124mm
severe	148mm

Evaporation (average)

current	1220mm
mild	1265mm
severe	1376mm

Wheat Season forecasts

Average Temperature (change)

mild	+0.6 °C
severe	+2.0°C

Rainfall (average)

current	215mm
mild	173mm
severe	202mm

Evaporation (average)

current	520mm
mild	558mm
severe	649mm

Regional Forecasts 2070

Wakool

(default weather station Deniliquin)

Rice Season forecasts

Average Temperature (change)

mild	+0.6°C
severe	+2.1°C

High rice flowering temperatures

Chance of heat damage

current	2.4%
forecast	11.9%

Low rice flowering temperatures

Chance of cold damage

current	43%
forecast	33%

Rainfall (average)

current	149mm
mild	124mm
severe	136mm

Evaporation (average)

current	1260mm
mild	1308mm
severe	1422mm

Wheat Season forecasts

Average Temperature (change)

mild	+0.6 °C
severe	+2.1°C

Rainfall (average)

current	207mm
mild	169mm
severe	195mm

Evaporation (average)

current	539mm
mild	578mm
severe	670mm

Whitton

(default weather station Griffith)

Rice Season forecasts

Average Temperature (change)

mild	+0.7°C
severe	+2.2°C

High rice flowering temperatures

Chance of heat damage

current	1.0%
forecast	7.1%

Low rice flowering temperatures

Chance of cold damage

current	29%
forecast	19%

Rainfall (average)

current	166mm
mild	129mm
severe	153mm

Evaporation (average)

current	1222mm
mild	1267mm
severe	1378mm

Wheat Season forecasts

Average Temperature (change)

mild	+0.6 °C
severe	+2.0°C

Rainfall (average)

current	233mm
mild	193mm
severe	221mm

Evaporation (average)

current	531mm
mild	569mm
severe	660mm

Real options from real farmers!

With Australia's climate being so variable and climate change likely to increase that variability continued adaptation is vital. This project looked for practical on-farm adaptation and research to support adaptation and decision making.

The workshops held in February 2008 at **Coleambally, Wakool and Whitton** presented **Riverina farmers** with the CSIRO model forecasts for climate change and it's possible effects.

Each grower group brainstormed and discussed **real options** to adapt to the predicted changes in climate and highlighted further research and information needs.

Foremost among the options discussed were:

Alternative rice water management practices

Alternate wet-and-dry watering of rice bays, letting them dry out between watering, rather than a continual flooding.

Aerobic rice, maintaining a non-saturated soil as required for rice growth using only supplementary watering and not flooding.

Specifically bred varieties, of both rice and other crops, that are adapted to likely future conditions and/or management practices. Rice research has focused on varieties which are cold-tolerant to reduce the need for flooding. There could be further expansion of this program to include climate change issues.



Changing irrigation practices and technologies in other crops.

High-tech irrigation systems (for example installing lateral moves or a drip system) to allow for efficient use of water, or a change in irrigation system to enable easier crop rotation using the same irrigation system

Using seasonal climate forecasts for on-farm management decisions. This would enable farmers to better manage water through optimum timing/application or change of crop rotation.

Real options from real farmers!

Future research and information to assist adaptation decisions:

Investigation of the **costs, benefits and trade-offs** in using alternate wet-and-dry and aerobic rice water management practices, as well as various fertilisation strategies.

Further **expand the breeding programs** for all crops to develop suitably adapted varieties for the forecast climatic conditions.

Investigate the **costs and benefits** of investing in **more efficient and high-tech irrigation technology** over the long-term.

Investigate the **costs and benefits of partial irrigation strategies in non-rice crops** to maximise WUE on a \$/Ml basis.

Develop and provide farmer-friendly **information on how to better understand and utilise seasonal climate forecasts** in on-farm management decisions for risk mitigation.

More information on this project and ongoing research is available on the Environmental Champions website in the climate change section.

www.environmentalchampions.rga.org.au



Links to climate change information

Australian Bureau of Meteorology

www.bom.gov.au/climate/change/

Australian Government

www.climatechangeinaustralia.gov.au/

www.greenhouse.gov.au

CSIRO

www.csiro.au/org/

ClimateAdaptationFlagshipOverview.html

Garnaut Climate Change Review

www.garnautreview.org.au/

CSIRO - Murray Darling Basin Sustainable Yields Project

www.csiro.au/partnerships/MDBSY.html

NSW Government

www.greenhouse.nsw.gov.au

www.environment.nsw.gov.au

www.dpi.nsw.gov.au

Climate change & biodiversity

Farmers won't be the only ones adapting. The region's biodiversity will be influenced by changes in climatic conditions and farming practices.

Potential changes that will be significant for biodiversity in irrigation areas include:

Reductions in the amount of ponded water on-farm and surface water draining off irrigation farms due to; increases in efficiency, decreased availability of water, reduced flood irrigation, and changes in infrastructure including increased piping.

This changes how much and how often water is available across the landscape for habitat and food – in both farm habitats (fields, channels, dams) and natural habitats.

It might also improve some natural habitats – e.g. drying out drowned areas, reducing water tables and associated salinity and restoring natural flow patterns.

Increasing pressure on remaining native vegetation

habitats, including paddock trees, through adoption of lateral moves or centre pivots, increasing grazing intensity, clearing, and/or invasion of weeds and feral species.

Changes in agrochemical usage linked to changing crops and/or irrigation methods, with possible effects on biodiversity.

Strategies for maintaining and improving biodiversity in response to these changes include:

- **Targeted and controlled watering** of a range of woodlands and wetlands (types and sizes) across the landscape.
- **Good management of remnant vegetation** through controlled grazing, retaining fallen timber, conserving standing timber (dead and alive), and preventing soil disturbance and nutrient enrichment.
- Strategies to **control residual chemicals** and nutrients.
- Maintaining a **network of complex habitats** at the site, farm and regional level, giving emphasis to bigger and less isolated patches of vegetation.
- **Restoration of vegetation** on areas converted from irrigation to dryland farming and management for multiple outcomes.

