



Department of
Agriculture and Food

A photograph of a vibrant rainbow arching over a lush green field with scattered trees under a grey, overcast sky. The image is partially obscured by a large, abstract graphic overlay in shades of green and blue on the right side.

Climate-ready agriculture

A situation statement for Western Australia

Bulletin 4876

Supporting your success



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Climate-ready agriculture: a situation statement for Western Australia

Bulletin 4876

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1 Introduction

The agricultural sector is particularly exposed to climate variability and change because most production depends on seasonal conditions. Western Australian (WA) producers have successfully responded to these pressures by adopting improved farm management practices and technologies.

Projected future changes in the state's climate will present new challenges for our producers. The Department of Agriculture and Food, Western Australia (DAFWA) continues to work with agricultural industries to lay solid foundations for an agricultural sector that has a range of response options.

This situation statement provides an assessment of how climate-ready the state's agricultural sectors are and provides guidance for investment priorities for DAFWA for the period 2015–2020. This document draws on [*Bulletin 4870 Climate change: impacts and adaptation for agriculture in Western Australia*](#), which reviews the literature relating to climate change and agriculture in WA.

2 Climate in Western Australia

Over the last 100 years, and particularly since the 1960s, [WA's climate](#) has become hotter with average annual temperatures increasing by 0.9 to 1.1°C. Annual rainfall has increased slightly over the northern and interior parts of the state and declined along the west coast, particularly in the south-west.

[Projections](#) show that WA will become hotter and drier in the south and south-west, and hotter with rainfall remaining largely unchanged in the northern and central areas. Climate change is expected to increase the frequency of [extreme climate events](#), such as droughts, heat waves and storms.

3 Implications for Western Australia's agricultural sector

The implications of climate change for the state's agricultural sector are far-reaching. Climate change will affect management responses, the types of production undertaken, how processing industries undertake their activities and the types of products that are processed.

At the global scale, climate change, agricultural and climate policy, agricultural innovation, population growth and changing income levels will all interact to affect our trading partners and international competitors.

3.1 Production challenges

On-farm consequences of climate change include:

- Broadacre crop and pasture production may benefit from less rainfall and higher temperatures in cooler high rainfall areas where current low temperatures and waterlogging limit plant growth in winter. However, production may decline in drier, warmer northern and eastern areas.

- The amount of water available for horticulture and other agricultural activities in the south-west will be affected by reduced surface water flows into farm dams and groundwater recharge.
- [Salinisation](#) has slowed in some areas because of reduced rainfall and groundwater reaching equilibrium. This trend may continue.
- [Water erosion](#) has declined, in part because rainfall is declining in the south-west; however, a projected increase in the intensity of summer storms may increase the risk of erosion in eastern and south-eastern areas. Projected increases in the intensity of rainfall associated with cyclones and tropical depressions may increase the erosion risk in the rangelands.
- [Wind erosion](#) may increase in regions where declining rainfall limits the growth of groundcover.
- Livestock welfare risks may increase if higher temperatures reduce the availability of feed or increase heat stress. Higher temperatures can also affect livestock productivity by reducing reproductive rates, growth rates and milk production.
- The cost of cooling housed animals in intensive livestock enterprises may increase.
- [Frost risk](#) to crops has increased with drier conditions in recent years and this risk may continue in the short-term, but in the long term, frost risk will decline. This reduction in frost risk will potentially benefit field crops, but may negatively affect horticultural crops that rely on low temperatures to set fruit.
- [Fire risk](#) is projected to increase, threatening human life, farm infrastructure and livestock and causing [fruit taint](#).
- Crops and pastures may use water more efficiently as rising carbon dioxide concentrations benefit plant growth.
- Risks from pests and diseases may change as shifting temperature and rainfall conditions alter the range and activity of many insects and diseases. The projected increase in extreme events could mean an increase in pest outbreaks because droughts and floods can trigger insect outbreaks.
- Weeds may spread into new areas as the climate potentially becomes more hospitable and the competitiveness of weeds increases.

Given the reliance that broadacre agriculture, pastoralism and field-based horticultural industries have on seasonal conditions, on-farm management options will continue to focus on maintaining or increasing production in the face of climate variability. For instance, strategies to increase water use efficiency, to overcome soil constraints such as non-wetting soils, soil compaction or soil acidity, to address pest and disease management, and to enhance crop and pasture breeding will be important.

For perennial crops, such as fruit trees or grapevines, producers will need to consider the long-term warming and drying trend in developing their strategies. In addition to annual strategies, such as increasing water use efficiency, options may include providing shade, undertaking water harvesting, breeding new plants and replanting with more heat-tolerant and water-efficient varieties or species.

The capacity of primary industries to adapt to the challenges listed above depends on the industry sector itself, the individual business and its location. Some will respond by changing their management and investment practices, whereas others will eventually need to develop an exit strategy.

Risks and opportunities for producers may also arise from policy settings such as capping or taxing greenhouse gas emissions and voluntary carbon markets. For instance, [voluntary carbon markets](#), such as the Australian Government's [Emissions Reduction Fund](#), give landholders the opportunity to create and sell carbon credits.

3.2 Supply chain challenges

Local changes in production will have consequences for agricultural supply chain businesses. Investment in manufacturing equipment can be costly, requiring a significant payback period. Although many production changes are projected to be gradual, some may be step changes. A threshold level of production is required for supply chains to remain profitable. In some instances, long-term climate change and its effect on agricultural production may result in the development of new supply chain businesses. In other instances, business may close or move to other locations.

Another consequence of climate change is the rise in sea level, which may affect transport, storage and processing infrastructure. In some areas, a warmer, drier climate with greater risks from fire and more extreme conditions will influence liveability and, consequently, workforce availability and cost. An increasing global population and rising demand for agricultural products adds another layer of complexity to this situation.

Producers, suppliers and processors wishing to mitigate climate changing emissions can participate in emission reduction activities, such as increasing energy efficiency, to create and sell carbon credits via the [Emissions Reduction Fund](#).

4 Climate-ready agriculture

Broadly, there are three levels of adaptive action that producers and rural communities can take when responding to a changing climate:

- adjusting practices, technologies and business structures (incremental)
- changing production systems (transitional)
- relocating production (transformative).

Agricultural businesses in the south-west have undertaken incremental and transitional production changes over the last 40 years in response to the drying and warming climate.

The ability of an agricultural business to continue adapting to increased climate variability and long-term climate change depends on the adaptive capacity of the business and of the people running the business. The capacity to adapt requires the following:

- the ability to manage the risks of change
- skills in planning, learning and reorganising
- financial capacity
- psychological flexibility to undertake change
- an interest in undertaking change.

When discussing adaptation, we generally assume that changes will be gradual and incremental. However, there is a risk that the rate and impacts of climate change may be non-linear, or have tipping points or step changes. Step changes may cause social, economic or ecological conditions to change so much that incremental changes become ineffective and fundamental changes to the structure or function of agribusinesses are needed.

4.1 Climate-ready broadacre farming

To date, climate change appears to have had relatively little impact on cropping enterprises in WA. Declining terms of trade, technological advances and ongoing climate variability have driven most of the change in WA's farming systems over the last 30 years.

Changes in crop and livestock production associated with future climate will vary with location, soil type and management. While crop and pasture yields are likely to increase in high rainfall south-western areas, they may decline in medium to low rainfall areas unless incremental adaptation continues.

While researchers have suggested various adaptation strategies, there is a common message that most grainbelt producers will be able to use incremental change to deal with climate change in the short-term. However, incremental changes will only be successful if terms of trade do not deteriorate significantly, farm debt is manageable and producers have ongoing access to farm management, business education and improved crop varieties and technologies.

For cropping producers, technical incremental adaptations include soil amelioration, agronomy and new plant varieties with better water use efficiency. Management improvements include precision agriculture, decision support tools, enterprise size (to achieving efficiencies of scale) and response to seasonal conditions. For livestock producers, incremental adaptation strategies that combine technology, behaviour, pasture and livestock breeding, management and policy options will be needed to ensure the viability of the sector.

Regardless of adaptation, it is likely that the inter-annual variability of weather conditions will increase across most of the state. These changes will affect the profitability and financial risk associated with farming enterprises, particularly at the

margins of the grainbelt. In low rainfall parts of the agricultural zone, transitional or even transformative changes may be needed in the long term.

Given what we know about climate change, it is prudent for most grainbelt producers to continue to adopt best practice incremental changes and to wait and see what happens with future climate and technological developments before making transformational changes to their businesses.

4.2 Climate-ready horticulture

As with broadacre farming, changes in horticultural production associated with future climate will depend on location, soil type and management. These changes will affect profitability and financial risk associated with farming enterprises, particularly in areas at the margins of enterprise suitability.

Decreased annual rainfall will likely continue to decrease surface water run-off and groundwater recharge and increase variability in groundwater and dam storage volumes in the southern half of WA. To deal with decreased rainfall, the sector will need to continue incremental improvements in irrigation practices and water policy.

Changes in water availability may be less of an issue for irrigation areas in the north of the state where there is no clear trend in projected rainfall and natural inter-annual variability will continue to dominate. However, increased temperature may be more problematic in the north compared to the south.

Matching appropriate climatic areas to crop type is an important consideration, particularly for long-lived perennial crops. As the areas that are suitable for growing tropical and subtropical crops expand, and the areas suitable for temperate crops with high chilling requirements decline, transitional adaptations may be needed. New crop varieties and improved technology and management techniques may have to be adopted to respond to a warmer, drier climate.

For some industries, such as wine production in the south-west, the impact of climate change may be relatively small. Research has shown that existing grape varieties are expected to remain suitable for the short to medium term, and the conditions for some newly planted varieties will become more suitable. However, adaptive management will be required for the more sensitive, aromatic white varieties.

Where producers face additional costs of capital adjustment because of increasing impacts of climate change, investing in long-lived, risk-exposed assets — such as irrigation infrastructure, orchards, vineyards and agroforestry — may become more difficult. Producers will need a greater understanding of medium- to long-term climate change trajectories and the possible impacts on their enterprises.

4.3 Climate-ready rangelands

For traditional pastoral businesses, long-term reductions in livestock carrying capacity and increased climate variability may be beyond the scope of incremental adaptation. Significant improvements in terms of trade or transitional changes will be required.

Incremental changes, such as improved grazing practices and better matching of livestock numbers to seasonal conditions and grazing capacity; transitional changes, such as moving to more heat-tolerant species; and transformative changes, such as tenure change allowing for non-pastoral activities like irrigated agriculture (where suitable water is available), will be needed and could provide opportunities to bolster economic and social sustainability and allow for landscape restoration in degraded areas.

4.4 Climate-ready dairy

In the dairy industry, research has shown a link between increased heat stress and reduced milk yields and reproduction rates. A changing climate will also alter the types and productivity of pastures and may reduce water availability.

A number of incremental adaptations have been identified, including management responses to mitigate heat stress, shifting calving times and using pasture mixes that take advantage of climatic conditions and improved irrigation management to offset any decline in water availability. Improving energy efficiency and generating carbon credits are transformative adaptations.

4.5 Climate-ready intensive animal industries

Intensive animal production often allows the producer to have greater control over environmental conditions, therefore reducing the potential impacts of climate change on production. For example, there are incremental adaptations, such as minimising heat stress by modifying the animals' environment (for example, via shade, misters, or pad cooling), nutritional manipulation, which could include changing feeding frequency, timing or energy density, and selecting animals that have greater tolerance for heat.

Increasing energy efficiency, generating electricity on-farm and generating carbon credits are more transformative adaptations.

5 DAFWA's investment principles

Although there is growing confidence in the direction and nature of long-term climate projections, some uncertainties about the detail and timing will remain, so agricultural businesses will need to take a risk-management approach based on imperfect knowledge. There is a high degree of confidence that:

- temperatures will continue to increase across the state
- the south-west will become drier while rainfall in the rest of the state is likely to stay much the same
- greater frequency and intensity of extreme weather events across the entire state.

However, there is less confidence about the magnitude of these changes.

In the short to medium term, the most effective responses will likely be similar to those associated with responding to climate variability. For instance, the agricultural

industry in the south-west has successfully adapted to the climate change experienced since the mid-1970s using strategies that were predominantly aimed at increasing production or managing seasonal variability.

The Western Australian Government's [Adapting to our changing climate](#) identifies four approaches to continue building foundations for a profitable agricultural sector challenged by climate change:

- improve the provision of information to key stakeholders to enhance their understanding of future risks associated with climate change
- assist land managers to benefit from carbon capture opportunities
- support development and commercialisation of technology to increase the resilience of agricultural businesses to climate change
- support research to enable adaptation to a changing climate, such as new crop varieties that can thrive in hotter and drier climates.

In addition to these actions, DAFWA will also provide leadership, policy advice and strategic analysis of climate change issues for agriculture in the context of the state government's policies and priorities. These principles form the basis of DAFWA's investment priorities.

6 DAFWA's investment priorities

The WA Minister for Agriculture has set a goal to [double the value of the agricultural sector by 2025](#). It is unlikely that climate changes within the next 10 years will impede achieving this goal, but seasonal variability will pose progressively greater challenges. Long-term climate change will challenge the industry's continued productivity and profitability. DAFWA has identified actions to achieve each of the investment principles listed above. These actions form the basis of our investment priorities to assist the agricultural industry to address the impacts of climate change.

6.1 Continue to provide information to stakeholders to enhance their understanding of future risks associated with climate change

Primary producers and the broader agricultural sector will need to be able to interpret the implications of climate change for their business, understand their vulnerability and have the capacity to adapt and respond. Understanding the implications of climate change will encourage better seasonal on-farm planning and better long-term business development. DAFWA is working to increase the sector's understanding, and we are developing mitigation and adaptation options for producers. Over the last five years, DAFWA has:

- participated in the work of the [Indian Ocean Climate Initiative](#)
- investigated climate prediction models for WA to improve seasonal forecasting
- investigated options for managing consistently unprofitable agricultural land in the north-eastern grainbelt

- developed a series of web-based information notes detailing projected regional climate changes and possible adaptive responses
- investigated the most robust business structures for agricultural industries to respond to climate change
- conducted a series of workshops for grape producers that investigated the potential impacts of climate change and explored adaptation options.

Over the next five years, DAFWA will continue to access and share the data, information and analyses needed to underpin successful responses to climate change.

6.2 Assist land managers to benefit from carbon capture opportunities

Land managers have the opportunity to participate in voluntary carbon markets via schemes such as [carbon farming](#) and the [Emissions Reduction Fund](#). Land managers can create and sell carbon credits by sequestering carbon in plant biomass or in the soil, by reducing greenhouse gas emissions from livestock, savanna fires, manures and the soil, or by increasing the energy efficiency of their operations.

Over the last five years, DAFWA has:

- contributed to or led various research and extension collaborations with the University of Western Australia (UWA) and CSIRO on understanding the processes related to soil organic carbon accumulation and manipulation in WA soils
- collaborated with UWA on researching nitrous oxide emissions from WA farming systems and how they can be mitigated
- collaborated with the Future Farm Cooperative Research Centre to investigate using perennial pastures to increase soil carbon sequestration
- collaborated with the Future Farm Cooperative Research Centre and CSIRO to quantify the carbon sequestration potential of revegetation plantings
- undertaken various collaborations with UWA, Murdoch University, Meat and Livestock Australia and the Victorian Department of Economic Development Jobs Transport and Resources to investigate how livestock systems can adapt to climate change and reduce methane emissions
- led a collaborative project with regional natural resource management (NRM) groups to develop extension materials to increase awareness of carbon farming opportunities
- provided [information for land managers](#) via the DAFWA website
- provided data on land capability and salinity risk to regional NRM groups to locate sequestration plantings and update their climate change strategies.

Over the next five years, DAFWA will:

- continue to provide information to land managers wanting to investigate [carbon farming](#)
- continue collaborative research activities with a focus on the benefits of increasing [soil carbon](#) to improve agricultural production and [carbon sequestration](#)
- continue working with livestock industry bodies to increase producer awareness of manure management technologies
- collaborate with Rangelands NRM to investigate innovative grazing systems that increase livestock productivity and carbon sequestration in soil and vegetation.

6.3 Support development and commercialisation of technology to increase the resilience of agricultural businesses to climate change

DAFWA has been working with producers to research and develop robust farming systems. New plant varieties, improved technologies, and better farm and business management have resulted in substantial increases in crop and livestock productivity for WA producers. Given WA's past climate trends and the pace of change, much of the work that DAFWA does has value in increasing the resilience of the sector to climate variability and climate change.

Over the last five years, DAFWA has:

- increased the number and geographical coverage of DAFWA [climate monitoring stations](#) and provided real time weather data on the DAFWA website
- collaborated with industry bodies, universities and CSIRO to develop precision agriculture technologies that reduce input costs (including fossil fuels) and improve plant water relations
- provided [seasonal information](#) and projected impacts on cropping and agriculture to assist in making on-farm decisions
- conducted research to better understand [soil constraints](#) to crop growth with the aim of developing technologies and practices that maximise plant access to water in the soil and increase the soil's ability to store rainfall in excess of plant water use
- run the irrigated agriculture water use efficiency project, [More dollars per drop](#), to assess current use and develop innovative ways to improve water use in the horticulture, wine and dairy industries
- collaborated with government departments and industry bodies across Australia to quantify the likely impacts of climate change on livestock production in southern Australia. The profitability of a number of adaptation strategies was investigated
- examined the financial performance of 249 grainbelt farms between 2002 and 2011 to identify the most successful business types and adaptation strategies.

In the next five years, DAFWA will:

- promote adaptations, such as overcoming [subsoil constraints](#), that enhance the productivity of the agricultural sector, mitigate climate change and enhance the sustainable use of land and water
- support the use of life cycle analysis to reduce input costs and mitigate the emission of greenhouse gases and other pollutants
- provide real time [weather data](#) on the DAFWA website
- augment the existing climate monitoring stations with a network of wind radars and make the data available on the DAFWA website
- provide [seasonal information](#) and projected impacts on cropping and agriculture to assist producers to make on-farm decisions
- develop an interactive online database that details the location and quantity of agricultural residues and by-products suitable for biofuels and biofeedstocks
- work with the [bioenergy industry](#) to develop new markets and opportunities for WA producers
- provide information to producers via various media, including the DAFWA website, about [soil constraints](#) and the technologies and practices available that maximise the plant's ability to access water in the soil and increase the soil's ability to store rainfall in excess of plant water use
- link producers to better agronomy and new varieties to ensure that productivity gains continue during dry seasons under the Royalties for Regions' [Grain from less rain](#) activity
- develop new crop management packages to provide new opportunities for producers to take advantage of high-rainfall seasons under the Royalties for Regions' [Lifting the yield ceiling](#) activity
- continue the irrigated agriculture water use efficiency project, [More dollars per drop](#), to assess current water use and develop innovative ways to improve water use in the horticulture, wine and dairy industries.

6.4 Support research to enable adaptation to a changing climate, such as new crop varieties that can thrive in hotter and drier climates

Collaboration allows for the more effective use of scarce research funding and can provide for more rigorous and more solid research outcomes.

Over the last five years, DAFWA has:

- collaborated with Curtin University to develop life cycle analyses of major WA crops to reduce inputs and mitigate embedded emissions

- undertaken various collaborations to develop new crop varieties that are more able to exploit soil water resources, are more tolerant of water deficits and are [better at resisting frost](#)
- developed the [managed environment facility](#) at Merredin as part of a network of Australian research sites dedicated to developing broadacre crop varieties that are more resistant to drought, frost and disease
- collaborated in several research activities under the [National Climate Change Adaptation Research Facility](#).

Over the next five years, DAFWA will:

- make the [managed environment facility](#) at Merredin available to collaborators to develop broadacre crop varieties that are more resistant to drought, frost and disease
- research how wheat and barley responds to water deficits and benchmark genetic diversity for adaptive trait that provide heat and drought resistance
- investigate wheat varieties and agronomy for early season suitability and for sowing into dry conditions
- investigate canola varieties and agronomy for drier areas
- develop new strategies for phenotyping frost and chilling tolerance in wheat during reproductive stages
- bring new research technologies and skills to regional WA to improve our understanding of managing frost damage under the Royalties for Regions' [Frost-proofing farm businesses](#)
- research soil constraints via the *Soil constraints west* suite of research activities in collaboration with CSIRO, UWA and Murdoch University
- collaborate with Melbourne University and the Victorian Department of Economic Development, Jobs, Transport and Resources to investigate adaptation tipping points for Australian fruit trees under the *Crossing the threshold; Adaptation tipping points for fruit trees* research activity.

6.5 Provide leadership, policy advice and strategic analysis of climate change issues for agriculture

DAFWA has a role in representing the interests of WA agriculture in state and national policy issues related to climate change.

Over the last five years, DAFWA has:

- worked with the state and federal governments in developing rules for the carbon farming initiative
- developed a [Climate change response strategy](#) for the period 2010–2015, which has been superseded by this situation statement.

Over the next five years, DAFWA will:

- provide informed climate change planning and policy advice to industry and local, state and federal governments
- ensure that the interests of WA agriculture are represented on state and federal peak bodies such as the [Climate Change Research Strategy for Primary Industry](#) and [Bioenergy RD&E Advisory Forum](#).

7 Conclusion

It is likely that most agricultural sectors will be able to deal with climate variability and short-term climate change as long as they manage farm finances and have ongoing access to farm management and business education and improved crop varieties and technologies. In the long term, an enterprise's ability to adapt to climate change is constrained by its adaptive capacity.

Adaptation strategies combining technology, behaviour, management and policy will be needed to offset the increasingly negative effects of climate change and may actually improve enterprise profitability in the short-term.

While the agricultural sector needs to be informed about and be prepared for climate change, for most farms businesses our best advice is to continue making incremental changes and continually assess future climate and technological developments before making decisions about long-term transformational changes.

In the short to medium term, the most important climate issue is to increase enterprise resilience to climate variability. Climate change is broadly acknowledged as a long-term issue. To address these priorities, there are some commonly identified research and development themes including:

- systems-based research to continue delivering incremental adaptations for short- to medium-term climate variability and change
- improved weather forecasting and making climate projections available at a local scale
- a better understanding of the potential long-term impacts of climate projections on farming systems and related industries.

DAFWA has a role to ensure that these areas are covered, either through our own work or through research and development carried out by other state and federal bodies.