Climate change will provide opportunities and challenges to producers across the South West Agricultural Region. This Farmnote is designed to promote risk management planning by producers in anticipation of those changes.

The following climate projections were done under a range of Intergovernmental Panel on Climate Change (IPCC) emission scenarios using CSIRO Mark 3.0 considered one of the better international models which reproduce Australian climatology.

In this analysis we have used the worst case emission scenario. Climate change could escalate competition for water and land and result in significant adjustment in the mix of industries across the region.

The most direct impact will be for some horticultural tree crops that may not receive enough chilling to properly set fruit. Intensive animal industries will need to prepare for increased water intake by livestock and additional cooling costs.

Climate change will also present opportunities to increase crop and pasture production on low-lying land and diversify wine grape varieties.

Farmers need to be increasingly flexible in the way they manage their farm businesses to cope with increased variability within and between seasons.

**Recent climate changes**

Rainfall has declined significantly over the past 30 years compared with the early twentieth century (see Figure 1). Autumns in particular have become drier and more variable with some districts experiencing more summer rainfall.

**Likely changes by 2030**

Growing season rainfall decline is expected to be larger than in other parts of the South West Land Division and more rapid than over the past 30 years:

- Annual rainfall 5–20 per cent less than 1990 baseline (e.g. Manjimup 50–200 mm decrease)

---

**Note:** 413

April 2010

Figure 1 Changes in May to October rainfall (left) and November to April rainfall (right) for the South West Agricultural Region for 1976-2008 compared with 1910-1975
• Average annual temperatures 0–2 °C higher, less in coastal districts
• Growing season rainfall (May–October) down by 10–20 per cent from 1990 baseline
• Spring rainfall to decline by 20–40 per cent
• Diurnal temperature range to widen as day-time maximums increase
• Chill accumulation down by up to 100 hours
• Autumn rainfall up or down by up to 5 per cent
• Rainfall variability to increase within seasons, particularly in autumn and winter
• More dry years
• Fewer major rainfall events in growing season
• Longer and more frequent heat waves
• Extreme events to be more severe, including more intensive heat waves, bush fires, drought, flooding and storm surges.

The overall effect is one of shifting existing climate zones south-westwards. For example, future farming systems at Manjimup may look like Boyup Brook today.

Agriculture in 2030
• More competition for productive irrigated land away from pasture to more intensive production.
• Higher temperatures and lower rainfall will have a negative impact on pasture and crop growth, but provide opportunities to crop low-lying land that would normally be too wet.
• Increased competition for fresh water resources and higher cost of water for irrigation.
• Longer and more frequent heat waves impact on fruit quality and burn some leafy horticultural crops.

As the frequency and amount of rain to fall decrease, so will the frequency of run-off to fill water storages and run streams. Roaded and natural catchments will need to be 15–20 per cent larger to fill existing dams.

Increased temperatures and more carbon dioxide will initially have a positive effect on pasture and crop yields. For most plants increased temperature will mean faster growth rates and some initial gain in water use efficiency.

Increased levels of carbon dioxide will have a different effect depending on the crop species and the amount in the atmosphere. Current projections are for carbon dioxide to reach 400–450 parts per million (ppm) by 2030 and most crops and pastures can expect to benefit from its fertilisation effect.

Forage and pasture quality for stock is closely related to growing season, soil fertility, plant stage and moisture stress. While slightly warmer conditions will tend to have a neutral effect on the overall quality of feed intake, less is known about how raised carbon dioxide levels will impact on the overall quality of fodder and pastures.

Higher spring temperatures will increase stress on pastures and crops during seed set. Pastures may require additional water to prevent decreasing digestibility. A shorter growing season will become evident, especially around Perth.

Higher temperatures are likely to increase some soil-borne diseases. Some increase in insect activity in pastures will also challenge productivity. For example, producers will need to shift the timing of spring control measures to manage redlegged earth mite.

Higher minimum temperatures will affect tree crops (e.g. cherries and nuts) which require a minimum number of chilling days. Growers need to be aware of current ranges and monitor them to determine risks. Some tree crops in the north are likely to experience poor fruit set and variable bud burst.

Decreased humidity could reduce the incidence of some aerial fungal diseases in horticultural crops however the risk of insect-borne diseases will increase with higher temperature. Heat stress will impact on fruit quality and could cause burning of some leafy horticultural crops. Increased temperatures are also likely to lead to greater prevalence of some fungal/bacterial diseases requiring more control options.

Some insect pests are likely to persist longer into the autumn-winter period leading to increased control costs and yield losses.

Cattle industries will experience less pasture production through a combination of late breaks, reduced growing season rainfall and increased moisture stress. Longer heat waves and more solar radiation will stress herds as they demand more water and may become slightly less fertile.

Water and land costs are likely to increase due to greater demand pressure. Competition is likely to increase between pasture-based and more intensive production systems for irrigated agricultural land.

Ability to adapt
The South West is renowned for its reliable high rainfall and diversity of agricultural industries, predominately beef, dairy and horticulture. In the past decade most producers have not seen climate variability beyond what they have experienced in the past 50 years, but this is likely to change in the next 20 to 30 years.

Orchardists will be challenged by decreased chilling and poor bud burst.

Higher temperatures may result in some increase in animal husbandry problems such as heat stress, more summer flies, greater water uptake and decline in fertility. Many cattle producers will...
need to consider major changes to their grazing strategies, irrigation techniques and pasture or fodder mixes. Some may even have to move due to increased water costs and competition for land. Forestry will remain significant with agroforestry likely to move further inland due to increased competition for land. A more diverse mix of trees is likely, better adapted to soil types and drier climate.

The South West will continue to provide a favourable environment for premium wine and grape production despite increased competition for water. Some change to the mix of red and white grapes will be necessary to improve adaptability to hot summers. More quality vintages for late maturing varieties and increased diversity of varieties will increase the resilience of viticulturalists.

Use of inexpensive, canopy temperature monitoring dataloggers to improve understanding of temperature stress and water demands will be important in horticultural industries.

Approaches to adaptation

Generally, projections of future climate are uncertain. There is unavoidable uncertainty in the emission scenarios as it is impossible to predict human behaviour globally.

Industry needs to be developing flexible and resilient farming systems that are better able to cope with variability of seasonal climate and better able to face the challenge of climate change.

Key overall management strategies include:

• Selecting new varieties and pasture species which are better adapted to increased temperatures, moisture stress and shorter growing seasons.
• Using a mix of rotational grazing, supplementary feeding and fodder conservation for livestock to adapt to dry and variable seasons.
• Using smart technology, for example, Pastures from space to manage rotational grazing strategies, with pasture and fodder conservation.
• Using passive solar designs to reduce energy costs and improve comfort for intensive livestock.
• Breeding or switching to livestock that genetically are less sensitive to heat stress and have better emission profiles. Plan for higher water intake.
• Factoring in increased costs of cooling and ventilation for intensive animal industries due to projected higher temperatures.
• Shifting some horticultural tree crops further south or phasing out less tolerant varieties.
• Planting genetically modified crops or varieties which are more efficient at higher CO₂ levels and tolerate heat stress during grain fill.
• Better land use planning and matching of soils to crop types, especially as good agricultural land becomes scarcer.
• Using decision tools and risk management strategies to manage productivity within and between seasons.
• Changing pest control strategies as insects and diseases adjust their infestation ‘windows’ due to warmer conditions.

Some of these points are summarised in Table 1.

Further information

Farmnotes

411 Climate adaptation for Central Agricultural Region
412 Climate adaptation for Northern Agricultural Region
414 Climate adaptation for Southern Agricultural Region
415 Climate change and impact on WA agriculture

Websites

Bureau of Meteorology
CSIRO Atmospheric Research
www.cmar.csiro.au/research/climate.html
CSIRO Ozclim
www.csiro.au/ozclim/about.do#CSIRO
IPCC http://sres.ciesin.org/
### Table 1 Future climate scenarios for the South West Agricultural Region by 2030

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Likely production impacts</th>
<th>Possible adaptation response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horticulture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Temperature increased by 1 °C</strong></td>
<td>• Shorter winter growing season, longer summer growing season • Low fruit set for temperate trees (e.g. cherries and nut trees) • Minor heat stress • Leaf burn on some leafy vegetables</td>
<td>• Switch to ‘low-chill’ cultivars or crops • Change species or switch to more tolerant cultivars • Change site for perennial horticultural or change crop type • Reduce reliance on glasshouses, increase flexibility in these structures and consider shading • Invest in GM technology &amp; breeding of heat/stress tolerant varieties</td>
</tr>
<tr>
<td><strong>Rainfall decreased by 20%</strong></td>
<td>• Less run-off and water availability, increased salinity • Lower stream flows and dam storages • Shorter pasture growing season</td>
<td>• Improve roaded catchments, plan for increase investment in tanks and dams storages • Increase capacity to improve water use efficiency through management &amp; tools, e.g. extend Waterwise activities • Identify priority horticultural land • Relocate some vegetable production to other districts e.g. Manjimup, Boyup Brook</td>
</tr>
<tr>
<td><strong>More variability</strong></td>
<td>• Shifts in crop growing season • Existing dams dry by autumn • Smaller horticultural production areas</td>
<td>• Increase diversity of crop types &amp; locations • Integrate catchment management at sub-regional level • Invest in larger dam storage, improve roaded catchment design and construction • Revisit sites considered too waterlogged e.g. potatoes at Scott River</td>
</tr>
<tr>
<td><strong>Increased pest incidence</strong></td>
<td>• Increased incidence &amp; control measures • Increased variation in fruit and vegetable quality • Less apple and pear scab, brown rot of stone fruit due to lower humidity</td>
<td>• Better predictive &amp; monitoring technology to assist producers in managing changes in pests &amp; disease • Improve integrated pest management strategies at local and regional levels • Better understand crop-by-crop impacts of drier and warmer climate</td>
</tr>
<tr>
<td><strong>Temperature increased by 1 °C</strong></td>
<td>• Increased pasture growth &amp; production • Increased livestock heat stress during summer • Capacity of current pivot irrigation systems may be insufficient • Increase in external parasites • Change in timing and type of pests and weedy species</td>
<td>• Breed and switch to more tolerant forage and pasture species • Introduce earlier calving, improve shade for stock • Increase sprinkler efficiency • Increase use of real time evaporation monitoring tools to improve watering efficiencies • Better canopy management strategies for fodder and pastures (e.g. nitrogen input technology) • Prepare for increased demand for water in all systems</td>
</tr>
<tr>
<td><strong>Rainfall decreased by 20%</strong></td>
<td>• Less pasture on slopes, more in low-lying areas • Soil type and aspect will determine degree of impact • Increased feed costs for beef/dairy feedlots</td>
<td>• Increase fodder conservation and diversity feedstocks • Remove soil constraints and increase pasture water use efficiency • Switch breed or genotypes which have higher feed conversions for relevant feedstocks • Adopt grain and graze strategies where appropriate • Intensify rotational grazing management with strategic confined feeding • Invest in multi-purpose infrastructure, shading/rainfall capture/fodder storage/livestock handling</td>
</tr>
<tr>
<td><strong>More variability</strong></td>
<td>• Increased feeding regime for both dairy and beef herds • Longer dry spells, increased water and feed requirements • Increases in late breaks &amp; early finishes • More irrigation required</td>
<td>• Increase fodder conservation &amp; confined feeding of livestock; explore pasture leasing in other districts • Increase fertilised efficiencies, fertilise to demand • Continuously monitor feed on offer and adjust stoking rates accordingly or confine feeding areas • More efficient watering systems, more flexibility in feedbase • Improve business skills to plan for variability e.g. software, training, professional support • Manage fodder reserves to minimise climate impacts</td>
</tr>
<tr>
<td><strong>Pests and disease</strong></td>
<td>• Increased activity of insect pests (summer flies, lice) • Less pasture disease with lower humidity • Increased costs in insect control</td>
<td>• Manage specific pests and monitoring of livestock and pasture • Increase understanding of how specific species will be affected i.e. dung beetles, internal parasites • Improve integrated pest management strategies at local &amp; regional levels</td>
</tr>
<tr>
<td><strong>Other issues</strong></td>
<td>• More bush fires • Reduced water and energy consumption</td>
<td>• Prepare firebreaks and control burns earlier • Improve feed conversion and reduce methane emissions • Develop feedstock/livestock that minimises emissions • Manage input costs tightly and improve efficiency • Explore suitable feedstocks from biofuel by-products • Optimise balance between energy requirement, feed efficiency and emission profiles • Monitor and improve energy efficiency</td>
</tr>
</tbody>
</table>