Australian grains
Outlook for 2017–18 and industry productivity
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Overview

This publication summarises the forecasts presented in the December 2017 editions of ABARES Agricultural commodities (ABARES 2017a) and Australian crop report (ABARES 2017b). It also includes material from ABARES latest estimates of Australian cropping productivity (Xia, Zhao & Valle 2017). This publication was commissioned by the Grains Research and Development Corporation (GRDC).

In 2017–18 the world wheat indicator price (US no. 2 hard red winter, fob Gulf) is forecast to average US$218 per tonne. World wheat production is forecast to be only slightly lower than the record achieved in 2016–17. However, high-quality hard wheat supplies are expected to decline because of smaller harvests in Australia, Canada and the United States. High-quality hard wheat prices (including the world indicator price) are expected to remain historically low but average higher than in 2016–17.

In 2017–18 the world coarse grain indicator price (US no. 2 yellow corn, fob Gulf) is forecast to average US$159 per tonne, a 1 per cent increase from 2016–17. The world indicator price for barley (France feed barley, fob Rouen) is forecast to average US$180 per tonne, a 14 per cent increase from 2016–17. This reflects a reduction in supply in major exporting countries.

In 2017–18 the world canola indicator price (Europe rapeseed, fob Hamburg) is forecast to remain unchanged at US$425 per tonne. Relatively high prices for palm oil, a substitute for canola oil, are expected to largely offset downward pressure on canola prices resulting from abundant soybean supplies. Exportable supplies of canola are forecast to remain steady year-on-year due to mixed growing conditions in the major exporters—Australia, Canada and Ukraine. The oilseed indicator price (US no. 2 soybeans, fob Gulf) is forecast to decrease by 4 per cent to average US$370 per tonne. This reflects record high soybean opening stocks and continued high global soybean production.

Total winter crop production in 2017–18 is forecast to decrease by 41 per cent to 34.9 million tonnes, largely reflecting an expected fall in average yields from the exceptionally high yields of 2016–17. Production is forecast to fall for the three major crops: wheat by 42 per cent to 20.3 million tonnes, barley by 40 per cent to 8.0 million tonnes and canola by 31 per cent to 2.9 million tonnes. Chickpea production is forecast to decrease by 48 per cent to 1.0 million tonnes and oat production by 44 per cent to 1.1 million tonnes.

The Bureau of Meteorology’s three-month rainfall outlook (December to February), issued on 30 November 2017, indicates no strong tendency towards either a wetter or drier than average summer in all cropping regions. Given this, ABARES has assumed average rainfall over summer in the summer cropping regions.

In 2017–18 total area planted to summer crops is forecast to increase by 13 per cent to 1.5 million hectares, reflecting a more favourable opening to the summer crop season for grain sorghum than in 2016–17. Rainfall in October and November increased soil moisture levels. However, soil moisture levels were very low in many summer cropping regions at the start of spring so further rainfall will be required during the planting window for planting intentions to be realised. Total summer crop production is forecast to increase by 23 per cent to around 4.8 million tonnes.

Productivity growth is an important measure of performance for the Australian cropping industry because, in the long term, it reflects changes in the efficiency with which farmers use
land, labour, capital and intermediate inputs (for example, chemicals and purchased services) to produce crop outputs.

Productivity in the cropping industry grew on average by 1.5 per cent a year between 1977–78 and 2014–15. This was driven by strong output growth (2.6 per cent a year) relative to input growth (1.2 per cent a year).
1 World outlook

Wheat

In 2017–18 the world wheat indicator price (US no. 2 hard red winter, fob Gulf) is forecast to average US$218 per tonne. World wheat production is forecast to be only slightly lower than the record achieved in 2016–17. However, high-quality hard wheat supplies are expected to decline because of smaller harvests in Australia, Canada and the United States. High-quality hard wheat prices (including the world indicator price) are expected to remain historically low but average higher than in 2016–17.

World wheat production in 2017–18 is forecast to fall by 1 per cent to 747 million tonnes. Production contracted for all major exporters except the European Union and the Russian Federation. Russian wheat production in 2017–18 is estimated to be 81 million tonnes, 12 per cent higher than the record set in 2016–17. The Russian Federation is expected to be the world’s largest exporter of wheat for the first time as a result of substantial supplies and a depreciation of the rouble.

In 2017–18 world closing stocks are forecast to reach a record 250 million tonnes. However, stocks held in major exporting countries are forecast to decline following reduced harvests in most countries. The stocks-to-disappearance ratio in major exporting countries is forecast to fall slightly. This indicates that major exporters will have reduced supplies to make available for the global market.

Coarse grains

In 2017–18 the world coarse grain indicator price (US no. 2 yellow corn, fob Gulf) is forecast to average US$159 per tonne, a 1 per cent increase from 2016–17. The world indicator price for barley (France feed barley, fob Rouen) is forecast to average US$180 per tonne, a 14 per cent increase from 2016–17. This reflects a reduction in supply in major exporting countries.

In 2017–18 global coarse grain production is forecast to fall to just over 1.3 billion tonnes. This reflects a fall in area planted and a decline in yields in most major producing countries.

Global corn production in 2017–18 is forecast to fall to just over 1 billion tonnes, 3 per cent lower than the record of 2016–17. This reflects a decrease in area planted and lower yields in most major producing countries—including Argentina, Brazil and China. In the United States, production is estimated at around 370 million tonnes—the second highest on record after 2016–17—despite a decrease in area planted and below average seasonal conditions.

In 2017–18 world barley production is forecast to fall by 4 per cent to 142 million tonnes, reflecting reduced area planted and lower yields than the record achieved in 2016–17. Lower production is forecast for all major exporters (Argentina, Australia, Canada, the European Union and Ukraine) with the exception of the Russian Federation. Russian production is forecast to increase by 17 per cent to around 21 million tonnes, reflecting favourable growing conditions. Total EU barley production has fallen in 2017–18 but production of malting barley has been good, particularly in France.
In 2017–18 global coarse grain consumption is forecast to rise to a new record of 1.3 billion tonnes. Global feed consumption of corn is forecast to rise by 3 per cent to a new record of 650 million tonnes as meat and dairy production continues to grow globally. Ample competitively priced global supplies of corn are expected to lead to its continued use as a major component of compound feed rations. World barley consumption is forecast to fall by 5 per cent to around 143 million tonnes due to reduced supply, higher prices and ample supplies of feed grain substitutes (such as corn and wheat) making feed barley less competitive. Industrial demand for malting barley is forecast to increase as demand for brewing continues to increase, particularly in Asian and African countries.

In 2017–18 world coarse grain closing stocks are forecast to fall to around 264 million tonnes as forecast consumption exceeds production. Despite this, stocks are expected to be the second highest on record. World closing stocks of corn are forecast at around 233 million tonnes. If realised, closing stocks will be the second highest on record after 2016–17 and 35 per cent above the five-year average. Closing stocks in the major exporting countries of Argentina, Brazil, Ukraine and the United States are at their highest level since the late 1980s. In 2017–18 World closing stocks of barley are forecast to fall to just under 23 million tonnes. If realised, this will be the lowest level in five years. Closing stocks in the major exporting countries of Argentina, Australia, Canada, the European Union, the Russian Federation and Ukraine are forecast to fall by 19 per cent to just over 9.3 million tonnes.

**Oilseeds**

In 2017–18 the world canola indicator price (Europe rapeseed, fob Hamburg) is forecast to remain unchanged at US$425 per tonne. Relatively high prices for palm oil, a substitute for canola oil, are expected to largely offset downward pressure on canola prices resulting from abundant soybean supplies. Exportable supplies of canola are forecast to remain steady year-on-year due to mixed growing conditions in the major exporters—Australia, Canada and Ukraine. The soybean indicator price (US no. 2 soybeans, fob Gulf) is forecast to decrease by 4 per cent to average US$370 per tonne. This reflects record high soybean opening stocks and continued high global soybean production.

Global oilseed production in 2017–18 is forecast to reach 571 million tonnes, a marginal increase from the record high in 2016–17. Average oilseed yields are expected to fall year-on-year following record soybean yields in 2016–17 in the two largest producing countries, Brazil and the United States.

In 2017–18 global production of rapeseed (including canola) is forecast to increase by 3 per cent to reach 72 million tonnes. Despite this, production of rapeseed (including canola) in the major exporting countries is forecast to remain steady at 2016–17 volumes. Falls in Australian production are expected to be offset by production increases in other major exporting countries.

World soybean production in 2017–18 is forecast to decrease slightly to around 347 million tonnes.
Global oilseed consumption in 2017–18 is forecast to increase by 3 per cent to 569 million tonnes, reflecting increased demand for oilseed meal (from livestock industries) and vegetable oil (for human consumption and biodiesel production). World rapeseed (including canola) consumption is expected to increase by 2 per cent to 71 million tonnes, with steady consumption growth expected globally. World soybean consumption is forecast to increase by 4 per cent to 348 million tonnes, primarily due to growth in Chinese soybean consumption. Increased feed use in the pig and poultry industries in China is expected to drive up Chinese consumption by 7 per cent to 109 million tonnes.

In 2017–18 world oilseed exports are forecast to increase by 2 per cent to 170 million tonnes. World rapeseed (including canola) exports are forecast to increase marginally to 16 million tonnes. Lower forecast production in Australia is expected to lead to relatively steady year-on-year exportable supplies from the major canola exporters. Global soybean exports are expected to increase by 4 per cent to 151 million tonnes, reflecting expected increased exportable supplies due to back-to-back years of high Brazil and US production.

In 2016–17 world oilseed closing stocks increased by 22 per cent to a record 108 million tonnes due to record soybean production. In 2017–18 closing stocks are forecast to increase further to 110 million tonnes.
2 Australian crop prospects

Prospects for total winter crop production in Australia fell slightly during spring but there was significant regional variation. The condition of crops varied substantially at the start of spring and seasonal conditions during spring were mixed.

The two changes to state level crop prospects over spring with most significance for national level production were in Western Australia and New South Wales. In Western Australia, favourable seasonal conditions boosted crop prospects in all cropping regions. In the northern and central east cropping regions, crops were generally in very poor condition at the start of spring and the favourable finish to the season averted failure for many of these crops. In contrast, seasonal conditions were very unfavourable during spring in most New South Wales cropping regions and adversely affected crop prospects. Yields in most regions are expected to be well below average.

Crop prospects also deteriorated significantly in Queensland over spring but this change will have a much smaller effect on expected national production than the changes in Western Australia and New South Wales.

In Victoria and South Australia, regional changes to crop prospects over spring varied but changes to forecast state level production are relatively small.

Harvest was slowed during November and early December by rainfall events and heavy rainfall in early December across the south-east of Australia may result in a downgrade of grain quality. According to the rainfall outlook, issued by the Bureau of Meteorology on 30 November 2017, December is likely to be wetter than average in south-east cropping regions.

In 2017–18 total winter crop production is forecast to decrease by 41 per cent to 34.9 million tonnes, largely reflecting an expected fall in average yields from the exceptionally high yields of 2016–17. This forecast production is 2 per cent below the 10-year average to 2015–16.

Production is forecast to fall in 2017–18 for the three major crops: wheat by 42 per cent to 20.3 million tonnes, barley by 40 per cent to 8.0 million tonnes and canola by 31 per cent to 2.9 million tonnes. Amongst other crops, chickpea production is forecast to decrease by 48 per cent to 1.0 million tonnes and oats production is forecast to fall by 44 per cent to 1.1 million tonnes.

In 2017–18 total area planted to summer crops is forecast to increase by 13 per cent to 1.5 million hectares, which reflects a more favourable opening to the summer crop season for grain sorghum than in 2016–17. In particular, Rainfall in October and November increased soil moisture levels. However, because soil moisture levels were very low in many summer cropping regions at the start of spring, further rainfall will be required during the planting window for planting intentions to be realised. Total summer crop production is forecast to increase by 23 per cent to around 4.8 million tonnes.

According to the three-month rainfall outlook (December to February), issued by the Bureau of Meteorology on 30 November 2017, there is no strong tendency toward either a wetter or drier than average summer in all cropping regions. Given this, ABARES has assumed average rainfall over summer in the summer cropping regions.
3 Seasonal conditions

Late winter and early spring rainfall was higher than average across much of Western Australia in 2017. In contrast, there was record low rainfall and above average daytime temperatures during September in New South Wales and Queensland.

While daytime temperatures during spring were generally above average in most cropping regions, numerous lowest minimum temperature and maximum temperature records were set in eastern Australia in September. In central and southern cropping regions in Western Australia mild temperature and abundant soil moisture levels during October and early November extended the grain fill period and added up to a month to the growing season.

Rainfall percentiles for spring 2017 as a whole were generally below average to average across most cropping regions in New South Wales, Victoria, South Australia and Western Australia (Map 1). While Queensland cropping regions experienced average to well above average rainfall during spring, this was the result of very much above average rainfall during October. November rainfall was more variable and drier than average across summer cropping regions in Queensland and New South Wales with most regions receiving between 40 and 80 per cent of the November average.

Map 1 Australian rainfall percentages, spring 2017

Note: Rainfall percentages are displayed for wheat–sheep zone only.
Spatial rainfall percentage analyses are based on historical monthly rainfall data provided by the Bureau of Meteorology. Percentages between 0 per cent and 100 per cent indicate lower than average rainfall, while percentages greater than 100 per cent indicate higher than average rainfall. The Rainfall percentage maps are generated from monthly means, calculated for each calendar month for the period 1961 to 1990.
Source: Bureau of Meteorology
Map 2 and Map 3 show the relative levels of modelled upper layer (surface to 0.1 metres) and lower layer (~0.1 to ~1 metres) soil moisture for cropping zones across Australia as at 27 November 2017. Upper layer soil moisture responds quickly to seasonal conditions and will often show a pattern that reflects rainfall and temperature events in the days leading up to the analysis date. Lower layer soil moisture is a larger, deeper store that is slower to respond to seasonal conditions and tends to reflect the accumulated effects of events that have occurred over longer periods.

Upper layer soil moisture levels as at 27 November 2017 were generally average to above average for most of the summer cropping regions in Queensland and New South Wales (Map 2). Conversely, in the south-eastern corner of Queensland upper layer soil moisture was well below average.

Map 2 Upper layer soil moisture, as at 27 November 2017

Note: Relative upper layer soil moisture is displayed for summer cropping regions only. Soil moisture estimates are relative to the long-term record and ranked in percentiles. Estimates are used to compare the upper layer soil moisture as at 27 November 2017 and are ranked according to percentiles for that same day during the entire historical record (1911–2016). The extremely high band indicates where the estimated soil moisture level for 27 November 2017 was in the wettest 10 per cent of estimated soil moisture levels for 27 November during the 1911–2016 reference period. The extremely low band indicates where the estimated soil moisture level for 27 November 2017 was in the driest 10 per cent of estimated soil moisture levels for 27 November during the 1911–2016 reference period. These data are from the Australian Water Resources Assessment Landscape model (AWRA-L version 5.0), which was developed through the Water Information Research and Development Alliance (WIRADA) initiative. WIRADA is a collaborative project between the BoM and the CSIRO.

Source: Bureau of Meteorology

Lower layer soil moisture as at 27 November 2017 was average to above average in Queensland summer cropping regions, with the exception of far south-eastern regions which continue to show extremely low levels. In New South Wales, lower layer soil moisture was more variable but
generally average in summer cropping regions, with both above and below average areas of lower layer soil moisture throughout (Map 3). Crop development in areas of above average lower layer soil moisture will be less reliant on rainfall during summer. Conversely, those areas with below average lower layer soil moisture will require timely in-crop rainfall to support crops through to harvest.

According to the three-month rainfall outlook (December to February), issued by the Bureau of Meteorology on 30 November 2017, there is no strong tendency toward either a wetter or drier than average summer in cropping regions in New South Wales and Queensland (Map 4). There is a similar outlook for maximum and minimum temperatures for summer 2017–18, where there is no strong tendencies towards cooler or hotter than average daytime temperature in cropping regions in New South Wales and Queensland.

The Bureau of Meteorology has raised its ENSO Outlook to LA NIÑA, indicating that sea surface temperatures in the tropical Pacific have reached La Niña levels. Climate models suggest this La Niña will be weak and short-lived, persisting until early autumn 2018.
While La Niña typically brings above average rainfall to eastern Australia during late spring and summer, sea surface temperature patterns in the Indian Ocean and closer to Australia are not typical of a La Niña event, reducing the likelihood of widespread above average summer rainfall. This indicates that during the next three months, climatic conditions in Australia are expected to be largely driven by localised influences such as sea surface temperatures around the Australian coastline, rather than large-scale oceanic drivers such as the El Niño–Southern Oscillation and the Indian Ocean Dipole.

Map 4 Rainfall outlook, December 2017 to February 2018

![Map showing rainfall outlook](image)

Note: Rainfall outlook is displayed for summer cropping regions only.
The map shows the likelihood of exceeding the 1981–2010 median rainfall. Median rainfall is defined as the 50th percentile calculated from the 1981–2010 reference period.
Source: Bureau of Meteorology

Map 5 shows the shire-scale forecast of grain sorghum yields obtained from the University of Queensland’s Queensland Alliance for Agriculture and Food Innovation (QAAFI). These forecasts are based on soil moisture conditions and the seasonal outlook, including the most recent trend in the Southern Oscillation Index (SOI). It is important to note that final sorghum crop yield is affected more by in-crop rainfall and temperatures during crop growth than by soil moisture at time of sowing.

At the beginning of November 2016, the forecast indicated a generally positive outlook for the 2017–18 sorghum crop. Areas in central Queensland and southern sorghum growing areas of New South Wales showed between 60 and 100 per cent chance of exceeding the median shire sorghum yield. Parts of southern Queensland and most of northern New South Wales showed between 40 and 50 per cent chance of exceeding the long-term median shire sorghum yield. However, the forecast was made early in the growing season and a wide range of possible yields exist.
Map 5 Probability of exceeding long-term median grain sorghum yield, 2017–18

Note: Probability of exceeding the long-term sorghum yield, given SOI phase was “rapidly falling” in the September to October period.
Source: Queensland Alliance for Agriculture and Food Innovation
4 Crop conditions and production by state

New South Wales

May to October rainfall was below to very much below average in most winter cropping regions in New South Wales. Many crops in the north-west cropping region had already failed by the end of winter and many crops in the central west cropping region needed favourable seasonal conditions in early spring to avert failure. However, rainfall during September was below average and temperatures above average. Additionally there were frost events in late August and early spring that adversely affected crop development in many regions. As a result of the unfavourable seasonal conditions, yields in most regions are forecast to be significantly below average.

October rainfall boosted crop prospects in the south-east cropping region and yields in this region are forecast to be close to average but this rainfall was too late to benefit crops in most other regions. November rainfall resulted in harvest delays and caused further damage to some crops. According to the rainfall outlook issued by the Bureau of Meteorology on 30 November 2017 December is likely to be wetter than average in southern NSW cropping regions. Ongoing rainfall in December is likely to adversely affect crop quality.

In 2017–18 winter crop production in New South Wales is forecast to decrease by 56 per cent to around 7.3 million tonnes, largely reflecting a fall in yields from the record high yields of 2016–17 to below average yields in 2017–18. Average yields are expected to fall because of generally unfavourable seasonal conditions during the winter crop season.

In 2017–18 area planted to summer crops in New South Wales is forecast to decrease marginally to 684,000 hectares. Total summer crop production in New South Wales is forecast to increase by 16 per cent to 2.7 million tonnes.

According to The three-month rainfall outlook (December to February), issued by the Bureau of Meteorology on 30 November 2017, there is no strong tendency toward either a wetter or drier than average summer in northern New South Wales. Given this, ABARES has assumed average rainfall over summer. If rainfall is below average, planting intentions for dry land summer crops and the forecast yields may not be realised.

Queensland

Seasonal conditions have been generally unfavourable for Queensland winter crops in 2017–18. Winter and spring rainfall was generally well below average across all major cropping regions in Queensland. Above average rainfall in October was generally too late to benefit most winter crops but some late planted crops in parts in southern Queensland did benefit. Additionally, daytime temperatures were generally well above average and some crops were adversely affected by significant frost events in August.

Harvesting of winter crops in Queensland is largely complete, with total winter crop production in 2017–18 expected to fall by 56 per cent to 1.4 million tonnes. The decline in production largely reflects a fall in yields from the record high yields of 2016–17 to below average yields in 2017–18. Early planted crops in central Queensland generally fared better than other crops, with cropping outcomes in south-west Queensland having been particularly poor. An above
average share of planted area was not harvested because of the unfavourable seasonal conditions.

Area planted to summer crops in 2017–18 is forecast to increase by 30 per cent to 770,000 hectares, driven by an increase in area planted to grain sorghum. Total summer crop production is forecast to rise by 39 per cent to 2.1 million tonnes.

Seasonal conditions over summer will be critical to realising planting intentions and forecast yields. According to the three-month climate outlook (December to February), issued by the Bureau of Meteorology on 30 November 2017, there is no strong tendency toward higher or lower than average rainfall and daytime temperatures in all summer cropping regions in Queensland.

**Victoria**

Seasonal conditions were variable in Victoria during spring after winter conditions were generally favourable. Rainfall in September was well below average for the Mallee and Central regions and reduced crop prospects. In contrast, September rainfall in the southern Wimmera and western regions was around average. Yield prospects across the state were supported during spring by high levels of soil moisture following above average rainfall in August and October.

Frost events in early November are expected to reduce yields for some Victorian winter crops, particularly pulses. Harvest is currently underway in Victoria but was delayed by rainfall events in November and December. According to the rainfall outlook issued by the Bureau of Meteorology on 30 November 2017, December is likely to be wetter than average in Victorian cropping regions.

Total winter crop production in 2017–18 is forecast to fall by 32 per cent to around 7.0 million tonnes, reflecting a fall in average yields following the exceptional yields of 2016–17. This forecast production is 13 per cent above the 10-year average to 2015–16.

**South Australia**

Spring seasonal conditions were variable in cropping regions in South Australia during spring. In southern areas including the lower Eyre Peninsula, Yorke Peninsula and the south-east, rainfall was average in September which assisted crop flowering. However, in northern areas of the Eyre Peninsula, the upper north and northern Murray Mallee regions, rainfall was well below average and daytime temperatures were above average. These unfavourable conditions reduced soil moisture levels and hampered crop development during spring in these regions. October rainfall was average in most cropping regions but there was below average rainfall in some parts of the Yorke Peninsula and the mid-north. Strong winds, hail and frost damage during October and November adversely affected crop prospects in some regions.

Harvest is underway across the state but rainfall events during November and December have slowed progress. According to the rainfall outlook issued by the Bureau of Meteorology on 30 November 2017 December is likely to be wetter than average in South Australian cropping regions in the east of the state.

In 2017–18 total winter crop production in South Australia is forecast to decrease by 45 per cent to 6.2 million tonnes, driven by large declines in yields from the high yields of 2016–17. This forecast production is 2 per cent below the 10 year average to 2015–16.
Western Australia

There was a cool mild finish to the winter crop season in Western Australia following widespread above average rainfall in August. These conditions were favourable for crop development in the vital grain fill period. Crops in the central west and southern regions are expected to achieve average to above average yields after being in generally good condition at the start of spring. The favourable finish boosted crops prospects in the northern and central east regions after these crops were generally in very poor condition at the start of spring.

Harvest is around 50 per cent complete in Western Australia despite rainfall events during November slowing harvest in many regions. The late rainfall is not expected to result in significant crop quality issues. According to The three-month rainfall outlook (December to February), issued by the Bureau of Meteorology on 30 November 2017, there is no strong tendency toward either a wetter or drier than average summer in all cropping regions in Western Australia.

In 2017–18 total winter crop production in Western Australia is forecast to decrease by 28 per cent to 12.9 million tonnes, driven by large declines in yields from the very high yields of 2016–17. This forecast production is 2 per cent above the 10 year average to 2015–16.
5 Productivity in Australia’s cropping industry

Productivity growth is an important measure of performance for Australian agriculture because in the long term it reflects changes in the efficiency with which farmers use land, labour, capital and intermediate inputs (for example, chemicals, fodder and purchased services) to produce outputs such as crops, meat, wool and milk.

Productivity growth is the key mechanism by which farmers maintain profits. Profitability improves farmers’ livelihoods and attracts investment and resources into agriculture. It also helps farmers:

- finance ongoing expenditure on farm inputs
- meet debt-servicing obligations
- fund investments in new technologies
- earn a return on their entrepreneurial ability and capital investments.

Productivity growth helps farmers offset the impact on profitability of a declining trend in farmer terms of trade (output prices relative to input prices). Improving productivity is the main way farmers can meet the challenges of uncertain seasonal conditions and other factors beyond their control.

Trends in cropping industry productivity

Between 1977–78 and 2014–15 productivity in the cropping industry grew on average by 1.5 per cent a year. This was driven by strong output growth (2.6 per cent a year) relative to input growth (1.2 per cent a year) (Figure 1; Table 1).
Jackson (2010) and Knopke, O’Donnell & Shepherd (2000) attributed strong productivity growth in the cropping industry in the 1980s and 1990s to developments in technology such as larger machinery, new plant varieties, improved water management and a better understanding of harvesting and planning strategies. Productivity growth in the cropping industry has slowed since the late 1990s (Sheng, Mullen & Zhao 2011). This has been attributed to drought, the slower spread of new technology, a slowdown in the development of breakthrough technologies, the effects of knowledge constraints, loss of a profitable break crop and a shift in research priorities away from productivity-related factors (Jackson 2010).

Output has grown strongly in the cropping industry, but input use has also increased. This is largely due to increased land and material input use. From 1977–78 to 2014–15 cropping farms have operated larger farms, with average farm sowing areas increasing nearly threefold. Use of material inputs including fertiliser, fuel, crop chemicals and seed has increased by an average of 4 per cent per year. Improved understanding of cropping systems, including plant physiology and determinants of soil fertility, has expanded use of fertiliser and crop chemicals (especially nitrogen and soil ameliorants such as lime and gypsum).

The Grains Research and Development Corporation (GRDC 2017) identifies three broad cropping regions across Australia: northern, southern and western. Between 1977–78 and 2014–15 all three regions experienced productivity growth but output and input growth varied (Table 1). Variations in climate conditions, soil fertility and operating environment across the regions contribute to differences in crop varieties and production systems. For example, climate and soil conditions in the northern region enable farmers to diversify crop production (GRDC 2017). In contrast, farmers in the western region have practised no-tillage farming extensively over the longest period (Llewellyn, D’Emden & Kuehne 2012).
Table 1 Total factor productivity, output and input growth, cropping industry, by GRDC region, Australia, 1977–78 to 2014–15

<table>
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<tr>
<th>Region</th>
<th>Total Factor productivity (%)</th>
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<th>Input (%)</th>
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GRDC Grains Research and Development Corporation.
Source: ABARES Australian Agricultural and Grazing Industries Survey

Effect of climate on cropping-farm productivity

ABARES productivity estimates are subject to significant climate effects, including large decreases in drought years. This can make it difficult to discern underlying trends in farm performance—both in the short term due to annual climate variability and in the longer term due to climate change. Over the 20 years to 2013, the CSIRO and Bureau of Meteorology have observed marked changes in Australia’s climate, including reductions in average winter rainfall in southern Australia and general increases in temperature (CSIRO & BoM 2014). Evidence suggests these trends are partly due to climate change (CSIRO 2012; CSIRO & BoM 2016). A 2017 ABARES study (Hughes, Lawson & Valle 2017) quantifies the effects of climate on the productivity of Australian cropping farms from 1977–78 to 2014–15. It also presents climate-adjusted productivity estimates for cropping farm performance after removal of climate effects.

The climate-adjusted figures suggest that productivity grew strongly during the 1980s and early 1990s but slowed considerably from around 1993–94 (Figure 2). However, evidence suggests that productivity growth of cropping farms has been rising since 2006–07 at 1.7 per cent per year. Around 85 per cent of total productivity gains since 1977–78 occurred from 1987–88 to 1993–94 and from 2007–08 to 2013–14.
In the two decades to 2014–15, climate conditions deteriorated across many grain-growing regions. Map 6 shows the average effect of climate on productivity levels from 2000–01 to 2014–15 (relative to long-term average conditions). From 2000–01 to 2014–15 southern New South Wales and northern parts of the western GRDC region were significantly affected by adverse climate conditions, due largely to declines in average winter rainfall. However, from 2000–01 onward some regions also experienced slight improvements, including the high-rainfall zones of southern Australia and parts of coastal northern New South Wales and southern Queensland. The results show that farms have become less sensitive to adverse climate shocks over the decade to 2014–15. This suggests that cropping farms are adapting to the longer-term changes in climate by focusing on technologies that improve productivity in dry years. Anecdotal evidence suggests that farmers have adopted a variety of management practices, including conservation tillage, to exploit summer soil moisture in anticipation of reduced winter rainfall.
Map 6 Average climate effect on productivity levels, cropping farms, Australia, 2000–01 to 2014–15

Note: Climate effect is relative to the period 1914–15 to 2014–15.
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