Responding to change: Irrigation in the Murray–Darling Basin 2006–07 to 2010–11

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The Murray–Darling Basin is an important agricultural region in Australia that supports a large irrigation sector. In 2009–10 the basin accounted for almost 40 per cent of Australia’s gross value of irrigated agricultural production. Irrigated agriculture has faced many challenges over the past decade, including severe and prolonged drought, reduced water availability, fluctuations in commodity prices and ongoing reform of government water policies.

The responses of individual farmers to their changing circumstances have implications for the wellbeing of farming families, regional communities, and regional, state and national economic growth.

Since 2007 ABARES has been surveying irrigated horticulture, dairy and broadacre farms throughout the Murray–Darling Basin to monitor the changes occurring in irrigation industries. The surveys, funded by the Australian Government Department of Sustainability, Environment, Water, Population and Communities and the National Water Commission, provide data that allow for a better understanding of the economic characteristics of irrigation industries at a farm level. The results derived from the ABARES survey of irrigation farms covering the 2006–07 to 2010–11 financial years are used to examine the ways in which irrigators have responded to changes in their operating environment.

This report presents the results of detailed analysis of adjustments made by irrigators in the Murray–Darling Basin, including farm financial performance, water trading, water use and irrigation technologies.

The report is the latest in a series by ABARES on irrigation in the Murray–Darling Basin that provides policymakers, irrigation communities and resource managers with an integrated physical, financial and socioeconomic dataset for monitoring, evaluating and reporting changes in the irrigation sector.

Kim Ritman
Acting Executive Director
June 2012
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Irrigation industries in Australia have faced a range of changes in their operating environment in recent decades. Following rapid expansion in irrigated production in the 1980s and 1990s, the first decade of the twenty-first century featured prolonged drought and significantly reduced inflows to river systems in the Murray–Darling Basin. Stressed river and groundwater systems, combined with the prospect of longer term adverse climate change impacts, heightened realisation that water resources in the basin were becoming increasingly scarce and degraded. In response, the Australian Government introduced a range of policy and program initiatives that have reshaped the landscape for irrigators and other water users. Among the reforms are better developed water markets, changes to pricing for water storage and delivery, funding for more efficient irrigation infrastructure, government purchases of permanent water entitlements and commitment to a plan to better manage water in the Murray–Darling Basin.

At the same time, irrigators’ incomes have been affected by other factors, such as fluctuations in commodity prices and the cost of farm inputs, historically low irrigation water allocations and, more recently, widespread flooding in some areas.

Irrigators’ management decisions and farm business outcomes are influenced by a range of interrelated factors, as well as the factors driving longer term change in agricultural industries more generally. Past investment decisions, the fixed nature of many farm assets, and the length of time for a return on new investments mean that some changes in irrigation industries can be quite slow.

This report presents the results of detailed analysis of ways in which irrigators have responded to changes in their operating environment. The analysis uses data collected in the ABARES irrigation surveys from 2006–07 to 2010–11.

**Farm financial performance**

Overall, the survey results showed considerable variability in financial returns across the Murray–Darling Basin with no industries or regions significantly having better or worse financial results than the others.

Nevertheless, some irrigators reported low farm incomes and low farm business equity ratios in each year. These farms are likely to face the greatest short-term...
financial pressures, including debt servicing difficulties. This group included large and small farms across all industries and regions.

For irrigated broadacre farms, average farm cash income fell in 2008–09 and 2009–10 before rising sharply in 2010–11. Improved seasonal conditions, greater water availability and higher commodity prices (particularly for cotton) were key drivers of the increase in incomes in 2010–11.

Average farm cash income for horticulture farms declined over the survey period, mainly as a result of lower incomes for wine grape growers. For other horticulture producers (vegetable, citrus, stone fruit and pome fruit growers) there was no obvious trend in farm incomes over the period, with fluctuations in incomes largely reflecting annual changes in irrigated agricultural production, commodity prices, and farm cash costs.

Incomes for dairy farms varied over the survey period, largely reflecting changes in farmgate milk prices and expenditure on farm inputs, particularly fodder.

Most irrigation farms in the Murray–Darling Basin reported having some form of off-farm income to supplement their farm income. Around one-third of farms obtained more than half of their total family income from off-farm sources. Irrigators with smaller farm areas tended to be more reliant on off-farm income than irrigators operating larger farms.

**Farm enterprise mix**

Adjustments in farm enterprise mix are an important way for irrigators to manage changes in their business operating environment. In the short term, changes can be made to crop areas, stocking rates and inputs used, such as water and fertiliser. Longer term changes can involve more permanent shifts, such as planting or removing grapevines or fruit trees.

Horticulture farms tend to have a broader range of farm enterprises than either dairy or broadacre farms. However, as most horticulture farms (apart from vegetable growers) have permanent plantings of tree and vine crops, there tends to be little change in crop areas or the mix of enterprises on these farms from year to year.

While broadacre farms were less diversified than horticulture farms, the survey results suggest broadacre farms have greater scope to respond in the short term (in terms of enterprise mix) to changes in the farm operating environment. For example, as water allocations declined, cotton growers reduced irrigated cotton areas and planted predominantly dryland crops, such as grain sorghum. With improved water availability from 2009–10 onwards, and with higher cotton prices, these irrigators returned to growing mainly cotton crops. By comparison, rice growers tended to respond to lower water allocations by planting dryland crops (mainly wheat) and/or running livestock on irrigated pasture.

Dairy farms tend to be predominantly single enterprise operations based on milk production. Rather than changing enterprises in response to lower water allocations, many dairy farmers tended to reduce herd size or in some instances cease farming altogether. As a consequence, there was a reduction in both the number of dairy farms in the Murray–Darling Basin and the average size of dairy herds.

**Investment**

The survey results highlight differences in on-farm investment in irrigation infrastructure among the three industries. For most irrigation farms, land and water
entitlements accounted for most of existing total farm capital. Some irrigators made net additions (that is, additions were greater than disposals) to farm capital in each year from 2006–07 to 2010–11. However, for most farms, increased water entitlement sales outweighed new farm investments, particularly in 2009–10 and 2010–11.

Average farm business debt rose across the Murray–Darling Basin in each survey year. Many farms increased short-term working capital debt to fund purchases of water allocations, fodder or other running costs. The survey results suggest that the financial position of irrigators deteriorated between 2006–07 and 2010–11 because of higher interest payments associated with increases in debt.

The survey results also suggest that many irrigators used at least part of the proceeds from capital disposals to reduce farm business debt. For example, irrigators selling water entitlements to the Australian Government recorded lower average debt in 2009–10, while those not selling entitlements recorded higher average debt.

On average, farm business equity remained steady for irrigation farms, with increases in the value of land and water entitlements largely offsetting increases in average farm business debt.

**Water trading**

The expansion of water trading has been a key result of water policy reform in Australia, with various government initiatives and policies contributing to the development and growth of markets for both permanent water access entitlements and temporary water allocations.

Water markets have become most developed in the southern basin, which has more irrigators and more connected river systems than the northern basin. Water trading markets have also developed in the northern regions of the basin, although their use is less widespread than in the south.

Water trading provided irrigators with an important tool for managing low water allocations during severe drought between 2006–07 and 2008–09. Water trading allowed irrigators to adjust flexibly to changing water availability and provided an alternative source of income for many irrigators.

The industry composition of buyers and sellers tended to change over time, partly depending on the availability and price of water. As water availability declined and prices rose, horticulture farms tended to account for a large proportion of the farms that were net buyers of allocation water, whereas net sellers were predominantly irrigated broadacre or dairy farms.

As seasonal conditions improved and water allocations increased in 2009–10 and 2010–11, the proportion of irrigators participating in water allocation trading declined. However, there was an increase in total water volume traded in aggregate and on a per farm basis as cotton and rice growers responded to increasing water availability and resultant lower prices by purchasing larger volumes of water. The group of non-traders tended to include a mix of dairy, broadacre and horticulture farms in each year.

The effect of water allocation trading on irrigators’ farm financial performance varied according to whether the irrigator was a net buyer or net seller of water allocations. The effect for net sellers is an increase in farm cash receipts from the sale of water allocations. The increase in receipts is likely to be offset by some reduction in receipts from irrigated agricultural production for these farms where water allocation sales correspond with reduced areas of irrigated crops or pasture. The effect for net buyers
includes additional production and receipts from crop or livestock sales that would otherwise not have been generated, which will be offset to a degree by additional costs from purchasing water allocations.

The market for permanent water access entitlements has also provided irrigators with an important tool for managing their farm businesses. However, decisions on whether to buy or sell permanent entitlements are generally based on longer term considerations than for trading water allocations. As a consequence, there have been fewer trades in entitlements than in water allocations.

While some irrigators sold entitlements and ceased irrigation or farming altogether, the survey results suggest that other irrigators used the proceeds from entitlement sales to reduce debt and continue farming. Some of those that continued farming remained irrigators by purchasing water allocations or entitlements. However, the survey results do not provide a complete picture because those that left farming altogether are not included in the survey.

Water use, technology and productivity

New irrigation technologies and management practices have helped irrigators adapt their farms in response to changes in markets, seasonal conditions and government policies. Such responses have varied across farms, depending on factors such as enterprise type, region, availability of irrigation water, and seasonal variations in rainfall or farm incomes.

Across the Murray–Darling Basin, flood/furrow systems were the most commonly used technologies for applying water on both dairy and broadacre farms. Much smaller proportions of farms in these two groups made use of travelling irrigators and moveable spray lines.

With much smaller average areas irrigated, horticulture farms tended to use a wide variety of irrigation systems with drip/trickle and low-throw fixed sprinklers being the most common.

Farms using flood/furrow systems applied the highest average volume of water per farm, while farms in the micro-systems group applied the lowest. Farms with fixed sprinkler and moveable systems applied similar total volumes of water.

Water use and application rates declined for most commodities and irrigation systems between 2006–07 and 2008–09 as irrigators modified their irrigation practices to accommodate reduced water allocations. An improvement in water availability in 2009–10 resulted in increased average water use per farm and water application rates per hectare.

Farms using fixed sprinklers and micro-systems tended to record higher average farm business profits and rates of return on capital than farms using other systems. Similarly, the relatively high receipts per megalitre of water applied for the fixed sprinkler and micro-systems group reflected the high returns recorded by horticulture producers.

The survey results also suggest the productivity of irrigated farms in the Murray–Darling Basin rose on average from 2006–07 to 2009–10. Average total factor productivity was highest for horticulture farms and lowest for irrigated broadacre farms, although broadacre farms had the highest annual average rate of growth in total factor productivity over the period. However, because of the short time series, these results should be used with caution as productivity growth is best measured over the longer term to smooth out annual variability due to factors such as year-to-year changes in seasonal conditions.
Irrigators in the Murray–Darling Basin have faced a range of challenges in their operating environment over the past decade. In particular, prolonged drought in south-eastern Australia significantly reduced inflows to many river systems between 2006 and 2010 and resulted in historically low allocations of water to irrigators. More recently, irrigators in some regions experienced widespread flooding in 2011 and 2012. Irrigators’ incomes were affected not only by the impacts on production of severe reductions in water availability, but also fluctuations in commodity prices and the cost of farm inputs.

Despite recent improved seasonal conditions, the long-term outlook for water in the Murray–Darling Basin is likely to be one of increasing competition for scarce water resources from agricultural, urban, industrial and environmental uses. Managing uncertainty in water availability in the short and long term has been a key challenge for irrigators. The ways in which irrigators respond to these challenges have implications for individual farms, regional communities, and regional, state and national economic growth.

Over time, the Australian Government has initiated policies and programs that have changed the operating environment for irrigators and other water users. Significant recent initiatives include the National Water Initiative, the Water Act 2007, the Water for the Future program, and on-going development of a plan for the Murray–Darling Basin.

Since 2007 ABARES has conducted annual surveys of irrigation farms throughout the Murray–Darling Basin to provide industry stakeholders and governments with comprehensive economic profiles for irrigation industries. The surveys have collected financial and physical data from irrigation farms in selected regions and industries in the basin. The most recent survey, covering the 2009–10 and 2010–11 financial years, was funded by the National Water Commission and the Australian Government Department of Sustainability, Environment, Water, Population and Communities.

As well as ‘point in time’ references, the survey results provide a baseline for monitoring trends in industry performance. The results provide an integrated dataset that has been used to research issues affecting irrigation industries, including water trading, pressures for structural adjustment, on-farm investment in irrigation infrastructure and changes in farm productivity and technology use.
Introduction

This report presents the results of detailed analysis of ways in which irrigators have responded to changes in their operating environment. The analysis uses data collected in the ABARES irrigation surveys from 2006–07 to 2010–11.

Chapter 2 outlines key changes since the National Water Initiative was agreed in 2004, including developments in government water policies and programs, commodity prices and water availability. Chapter 3 presents recent farm financial performance estimates, including changes in farm enterprise mix and off-farm income. Chapter 4 examines changes in farm capital investments, debt and equity. An analysis of farm level water trading is provided in Chapter 5, including participation in water trading, characteristics of traders and non-traders and profiles of irrigators selling water entitlements to the Australian Government. Chapter 6 presents changes in water use, irrigation technology and farm productivity and Chapter 7 provides a case study analysis of broadacre farms in the Murrumbidgee region and dairy farms in the Goulburn–Broken region.
Change in agricultural industries is ongoing, driven by factors including movements in commodity prices, input costs, climatic conditions, farmers’ terms of trade and farm productivity. Issues specific to the irrigation sector have also been driving changes on irrigation farms for over a decade. Issues include changes in the water policy framework, increased water scarcity caused by lower inflows to river systems, and increased competing demands for scarce water resources.

The influence of the main drivers of change is likely to differ between regions according to the size and financial performance of farms, type of commodities irrigated, age and type of irrigation infrastructure (both on and off-farm) and proximity of alternative employment.

Water policy and programs

Stressed river and ground water systems, prolonged drought and the adverse effects of climate change have heightened realisation that water resources are becoming increasingly scarce and degraded. Past and likely future stresses on the water resources of the Murray–Darling Basin emphasise the need to adapt to a future with less water.

While objectives of water reform initiatives vary, they all aim for sustainable and efficient use of water over the longer term. The National Water Initiative sets out objectives, outcomes and agreed commitments by governments to improve the management of Australia’s water resources. Under the initiative, the Australian and state governments agreed to:

- prepare water plans with provision for the environment
- deal with over-allocated or stressed water systems
- introduce registers of water rights and standards for water accounting
- expand trade in water
- improve pricing for water storage and delivery
- meet and manage urban water demands (NWC 2012).

In 2007, with inflows to many river systems at record lows and the prospect of longer-term reductions in inflows due to climate change, the Australian Government
Drivers of change

announced the National Plan for Water Security to improve water efficiency and address over-allocation of water in rural Australia (Howard 2007). With a focus on the Murray–Darling Basin, priority investments were for modernising irrigation infrastructure, with funds also provided to aid adjustment in the irrigation sector and the purchase of water entitlements. The plan depended on basin states/territories transferring their relevant water management powers to the Australian Government. A strategic basin plan, including a revised cap on diversions, was also proposed.

The Water Act 2007 gave effect to key elements of the National Plan for Water Security (SSCEAC 2010; Turnbull 2007). Among the Act’s provisions was establishment of a single, independent agency, the Murray–Darling Basin Authority, to manage water resources across the basin (MDBA 2009). The authority has to develop a basin plan.

Introduced in 2008, the Water for the Future program aims to better balance the water needs of communities, farmers and the environment (DSEWPAC 2010; Wong 2008). The program includes funding for Australian Government purchases of water entitlements and projects to improve water efficiency on farms and in irrigation delivery systems.

Research and assessments conducted on aspects of water reform under the National Water Initiative include studies on water trade and investigating the impact of policies that encourage efficient use of water (NWC 2011a; 2011b; 2011e; 2010b). This research indicates that policy reform during the past decade, such as the progressive removal of barriers to water trade and the rationalisation of water property rights, has helped improve the efficiency and productivity of Australian water use. However, some barriers to trade could be slowing the process of adjustment and limiting potential gains. Further reform of water property rights could also increase the efficiency of water use, particularly controls over intertemporal water use and storage (Hughes and Goesch 2009).

Seasonal conditions and water availability

Prevailing seasonal conditions and water availability are important determinants of irrigators’ farm performance. Seasonal conditions vary across the Murray–Darling Basin, within and between years. Irrigation seasons from 2006–07 to 2008–09 were among the driest on record for the basin as a whole.

Seasonal conditions generally improved across the basin in 2009–10, particularly in the southern parts during the second half of the financial year. Despite the improvement in seasonal conditions, dam levels and irrigation water allocations remained low in most regions at the beginning of 2010–11. Seasonal conditions continued improving throughout 2010–11, particularly in the first six months of the year when rainfall throughout the entire basin was very much above average to the highest on record, with some parts experiencing widespread flooding (BoM 2012).

While rainfall is an important part of the availability of water for irrigation, use of water storages allows temporal shifts between rainfall events and water use. For example, while inflows were low across the basin in 2006–07, there was a less than proportional decline in the volume of water used for irrigation as storages were drawn down (Figure 1). Although inflows to storages were much higher the following year, allocations to irrigators remained low as the volume of water held in storages was replenished.
Drivers of change

Water trading

Water trading is the business of buying and selling either permanent water access entitlements or water allocations. Water trading among irrigators in Australia has expanded considerably in the past decade, partly because of institutional reforms implemented under the National Water Initiative.

Water markets are most developed in the southern Murray–Darling Basin, which has significantly more irrigators and hydrologically linked river systems than the northern basin. Water markets have also developed in the northern regions of the basin, although the volumes traded and number of irrigators trading is less than in the south. In the southern Murray–Darling Basin, the volume of water allocations traded was greater than the volume of entitlements traded in most years from 2006–07 to 2010–11 (Figure 2). The reverse was the case in the northern basin.

Note: Annual inflow estimates are based on hydrologic modelling for the basin and are therefore only indicative of actual inflows. Inflows data are not available for 2009–10. Water storage does not include on-farm water storage. Sources: Murray–Darling Basin Authority 2011 (unpublished data); Murray–Darling Basin Commission 2008

FIGURE 1 Inflows, irrigation diversions and water storage, Murray–Darling Basin, 2000–01 to 2009–10

Note: Data not available for northern basin for 2006–07.
Source: National Water Commission 2011a

Drivers of change

Water markets provide opportunities for water to be reallocated between competing uses, while an effective market for water gives entitlement holders flexibility to respond to changes in their operating environment. Water purchases will be driven by irrigators who are able to produce agricultural outputs for which the benefits of using additional water outweigh the market costs of acquiring that water. Conversely, water will be made available for sale by irrigators for whom the benefits of using additional water are outweighed by the water market price; these irrigators will find it more profitable to sell water and reduce farm production in dry times.

Increased water scarcity and strong competing demands resulted in increased market prices of water allocations from 2006–07 to 2008–09. Low allocations, depleted water storages and prospects of continued low inflows resulted in a peak in market prices for water allocations early in 2007–08; prices then eased slightly as allocations improved. Prices for water allocations were substantially lower in 2009–10 and 2010–11 as a result of higher rainfall and increased allocations in many regions (NWC 2011a). Reflecting the long-term nature of permanent water access entitlements, prices for entitlement trades remained relatively stable from 2006–07 to 2010–11 (NWC 2011a).

Commodity prices

Irrigators produce many irrigated agricultural products and prices received for those products can vary widely from year to year. For irrigated broadacre farms, cotton prices increased by 16 per cent between 2006–07 and 2009–10 as world demand for cotton improved, before rising sharply in 2010–11 (Figure 3). Rice prices rose in 2007–08 and 2008–09 as supplies contracted, before declining in the latter two years. Wheat prices rose sharply in 2007–08 and declined in 2008–09 and 2009–10. Lower world supplies led to an increase in wheat prices in 2010–11.

For irrigated dairy farms, farmgate milk prices fluctuated over the survey period, largely reflecting changes in world supply and demand of dairy products. For irrigated horticulture farms, fruit and vegetable prices fell in 2009–10 before improving in 2010–11. Prices for wine grapes fell over most of the survey period, particularly in 2008–09 when prices fell by around 33 per cent. Although wine grape prices rose by around 5 per cent in 2010–11, the indicator price for wine grapes was only around half of the 2006–07 price.
Price indexes for selected commodities

Wheat
Sorghum
Cotton
Wine grapes
Milk
Vegetables
Rice

2006–07
2007–08
2008–09
2009–10
2010–11

Index
2006–07
2007–08
2008–09
2009–10
2010–11

ABARES preliminary estimate.
ABARES provisional estimate.

Note: ABARES estimates.
Terms of trade and productivity growth

A measure of the business operating environment for farmers is the terms of trade, which is the ratio of prices received by farmers to prices paid for farm inputs. For Australian farms, including both irrigated and dryland farms, prices paid for farm inputs have been increasing over time at a faster rate than the prices received for farm outputs—resulting in declining farm terms of trade (Figure 4). Over the longer term, farm prices have fallen in real terms as global production of agricultural commodities grew faster than global demand.

Changes in terms of trade for individual sectors are more difficult to demonstrate. While farm costs overall tend to rise relatively uniformly, unit prices received for individual commodities vary considerably over time.

Productivity growth on Australian farms over the last 30 years has broadly offset the ongoing decline in farm terms of trade. Productivity growth is achieved through using fewer inputs to produce the same output, or alternatively, generating more output from the same input use (Nossal & Gooday 2009). However, productivity growth has not been equally distributed across and within all industry groups. Irrigation farm productivity is discussed further in Chapter 6.
The concept of adjustment encompasses the many ways farmers respond to changes in their operating environment, which is reflected in more permanent changes in the pattern of production and use of resources by farmers. Past investment decisions, the fixed nature of many farm assets, and the length of time for a return on new investments mean that some changes in irrigation industries can be quite slow. Other changes, however, are quicker because they can be undertaken in the short term and will vary from year to year.

An irrigator seeking to maximise profits allocates a wide range of inputs such as land, water and fertiliser to that combination of farm enterprises expected to generate the highest net profit, where profits are defined as the excess of revenue from commodities sold, minus the total cost of inputs used. Farm businesses continually adjust their input and production decisions in the short term in response to changing environmental and economic conditions, including changes in prices for farm inputs and commodities, and the availability and cost of irrigation water (Box 1).

In contrast, on-farm irrigation infrastructure and assets, such as irrigation systems and trees/vines, have relatively long life cycles with little or no salvage value. For these assets, an irrigator’s response to economic signals will depend on factors such as the age of existing assets and the remaining cash flow of those assets in use, versus the cost and expected flow of returns from new assets. Such decisions will also be affected by an individual’s current financial situation.

In this context, a detailed analysis of changes in irrigation farm financial performance, the role of off-farm income and changes in farm enterprise mix over the period 2006–07 to 2010–11 is provided in this chapter. Changes in farm investment, water trading and the use of irrigation technologies—all of which are important for farm adjustment—are examined in subsequent chapters of this report. Decisions to cease irrigating or exit farming altogether are also an important part of adjustment options for some farmers. However, these are not discussed further in this report because the ABARES survey does not include those irrigators that have left farming.
Recent trends

Number of irrigators

Generally, there has been a long-term trend in Australia of declining numbers of farms but increasing average farm areas operated. Although there are no data available on long-term trends in the number of irrigators in the Murray–Darling Basin, it is likely that there has been a similar overall trend of fewer and larger irrigation farms (Box 2). Largely, these trends have been driven by adjustment pressures, such as the long-term decline in farmers’ terms of trade.

In 2009–10, around 15 100 agricultural business in the basin used water for irrigation, about 20 per cent fewer than in 2005–06 (ABS 2011a). Low or no water allocations in many regions at that time may explain reductions in usage. Some farms that stopped irrigating because of a lack of water have sold part or all their water allocations or entitlements.

Box 1 Resource allocation considerations

Price of water: As with any farm input, the price of water will influence the volume of water used by irrigators. Irrigators’ demand for water tends to be much less responsive to changes in water prices or charges in the short term than in the longer term.

Water allocations: In most surface water regulated systems, irrigators must have a license that entitles them to a nominal allocation of water. The allocation irrigators actually receive is subject to the total available supply of water held in storage and expected inflows over the irrigation season. If the volume of water held in storages is low, as has happened in many areas over the past decade, then allocations to irrigators will be correspondingly low.

Ability to trade water: Water trading is selling/buying either water entitlements and/or seasonal water allocations. Generally, irrigators purchase water when the benefit of applying that water to crops and pastures outweighs the water acquisition cost. Conversely, water will be sold by irrigators when the return from water sales is greater than the return from on-farm use.

Availability of substitute inputs: Irrigators often have no substitute for irrigation water other than rainfall. However, livestock producers may substitute purchased fodder for irrigated pasture or fodder crops, depending on the availability of water and the relative cost of water and purchased fodder.

Type of farm enterprise: Reliance on irrigation water varies between enterprises. Rice and many horticultural crops rely entirely on the availability of irrigation water. Grains, oilseeds, pasture and cotton use irrigation water when available, but with adequate rainfall can also be grown under dryland conditions. Farm enterprises with similar production requirements, such as soils and irrigation infrastructure, will be closer substitutes than enterprises with dissimilar needs. For example, a broadacre farmer may substitute rice for wheat, depending on seasonal and market conditions, but would be less likely to shift into a horticultural crop in the short term. The type of farm enterprise will also influence short and long-term decisions. For example, irrigators have an incentive to protect perennial tree and vine crops in the short term because such crops provide an income stream in future years. Decisions to plant annual crops, such as cotton or rice, will be made from year to year.

continued...
Box 1 Resource allocation considerations  

Commodity and input prices: Current and expected future prices for commodities and farm inputs are important determinants of which commodities are produced and in what quantities. Irrigators are primarily price takers in commodity markets (that is, no single irrigator can affect market prices); therefore, irrigators typically respond to changing commodity and input prices through changes to the quantity produced, switching to more profitable enterprises, and/or looking for greater efficiencies.

Box 2 Defining and identifying irrigation farms

The Australian Bureau of Statistics identifies irrigators as farms that use irrigation water during a financial year. However, during times of low water allocations such a definition tends to underestimate the number of farms that would otherwise normally be irrigators.

In the ABARES survey of Murray–Darling Basin irrigation farms, a farm is defined as an eligible irrigator if it held a permanent water access entitlement and/or used water for irrigation during the financial year. The survey includes farmers with permanent water access entitlements who did not use water during the survey year because of, for example, low water allocations.

Refer to the Appendix for further explanation of survey methods and industry definitions.

Gross value of irrigated agricultural production

The gross value of irrigated agricultural production (GVIAP) is commonly used to indicate the contribution of an agricultural activity to the economy. When expressed in 2009–10 dollars, total GVIAP for the basin declined by around 14 per cent between 2000–01 and 2009–10 (Figure 5).

FIGURE 5 Gross value of irrigated agricultural production, Murray–Darling Basin, 2000–01 to 2009–10

Note: ABARES estimate. Data are not available for 2001–02 to 2004–05.
Source: Australian Bureau of Statistics 2011b, 2010
Trends in GVIAP for many major commodities reflected the downward trend in total GVIAP for the basin (Figure 6). Between 2000–01 and 2009–10, the gross value of irrigated cotton production fell from about $1.4 billion to $0.6 billion (in 2009–10 dollars). The gross value of irrigated wine grapes, dairy production and rice also fell in most years.

In contrast, the gross value of irrigated fruit and nut production rose by around 22 per cent, from $903 million in 2000–01 to about $1.1 billion in 2009–10.

While estimates of GVIAP provide important information about irrigated activity in a region or industry, this measure has limitations. For example, GVIAP cannot be used to compare the net benefits from using irrigation water for alternative uses, such as producing rice or vegetables. In this case, the relevant measure is the net benefit (revenue less all costs) of using an additional megalitre of irrigation water for an alternative use.

**Figure 6** Gross value of irrigated agricultural production, by commodity, Murray–Darling Basin, 2000–01 to 2009–10

Recent farm performance

At a basin scale, farm financial performance (based on the measures in Box 3), for irrigated broadacre and dairy farms is estimated to have improved between 2009–10 and 2010–11. However, irrigated horticulture farms recorded a decline in financial performance. In terms of farm cash income, irrigated broadacre farms recorded the largest increase in absolute and percentage terms (Figure 7; Table 1).
Box 3 Key financial performance measures

Farm cash income: Total cash receipts less total cash costs. Total cash receipts are defined as revenues received by the farm business during the financial year, and total cash costs as payments made by the farm business for materials and services and for permanent and casual hired labour, excluding owner-manager, partner and family labour. Farm cash income is the surplus farm-based income available after paying for cash operating costs.

Farm business profit: Refines farm cash income by adding changes in trading stocks and deducting depreciation and an imputed value of family labour. Farm business losses do not necessarily mean negative cash flows. In practice, positive cash flows can be maintained by reducing expenditure on capital asset replacement and forgoing wages for family labour.

Rate of return: Farm business profit with interest, lease and rent payments added (adjusted to full equity basis), expressed as a percentage of total farm capital. Rate of return represents the ability of the farm business to generate a return to all capital used by the business, including that which is borrowed or leased.

FIGURE 7 Average farm cash income, by industry, 2006–07 to 2010–11

p ABARES preliminary estimate, y ABARES provisional estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin
Horticulture in 2009–10 total cash receipts for irrigated horticulture farms in the Murray–Darling Basin rose by around 3 per cent, with increased receipts for tree and vine crops, livestock and off-farm contracts. Total cash costs rose by around 10 per cent in 2009–10, largely because increased expenditure on hired labour, packing materials, crop and pasture chemicals, fuel, and interest payments were partly offset by reduced expenditure on temporary water allocations, fertiliser and freight. Consequently, average farm cash income for irrigated horticulture farms fell by around 23 per cent to $44 602, while an average farm business loss of $20 885 was recorded in 2009–10.

In 2010–11 total cash receipts declined by around 5 per cent, with lower receipts from tree and vine crops. Total cash costs rose by less than 1 per cent in 2010–11, with increases in expenditure on hired labour, chemicals, freight and interest payments being offset by reduced expenditure on temporary water allocations, and repairs and maintenance. Overall, average farm cash income for irrigated horticulture farms fell to $31 171 in 2010–11, with an average farm business loss of $36 348.

In line with declines in farm cash income and farm business profit, the average rate of return (excluding capital appreciation) for irrigated horticulture farms in the Murray–Darling Basin was estimated to have declined to –0.2 per cent in 2010–11, compared with an average of 0.3 per cent in 2009–10. The best performing regions for irrigated horticulture farms in 2010–11, by rate of return, were the Condamine–Balonne and Murray regions (Figure 8). The remaining regions surveyed all recorded negative average rates of return in 2010–11.

While these estimates for 2009–10 and 2010–11 show a decline in financial performance for irrigated horticulture farms as a whole, there was considerable variation across different regions.
FIGURE 8 Rate of return, irrigated horticulture farms, by region, Murray–Darling Basin, 2000–01 to 2010–11 (average per farm)

- Condamine–Balonne
- Border Rivers
- Macquarie–Castlereagh
- Lachlan
- Murrumbidgee
- Murray
- Goulburn–Broken
- Loddon–Avoca
- Eastern Mount Lofty Ranges

Note: Rate of return excluding capital appreciation.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin

p ABARES preliminary estimate. y ABARES provisional estimate.
variation across farms in all regions. For example, around 37 per cent of irrigated horticulture farms recorded a positive rate of return in 2010–11.

**Broadacre farms**

In 2009–10 total cash receipts for irrigated broadacre farms in the Murray–Darling Basin declined by around 6 per cent, with lower receipts from broadacre crops, particularly cotton, being partly offset by increased receipts for livestock, wool and sales of temporary water allocations. By comparison, total cash costs were largely unchanged with a decline of less than 1 per cent in 2009–10.

Overall in 2009–10 average farm cash income for irrigated broadacre farms in the Murray–Darling Basin fell to $55 406 a farm in 2009–10, with an average farm business loss recorded of $44 659 a farm.

In 2010–11 total cash receipts increased by around 33 per cent, with higher receipts for cotton and grain sorghum. Reflecting an increase in the area cropped, total cash costs rose by around 10 per cent in 2010–11, with increases in expenditure on fertiliser, crop and pasture chemicals, fuel, freight, cropping contracts and interest payments. Consequently, farm cash income for irrigated broadacre farms rose sharply in 2010–11, to average around $176 275 a farm, with an average farm business profit of around $74 532.

Reflecting the changes recorded in farm cash income and farm business profit, the average rate of return (excluding capital appreciation) for irrigated broadacre farms in the Murray–Darling Basin rose to average 3.2 per cent in 2010–11, compared with an average of 0.6 per cent in 2009–10.

All regions recorded positive rates of return in 2010–11 (Figure 9), however, there was wide variation in results among individual farms. An estimated 58 per cent of irrigated broadacre farms recorded a positive rate of return (excluding capital appreciation) in 2010–11.

**Dairy farms**

In 2009–10 total cash receipts for irrigated dairy farms in the Murray–Darling Basin declined by around 9 per cent, with lower milk receipts reflecting a decline in farmgate milk prices and lower milk production per farm. Total cash costs fell further by around 18 per cent in 2009–10, as dairy farmers reduced expenditure on fodder and, to a lesser extent, hired labour. Farm cash income for irrigated dairy farms in the Murray–Darling Basin therefore improved substantially to average around $42 044 a farm in 2009–10. Irrigated dairy farms recorded an average farm business loss of $37 215 a farm in 2009–10.

In 2010–11 total cash receipts increased by around 13 per cent, mainly because of higher farmgate milk prices. Total cash costs rose by around 4 per cent in 2010–11, with increases in expenditure on hired labour, freight and interest payments being partly offset by reduced expenditure on fodder and water allocation purchases. Average farm cash income for irrigated dairy farms increased to around $66 500 in 2010–11, with an average farm business loss of around $15 000.

In line with recorded changes in farm cash income and farm business profit, the average rate of return (excluding capital appreciation) for irrigated dairy farms in the basin increased to around 1.1 per cent in 2010–11, compared with an average of −0.1 per cent in 2009–10. The best performing regions in 2010–11, by rate of return, were the Condamine–Balonne, Murray and Eastern Mount Lofty Ranges (Figure 10).
FIGURE 9 Rate of return, irrigated broadacre farms, by region, Murray–Darling Basin, 2000–01 to 2010–11 (average per farm)

p ABARES preliminary estimate
y ABARES provisional estimate.

Note: Rate of return excluding capital appreciation.

Source: ABARES survey of irrigation farms in the Murray–Darling Basin
The remaining regions with irrigated dairy farms, Goulburn–Broken and Loddon–Avoca, recorded negative average rates of return in 2010–11.

While results in Figure 10 suggest relatively low rates of return for irrigated dairy farms in 2009–10 and 2010–11, financial performance varied across farms in all regions. Around 35 per cent of irrigated dairy farms recorded a positive rate of return in 2010–11.

**FIGURE 10 Rate of return, irrigated dairy farms, by region, Murray–Darling Basin, 2000–01 to 2010–11 (average per farm)**

Adjustment on irrigation farms

The mix of enterprises among irrigation farms across the Murray–Darling Basin varies according to physical factors such as climate, topography, soil type and type of irrigation infrastructure. From year to year, the mix of farm enterprises changes in response to factors such as commodity prices, the cost of farm inputs, seasonal conditions and water availability.

For the following analysis, individual enterprises were defined as: citrus, pome fruit (apples and pears), stone fruit (including peaches, apricots and cherries), wine grapes, vegetables, beef cattle, dairy cattle, sheep, rice, cotton and cereal crops (such as wheat).

Analysis of survey data showed that most farms have a range of enterprises, typically up to three key enterprises, depending on the type of farm. For example, in 2009–10 around 57 per cent of irrigators had two enterprises and 33 per cent had three enterprises. Around 6 per cent of farms had a single enterprise and the remaining 4 per cent of farms had four or more enterprises.
**Horticulture farms**

Horticulture farms often have a greater range of enterprises than dairy or broadacre farms. In 2009–10, around 24 per cent of horticulture farms had two enterprises and a further 43 per cent had three enterprises. Around 8 per cent of horticulture farms had a single enterprise and the remaining 25 per cent of farms had four or more enterprises.

Since 2006–07 horticulture farms in the Murray-Darling Basin have become more diversified. In particular, many citrus growers have become more diversified, with around 82 per cent of citrus growers having four or more enterprises in 2009–10, compared with 39 per cent in 2006–07. Wine grape farms with four or more enterprises rose from 25 per cent in 2006–07 to around 42 per cent in 2009–10.

In contrast, only 7 per cent of vegetable growers had four or more enterprises in 2009–10, compared with around 41 per cent of farms in 2006–07. However, 24 per cent of vegetable growers had two enterprises and 69 per cent had three enterprises in 2009–10.

In most regions average receipts from horticulture crop produce sales were usually greater than 80 per cent of total cash receipts (Figure 11). Livestock enterprise receipts represented a growing proportion of total average cash receipts in the Loddon-Avoca region, and to a lesser extent in the Macquarie-Castlereagh and Lachlan regions because of increased livestock sales and reduced crop sales. Water allocation sales represented a substantial proportion of total cash receipts in the Murrumbidgee.

The largest average total crop areas, both dryland and irrigated, were mostly in the Condamine-Balonne region (around 60 hectares), while the smallest areas were in the Border Rivers region (less than 20 hectares) (Figure 12).

Annual irrigated crop areas tend to vary less than dryland crop areas because a significant proportion of irrigated crops on horticulture farms include permanent plantings of trees and vines. Horticulture farms in some regions also grew broadacre crops. For example, horticulture farms in the Condamine-Balonne region planted significant areas of grain and fodder crops in addition to vegetables (Figure 13). In most regions, cereal and fodder crops accounted for most total dryland crop areas (Figure 14).
FIGURE 11 Contribution to cash receipts, horticulture farms, by region, 2000–01 to 2010–11 (average per farm)

Source: ABARES survey of irrigation farms in the Murray-Darling Basin.

p ABARES preliminary estimate. y ABARES provisional estimate.
FIGURE 12 Irrigation and crop areas, horticulture farms, by region, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

p ABARES preliminary estimate. y ABARES provisional estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin
FIGURE 13 Irrigated crop areas, horticulture farms, by region, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

Condamine–Balonne Border Rivers Macquarie–Castlereagh Lachlan Murrumbidgee Murray Goulburn–Broken Loddon–Avoca Eastern Mount Lofty Ranges

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p ABARES preliminary estimate. y ABARES provisional estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin
**FIGURE 14** Dryland crop areas, horticulture farms, by region, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

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- **Total dryland wheat/oats/barley area**
- **Total dryland fodder crop area**
- **Total dryland oilseeds/pulses area**
- **Total dryland grain sorghum/maize area**

*p ABARES preliminary estimate. y ABARES provisional estimate.*

*Source:* ABARES survey of irrigation farms in the Murray–Darling Basin
Broadacre farms

The majority of broadacre farms operated two or three enterprises in most years. While less diversified than horticulture farms, survey results suggest that in the short term, broadacre farms are more responsive (in terms of adjusting enterprise mix) to changes in the farm operating environment.

Irrigated broadacre farms in the northern basin regions, the Condamine–Balonne, Namoi and Macquarie–Castlereagh, which generated most of their total farm gross receipts from cropping activities (Figure 15), typically grew both summer and winter crops. Broadacre farms in the southern basin regions were more diversified with a mix of cropping and livestock enterprises.

In the Murrumbidgee, Murray, Goulburn–Broken and Loddon–Avoca regions, where significant volumes of allocation water were traded, water allocation sales contributed significantly to total cash receipts in some years. In the Goulburn–Broken region, for example, water allocation receipts accounted for 23 per cent of average total cash receipts in 2007–08. In contrast, receipts from sales of water allocations in northern basin regions were negligible in all years.

In most regions there was a downward trend in average area irrigated, as a proportion of average total farm area, and an upward trend in dryland crop area (Figure 16). As water allocations declined, irrigated broadacre farms in northern regions reduced irrigated cotton areas and planted dryland crops, such as grain sorghum and cereals. Irrigated broadacre farms in southern regions increased cereal crop areas and reduced fodder crop areas (Figure 17).
FIGURE 15 Proportions of total cash receipts, broadacre farms, by region, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

Source: ABARES survey of irrigation farms in the Murray–Darling Basin

p ABARES preliminary estimate. y ABARES provisional estimate.
FIGURE 16 Irrigation and crop areas, broadacre farms, by region, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

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<td>Goulburn–Avoca</td>
<td>110</td>
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Source: ABARES survey of irrigation farms in the Murray–Darling Basin
FIGURE 17 Proportions of total crop areas, broadacre farms, by region, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

Source: ABARES survey of irrigation farms in the Murray–Darling Basin

Note: Total crop area comprises both dryland and irrigated crops.

ABARES provisional estimate.

Adjustment on irrigation farms.
Dairy farms

Dairy farms tend to be single enterprise operations based on milk production, supplemented by dairy and beef cattle sales. The enterprise mix on dairy farms changed little between 2006–07 and 2009–10, with many farms having one or two enterprises in most years.

Milk and cattle receipts for most farms were usually above 80 per cent of total cash receipts in all regions (Figure 18). While receipts from cropping enterprises increased in the Condamine–Balonne and Murray in 2009–10 and 2010–11, they accounted for only about 20 per cent or less of total average cash receipts.

The average size of dairy herds declined by around 51 per cent over the survey period as dairy farmers’ scaled back production by drying off cows. Milking cow numbers as a proportion of the total herd declined from around 65 per cent in 2006–07 to around 57 per cent in 2009–10.

The average area of pasture irrigated per farm declined over the survey period, reflecting declines in cow numbers and average dairy herd size, combined with changes in water availability. However, most of that decline occurred in 2007–08 before remaining steady in subsequent years (Figure 19).

Off-farm income

Survey results show that most irrigation farms in the Murray–Darling Basin had some form of off-farm income, including wages and salaries, off-farm sharefarming, government assistance and non-farm investments. Total off-farm income for irrigation farms increased in each year, rising from an average of $27,350 per farm in 2006–07 to around $48,600 per farm in 2009–10 (Figure 20).

On average, around one-third of total off-farm income earned by irrigation farms was typically from wages or salaries, while around one-half was from non-farm income sources, such as government assistance and non-farm investments. Although small in absolute terms, receipts from off-farm contracting increased each year as seasonal conditions improved and provided greater opportunities for off-farm harvesting contracts.

Off-farm contracts accounted for the highest component of off-farm income for broadacre farms, whereas it was the lowest component for dairy farms. Broadacre farms also had higher average receipts from off-farm sharefarming than dairy or horticulture farms.

Average off-farm income for horticulture farms rose from around $25,304 per farm in 2006–07 to an average of $42,787 in 2009–10. However, these averages mask large differences in off-farm income between individual horticulture farms. In addition, the most important source of off-farm income for horticulture farms was government assistance and non-farm investments, rather than off-farm wages or salaries.

Increases in average off-farm income were particularly important in the context of declines in average farm cash income across the basin in 2008–09 and 2009–10. When off-farm income is taken into account, total farm family income (farm cash income plus off-farm income) rose on average in 2009–10, whereas farm cash income declined (Figure 21).
FIGURE 18 Proportions of total cash receipts, dairy farms, by region, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

p ABARES preliminary estimate. y ABARES provisional estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin
FIGURE 19 Crop and pasture areas, dairy farms by, region, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

Source: ABARES survey of irrigation farms in the Murray–Darling Basin

p ABARES preliminary estimate. y ABARES provisional estimate.
For a number of farms (ranging from 33 per cent to 41 per cent over the four years) off-farm income contributed between 96 per cent and 100 per cent of total farm family income over the survey period because of relatively low farm cash income and higher than average off-farm income. Those farms with a high reliance on off-farm income generally had lower total farm family income that farms with a low reliance on off-farm income (Figure 22).
**FIGURE 22** Farm cash income and farm family income, by reliance group, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

- **High reliance group**
  - Family farm income
  - Farm cash income

- **Low reliance group**
  - Family farm income
  - Farm cash income

**Note:** The high reliance group includes farms where off-farm income accounts for more than half of total farm family income. The low reliance group includes farms where off-farm income accounts for less than half of total farm family income.

**Source:** ABARES survey of irrigation farms in the Murray–Darling Basin
Chapter 4

Farm investment

Farm capital

Past investment decisions by farmers are reflected in the total value of farm capital (Box 4). Land and permanent water access entitlements typically account for the largest components of total capital on most farms. Such capital items tend to be relatively fixed in the short term, while other items such as livestock, plant and equipment may be varied more readily.

The total value of capital for irrigated broadacre farms averaged around $5.1 million per farm in 2009–10. Land accounted for an estimated 58 per cent of the total value of capital and permanent water access entitlements accounted for a further 25 per cent (Figure 23). On-farm irrigation infrastructure and equipment accounted for around 4 per cent of the total value of capital in 2009–10. In comparison with 2006–07 (the first year of the survey), broadacre farms in 2009–10 had a higher proportion of their capital invested in land and on-farm irrigation infrastructure and equipment and less in water entitlements, largely because of permanent water entitlement sales.

For horticulture farms, the total value of capital averaged around $1.9 million per farm in 2009–10. Land accounted for an estimated 50 per cent of total capital value and water entitlements accounted for a further 27 per cent. On-farm irrigation infrastructure and equipment accounted for around 11 per cent of the total value of capital in 2009–10.

The average total value of capital for dairy farms in the Murray–Darling Basin was around $2.4 million in 2009–10. Land accounted for around 49 per cent of total capital value, water entitlements for a further 28 per cent and livestock for 8 per cent. On-farm irrigation infrastructure and equipment accounted for around 2 per cent of the total value of capital in 2009–10. Compared with 2006–07, dairy farms in 2009–10 had more capital invested in land and relatively less in all other types of capital.
Additions and disposals of capital

The survey results show an estimated 34 per cent of irrigation farms made net additions (that is, additions minus disposals) to total farm capital in 2009–10, compared with an estimated 30 per cent in 2006–07. The proportion of farms making net additions to capital increased in both 2007–08 and 2008–09, largely because of higher farm incomes and improved prospects for most commodities. However, increased sales of permanent water access entitlements outweighed the extent of other new farm investments and led to fewer farms making net additions to capital in 2009–10.
The proportion of farms making net capital additions varied among each industry from year to year (Figure 24). For those horticulture, broadacre and dairy farms making net additions to total capital, purchases of land were the largest component of additions in each year. For farms making net disposals of capital, sales of permanent water access entitlements accounted for the largest component of disposals in most years, although results differed by industry. For horticulture farms, most sales of water entitlements were in 2008–09, while for broadacre farms it was 2009–10, and 2006–07 for dairy farms. In 2008–09 a number of dairy farms also had net disposals of land. Regardless of the source of net capital disposals, survey results suggest that many farms used at least part of the proceeds from these sales to reduce debt.

**FIGURE 24 Percentage of farms making net capital additions, by industry, Murray–Darling Basin, 2006–07 to 2009–10 (proportion of farms)**

![Graph showing percentage of farms making net capital additions by industry from 2006-07 to 2009-10.](image)

p ABARES preliminary estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin

### Farm debt

On average, farm business debt of irrigated farms in the Murray–Darling Basin rose by an estimated 3 per cent a year between 2006–07 and 2009–10, although the annual increase in debt became progressively smaller each year.

Changes in debt varied across the industries from year to year, largely in line with relative changes in farm incomes. For horticulture farms, debt rose in 2007–08 and 2008–09 because of increased demand for working capital, before falling in 2009–10 (Figure 25). The changes in debt for horticulture farms were partly related to allocation water purchases and sales. That is, working capital debt rose in those years when horticulture farms were net buyers of water allocations and fell when horticulture farms were net sellers of water.

Farm business debt for dairy farmers rose substantially in 2006–07, largely because of increased purchases of fodder and water allocations, before falling in each of the subsequent years. Several factors contributed to dairy farm business debt falling over these years, including periods of increased farm incomes, sales of water allocations, and sales of permanent water access entitlements.
Farm business debt for irrigated broadacre farms rose in each year, although the rate of increase declined slightly over time. While broadacre farmers have consistently been net sellers of water allocations, these farms have tended to use the resulting funds for working capital rather than to pay off debt.

For all three industry groups, the major components of total farm debt were for land purchases and working capital (Figure 26). The proportion of debt associated with land purchases was highest in the dairy industry, at 52 per cent in 2009–10. Irrigated dairy farms also reported an increase in the relative importance of working capital debt, from 12 per cent in 2006–07 to 26 per cent in 2009–10. In the other two industries the relative importance of working capital was similar in each year.

The ability of farmers to service debts from their revenue stream is an important aspect of farm viability. Measures of debt servicing provide an indication of a farmer’s ability to make annual interest payments on debt. Figure 27 shows the ratio of interest payments to total farm cash receipts. A low ratio means interest payments account for a small proportion of cash receipts.

The ratio of interest paid to total cash receipts (expressed as a percentage) for irrigated farms averaged around 11 per cent from 2006–07 to 2009–10, rising slightly over time. By comparison, the ratio of interest paid to farm cash income rose from around 30 per cent in 2006–07 to an estimated 52 per cent in 2009–10. Both measures indicate some deterioration in the financial position of irrigators over the survey period.

The ratio of interest paid to total cash receipts for irrigated broadacre farms was higher than for horticulture or dairy farms, averaging around 15 per cent for the basin as a whole in 2009–10 (Figure 28). By comparison, the ratio for Australian dryland broadacre farms has averaged around 7 per cent since 1977–78. More recently, the debt servicing ratio for Australian dryland broadacre farms was 8 per cent in 2008–09 and 9 per cent in 2009–10.
FIGURE 26 Components of farm business debt, by industry, Murray–Darling Basin, 2006–07 to 2009–10 (average per farm)

Horticulture

Broadacre

Dairy

$'000

Land purchase

Working capital

Land development

Vehicles/machinery

Debt reconstruction

Note: Debt reconstruction refers to loans that have been renegotiated or consolidated.

Source: ABARES survey of irrigation farms in the Murray–Darling Basin

FIGURE 27 Debt servicing ratios, Murray–Darling Basin, 2006–07 to 2009–10 (average per farm)

%  

Ratio of interest to farm cash income

Ratio of interest to total cash receipts

Source: ABARES survey of irrigation farms in the Murray–Darling Basin
Farm equity

Financial institutions that lend to farm businesses take into account the capacity of the business to service increased debt and the equity (or security) farmers have in their business. Despite increases in farm debt, average farm business equity has remained strong for irrigation farms, consistently averaging around 82 per cent, because of increases in the value of agricultural land and permanent water access entitlements. However, results have been mixed for individual farms across the Murray–Darling Basin. By industry, equity ratios for dairy farms increased between 2006–07 and 2009–10, but fell slightly for irrigated broadacre and horticulture farms.

To gain greater insight into the financial performance of irrigators, farms were assigned to one of four groups based on income and equity. High/low income farms were defined as having farm cash income above/below $50 000, while high/low equity farms were defined as having a farm business equity ratio above/below 70 per cent.

In 2006–07 around 35 per cent of irrigation farms in the Murray–Darling Basin recorded high farm incomes. Most of these farms also had high farm business equity. The proportion of farms with high income and high equity fluctuated from year to year, accounting for 33 per cent of irrigation farms in 2007–08, compared with 29 per cent of farms in 2009–10 (Figure 29). By comparison, an estimated 66 per cent of irrigation farms had low farm incomes in 2006–07, rising to 71 per cent in 2008–09 before falling back to around 66 per cent in 2009–10.

Around 13 per cent of irrigation farms in 2006–07 had both low income and low farm business equity (Figure 29). These farms face the greatest financial pressures and are likely to experience difficulty servicing their debts in the short term. The proportion of farms with low income and low equity increased in 2007–08 and 2008–09 before falling slightly in 2009–10.
From 2006–07 to 2009–10 the irrigation farms with low farm incomes tended to rely more heavily on irrigated crops than did high income farms. There was little difference in the proportion of irrigable area that was actually irrigated across farms by income and equity, although high income farms tended to have larger areas of dryland crops than low income farms.

The distribution of high and low income irrigation farms can be partly explained by the scale of operations. High income farms were, on average, significantly larger in terms of area operated than low income farms and were therefore able to generate higher total cash receipts. ABARES survey results also suggest that larger irrigation farms were able to generate higher receipts per megalitre of irrigation water used than smaller farms, although more detailed analysis is needed to understand why this occurred (for example, by examining the data for economies of scale or size).

From 2006–07 to 2009–10 farm business debt rose on average for farms in each of the income/equity groups, except for high income/high equity farms for which debt declined by an estimated average of 3 per cent a year (Figure 30).

For all four income/equity groups, the major components of total farm debt were for land purchases and working capital, although there was an increase in the proportion of reconstructed debt (Figure 31). Reconstructed debt is where existing loans have been refinanced and/or consolidated and the original purpose cannot be identified at interview. Working capital accounted for the major part of debt in most years for farms with low income and high equity, while the proportion of reconstructed debt was highest on those farms with low income and low equity.

In percentage terms, the largest change in debt between 2006–07 and 2010–11 was an increase in reconstructed debt, particularly for high income/low equity farms. The substantial increase in reconstructed debt was partly a result of relatively low interest rates for some categories of loans in 2009–10, while concern about expected future interest rate increases at the time also encouraged debt restructuring.
The ratio of interest paid to total cash receipts varied by income/equity group, with low equity farms having a higher ratio than high equity farms in all years. Interest paid to receipts ratio for low income/low equity farms in 2009–10 increased markedly, while this ratio increased only slightly for the other groups in that year.

Despite changes in farm incomes and debt, average farm business equity ratios for each of the income/equity groups remained relatively stable over the survey period. As mentioned above, the proportion of irrigators having low income and low equity (that is, those farms facing the greatest financial pressures) also remained relatively stable over the period. These results suggest that a majority of irrigation farm businesses withstood many of the pressures they faced over the survey period without significantly eroding their farm asset base. As a consequence, while the results vary significantly across regions and industries, many irrigators have been able to maintain their capacity to earn future revenues.

However, the irrigation survey results are based on a relatively short period during which, as already discussed, farm incomes were adversely affected by a range of factors (such as commodity prices and drought). Ideally, a longer time series would allow current farm financial performance to be better placed in context as seasonal and market conditions change.
FIGURE 31 Components of farm business debt, by income and equity, Murray–Darling Basin, 2006–07 to 2009–10 (average per farm)

Low income/low equity

Low income/high equity

High income/low equity

High income/high equity

- Land purchase
- Working capital
- Other
- Land development
- Debt reconstruction

% 60 50 40 30 20 10 0


Low income/low equity

Low income/high equity

High income/low equity

High income/high equity

p ABARES preliminary estimate.

Note: Debt reconstruction refers to loans that have been renegotiated or consolidated.

Source: ABARES survey of irrigation farms in the Murray–Darling Basin
Chapter 5

Water trading

Water trading provides irrigators with greater flexibility in managing their use of water and consequently their farm business outcomes. Water trading has allowed some irrigators to reduce water use for agricultural production and instead generate income from selling water allocations or entitlements. Conversely, water trading has allowed other irrigators to expand their water use.

Previous research has shown that water trading played a critical role in enabling irrigators to adjust to changing water availability, particularly during the recent extended drought, and provided irrigators with a potential additional source of income (for example, NWC 2011a, 2011c, 2011d; 2010b; Sanders et al. 2010; Mallawaarachchi & Foster 2009; Oliver et al. 2009).

Qualitative interviews with irrigators highlighted the benefits of water trade in allowing irrigators with lower value water uses to generate income by selling to irrigators with higher value water uses (NWC 2011d; Mallawaarachchi & Foster 2009). Purchases of water have also prevented economic losses for some irrigators whose permanent plantings would otherwise have been lost to water stress.

Water allocation trading

Across the Murray–Darling Basin, ABARES survey results show the proportion of irrigation farms trading water allocations (either buying or selling) ranged from 51 per cent in 2007–08 to an estimated 6 per cent in 2010–11. An estimated 47 per cent of horticulture farms, 32 per cent of broadacre farms and 40 per cent of dairy farms traded water allocations during this time.

The proportion of farms trading water allocations was highest in the Murray (49 per cent), Murrumbidgee (47 per cent), Goulburn–Broken (47 per cent) and Loddon–Avoca (41 per cent) regions.

For those farms that traded water allocations in the three years to 2010–11, 27 per cent traded with another irrigator in their own region. An estimated 34 per cent of farms traded on a water exchange where the buyer was unknown. Only 6 per cent of farms traded water directly with an irrigator in another region, although some of the trades on a water exchange may have been with an irrigator in another region. An estimated 6 per cent of farms traded with an urban water authority and 25 per cent with other entities, such as an irrigation corporation. Around 13 per cent of irrigators reported that they did not know the identity of their trade partner.
Trading with a water exchange was the most common trading method for horticulture farms (47 per cent), while dairy (41 per cent) and broadacre farms (31 per cent) most commonly traded directly with another irrigator in their own region.

The most common reasons given for trading water allocations were to generate cash (40 per cent) or because of prevailing seasonal conditions (38 per cent). Most irrigators found the process of water allocation trading to be easy (87 per cent), reliable (84 per cent) and affordable (73 per cent). Most irrigators also found water allocation trading to be beneficial for their farm business (93 per cent).

**Characteristics of water allocation traders**

In 2006–07 an estimated 18 per cent of irrigators in the Murray–Darling Basin were net buyers of water allocations (defined as farms which either only bought water or bought more water than they sold) (Figure 32). This proportion rose to 29 per cent in 2007–08 as some irrigators responded to reduced water allocations by obtaining water on the market. The number of net buyers declined in each of the subsequent three years to an estimated 6 per cent in 2010–11 as water availability increased.

However, the total volume of water traded increased as cotton and rice growers (using larger volumes of water per farm than horticulture producers) became the main buyers instead of horticulture farms in 2010–11.

**FIGURE 32** Proportion of farms, by trading group, Murray–Darling Basin, 2006–07 to 2010–11 (proportion of farms)

The proportion of irrigators that were net sellers (defined as farms that either only sold water or sold more water than they bought) followed a similar pattern over time as for net buyers. In 2006–07, an estimated 15 per cent of irrigators were net sellers of water allocations, rising to 26 per cent in 2008–09 before declining to 4 per cent in 2010–11.

Non-traders (defined as farms that did not buy or sell water allocations) comprised the majority of farms in all years. In 2006–07 two-thirds of irrigators did not trade water allocations. This proportion fell to around 50 per cent in the following two years before increasing to 90 per cent in 2010–11, again as a result of higher water availability.
Industry composition of trading groups

The proportions of horticulture, broadacre and dairy farms in each of the three trading groups are shown in Figure 33. To place these proportions in context, the total number of farms in each group is also shown.

In most years, horticulture farms accounted for a large proportion of the net buyers group, particularly in those years with the most trading activity (2007–08 and 2008–09). By 2009–10, rice and cotton growers were also significant buyers of water allocations. In 2010–11 rice and cotton growers accounted for the majority of net buyers, although only 6 per cent of all farms were net buyers in that year.

In 2007–08 and 2008–09 net sellers were mainly a combination of horticulture and broadacre farms. However, the industry composition of the net sellers group changed over time, with a fall in the proportion of horticulture farms and an increase in the proportion of broadacre farms.

There was little change in the industry composition of the non-traders group, compared with the other two groups, although there was a rise in the proportion of broadacre farms and a corresponding fall in the proportion of horticulture farms in 2009–10 and 2010–11.

Areas operated and irrigated

At the basin scale, net buyers tended to operate smaller farm areas than net sellers or non-traders (Figure 34), reflecting the relative industry composition of the three groups. That is, a high proportion of net buyers were horticulture farms, particularly in 2007–08 and 2008–09, that usually operate smaller farm areas than either dairy or broadacre farms.

The relatively larger areas operated by net sellers and non-traders reflect the mostly higher proportions of broadacre farms in these groups. That is, broadacre farms tend to operate larger farm areas than horticulture or dairy farms.
The types of crops and pasture irrigated by net buyers and net sellers also largely reflect the industry composition of each group. In 2006–07 net buyers irrigated a range of horticulture crops, particularly wine grapes and vegetables. From 2007–08 to 2009–10 the largest average areas irrigated by net buyers were wine grapes. For net sellers the largest areas irrigated on average in each year since 2006–07 were broadacre crops and pasture. Non-traders grew mostly broadacre crops.

**FIGURE 34** Area operated and broadacre farm proportion, by trading group, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm and proportion of farms)

In 2006–07 the average area of dryland crops grown per farm was similar for net buyers, net sellers and non-traders (Figure 35). In subsequent years there was an increase in average dryland crop areas for all three groups. This increase likely reflected a move by irrigators, particularly broadacre irrigators, to grow more dryland crops in response to continued low water availability. It is also likely that improving seasonal conditions in the northern basin regions from 2008–09 onwards, allowed farms to expand both irrigated and dryland cropping areas.

**Water use**

From 2006–07 to 2010–11 the average volume of water applied to crops and pasture per farm tended to follow a similar pattern in each of the trading groups (Figure 36). That is, total average water use per farm for all groups fell in 2007–08 (and in 2008–09 for net sellers) and then gradually increased in subsequent years. Changes in total water use for non-traders were smaller in both volume and percentage terms than for either net buyers or net sellers.

Despite operating smaller farm areas on average, net buyers applied higher volumes of water per farm in all four years than either net sellers or non-traders. Changes in the total volume of water applied per farm were associated more with changes in the average area irrigated than with changes in water application rates per hectare.

On average, net buyers applied more water per hectare than net sellers or non-traders in most years. Average application rates per hectare for net buyers ranged from around 4.0 to 4.5 megalitres per hectare. For net sellers there was a decline in
Water application rates per hectare, despite significant increases in both the area irrigated and total water applied from 2008–09 onwards (Figure 36). It appears from the data that this reduction for net sellers was the result of changes in farm water use and management practices rather than because of changes in water application technologies.

**FIGURE 35** Crop areas, by trading group, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

**FIGURE 36** Water use, by trading group, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)
Allocation trading and financial performance

Water trading has had a significant influence on irrigation farm financial performance in a number of ways. The ability to trade water provides farmers with greater flexibility in making water use and production decisions.

During the dry years, net sellers (mostly broadacre farms) tended to have annual crops or pasture that allowed them to be more opportunistic in their use of water, whereas buyers (mostly horticulture farms) tended to have tree and vine crops that require reliable access to water to keep plantings alive.

On average, there was little overall difference in financial performance of net buyers and net sellers. In each year since 2006–07 net buyers recorded higher average total cash receipts and cash costs than either net sellers or non-traders (Figure 37). However, each group recorded similar average farm cash income (total cash receipts minus total cash costs) across the years.

The direct impacts of water allocation trading on irrigators’ farm financial performance vary according to whether the irrigator was a buyer or seller of water allocations or entitlements.

For net sellers, farm cash receipts from the sale of water allocations have increased. Conversely, some reduction in receipts from irrigated agricultural production is likely for farms where water allocation sales correspond with reduced areas of irrigated crops or pasture, although it is not possible to reliably estimate what such receipts might have been. In many cases, receipts from water allocation sales for some farms proved to be the difference between recording a positive farm cash income or a cash loss. Had the water not been sold it is likely that these irrigators would have used the water for productive purposes on their own farms, thereby generating additional income from irrigated production.
For net sellers, allocation water sales significantly contributed to total farm cash receipts from 2006–07 to 2010–11, reaching a peak of 19 per cent of total receipts in 2008–09 (Figure 38).

As seasonal conditions and water availability improved, demand for additional irrigation water weakened. The volume of water traded and market prices for traded water allocations declined in 2009–10 and 2010–11. As a consequence, receipts from the sale of water allocations contributed only 2 per cent of total cash receipts in 2010–11.

By region, the contribution of water sales to total cash receipts varied across each year, generally rising in 2007–08 and 2008–09 before declining in 2009–10 and 2010–11 as water prices and volumes sold declined. The highest percentage contribution of water sales to total cash receipts was recorded in the Eastern Mount Lofty Ranges region in 2006–07 (34 per cent) (Table 2).

**FIGURE 38** Contribution of water sales to total cash receipts, net sellers, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

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<tbody>
<tr>
<td>Condamine–Balonne</td>
<td>%</td>
<td>na</td>
<td>na</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Border Rivers</td>
<td>%</td>
<td>na</td>
<td>na</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Namoi</td>
<td>%</td>
<td>8</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Macquarie–Castlereagh</td>
<td>%</td>
<td>14</td>
<td>4</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>Lachlan</td>
<td>%</td>
<td>11</td>
<td>9</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>%</td>
<td>8</td>
<td>19</td>
<td>26</td>
<td>13</td>
</tr>
<tr>
<td>Goulburn–Broken</td>
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<td>14</td>
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</tr>
<tr>
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<td>8</td>
<td>28</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Murray</td>
<td>%</td>
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<td>13</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>Eastern Mount Lofty Ranges</td>
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<td>11</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>Murray–Darling Basin</td>
<td>%</td>
<td>9</td>
<td>16</td>
<td>19</td>
<td>10</td>
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*ABARES preliminary estimate. y ABARES provisional estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin*
For net buyers, purchases of water allocations led to a direct increase in total farm cash costs in each of the survey years, ranging from an average of 3 per cent in 2010–11 to 15 per cent in 2007–08 at the basin scale (Figure 39). The contribution of water purchases to total cash costs was uniform across the regions in most years, peaking in the Condamine–Balonne (23 per cent), Murrumbidgee (13 per cent), Murray (19 per cent) and Eastern Mount Lofty Ranges (11 per cent) regions in 2007–08 (Table 3).

**FIGURE 39** Contribution of water purchases to total cash costs, net buyers, Murray–Darling Basin, 2006–07 to 2010–11 (average per farm)

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<tbody>
<tr>
<td>Condamine–Balonne</td>
<td>% 6</td>
<td>23</td>
<td>2</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Border Rivers</td>
<td>% 9</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Namoi</td>
<td>% 2</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Macquarie–Castlereagh</td>
<td>% 9</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Lachlan</td>
<td>% 4</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Murrumbidgee</td>
<td>% 7</td>
<td>13</td>
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<td>6</td>
<td>4</td>
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<tr>
<td>Goulburn–Broken</td>
<td>% 10</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Loddon–Avoca</td>
<td>% 12</td>
<td>5</td>
<td>5</td>
<td>5</td>
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</tr>
<tr>
<td>Murray</td>
<td>% 9</td>
<td>19</td>
<td>10</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Eastern Mount Lofty Ranges</td>
<td>% 7</td>
<td>11</td>
<td>6</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Murray–Darling Basin</td>
<td>% 9</td>
<td>12</td>
<td>8</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

*p ABARES preliminary estimate. y ABARES provisional estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin*
Water entitlement trading

Decisions to buy or sell entitlements are based on a range of factors, such as the expected future income stream from holding or buying entitlements versus the income stream from selling entitlements and investing elsewhere.

Across the Murray–Darling Basin, an estimated 32 per cent of irrigators traded water entitlements in the three years to 2010–11. An estimated 11 per cent of horticulture farms, 11 per cent of broadacre farms and 17 per cent of dairy farms traded entitlements over that period. By region, the proportion of farms trading entitlements was highest in the Goulburn–Broken region.

The survey results show that an estimated 39 per cent of farms that traded water entitlements sold to the Australian Government, while a further 25 per cent of irrigators sold to a state government environmental purchase program.

Around two-thirds of irrigators who traded water entitlements had sold their entitlements, while the remaining one-third had purchased entitlements. The main reason for selling entitlements was to generate cash (62 per cent). Around one-third of these irrigators planned to cease irrigation, while a further one-third had bought temporary water allocations since selling their permanent water access entitlements.

The most common use of proceeds from selling water entitlements was to pay off debt (53 per cent). Most irrigators felt the ability to trade entitlements had helped their farm business (92 per cent).

Entitlement sales to the Australian government

From 2007–08 to 2010–11 the Australian Government secured around 1052 gigalitres of water entitlements as part of its Restoring the Balance in the Murray–Darling Basin program (NWC 2011b). Almost 40 per cent (415 gigalitres) were secured in 2009–10.

Of the 415 gigalitres secured in 2009–10, around two-thirds were sourced from irrigators in the Murray region (NWC 2010a). Around a further 16 per cent of entitlements were sourced from the Goulburn–Broken and 7 per cent from the Murrumbidgee (Figure 40).

FIGURE 40 Water entitlements secured by the Australian Government, by region, 2009–10

Source: National Water Commission 2010a
For the following analysis, farms were assigned to two groups:

- sellers group—farms that sold entitlements to the Australian Government in 2009–10
- non-sellers group—farms that did not sell entitlements to the Australian Government in 2009–10.

There were some farms in both groups that sold entitlements to other environmental water purchasing programs.

At a basin scale the sellers group sold an average of 156 megalitres of entitlement water in 2009–10. These sales equated to around 15 per cent of total average entitlement volume held by these farms (Table 4). On average, both entitlement sellers and non-sellers were net sellers of water allocations in 2009–10, with net volumes sold of 10 megalitres and 22 megalitres, respectively.

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Selected estimates, farms selling entitlements in 2009–10, Murray–Darling Basin (average per farm)</th>
</tr>
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<tbody>
<tr>
<td>Entitlement sold</td>
<td>Sold entitlements to Australian Government p</td>
</tr>
<tr>
<td>Total entitlement held at 30 June</td>
<td>ML</td>
</tr>
<tr>
<td>Farm cash income</td>
<td>$</td>
</tr>
<tr>
<td>Farm business profit</td>
<td>$</td>
</tr>
<tr>
<td>Rate of return</td>
<td>%</td>
</tr>
<tr>
<td>Change in total farm debt</td>
<td>$</td>
</tr>
</tbody>
</table>

p ABARES preliminary estimate.

Note: Water rates include water allocation purchases as, well as fixed and variable costs associated with water holdings and delivery. Change in total farm debt is the difference between debt at 1 July and 30 June.

Source: ABARES survey of irrigation farms in the Murray–Darling Basin

There was little difference in average farm cash income and farm business profit between sellers and non-sellers in 2009–10. However, there was a marked difference between the groups in changes in average farm business debt. Although identifying how entitlement sale proceeds are used is not straightforward (Box 5), it appears that at least part of the proceeds from entitlement sales were used to retire some debt in 2009–10. Entitlement sellers recorded a fall in average farm business debt in 2009–10, while non-sellers recorded a rise in average debt.

**Box 5 Entitlement trade and farm financial performance**

Receipts and costs associated with purchases and sales of water allocations are included in the survey estimates of total cash receipts and total cash costs and, consequently, farm cash income and farm business profit. However, permanent water access entitlements are treated as a capital item and not as part of farm cash flows.

When permanent entitlements are sold during the year, the value of total capital at the end of the financial year is lower. Where proceeds from entitlement sales are used to reduce debt, the survey records a reduction in farm business debt. In some cases entitlement sales are used to buy other capital items, such as machinery and buildings, which then add to the value of total capital.

Alternatively, proceeds from entitlement sales may form part of farm liquid assets, investments that are easily converted to cash. However, the survey does not record details of non-farm investments or businesses.
Results are reported on a region basis where there were sufficient sample farms selling entitlements to produce reliable survey estimates. For 2009–10 sufficient farm numbers were available for the Murrumbidgee, Murray, Goulburn–Broken and Loddon–Avoca regions. These four regions collectively accounted for almost 80 per cent of total Australian Government entitlement purchases in 2009–10.

In all four regions entitlements sellers reduced their average farm business debt, while non-sellers recorded increases in average farm debt. On average, entitlement sellers reported reductions in total farm business debt from between 5 and over 10 per cent in 2009–10, while non-sellers reported similar percentage increases in debt (Figure 41).

**FIGURE 41** Percentage change in debt, selected regions by trading group, 2009–10 (average per farm)

Note: ABARES preliminary estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin
Irrigation systems and water use

An irrigator’s choice of system will depend on a number of factors, including farm topography, crop type, water quantity and quality, on-farm water storage capacity, labour and financial resources, total area irrigated and existing infrastructure (DPI 2012).

ABARES surveys of irrigation farms in the Murray–Darling Basin contained questions on irrigation systems, including flood/furrow, overhead fixed sprinklers, low-throw fixed sprinklers, micro-jet sprinklers, drip/trickle, travelling irrigators and moveable spray lines. Attributes of irrigation systems are described in Box 6.

Horticulture farms used a wide variety of irrigation systems, with drip/trickle systems and low-throw sprinklers being the most common (Figure 42). From 2006–07 to 2009–10 survey results suggest there was an increase in the proportion of farms using drip/trickle systems and fewer horticulture farms using flood/furrow or overhead sprinkler systems.

FIGURE 42 Main irrigation systems, by industry, Murray–Darling Basin, 2006–07 to 2009–10 (proportion of farms)

p ABARES preliminary estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin
Most broadacre and dairy farms used flood/furrow systems to irrigate often considerable areas of crops and pasture (Figure 42). Both farm groups also made use of travelling irrigators and moveable spray line systems.

**Box 6 Selected characteristics of irrigation systems**

**Flood/furrow** systems (including bay, border check, bankless channel and siphon irrigated furrow systems) deliver high volumes of water quickly (Irrig8right 2012; DPI 2012). They are usually gravity fed systems, relatively low cost to set up and require only moderate skills to operate. However, they are labour-intensive systems that can be difficult to automate. Such systems are typically used for a range of field crops, pasture and some orchard crops.

**Fixed (or solid set) sprinkler** systems involve an arrangement of fixed pipelines with sprinklers (usually impact sprinklers) mounted on risers of varying height. The ABARES survey categorised fixed sprinkler systems into overhead sprinklers (sprinklers mounted on risers above a tree canopy or crop) and low-throw sprinklers (sprinklers closer to ground level). Fixed systems are suitable for any paddock shape and most crop types (Irrig8right 2012). Overhead sprinklers are also used in orchards for frost protection and crop cooling (DPI 2012). Once installed these systems are readily automated and require only moderate skills to operate. The capital costs of installing fixed sprinkler systems are mid-range, around $6000 to $8000 per hectare.

**Micro and drip/trickle** systems apply water above or below the soil surface at low flow rates in the form of droplets and miniature streams or sprays. The emitting devices include tape, tricklers, pulsators, micro-sprinklers, micro-sprayers and micro-jets (Irrig8right 2012; DPI 2012). While easy to automate and not particularly labour intensive, these systems require high skills to operate efficiently. Capital costs of these systems tend to be mid-range. Micro and drip-trickle systems are most suited to orchards, vineyards and vegetable crops.

**Travelling irrigators** comprise centre-pivot, linear or lateral move and travelling gun systems. Largely automated and not highly labour intensive, these systems require skilled operation. Travelling irrigators are suitable for a range of forage and field crops, vegetable crops and pasture.

**Centre-pivot** irrigators consist of a single pipeline (lateral) of varying length supported by a truss network (towers). The self-propelled unit rotates around a pivot in the centre of an irrigation circle. Linear or lateral move systems are similar to centre-pivots except that they move in a continuous straight path across a paddock (Irrig8right 2012; DPI 2012). The capital costs of these systems are in the low to mid-range, around $1000 to $5000 per hectare.

**Travelling gun** systems consist of either a large gun sprinkler or a boom spray unit mounted on a wheel or trailer and connected to a flexible hose on a reel (Irrig8right 2012; DPI 2012). These systems are powered through either self-propulsion or an auxiliary motor (Irrig8right 2012). Capital costs for travelling gun systems are mid-range to high, around $6000 to $11 000 per hectare.

**Moveable spray lines** include hand-move sprinkler systems and side-roll sprinkler systems. These systems are labour intensive but require only moderate skills to operate and are low cost to install.

continued...
Box 6 Selected characteristics of irrigation systems  continued

**Hand-move** systems involve moving lightweight pipelines manually from one position to another. They are flexible systems that suit any paddock shape and many crop types, except tall growing field crops that make moving pipelines difficult (Irrig8right; DPI 2012).

**Side-roll** systems are similar to hand move systems except that wheels are attached to the pipeline, allowing operators to roll the line from one position to another. The unit does not move while irrigating (Irrig8right 2012; DPI 2012). Side-roll systems are suited to square/rectangular paddock shapes and low crop types, with the pipeline usually supported about one metre above the ground.

Water application rates declined for most commodities and irrigation systems between 2006–07 and 2009–10 as irrigators modified their irrigation practices in response to reduced water allocations.

Analysis of annual average growth rates shows a reduction in water application rates for each irrigation system across the basin (Table 5). The results vary slightly by industry, but water application rates also declined on average for the major irrigation systems used in each industry.

These results should be used with caution because of the relatively short time series of data available and the effects of severe drought prevailing over the period that affected the volume of water available for irrigation. A longer time series would allow better analysis of trends in water application rates.

<table>
<thead>
<tr>
<th><strong>TABLE 5</strong> Average annual percentage change in water application rates</th>
<th>Horticulture</th>
<th>Broadacre</th>
<th>Dairy</th>
<th>Murray–Darling Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood/furrow systems</td>
<td>%</td>
<td>−5.5</td>
<td>−3.2</td>
<td>−12.0</td>
</tr>
<tr>
<td>Overhead sprinklers</td>
<td>%</td>
<td>−15.6</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Low-throw sprinklers</td>
<td>%</td>
<td>−5.1</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Micro-systems</td>
<td>%</td>
<td>−17.6</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Drip/trickle systems</td>
<td>%</td>
<td>−5.8</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Travelling irrigators</td>
<td>%</td>
<td>na</td>
<td>−12.6</td>
<td>na</td>
</tr>
<tr>
<td>Moveable spray lines</td>
<td>%</td>
<td>na</td>
<td>−18.3</td>
<td>na</td>
</tr>
<tr>
<td>Other</td>
<td>%</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>

**na** Not available.

**Note:** Percentage is based on a growth trend function applied to survey data to remove effects of annual variations in water application rates.

**Source:** ABARES survey of irrigation farms in the Murray–Darling Basin

### Horticulture farms

**Vegetable growers**

Vegetable growing farms tend to use a wide range of irrigation systems (Figure 43). Survey results suggested that drip/trickle, travelling irrigators and overhead sprinklers were the most used systems on vegetable farms throughout the basin.
Vegetable growers with travelling irrigators irrigated the largest average area of vegetables per farm in 2009–10, although flood/furrow irrigators held the highest volumes of water entitlements and irrigated a range of crops other than vegetables.

**FIGURE 43** Irrigation systems and water application rates, vegetable farms, Murray–Darling Basin, 2006–07 to 2009–10 (proportion of farms and average per farm)

While vegetable growers using travelling irrigators had the highest average farm cash income and rate of return in 2009–10, the average financial performance of all vegetable growers declined over the survey period, irrespective of irrigation system used (Figure 44).

**FIGURE 44** Rate of return, by irrigation system, vegetable farms, Murray–Darling Basin, 2006–07 to 2009–10 (average per farm)
Wine grape growers
ABARES survey results suggest that wine grape growing farms use a wide range of technologies, with drip/trickle systems being the most common (Figure 45). The proportion of wine grape growers using drip/trickle systems was significantly larger than those using sprinklers in terms of area operated, average area of wine grapes per farm, total permanent water access entitlements held and volume of water used. Wine grape growers using drip/trickle systems also had better financial performance in most years than those using sprinklers (Figure 46).

Citrus growers
Citrus growing farms also use a wide range of technologies, although drip/trickle and low-throw sprinklers are the most commonly used systems (Figure 47). Citrus growers using micro or drip/trickle systems irrigated significantly larger areas of citrus crops than irrigators using mainly sprinkler systems. Farms using micro or drip/trickle systems also had significant areas of dryland crops and better financial performance than farms using sprinkler systems (Figure 48).

FIGURE 45 Irrigation systems and water application rates, wine grape farms, Murray–Darling Basin, 2006–07 to 2009–10 (proportion of farms and average per farm)

- **Proportion of farms**
  - Drip/trickle
  - Micro systems
  - Low-throw sprinklers
  - Overhead sprinklers
  - Flood/furrow

- **Water application rate**
  - ML/Ha

Source: ABARES survey of irrigation farms in the Murray–Darling Basin
FIGURE 46 Rate of return, by irrigation system, wine grape farms, Murray–Darling Basin, 2006–07 to 2009–10 (average per farm)

[Graph showing rate of return by irrigation system]

p ABARES preliminary estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin

FIGURE 47 Irrigation systems and water application rates, citrus farms, Murray–Darling Basin, 2006–07 to 2009–10 (proportion of farms and average per farm)

[Graph showing proportion of farms and water application rates]

p ABARES preliminary estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin
Stone fruit growers

Drip/trickle systems and low-throw sprinklers were the most commonly used irrigation systems on stone fruit farms (Figure 49). From 2006–07 to 2009–10 there was a marked increase in the proportion of stone fruit farms using drip/trickle systems instead of micro-systems. Drip/trickle systems were also the most widely used irrigation system in terms of the area of stone fruit irrigated and the volume of water applied.

There was little difference in size for stone fruit growing farms by irrigation system in terms of area of stone fruit irrigated and water used, although those farms with micro or drip/trickle systems also irrigated a range of crops other than stone fruit. Farms with micro or drip/trickle systems recorded positive rates of return in each of the survey years, whereas farms using sprinkler systems consistently had negative rates of return (Figure 50).

Pome fruit growers

Pome fruit growing farms use a wide range of technologies, with drip/trickle systems being the most common (Figure 51). Drip/trickle systems were the most widely used irrigation system in terms of the area of pome fruit irrigated, although the largest volume of water was applied using micro-systems.

In terms of total areas irrigated, volume of water used and farm size, there was little difference between pome fruit growers using micro or drip/trickle systems and the remaining farms using other systems. However, pome fruit farms with micro or drip/trickle systems consistently recorded better farm financial performance than farms using other systems.
FIGURE 49 Irrigation systems and water application rates, stone fruit farms, Murray–Darling Basin, 2006–07 to 2009–10 (proportion of farms and average per farm)

Source: ABARES survey of irrigation farms in the Murray–Darling Basin

FIGURE 50 Rate of return, by irrigation system, stone fruit farms, Murray–Darling Basin, 2006–07 to 2009–10 (average per farm)

Source: ABARES survey of irrigation farms in the Murray–Darling Basin
Irrigated broadacre farms

The proportions of irrigated broadacre farms in the Murray–Darling Basin using various irrigation technologies are shown in Figure 52. Flood/furrow systems were the most commonly used technologies for applying water on broadacre farms, being used primarily for crops such as rice, cotton and pasture. Fewer broadacre farms made use of methods such as travelling irrigators and moveable spray line systems.

FIGURE 51 Irrigation systems and water application rates, pome fruit farms, Murray–Darling Basin, 2006–07 to 2009–10 (proportion of farms and average per farm)

Proportion of farms

Water application rate

ABARES preliminary estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin

FIGURE 52 Irrigation systems and water application rates, broadacre farms, Murray–Darling Basin, 2006–07 to 2009–10 (proportion of farms and average per farm)

Proportion of farms

Water application rate

ABARES preliminary estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin
Dairy farms

Flood/furrow systems were the most commonly used technologies for applying water on dairy farms across the Murray–Darling Basin, primarily for irrigated pasture (Figure 53). Fewer dairy farms used other methods, such as travelling irrigators and moveable spray line systems.

**FIGURE 53 Irrigation systems and water application rates, dairy farms, Murray–Darling Basin, 2006–07 to 2009–10 (proportion of farms and average per farm)**

![Graph showing irrigation systems and water application rates for dairy farms from 2006-07 to 2009-10.]

- **Proportion of farms**
  - Flood/furrow: 80% in 2007-08, increasing to 90% in 2009-10.
  - Moveable spray lines: 20% in 2006-07, decreasing to 10% in 2009-10.
  - Travelling irrigators: 5% in 2006-07, increasing to 10% in 2009-10.

- **Water application rate**
  - Flood/furrow: 20 ML/Ha in 2006-07, increasing to 40 ML/Ha in 2009-10.
  - Moveable spray lines: 6 ML/Ha in 2006-07, increasing to 8 ML/Ha in 2009-10.
  - Travelling irrigators: 4 ML/Ha in 2006-07, decreasing to 2 ML/Ha in 2009-10.

*p ABARES preliminary estimate.  
Source: ABARES survey of irrigation farms in the Murray–Darling Basin*

Farm productivity

As discussed in Chapter 2, declining farm terms of trade have been an important long-term driver of change in Australian agriculture. Over time, farm input prices have tended to increase at a faster rate than prices received by farmers, resulting in declining terms of trade. Offsetting the effect of declining terms of trade on farm incomes, Australian agriculture has been achieving productivity growth; that is, the quantity of outputs produced has increased relative to the quantity of inputs used (Box 7).

Key drivers of productivity growth across the Australian economy include price incentives that follow increased competition and regulatory reform. These incentives apply external pressures and disciplines on producers to perform well. The National Water Initiative can influence productivity by encouraging competition and, in turn, enhancing price incentives between competing water users in agriculture. Removal of barriers to water trade and inclusion of environmental water demands in a market context have been the major drivers of increased competition.
The survey results suggest that total factor productivity (TFP) of irrigated farms in the Murray–Darling Basin has risen, on average, over the period from 2006–07 to 2009–10. Across the basin, farm productivity differed between farm types and regions. Average TFP levels were highest for horticulture farms and lowest for irrigated broadacre farms (Figure 54). Annual average TFP growth was highest for farms in the Macquarie–Castlereagh, Condamine–Balonne and Namoi regions, while there was an overall decline in TFP for farms in the remaining regions.

However, because TFP estimates can vary significantly from year to year, and given the adverse seasonal conditions experienced over much of the survey period, it would be inappropriate to draw any firm conclusions regarding long-term trends based on available data. Collection of further survey data is needed to extend the time series in order to produce more reliable estimates of productivity growth on irrigation farms.

**FIGURE 54 Farm-level total factor productivity index, by industry, Murray–Darling Basin, 2006–07 to 2009–10**

- **Horticulture**
- **Dairy**
- **Broadacre**

*Source: ABARES survey of irrigation farms in the Murray–Darling Basin*

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**Box 7 Defining productivity**

Productivity reflects the ability to produce goods and services (outputs) given the available resources (inputs). An increase in productivity indicates that inputs are being used more efficiently; that is, fewer inputs are required to produce the same output or, alternatively, additional output is possible from a given level of input use.

ABARES productivity estimates are derived using an index method to calculate total factor productivity (TFP), which is a ratio of a measure of total output to a measure of multiple inputs used in the production process.

The farm-level estimates of TFP presented in this report have been calculated using a Fisher quantity index, converted for transitivity in order to maintain consistency and comparability across farms and time. For aggregating individual inputs and outputs, the Fisher index requires a farm quantity and price for each input and output. The aggregate output index includes receipts from crops, livestock sales, wool, milk and other farm income, while the aggregate input index includes capital, land, labour, materials and services. Prices or values of each input and output are used as weights for the aggregation process (Sheng et al. 2011; Gray et al. 2011).
Irrigated broadacre farms in the Murrumbidgee region

The Murrumbidgee region is located in southern New South Wales. The main waterway is the Murrumbidgee River and the major water storages are the Burrinjuck and Blowering dams. Groundwater is also an important source of irrigation water in some parts of the region.

The two main irrigation areas in the region are the Murrumbidgee Irrigation area, located around Griffith and Leeton, and the Coleambally Irrigation area. Some irrigation activity also occurs around Wagga Wagga, Batlow, Hay, Jerilderie and Balranald. These areas typically support a broad range of irrigation activities, with the more important being rice, cereal crops, grapes, citrus, vegetables, pasture and hay production.

Irrigated broadacre farms in the Murrumbidgee region have a range of farm enterprises, such as rice, cereal crops, sheep and lambs on irrigated and dryland pasture, and wine grapes. In 2009–10 these farms accounted for around 50 per cent of all irrigators and 95 per cent of the total area set up for irrigation in the Murrumbidgee region. Irrigated broadacre farms accounted for 85 per cent of the total area irrigated in 2006–07, declining to a low of 74 per cent in 2008–09 as water allocations declined.

Recent farm performance

The average area operated by irrigated broadacre farms in the Murrumbidgee region in 2009–10 was estimated to have been around 1350 hectares, with 50 per cent of farms operating an area between 245 and 1050 hectares. On average, around 125 hectares of crops were irrigated in 2009–10, almost two-thirds higher than the average area irrigated in 2008–09. The average area of crops irrigated in 2010–11 is estimated to have been around 139 hectares.

Irrigated broadacre farms in the Murrumbidgee region used an average of 397 megalitres of irrigation water per farm in 2009–10, at an estimated rate of 2.9 megalitres per hectare. The volume of water used in 2010–11 is estimated to have been around 532 megalitres, at a rate of 3.8 megalitres per hectare.
Average farm cash income was estimated to have been $75,845 per farm in 2009–10, with an average farm business profit of $2,325 per farm. The average rate of return to capital (excluding capital appreciation) for these farms was estimated to have been around 1.2 per cent in 2009–10, compared with an average of –0.1 per cent in 2008–09. The average rate of return to capital (excluding capital appreciation) is estimated to have been 3.0 per cent in 2010–11.

**Selected trends over five years**

As in many other basin regions, irrigated broadacre farms in the Murrumbidgee experienced several years of below average rainfall and historically low water allocations over most of the survey period. Before the first irrigation survey was conducted in 2005–06 the maximum water allocation for general security license holders in the Murrumbidgee region, including most broadacre farms, was just over 50 per cent. In 2006–07, the first year of the survey, irrigators’ maximum allocation for general security entitlements was around 15 per cent (Figure 55). Irrigators also experienced sharp increases in water prices in 2006–07 and 2007–08 as allocations fell.

Reflecting their diversified enterprise mix, irrigated broadacre farms in the Murrumbidgee region generated income from a variety of crops, livestock and other sources. On average, receipts from cereal crops (wheat, oats and barley) and sheep and wool production made up a large proportion of total cash receipts (Figure 56). Water allocation sales were particularly important in 2008–09, making up around 20 per cent of total cash receipts.

Irrigated broadacre farms in the Murrumbidgee region used most of their irrigation water for crop production rather than on pastures. The average crop area as a percentage of total area varied from around 20 per cent to 30 per cent over the five years to 2010–11. From 2007–08 onwards, while irrigated crop areas increased as allocations rose, around two-thirds of all crops on these farms were still grown on a dryland basis (Figure 57).
On average, cereal crops accounted for around at least 75 per cent of total crop area, with a significant proportion grown on a dryland basis (Figure 58). Farmers grew comparatively smaller areas of fodder crops, oilseeds and pulses. From 2006–07 pulse crops were mostly grown on a dryland basis, while roughly half of fodder and oilseed crops were irrigated to some extent. With low water allocations, little rice was grown in the Murrumbidgee region between 2006–07 and 2010–11.

As rice production is entirely dependent on irrigation water in the region, there is a strong relationship between water availability and rice production. From a peak in 2000–01, the area planted to rice had declined by around 70 per cent as a result of increased water scarcity and lower allocations. While rice prices generally rose throughout this period, the gross value of rice production fell because of lower production.
**FIGURE 58** Irrigation by crop type, broadacre farms, Murrumbidgee region, 2006–07 to 2010–11 (average per farm)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat/barley/oats</td>
<td>80%</td>
<td>60%</td>
<td>40%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Fodder</td>
<td>70%</td>
<td>50%</td>
<td>30%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>90%</td>
<td>70%</td>
<td>50%</td>
<td>30%</td>
<td>10%</td>
</tr>
<tr>
<td>Pulses</td>
<td>100%</td>
<td>80%</td>
<td>60%</td>
<td>40%</td>
<td>20%</td>
</tr>
<tr>
<td>Rice</td>
<td>50%</td>
<td>30%</td>
<td>20%</td>
<td>10%</td>
<td>5%</td>
</tr>
</tbody>
</table>

*Proportion of total crop area

- Orange: Proportion of dryland
- Red: Proportion of irrigated

**Source:** ABARES survey of irrigation farms in the Murray-Darling Basin

*p ABARES preliminary estimate. y ABARES provisional estimate.*
Water allocation trading

In aggregate, the Murrumbidgee region was a net seller of allocation water in each year from 2006–07 to 2009–10. Reflecting this, the proportion of farms in the Murrumbidgee region that were net sellers was significantly higher than the proportion that were net buyers. Apart from 2010–11, when little trade occurred, net sellers accounted for at least one-third of farms in each year (Figure 59).

The proportion of net sellers that were broadacre farms increased consistently between 2006–07 and 2010–11, while the proportion that were horticulture farms declined over the same period. The smaller numbers of net buyers in this region were mostly broadacre farms.

With the sharp increases that occurred in water allocation prices relative to rice or wheat prices, irrigated broadacre farms were active sellers of water from 2007–08 to 2009–10. Around 60 per cent of broadacre farms sold water in 2008–09 (Figure 60). Compared with non-traders, net sellers recorded higher average total cash receipts and cash costs in most years and higher farm cash incomes in all years.

FIGURE 59 Proportions of farms, Murrumbidgee region, by water trading group, 2006–07 to 2010–11 (proportion of farms)

---

p ABARES preliminary estimate. y ABARES provisional estimate.

Source: ABARES survey of irrigation farms in the Murray–Darling Basin
Dairy farms in the Goulburn–Broken region

The Goulburn–Broken region is located in north-eastern Victoria. The main waterways are the Goulburn and Broken Rivers and the major water storage is Lake Eildon. Groundwater is also an important source of irrigation water in the region. The main irrigation districts in the Goulburn–Broken region are the Central Goulburn Irrigation Area, around Kyabram, and the Shepparton Irrigation Area. Principal irrigation industries in the region include dairy, horticulture, mixed grazing and broadacre cropping.

Dairy farms in the Goulburn–Broken accounted for around 60 per cent of all irrigators and 70 per cent of the area set up for irrigation. In 2006–07 dairy farms also accounted for 74 per cent of the total area irrigated, before declining to 48 per cent in 2010–11.

Recent farm performance

The average area operated by irrigated dairy farms in the Goulburn–Broken region in 2009–10 was around 174 hectares, with 50 per cent of farms operating an area between 85 and 215 hectares. On average, around 19 hectares of crops and 28 hectares of pasture were irrigated in 2009–10, 22 per cent lower than in 2008–09. The average area irrigated in 2010–11 was around 14 hectares of crops and 25 hectares of pasture.

Irrigated dairy farms in the Goulburn–Broken region used an average of 109 megalitres of irrigation water per farm in 2009–10, at an estimated rate of 2.3 megalitres per hectare. The volume of water used in 2010–11 is estimated to have been around 75 megalitres per farm, at an estimated rate of 1.9 megalitres per hectare.

Average farm cash income for dairy farms in the Goulburn–Broken region was estimated to have been $21 881 per farm in 2009–10, with an average farm business loss of $66 686 per farm. The average rate of return to capital (excluding capital appreciation) for these farms was estimated to have been around –2.2 per cent in

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**FIGURE 60** Financial performance, broadacre farms, Murrumbidgee region, by water trading group, 2006–07 to 2010–11 (proportion of farms and average per farm)

- **All farms**
- **Net sellers**
- **Non-traders**

- Proportion of farms in group
- Total cash receipts (right axis)
- Total cash costs (right axis)
- Farm cash income (right axis)

p ABARES preliminary estimate.

y ABARES provisional estimate.

Note: There were insufficient farm numbers to produce reliable survey estimates for net buyers and net sellers in 2006–07.

2009–10, compared with an average of −2.5 per cent in 2008–09. The average rate of return to capital (excluding capital appreciation) was estimated to have been −2.2 per cent in 2010–11.

**Selected trends over five years**

While much of the Murray–Darling Basin had experienced below average rainfall since around 2002, it was in 2006–07, the first year of the survey, that dairy farms in the Goulburn–Broken faced the full effects of declining inflows into river systems and storages. Maximum water allocations in the Goulburn water system fell from 100 per cent in 2005–06 to 29 per cent in 2006–07. In the Broken water system, severe cuts in allocations occurred in 2008–09 and 2009–10 (Figure 61).

For dairy farms in the Goulburn–Broken region, severe drought conditions in 2006–07 and subsequent low water allocations followed on from the two previous years where farm incomes had been above the long-term average in real terms.

As water allocations fell in 2006–07, dairy farmers in this region became major buyers of water allocations. However, as water supplies decreased throughout the southern basin, there were sharp rises in market prices for traded water. At the same time, prices for fodder and hay were also higher because of reduced availability due to drought (the highest cost component on dairy farms is usually fodder). Fodder costs as a proportion of average total cash costs reached a peak in 2008–09 before declining in subsequent years as seasonal conditions improved and fodder prices fell (Figure 62).

The average total area of irrigated pastures, irrigated crops and dryland crops remained at around 50 per cent of total farm area until 2009–10. While average total irrigated area declined, this was offset by increases in average dryland crop area (Figure 63).

Dairy farmers in the Goulburn–Broken region used at least 75 per cent of their total irrigated crop area for hay and silage production. In most years, hay and silage were also the main dryland crop enterprises—mostly between 70 and 90 per cent of total average dryland crop area.

While the total area irrigated declined (Figure 64), dairy farmers kept water application rates per hectare constant. Over the four years to 2009–10, water application rates remained within a bound of 2.2 to 2.4 megalitres per hectare. Improved rainfall in 2010–11 meant less irrigation water was applied to pasture in that year.
**FIGURE 61** Selected indicators, Goulburn–Broken region, 2005–06 to 2010–11

- **Milk price (c/L)**
- **Fodder price ($/t)**
- **Allocation water price ($/ML)**
- **Allocation percentage (%)**

- **Pre-survey year**
- **Goulburn (right axis)**
- **Broken (right axis)**

**Note:** Allocation percentage is the maximum allocation amount for Murrumbidgee regulated river waters.

**Sources:** Goulburn–Murray Water 2011; The Waterexchange 2012
FIGURE 62 Key influences on farm cash income, Goulburn–Broken region, dairy farms, 2006–07 to 2010–11 (average per farm and cents per litre)

![Graph showing farm cash income, costs side and receipts side, with various data points and line trends over the years 2006-07 to 2010-11.]

\*p ABARES preliminary estimate. y ABARES provisional estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin

FIGURE 63 Area trends, dairy farms, Goulburn–Broken region, 2006–07 to 2010–11 (average per farm)

![Graph showing area trends with various proportions of total area, including irrigated area, crop area, and pasture area, with data points over the years 2006-07 to 2010-11.]

\*p ABARES preliminary estimate. y ABARES provisional estimate.
Source: ABARES survey of irrigation farms in the Murray–Darling Basin
Water allocation trading

With the exception of 2007–08, the Goulburn–Broken region was a net buyer of allocation water in most years from 2006–07 to 2009–10. In 2007–08 the region was a net seller of allocation water. Largely reflecting this, the proportion of farms surveyed in the Goulburn–Broken region that were net buyers was higher than the proportion of net sellers. An estimated 37 to 42 per cent of farms were net buyers of water allocations between 2006–07 and 2009–10, while very few farms in the region traded water in 2010–11 (Figure 65).

Until 2009–10 dairy and horticulture farms were the main net buyers of allocation water in the Goulburn–Broken region. In 2009–10 the net buyers group comprised a mix of farms from all three industries. In 2010–11 the group consisted mainly of broadacre farms, although the total number of farms buying water in the region was small that year.

In contrast to dairy farmers in other basin regions, a relatively small proportion of dairy farmers in the Goulburn–Broken region were net sellers of water allocations. Despite high water prices, most dairy farmers in the Goulburn–Broken region were net buyers of water allocations; that is, they purchased more than they sold throughout the survey period, as they found it more profitable to purchase water allocations and grow feed than to purchase fodder.

From 2006–07 to 2009–10 around half the dairy farms in the Goulburn–Broken region traded water allocations. The proportion of farms buying water allocations declined each year from 2006–07 to 2009–10, while the proportion selling water allocations in the region exhibited greater year-to-year variation.

On average, net buyers of water allocations irrigated larger areas in absolute terms and as a proportion of total farm area (Figure 66). These farms also applied more water on average than net sellers or non-traders—in both total megalitres and megalitres per hectare. Although net buyers reported the highest average total cash receipts and cash costs in most years, their average farm cash income was similar to that recorded by net sellers and non-traders (Figure 67).
FIGURE 65 Proportion of farms, Goulburn–Broken region, by water trading group, 2006–07 to 2010–11 (proportion of farms)

[Graph showing the proportion of farms in different trading groups over the years from 2006–07 to 2010–11.]

p: ABARES preliminary estimate. y: ABARES provisional estimate.

FIGURE 66 Areas and water use, dairy farms, Goulburn–Broken region, by water trading group, 2006–07 to 2010–11 (average per farm)

[Graph showing areas and water use for dairy farms across different trading groups over the years from 2006–07 to 2010–11.]

p: ABARES preliminary estimate. y: ABARES provisional estimate.
Note: There were no farms in the net buyers and net sellers groups in 2010–11.
FIGURE 67 Financial performance, dairy farms, Goulburn–Broken region, by water trading group, 2006–07 to 2010–11 (proportion of farms and average per farm)

Net buyers

Net sellers

Non-traders

- Proportion of farms in group
- Total cash receipts (right axis)
- Total cash receipts (right axis)
- Fodder cost (right axis)
- Water cost (right axis)
- Farm cash income (right axis)

p ABARES preliminary estimate. y ABARES provisional estimate.

Note: There were no farms in the net buyers and net sellers groups in 2010–11.

Source: ABARES survey of irrigation farms in the Murray–Darling Basin
In 2009–10 about 37 per cent of Australia’s irrigating agricultural businesses were located in the Murray–Darling Basin (ABS 2011a). These businesses undertake a range of irrigated agricultural enterprises, including vegetable crops, perennial tree and vine crops, pastures for grazing, hay, rice, cotton, cereal and oilseed crops.

The ABARES survey of irrigation farms in the Murray–Darling Basin provides coverage of broadacre (including rice and cotton growers), dairy and horticulture irrigation farms in 10 regions throughout the basin. Broadacre and horticultural industries were significant in most of the 10 regions surveyed. Dairying was important in fewer regions.

The survey regions chosen cover the major irrigation areas in the basin and are drawn from those defined by the Commonwealth Scientific and Industrial Research Organisation in its Sustainable Yields Project (CSIRO 2007). The regions are Condamine–Balonne, Border Rivers, Namoi, Macquarie–Castlereagh, Lachlan, Murrumbidgee, Murray, Goulburn–Broken, Loddon–Avoca and Eastern Mount Lofty Ranges (Map A).

ABARES field officers used face-to-face interviews with irrigators to obtain detailed farm financial and physical information. This information included land area and value, crop and livestock production and sales, irrigation water use by crop type and pasture, irrigation water delivery methods, farm receipts and costs, labour use, debts and assets, and market value of farm capital. The survey also included questions on types of water licences held, participation in water trading, types of irrigation infrastructure, basis for irrigation scheduling decisions, and future intentions. Summary results for each region are provided in Ashton and Oliver (2012).

In most regions, the farm businesses surveyed in each industry were relatively homogeneous in enterprise mix, but there was considerable variability across farms for individual estimates. Distributions of selected variables are provided in Ashton and Oliver (2012).

**Target populations**

ABARES surveys are designed, and samples selected, on the basis of a framework drawn from the Business Register maintained by the Australian Bureau of Statistics. This framework includes agricultural establishments (farms) classified by size and industry in each statistical local area.
To be eligible for the ABARES survey of irrigation farms in the Murray–Darling Basin farms had to have engaged in irrigated agricultural activities during the survey year, had an estimated value of agricultural operations of $40 000 or more, and be defined as broadacre, dairy or horticulture industry farms.

The industry classifications used in this study are based on the Australian and New Zealand Standard Industrial Classification (ANZSIC). This classification is consistent
with an international standard and permits comparisons between industries, both in Australia and internationally. Farms assigned to a particular ANZSIC class have a high proportion of their total output characterised by that class (ABS & SNZ 2006).

The ANZSIC industry classes and codes associated with the broadacre, dairy and horticulture industries used for this study were:

<table>
<thead>
<tr>
<th>Broadacre</th>
<th>Dairy</th>
<th>Horticulture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep farming</td>
<td>Dairy cattle</td>
<td>Vegetable growing (under cover)</td>
</tr>
<tr>
<td>Beef cattle farming</td>
<td></td>
<td>Vegetable growing (outdoors)</td>
</tr>
<tr>
<td>Sheep–beef cattle farming</td>
<td></td>
<td>Grape growing</td>
</tr>
<tr>
<td>Grain–sheep and grain–beef cattle</td>
<td></td>
<td>Apple and pear growing</td>
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<td>growing</td>
<td></td>
<td>Stone fruit growing</td>
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<tr>
<td>Rice growing</td>
<td></td>
<td>Citrus fruit growing</td>
</tr>
<tr>
<td>Other grain growing</td>
<td></td>
<td>Other fruit and nut tree growing</td>
</tr>
<tr>
<td>Cotton growing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Survey design and sample weighting

The farm population to be surveyed was stratified by operation size using the estimated value of agricultural operation (EVAO). The size of each stratum was determined using the Dalenius–Hodges method (Lehtonen & Pahkinen 2004). The sample allocation to each stratum was performed using a mixture of the Neyman allocation, which takes into account variability within strata of the auxiliary variable (in this case EVAO), and proportional allocation, which only considers the population number in each stratum. The Neyman allocation allocates large proportions of sample to strata with large variability—in the case of this survey, strata of larger farms (Lehtonen & Pahkinen 2004).

The estimates presented in this report are calculated by appropriately weighting the data collected from each sample farm and then using the weighted data to calculate population estimates. Generally, larger farms have smaller weights and smaller farms have larger weights, reflecting the strategy of sampling a higher fraction of larger farms than of smaller farms (the former having a wider range of variability of key characteristics).

### Reliability of estimates

The reliability of the estimates of population characteristics presented in this report depends on the design of the sample and the accuracy of the measurement of characteristics for the individual sample farms.
Sampling errors

Only a small number of farms out of the total number of farms in a particular industry/region were surveyed. The data collected from each sample farm was weighted to calculate population estimates. Estimates derived from these farms are likely to be different from those that would have been obtained if information had been collected from a census of all farms. Any such differences are called sampling errors.

The size of the sampling error is most influenced by survey design and estimation procedures, as well as the sample size and variability of farms in the population. The larger the sample size, the lower the sampling error is likely to be. Therefore, national estimates are likely to have smaller sampling errors than industry or region estimates.

Sampling errors are a guide to the reliability of survey estimates and have been calculated for all estimates in this report. These sampling errors, expressed as percentages of the survey estimates and termed relative standard errors, are provided next to each estimate in parentheses.

Calculating confidence intervals using relative standard errors

Relative standard errors can be used to calculate confidence intervals; these indicate how close the actual population value is likely to be to the survey estimate.

The standard error is obtained by multiplying the relative standard error by the survey estimate and dividing by 100. For example, if average total cash receipts are estimated to be $100 000 with a relative standard error of 6 per cent, the standard error for this estimate is $6000. One standard error is equal to $6000 and two standard errors are equal to $12 000.

For a 66 per cent confidence interval, there is roughly a two-in-three chance that the census value (the value that would have been obtained if all farms in the target population had been surveyed) is within one standard error of the survey estimate. This range of one standard error is described as the 66 per cent confidence interval. In this example there is an approximately two-in-three chance that the census value is between $94 000 and $106 000, ($100 000 + or – $6000).

For a 95 per cent confidence interval, there is roughly a 19-in-20 chance that the census value is within two standard errors of the survey estimates (the 95 per cent confidence interval). In this example, there is an approximately 19-in-20 chance that the census value lies between $88 000 and $112 000, ($100 000 + or – $12 000).

The size of the relative standard error is mainly influenced by survey design, sample size and variability in the population. For example, the larger the sample size, the lower the relative standard error is likely to be.

Comparing estimates

When comparing estimates between two groups, it is important to recognise that the differences are subject to sampling error. A conservative estimate (an overestimate) of the standard error of the difference can be found by adding the squares of the estimated standard errors of the component estimates and taking the square root of the result.

For example, estimates of farm cash income are $139 210 for irrigated horticulture farms in New South Wales and $162 020 for irrigated horticulture farms in...
Queensland, with relative standard errors of 33 per cent and 26 per cent, respectively. The difference between these two estimates is $22 810. The standard error of the difference is estimated as:

$$\sqrt{(33 \times \frac{139 210}{100})^2 + (26 \times \frac{162 020}{100})^2} = $62 330$$

A 95 per cent confidence interval for the difference is:

$22 810 \pm 1.96 \times 62 330 = (-$99 357, $144 977)$

Therefore, if 100 different samples are taken, in 95 of them the difference between these two estimates would be between –$99 357 and $144 977.


Bibliography


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Bibliography


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