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Agricultural and food policy choices in Australia

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Australian Bureau of Agricultural and Resource Economics – Bureau of Rural Sciences (ABARE–BRS)
Sustainable agriculture and food policy in the 21st century: challenges and solutions

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Abstract

This paper examines some of the key features of Australian agriculture and policy approaches to address challenges in the sector. Some major challenges that are highlighted include: the long-term decline in the farmers' terms of trade and the important role of productivity growth to maintain cost competitiveness; the relatively high volatility in yields and prices in agricultural markets; and the economic impact of the resources boom. An analytical framework and examples of agricultural policy approaches in Australia are presented. A case study of water management in Australia is included to highlight the important role of market-based instruments in Australia's policy approach.

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Introduction

Australia is a small open economy with relatively abundant natural resources. Around 60 per cent of Australia's land mass is used in some form of agricultural activity, although water availability is a major challenge for the industry (Lubulwa et al. 2010). In 2009–10 (year ending 30 June 2010), agriculture accounted for 2.2 per cent of total output (gross domestic product or GDP) and 2.9 per cent of total employment; and the rural sector, including food processing, accounted for 4.3 per cent and 5.4 per cent of total output and employment, respectively (ABARE–BRS 2010a). Agriculture is a particularly important economic activity for communities in regional Australia.

In aggregate, around 60 per cent of Australia's farm production is exported and farm exports account for 11 per cent of the total value of Australia's exports of goods and services (ABARE–BRS 2010a). By international standards, Australia is a major exporter of several agricultural commodities. In 2008–09, Australia was one of the two leading exporters of raw wool, beef and veal, sheep meat and barley (table 1). Australia also ranks highly in world exports for a number of other commodities, including sugar, raw cotton and dairy products.

The main objective of this paper is to examine the Australian Government's policy approach to agriculture. In recent decades, there has been increasing recognition that market-based mechanisms have an important role in achieving efficient policy responses to identified market failures. There are a number of important challenges in Australian agriculture including: the long-term decline in the farmers' terms of trade and the role of productivity growth to maintain cost competitiveness; the relatively high volatility in yields and prices in Australian agriculture; and the economic impact of the current resources boom.

1 Australia's ranking and share in world exports for selected commodities, 2008–09 a

	world ranking	share of world
	no.	%
Crops		
Wheat	5	9.9
Barley	2	19.4
Sugar	4	6.1
Raw cotton	5	3.2
Livestock		
Beef and veal b	2	18.8
Sheep meat b	2	30.6
Raw wool	1	67.1
Dairy products b		
– Butter	6	7.9
– Cheese	6	16.8
– Skim milk powder	4	14.9

a Based on volume of exports. **b** 2008 data.
Source: ABARE 2009.

The outline of the paper is as follows. Key features and challenges in Australian agriculture are discussed briefly in the next two sections. An analytical framework and examples of agricultural policy approaches in Australia are then presented. A case study of water management is provided in the following section to highlight the important role of market-based instruments in the Australian Government's policy approach. Some concluding comments are given in the final section.

Key features of Australian agriculture

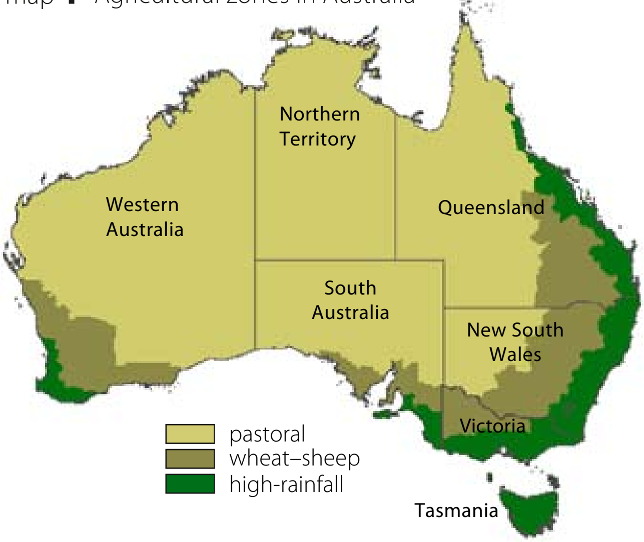
Geographic zones and farm characteristics

In Australia, agricultural activity occurs in three broad geographic zones, which vary significantly in terms of climate, soil types, water availability and proximity to markets (see map 1) (Lubulwa et al. 2010):

- **Pastoral zone**—characterised by low rainfall and less fertile soils, agricultural land use is characterised by extensive grazing of native pastures.
- **Wheat–sheep zone**—the climate and topography generally allow regular cropping of grains in addition to the grazing of sheep and beef cattle on a more intensive basis than in the pastoral zone.
- **High-rainfall zone**—more suitable for grazing and intensive crop growing. Australia's dairy industry is mainly located in coastal areas of the high rainfall zone.

Irrigation-based farming also occurs within these areas. In 2005–06, the latest year for which Australian Bureau of Statistics (ABS) census data are available, there were around 154 700 farms: 6600 farms operated in the pastoral zone (with an average farm area of 47 400 hectares per farm), 64 600 farms in the wheat–sheep zone (1400 hectares per farm) and 83 500 farms in the high-rainfall zone (397 hectares per farm).

map **1** Agricultural zones in Australia



As has happened in other developed countries, farm numbers in Australia have declined over the past four decades—at an average annual rate of slightly less than 1 per cent (ABARE 2009). Rural employment has also declined over time; over the past decade, rural employment fell by 17 per cent from around 437 000 persons in 1999–2000 to around 363 000 persons in 2009–10 (ABARE 2009; ABARE–BRS 2010a).

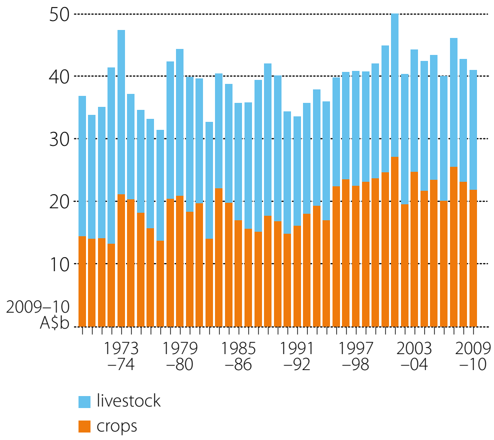
In 2008–09, around 136 000 commercial-scale farms (classified by the ABS as farms with an estimated value of agricultural operations of more than A$5000) were located in the three agricultural zones (Lubulwa et al. 2010). Smaller farms are mainly rural residential holdings that are clustered around major regional centres and rely on non-farm income. More than 98 per cent of farms in Australia are family owned.

Larger farms tend to account for a relatively high share of industry output and the degree of market concentration has increased over time (Lubulwa et al. 2010). For example, in the beef industry the largest 30 per cent of farms (in terms of area operated) accounted for around half of total output in 2008–09, while the smallest 30 per cent of farms accounted for 16 per cent. Larger farms tend to benefit from economies of scale and report better financial performance than smaller farms because larger farms are typically characterised by better farm management planning, greater use of new technologies and higher levels of participation in a range of learning and training activities.

Farm production

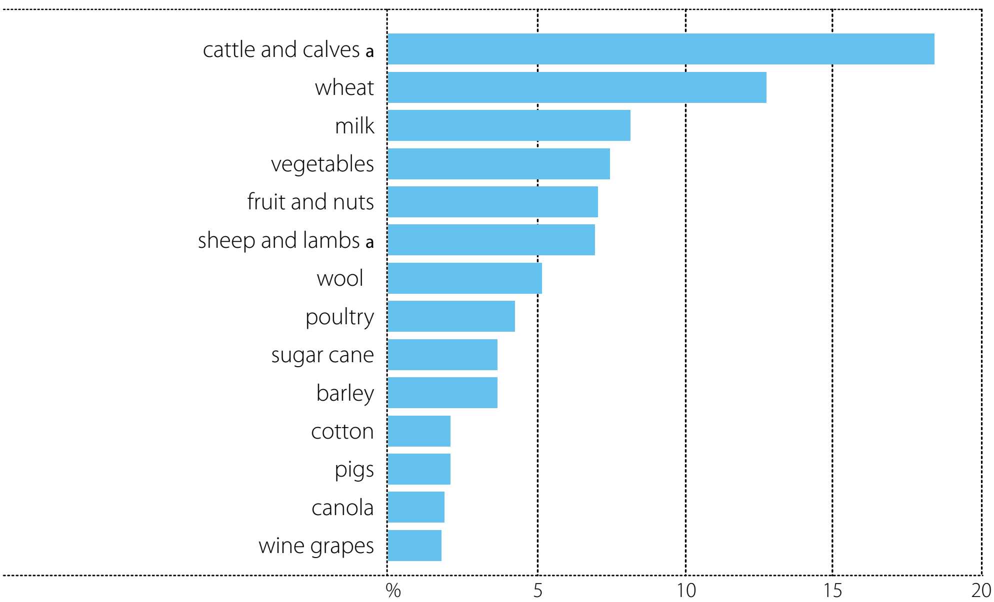
Australia's real gross value of farm production has increased slightly over the past four decades, from A$37 billion in 1969–70 to A$41 billion in 2009–10 (in 2009–10 prices) (figure 1) (ABARE 2009; ABARE–BRS 2010a). This represents an average annual growth rate of 0.3 per cent. Over this period, the value of crop production has increased (1.1 per cent a year) and the value of livestock production has declined slightly (–0.4 per cent a year). Real gross value of farm production peaked at A$50 billion in 2001–02, but has been affected by drought and poor seasonal conditions since then.

1 Australia's real gross value of farm production,1969–70 to 2009–10



The major agricultural commodities produced in Australia are indicated in figure 2. In 2009–10, around two-thirds of Australia's real gross value of farm production was sourced from cattle and calves, wheat, milk, vegetables, fruit and nuts, sheep and lambs, and wool (see table A1 in appendix A for further information).

2 Share of major commodities in Australia's gross value of farm production, 2009–10

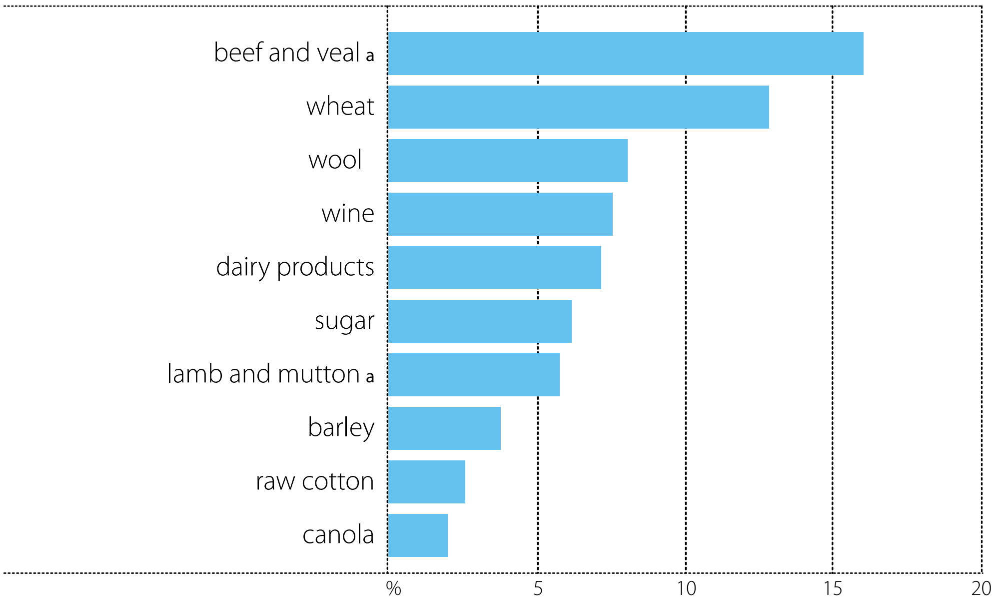


a Includes exports of live animals.

Farm exports

In 2009–10, Australia's farm exports were valued at A$29 billion, comprising crop exports of A$15 billion (53 per cent of total farm exports) and livestock exports of A$13 billion (47 per cent) (ABARE–BRS 2010a). The major agricultural commodities exported from Australia are indicated in figure 3. In 2009–10, nearly two-thirds of Australia's farm exports were sourced from beef and veal, wheat, wool, wine, dairy products, sugar, and mutton and lamb (see table A2 in appendix A for further information).

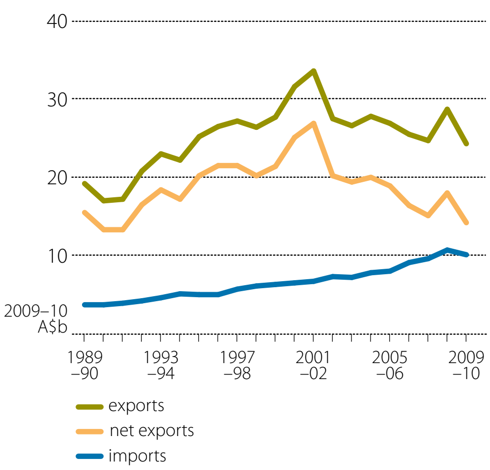
3 Share of major commodities in Australia's farm exports, 2009–10



a Includes exports of live animals.

In 2008–09, the four main export markets for Australia's agricultural commodities were Japan (16 per cent of total farm exports), China (10 per cent), the United States (9 per cent) and Indonesia (8 per cent). The European Union accounted for 8 per cent of Australia's farm exports (see table A3 in appendix A for further information).

4 Australia's food exports and imports, 1989–90 to 2009–10



Food trade

Australia's food exports increased during the 1990s, reaching a high of A$34 billion in 2000–01 (in 2009–10 prices) (ABARE 2009; ABARE–BRS 2010a). Reflecting the impact of drought and increased domestic demand, food exports have since declined to A$24 billion in 2009–10. Food imports have more than doubled over this period, to A$10 billion in 2009–10. As a result, Australia's net food exports have fallen markedly in recent years, from a high of A$27 billion in 2000–01 to A$14 billion in 2009–10. Australia's major food trading partners are indicated in figure A1 in appendix A.

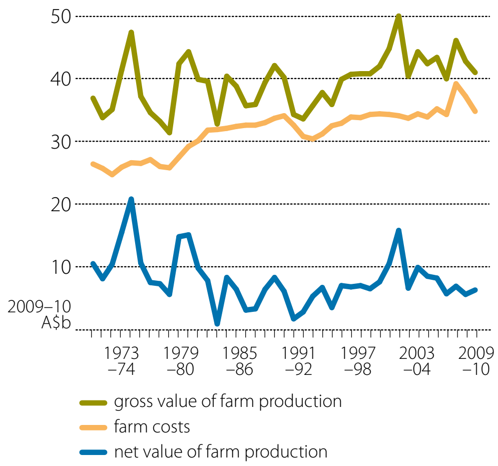
Major challenges in Australian agriculture

In recent decades, real farm costs have increased (at an average annual rate of 0.7 per cent between 1969–70 and 2009–10) and the real net value of farm production has declined overall (–1.3 per cent) (figure 5). Australia's farm performance in recent years is discussed in some detail in Martin et al. (2010). Important challenges in Australian agriculture, discussed briefly below, are the long-term downward trend in the farmers' terms of trade, variability in the real net value of farm production (or farm income), economy-wide effects of resource booms, and climate change effects.

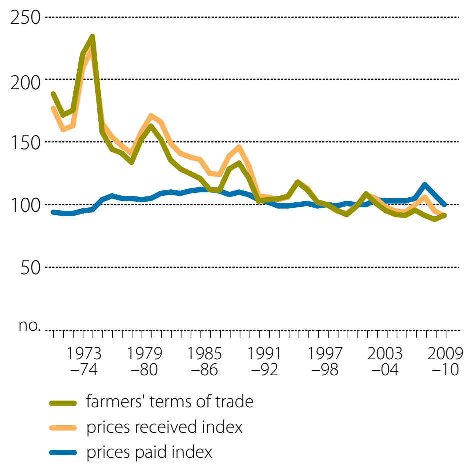
Long-term decline in the farmers' terms of trade

Measured as the ratio of the prices received index to the prices paid index, the farmers' terms of trade has declined in recent decades (at an average annual rate of 1.8 per cent between 1969–70 and 2009–10) (figure 6). Over this period, real prices received by farmers have declined significantly (–1.6 per cent a year), while real prices paid by farmers have increased marginally (0.2 per cent a year).

5 Real farm returns and costs in Australia



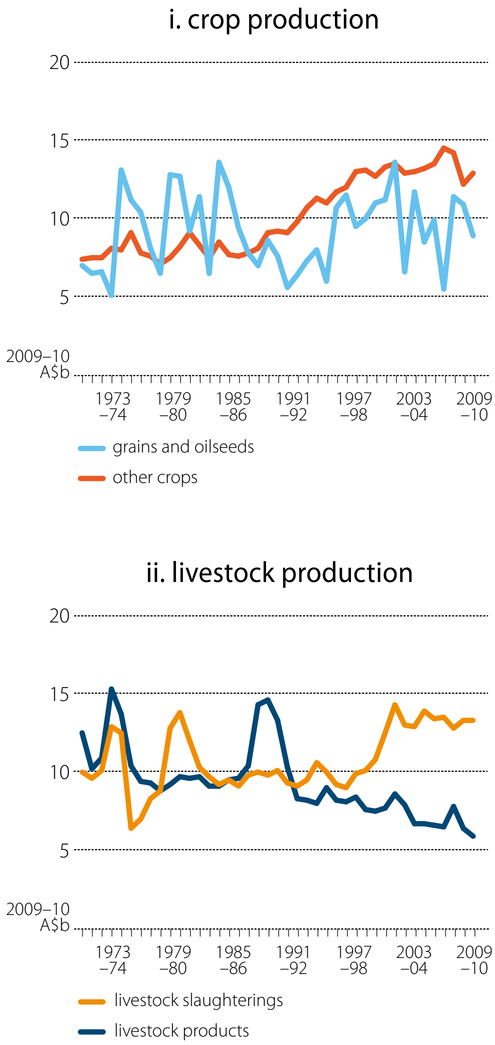
6 Australian farmers' terms of trade, and the real prices received and paid indexes
(base: 1997–98=100)



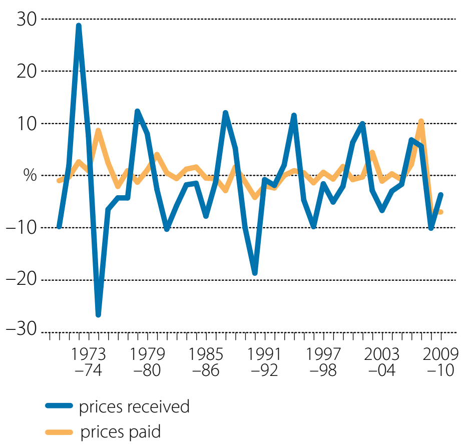
Productivity growth has been a critical factor underpinning industry profitability in recent decades. Growth in agricultural production largely depends on increases in productivity because of limitations in the availability of key inputs, particularly land and water resources. Between 1974–75 and 2007–08, total factor productivity (the value of output relative to the value of inputs used) in Australia's agriculture, forestry and fisheries sector increased at an average annual rate of 2.2 per cent, substantially higher than in the manufacturing sector (1.2 per cent a year), the retail trade sector (0.9 per cent a year) and the mining sector (0.8 per cent a year) (Productivity Commission 2009a).

Based on ABARE estimates for the period 1977–78 to 2006–07, total factor productivity in broadacre agriculture increased at an average annual rate of 1.5 per cent (Nossal et al. 2009). Over this period, total factor productivity growth was highest for cropping specialists and lowest for sheep specialists:

7 Australia's real gross value of farm production for major commodity groups



8 Volatility in Australian real prices received and prices paid by farmers (annual percentage change)



- **cropping specialists**—productivity growth was 2.1 per cent a year with outputs increasing more than inputs
- **mixed crop–livestock farms**—productivity growth was 1.5 per cent a year with relatively constant outputs and reduced inputs
- **beef specialists**—productivity growth was 1.5 per cent a year with increased outputs and relatively constant inputs
- **sheep specialists**—productivity growth was 0.3 per cent a year with reduced outputs and a larger fall in inputs

Over the period 1988–89 to 2006–07, the productivity growth of dairy farmers averaged 1.2 per cent a year, with outputs increasing more than inputs (Nossal et al. 2009).

The capacity of Australian farmers to respond to changing physical, economic and policy conditions in recent decades is highlighted in figure 7. As indicated by movements in the real gross value of farm production, there has been a major shift over the past two decades away from livestock products, particularly wool, toward livestock slaughterings and other crops (crops other than grains and oilseeds).

Variability in real net value of farm production

The variability in real net value of farm production has two key components: yield or production variability and price variability.

Yield or production variability—domestic supply side factors, particularly the influence of weather and climate, can have a substantial effect on farm sector earnings; for example, 1982–83, 1994–95, 2002–03 and 2006–07 were years of substantial drought and lower farm incomes in Australia (Lubulwa et al. 2010). Yield or production variability is mainly associated with fluctuations in seasonal weather conditions (particularly rainfall), but is also caused by other factors such as natural disasters (for example, bushfires and floods), and pest and disease outbreaks. Yield variability is relatively high for grains and oilseeds producers (figure 7).

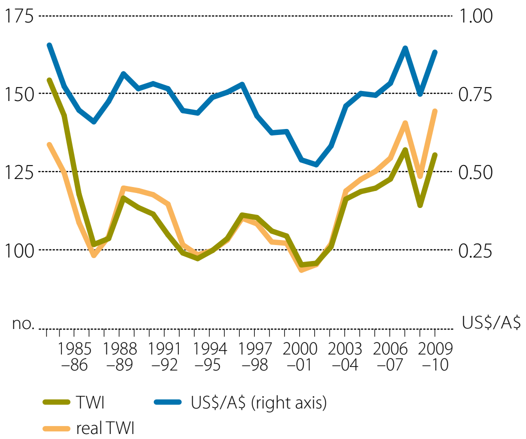
Price variability—real prices received by farmers tend to be highly variable, particularly compared with real prices paid by farmers (figure 8). Movements in agricultural commodity prices in Australian dollars are determined by movements in world commodity prices (reflecting supply and demand conditions in world commodity markets) and movements in the Australian dollar.

A recent OECD study examined variability in wheat yield and prices in Australia and five European countries (Kimura et al. 2010). Yield variability and price variability at both the farm level and aggregate level were found to be important sources of risk in Australia. A negative correlation between wheat yield and price moderated the variability in wheat revenue, particularly at the aggregate level.

Economy-wide effects of resource booms

Resource booms have a significant influence on price variability in Australian agriculture through the exchange rate. Australia is a major exporter of mineral resources, and the domestic and international competitiveness of Australian agriculture is influenced by the cyclical fluctuations that occur in the mining sector. There are two important economy-wide effects of resource booms: increased national income and spending, placing upward pressure on the value of the Australian dollar; and increased demand for inputs, placing upward pressure on wages and other input costs.

9 Australia's trade weighted index (TWI) and the US$/A$ exchange rate, 1983–84 to 2009–10
(index base: 1994–95=100)



The real trade weighted index of the value of the Australian dollar has increased strongly in recent years, corresponding to a strong upturn in the mining sector (figure 9). Conversely, a minerals downturn around 10 years ago corresponded to a relatively low real exchange rate and a relatively high net value of farm production. Although cyclical fluctuations in the mining sector result in major challenges for other export and import competing industries, such as agriculture, resource booms provide important economic benefits to the Australian economy (see, for example, Hogan et al. 1996 and Hogan et al. 2002).

Other challenges

Other important issues in the outlook for agriculture include climate change and market access for Australia's commodity exports. There has been an increase in average temperatures and a decline in average rainfall across parts of Australia over the past century (CSIRO and BoM 2007; Garnaut 2008). In Australia, climate change is expected to result in further increases in average temperatures and declines in rainfall, as well as an increase in the likelihood of extreme weather events, including exceptionally high temperatures, heavy daily rainfall events and strong tropical cyclones (Garnaut 2008). Importantly, the effects of climate change will differ significantly between regions in terms of the direction, scope and types of changes.

Australian agriculture is likely to be affected by climate change in a number of ways. First, higher temperatures and reduced rainfall are likely to reduce crop yields and livestock productivity, unless alternative production methods and new technologies can be developed to adapt to the changing climate. Second, government policies introduced to mitigate greenhouse gas emissions are likely to change production costs (Calford et al. 2010). Third, global trade patterns are likely to alter, as climate change continues to affect producers and consumers of agricultural commodities worldwide.

Despite considerable uncertainty about the nature and extent of changes to the pattern of rainfall and temperature in Australia, there have been attempts to quantify the potential impacts of climate change on the agricultural sector in the absence of mitigation efforts. Gunasekera et al. (2007) estimate that Australian production of key agricultural commodities (wheat, beef, dairy and sugar) could decline by 9–10 per cent by 2030 and 13–19 per cent by 2050, compared with the reference case. Australia is projected to be one of the most adversely affected regions from future climate change in terms of negative impacts on agricultural activity (Gunasekera et al. 2007). For example, beef and dairy production in Australia is projected to decline by 19 per cent and 18 per cent, respectively, by 2050 (compared with the reference case) in the absence of mitigation and planned adaptation, while production in the United States is projected to decline by less than 10 per cent over the same period as a result of climate change (Gunasekera et al. 2007). Adapting to this changing climate may allow some of these production losses to be avoided.

Border tax adjustments, if introduced in major countries or regions such as the European Union, would have a significant impact on global trade outcomes. Private standards such as some companies applying the concept of food miles (the distance food travels from farmer to consumer) may distort international agricultural trade and result in higher, not lower, greenhouse gas emissions (Hogan and Thorpe 2009).

Policy approaches in Australian agriculture

In recent decades there has been an important policy reform process in Australia and other developed economies toward the adoption of more efficient market-based mechanisms to address market failures in agriculture. The aim in this reform process has been to implement a policy framework that encourages industry participants to respond efficiently to changing market conditions. The capacity of Australian farmers to respond to changing physical, economic and policy conditions in recent decades was indicated in figure 7. It is particularly important to continue the reform process to further increase the flexibility of farmers to adapt to changing conditions, given the expected challenges in Australian agriculture over the medium to longer term.

Agriculture is a highly competitive industry with a relatively large number of farmers in Australia. Markets are highly competitive when the decisions of participants (buyers and sellers) do not influence prices; that is, prices are determined by the interaction of many buyers and sellers. Market failures, such as those in box 1, distort market prices and hence production and consumption outcomes; that is, market failures result in an inefficient allocation of resources in the economy. The main criteria used in assessing the benefits, costs and risks of policy options are economic efficiency—that is, the extent to which a policy may have a negative impact on farm investment and production decisions—and administrative simplicity, including administration and compliance costs. Governments also have an important role in assessing the equity implications of policy options.

box 1 Analytical framework

The analytical framework for considering policy approaches in Australian agriculture has two key components: the production and investment decisions of farmers, and the economic justification for government intervention in agriculture. In making production and investment decisions, farmers are assumed to be profit maximisers who take into account possible agricultural input–output relationships (including technology options) and various risks associated with the physical environment (such as weather) and economic and policy setting. An analytical framework for risk, including a brief discussion of risk management strategies in agriculture, is presented in appendix B.

The economic justification for government intervention in agriculture is based on the presence of market failures. In general terms, market failures occur when the private sector does not produce an appropriate (or optimal) level of goods or services, and government intervention is justified if an appropriate policy response increases the wellbeing of the community. Some important examples of market failures relevant to agriculture include public goods, externalities, natural monopolies and risk. These are discussed below.

Public goods are non-rival (consumption of the good by one individual has no impact on consumption by others) and non-exclusive (individuals cannot be excluded from consuming the good). For example, the environment provides a range of services but private markets will not appropriately price these services if it is not possible, or is extremely costly, to exclude consumers. In the case of water, an option for government policy is to introduce private property rights that are exclusive and enforceable. The government also has an important role in making a subjective judgment about the non-market value of natural resources; for example, in allocating water rights between environment and consumptive uses (see, for example, Goesch et al. 2008).

Externalities occur as an unpriced by-product or side effect of either the production or consumption of a good or service, and are also referred to as spillover or third party effects. Research and development (R&D) is an example of a positive externality because private firms that invest in R&D often do not capture all the benefits of the investment—that is, third parties may free ride on the R&D activity of private investors. In the absence of government intervention, private markets invest too little in R&D. Air pollution is an example of a negative externality, as it results in damage to the environment and/or human health. In the absence of government intervention, private markets produce too much air pollution.

A natural monopoly occurs when a single firm can produce a good at lower cost than any alternative market structure but, without policy intervention, the single provider would restrict output and charge a relatively high price.

continued...

box 1 **Analytical framework** continued

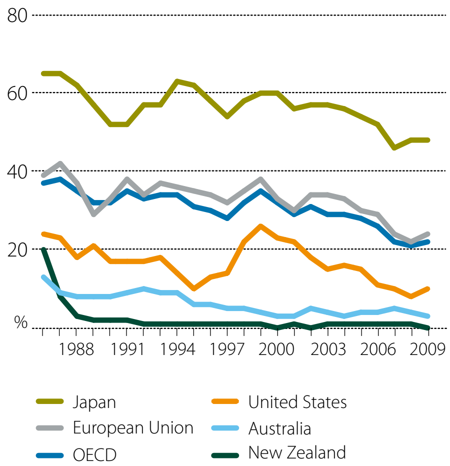
For example, there tend to be natural monopoly conditions in the water supply industry (because initial infrastructure investment costs are relatively high), at least within particular regions (the spatial boundaries of a natural monopoly may vary between locations). Industry costs tend to be lower if there is a single provider because this avoids costly duplication of water storage, purification and delivery infrastructure. The characteristics of the natural monopoly may change over time because of factors such as technological change.

Risk occurs when buyers and sellers do not have full information—there may be a general lack of information or information may be restricted to one part of the market (asymmetric information). Agriculture is a highly risky activity. Markets have been developed to manage risk, including futures markets (to manage price risk) and crop insurance (to manage yield risk). Risk management strategies may also be adopted by individual farmers, including diversifying the output mix on farms and gaining off-farm employment. However, private risk management strategies do not fully address risk, particularly catastrophic risk. In the absence of government intervention, risk results in private markets producing too little output (see appendix B for further discussion).

Australia's agricultural policy framework

The OECD recently noted that Australia has made substantial and continuing progress since the mid-1980s in removing policies that distort agricultural production and trade (OECD 2009a). The OECD's producer support estimate (PSE) is a measure of the annual monetary transfers to farmers from three broad categories of government policy, including market price support, budgetary payments and budgetary revenue foregone through, for example, an investment credit.

10 Estimates of producer support, as a percentage of gross farm receipts, in selected OECD economies



Source: OECD 2010, PSE/CSE database.

Australia's percentage PSE (the PSE as a percentage of gross farm receipts) has declined from 13 per cent in 1986 to 3 per cent in 2009 (figure 10 and table 2). Over this period, the percentage PSE has fallen in the OECD region (from 37 per cent to 22 per cent), but remains high in some countries (such as Japan, the Republic of Korea and European countries). In New Zealand, the percentage PSE has declined from 20 per cent in 1986 to 0 per cent in 2009.

In nominal terms, producer support in Australia has been reduced from A$2.3 billion in 1986 to A$1.2 billion in 2009. The main areas of producer support in Australian agriculture have changed markedly since the mid-1980s (table 2). In 1986, the main areas of producer support were market price support (75 per cent) and fuel tax credits (16 per cent). With market liberalisation of the milk industry in 2000, market price support in Australia was reduced to close to zero. In 2009, the main areas of producer support were payments based on input use (51 per cent) and payments based on historical arrangements where current production is not required (38 per cent).

General services support in Australian agriculture has increased from $0.1 billion in 1986 to A$0.8 billion in 2009 (table 3). Public research and development (R&D) expenditure through CSIRO plant and animal research was the only form of general services support in 1986. Since that time, public investment in R&D has increased and become more diversified (accounting for 75 per cent of total general services support in 2009), and governments now also support other areas, particularly inspection services (12 per cent) and infrastructure (11 per cent).

2 Estimates of producer support in Australian agriculture

	1986		2009	
	value A$m	share of total %	value A$m	share of total %
Support based on commodity outputs				
Market price support (MPS)				
Milk MPS	866.4	38.1	0.0	0.0
Wheat MPS (up to 1998)	302.4	13.3	0.0	0.0
Eggs MPS (1986 to 1995)	75.6	3.3	0.0	0.0
Refined sugar MPS (1986 to 1996)	67.4	3.0	0.0	0.0
Wool MPS (1986 to 1997)	39.5	1.7	0.0	0.0
Cotton MPS	14.2	0.6	0.0	0.0
Rice MPS	12.4	0.5	1.7	0.1
Sheep meat MPS (1986 to 1990)	10.7	0.5	0.0	0.0
Pig meat MPS (1986 to 1998)	0.5	0.0	0.0	0.0
Other MPS	319.4	14.1	0.8	0.1
Total	1 708.5	75.2	2.5	0.2
Payments based on output	0.0	0.0	0.0	0.0
Total support based on commodity outputs	1 708.5	75.2	2.5	0.2
Payments based on input use				
On-farm services				
State extension and advisory services	0.0	0.0	104.5	8.8
Disease and pest control (state)	0.0	0.0	94.3	7.9
Drought assistance - Professional Advice and Planning Grants	0.0	0.0	28.0	2.4
Training services (state)	0.0	0.0	20.6	1.7
Climate Change Adjustment Program (CCAP)	0.0	0.0	13.8	1.2
Bovine brucellosis and tuberculosis eradication campaign	16.2	0.7	0.0	0.0
Other	0.0	0.0	8.7	0.7
Total	16.2	0.7	270.0	22.7
Variable input use				
Exceptional Circumstances Interest Rate Subsidy	0.0	0.0	219.9	18.5
Fuel tax credits	367.7	16.2	0.0	0.0
Total	367.7	16.2	219.9	18.5
Fixed capital formation				
Valuation of livestock from natural increase	0.0	0.0	65.0	5.5
3 years write-off on water facilities for primary producers	0.0	0.0	30.0	2.5
Other	0.0	0.0	21.0	1.8
Total	0.0	0.0	116.0	9.8
Total payments based on input use	383.9	16.9	605.9	51.0
Payments based on:				
current A/An/R/I production required **a**	0.0	0.0	110.5	9.3
non-current A/An/R/I production not required **b**	180.0	7.9	445.2	37.5
non-commodity criteria **c**	0.0	0.0	24.3	2.0
Producer support estimate (PSE)	2 272.4	100.0	1 188.3	100.0
Percentage PSE (%) **d**	13.0	–	2.7	–

a Payments based on current A/An/R/I, production required: transfers from taxpayers to agricultural producers arising from policy measures based on current area (A), animal numbers (An), revenue (R) or income (I), and requiring current production.
b Payments based on non-current A/An/R/I, production not required: transfers from taxpayers to agricultural producers arising from policy measures based on non-current (that is, historical or fixed) area, animal numbers, revenue or income, with current production of any commodity not required but optional.
c Payments based on non-commodity criteria: transfers from taxpayers to agricultural producers arising from policy measures based on long-term resource retirement, a specific non-commodity output and other non-commodity criteria (transfers which apply equally to all farmers).
d PSE as a percentage of gross farm receipts.
Sources: OECD 2010, PSE/CSE database; definitions from OECD 2009a.

3 Estimates of general services support in Australian agriculture

	1986		2009	
	value A$m	share of total %	value A$m	share of total %
Research and development				
CSIRO plant and animal research	135.5	100.0	304.0	36.9
Developing agricultural industries (Queensland)	0.0	0.0	72.0	8.7
Marketing processing pest and disease control (WA)	0.0	0.0	59.4	7.2
Cooperative Research Centres	0.0	0.0	50.1	6.1
Food and fibre (NSW)	0.0	0.0	45.0	5.5
Victorian ag industries	0.0	0.0	29.7	3.6
Climate Change Research Program	0.0	0.0	15.0	1.8
Other	0.0	0.0	43.5	5.3
Total	135.5	100.0	618.7	75.2
Inspection services	0.0	0.0	94.6	11.5
Infrastructure	0.0	0.0	94.1	11.4
Marketing and promotion	0.0	0.0	10.3	1.3
Agricultural schools	0.0	0.0	5.0	0.6
Public stockholding	0.0	0.0	0.0	0.0
Miscellaneous	0.0	0.0	0.2	0.0
General services support estimate (GSSE)	135.5	100.0	822.9	100.0

Source: OECD 2010, PSE/CSE database.

Overall, Australia's agricultural policy framework incorporates the following key elements:

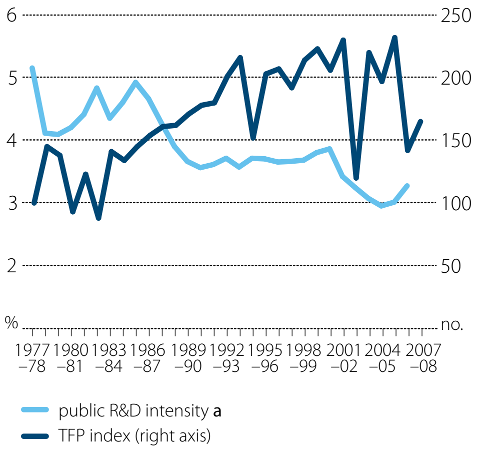
- **risk management and adjustment policies**—includes drought policy, climate change adjustment policies (Australia's Farming Future), biosecurity (pest and disease controls to reduce the risk of an outbreak occurring and to reduce costs if an outbreak occurs), and more generally, natural disaster relief and recovery arrangements
- **other policies that address income variability issues**—for example, the farm management deposit scheme (to encourage saving in relatively high income years for use in relatively low income years) and tax averaging (to reduce distortions associated with the progressive personal income tax system)
- **development of water markets**—assigning exclusive, enforceable and transferable water rights increases the efficiency of water use over time, particularly given expected reduced water availability associated with climate change and recurring drought conditions
- **R&D policies**—to address underinvestment by the private sector
- **market access for Australia's agricultural commodities**—the Australian Government's trade policy includes membership of the World Trade Organization and the development of free trade agreements with a number of countries (including New Zealand, Singapore, Thailand, the United States and Chile). In February 2009 a free trade agreement was signed between ASEAN, Australia and New Zealand, and other agreements are also being pursued (OECD 2009a).

Two important examples of Australia's policy approaches in agriculture are discussed briefly below. Water reform is discussed in the next section.

Productivity growth and public investment in R&D

As noted earlier, productivity growth in Australia in recent decades has been strong for agriculture compared with other industries. However, consistent with observations in other developed economies, productivity growth in Australia's broadacre industry appears to have slowed over the past decade. Sheng et al. (2010) found that a statistically significant slowdown in Australia's productivity growth occurred around the mid-1990s, driven by a long-term decline in public R&D investment (as a percentage of gross domestic product) and poor seasonal conditions over the past decade. The relationship between productivity growth and public R&D investment in Australian agriculture is indicated in figure 11.

11 Total factor productivity (TFP) index and public R&D intensity in Australian agriculture,1977–78 to 2007–08
(index base: 1977–78=100)



a Public R&D intensity is public R&D expenditure as a % of GDP.

Many innovations already available to Australian farmers are not adopted to their full potential, meaning that possible productivity gains are forgone (Nossal and Gooday, 2009). There is a role for government to increase adoption of existing innovations through investments in information provision, human capital and infrastructure to build the capability of farms. Strengthening rural institutions and reducing the policy impediments to innovation uptake is also a priority. The Productivity Commission is currently undertaking a review of rural research and development corporations in Australia (Productivity Commission 2010).

From an economic perspective, the justification for government intervention in technology R&D, adoption and transfer is based on the presence of positive externalities (spillover or third party effects) and imperfect information (including public good aspects). The role of government in the technology innovation process has been the focus of considerable analysis in recent years, particularly with respect to climate change issues (see, for example, Garnaut 2008). An important issue for the government is the difficulty in assessing (and quantifying) the costs and likely future benefits of government policies in this area.

Industry investment in R&D tends to be focused mainly on applied research and experimental development work (see box 2) where the commercial applications are more apparent—that is, areas that are substantially less risky in terms of capturing the benefits from their investment. Government tends to focus on basic and applied research, particularly where there may be broader industry and economy-wide benefits—that is, in areas where the private sector may not participate if the assessment is made that they would not capture adequate benefits, for example, through a patent or by maintaining secrecy about the knowledge.

Drought policies

The long-term challenge of production variability in Australian agriculture, particularly for grains and oilseeds, was indicated in figures 5 and 7. From a policy perspective, the major concern is assessing the role of government in assisting farmers to manage the risks and costs of extremely adverse events (that is, managing catastrophic risk). Drought is a recurring feature of the Australian environment. The National Drought Policy (NDP) was adopted in 1992 to manage drought risk in Australia. Productivity Commission (2009b) notes that the main objectives in the NDP are to:

- encourage primary producers and other sections of rural Australia to adopt self-reliant approaches to manage climatic variability
- maintain and protect Australia's agricultural and environmental resource base during periods of extreme climate stress
- ensure early recovery of agricultural and rural industries, consistent with long-term sustainable levels.

box 2 **Categories of R&D**

R&D activity is defined by the Australian Bureau of Statistics (ABS) as the systematic investigation or experimentation involving innovation or technical risk, the outcome of which is new knowledge, with or without a specific practical application, or new or improved products, processes, materials, devices or services—R&D activity extends to modifications to existing products/processes and ceases when work is no longer experimental (ABS 2002). The ABS provides the following definitions for different categories of research and experimental development:

- **basic research**—experimental and theoretical work undertaken primarily to acquire new knowledge without a specific application in view; basic research may be pure basic research or strategic basic research
  - pure basic research—carried out without looking for long-term benefits other than the advancement of knowledge
  - strategic basic research—directed into specified broad areas in the expectation of useful discoveries; strategic basic research provides the broad base of knowledge for the solution of recognised practical problems
- **applied research**—original work undertaken to acquire new knowledge with a specific application in view. It is undertaken either to determine possible uses for the findings of basic research or to determine new methods or ways of achieving some specific and predetermined objectives
- **experimental development**—systematic work, using existing knowledge gained from research or practical experience, for the purpose of creating new or improved products/processes.

The main focus in NDP programs is to provide relief primarily to farm households and farm businesses suffering hardship during severe drought. A farm must be in an area declared as being in Exceptional Circumstances (EC) and satisfy the eligibility criteria of individual programs to be eligible for assistance. Major programs include the EC Relief Payment (ECRP), the EC Interest Rate Subsidies (ECIRS) and the EC Exit Package.

Over the past 15 years, the Australian Government has spent almost $4 billion on drought assistance, of which around $2.2 billion has been for business support (payments are in 2007–08 prices). The funds provided have increased significantly in recent years, partly reflecting an increase in the severity of drought but also an easing of the eligibility criteria. There is also a growing proportion of farmers that receive continuous assistance. Of all farms receiving exceptional circumstances income support assistance, 18 per cent have received assistance for two to three years. A further 11 per cent have received assistance for between three and six years. Projected increases in the frequency and severity of drought in Australia mean that increasing support is likely to be required under current policy settings.

Government drought support in Australia was recently reviewed by the Productivity Commission (2009b). The review highlighted the mismatch between policy objectives to help farmers improve preparedness to cope with drought and manage climate variability, and programs which have provided emergency payments to farmers in hardship. The current business support measures, including interest rate subsidies and exit grants, are distorting the decisions that farmers might otherwise make to pursue productivity gains, encouraging the accumulation of excessive debt or delaying adjustment decisions. It also appears that these measures are reducing the incentive for farmers to use risk management tools, such as farm management deposits, to manage fluctuations in cash flow caused by climate variability. The seasonal pattern of farm management deposits and withdrawals reflects the tax incentive for farmers to lock money away before 30 June so that it is exempt from income tax in that year. However, there is little evidence that these deposits have been significantly drawn on during recent drought years. The Productivity Commission made a number of recommendations for reform.

In response to the national review of drought policy, the Australian Government, in partnership with the Western Australian Government, is conducting a pilot of drought reform measures in part of Western Australia (see www.daff.gov.au for further information).

Case study: water reform in Australia

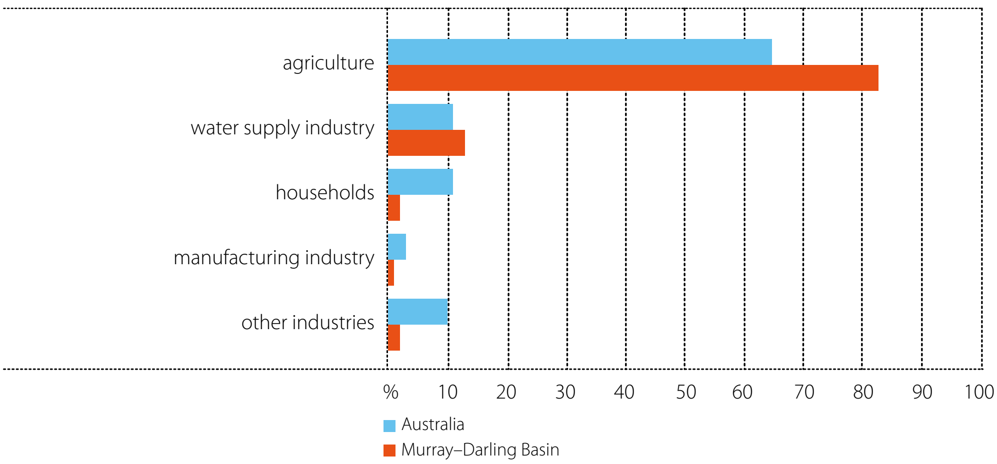
Water use in Australia

In 2004–05, the latest year for which comprehensive water accounts across industries and households are available, agriculture accounted for 65 per cent of water used in Australia (figure 12) (ABS 2008). The Murray–Darling Basin (MDB) is an important agricultural region, which covers an area of more than 1 million square kilometres in south-eastern Australia. The MDB accounts for around:

- 20 per cent of Australia's agricultural land area
- 40 per cent of Australia's gross value of agricultural production
- 65 per cent of Australia's irrigated land area
- 45 per cent of Australia's gross value of irrigated agricultural production (ABARE–BRS 2010b).

In 2004–05, agriculture accounted for 83 per cent of water used by all industries and households in the Murray–Darling Basin (figure 12).

12 Consumptive water use in Australia and the Murray–Darling Basin, 2004–05



Key water policy developments

In Australia, the state and territory governments are responsible for the management of water resources in their respective jurisdictions. This complicates management as, for example, the MDB spans four states and one territory. To offset, at least to some extent, the natural variability in the quantity, timing and location of rainfall in Australia, water providers invest in water storage, purification and delivery infrastructure to provide water services to metropolitan and non-metropolitan urban areas and rural areas. Historically, water infrastructure in rural areas was developed mainly by governments to support regional economic development, particularly the expansion of the agricultural sector and rural communities.

An important water reform process has been occurring in Australia since the 1980s, consistent with broader policy developments toward the adoption of more efficient market-based mechanisms. An additional issue for the water industry is that the traditional policy approach has had major unintended adverse consequences for the environment. The focus in water policy since the early 1990s has changed, from supporting regional development for consumptive uses to managing competing demands for a fully, or over, allocated resource (Heaney et al. 2005).

Although surface water trade was first introduced in Australia in 1983, the 1994 agreement by the Council of Australian Governments (COAG; a council of the heads of federal, state and territory governments) on the need for coordinated action by governments has been important in making the necessary reforms to water policy in Australia. A water reform agreement was a turning point in domestic water policy by recognising that better management of Australia's water resources is an issue of national importance (Heaney et al. 2005). The major objective in the 1994 COAG agreement was to achieve an efficient and sustainable water industry in Australia.

Importantly, COAG agreed to a water resource policy and strategic reform framework to improve the efficiency of Australia's water supply and wastewater industry, to address negative environmental impacts and improve community understanding of the need to change water use in Australia (COAG 1994; NCC 2004). Some key principles of the 1994 water reform agreement were to achieve full cost recovery, separate water entitlements from land titles, allocate water specifically for environmental use, encourage intrastate and interstate trading in water entitlements and improve water quality. In addition, there was a commitment to 'implement a range of institutional reforms, including separating the roles of service provision and standards setting and regulation, and ensuring better commercial performance by water businesses' (NCC 2004, p.1.1).

Subsequent to the COAG agreement, the Murray–Darling Basin Ministerial Council—a council of federal, state and territory environment ministers—implemented a cap on river diversions within the MDB. The cap effectively limited water use in the MDB to 1993–94 levels, with some allowances for additional water use (Sanders et al. 2010).

In 2004, most governments in Australia agreed to the National Water Initiative (NWI), which was designed to complement and extend the 1994 reform framework (COAG 2004). The National Water Initiative confirmed the commitment to the 1994 water reform agreement, but recognised that progress in water reform varied between jurisdictions and increased knowledge provided an opportunity to enhance the water reform agenda (NCC 2004). Some key features of the NWI were to create water access entitlements for consumptive water that are separated from land, give statutory recognition to environmental water, adjust overallocated and/or overused water systems to more sustainable levels of use, and implement water trading arrangements that facilitate the efficient operation of water markets (Sanders et al. 2010).

In 2007, the National Plan for Water Security pursued the option of reallocating water to the environment by purchasing water from irrigators (Commonwealth of Australia 2007). This represented a change from the previous policy approach, which attempted to address the absence of a market for environmental water by regulating water access through a cap on extractions for consumptive uses (Goesch et al. 2008). The *Water Act 2007* was enacted so that the water resources in the Murray–Darling Basin could be better managed in the long-term national interest. The Murray–Darling Basin Authority (MDBA), the statutory authority responsible for implementing the rules and provisions of the Act, is developing a management plan for the MDB's water resources (ABARE–BRS 2010b). A central goal of the Basin plan is to set limits, referred to as sustainable diversion limits, on the volume of surface water and groundwater that can be taken for consumptive uses.

The Australian Government's Water for the Future Program is a 10-year initiative with funding of more than A$12 billion, which aims to assist irrigators in the transition to the new sustainable diversion limits under the Basin plan (ABARE–BRS 2010b). The initiative has two main components that are currently in progress: a water entitlement purchasing program (Restoring the Balance in the Murray–Darling Basin) and an infrastructure investment program (including the Sustainable Rural Water Use and Infrastructure Program, and Water Smart Australia). At 30 September 2010, the Australian Government had purchased around 650 gigalitres (GL) under the first of these programs.

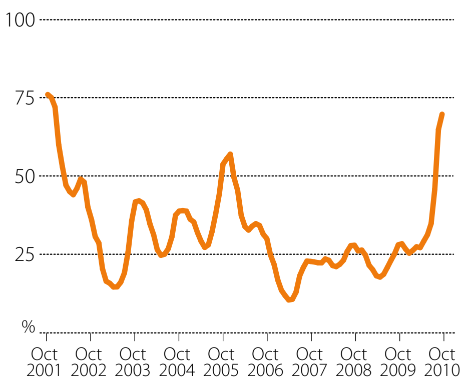
Water trading in the Murray–Darling Basin

The cap and trade system introduced in the Murray–Darling Basin places a value on irrigation water and encourages the available water to be consumed in its highest value use. Water trading has been an important adaptation strategy for farmers in recent years during the prolonged drought conditions in the Murray–Darling Basin.

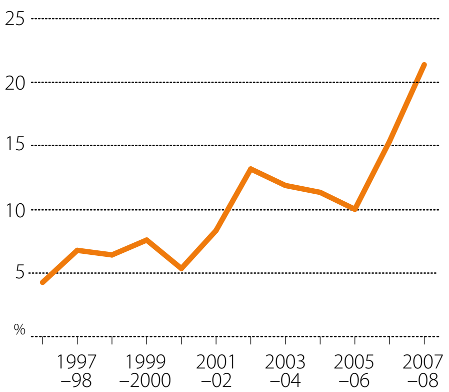
Water availability and use

Much of Australia experienced drought during the period 2001–02 to 2009–10, with the extent and severity of the drought greatest in 2002–03 and 2006–07. For example, Murray system inflows have been below average for nine out of the past 10 years and 2006–07 was the driest on record. Water storage levels in the Murray–Darling Basin declined from 76 per cent in October 2001 to a low of 10 per cent in April 2007 (figure 13). Recently, water storage levels have recovered substantially, increasing from 25 per cent in January 2010 to 70 per cent in October.

13 Water in storage in the Murray–Darling Basin, mid-October 2001 to mid-October 2010



14 Temporary water trade in the Murray–Darling Basin, 1996–97 to 2007–08
(temporary allocation sold as a percentage of irrigation diversions)



Sources: MDBC 1997–2008; MDBA 2009.

In 2005–06, agricultural water use in the Murray–Darling Basin was 7720 GL, and accounted for 66 per cent of total water consumption in Australia (ABS 2008). Major water users were cotton (1574 GL), dairy farming (1287 GL), pasture for livestock (excluding dairy, 1284 GL) and rice (1252 GL). In 2008–09, agricultural water use in the Murray–Darling Basin had approximately halved to 3753 GL (52 per cent of Australia's water consumption), of which 3492 GL or 93 per cent was used for irrigation (48 per cent of Australia's water consumption) (ABS 2010).

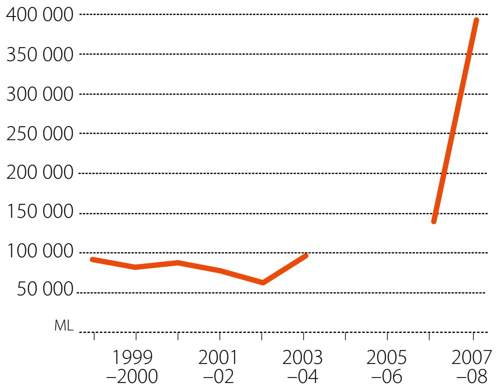
Temporary and permanent water trade

In recent years, water trading has been an important risk management strategy for irrigators to adjust to changes in water availability (Mallawaarachchi and Foster 2009). Sanders et al. (2010) provide information on recent temporary and permanent water trade in the Murray–Darling Basin.

The volume of temporary trade as a proportion of irrigation water diversions increased sharply from 5 per cent in 2000–01 to 21 per cent in 2007–08 (figure 14). More recently, between 2007–08 and 2008–09, there was a 41 per cent increase in the volume of temporary trade within the southern connected Murray–Darling Basin (Sanders et al. 2010).

There was a sharp rise in trade of permanent water entitlements in 2007–08, although this was from a relatively low base (figure 15). Between 2007–08 and 2008–09, there was a 75 per cent increase in the volume of entitlement trade within the southern connected

15 Permanent entitlement water trade in the Murray–Darling Basin, 1998–99 to 2007–08 a



a Data incomplete for 2004–05 and 2005–06.
Sources: MDBC 1997–2008, MDBA 2009.

4 Rate of return to farm capital in the Murray–Darling Basin

	2006–07 %	2007–08 %
Broadacre farms	0.5	1.2
Dairy farms	0.1	1.5
Horticulture farms	1.5	2.0

Source: Ashton 2010.

Murray–Darling Basin, although part of this increase is the result of the Australian Government's entry into the water market as part of the Restoring the Balance in the Murray–Darling Basin program (Sanders et al. 2010).

Farm profitability

Both buyers and sellers gain from water trade. Mallawaarachchi and Foster (2009) estimated the benefits of water trade into South Australia and found that South Australian irrigators, who are mainly horticulture farmers, gained around A$31 million in 2007–08.

Ashton (2010, p. 18) also found that water trading mitigated the severity of the effects of the drought in 2006–07 and 2007–08, arguing that the 'ability to trade water appears to have assisted some irrigators in avoiding substantial financial losses in these years'. Overall, farm financial performance improved in 2007–08 in the Murray–Darling Basin, although it remains relatively weak (table 4).

Water trading has significantly increased the flexibility of farmers to change the output mix. For example, rice production fell from 1.6 million tonnes in 2000–01 to 18 000 tonnes in 2007–08, while grape production increased from 1.6 million tonnes to 2.0 million tonnes over the same period.

Directions for future reform

The outlook for the Murray–Darling Basin is likely to be one of increasing water scarcity, with climate change a major risk to water availability (Goesch et al. 2008). The adaptation strategies by irrigators in the Murray–Darling Basin to limit the effects of lower and more variable water supplies on their farm businesses have been examined in a number of recent reports, including Sanders et al. (2010), Ashton (2010), Mallawaarachchi and Foster (2009), Oliver et al. (2009) and Goesch et al. (2008). Participation by farmers in water markets has been an important risk management strategy, but there are still significant impediments to trade.

An important objective of future policy reform should be to facilitate autonomous adjustment within the irrigation sector and to adjust any policies that distort market-based incentives to enter or exit the industry (Sanders et al. 2010). Two key areas for future reform to enhance the efficiency of water markets in Australia include removing restrictions on water trade and improving water property rights.

The number of participants in the water market may be increased by removing restrictions on who can participate in the water market (for example, by allowing trade between irrigators, domestic water utilities, industrial users and mining companies) and by extending the geographic range of the market (by reducing or removing barriers to interregional water trade) (Goesch et al. 2008). Water property rights may be enhanced, for example, by allowing carryover rights or considering a capacity sharing approach, which involves the definition of explicit storage capacity rights, inflow rights and individual accounting of both storage and delivery losses (Sanders et al. 2010).

Concluding comments

As with agriculture throughout the world, Australian agricultural producers face a wide range of challenges associated with the climate, soil types, water availability, market variability, competing resource demands (including environmental and other users), competition and resource degradation. Governments worldwide are asked to intervene in farming activities and markets to assist in the management of these issues and to achieve outcomes that are perceived to be more socially preferred.

As discussed in this paper, over the past three decades the Australian Government has attempted to minimise intervention in the operation of markets. Where intervention has been necessary, it has taken an approach of intervening in ways that:

- serve to improve the operations of markets where possible, or
- are minimally distorting where markets can't be established.

By taking this approach, Australian agriculture has maintained its competitiveness domestically and in international markets, and has been able to adapt to variability in its operating environment as a result of factors such as market and climate variability. The case study of water reform has shown how establishing an effective system of tradable water rights has enabled farmers to remain productive despite a decade of dry weather conditions in eastern and southern Australia.

Significant challenges remain for the future, but the key to the agriculture sector adapting to these challenges will be maintaining a market-based policy approach that enables farmers to respond.

Appendix A

Statistical tables and figures

A1 Gross value of farm production in Australia, 2009–10

	value a A$m	share of total %
Crops		
Grains and oilseeds		
Wheat	5 250	12.8
Barley	1 509	3.7
Canola	781	1.9
Other	1 538	3.8
Total	9 079	22.2
Industrial crops		
Sugar cane (cut for crushing)	1 526	3.7
Cotton lint and cotton seed	876	2.1
Wine grapes	750	1.8
Total	3 152	7.7
Horticulture		
Vegetables	3 072	7.5
Fruit and nuts (excluding grapes)	2 926	7.1
Other	1 951	4.8
Total	7 949	19.4
Other crops	1 695	4.1
Total crops	21 875	53.4
Livestock		
Livestock slaughterings		
Cattle and calves b	7 582	18.5
Sheep and lambs b	2 862	7.0
Poultry	1 742	4.3
Pigs	873	2.1
Total	13 111	32.0
Livestock products		
Milk	3 363	8.2
Wool	2 124	5.2
Other	510	1.2
Total	5 997	14.6
Total livestock	19 107	46.6
Total farm	40 982	100.0

a ABARE–BRS estimate. **b** Includes exports of live animals.
Source: ABARE–BRS 2010.

A2 Value of Australia's farm exports (fob), 2009–10

	value a A$m	share of total %
Crops		
Grains and oilseeds		
Wheat	3 688	12.9
Barley	1 098	3.8
Canola	583	2.0
Other	741	2.6
Total	6 109	21.4
Industrial crops		
Wine	2 172	7.6
Sugar	1 770	6.2
Raw cotton	755	2.6
Total	4 697	16.5
Other crops	4 328	15.2
Total crops	15 134	53.0
Livestock		
Meat and live animals for slaughter		
Beef and veal b	4 608	16.1
Lamb and mutton b	1 645	5.8
Other	145	0.5
Total	6 398	22.4
Wool	2 308	8.1
Dairy products	2 066	7.2
Other livestock	2 631	9.2
Total livestock	13 404	47.0
Total farm	28 537	100.0

a ABARE–BRS estimate. **b** Includes exports of live animals.
Source: ABARE–BRS 2010.

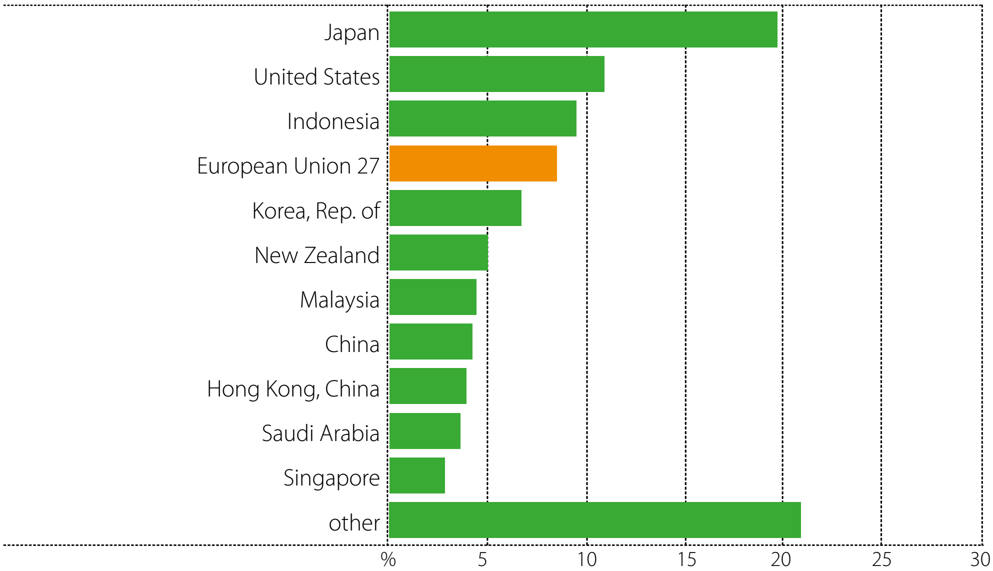
A3 Markets for Australia's farm exports (fob), 2008–09

	value a A$m	share of total %
North Asia		
Japan	5 228	16.3
China	3 216	10.0
Korea, Rep. of	1 823	5.7
Other North Asia	1 210	3.8
Total	11 477	35.8
South-East Asia		
Indonesia	2 630	8.2
Malaysia	1 017	3.2
Other South-East Asia	2 446	7.6
Total	6 093	19.0
Americas		
United States	2 999	9.4
Other Americas	653	2.0
Total	3 652	11.4
Middle East	3 557	11.1
Europe		
European Union	2 628	8.2
Other Europe	374	1.2
Total	3 002	9.4
Oceania		
New Zealand	1 401	4.4
Other Oceania	481	1.5
Total	1 882	5.9
Africa	1 101	3.4
South Asia	1 039	3.2
Other	249	0.8
Total	32 052	100.0

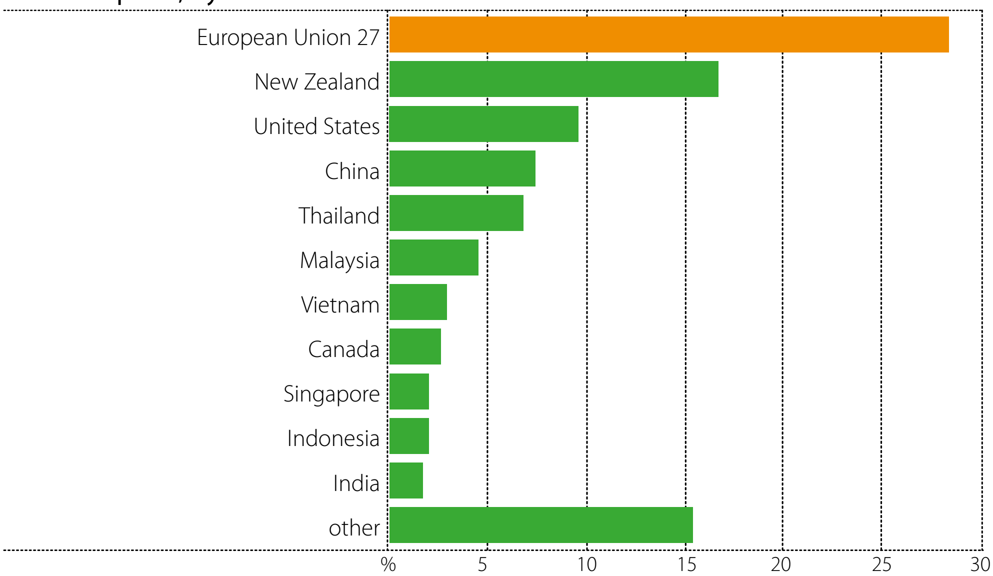
Source: ABARE–BRS 2010.

A1 Directions in Australia's food trade, 2008–09

i. food exports, by destination



ii. food imports, by source



Source: ABARE–BRS 2010.

Appendix B

Analytical framework for risk

Certainty equivalent approach for assessing project profitability

Risk is an important feature in Australian agriculture. The certainty equivalent approach is an analytical framework for the profitability assessments of risky projects. The certainty equivalent approach is consistent with the risk framework that was identified in OECD (2009b, p. 46) as probably the most representative of the situation of farmers in most OECD countries.

Private investors (farmers) are assumed to be profit maximisers. The private investor's assessment of the profitability of a prospective project depends on the risks in the physical, economic and policy setting over the life of the project and the attitude of the investor to incurring risk. In the assessment of risky projects, it is assumed the investor is able to identify a range of possible outcomes that reflect significant sources of risk and assign (objective or subjective) probabilities to each of these outcomes.

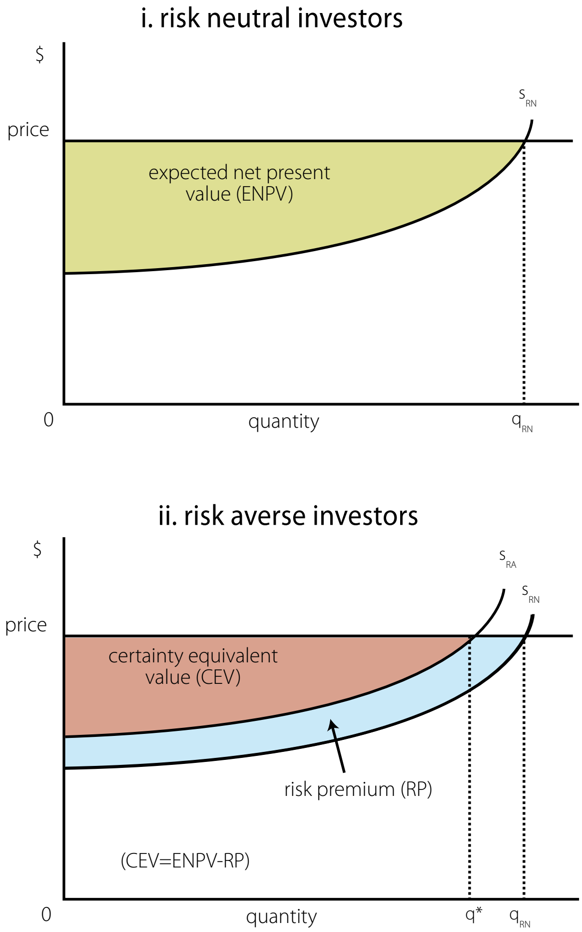
It is useful to consider the profitability assessments for projects in three categories, which vary according to the presence of risk and attitudes toward risk (the decision criteria used in the profitability assessments are summarised in table B1):

- **Risk free investment**—risk free projects are ranked according to the net present value, since it is a measure of the return to the investment when the future is know with certainty. The net present value is the sum of the annual net cash flow over the duration of the project discounted at the risk free interest rate (assumed to be the long-term government bond rate). A project with a net present value greater than or equal to zero is assessed to be profitable since it indicates that the investment will achieve a return that is greater than or equal to the risk free interest rate.
- **Risky investment with risk neutral investors**—a risk neutral investor is indifferent to the risk that an outcome may be either worse or better than expected. Risky projects are ranked according to the expected net present value (ENPV). The expected net present value is the probability weighted sum of the net present value of each possible outcome. A project with an expected net present value greater than or equal to zero is assessed to be profitable since it indicates the investment is expected to achieve a return that is greater than or equal to the risk free interest rate.
- **Risky investment with risk averse investors**—a risk averse investor is relatively more concerned about the risk of unexpected losses than the risk of unexpected gains. Risky projects are ranked according to the certainty equivalent value (CEV). The certainty equivalent value is equal to the project's expected net present value less a risk premium (RP), which provides adequate compensation for the risks associated with the project (that is, CEV = ENPV – RP). A project with a certainty equivalent value greater than or equal to zero is assessed to be profitable. The certainty equivalent value of a project may be interpreted as the net present value of a risk free project that is ranked equally with the risky project. The valuation of the risk premium may have an important influence on the assessment of project profitability.

B1 Decision criteria for profitability assessments of risky projects

		profitability assessment		
risk / attitude toward risk	profitability measure	uneconomic	marginal	economic
Risk free investment	net present value (NPV)	< 0	= 0	> 0
Risky investment				
– Risk neutral investor	expected net present value (ENPV)	< 0	= 0	> 0
– Risk averse investor	certainty equivalent value (CEV)	< 0	= 0	> 0

B1 Industry representation of the certainty equivalent approach for risky projects



The certainty equivalent approach is illustrated in figure B1 at the industry level for risk neutral investors (i) and risk averse investors (ii), and the industry supply curves are given by S_{RN} and S_{RA}, respectively. Assuming a given price, the market equilibrium occurs with industry output at q_{RN} for risk neutral investors and q* for risk averse investors. That is, in the presence of risk with risk averse investors, industry output is lower than would otherwise be the case. In practice, investors are assumed to be risk averse and, hence, the economic framework presented in figure B1 (ii) is most relevant to actual outcomes.

From an economic perspective, an issue in assessing policy options that address market failures is the impact on the risk assessment of private investors. For example, a policy is preferred if it is associated with a lower level of sovereign risk (risk of future adverse policy change), assuming all else is constant.

Risk management strategies in agriculture

Farmers are assumed to be profit maximisers who take into account production constraints (agricultural input–output relationships) and various risks associated with the physical environment (such as weather) and the economic and policy setting. Farmers adopt various strategies to reduce risk and, hence, reduce the risk premium in figure B1. In general, risk management strategies aim to reduce the probability of an adverse event occurring and/or moderate the likely negative impact of an adverse event should it occur. Risk management strategies include risk sharing and risk diversification, and are discussed below.

Risk sharing (or risk pooling) is spreading risk over a number of agents. For example, joint ventures spread risk between investors and are a particularly important risk management strategy in the mining sector. In agriculture, share-cropping arrangements allow production risk to be shared between the worker/tenant and the landowner (OECD 2009b). Insurance is based on the risk sharing principle because the risk of an adverse event is shared between a large number of agents; however, insurance may not be a viable option to manage systemic risks (for example, risks that are highly correlated across farms).

Risk diversification is reducing risk by investing in several activities and/or assets, provided the expected returns of these activities and/or assets are not highly correlated. Diversification strategies in agriculture include on-farm strategies such as mixed cropping–livestock activities and farming in different geographic locations, and off-farm strategies such as gaining off-farm employment and investing in off-farm assets. Gunasekera et al. (2008) discuss strategies to manage climate change risks in Australian agriculture.

In agriculture, two important market mechanisms are futures markets to manage price risk and insurance markets to manage production risk (OECD 2009b). A useful discussion of sources of risk and risk management strategies in agriculture is presented in two recent OECD reports (OECD 2009b; Kimura et al. 2010).

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