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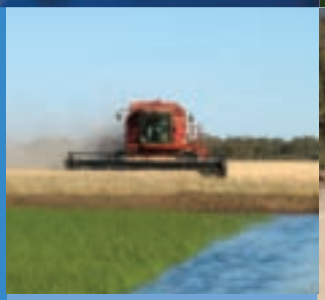
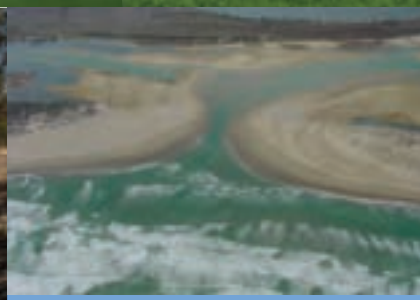
Water and the Murray-Darling Basin
A Statistical Profile 2000-01 to 2005-06





Water and the Murray-Darling Basin - A Statistical Profile

Australia

2000–01 to 2005–06

Brian Pink
Australian Statistician

AUSTRALIAN BUREAU OF STATISTICS

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INQUIRIES

- For further information about these and related statistics, contact the National Information and Referral Service on 1300 135 070 or Bernard Morrisson on Canberra (02) 6252 5321

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PREFACE

This publication provides environmental, economic and social information for the Murray-Darling Basin (MDB). It aims to provide statistics to inform decision-making, research and discussion about the Basin within governments and in the wider community. The publication is presented in five chapters:

- Chapter 1 presents a physical description of the MDB, including the area covered, land use, climate, water availability and environmental assets.
- Chapter 2 explores the characteristics of people living in the MDB. The chapter is divided into four main sections: population characteristics; education; work; and farmers. Data are presented for 1996, 2001 and 2006, and comparisons are provided with national level data.
- Chapter 3 examines water use by industries and households, using the most recent economy-wide water use data available. As a result of the significance of agricultural water use in the MDB, this chapter places a strong emphasis on water use by agriculture. Data presented include: water use for a range of crops and pastures, changes in water use over time, the location of water use, water sources, and irrigation practices.
- Chapter 4 outlines agricultural production in the MDB and includes comparisons with Australian totals and between irrigated and non-irrigated agriculture. It also outlines changes in agricultural area and production levels between 2000–01 and 2005–06. The economic contribution of irrigated agriculture in the MDB, including comparisons for different agricultural commodities, is also discussed.
- Chapter 5 presents information about natural resource management (NRM) activities that farmers in the MDB are implementing to address a range of NRM issues including water issues.

The ABS is indebted to a range of people and organisations that provided data for inclusion in this publication, and to those who refereed the manuscript. The organisations that provided data include the *Department of the Environment, Water, Heritage and the Arts* (DEWHA), *Bureau of Meteorology* (BoM), *Bureau of Rural Sciences* (BRS), and *Murray-Darling Basin Commission* (MDBC).

Suggestions or comments on this publication would be appreciated, and should be sent to the Director, Environmental Accounts and Water, Locked Bag 10, Belconnen ACT 2616.

Brian Pink
Australian Statistician

INTRODUCTION

The Murray-Darling Basin (MDB) is an area of national significance for social, cultural economic and environmental reasons. The social impacts of changes in agriculture and environmental events, such as drought, are important for people in the MDB. The MDB also contains nationally significant environmental assets which are reliant on water to maintain ecosystem health.

SUMMARY OF FINDINGS

Physical Attributes

- The Basin covers 1,059,000 square kilometres or 14% of Australia's land area. Most of the Basin's area is located in New South Wales (597,926 square kilometres or 56% of the Basin's area) and Queensland (259,313 square kilometres or 24% of the Basin's area) (BRS data available on request 2008).
- Australia's three longest rivers, the Darling (2,740 km), Murray (2,530 km) and Murrumbidgee (1,690 km) are found in the MDB (MDBC 2006).
- The 2005–06 ABS Agricultural Census found that 84% of the land in the MDB is owned by businesses engaged in Agriculture. Modelling by the Bureau of Rural Sciences (BRS) has identified that 67% of the MDB is used for growing crops and pasture.
- In 2005–06 temperatures recorded in the MDB were up to 2°C hotter than average.
- The MDB receives an average annual rainfall of 530,618 GL. Of this, 94% evaporates or transpires, 2% drains into the ground, and the other 4% becomes run-off.

People

- At the time of the ABS 2006 Census of Population and Housing there were 2,004,560 people living in the MDB - 10% of Australia's population.
- Most of the MDB population lived in New South Wales (39%) and Victoria (29%).
- Agriculture is a significant employer in the MDB. In 2006, 10% of all people employed in the MDB worked in Agriculture, compared to 3% Australia-wide.
- The other common industries of employment in the MDB were Retail (14% of all people employed), Health and community services (11%), Government administration and defence (10%), and Manufacturing (9%).
- The mean equivalised household income of people in the MDB in 2006 was $675 per week compared to $732 per week for Australia as a whole.
- Almost two-fifths (38%) of Australia's farmers resided in the MDB.
- The number of people employed as farmers in the MDB decreased by 10% between 1996 and 2006. Over the same period the number of people employed in all other occupations increased by 18%.
- Nearly two-fifths (39%) of people employed and aged 65 years or over in the MDB were farmers.

Water Use

- In 2004–05, industries (including Agriculture) and households in the MDB used more than half (52%) of Australia's total water consumption.
- In 2004–05, 83% of water consumed in the MDB was consumed by the Agriculture industry.
- Other users of water in the MDB included the Water supply industry, which consumed 13% (predominantly through irrigation water supply losses), and Households (2%).
- In 2004–05, 3% of Australia's electricity and 33% of the nation's hydro-electricity was generated in the MDB.
- In 2005–06, 7,720 GL of water was consumed for agricultural production in the MDB, 66% of Australia's agricultural water consumption.
- In 2005–06, the majority of water consumed in the MDB originated from two main sources: surface water (6,499 GL or 84% of MDB agricultural water consumption) and groundwater (1,069 GL or 14%).
- In 2005–06, the majority of surface water consumed by Agriculture in the MDB was in New South Wales (57%) and Victoria (30%). Over 70% of the 1,069 GL of groundwater consumed in the MDB was in New South Wales.
- In 2005–06, the agricultural commodities that used the most water in the MDB were:
  - cotton - 1,574 GL or 20% of water used for agricultural production in the MDB;
  - dairy farming - 1,287 GL or 17%;
  - pasture for other livestock - 1,284 GL or 17%; and
  - rice - 1,252 GL or 16%.
- Between 2000–01 and 2005–06, water consumption by some agricultural commodities was more variable than others. For example:
  - cotton water consumption - ranged from 1,186 to 2,599 GL; and
  - rice - ranged from 615 to 2,418 GL.

Agriculture

- There were 61,033 farms in the MDB in 2005–06, accounting for 39% of all farms in Australia.
- A significant proportion of Australia's food production was grown in the MDB in 2005–06:
  - 100% of rice;
  - 95% of oranges;
  - 62% of pigs;
  - 54% of apples; and
  - 48% of wheat.
- In 2005–06, the MDB contained 65% of Australia's irrigated land.
- The 1.65 million hectares (ha) of irrigated crops and pasture in the MDB were distributed as follows:
  - pasture (43%);
  - cereals other than rice (20%);
  - cotton (15%);
  - rice (6%);
  - grapes (6%);
  - fruit and nuts (5%); and
  - vegetables (2%).

Agriculture continued

- In 2005–06, the Gross Value of Agricultural Production (GVAP) in the MDB was worth $15 billion, or 39% of the total Australian value of agricultural commodities.
- Between 2000–01 and 2005–06, the GVAP in the MDB increased by 7.3%, from $13,972 million to $14,991 million. Over the same period, the GVAP of all Australian Agriculture increased by 12.8%.
- Between 2000–01 and 2005–06, the total Gross Value of Irrigated Agricultural Production (GVIAP) in the MDB remained at approximately $4,600 million. GVIAP as a proportion of GVAP in the MDB decreased from 33% in 2000–01 to 31% in 2005–06.
- In 2005–06, irrigated agriculture in the MDB generated 44% of Australia's GVIAP. Of this:
  - dairy farming generated $938 million, or 20% of the total MDB GIVAP;
  - fruit and nuts generated $898 million, or 20%;
  - cotton generated $797 million or 17%; and
  - grapes generated $722 million or 16%.
- In 2005–06, some irrigated crops in the MDB accounted for relatively high levels of GVIAP using relatively low levels of water consumption. Examples included:
  - fruit and nuts (20% of total GVIAP; 5% of agricultural water consumption); and
  - vegetables (12% of total GVIAP; 2% of agricultural water consumption).
- Other irrigated crops in the MDB accounted for relatively low levels of GVIAP using relatively high levels of water consumption. Examples included:
  - rice (6% of total GVIAP; 16% of agricultural water consumption); and
  - cereals other than rice (2% of total GVIAP; 10% of agricultural water consumption).

Natural Resource Management

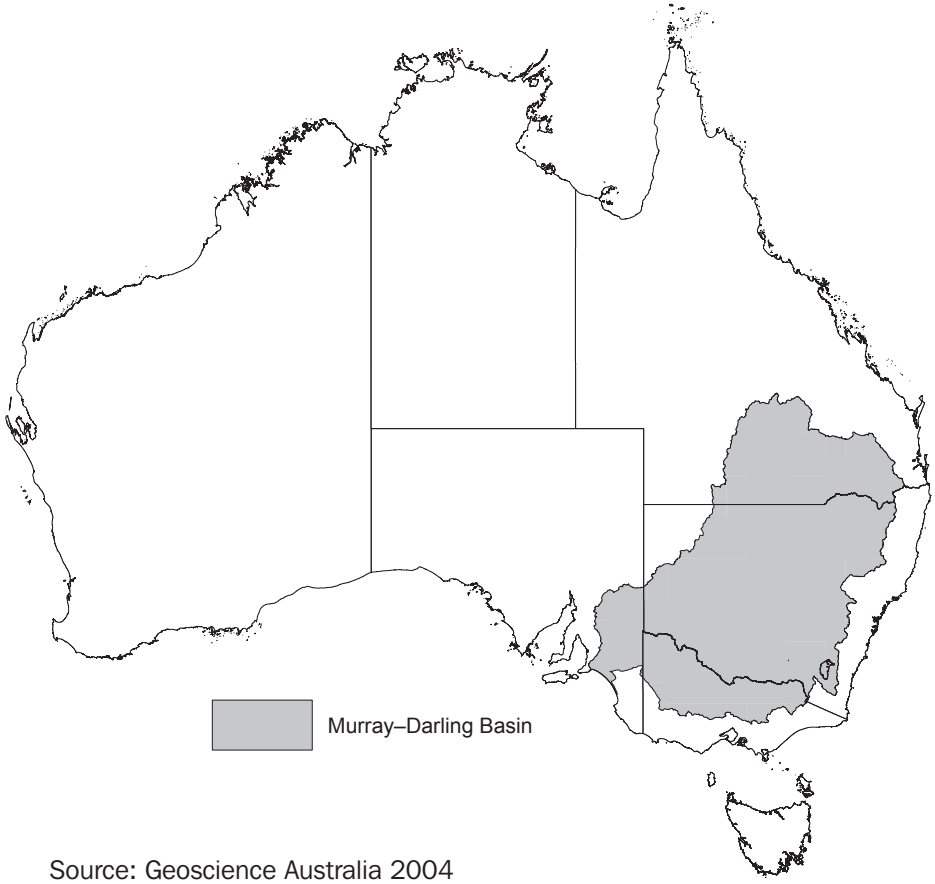
- In 2004–05, the vast majority of MDB farms (92% of total farms in the MDB) conducted NRM activities for preventative or remedial reasons, consistent with the proportion of all Australian farms (92%).
- Most NRM effort in the MDB during 2004–05 was spent managing weeds, pests, and land and soil. Farmers in the MDB reported the lowest effort expended on managing water issues (27 person days per farm on average) of all the NRM issues, equivalent to half of the effort put towards land and soil activities (54 person days per farm on average).

CHAPTER 1 ATTRIBUTES OF THE MURRAY-DARLING BASIN ....

GEOGRAPHIC LOCATION

The Murray-Darling Basin (MDB) is a topographically-defined region located in the south-east of Australia (map 1.1). The Basin covers 1,059,000 square kilometres or 14% of Australia's land area. Most of the Basin's area is located in New South Wales (56%) and Queensland (24%). The Basin completely encloses the Australian Capital Territory, and incorporates the majority of New South Wales (75%) and Victoria (60%). A smaller proportion of Queensland's (15%) and South Australia's (7%) area are included in the MDB (MDBC 2006).

1.1 THE MURRAY–DARLING BASIN



Source: Geoscience Australia 2004

RIVER BASINS

The Murray-Darling Basin is formed from many sub-catchments (the most significant being the Murray and the Darling). The Australian Water Resources Council, in its report *1985 Review of Australia's Water Resources and Water Use* (AWRC 1987), identified 26 river basins which comprise the Murray-Darling Basin Drainage Division (see map 1.2). These river basins represent the major tributaries of the Murray and Darling Rivers, and therefore follow topographical boundaries. River basins are often the basis for water planning and management.

RIVER BASINS *continued*

The Murray River begins in the New South Wales Snowy Mountains, flowing approximately north-west. At Wentworth in western New South Wales, the Murray joins the Darling River, which flows south-west from Queensland. Subsequently, the Murray flows through the South Australian Riverland to its mouth at Goolwa, South Australia.

1.2 RIVER BASINS FORMING THE MURRAY-DARLING BASIN

1 Upper Murray River
2 Kiewa River
3 Ovens River
4 Broken River
5 Goulburn River
6 Campaspe River
7 Loddon River
8 Avoca River
9 Murray-Riverina
10 Murrumbidgee River
11 Lake George
12 Lachlan River
13 Benanee
14 Mallee
15 Wimmera-Avon Rivers
16 Border Rivers
17 Moonie River
18 Gwydir River
19 Namoi River
20 Castlereagh River
21 Macquarie-Bogan Rivers
22 Condamine-Culgoa Rivers
23 Warrego River
24 Paroo River
25 Darling River
26 Lower Murray River

Source: Geoscience Australia 2004

LAND USE

Significant proportions of the Basin's area are comprised of agriculture (66.7%) and native forest (31.9%). There are relatively smaller water (0.8%) and urban areas (0.2%) (table 1.3).

1.3 LAND USE—Murray-Darling Basin—2008

	Area	*Proportion of total area*
	km²	%
Agriculture(a)	706 045	66.7
Forests and plantations		
Native forest	338 023	31.9
Plantation forest	3 567	0.3
Total	341 590	32.3
Urban	1 792	0.2
Water	8 076	0.8
Bare ground	1 004	0.1
Total area(b)	**1 058 549**	**100.0**

(a) Agricultural area does not equal the area from the 2005–06 Agricultural Census due to differences in concepts, methods and sources.
(b) Components may not add to total MDB area due to rounding. The total area is calculated independently from the land use category areas.

Source: Bureau of Rural Sciences 2008, Rural Water, viewed 9 July 2008, http://adl.brs.gov.au/water2010/index.phtml

Bureau of Rural Sciences (BRS) modelling shows that almost 67% of the MDB is used for agricultural purposes (growing crops and pasture), as shown in table 1.3. The ABS 2005–06 Agricultural Census found that 84% of land in the MDB was owned by businesses engaged in agriculture. This shows that some parts of agricultural holdings were not necessarily used for growing crops or pasture.

In 2005–06, the MDB contained 888,000 square kilometres of agricultural holdings as reported by farmers in the ABS Agricultural Census (table 1.4). This was 20% of total land held by Australian agricultural holdings. Most agricultural area in the MDB is located in New South Wales (512,136 km²) and Queensland (234,213 km²). While South Australia has the smallest area of land in the MDB when compared with the other MDB states, more of this land is held as agricultural holdings (95%).

LAND USE *continued*

1.4 DISTRIBUTION OF AGRICULTURAL AREA—2005–06

	Agricultural land area(a)	*Total land area*	*Agricultural area as a proportion of total area*
	km²	km²	%
Murray-Darling Basin			
New South Wales	512 136	597 926	86
Victoria	75 929	129 761	59
Queensland	234 213	259 313	90
South Australia	65 549	69 216	95
Australian Capital Territory	449	2 354	19
Total(b)	888 277	1 058 549	84
Balance of Australia	3 460 972	6 614 096	52
Australia(b)	**4 349 248**	**7 672 645**	**57**

(a) Represents agricultural area of holding reported by farmers in the ABS Agricultural Census 2005–06.

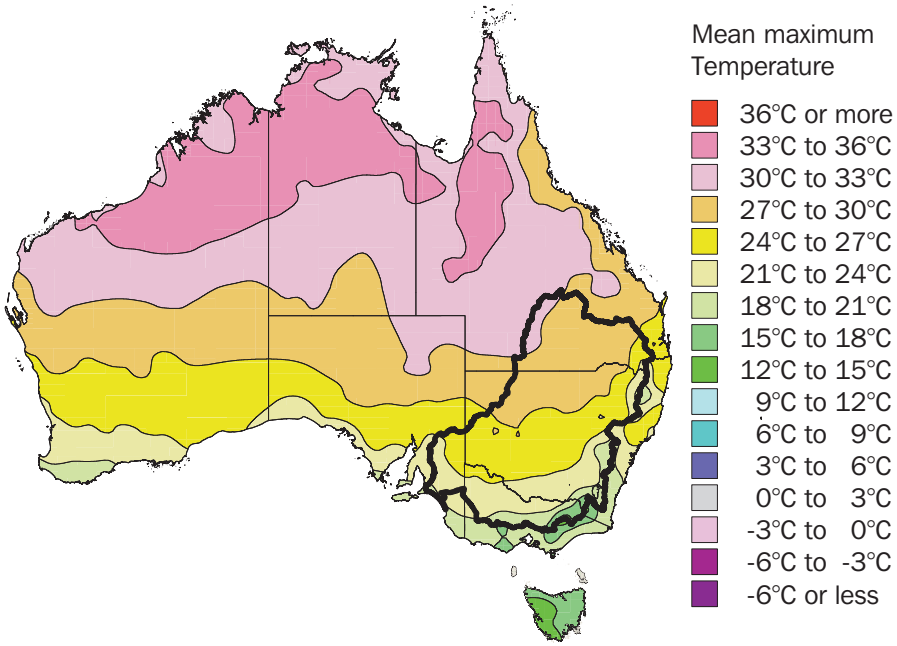
(b) Components may not add to total due to rounding.

Source: BRS data available on request, 2008; ABS data available on request, ABS Agricultural Census, 2005–06

TEMPERATURE

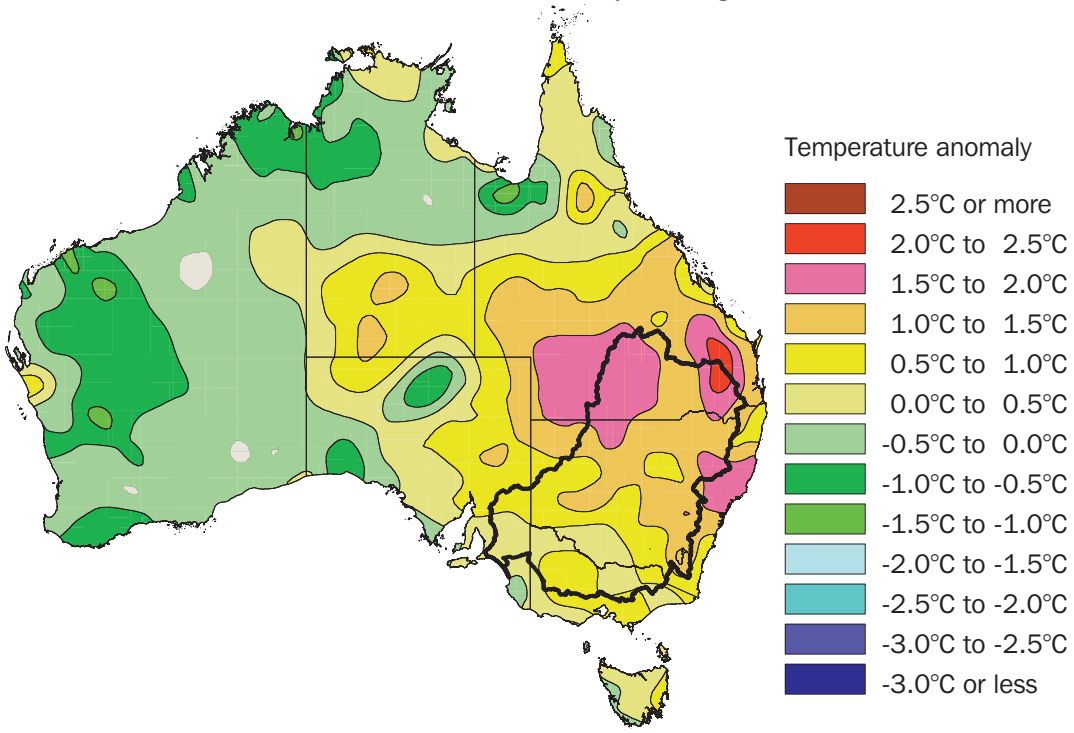
Temperatures in the MDB are cooler than most parts of the country because of its location in south eastern Australia (map 1.5). Temperature anomalies measure the deviation from the mean annual temperature (the mean is calculated from 1960 to 1990). In 2005–06, most areas in the Basin were hotter than average by as much as 2°C (as measured by maximum and minimum temperature anomalies, see map 1.6 and 1.7).

1.5 MEAN MAXIMUM TEMPERATURE, Murray–Darling Basin–2005–06



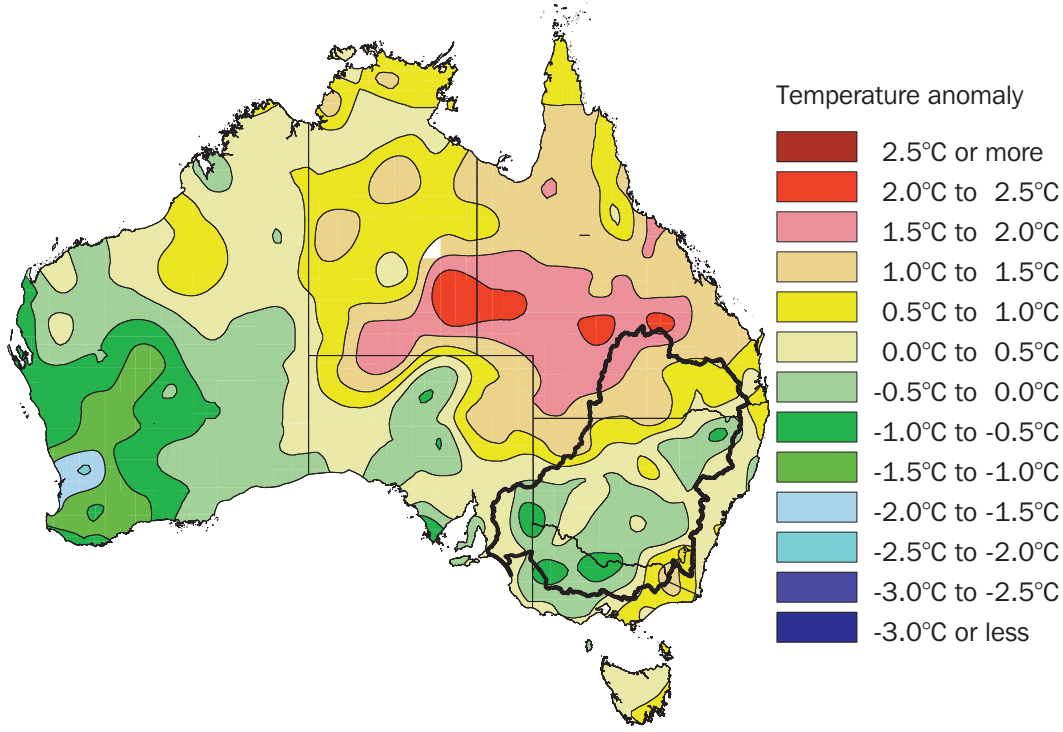
Source: Bureau of Meteorology 2008, Geoscience Australia 2004

1.6 MAXIMUM TEMPERATURE ANOMALY—Murray-Darling Basin—2005–06



Source: Bureau of Meteorology 2008, Geoscience Australia 2004

1.7 MINIMUM TEMPERATURE ANOMALY, Murray-Darling Basin—2005–06

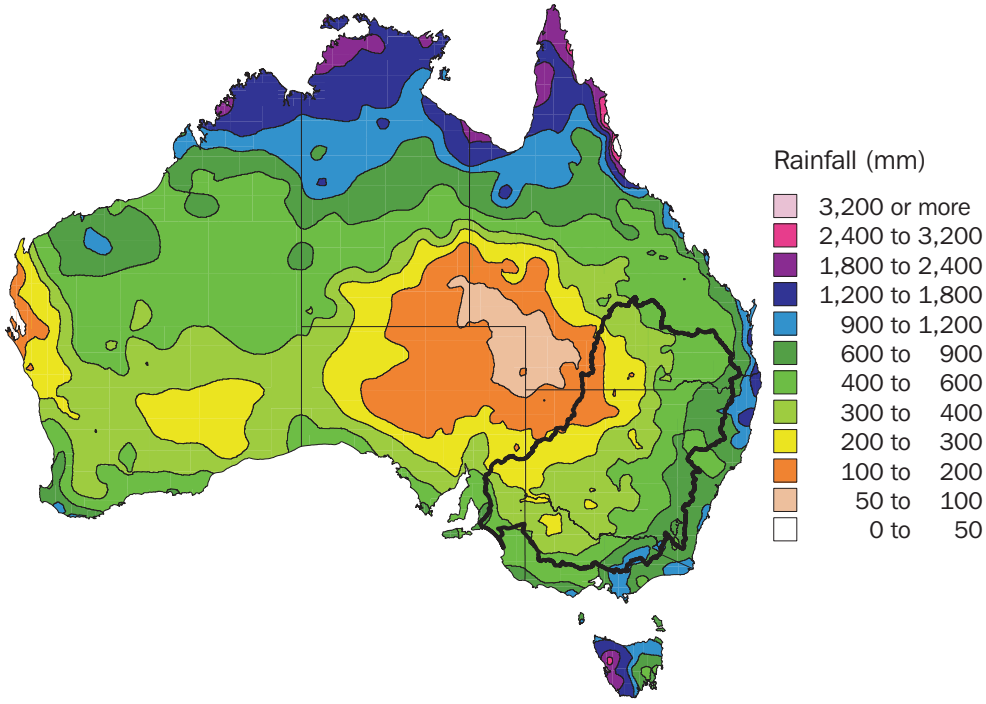


Source: Bureau of Meteorology 2008, Geoscience Australia 2004

RAINFALL AND WATER AVAILABILITY

The climate of the MDB is relatively dry compared to other regions of Australia (map 1.8). Annual rainfall in 2005–06 was lower in the MDB than in the tropical north, eastern seaboard and south-west of the continent, as well as in Tasmania. However, most of the Basin received more rainfall than central Australia.

1.8 TOTAL RAINFALL—2005–06



Source: Bureau of Meteorology 2008, Geoscience Australia 2004

RAINFALL AND WATER AVAILABILITY *continued*

Based on long-term averages, the MDB receives 530,618 GL of rainfall annually, of which 94% is evaporated or transpired (table 1.9). Almost 2% of rainfall enters the soil and groundwater as deep drainage. In the MDB, approximately 23,609 GL or 4% of rainfall appears as run-off. Run-off is "the part of precipitation in a given area and period of time that appears as streamflow" (NWC 2007:87).

Proportionally more evapotranspiration (94% of rainfall) occurs in the MDB than for the whole of Australia (89%). This results in less rainfall being transformed into run-off in the MDB (4% of rainfall) compared with the whole of Australia (9%). This means that rainfall is less likely to become available for use from river basins in the MDB.

1.9 ANNUAL WATER BALANCE—2008

	MURRAY-DARLING BASIN		AUSTRALIA	
Water balance component	*Volume* GL	*Proportion of rainfall* %	*Volume* GL	*Proportion of rainfall* %
Rainfall(a)	530 618	100	3 704 913	100
Evapotranspiration	497 290	94	3 291 649	89
Run-off	23 609	4	349 431	9
Deep drainage	9 719	2	63 833	2

(a) Components may not add to rainfall total due to rounding.

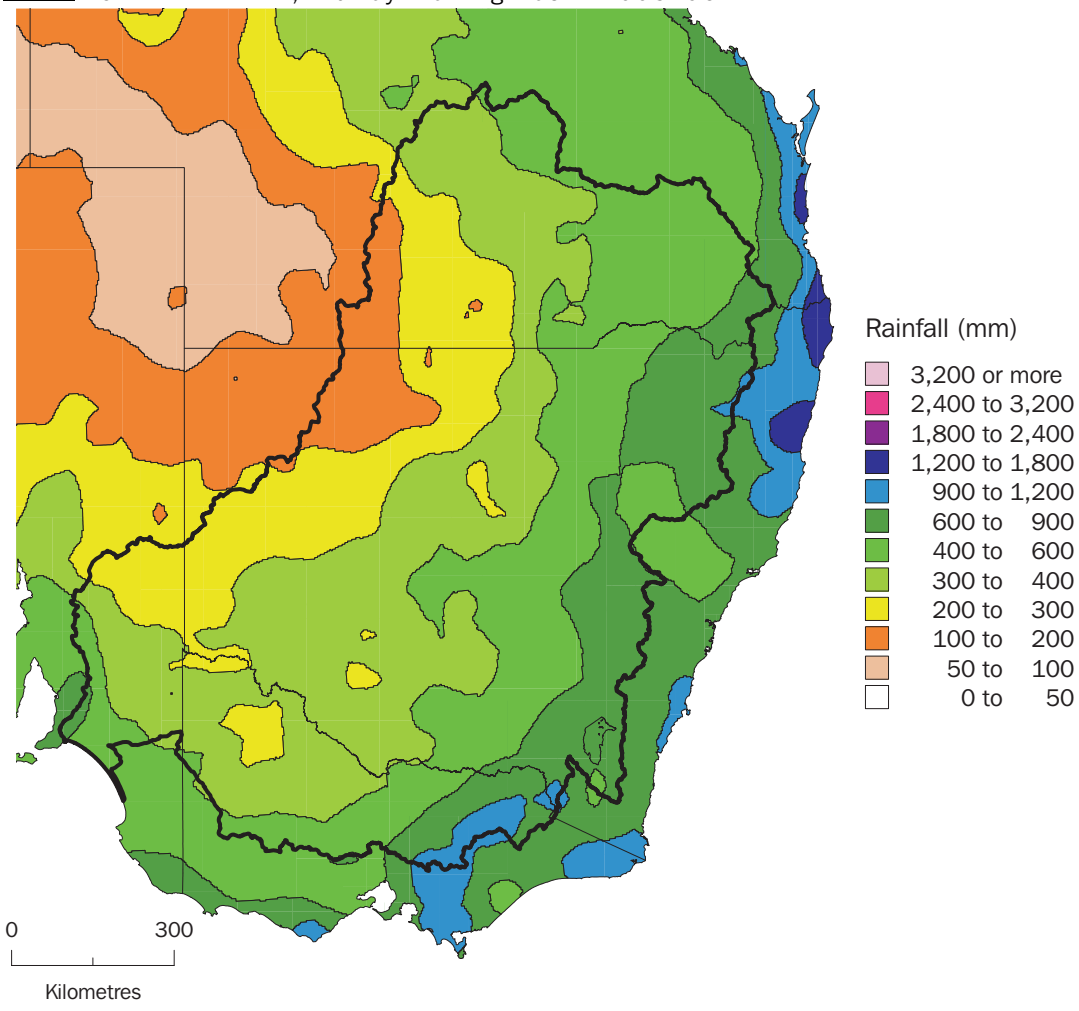
Note: Data relates to long-term averages, and is not indicative of a single period of time.

Source: Bureau of Rural Sciences, 2008, Rural Water, viewed 9 July 2008, http://adl.brs.gov.au/water2010/index.phtml

Regional distribution of rainfall

The spatial distribution of rainfall in the MDB is important as an indicator for vegetation growth - a key driver for agricultural production in Australia. In 2005–06, the highest levels of rainfall occurred in the south eastern and eastern areas of the MDB, declining towards the western and north western boundary as shown in map 1.10.

1.10 TOTAL RAINFALL, Murray–Darling Basin–2005–06



Source: Bureau of Meteorology 2008, Geoscience Australia 2004

The distribution of rainfall across the river basins within the MDB is extremely variable. Based on long-term averages, annual rainfall (expressed in volume terms) is highest in the Condamine-Culgoa (85,755 GL), Murrumbidgee (48,691 GL) and Lachlan (46,120 GL) river basins (table 1.11). Rainfall is lowest in the Lake George (686 GL), Kiewa (2,374 GL) and Campaspe (2,658 GL) river basins.

Rainfall expressed volumetrically is influenced by the size of each river basin. Generally, larger river basins have higher rainfall volumes. Therefore, in area-adjusted (GL/km^2) terms, river basins with the highest concentration of rainfall are the Kiewa (1.24 GL/km2), Upper Murray (1.18 GL/km^2) and Ovens (1.06 GL/km^2) river basins.

At the river basin level, more run-off occurs in the Upper Murray (4,472 GL), Murrumbidgee (3,831 GL) and Goulburn (2,686 GL) river basins compared with others. Run-off also exceeds 1,000 GL in the Ovens, Macquarie-Bogan, Lachlan, Namoi,

Regional distribution of rainfall continued

Condamine-Culgoa and Border Rivers basins. Some parts of the MDB have negligible run-off, for example, the Paroo (1 GL), Benanee (3 GL) and Darling (6 GL) river basins (table 1.11).

1.11 AVERAGE ANNUAL RAINFALL AND RUNOFF, by river basin—Murray-Darling Basin—2008

	Area	Rainfall		Run-off
River basin	km²	GL	GL/km²	GL
Avoca River	14 182	5 621	0.40	95
Benanee	21 345	6 778	0.32	3
Border Rivers	48 031	32 582	0.68	1 199
Broken River	7 096	4 466	0.63	341
Campaspe River	4 050	2 658	0.66	250
Castlereagh River	17 420	10 377	0.60	346
Condamine-Culgoa Rivers	162 595	85 755	0.53	1 212
Darling River	112 834	35 539	0.31	6
Goulburn River	16 860	14 613	0.87	2 686
Gwydir River	26 593	18 123	0.68	753
Kiewa River	1 908	2 374	1.24	676
Lachlan River	90 874	46 120	0.51	1 565
Lake George	944	686	0.73	66
Loddon River	15 658	7 796	0.50	349
Lower Murray River	58 261	16 764	0.29	207
Macquarie-Bogan Rivers	74 775	42 583	0.57	1 648
Mallee	41 498	13 210	0.32	37
Moonie River	14 341	8 023	0.56	106
Murray-Riverina	15 055	6 279	0.42	109
Murrumbidgee River	81 641	48 691	0.60	3 831
Namoi River	42 004	28 675	0.68	1 377
Ovens River	7 979	8 425	1.06	1 727
Paroo River	73 944	23 591	0.32	1
Upper Murray River	15 342	18 077	1.18	4 472
Warrego River	62 945	29 597	0.47	181
Wimmera-Avon Rivers	30 374	13 216	0.44	368
Murray Darling Basin(a)	**1 058 549**	**530 618**	**0.50**	**23 609**

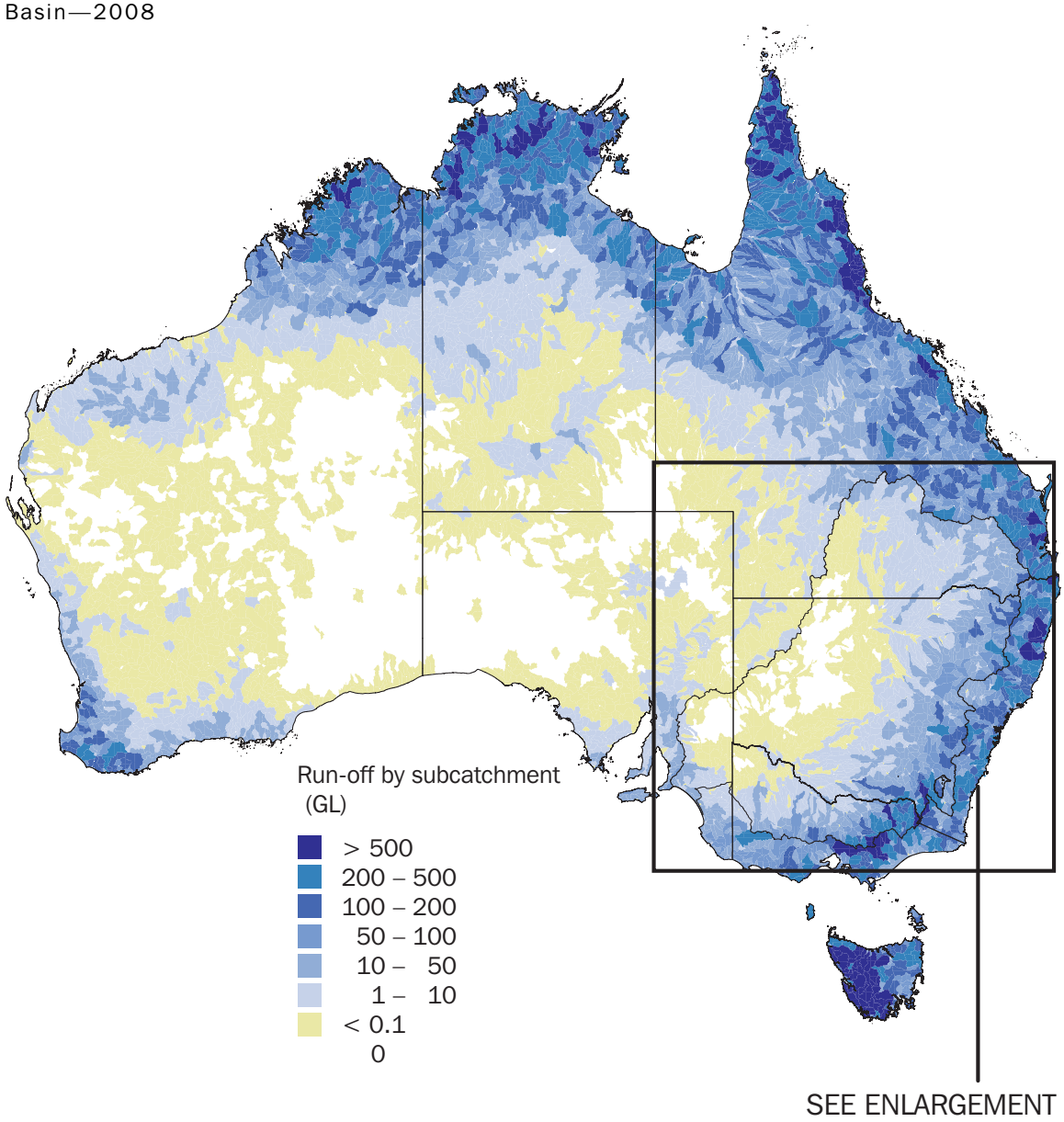
(a) Components may not add to total due to rounding.

Note: Data relates to long-term annual averages, and is not indicative of a particular year.

Source: Bureau of Rural Sciences, 2008, Rural Water, viewed 9 July 2008, http://adl.brs.gov.au/water2010/index.phtml

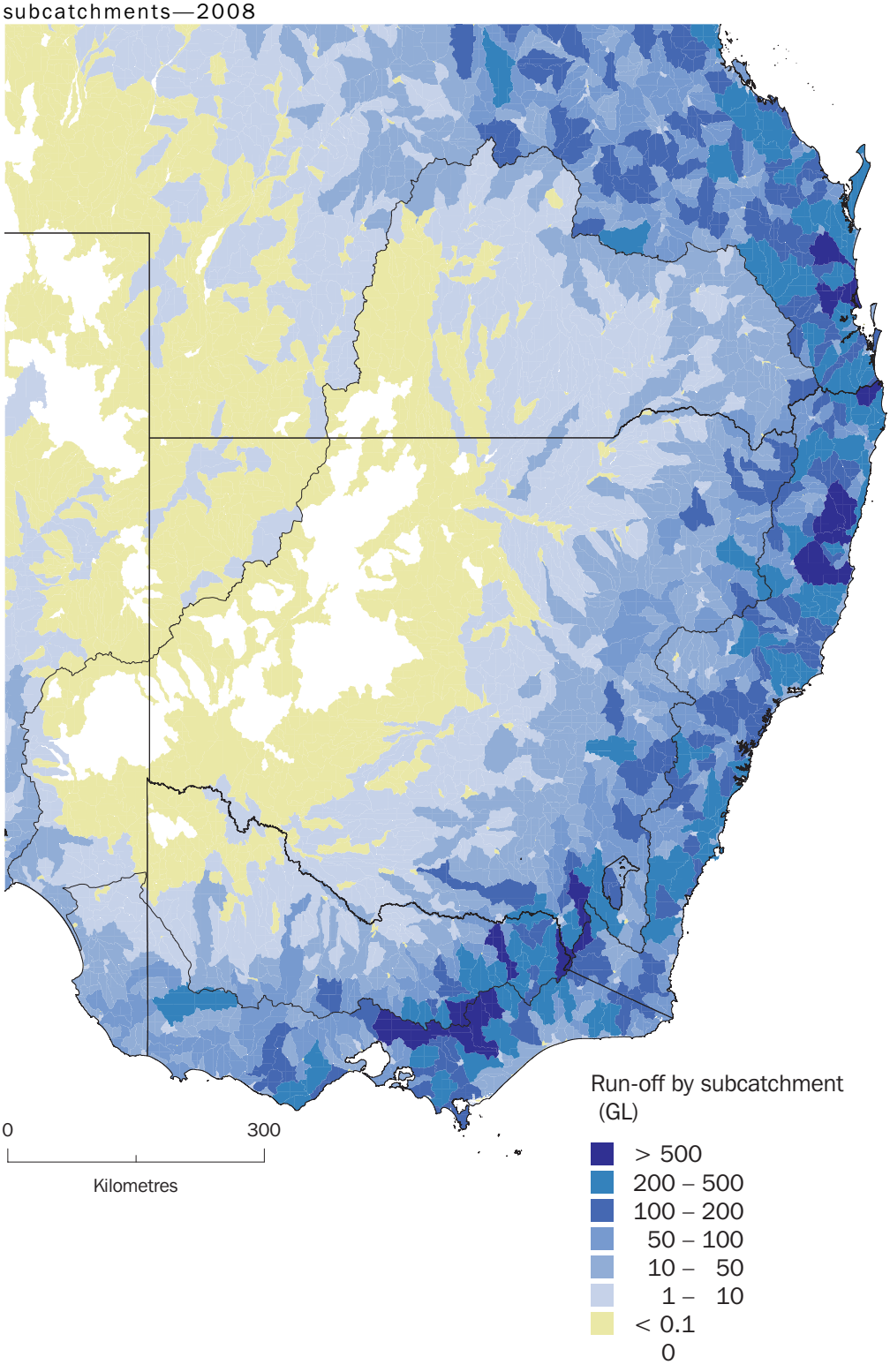
The inter-relationship between rainfall, temperature, topography and geology affect the pattern of run-off in the Australia and the MDB (map 1.12). This is significant because it influences where water becomes available for use by society and the environment. Based on long-term averages, annual run-off levels are highest in the north eastern Victoria and south eastern New South Wales river basin sub-catchments, and lowest in the western and north western sub-catchments (map 1.13).

1.12 MEAN ANNUAL RUN-OFF IN AUSTRALIAN SUBCATCHMENTS, Murray-Darling Basin—2008



Source: Bureau of Rural Sciences 2008, data available on request, Geoscience Australia 2004

1.13 ENLARGEMENT, mean annual run-off, Murray-Darling Basin subcatchments—2008



Source: Bureau of Rural Sciences 2008, data available on request, Geoscience Australia 2004

Rainfall anomalies 2000–01 to 2005–06

Rainfall anomalies measure the deviation from the long-term average (1960–1990) rainfall for given locations (BoM 2008). The rainfall anomalies across Australia are described in the following section and illustrated in maps 1.14 and 1.15, for the period 2000–01 to 2006–07.

2000–01

In 2000–01, average levels of rain fell in the majority of the MDB. Northern and central Australia experienced more rainfall than normal.

2001–02

The 2001–02 year was drier than average in the majority of the MDB, but not as severe as 2002–03. This pattern was similar to the trend over most of the rest of Australia, except in central Australia which was wetter than average.

2002–03

The 2002–03 year was extremely dry throughout the MDB, particularly in the eastern and south eastern areas of the Basin where rainfall is usually highest (see map 1.10). The resulting reduction in catchment run-off severely affected water storage levels in large dams (see Chapter 3, graph 3.18). The reduced rainfall experienced in the MDB was reflected over most of eastern Australia in 2002–03. The northern part of the Northern Territory was wetter than usual, but far north Queensland was much drier.

2003–04

The 2003–04 year was drier than average in the MDB, but not as dry as the previous two years. Northern and central Australia received more rainfall than normal.

2004–05

The 2004–05 year was drier than average in the MDB, and geographically exhibited a similar rainfall anomaly pattern to 2003–04. Many areas of north eastern, north western, northern and central Australia were drier than normal.

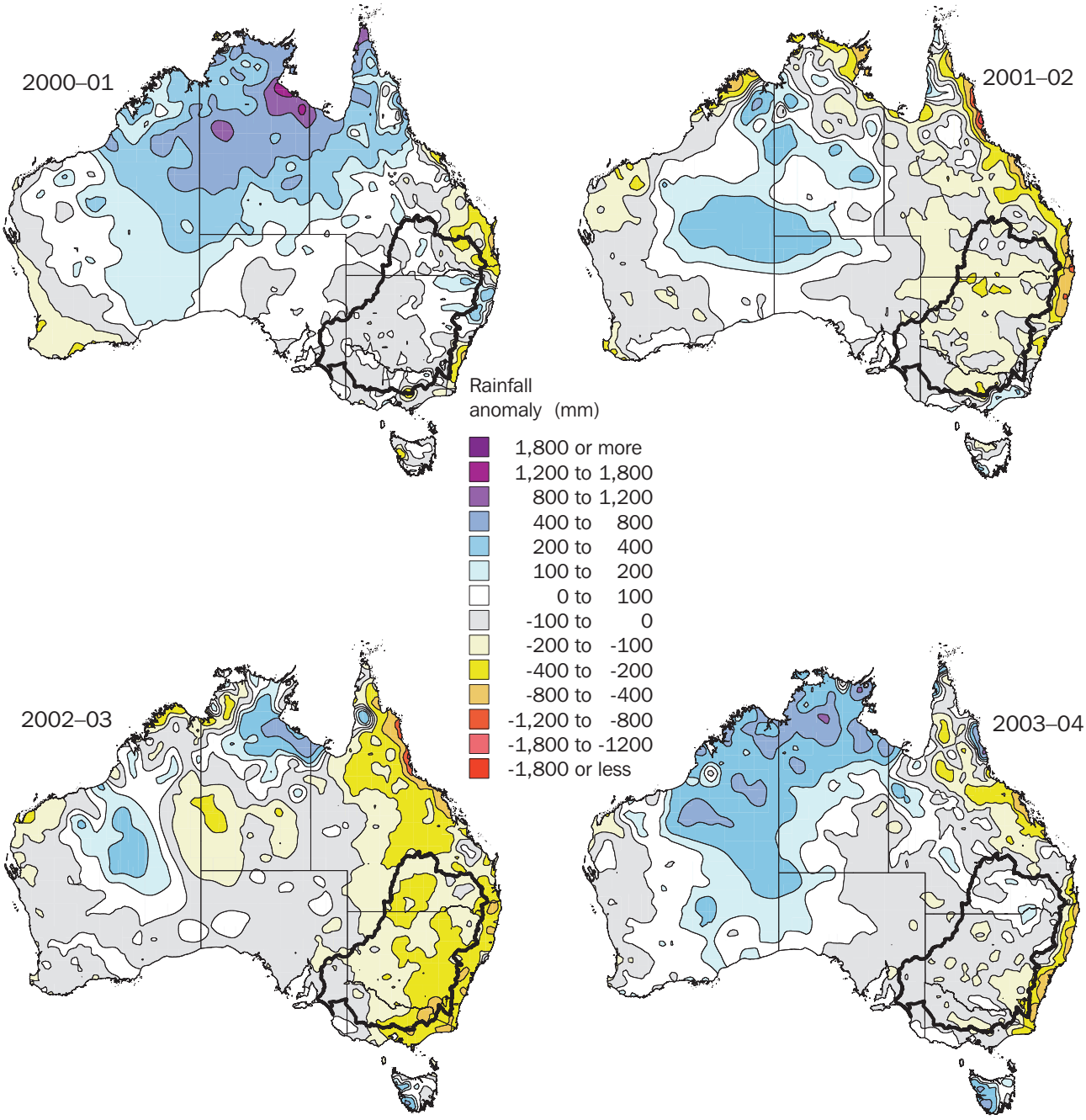
2005–06

The 2005–06 year was drier than average in the MDB, especially in the northern part of the Basin. North eastern, north western, northern, and central Australia experienced more rainfall than normal.

2006–07

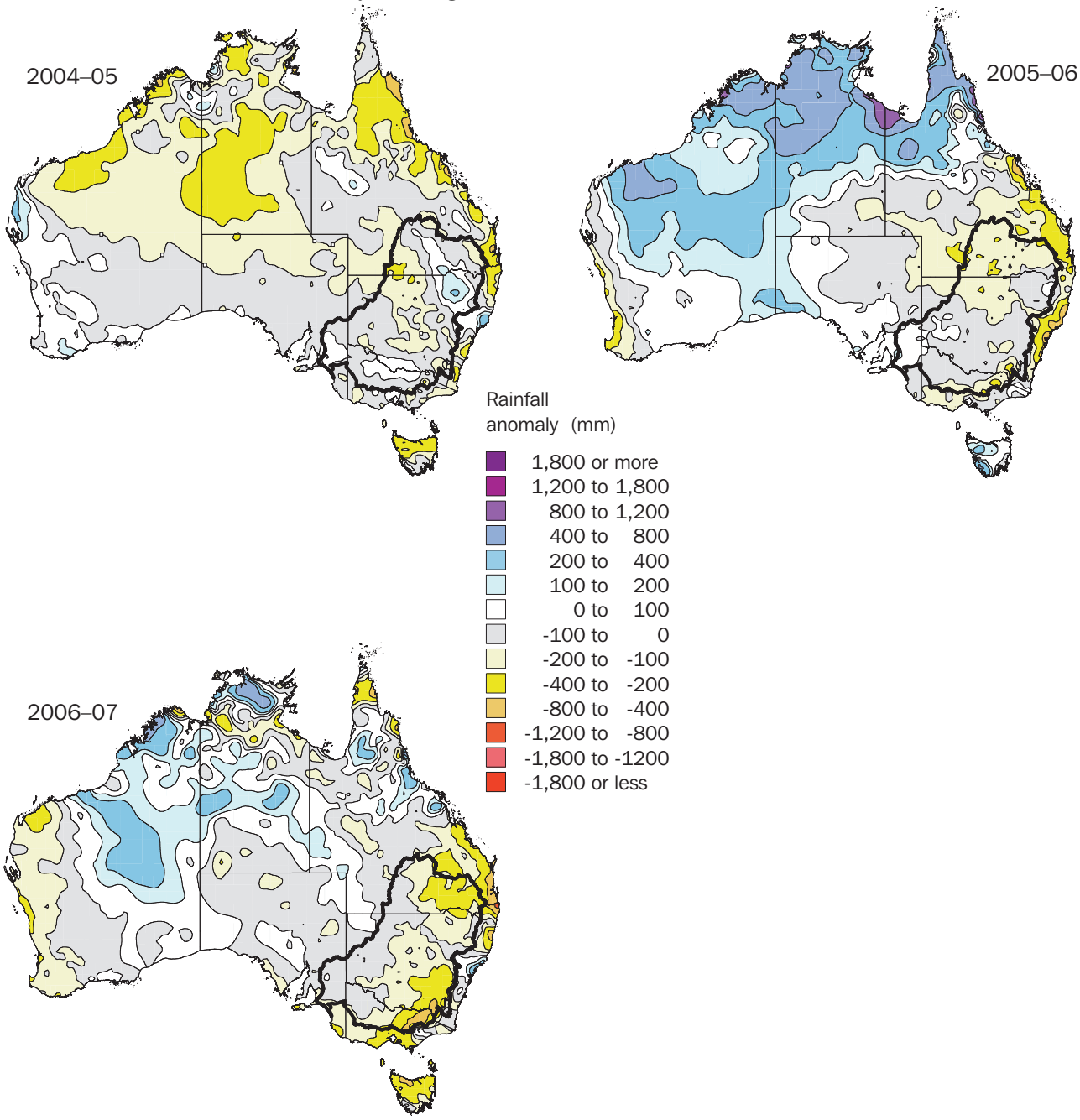
The 2006–07 year was extremely dry throughout the MDB, particularly in the eastern, northern and south eastern areas of the Basin where rainfall is usually highest (see map 1.10).

1.14 RAINFALL ANOMALIES, Murray–Darling Basin–2000–01 to 2003–04



Source: Bureau of Meterology 2008, Geoscience Australia 2004.

1.15 RAINFALL ANOMALIES, Murray–Darling Basin–2004–05 to 2006–07



Source: Bureau of Meterology 2008, Geoscience Australia 2004.

ENVIRONMENTAL FEATURES

Many key natural features, habitats, flora and fauna of Australian significance are found in the MDB. Some significant facts about the MDB environment are:

- The Darling (2,740 km), Murray (2,530 km) and Murrumbidgee (1,690 km) are Australia's three longest rivers (MDBC 2006).
- At the time of European settlement, about 28% of Australia's mammal species, 48% of its birds, and 19% of its reptiles were found in the MDB (DEWHA 2008a).
- The MDB has at least 35 endangered bird species and 16 endangered mammal species with 20 mammal species now extinct (MDBC 2006).
- Several migratory bird species, including the *Regent Honeyeater* and the *Swift Parrot*, are reliant on habitats in the MDB (DEWHA 2007a).
- There are 11 introduced species of fish in the Basin (MDBC 2006).
- It is estimated that there are more than 30,000 wetlands in the MDB (MDBC 2006).
- 16 of Australia's 65 internationally-listed wetlands are in the Basin, including the Currawinya Lakes in Queensland, Macquarie Marshes in New South Wales, Gunbower and Barmah Forests in Victoria, and the Coorong in South Australia. These are also known as Ramsar Wetlands, after the Iranian town of Ramsar, where the *Convention on Wetlands of International Importance* was signed in 1971 (DEWHA 2008b).

Significant water assets in the Basin, including major rivers, water bodies, and internationally-listed (Ramsar) wetlands are shown in map 1.16 (sourced from the Department of the Environment, Water, Heritage and the Arts). Areas of significant irrigation activity (Irrigation Areas) are shown to indicate their proximity to Ramsar wetlands and other environmental water assets. As can be seen from the map, some of the Ramsar wetlands are located very close to large irrigation areas, especially along the Murray River.

Number of Threatened Species and Communities

Map 1.17 shows the number and location of threatened and migratory species, and ecological communities listed under the *Environment Protection and Biodiversity Conservation Act 1999*. The information in map 1.17 has been modelled by the Department of the Environment, Water, Heritage and the Arts using a combination of actual sightings, likely sightings, habitat and climatic conditions suitable to each species or community in the MDB.

Areas shown on the map with a higher number of species and communities are typified by significant areas of remnant vegetation and related species diversity, many of which are under pressure from various sources and processes. These include the Great Dividing Range, stretching from Toowoomba in Queensland south into New South Wales, box gum woodland in the vicinity of Canberra, mallee woodland on the New South Wales-Victoria border around Mildura, the Grampians in central-west Victoria, and the Coorong wetlands at the mouth of the Murray River in South Australia.

1.16 ENVIRONMENTAL WATER ASSETS—Murray–Darling Basin – 2008

Data Sources:
Drainage Division, Rivers, States, Water bodies, Localities: © Commonwealth of Australia (Geoscience Australia).
Ramsar wetlands:
© Commonwealth of Australia (Dept of the Environment, Water, Heritage and the Arts) 2007.
Irrigation areas:
© Murray - Darling Basin Commission, 2006.

Caveat:
All data are presumed to be correct as received from data providers. No responsibility is taken by the Commonwealth for errors or omissions. The Commonwealth does not accept responsibility in respect to any information or advice given in relation to, or as a consequence of anything contained herein.

Map produced by:

ERIN

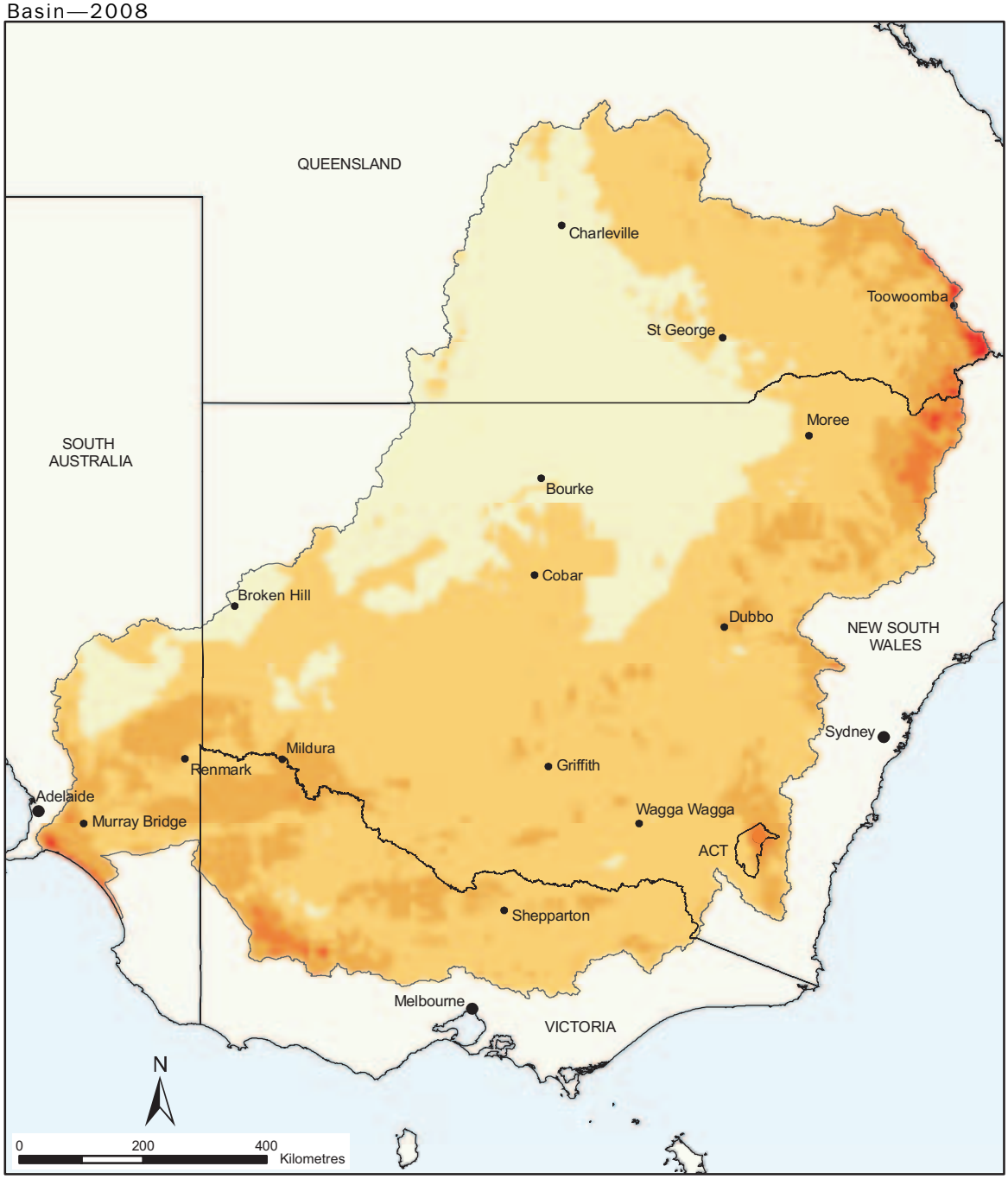
Department of the Environment, Water, Heritage and the Arts, July 2008.

Geographic Coordinate System on the GDA94 Datum.

Capital Cities
Towns
Major Rivers
Water Bodies
Ramsar Wetlands
Irrigation Areas
Murray-Darling Basin
State Borders

Australian Government
Department of the Environment, Water, Heritage and the Arts

1.17 NUMBER OF THREATENED SPECIES AND COMMUNITIES, Murray-Darling Basin—2008



Data Sources:
Drainage Division, States, Localities:
© Commonwealth of Australia (Geoscience Australia).

Caveat:
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Map produced by:

ERIN

Department of the Environment, Water, Heritage and the Arts, July 2008.

Geographic Coordinate System on the GDA94 Datum.

No. of Threatened & Migratory Species and Ecological Communities

- 2 - 4
- 5 - 9
- 10 - 14
- 15 - 19
- 20 - 29

- Capital Cities
- Towns
- Murray-Darling Basin
- State Borders

Australian Government
Department of the Environment, Water, Heritage and the Arts

CHAPTER 2 PEOPLE IN THE MURRAY-DARLING BASIN

INTRODUCTION

This chapter provides an overview of the social and living conditions of the people living within the Murray-Darling Basin (MDB). It presents a range of population statistics (e.g. size, composition, distribution etc.) to enable analysis of a number of social and economic issues that may affect the sustainability of rural and regional communities within the MDB.

The chapter is divided into four main sections: population characteristics, education, work and farmers in the MDB. Together these provide an indication of social wellbeing in the MDB, and enable comparisons with national level statistics.

All data presented in this chapter are from ABS Censuses of Population and Housing and relate to where people usually live. Census data are used as Census Collection Districts allow better aggregation to the MDB geographic area than other data sources such as Estimated Resident Population or ABS household survey estimates. Census data do however have some limitations. See Explanatory Notes for more detail.

POPULATION CHARACTERISTICS

Population size and density

In 2006, more than two million people were living within the MDB (as reported in the Census), around 10% of Australia's population. The largest shares of the Basin's population resided within the states of New South Wales (39%) and Victoria (29%) (table 2.1).

Less than 70,000 people (4%) in the MDB were identified as Indigenous (Aboriginal and/or Torres Strait Islander), a higher proportion than the national average of 2%. The majority of Indigenous people in the MDB (45,650 people) resided in New South Wales with fewer residing in Queensland (8,870) and Victoria (8,670).

2.1 POPULATION CHARACTERISTICS—2006

	MURRAY-DARLING BASIN						AUSTRALIA
	NSW	*Vic.*	*Qld*	*SA*	*ACT*	*Total MDB*	
Area covered(a) *(km^2)*	597 926	129 761	259 313	69 216	2 354	1 058 549	7 672 645
Population density *(persons/km^2)*	1.3	4.4	0.8	1.6	137.1	1.9	2.6
Indigenous status							
Non-Indigenous							
Number *(no.)*	695 330	543 120	198 500	104 510	304 510	1 845 970	18 266 810
Percent *(%)*	89.6	94.3	91.3	93.1	94.2	92.1	92.0
Indigenous							
Number *(no.)*	45 650	8 670	8 870	2 500	3 850	69 530	455 030
Percent *(%)*	5.9	1.5	4.1	2.2	1.2	3.5	2.3
Not stated							
Number *(no.)*	34 670	24 190	9 940	5 290	14 970	89 050	1 133 450
Percent *(%)*	4.5	4.2	4.6	4.7	4.6	4.4	5.7
Total Population(b) *(no.)*	**775 640**	**575 980**	**217 310**	**112 300**	**323 330**	**2 004 560**	**19 855 290**
State/territory population as a proportion of MDB population *(%)*	38.7	28.7	10.8	5.6	16.1	100.0	. .

. . not applicable
(a) BRS data, available on request, 2008.
(b) Components may not add to total due to rounding.

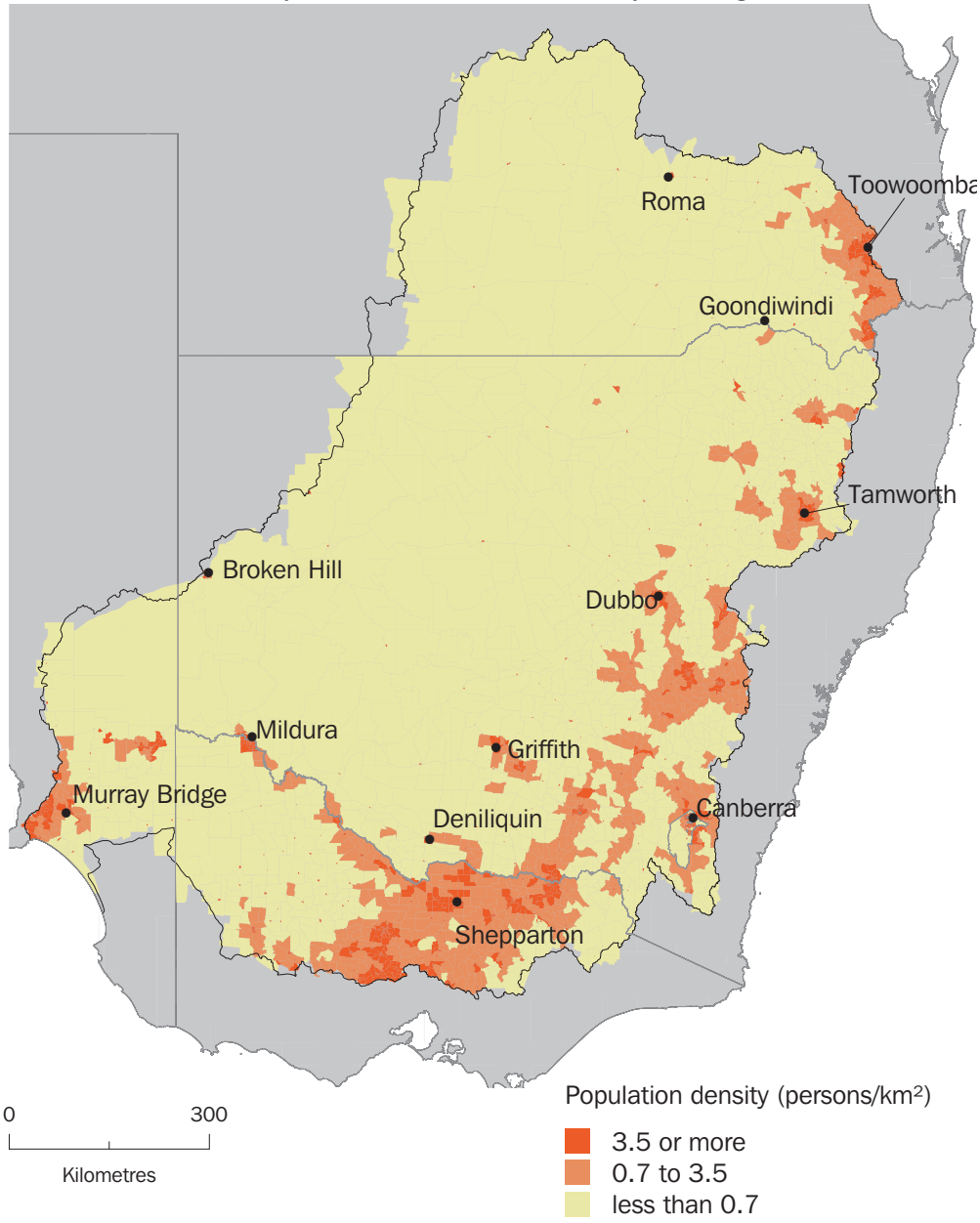
Source: ABS data available on request, ABS Census of Population and Housing, 2006; BRS data available on request, 2008

Population size and density continued

Overall, the MDB is sparsely populated with an average density of 1.9 persons per square kilometre, well below the national rate of 2.6 persons per square kilometre. The Australian Capital Territory (comprising mainly the city of Canberra) had the highest population density of 137 persons per square kilometre. Besides Victoria (4.4 persons per square kilometre), the population density in the other Basin states were all below the national average, reflecting that much of the area covered is classified as regional or remote.

Map 2.2 below shows the population density of the MDB in 2006 by Census Collection District (see map E.1 of the Expanatory Notes).

2.2 POPULATION DENSITY, by Collection District—Murray–Darling Basin—2006



Source: ABS data available on request, ABS Census of Population and Housing 2006, Geoscience Australia 2004

Urban Centres

Table 2.3 lists the 11 largest urban centres in the MDB (those with a population of 25,000 and over) in 2006. These centres were home to more than 830,000 people (as reported in the Census) or around two-fifths of the Basin's population. Canberra, with the adjoining New South Wales town of Queanbeyan, is the largest urban centre in the MDB, with a population of more than 350,000 people, or 18% of the Basin's population. Other major urban centres, with a population of more than 50,000 were: Toowoomba in Queensland (84,850), Bendigo in Victoria (76,050) and the adjoining towns of Albury-Wodonga in New South Wales and Victoria (73,500).

Urban Centres continued

2.3 POPULATION OF MAJOR URBAN CENTRES(a)—Murray-Darling Basin—2006

	State/territory	Population	Urban centre as a proportion of MDB population
		no.	%
Canberra-Queanbeyan	NSW/ACT	356 120	17.8
Toowoomba	Qld	84 850	4.2
Bendigo	Vic.	76 050	3.8
Albury-Wodonga	NSW/Vic.	73 500	3.7
Wagga-Wagga	NSW	46 740	2.3
Shepparton-Morroopna	Vic.	38 770	1.9
Tamworth	NSW	33 480	1.7
Orange	NSW	31 550	1.6
Dubbo	NSW	30 570	1.5
Mildura	Vic.	30 020	1.5
Bathurst	NSW	28 990	1.4

(a) Towns with population 25,000 or more.

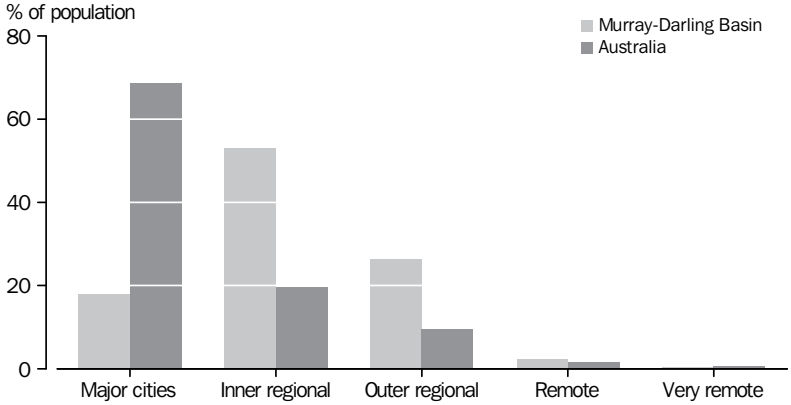
Source: ABS data available on request, ABS Census of Population and Housing, 2006

Remoteness

The Australian Standard Geographical Classification classifies remoteness areas into five categories; major cities, inner regional, outer regional, remote and very remote areas. The classification is based on the road distance to different sized population centres, where the population size is considered to govern the range and type of services available. For further information see *Statistical Geography: Volume 1 - Australian Standard Geographical Classification (ASGC) 2001* (ABS cat. no. 1216.0)

In 2006, the distribution of the MDB population by remoteness was quite different from that of Australia. In Australia, the majority of people were located in the major cities (68% of the total population), while in the MDB the majority of people lived in inner and outer regional areas (53% and 26% respectively) (graph 2.4).

2.4 POPULATION, by remoteness area—Murray-Darling Basin and Australia—2006



Source: ABS data available on request, ABS Census of Population and Housing, 2006

Population growth

The change in size and distribution of population has implications for service provision and delivery in areas such as health, education, housing and social welfare. Population increase, especially in the urban centres, also places pressure on water supplies and infrastructure.

Between 1996 and 2006, the number of people living in the Basin rose by 5% - this was well below the national growth rate of 12%. Much of the growth in the MDB occurred between 2001 and 2006 when the population rose by 4% compared to less than 1% between 1996 and 2001.

Population growth was observed in all Basin states between 1996 and 2006, although New South Wales experienced a decline in population (more than 1%) between 1996 and 2001. South Australia experienced the largest growth (12%) between 1996 and 2006, similar to the national rate. The Australian Capital Territory and Queensland both experienced increases of 9% (table 2.5).

2.5 POPULATION CHANGE—Murray-Darling Basin—1996–2006

	POPULATION			CHANGE		
	1996	*2001*	*2006*	*1996–2001*	*2001–2006*	*1996–2006*
	no.	no.	no.	%	%	%
New South Wales	765 690	755 010	775 640	–1.4	2.7	1.3
Victoria	542 770	550 700	575 980	1.5	4.6	6.1
Queensland	199 750	204 420	217 310	2.3	6.3	8.8
South Australia	100 210	103 530	112 300	3.3	8.5	12.1
Australian Capital Territory	297 180	308 180	323 330	3.7	4.9	8.8
Murray-Darling Basin	***1 905 600***	***1 921 840***	***2 004 560***	***0.9***	***4.3***	***5.2***
Total Australia	**17 752 830**	**18 769 250**	**19 855 290**	**5.7**	**5.8**	**11.8**

Source: ABS data available on request, ABS Census of Population and Housing, 1996, 2001 and 2006

The Basin's largest population growth occurred in the major urban centres, particularly those located in Victoria, namely, Bendigo (27% increase between 1996 and 2006), Mildura (25%) and Shepparton-Moroopna (22%). Other significant growth in the Basin was observed in Toowoomba (13%), Bathurst (12%) and Canberra-Queanbeyan (11%) (table 2.6).

2.6 POPULATION CHANGE, Major urban centres(a)—Murray-Darling Basin—1996–2006

	STATE/TERRITORY	POPULATION			CHANGE		
		1996	*2001*	*2006*	*1996–2001*	*2001–2006*	*1996–2006*
		no.	no.	no.	%	%	%
Canberra-Queanbeyan	NSW/ACT	320 610	327 230	356 120	2.1	8.8	11.1
Toowoomba	Qld	75 050	77 640	84 850	3.5	9.3	13.1
Bendigo	Vic.	59 830	66 930	76 050	11.5	13.6	27.1
Albury-Wodonga	NSW/Vic.	67 190	67 620	73 500	0.6	8.7	9.4
Wagga-Wagga	NSW	42 770	42 840	46 740	0.2	9.1	9.3
Shepparton-Morroopna	Vic.	31 900	34 960	38 770	9.6	10.9	21.6
Tamworth	NSW	31 800	31 240	33 480	–1.8	7.2	5.3
Orange	NSW	30 660	31 000	31 550	1.1	1.8	2.9
Dubbo	NSW	30 060	29 610	30 570	–1.5	3.2	1.7
Mildura	Vic.	24 100	26 460	30 020	9.8	13.5	24.6
Bathurst	NSW	25 960	26 040	28 990	0.3	11.3	11.7

(a) Towns with population of 25,000 or more.

Source: ABS data available on request, ABS Census of Population and Housing, 1996, 2001 and 2006

Population growth continued

Analysing population changes by remoteness area shows population declines in the outer regional (4% decrease between 1996 and 2006), remote (16%) and very remote (41%) areas of the Basin. There were corresponding population increases in inner regional areas and major cities (table 2.7).

2.7 POPULATION CHANGE, by remoteness area—Murray-Darling Basin—1996–2006

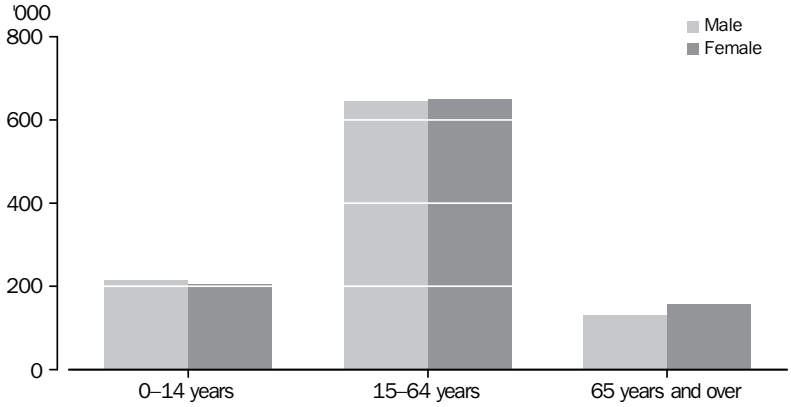
	POPULATION			CHANGE		
	1996	*2001*	*2006*	*1996–2001*	*2001–2006*	*1996–2006*
	no.	no.	no.	%	%	%
Major cities	324 940	349 370	358 560	7.5	2.6	10.3
Inner regional	958 530	975 110	1 059 260	1.7	8.6	10.5
Outer regional	548 060	525 180	527 880	–4.2	0.5	–3.7
Remote	60 580	58 120	50 910	–4.1	–12.4	–16.0
Very remote	13 500	13 890	7 950	2.9	–42.8	–41.1

Source: ABS data available on request, ABS Census of Population and Housing, 1996, 2001 and 2006

Age and sex distribution

In 2006, there were 19,500 more females in the MDB than males (as reported in the Census), resulting in a sex ratio of 98.1 (number of males per 100 females). There were 9,800 more males than females aged 14 years and under while the number of males aged 65 years and over was 26,300, or 20% lower than the number of females in this group (graph 2.8). The number of females in the 15–64 year range was slightly higher than the number of males (3,000).

2.8 POPULATION DISTRIBUTION, by sex, Murray-Darling Basin—2006



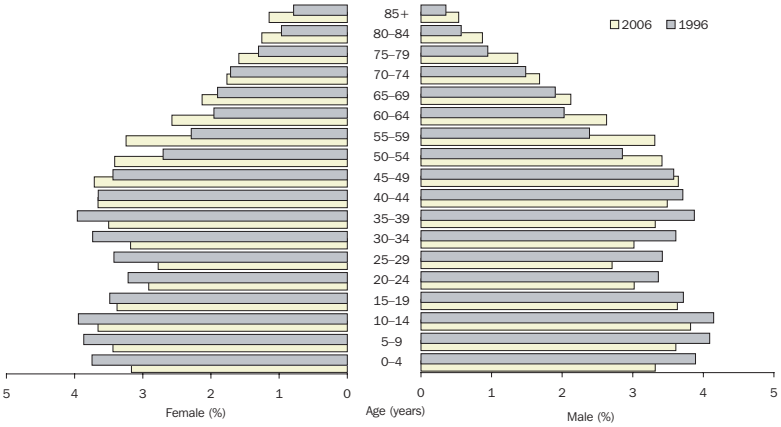
Source: ABS data available on request, ABS Census of Population and Housing, 2006

The age structure of the population impacts on requirements for service provision and labour force participation. Australia's ageing population has implications for health services, housing, and the capacity for people to contribute to community life. The relative supply of labour will decline and the average age of the workforce will increase (BRS 2008b).

In line with the national trend, the Basin's population is ageing (as shown in graph 2.9 below), largely due to the combination of lower fertility rates and increasing life expectancy. In 1996, children aged 0–14 years represented 21% of the Basin's population, those aged 15–64 years represented 65% and those aged 65 years and over represented 15%. Although the Basin's population has continued to grow since 1996, the proportion of the population in the older age groups increased while the proportion in younger age groups declined (graph 2.9). For example, between 1996 and 2006, the proportion of children aged 0–14 years in the MDB decreased by 4 percentage points while the proportion of people aged 65 years and over increased by 3 percentage points.

Age and sex distribution continued

2.9 AGE AND SEX DISTRIBUTION OF POPULATION—Murray-Darling Basin—1996 and 2006



Source: ABS data available on request, ABS Census of Population and Housing 2006

The change in the age structure can be summarised by the change in the median age. In 2006, the median age of the MDB's population was 38 years, similar to the national median age of 37 years. The median age of the Basin's population has increased by 5 years since 1996 and about 2 years since 2001.

Living arrangements - households and families

Families provide emotional, physical and financial care and support to their members and are often the basis on which government assistance is determined and administered. Australians have traditionally experienced three main living arrangements over a lifecycle: living with parents, living with a partner (for some of this period with children) and living alone in old age if that partner died. Now and into the future, living arrangements throughout a lifecycle may also include living alone or in a group household before perhaps forming a long-term partnership, or living as a lone parent or alone after divorce or separation. These changes in living arrangements and family characteristics are the outcome of various demographic and social trends, such as declining fertility, increased rates of divorce and longer life expectancy (ABS 2005).

Table 2.10 and graph 2.11 show the living arrangements by household type and family type in the MDB. In 2006, there were nearly 780,000 households in the Basin (as reported in the Census) with an average size of 2.4 persons per household (a slight decrease from 2.6 in 1996).

More than two-thirds (68%) of households in the Basin were single family households and a quarter (25%) were lone or single person households. These were slightly higher than the equivalent Australian proportions (67% single family, 23% lone person).

The proportion of single family households decreased by almost 4 percentage points between 1996 and 2006 in the MDB (similar to the decline for Australia as a whole), while the proportion of lone person households increased by 2 percentage points during the same period (compared to an increase of 0.8 percentage points for Australia).

2.10 HOUSEHOLD CHARACTERISTICS(a)—1996 and 2006

	MURRAY-DARLING BASIN		AUSTRALIA	
	1996	*2006*	*1996*	*2006*
***Total number of households** (no.)*	***684 940***	***778 980***	***6 374 870***	***7 463 790***
***Total number of persons** (no.)*	***1 807 180***	***1 903 080***	***16 967 760***	***19 022 540***
Average number of persons/ household *(persons/household)*	2.6	2.4	2.7	2.5
Single family household				
Number *(no.)*	491 720	529 790	4 512 470	5 029 520
Proportion of total households *(%)*	71.8	68.0	70.8	67.4
Multi-family household				
Number *(no.)*	4 280	6 150	70 530	93 240
Proportion of total households *(%)*	0.6	0.8	1.1	1.2
Lone person household				
Number *(no.)*	157 720	195 050	1 432 820	1 740 480
Proportion of total households *(%)*	23.0	25.0	22.5	23.3
Group household				
Number *(no.)*	24 170	24 940	266 000	280 850
Proportion of total households *(%)*	3.5	3.2	4.2	3.8
Other not classifiable				
Number *(no.)*	7 060	23 050	93 060	319 700
Proportion of total households *(%)*	1.0	3.0	1.5	4.3

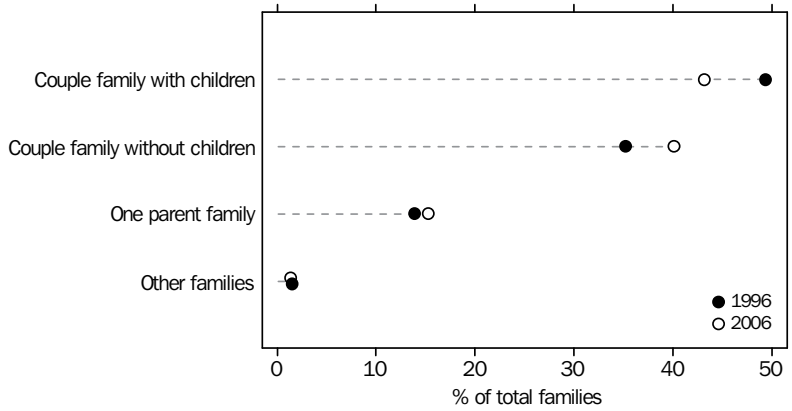
(a) Occupied private dwellings only. Excludes overseas visitors and persons with no usual address.

Source: ABS data available on request, ABS Census of Population and Housing, 1996 and 2006

Living arrangements - households and families continued

Overall, an increase in the number of families in the MDB would be expected from overall population increase. However, over the last decade, there have been changes in the relative proportions of family types in the MDB. Couple families with children were the most common type of family in the MDB, although, as a proportion of all families, they have decreased from 49% in 1996 to 43% in 2006 (table 2.11). Over the same period, the proportion of couple families without children increased by 5 percentage points while one parent families increased by 1 percentage point.

2.11 CHANGE IN FAMILY COMPOSITION, Murray-Darling Basin—1996 and 2006



Source: ABS data available on request, ABS Census of Population and Housing, 2006

EDUCATION

Education contributes to individual wellbeing and economic growth. Higher levels of educational attainment are associated with increased employment opportunities and higher wages, and contribute to improving Australia's economic standing. The changing structure and growth of the Australian economy has increased the demand for a diverse, skilled workforce, with higher levels of educational attainment required to meet this demand.

Level of highest educational attainment

The indicator of educational progress used in this chapter measures the attainment of formal non-school qualifications. The statistics relating to educational attainment relate to people aged 15 years and over.

In 2006, more than one-third (34%) of the 1.6 million people aged 15 years and over living in the MDB held at least one non-school qualification (as reported in the Census), lower than the national rate of 37% (table 2.12). Of these, more than 204,000 people held a Bachelor degree or higher, 96,000 people held an Advanced diploma or Diploma, and 240,000 people held a Certificate level qualification - a group which includes the traditional trade qualifications.

2.12 LEVEL OF HIGHEST NON-SCHOOL QUALIFICATION(a)—2006

	MURRAY-DARLING BASIN		AUSTRALIA	
	Population	*Proportion of total persons*	*Population*	*Proportion of total persons*
	no.	%	no.	%
With non-school qualification				
Postgraduate degree	31 960	2.0	412 270	2.6
Graduate diploma and Graduate certificate	25 130	1.6	228 150	1.4
Bachelor degree	146 970	9.3	1 836 610	11.6
Advanced diploma and Diploma	96 140	6.1	1 128 220	7.1
Certificate	240 270	15.2	2 284 590	14.4
Total	540 470	34.1	5 889 840	37.1
Without non-school qualification	835 700	52.7	7 760 700	48.9
Total persons aged 15 years and over(b)	**1 583 390**	**100.0**	**15 879 920**	**100.0**

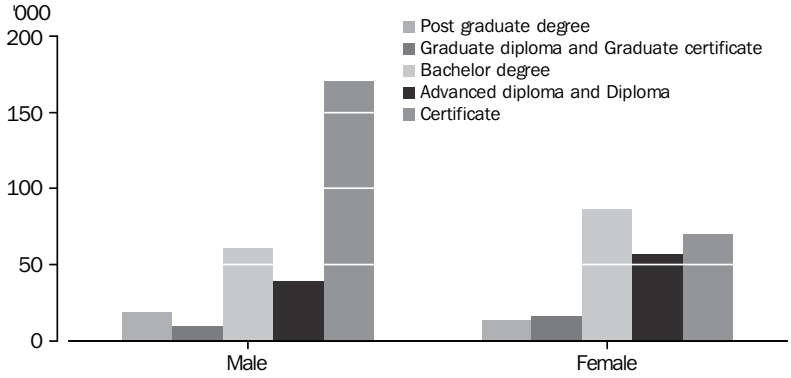
(a) Persons aged 15 years and over.
(b) Includes persons who did not state or inadequately described their qualifications.
Source: ABS data available on request, ABS Census on Population and Housing, 2006

As with Australia, the educational attainment of people living in the MDB has increased over the last decade. Between 1996 and 2006 the number of people holding a non-school qualification increased by 36%. The increase mostly reflected the increase in the proportion of people whose level of highest non-school qualification was a Bachelor degree or higher which increased by 42% since 1996 (compared to a 57% rise for Australia).

In 2006, more males than females in the MDB held a non-school qualification (38% and 30% respectively), although females were more likely to have a Bachelor degree or higher than males (14% and 11% respectively). The most common level of highest non-school qualification held by males was a Certificate (22%) (graph 2.13).

Level of highest educational attainment continued

2.13 LEVEL OF HIGHEST NON-SCHOOL QUALIFICATION(a), by sex—Murray-Darling Basin—2006



(a) Persons aged 15 years and over and with a non-school qualification.

Source: ABS available data on request, ABS Census of Population and Housing, 2006

Field of study

The most common fields of study of people in the MDB with a non-school qualification were Engineering and related technologies (20%), Management and commerce (14%) and Society and culture (12%). While Agriculture was not as common (4%), its proportion in the MDB was much higher than the national rate (1%) (table 2.14).

2.14 SELECTED FIELDS OF STUDY(a)—2006

	MURRAY-DARLING BASIN		AUSTRALIA	
	Number	*Proportion of total persons*(a)	*Number*	*Proportion of total persons*(a)
	no.	%	no.	%
Engineering and related technologies	107 530	19.9	1 259 300	21.4
Management and commerce	74 130	13.7	1 026 610	17.4
Society and culture	65 980	12.2	659 980	11.2
Education	61 570	11.4	584 180	9.9
Health	60 300	11.2	604 850	10.3
Agriculture	18 730	3.5	59 480	1.0
Horticulture and viticulture	6 920	1.3	53 150	0.9
Other fields of study(b)	145 300	26.9	1 642 290	27.9
Total persons with a non-school qualification(c)	**540 470**	**100.0**	**5 889 840**	**100.0**

(a) Persons aged 15 years and over and with a non-school qualification.
(b) Includes Natural and physical sciences, Information technology, Architecture and building, Other agriculture, environmental and related sciences etc.
(c) Components may not add to total due to rounding.

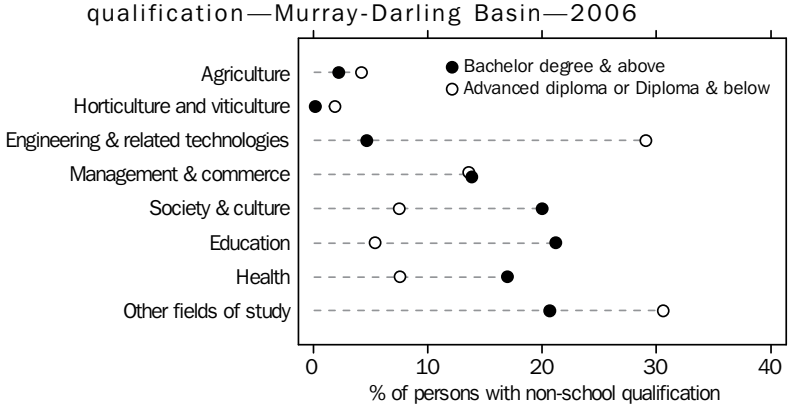
Source: ABS data available on request, ABS Census of Population and Housing, 2006

The level of qualification attained by people varies depending on their field of study. Some fields of study are more likely to result in Bachelor degrees, however, other fields were more likely to result in Certificate or Diploma level qualifications (graph 2.15). For people whose highest non-school qualification was a Bachelor degree or higher, the most common fields of study were Education (21%), Society and culture (20%), Health (17%) and Management and commerce (14%). For those with Certificate and Diploma

Field of study continued

level qualifications, the most common field of study was Engineering and related studies (29%); followed by Management and commerce (14%). There were more holders of Certificates/Diplomas (4%) than Bachelor degrees or higher (2%) who were educated in Agriculture.

2.15 FIELD OF STUDY(a), by highest non-school qualification—Murray-Darling Basin—2006



(a) Persons aged 15 years and over and with a non-school qualification.

Source: ABS data available on request, ABS Census of Population and Housing, 2006

INCOME

The needs of a household are related to its size and composition. Larger households need greater economic resources to achieve the same standard of living as smaller households, but larger households have economies arising through the sharing of benefits between household members, such as accommodation, heating and other utilities. To make meaningful comparisons of living standards, measures of household income in this section are adjusted or equivalised to take account of differing household size and composition. A more detailed explanation of equivalised income is given in Appendix 3 of the ABS publication *Household Income and Income Distribution, Australia* (cat. no. 6523.0).

Income statistics presented in this section are based on data from the Census of Population and Housing. There are a number of limitations with household income estimates produced from the Census as they are based on personal income which is collected in ranges. However, the Census, is the best source when analysing incomes relating to small population groups, or for specific geographic areas such as the MDB.

In 2006, the mean equivalised gross weekly household income (hereafter referred to as equivalised household income) of people in the MDB was $675 per week, compared to $732 per week in Australia. The equivalised household income of people living in the major cities of the MDB was $971 per week which was 44% higher than the equivalised household income for all people in the MDB. Equivalised household income of people in remote areas ($593 per week) was higher than in outer regional areas ($571 per week). The income in areas classified as very remote averaged about $528 per week.

Table 2.16 shows the distribution across national income quintiles of equivalised household income of people in the MDB by remoteness area. Almost half (46%) of people in the Basin had an equivalised household income in the lowest two quintiles (up

INCOME *continued*

to $515 a week), with close to one-quarter (23%) in the lowest quintile (less than $315 a week).

The distribution of the MDB population across income quintiles in major cities is markedly different from other remoteness categories in the MDB. Less than one-quarter of people in the major cities were in the bottom two income quintiles, while almost two-fifths (38%) were in the top quintile. Conversely, the proportion of people in regional and remote areas within the bottom two quintiles ranged between 48% and 64%. Less than 12% of the population in regional and remote areas were in the highest quintile. For very remote areas, almost two-thirds of people (64%) were in the lowest two quintiles, nearly two-fifths (38%) were in the lowest quintile.

2.16 POPULATION DISTRIBUTION(a), by equivalised household income and remoteness area—2006

	MURRAY-DARLING BASIN						AUSTRALIA
	Major cities	*Inner regional*	*Outer regional*	*Remote*	*Very remote*	*Total*	
Mean equivalised gross household weekly income ($/week)(b)	***971***	***629***	***571***	***593***	***528***	***675***	***732***
Income quintile(c)							
Lowest quintile (Less than $315 a week) (%)	10.6	24.0	30.3	30.9	38.0	23.4	20.0
2nd quintile ($315 to $515 a week) (%)	11.4	24.0	25.5	23.6	25.7	22.1	20.0
3rd quintile ($516 to $742 a week) (%)	16.0	21.8	20.0	18.6	14.3	20.2	20.0
4th quintile ($743 to $1077 a week) (%)	24.1	18.4	15.0	15.3	12.8	18.5	20.0
Highest quintile ($1078 or more a week) (%)	38.0	11.7	9.2	11.6	9.2	15.8	20.0
Total population (%)(d)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

(a) Persons aged 15 years and over.
(b) In 2006 dollars.
(c) Based on total Australia.
(d) Components may not add to total due to rounding.
Source: ABS data available on request, ABS Census of Population and Housing, 2006

INDEX OF RELATIVE SOCIO-ECONOMIC DISADVANTAGE

This section analyses the socio-economic status of the Murray-Darling Basin using the Index of Relative Socio-economic Disadvantage (IRSD) constructed for Statistical Local Areas (SLAs, see map E.2 of the Explanatory Notes). Areas with the highest relative disadvantage typically have higher proportions of low income families, unemployed people, people without educational qualifications, households renting from public housing, and people in unskilled or semi-skilled occupations. Conversely, the least disadvantaged areas tend to have a low proportion of people with these characteristics.

In 2006, more than half (55%) of the SLAs in the Basin had an index value lower than the national average. About 68% of the population in the MDB resided in these areas.

Table 2.17 below shows the IRSD in SLAs across quintiles in the Basin compared to the national distribution. SLAs in the highest quintile are considered less disadvantaged while SLAs in the lower quintiles are more disadvantaged.

Australia-wide, there are equal numbers of SLAs in each quintile. However, the data shows that the Basin has many more SLAs in the second (26% of SLAs) and highest quintile (25% of SLAs). Less than 15% of SLAs in the Basin were in the lowest quintile, those considered to be the most disadvantaged.

INDEX OF RELATIVE SOCIO-ECONOMIC DISADVANTAGE *continued*

2.17 INDEX OF RELATIVE SOCIO-ECONOMIC DISADVANTAGE, by Statistical Local Area—2006

	MURRAY-DARLING BASIN		AUSTRALIA
Income quintile	*Number of SLAs*	*Proportion of total SLAs*	*Proportion of total SLAs*
	no.	%	%
Highest quintile	75	25.3	20.0
4th quintile	52	17.6	20.0
3rd quintile	48	16.2	20.0
2nd quintile	78	26.4	20.0
Lowest quintile	43	14.5	20.0
Total SLAs(a)	**296**	**100.0**	**100.0**

(a) Excludes SLAs without information.

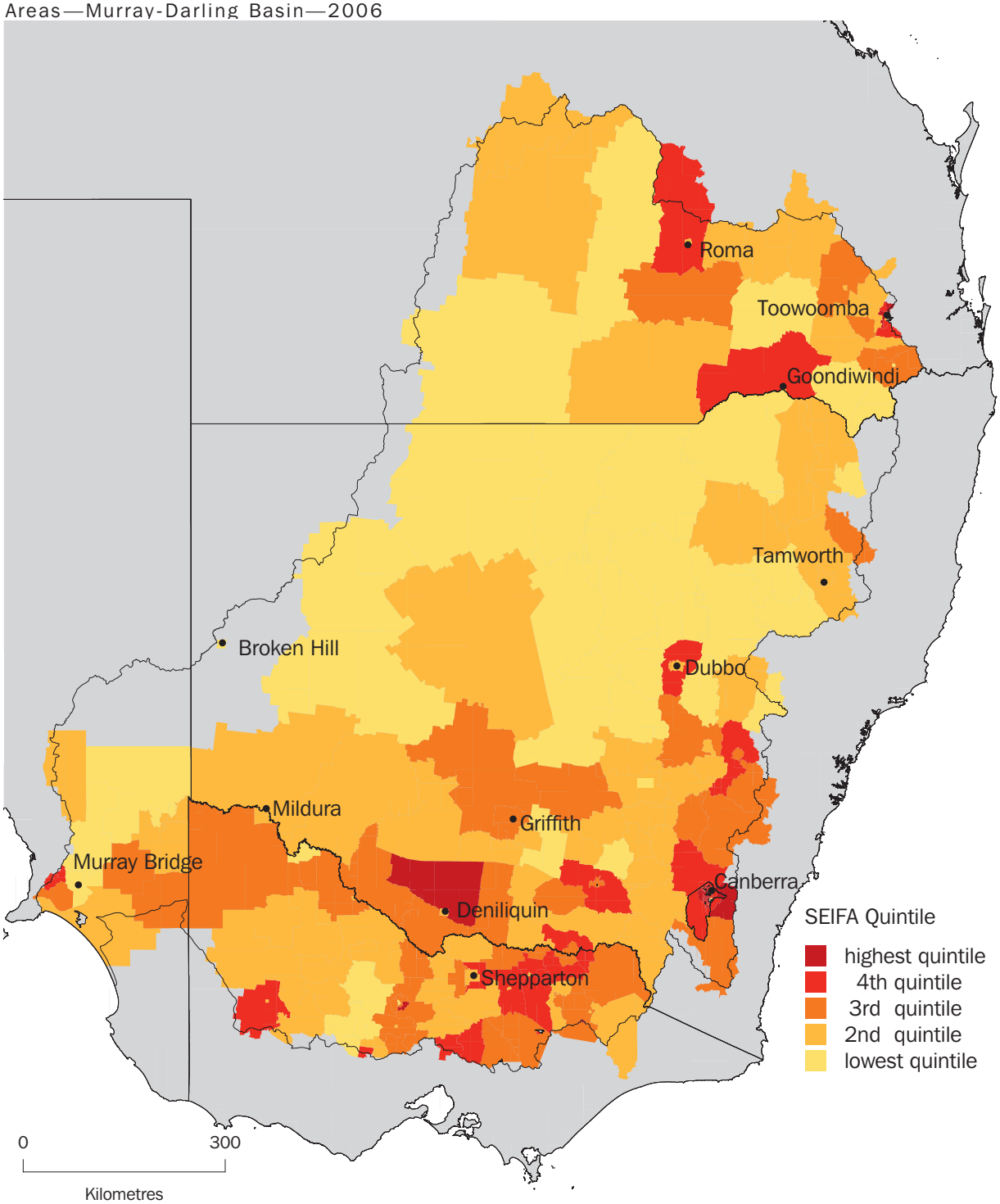
Source: ABS data available on request, Socio-Economic Indexes for Areas (SEIFA), 2006

Map 2.18 shows the distribution of IRSD for SLAs in the Basin. Lighter shading indicates higher levels of disadvantage while darker shading indicates lower levels of disadvantage.

INDEX OF RELATIVE SOCIO-ECONOMIC DISADVANTAGE *continued*

The more disadvantaged areas (lowest quintiles) tend to cluster around the central, south-western and northern parts of the Basin. The less disadvantaged areas (highest quintiles) tend to cluster around some of the major urban centres in the southern and south-eastern parts of the Basin, as well as in the northern and north-eastern parts.

2.18 INDEX OF RELATIVE SOCIO-ECONOMIC DISADVANTAGE, Statistical Local Areas—Murray-Darling Basin—2006



Source: ABS Socio-Economic Indexes for Areas (SEIFA) 2006, data available on request, Geoscience Australia 2004

LABOUR FORCE

Paid work is the way most people obtain the economic resources needed for day to day living, for themselves and their dependants, and to meet their longer term financial needs. Having paid work contributes to a person's sense of identity and self-esteem. People's involvement in paid work also contributes to economic growth and development.

In 2006, there were about 921,000 people aged 15 years and over employed in the MDB (as reported in the Census). This represented more than half (58%) of the Basin's population aged 15 years and over, giving an employment to population ratio similar to the national level of 57% (table 2.19).

Of the Basin states, the Australian Capital Territory had the highest employment to population ratio (67%) followed by Queensland (59%). The employment to population ratio in the other Basin states was about 56%.

The number of unemployed people in the MDB decreased from 77,500 in 1996 to 49,900 in 2006, a decrease of 37%. Over this period, the unemployment rate in the MDB dropped from 8.7% to 5.0%, to be similar to the national figure of 5.2% in 2006.

2.19 LABOUR FORCE STATUS(a)—2006

	MURRAY-DARLING BASIN						AUSTRALIA
	NSW	*Vic.*	*Qld*	*SA*	*ACT*	*Total MDB*(b)	
Employed *(no.)*	342 090	254 180	99 480	49 580	175 980	921 300	9 089 140
Unemployed *(no.)*	20 990	14 580	4 650	2 580	6 150	48 950	500 570
Not in the labour force *(no.)*	211 020	163 930	55 370	32 520	66 890	529 720	6 290 220
Total labour force(b)(c) *(no.)*	**606 700**	**457 030**	**168 800**	**89 350**	**261 510**	**1 583 390**	**15 879 920**
Employment to population ratio *(no.)*	56.4	55.6	58.9	55.5	67.3	58.2	57.2
Participation rate *(%)*	59.8	58.8	61.7	58.4	69.6	61.3	60.4
Unemployment rate *(%)*	5.8	5.4	4.5	4.9	3.4	5.0	5.2

(a) Persons aged 15 years and over.
(b) Components may not add to total due to rounding.
(c) Includes labour force status not stated.

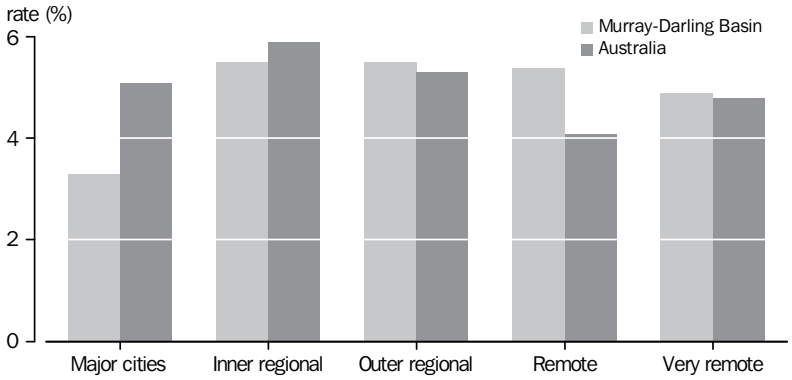
Source: ABS data available on request, ABS Census of Population and Housing 2006

The unemployment rate varied across the Basin's remoteness areas. In the Basin's major cities the unemployment rate was 3.3%; in regional areas (inner and outer) it was 5.5%; in remote areas 5.4%; and 4.9% in very remote areas (graph 2.20).

LABOUR FORCE

continued

2.20 UNEMPLOYMENT RATE (a), by remoteness area—2006



(a) Persons aged 15 years and over

Source: ABS data available on request, ABS Census of Population and Housing, 2006

Employed Persons

Australia's workforce is constantly changing in response to changing economic conditions and this is also reflected in the MDB. The past decade has seen an increasing diversity of employment arrangements, including changes in full-time and part-time employment.

In 2006, nearly two-thirds (64%) of people employed in the MDB worked full-time, close to one-third (29%) were part-time, and 7% were employed, but worked no hours in the week prior to Census night (away from work). Males in full-time employment outnumbered females (2:1), however, females in part-time employment outnumbered males (2:1) (table 2.21).

2.21 EMPLOYMENT STATUS(a), by sex—2006

	MURRAY-DARLING BASIN		AUSTRALIA	
	Number employed	*Proportion of total employed*	*Number employed*	*Proportion of total employed*
	no.	%	no.	%
Full-time				
Male	386 290	65.4	3 755 390	64.5
Female	204 600	34.6	2 062 720	35.5
Ratio male to female	1.9	. .	1.8	. .
Part-time				
Male	78 860	29.3	837 270	31.2
Female	190 120	70.7	1 844 340	68.8
Ratio male to female	0.4	. .	0.5	. .
Away from work(b)				
Male	31 650	51.5	309 470	52.4
Female	29 770	48.5	280 570	47.6
Ratio male to female	1.1	. .	1.1	. .

(a) Persons aged 15 years and over.

(b) On Census night.

Note: . . not applicable

Source: ABS data available on request, ABS Census of Population and Housing, 2006

Employed Persons continued

Table 2.22 shows the change in part-time and full-time employment in the MDB between 1996 and 2006. During this period, part-time employment increased at a greater rate than full-time employment (12% and 7%, respectively) even though the total number of people employed part-time decreased between 2001 and 2006. A similar pattern occurred nationally, where part-time employment increased by 17% and full-time employment by 12%. The increase in demand for part-time employment is often associated with the restructuring of Australia's economy, and in particular with the growth in service industries, the deregulation of the workplace and the introduction of new technologies (ABS 2001).

2.22 EMPLOYMENT STATUS(a)—Murray-Darling Basin—1996–2006

	NUMBER EMPLOYED			CHANGE		
	1996	*2001*	*2006*	*1996–2001*	*2001–2006*	*1996–2006*
	no.	no.	no.	%	%	%
Employed						
Full-time	550 760	552 580	590 890	0.3	6.9	7.3
Part-time	239 470	272 900	268 980	14.0	-1.4	12.3
Ratio full-time to part-time	2.3	2.0	2.2	. .	. .	. .
Total employed persons(b)	**810 760**	**850 900**	**921 300**	**5.0**	**8.3**	**13.6**

(a) Persons aged 15 years and over.
(b) Includes employment status not stated.
Source: ABS data on request, ABS Census on Population and Housing, 1996, 2001 and 2006

Employment by industry

In 2006, close to one million people (921,000 as reported in the Census) were employed across all industries in the MDB. Table 2.23 shows employment in significant industries in the MDB. Retail employed the greatest number of people (14%), followed by Health and community services (11%), Government administration and defence (10%), Agriculture (10%) and Manufacturing (9%). Employment in Agriculture in the MDB (10%) was significantly higher than the national figure of 3%. Employment in other industries was broadly in line with the trend at the national level. The employment distribution across industries in the MDB was similar in 1996 to 2006, with the exception of Agriculture and Health and community services (graph 2.24).

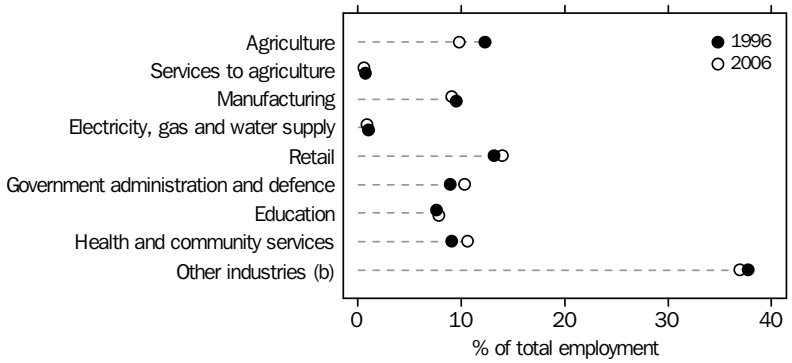
Employment by industry continued

2.23 EMPLOYMENT(a), by selected industry—2006

	MURRAY-DARLING BASIN		AUSTRALIA	
	Number employed	*Proportion of total employed*	*Number employed*	*Proportion of total employed*
	no.	%	no.	%
Agriculture	90 520	9.8	245 730	2.7
Services to agriculture	5 690	0.6	18 180	0.2
Manufacturing	83 760	9.1	997 150	11.0
Electricity, gas and water supply	8 470	0.9	70 930	0.8
Retail	128 740	14.0	1 299 210	14.3
Government administration and defence	94 710	10.3	429 870	4.7
Education	71 550	7.8	677 550	7.5
Health and community services	97 270	10.6	975 290	10.7
Other industries(b)	340 590	37.0	4 375 840	48.1
Total employed persons(c)	**921 300**	**100.0**	**9 089 750**	**100.0**

(a) Persons aged 15 years and over.
(b) Comprises: Mining, Construction, Wholesale, Accommodation and food services, Transport, postal and warehousing, Information, media and telecommunications, Financial and insurance services, Rental, hiring and real estate
(c) Components may not add to total due to rounding.
Source: ABS data available on request, ABS Census of Population and Housing 2006

2.24 EMPLOYMENT(a), by selected industry—Murray-Darling Basin—1996 and 2006



(a) Persons aged 15 years and over.
(b) Includes industries such as Mining, Construction, Wholesale etc.
Source: ABS data available on request, ABS Census of Population and Housing, 1996 and 2006

Employment in Agriculture

Agriculture is an important part of the Australian economy and in 2006 remained important in rural and regional areas such as the MDB. It is the third largest employer in the MDB, providing one in ten jobs (90,500 as reported in the 2006 Census). The MDB accounted for more than one-third (37%) of all agricultural workers in Australia (table 2.25).

Grain, sheep and beef cattle farming are the biggest agricultural employers in the MDB. In 2006, they accounted for nearly two-thirds (64%) of all people employed in Agriculture in the MDB. Horticulture and fruit growing employed 17% of the agricultural workers in the MDB while Dairy cattle farming employed 8%.

Employment in Agriculture continued

2.25 EMPLOYMENT(a), Agriculture industry—Murray-Darling Basin—2006

	Employed persons	*Proportion of total Agriculture*	*MDB as a proportion total Australian Agriculture*
	no.	%	%
Horticulture and fruit growing			
Plant, flower, seed growing	1 000	1.1	11.3
Vegetable growing	2 220	2.5	15.3
Grape growing	5 540	6.1	50.6
Apple and pear growing	970	1.1	45.5
Stone fruit growing	670	0.7	54.9
Other fruit growing	3 020	3.3	24.7
Total(b)	15 250	16.8	27.7
Grain, sheep and beef cattle farming			
Grain growing	10 680	11.8	59.0
Grain-sheep and grain-beef cattle farming	16 160	17.8	51.1
Sheep-beef cattle farming	6 170	6.8	46.8
Sheep farming	9 710	10.7	47.2
Beef cattle farming	14 660	16.2	30.2
Total(b)	57 780	63.8	43.5
Dairy cattle farming	6 920	7.6	31.5
Poultry farming	1 440	1.6	23.7
Other livestock farming	3 690	4.1	41.5
Other crop growing			
Cotton growing	1 700	1.9	87.6
Other crop growing	1 110	1.2	10.4
Total	2 810	3.1	22.2
Total Agriculture(b)	**90 520**	**100.0**	**36.8**

(a) Persons aged 15 years and over.

(b) Includes industries not further defined.

Source: ABS data available on request, ABS Census of population and Housing, 2006

New South Wales had close to half (48%) of the MDB's agricultural workforce with about one-third (30%) in Victoria. About 14% of the workforce were in Queensland and 8% in South Australia.

Across the MDB, the dominant agricultural industry employing people was Grain, sheep and beef cattle farming. New South Wales accounted for 58% of all Grain, sheep and beef cattle farming employment in the MDB (table 2.26). The majority of the Basin's Dairy farming employment was in Victoria (73%). Horticulture and fruit growing were also dominant in Victoria, New South Wales and South Australia (40%, 26% and 24% respectively). Water use and production by agricultural industries are discussed further in Chapter 3 and Chapter 4.

Employment in Agriculture continued

2.26 EMPLOYMENT(a), Agriculture industry, by Basin state—Murray-Darling Basin—2006

	NSW	*Vic.*	*Qld*	*SA*	*ACT*	*Total MDB*
Horticulture and fruit growing						
Number employed *(no.)*	3 910	6 210	1 340	3 700	90	15 250
Proportion of total Agriculture *(%)*	9.1	22.6	11.0	49.7	22.2	16.8
Proportion of total MDB *(%)*	25.6	40.7	8.8	24.3	0.6	100.0
Grain, sheep and beef cattle farming						
Number employed *(no.)*	33 510	13 220	8 220	2 640	180	57 770
Proportion of total Agriculture *(%)*	77.7	48.3	67.3	35.4	50.0	63.8
Proportion of total MDB *(%)*	58.0	22.9	14.2	4.6	0.3	100.0
Dairy cattle farming						
Number employed *(no.)*	870	5 040	500	510	—	6 920
Proportion of total Agriculture *(%)*	2.0	18.4	4.1	6.8	—	7.6
Proportion of total MDB *(%)*	12.6	72.8	7.2	7.4	—	100.0
Poultry farming						
Number employed *(no.)*	550	450	300	110	30	1 440
Proportion of total Agriculture *(%)*	1.3	1.6	2.5	1.5	8.3	1.6
Proportion of total MDB *(%)*	38.2	31.3	20.8	7.6	2.1	100.0
Other livestock farming						
Number employed *(no.)*	1 450	1 220	690	310	20	3 690
Proportion of total Agriculture *(%)*	3.4	4.5	5.6	4.2	5.6	4.1
Proportion of total MDB *(%)*	39.3	33.1	18.7	8.4	0.5	100.0
Other crop growing						
Number employed *(no.)*	1 390	540	820	60	—	2 810
Proportion of total Agriculture *(%)*	3.2	2.0	6.7	0.8	—	3.1
Proportion of total MDB *(%)*	49.5	19.2	29.2	2.1	—	100.0
Total Agriculture(b) *(no.)*	**43 090**	**27 380**	**12 230**	**7 460**	**360**	**90 520**

— nil or rounded to zero (including null cells)

(a) Persons aged 15 years and over.

(b) Includes industries not further defined.

Source: ABS data available on request, ABS Census of Population and Housing, 2006

There is also some diversity of agricultural employment in the MDB across remoteness areas. For example, in 2006 more than half (53%) of the people employed in Agriculture within the MDB were in outer regional areas, and more than one-third (37%) were in inner regional areas.

People employed in Grape growing were mostly located in outer regional areas (75% of all employment in the Grape growing industry within the Basin). Other major agricultural industries where employment mainly occurred in outer regional areas were Grain growing (64%), Grain-sheep and grain-beef cattle farming (64%) and Cotton growing (51%). People employed in Apple and pear growing (62%) were mostly located in the Basin's inner regional areas, together with Dairy cattle farming (68%) and Poultry farming (63%).

Trends in agricultural employment

Between 2001 and 2006, overall employment in Agriculture within the MDB declined by 12%. The workforce decline may be partially attributed to the prolonged drought experienced over most of Australia since 2002 which has severely affected the agricultural sector. The drought has disrupted farmer's cropping programs and reduced breeding stocks and productivity, ultimately affecting the long-term sustainability of agricultural industries, country areas and families (BRS 2008).

Trends in agricultural employment continued

Employment change between 2001 and 2006 in some agricultural industries was more marked than others. Cotton growing had the largest decrease in employment (42%), followed by Plant, flower and seed growing (31%) and Grape growing (30%) (table 2.27). The only two industries that showed an increase in agricultural employment within the MDB were Beef cattle farming (16%) and Other livestock farming (10%).

2.27 CHANGE IN EMPLOYMENT(a), Agriculture industry—Murray-Darling Basin—2001 and 2006

	EMPLOYED PERSONS		CHANGE
	2001	*2006*	
	no.	no.	%
Horticulture and fruit growing			
Plant, flower, seed growing	1 450	1 000	–31.0
Vegetable growing	2 540	2 220	–12.6
Grape growing	7 950	5 540	–30.3
Apple and pear growing	1 180	970	–17.8
Stone fruit growing	840	670	–20.2
Other fruit growing	3 370	3 020	–10.4
Total(b)	19 210	15 250	–20.6
Grain, sheep and beef cattle farming			
Grain growing	10 720	10 680	–0.4
Grain-sheep and grain-beef cattle farming	20 120	16 150	–19.7
Sheep-beef cattle farming	8 410	6 170	–26.6
Sheep farming	10 690	9 710	–9.2
Beef cattle farming	12 650	14 660	15.9
Total(b)	63 900	57 770	–9.6
Dairy cattle farming	8 860	6 920	–21.9
Poultry farming	1 690	1 440	–14.8
Other livestock farming	3 360	3 690	9.8
Other crop growing			
Cotton growing	2 950	1 700	–42.4
Other crop growing	960	1 110	–15.6
Total	3 930	2 810	–28.5
Total Agriculture(b)(c)	**103 360**	**90 520**	**–12.4**

(a) Persons aged 15 years and over.
(b) Includes industries not further defined.
(c) Components may not add to total due to rounding.
Source: ABS data available on request, ABS Census of Population and Housing, 2006

Occupation

Table 2.28 shows the occupation distribution of employed people in the MDB and Australia in 2006. The most common occupation group was Professionals (17%), followed by Intermediate clerical, sales and service workers (15%). Farmer and farm manager was the occupation of 7% of employed people in the MDB compared with only 2% Australia-wide.

Occupation continued

2.28 EMPLOYMENT(a), by occupation—2006

	MURRAY-DARLING BASIN		AUSTRALIA	
	Employed persons	*Proportion of total employed*	*Employed persons*	*Proportion of total employed*
	no.	%	no.	%
Professionals	155 630	16.9	1 745 840	19.2
Intermediate clerical, sales and service workers	138 800	15.1	1 534 860	16.9
Trades persons and related workers	109 890	11.9	1 100 430	12.1
Associate professionals	106 780	11.6	1 089 360	12.0
Labourers and related workers	95 710	10.4	755 970	8.3
Elementary clerical, sales and service workers	81 470	8.8	857 620	9.4
Intermediate production and transport workers	70 690	7.7	734 480	8.1
Farmers and farm managers	66 880	7.3	175 130	1.9
Other managers and administrators	56 090	6.1	642 380	7.1
Advanced clerical and service workers	24 570	2.7	288 590	3.2
Total employed persons(b)	**921 300**	**100.0**	**9 089 750**	**100.0**

(a) Includes persons aged 15 years and over

(b) Includes occupation inadequately described or not stated

Source: ABS data available on request, ABS Census of Population and Housing, 2006

FARMERS IN THE MURRAY-DARLING BASIN

Over the past decade, Australian farmers have responded to globalisation of markets, a continuing decline in their terms of trade, new technologies, changing consumer tastes and attitudes, and emerging environmental concerns. Changes in government policies, such as the rationalisation of statutory marketing arrangements, together with reforms in water and land use, have also influenced the context in which farmers operate (PC 2005). This section contains data from the ABS Census of Population and Housing relating to people who reported their occupation was a Farmer or farm manager.

As shown throughout this publication, the MDB was an important agricultural centre in Australia in 2005–06. It covered 20% of Australia's agricultural area, contained 65% of Australia's irrigated land and contributed 66% of Australian agricultural water consumption.

In 2006, almost 67,000 people aged 15 years and over in the MDB reported that their occupation was Farmer or farm manager in the Census, accounting for 38% of Australia's farmers (table 2.29). The majority of the MDB's farmers (59%) reported that they either owned or operated their farm business. About 27% were contributing family workers and almost 13% were employees. The proportion of farmers classified as contributing family workers in the MDB (27%) was higher than the national level (24%).

In 2006, most farmers in MDB were male (71%); a similar proportion to Australia. The 19,000 female farmers in the MDB accounted for 37% of all female farmers in Australia. The majority (76%) of these were spouses or partners to males who were also farmers.

2.29 EMPLOYMENT STATUS(a), Farmers(b)—Murray-Darling Basin—2006

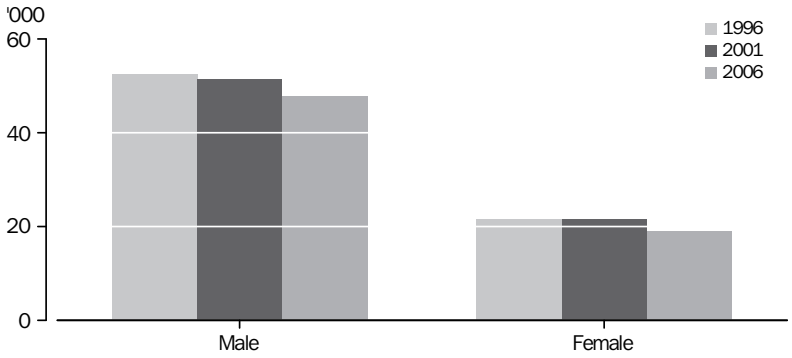
	MURRAY-DARLING BASIN			AUSTRALIA		
	Male	*Female*	*Total*	*Male*	*Female*	*Total*
Owner/managers(c) *(no.)*	28 330	11 350	39 680	74 170	31 690	105 850
Contributing family workers *(no.)*	11 310	6 560	17 880	26 070	16 320	42 390
Employees *(no.)*	7 790	1 130	8 910	21 750	3 920	25 670
Total farmers and farm managers *(no.)*	47 740	19 140	66 880	122 860	52 270	175 130
Total employed persons(d) *(no.)*	**496 810**	**424 490**	**921 300**	**4 911 130**	**4 193 050**	**9 089 750**
Farmers as a proportion of total employed *(%)*	9.6	4.5	7.3	2.5	1.2	1.9

(a) Persons aged 15 years and over.
(b) Includes farm managers.
(c) Owner managers of incorporated and unincorporated enterprises.
(d) Includes status in employment not stated.
Source: ABS data available on request, ABS Census on Population and Housing, 2006

Between 1996 and 2006, the number of people identifying themselves as a Farmer or farm manager in the MDB declined by 10% (from 74,000 to 67,000 as reported in the Census), while the number of people employed in all other occupations increased by 18% (from 888,000 to 921,000). Over the same time period, the number of male farmers in the MDB decreased from 53,000 to 48,000 (9%) while female farmers decreased at a slightly higher rate (12%) (graph 2.30). Much of the decline in the number of farmers occurred between 2001 and 2006, and may be attributed to environmental reasons such as the drought. However, other causes could be the restructuring of the industry, changes in commodity prices, health of farmers or their age.

FARMERS IN THE MURRAY-DARLING BASIN *continued*

2.30 NUMBER OF FARMERS (a)(b), by sex—Murray-Darling Basin—1996–2006



(a) Includes farm managers.
(b) Persons aged 15 years and over.

Source: ABS data available on request, ABS Census on Population and Housing, 2006

Age

Table 2.31 shows the age distribution of farmers in the MDB in 1996 and 2006. Over this period, the proportion of farmers in the 65 years and over range rose from 14% to 19% while the proportion of those aged 35 years or below declined from 18% to 13%. The proportion of farmers in the 50–64 year range also rose from 32% to 37% while the proportion of farmers in the 35–49 year range dropped from 36% to 31%. This change in population distribution was also reflected in the change in median age of farmers in the MDB, which increased from 48 years in 1996 to 52 years in 2006.

2.31 AGE DISTRIBUTION, Farmers(a)—Murray-Darling Basin—1996 and 2006

	1996		2006		CHANGE
	Number	*Proportion of total farmers*	*Number*	*Proportion of total farmers*	
	no.	%	no.	%	%
15–34 years	13 080	17.6	8 750	13.1	–33.1
35–49 years	27 060	36.4	20 680	30.9	–23.6
50–64 years	24 090	32.4	24 830	37.1	3.1
65 years and over	10 050	13.5	12 630	18.9	25.7
Total farmers(b)	**74 270**	**100.0**	**66 880**	**100.0**	**–10.0**

(a) Includes farm managers.
(b) Persons aged 15 years and over.

Source: ABS data available on request, ABS Census of Population and Housing, 1996 and 2006

Farmers also comprise a significant proportion of older workers. In 2006, nearly two-fifths (39%) of people employed and aged 65 years or over in the MDB were farmers. Farmers made up a smaller proportion of younger workers (only 3% of the 323,100 employed people aged 15–34 years) (table 2.32).

2.32 AGE DISTRIBUTION, Farmers and all other occupations—Murray-Darling Basin—2006

	15–34 YEARS		35–49 YEARS		50–64 YEARS		65 AND OVER		TOTAL	
	Number	*Proportion of total employed*	*Number*	*Proportion of total employed*	*Number*	*Proportion of total employed*	*Number*	*Proportion of total employed*	*Number*	*Proportion of total employed*
	no.	%	no.	%	no.	%	no.	%	no.	%
Farmers(a)	8 750	2.7	20 680	6.2	24 830	10.7	12 630	38.7	66 880	7.3
All other occupations	314 350	97.3	311 980	93.8	208 100	89.3	19 990	61.3	854 420	92.7
Total employed persons(b)	**323 100**	**100.0**	**332 670**	**100.0**	**232 930**	**100.0**	**32 610**	**100.0**	**921 300**	**100.0**

(a) Includes farm managers.
(b) Persons aged 15 years and over.

Source: ABS data available on request, ABS Census of Population and Housing, 2006

Age continued

There are several factors that could have contributed to the skewed age profile of farmers compared to all other occupations. This includes fewer young people entering farming, possibly compounded by limited interest of young people in taking over the family farm, along with low exit rates at the traditional retirement age in response to reduced farm capital during poor seasons, or reduced market values during periods of low commodity prices (PC 2005).

Family

Family farming has been a traditional way of life in the MDB as in other parts of Australia. Farm succession from one generation to another reflects the confidence of younger generations to enter the industry and earn their livelihood from farming. There is evidence that young people are departing rural areas to seek further education and employment, particularly females (RIRDC, NWI and MDBC, 2007).

Farming is also characterised by an intimate connection between the farm as a place of work and career. The planning and management of succession by farming families is a concern for the whole agricultural industry (Barclay et. al. 2007).

Almost all farming families in the MDB are couple families (95%), a significantly higher proportion than non-farming families (82%). In 2006, over half (51%) of all farming families consisted of a couple with children living with them and a further 45% were couple families without children (table 2.33).

Family continued

2.33 FAMILY TYPE, Farming and non-farming—Murray-Darling Basin—2006

	Farming families(a)	*Non-farming families*	*Total families*
Couple families			
with children *(%)*	50.5	42.6	43.2
without children *(%)*	44.6	39.7	40.1
Total couple families *(%)*	95.1	82.3	83.3
One parent families *(%)*	4.0	16.2	15.3
Other families *(%)*	0.9	1.5	1.4
Total families *(no.)*	**40 470**	**491 130**	**531 600**

(a) Includes farm managers.

Source: ABS data available on request, ABS Census of Population and Housing, 2006

Level of highest educational attainment

Changing farm practices have resulted in changes in the educational skill set required by farmers. Technological advancements, larger farms and greater awareness of environmental issues, have all meant that farmers are increasingly required to have a diverse set of skills (PC 2005).

Almost one-third of farmers (30%) in the MDB held a non-school qualification in 2006. This proportion was lower than for non-farmers of whom 47% held a non-school qualification (table 2.34). Half of the farmers with a non-school qualification had a Certificate level qualification; a further quarter had an Advanced diploma or Diploma level qualification.

2.34 LEVEL OF HIGHEST EDUCATIONAL ATTAINMENT(a)—Murray-Darling Basin—2006

	FARMERS(b)		OTHER OCCUPATIONS	
	Number	*Proportion of total persons*	*Number*	*Proportion of total persons*
	no.	%	no.	%
With non-school qualification				
Postgraduate degree	410	0.6	26 150	3.1
Graduate diploma and Graduate certificate	440	0.7	20 800	2.4
Bachelor degree	4 040	6.0	115 420	13.5
Advanced diploma and Diploma	5 030	7.5	66 180	7.7
Certificate	10 420	15.6	173 460	20.3
Total	**20 340**	**30.4**	**402 000**	**47.1**
Without non-school qualification	42 190	63.1	402 870	47.2
Total persons(c)	**66 880**	**100.0**	**854 420**	**100.0**

(a) Persons aged 15 years and over.

(b) Includes farm managers.

(c) Includes qualification not stated or inadequately described.

Source: ABS data available on request, ABS Census of Population and Housing, 2006

The proportion of farmers holding a non-school qualification in the MDB was markedly higher in 2006 (30%) than in 1996 (24%). This increase is partially reflected in an increase in the proportion of farmers holding a Bachelor degree or higher level qualification

Level of highest educational attainment continued

(from 4% in 1996 to 7% in 2006). The proportion of farmers with a Certificate level qualification in the MDB increased by 2 percentage points between 1996 and 2006.

Work

In 2006, the majority of farming couples (82%) in the MDB had both the husband and wife working. Also, 39% of the farming couples in the MDB had both members of the couple engaged in farming. The proportion of couples where the husband was a farmer and the wife was not working, was about 18% (table 2.35).

2.35 COMPOSITION OF FARMER COUPLE FAMILIES(a)—Murray-Darling Basin—2006

	Number	*Proportion of total farmer couple families*
	no.	%
Couple both farmers	14 540	39.3
Husband farmer - spouse other occupation	14 550	39.3
Wife farmer - spouse other occupation	1 270	3.4
Husband farmer - spouse not working	6 470	17.5
Wife farmer - spouse not working	190	0.5
Total farmer couple families	**37 020**	**100.0**

(a) Includes farm managers.

Source: ABS data available on request, ABS Census of Population and Housing, 2006

The once traditional role of the 'farmer's wife' has changed over time. The 'farmer's wife' is now more likely to be identified as a joint farm manager or having an occupation separate from the farm business. These changing roles were driven by several factors which include; changes in the demographic composition and economic situation of farm family households, the growth of part-time employment, as well as the changes in the returns of labour, both in farming and in off-farm work (PC 2005).

Table 2.36 below shows the five most common non-farming occupations engaged in by female partners of farmers in the MDB. The most common occupation were Intermediate clerical, sales and service workers (e.g. general clerk, receptionist, carer, hospitality worker or a sales representatives etc.) (22%); Educational professionals (e.g. teachers) (14%) and Health professionals (11%).

Work continued

2.36 NON-FARMING OCCUPATIONS OF FEMALE PARTNERS(a)—Murray-Darling Basin—2006

	Number	*Proportion of total families*
Selected occupations	no.	%
Intermediate clerical, sales and service workers	3 160	21.7
Education professionals	2 100	14.4
Health professionals	1 640	11.3
Advanced clerical and service workers	1 400	9.6
Labourers and related workers	1 300	8.9
Total non-farming occupations(b)	**14 550**	**100.0**

(a) In farming couples.

(b) Includes other non-farming occupations not separately listed.

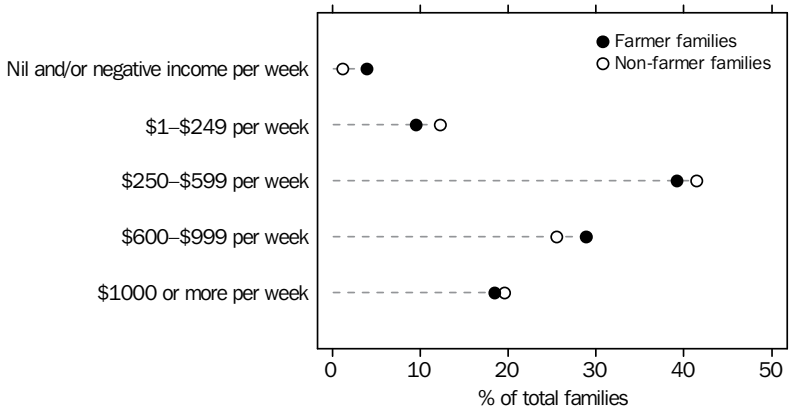
Source: ABS data available on request, ABS Census of Population and Housing 2006

Income

In 2006, the mean equivalised gross weekly household income of the 37,000 farming families (as reported in the Census) in the MDB was about $674 per week. This was similar to the mean equivalised gross weekly household income of all families in the MDB.

The income distribution of farming families was similar to non-farming families. About two-fifths of farming families (39%) earned between $250 and $599 per week, close to a one-third (29%) earned between $600 and $999, and nearly one-fifth (19%) earned $1,000 or more (graph 2.37). However, a greater proportion of farming households reported a negative or nil income (4%) compared with all families (1%).

2.37 MEAN EQUIVALISED GROSS WEEKLY HOUSEHOLD INCOME, Murray-Darling Basin—2006



Source: ABS data available on request, ABS Census Population and Housing, 2006

CHAPTER 3 WATER USE IN THE MURRAY-DARLING BASIN

INTRODUCTION

This chapter provides an overview of water use by major industries and households. It includes a more detailed analysis of water use by the Agriculture industry - the main water user in the Murray-Darling Basin (MDB). The statistics presented in this section are mainly from ABS Agricultural Surveys and Censuses conducted from 2000–01 to 2005–06.

Water is an essential input for the operation of Australia's businesses and households, and is critical to maintain ecosystem health within the environment. The most recent assessment of water use across industries and households was conducted for 2004–05 and presented in *Water Account, Australia 2004–05* (ABS cat. no. 4610.0) and Australian Water Resources 2005 (NWC 2007).

OVERVIEW OF WATER CONSUMPTION

Australia's Agriculture industry is particularly dependent on water to sustain its production. In 2004–05, the distribution of water consumption in the Australian economy was:

- 65% by Agriculture
- 11% by Households
- 11% lost in delivery systems (defined as Water supply industry consumption)
- 3% by Manufacturing
- 10% by Other industries (for example Mining, Electricity and gas, Service industries).

In contrast, water consumption in the MDB in 2004–05 was more skewed towards Agriculture:

- 83% by Agriculture
- 13% lost in delivery systems
- 2% by Households
- 1% by Manufacturing
- 2% by Other industries.

In 2004–05, the MDB comprised 65% of Australia's agricultural water consumption, and contributed 45% of Australia's Gross Value of Irrigated Agricultural Production (GVIAP). The majority of Australia's area of irrigated cotton (92%), rice (100%), cereals other than rice (88%), pasture (for dairy and other livestock, 67%), grapes (58%) and fruit and nuts (53%) were grown in the Basin. Total agricultural water consumption in the MDB is influenced by changes in water consumed by these crops and pasture.

WATER USE BY INDUSTRIES AND HOUSEHOLDS

The allocation of water to competing users in Australia's economy and society (e.g. Agriculture, other industries and households) presents a significant planning issue for resource managers. This becomes especially relevant during droughts when contingency plans are formed (e.g. MDB dry inflow contingency planning, see Appendix). To reliably underpin the trade-offs which arise during water planning, data are required on the volume of water used, and the value of that water use to society and industries.

Industries (including Agriculture) and households in the MDB accounted for more than half (52%) of Australia's total water consumption in 2004–05.

The following section examines water consumption by industries and households in the MDB, and presents comparisons with state and Australia-level water consumption.

Agriculture

Agriculture is a large user of water (in 2004–05 accounting for 83% of all industry and household water consumption in the MDB), but consumption varies across different agricultural activities. In 2005–06, agricultural water consumption in the MDB was 7,720 GL, accounting for 66% of total agricultural water consumption in Australia (table 3.1). The major agricultural water users in the MDB were: cotton (1,574 GL), dairy farming (1,287 GL), pasture for livestock (excluding dairy, 1,284 GL) and rice (1,252 GL). These crops and pasture collectively accounted for 70% of all agricultural water consumption in the MDB. The MDB accounted for all irrigated water consumption in Australia for rice (100%), and the vast majority for cotton (91%), cereals other than rice (88%) and grapes (81%).

3.1 WATER CONSUMPTION, by agricultural commodity—2005–06

	MDB	*Aust.*	*MDB as a proportion of Aust.*
	GL	GL	%
Dairy farming(a)	1 287	1 893	68
Pasture for other livestock(b)	1 284	2 042	63
Rice	1 252	1 253	100
Cereals (excl. rice)	782	894	88
Cotton	1 574	1 735	91
Grapes	515	633	81
Fruit (excl. grapes)	413	630	66
Vegetables	152	431	35
Other agriculture(c)	461	2 178	21
Total Agriculture(d)	**7 720**	**11 689**	**66**

(a) Includes irrigated pasture for grazing, hay and seed; livestock drinking; and shed washdown.
(b) Includes irrigated pasture for grazing, hay and seed.
(c) Includes other broadacre crops, nurseries, livestock (other than dairy) drinking.
(d) Components may not add to total due to rounding.

Source: Water use on Australian Farms (cat. no. 4618.0); ABS data available on request, Agricultural Census, 2005–06

Agriculture continued

Some irrigated agricultural crops are confined to relatively small areas of the MDB, others are more widely distributed (see table 3.2). This pattern of agricultural activity affects spatial patterns of water consumption. In 2005–06, 72% of water used for growing cotton was in New South Wales compared with 28% in Queensland (table 3.3). Almost all water consumption for rice (99%) occurred in New South Wales. The majority of water for dairy farming was consumed in Victoria (82%). Water used for growing grapes, fruit and nuts (hereafter referred to as fruit), and vegetables was more evenly distributed between New South Wales, Victoria and South Australia.

3.2 IRRIGATED AREA, by agricultural commodity and Basin state—Murray-Darling Basin—2005–06

	NSW/ACT		VIC.		QLD		SA		TOTAL MDB(a)	
	Area	*Proportion of total MDB*	*Area*	*Proportion of total MDB*	*Area*	*Proportion of total MDB*	*Area*	*Proportion of total MDB*	*Area*	*Proportion of total MDB*
	'000 ha	%	'000 ha	%	'000 ha	%	'000 ha	%	'000 ha	%
Pasture for dairy farming(b)	40	15	226	82	3	1	7	3	276	100
Pasture for other livestock(b)	243	55	174	40	15	3	8	2	441	100
Rice	101	99	1	1	—	—	—	—	102	100
Cereals (excl. rice)	252	77	39	12	37	11	2	—	329	100
Cotton	169	68	—	—	78	32	—	—	247	100
Grapes	39	37	33	32	1	1	32	30	106	100
Fruit (excl. grapes)	24	32	32	43	5	6	14	19	75	100
Vegetables	13	40	8	24	4	13	8	24	32	100
Other agriculture(c)	32	71	9	19	4	8	1	2	46	100
Total Agriculture(a)	**913**	**55**	**522**	**32**	**147**	**9**	**71**	**4**	**1 654**	**100**

— nil or rounded to zero (including null cells)

(a) Components may not add to total due to rounding.

(b) Includes irrigated pasture for grazing, hay and seed.

(c) Includes other broadacre crops, nurseries, livestock (other than dairy) drinking.

Source: Water use on Australian farms 2005–06; ABS data available on request, Agricultural Census, 2005–06

3.3 WATER CONSUMPTION, by agricultural commodity and Basin state—Murray-Darling Basin—2005–06

	NSW/ACT		VIC.		QLD		SA		TOTAL MDB(a)	
	Volume	*Proportion of total MDB*	*Volume*	*Proportion of total MDB*	*Volume*	*Proportion of total MDB*	*Volume*	*Proportion of total MDB*	*Volume*	*Proportion of total MDB*
	GL	%	GL	%	GL	%	GL	%	GL	%
Dairy farming(b)	167	13	1 057	82	9	1	54	4	1 287	100
Pasture for other livestock(c)	678	53	521	41	51	4	33	3	1 284	100
Rice	1 239	99	13	1	—	—	—	—	1 252	100
Cereals (excl. rice)	617	79	84	11	77	10	4	1	782	100
Cotton	1 128	72	—	—	447	28	—	—	1 574	100
Grapes	178	35	180	35	3	1	154	30	515	100
Fruit (excl. grapes)	125	30	165	40	7	2	116	28	413	100
Vegetables	59	39	37	24	10	7	45	30	152	100
Other agriculture(d)	295	64	79	17	66	14	20	4	461	100
Total Agriculture(a)	**4 487**	**58**	**2 136**	**28**	**671**	**9**	**426**	**6**	**7 720**	**100**

— nil or rounded to zero (including null cells)

(a) Components may not add to total due to rounding.

(b) Includes: irrigated pasture for grazing, hay and seed; livestock drinking; and, shed washdown.

(c) Includes irrigated pasture for grazing, hay and seed.

(d) Includes other broadacre crops, nurseries, livestock (other than dairy) drinking.

Source: Source: Water use on Australian farms 2005–06; ABS data available on request, Agricultural Census, 2005–06

Electricity and gas

Water is an essential production input for the Electricity and gas industry. Water is used for cooling processes during electricity generation within coal or natural gas power stations. This is an example of consumptive water use by the Electricity and gas industry. Water is also used non-consumptively (in-stream use) during hydro-electricity generation when water is extracted from a storage facility, then immediately discharged after passing through generating turbines. In the Snowy Mountains region of the MDB, water is diverted from outside the Basin via several storage dams, and then discharged into the MDB through a series of tunnels, dams and generating stations (Snowy Hydro 2007).

In 2004–05, approximately 3% of Australia's electricity and 33% of the nation's hydro-electricity was generated in the MDB. Hydro-electricity represented the bulk of the Basin's generated electricity. Approximately 15,900 GL of water was used (non-consumptively) in the MDB to generate 5,209 GWh of hydro-electricity (tables 3.4 and 3.5). The volume of water used in the MDB represented 27% of Australia's hydro-electricity (in-stream) water use. Two-thirds of the water used was in New South Wales, and one-third in Victoria.

3.4 HYDRO-ELECTRICITY GENERATORS' IN-STREAM WATER USE, by Basin state—2004–05

	GL
New South Wales	10 271
Victoria	5 581
Queensland	—
South Australia	—
Murray-Darling Basin	***15 852***
Australia	**57 867**

— nil or rounded to zero (including null cells)

Source: ABS data available on request, Water Account

3.5 ELECTRICITY GENERATED—2004–05

	GWh
Hydro-electricity	
Murray-Darling Basin	5 209
Australia	15 991
Total electricity - Australia	**194 471**

Source: ABS data available on request, Water Account.

Water supply industry

Minimising losses from water storage and delivery infrastructure is a fundamental aspect of national and MDB-specific water policies (see Appendix). The effectiveness of such policies can be assessed by evaluating whether the share of the entire economy's water consumption represented by water losses reduces over time.

Apart from Agriculture, the largest source of industry and household water consumption in the MDB was water lost or unaccounted for during delivery from water supply sources to end-users (accounting for 13% of total water consumption in the MDB). Water losses can result from evaporation, channel seepage, pipe leakage or bursts, mains flushing, and water meter errors. The standard water accounting convention, according to the System of Environmental and Economic Accounting for Water (UN 2006), is to attribute this consumption to the water supply industry. This industry includes both urban and irrigation water suppliers.

In 2004–05, water consumption by the water supply industry in the MDB (1,246 GL) accounted for 60% of Australia's total water supply industry consumption. This is because four of the five largest irrigation water suppliers in Australia (by delivery volume) operate in the MDB (ANCID 2007). Irrigation water suppliers in Australia lose more water (23% of total distributed water) than urban suppliers (12%) (ABS 2006a).

Most water consumption by the water supply industry in the MDB occurred in Victoria (53%) and New South Wales (39%) (table 3.6).

3.6 WATER SUPPLY INDUSTRY WATER CONSUMPTION, by state/territory—2004–05

	WATER CONSUMPTION		MDB WATER CONSUMPTION AS A PROPORTION OF	
	MDB	*Total state/Aust.*	*Total MDB*	*Total state/Aust.*
	GL	GL	%	%
New South Wales	486	631	39	77
Victoria	657	793	53	83
Queensland	83	426	7	20
South Australia	15	71	1	21
Australian Capital Territory	5	5	—	100
Total	**1 246**	(a) **2 083**	**100**	(a) **60**

— nil or rounded to zero (including null cells)

(a) Includes water consumption by WA, Tas. and NT.

Source: ABS data available on request, Water Account

Mining

Water is important for mining operations to facilitate the transport, flotation, grinding and separation of minerals (Norgate & Lovel 2004), as well as dust suppression. Water consumption by Mining in the MDB represented an insignificant proportion of MDB water consumption (0.2%) in 2004–05. As a proportion of all water consumption by the Mining industry, the MDB had a relatively minor contribution (5% or 20 GL). Of this, most (78%) occurred in the New South Wales section of the Basin (table 3.7). Of the businesses engaged in Mining in the MDB, metal ore mining businesses consumed the most water.

3.7 MINING WATER CONSUMPTION, by state/territory—2004–05

	WATER CONSUMPTION		MDB WATER CONSUMPTION AS A PROPORTION OF	
	MDB	*Total state/Aust.*	*Total MDB*	*Total state/Aust.*
	GL	GL	%	%
New South Wales	16	63	78	25
Victoria	2	32	11	7
Queensland	2	83	9	2
South Australia	—	19	1	2
Australian Capital Territory	—	—	1	100
Total(a)	**20**	(b)**413**	**100**	(b)**5**

— nil or rounded to zero (including null cells)
(a) Components may not add to total due to rounding
(b) Includes water consumption by WA, Tas. and NT.
Source: ABS data available on request, Water Account

Manufacturing

Water is used in Manufacturing for a variety of purposes including cooling, cleaning, as a solvent, and as a food or beverage constituent. The types of manufacturing businesses which use the highest volumes of water in the MDB include pulp and paper mills, abattoirs and other food manufacturing, dairy factories and breweries. Like Mining, water consumption by Manufacturing in the MDB was an insignificant proportion of overall MDB water consumption (0.6%) in 2004–05. Compared with Australia, MDB Manufacturing water consumption was also relatively minor (9%). Most occurred in the New South Wales (56%) and Victoria (28%) sections of the MDB (table 3.8).

3.8 MANUFACTURING WATER CONSUMPTION, by state/territory—2004–05

	WATER CONSUMPTION		MDB WATER CONSUMPTION AS A PROPORTION OF	
	MDB	*Total state/Aust.*	*Total MDB*	*Total state/Aust.*
	GL	GL	%	%
New South Wales	30	126	56	24
Victoria	15	114	28	13
Queensland	5	158	9	3
South Australia	3	55	5	5
Australian Capital Territory	1	1	1	100
Total(a)	**53**	(b)**589**	**100**	(b)**9**

(a) Components may not add to total due to rounding.
(b) Includes water consumption by WA, Tas. and NT.
Source: ABS data available on request, Water Account

Other industries

Water is also important for other industries operating in the MDB. These include, but are not limited to: local, state and commonwealth governments, service industries, restaurants, motels, schools and hospitals. Water is used for activities such as irrigating parks, gardens and sporting fields, for fire fighting, filling swimming pools and laundry operation. When describing water consumption, collectively these are referred to as "Other industries".

Although the quantity of water consumption by each of the "Other industries" cannot be disaggregated due to data quality issues, collectively these industries accounted for 1.6% of the total water consumption in the MDB in 2004–05.

Households

Households accounted for only 2% of MDB water consumption in 2004–05. Household water consumption in the MDB (189 GL) accounted for 9% of water consumption by all Australian households in 2004–05 (table 3.9). This is consistent with the proportion of total population living in the MDB (10% in 2006).

The majority of MDB household water consumption was in New South Wales (36%), followed by Victoria (28%), and the Australian Capital Territory (16%), which reflects the population distribution of the MDB (see Chapter 2). However, per capita water consumption varied across the Basin states and was highest in Queensland (119 kilolitres/person), and lowest in New South Wales (88 kilolitres/person) (table 3.10).

3.9 HOUSEHOLD WATER CONSUMPTION, by state/territory— 2004–05

	WATER CONSUMPTION		MDB WATER CONSUMPTION AS A PROPORTION OF	
	MDB	*Total state/Aust.*	*Total MDB*	*Total state/Aust.*
	GL	GL	%	%
New South Wales	68	573	36	12
Victoria	52	405	28	13
Queensland	26	493	14	5
South Australia	11	144	6	8
Australian Capital Territory	31	31	16	100
Total(a)	**189**	(b)**2 108**	**100**	(b)**9**

(a) Components may not add to total due to rounding
(b) Includes water consumption by WA, Tas. and NT.

Source: ABS data available on request, Water Account

3.10 HOUSEHOLD WATER CONSUMPTION, per household and per capita—2004–05

	Water consumption (GL)	*kL/household*	*kL/capita*
Murray-Darling Basin			
New South Wales	68	227	88
Victoria	52	233	91
Queensland	26	314	119
South Australia	11	253	101
Australian Capital Territory	31	252	96
Total(a)	189	244	94
Australia	**2 108**	**268**	**103**

(a) Components may not add to total due to rounding.

Source: Australian Demographic Statistics, Dec 2005 (cat. no. 3101.0); ABS data available on request, Water Account

AGRICULTURAL WATER CONSUMPTION

This section of the chapter provides a detailed analysis of Agricultural water consumption in the MDB and covers four topics:

- water sources used for agricultural activity;
- changes in agricultural water consumption over time;
- regional agricultural water consumption; and
- irrigation practices in the MDB.

Water Sources

The source of water used for agricultural production is of interest to policy makers and water resource managers (see Appendix). Issues that are of particular interest include:

- whether water sources (e.g. groundwater) are being overused relative to the volume of available water;
- the location of high and low levels of surface or groundwater consumption;
- change in the levels of surface and groundwater consumption, and change in the ratio of surface to groundwater consumption;
- the degree of water connectivity between surface and groundwater systems; and,
- the replacement of existing sources (e.g. surface or groundwater) with the use of alternative or 'new' water sources (e.g. recycled water).

SURFACE AND GROUNDWATER SOURCES

In 2005–06, the majority of water consumption by the Agriculture industry in the MDB originated from two main sources: surface water (6,499 GL) and groundwater (1,069 GL) (table 3.11). Combined, these two sources accounted for 98% of all water consumed for agricultural production in the Basin: 84% surface water, 14% groundwater. Other sources accounting for the remaining 2% of water consumption included recycled or reused water from off-farm sources and reticulated mains supply.

Although 14% of all agricultural water consumption inside the MDB was sourced from groundwater, areas outside the MDB were more reliant on groundwater, with 33% of water consumption originating from this source.

As shown in table 1.9 the long-term average annual run-off (23,609 GL) and deep drainage (9,719 GL) produce the long-term average annual water availability in the MDB of 33,328 GL. In 2005–06, Agriculture water consumption was 7,720 GL (table 3.11), or 23% of the long-term water availability in the MDB. Nation-wide, agricultural water consumption (11,689 GL) represents 3% of Australia's long-term water availability (413,264 GL).

As a proportion of the long-term average annual run-off in the MDB (table 1.9), surface water consumption by Agriculture represented 28% in 2005–06. In contrast, groundwater consumption (1,069 GL) represented 11% of the long-term average annual deep drainage.

3.11 AGRICULTURAL WATER CONSUMPTION, by source—Murray-Darling Basin—2005–06

	SURFACE WATER		GROUNDWATER		OTHER SOURCES(a)		TOTAL WATER CONSUMPTION	
		Proportion of total water consumption		*Proportion of total water consumption*		*Proportion of total water consumption*		*Proportion of total water consumption*
	GL	%	GL	%	GL	%	GL	%
Murray-Darling Basin								
New South Wales	3 680	82	762	17	44	1	4 486	100
Victoria	1 923	90	151	7	62	3	2 136	100
Queensland	550	82	109	16	12	2	671	100
South Australia	345	81	47	11	34	8	426	100
Australian Capital Territory	1	87	—	3	—	10	1	100
Total	***6 499***	***84***	***1 069***	***14***	***152***	***2***	***7 720***	***100***
Balance of Australia	2 498	63	1 323	33	148	4	3 969	100
Australia	**8 997**	**77**	**2 392**	**20**	**300**	**3**	**11 689**	**100**

— nil or rounded to zero (including null cells)

(a) Includes recycled/reuse water and town or country reticulated mains supply.

Source: Water use on Australian farms, 2005–06 (cat. no. 4618.0)

Water Sources continued

LOCATION OF SURFACE AND GROUNDWATER USE

In 2005–06, the majority of surface water consumption by the Agriculture industry in the MDB was in New South Wales (57%) and Victoria (30%). Over 70% of the 1,069 GL of groundwater consumption in the MDB occurred in New South Wales (table 3.12). A relatively low volume of groundwater (150 GL or 14%) was extracted for consumption by the Agriculture industry in the Victoria section of the Basin.

3.12 AGRICULTURAL WATER CONSUMPTION, by source and Basin state—Murray-Darling Basin—2005–06

	SURFACE WATER		GROUNDWATER	
	Water consumption	*Proportion of MDB*	*Water consumption*	*Proportion of MDB*
	GL	%	GL	%
New South Wales	3 680	57	762	71
Victoria	1 923	30	151	14
Queensland	550	8	109	10
South Australia	345	5	47	4
Australian Capital Territory	1	—	—	—
Murray-Darling Basin(a)	**6 499**	**100**	**1 069**	**100**

— nil or rounded to zero (including null cells)

(a) Components may not add to total due to rounding.

Source: Water use on Australian farms, 2005–06 (cat. no. 4618.0)

River basin scale measurement of water use from surface and groundwater sources is important for water management and planning agencies, because water management plans and water resource assessments commonly report at this level. Of the approximately 6,500 GL sourced from surface water in the MDB in 2005–06, most was from the Murrumbidgee (1,446 GL), Murray-Riverina (850 GL), Loddon (643 GL) and

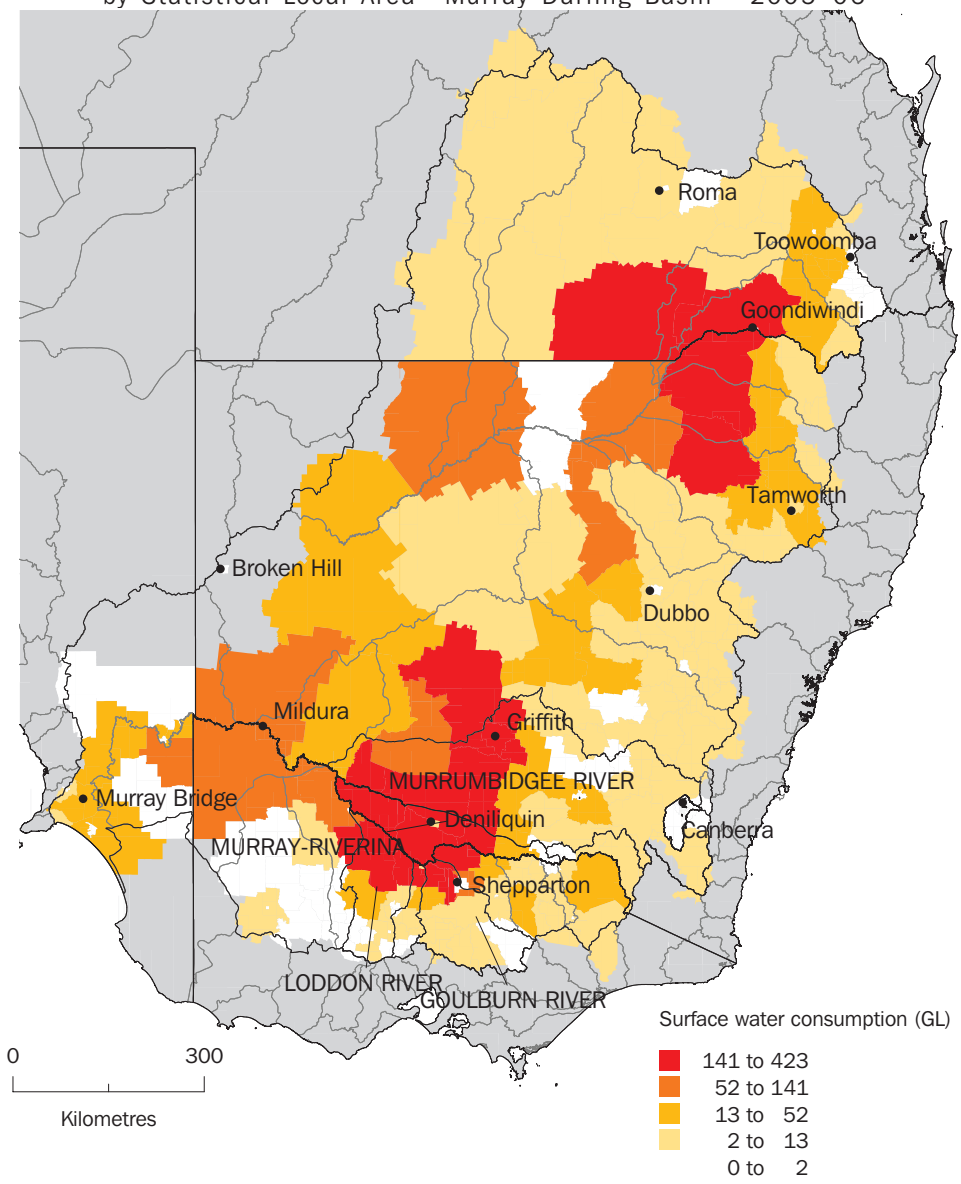
Water Sources continued

LOCATION OF SURFACE AND GROUNDWATER USE *continued*

Goulburn (417 GL) river basins (table 3.14). These are also the basins with the highest total agricultural water consumption.

Map 3.13 illustrates the volumes of surface water used for agricultural production in MDB Statistical Local Areas (SLAs, see map E.2 in the Explanatory Notes) in 2005–06. The data was sourced from the ABS Agricultural Census. This level of geography has been used to provide a more detailed picture of the distribution of surface water consumption relative to river basins in the MDB. The pattern demonstrates that in 2005–06, surface water was consumed in most Basin SLAs, and that the highest quantities of water consumption were in SLAs in the southern and northern MDB.

3.13 AGRICULTURAL SURFACE WATER CONSUMPTION IN RIVER BASINS, by Statistical Local Area—Murray-Darling Basin – 2005–06



Source: ABS data available on request, ABS Agricultural Census 2005–06, Geoscience Australia 2004

Water Sources continued

LOCATION OF SURFACE AND GROUNDWATER USE *continued*

In 2005–06, groundwater accounted for 14% (or 1,069 GL) of agricultural water consumption in the MDB. Most of the water sourced from groundwater in the Basin occurred in the Murrumbidgee (218 GL), Namoi (185 GL) and Lachlan (144 GL) river basins (table 3.14). Groundwater was a more important water source to farmers in the Namoi and Lachlan river basins than other river basins (contributing 41% and 38% of total water consumption respectively). Within these river basins, groundwater consumption was spread across the Namoi river basin SLAs, while for the Murrumbidgee and Lachlan river basins, most groundwater consumption occurred in the SLAs located in the lower regions (see map 3.15 sourced from the 2005–06 Agricultural Census).

3.14 AGRICULTURAL WATER CONSUMPTION IN SELECTED RIVER BASINS, by source—Murray-Darling Basin—2005–06

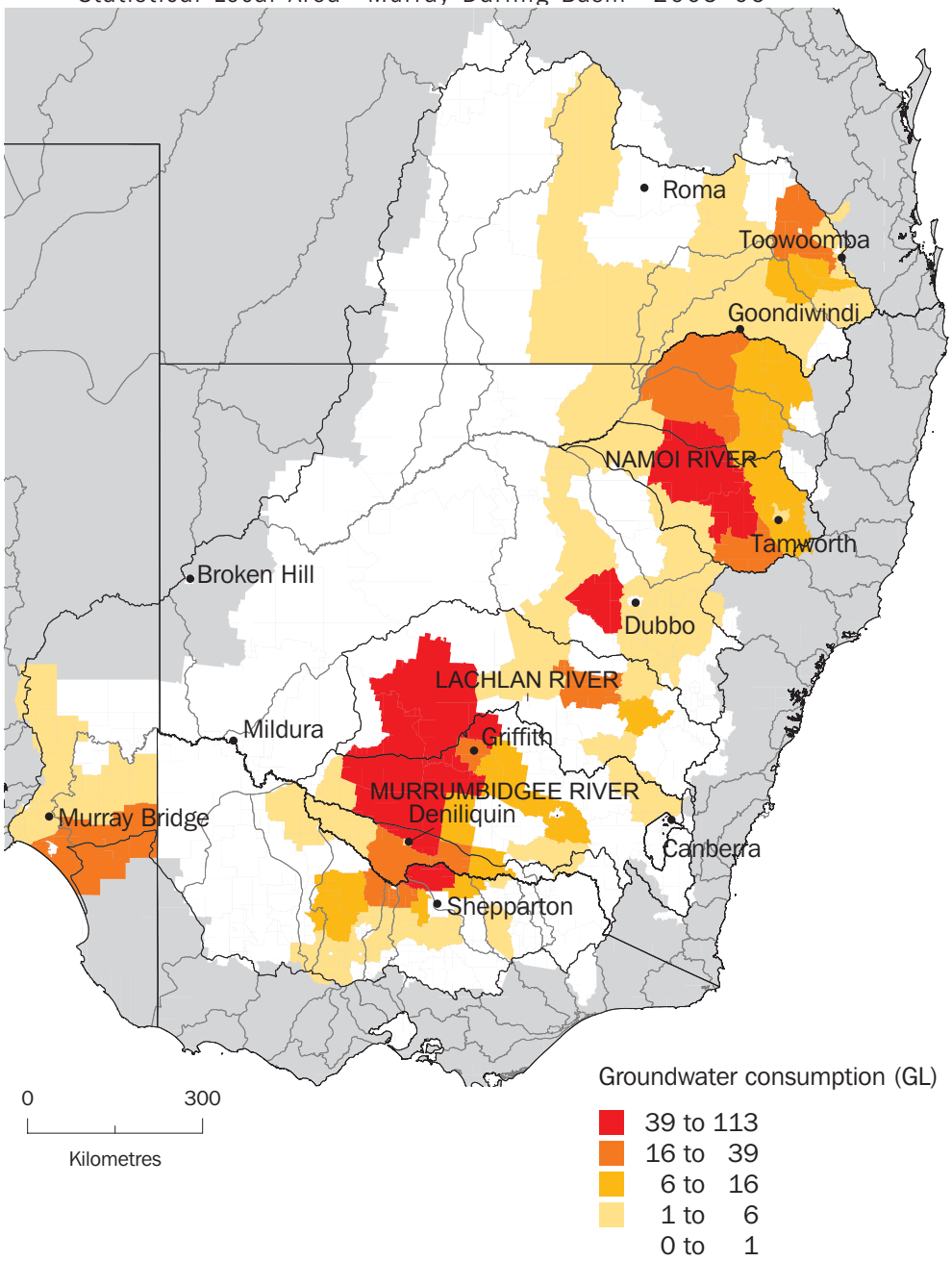
	SURFACE WATER		GROUNDWATER		OTHER SOURCES(a)		TOTAL WATER CONSUMPTION	
	Volume	*Proportion of total water consumption*	*Volume*	*Proportion of total water consumption*	*Volume*	*Proportion of total water consumption*	*Volume*	*Proportion of total water consumption*
	GL	%	GL	%	GL	%	GL	%
Murrumbidgee	1 446	86	218	13	14	1	1 678	100
Murray-Riverina	850	90	91	10	5	1	946	100
Loddon	643	95	25	4	13	2	681	100
Broken	399	85	58	12	12	2	470	100
Goulburn	417	90	31	7	16	3	464	100
Namoi	260	57	185	41	12	3	456	100
Condamine-Culgoa	335	76	99	22	7	2	441	100
Lachlan river	233	61	144	38	2	1	380	100
Macquarie-Bogan	180	73	66	27	1	—	246	100
Other river basins	1 735	89	153	8	70	4	1 959	100
Murray-Darling Basin(b)	**6 499**	**84**	**1 069**	**14**	**152**	**2**	**7 720**	**100**

— nil or rounded to zero (including null cells)

(a) Includes recycled/reuse water and town or country reticulated mains supply.

(b) Components may not add to total due to rounding.

3.15 AGRICULTURAL GROUNDWATER CONSUMPTION IN RIVER BASINS, by Statistical Local Area—Murray-Darling Basin—2005–06



Water Sources continued

CHANGE IN WATER SOURCES

Comparable agricultural surface and groundwater consumption data are not available for the MDB before 2005–06. However, as table 3.16 shows, of the total state surface and groundwater consumption, the MDB section of New South Wales accounts for 94% of both sources. Therefore, assessing the change in surface and groundwater consumption in New South Wales between 2004–05 and 2005–06 would be indicative of the change in the New South Wales section of the MDB. In other states (Victoria, Queensland and South Australia), the proportion of surface and groundwater consumption in the MDB as a proportion of the total state, are lower. Therefore, assessing the change in surface and groundwater consumption in those states is less indicative of the change in the MDB section of each respective state.

Water Sources continued CHANGE IN WATER SOURCES *continued*

3.16 AGRICULTURAL WATER CONSUMPTION, by source—2005–06

	SURFACE WATER			GROUNDWATER		
	MDB	*Total state/territory*	*MDB as a proportion of total state/territory*	*MDB*	*Total state/territory*	*MDB as a proportion of total state/territory*
	GL	GL	%	GL	GL	%
New South Wales	3 680	3 921	94	762	810	94
Victoria	1 923	2 254	85	151	297	51
Queensland	550	1 853	30	109	674	16
South Australia	345	448	77	47	459	10
Australian Capital Territory	1	1	100	—	—	—

— nil or rounded to zero (including null cells)

Source: ABS data available on request, Agricultural Census, 2005–06

The change in surface and groundwater consumption in New South Wales from 2004–05 to 2005–06 is shown in table 3.17. The volume of groundwater extracted by farmers decreased from almost 950 GL (25% of total water consumption) in 2004–05 to 810 GL (or 17%) in 2005–06. The decrease in groundwater used as a water source coincides with an increase in surface water consumption; from almost 2,800 GL (73% of total water consumption) to over 3,920 GL (or 82%).

One hypothesis for this trend is when more water is available for use from surface water storages (e.g. as in 2005–06, see graph 3.18) farmers use less groundwater for agricultural purposes. Conversely, when less surface water is available as a result of lower allocations induced by reduced water storage, (for example, in 2004–05), more groundwater is used. Although the data to support this hypothesis are limited, it would be expected that for 2006–07, when surface water storages were very low in the MDB, there may be some increase in the use of groundwater by farmers. Data which would enable this comparison are expected to be available in *Water Use on Australian farms, 2006–07* (ABS cat. no. 4618.0) in the near future.

3.17 AGRICULTURAL WATER CONSUMPTION IN NEW SOUTH WALES, by source—2004–05 and 2005–06(a)

	2004–05			2005–06		
	Surface water	*Groundwater*	*Total water consumption*(b)	*Surface water*	*Groundwater*	*Total water consumption*(b)
Volume (GL)	2 797	949	3 810	3 921	810	4 795
Proportion of total water consumption (%)	73	25	100	82	17	100

(a) Care should be taken when comparing volumetric water source data between years, due to changes in statistical methodologies, changes in survey frames, and sampling error. Climatic conditions should also be taken into account. Percentages should provide a more indicative estimate.

(b) Includes other sources.

Source: Water Use on Australian Farms, 2004–05 and 2005–06, (cat. no. 4618.0)

CHANGE IN AGRICULTURAL WATER USE OVER TIME

The volume of water used by different agricultural crops and pastures varies from year to year for a number of reasons. These include:

- level of rainfall;
- volume of water available for allocation during an irrigation season;
- technological improvements in irrigation infrastructure;
- water trading;
- input costs (e.g. water, petrol, fertiliser etc.); and
- commodity prices.

When water availability is high, for example, when water storage is elevated, high water allocations (or some equivalent) are typically announced by water management authorities and farmers decide how to use the available water. For example, cropping farmers might choose to plant relatively large areas of annual crops like rice and cotton which require more water per unit area.

When water availability is low, water management authorities announce lower allocations (or some equivalent) and irrigators are faced with decisions about how to manage the limited water resource. Cropping farmers might choose to switch from crops that typically use more water (e.g. rice - 12 ML/ha in 2005–06, see table 3.22) to alternatives which use relatively less (for example, cereals other than rice - 2 ML/ha). Alternatively, they might decide to trade some or all of their allocation and/or not sow a crop.

When there is low water availability, farmers with perennial plantings like fruit and grapes stand to lose not only their annual crop, but their assets of trees or vines if they decide not to irrigate. If their water allocation at the beginning of an irrigation season is insufficient to produce a grape or fruit crop, they may choose to purchase additional water or sacrifice their harvest to preserve their trees or vines.

Pasture and cereals are also irrigated to feed livestock, either from direct grazing or through hay/silage production. When relatively less water is available and adequate pasture or cereals cannot be grown to sustain livestock, farmers may need to purchase additional livestock feed, sell their livestock, or agist them elsewhere which has additional costs.

Technical efficiency refers to the economic value added for a given amount of water. For irrigators, technical efficiency is influenced by factors like wastage, evaporation, and production technologies (The Treasury: Roberts, Mitchell & Douglas 2006). To improve the technical efficiency of on-farm irrigation, improvements in technology, infrastructure and water management practices are required. A change in technical efficiency can be measured through monitoring water application rates over time, and taking account of climatic conditions (e.g. rainfall). This can be supplemented through assessing the irrigator uptake of more efficient technologies and practices (see 'Irrigation practices' section later in this chapter).

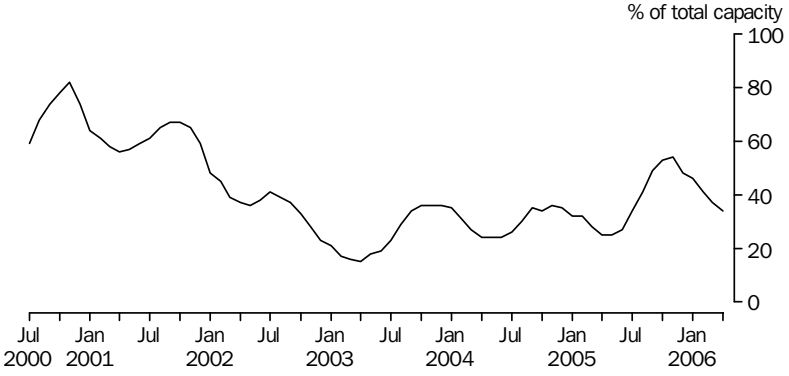
The following section examines water availability and the related change in water consumption, irrigated area and application rates by different crops and pasture between 2000–01 and 2005–06. As an indicator of surface water availability, water storage in large dams situated within the MDB has been plotted over the same period for comparison with water consumption change. Rainfall anomalies from 2000–01 to 2005–06 have been presented in Chapter 1.

Water storage in the MDB, July 2000 – June 2006

Large dams are defined as dams with a crest or wall height of greater than 15 metres, or as dams with a dam wall height of greater than 10 metres while also meeting another size criteria e.g. having a crest more than 500 metres in length; creating a reservoir of no less than 1,000 ML; the ability to deal with a flood discharge of no less than 2,000 cubic metres per second; or being of unusual design (ANCOLD 2008). Using this definition there are 105 large dams in the MDB (see map E.3 in the Explanatory Notes) with a storage capacity of 24,365 GL.

As shown in graph 3.18, water storage in large dams located in the MDB was relatively high between July 2000 and December 2001 (greater than 50% for this 18 month period). From January 2002, the combined storage level in large dams in the MDB did not increase above 50% except for a brief period in late 2005. There is a pattern of increased storage in the winter and spring months of almost every year. However, the amplitude and duration of water storage increase varies, and this impacts on the volume in storage. It is difficult to determine the relative impacts on storage of evaporation, water use and water transfer for management purposes between large dams.

3.18 WATER STORAGE (a), Murray-Darling Basin—July 2000 to June 2006



(a) In large dams.

Source: ABS data available on request, Water Account

Crop irrigation in the MDB

IRRIGATED PASTURE FOR DAIRY AND OTHER LIVESTOCK

Irrigated pasture uses more water than any other crop or pasture grown throughout Australia (3,800 GL or 36% of water used for irrigating crops or pasture in 2005–06, see *Water Use on Australian Farms 2005–06*, ABS cat. no. 4618.0). The MDB grew 67% of Australia's irrigated pasture (by area) in 2005–06. In addition, irrigated pasture consumed more water (2,537 GL) than any irrigated crop or pasture in the MDB. Irrigated pasture in the MDB is mainly used for grazing livestock (1,981 GL) and cutting for hay or silage (531 GL).

The area of irrigated pasture fluctuates from year to year. For example, the area of irrigated pasture in the MDB decreased from 760,000 ha in 2000–01, to 551,000 ha in 2002–03, and increased to 718,000 ha in 2005–06 (table 3.21).

In 2005–06, the Dairy industry accounted for 39% of the total irrigated area of pasture in the MDB. Water was used by dairy farmers for irrigating pasture for grazing, hay/silage and seed production, livestock drinking, and dairy shed washdown - in total 1,287 GL, or 17% of MDB agricultural water consumption (table 3.20). A similar quantity of water (1,284 GL) was used to irrigate pasture for other livestock in 2005–06, and accounted for 17% of the total agricultural water consumption in the MDB.

Dairy farming water consumption fluctuates to some degree from year to year. For example, water consumption decreased from 1,693 GL in 2000–01 to 1,227 GL in 2002–03 (table 3.20). From 2002–03 to 2005–06 the volume of water consumption did not reach the 2000–01 level. The proportion of agricultural water used for dairy farming in the MDB fluctuated between 15%–19% over the period from 2000–01 to 2005–06 (table 3.20). This was relatively less than for annual crops like rice (9%–23%), cotton (17%–26%) and cereals other than rice (7%–17%).

Between 2000–01 and 2005–06, the variation in water consumption by pasture for other livestock, (and the proportion of agricultural water used), exhibited a similar pattern to dairy farming.

Water was irrigated onto pasture with an application rate of 3.5 ML/ha, less than the average rate for all crops/pasture (4.5 ML/ha) in 2005–06 (table 3.22). This rate was lower than in 2000–01 (4.2 ML/ha).

COTTON

The MDB grew about 92% of Australia's irrigated cotton (by area) in 2005–06. In addition, cotton was consistently the crop with the highest water consumption in the MDB from 2000–01 to 2005–06. Cotton water consumption was almost 1,600 GL in 2005–06 (table 2.20).

Cotton water consumption fluctuates significantly from year to year, and the area of crop grown is dependent on water availability (see graph 3.19). In 2000–01, when water storage was relatively high in large dams servicing cotton growing areas in northern New South Wales and southern Queensland, the area of irrigated cotton (405,000 ha, table 3.21), volume of water consumption (2,599 GL, table 3.20), and proportion of agricultural water consumption in the MDB (25%) were all high. In 2003–04, when there was lower water storage, less irrigated cotton was planted (174,000 ha), a lower volume of water was consumed (1,186 GL), and the proportion of agricultural water

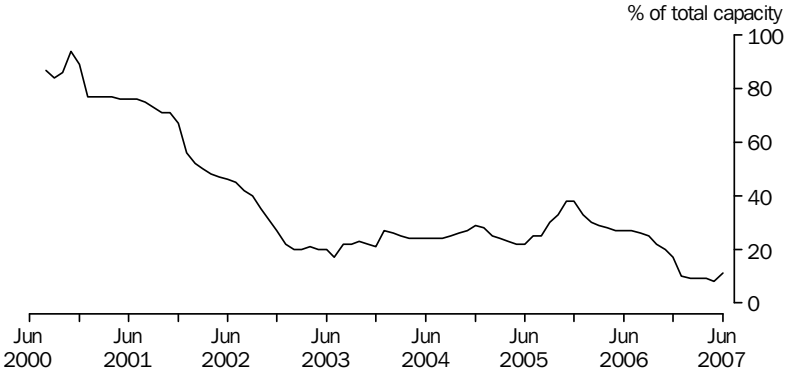
Crop irrigation in the MDB continued

COTTON *continued*

consumption accounted for by this crop dropped to 17%. Within large dams servicing cotton growing areas, the lowest water storage levels in the seven years to June 2007 were recorded in the six months between January and June 2007 (graph 3.19). This indicates that water consumption, area irrigated, and production were very low in 2006–07.

Water was irrigated onto cotton at a rate of 6.4 ML/ha in 2005–06, the second highest application rate of the major irrigated crops and pasture (table 3.22). This rate was lower than for the previous two years when the highest rates were recorded (6.8 ML/ha). As outlined above, in 2003–04, water availability was very low. Because there was less rainfall to supplement irrigated cotton, more irrigation water was required.

3.19 WATER STORAGE IN LARGE DAMS (a), Cotton growing regions—Murray-Darling Basin—2000–2007



(a) Large dams servicing cotton growing regions.

Source: ABS data avaialble on request, Water Account

RICE AND OTHER CEREALS

In 2005–06, all of Australia's rice and the vast majority (88%) of other irrigated cereals (hereafter referred to as 'cereals') were grown in the MDB. Between 2000–01 and 2005–06, more water was consumed by rice and cereal crops than by fruit, grapes or vegetables, but less than by pasture or cotton (table 3.20).

The volume of water applied to rice and cereals fluctuated significantly during the 2000–01 to 2005–06 period. The pattern of water consumption for both crops between 2000–01 and 2005–06 coincided with the change in water availability over the same period. When there was more water stored in large dams (e.g. in 2000–01, graph 3.18), water consumption for rice was higher relative to other years (table 3.20). However, when water availability was restricted, rice water consumption decreased. The opposite trend applies to irrigated cereals i.e. when water availability was restricted (e.g. 2002–03), water consumption was relatively higher than in years when water storage was high (e.g. 2000–01). This suggests there is crop substitution by irrigators depending on relative application rates (rice 12–14 ML/ha, cereals 2–3 ML/ha) and water availability from season to season.

Irrigation application rates of cereals appear to have decreased slightly from 2000–01 to 2005–06 (table 3.22). Of the major crops and pasture irrigated, cereals are irrigated with

Crop irrigation in the MDB continued

RICE AND OTHER CEREALS *continued*

the lowest application rate. By contrast, rice requires the highest application rate of water. Since 2002–03, rice farmers have significantly reduced the application rate of that crop from 14.1 ML/ha to 12.3 ML/ha in 2005–06.

GRAPES

The MDB grew the majority of Australia's irrigated grapes - 58% of Australia's irrigated area of grapes, in 2005–06. Grape growing consumed 515 GL of water in 2005–06 (table 3.20). From 2000–01 to 2005–06 significantly less water was irrigated onto grapes than onto pasture, cotton, rice or cereals, but more than for fruit or vegetables.

Being a perennial crop, the volume of water applied to grapes tends not to fluctuate from year to year to the extent of annual crops such as rice, cotton or cereals. The proportion of water used to grow grapes in the MDB compared to other agricultural commodities increased slightly between 2000–01 and 2005–06, from 4% to 7% of MDB agricultural water consumption. The volume of water applied (469 to 515 GL), gradually increased between 2000–01 and 2005–06 in the MDB (table 3.20). This is consistent with the increase in area of irrigated grapes over the same period (84,000 to 106,000 ha, table 3.21).

The irrigation application rate for grapes was relatively consistent between 2000–01 and 2004–05 (at around 5.5 ML/ha), however it decreased to 4.9 ML/ha in 2005–06. This application rate was lower than for rice, cotton and fruit, but higher than for cereals and pasture (table 3.22).

FRUIT

The MDB grew just over half of Australia's irrigated fruit - 53% of Australia's irrigated area, in 2005–06. Irrigated fruit consumed 413 GL of water in 2005–06, and between 2000–01 and 2005–06 consumed less water than most crops except vegetables (table 3.20).

Like grapes, irrigated fruit crops are perennial therefore require relatively regular annual volumes of water to sustain production. The proportion of water used by fruit in the MDB compared to other agricultural commodities remained relatively constant (approximately 5% of MDB agricultural water consumption) between 2000–01 and 2005–06. The area of irrigated fruit (59,000 to 75,000 ha, table 3.21), and volume of water applied (372 to 413 GL, table 3.20) increased over this period.

The fruit irrigation application rate, ranging from 5.5 to 6.5 ML/ha, was more variable than that for grapes between 2000–01 and 2005–06 (table 3.22). This application rate was higher than for each major crop and pasture in the MDB except rice and cotton.

VEGETABLES

The MDB grew about 28% of Australia's area of irrigated vegetable crops in 2005–06. In the MDB, vegetables use less water than all of the major crops and pastures, just 2–3% of all agricultural water consumption between 2000–01 and 2005–06 (table 3.20).

In the MDB, the area of irrigated vegetables, and volume of water applied, both decreased slightly from 37,000 ha and 166 GL in 2000–01 to 32,000 ha and 152 GL in 2005–06 (tables 3.20 and 3.21).

Crop irrigation in the MDB continued

VEGETABLES *continued*

The irrigation application rate for vegetables was reasonably consistent, ranging between 4.3 and 4.9 ML/ha in the 2000–01 to 2005–06 period. These application rates are similar to the 2005–06 average application rate for all irrigated crops and pasture in the MDB (4.5 ML/ha, table 3.22).

OTHER CROPS AND LIVESTOCK

Other agriculture includes agricultural activities like the irrigation of other broadacre crops (e.g. oilseeds) and plant nurseries, the watering of livestock, and the washdown of stock enclosures, for example, piggeries. Dairy shed washdown and dairy livestock watering are excluded from this category, and instead are included within dairy farming. The quantity of water consumption by other agriculture is substantial and ranged from 460 GL to 596 GL in the period from 2000–01 to 2005–06 (table 3.20). The decrease observed in 2002–03 relative to other years reflects changes in livestock numbers.

3.20 WATER CONSUMPTION, by agricultural commodity—Murray-Darling Basin—2000–01 to 2005–06

	2000–01(a)	*2001–02*(a)	*2002–03*	*2003–04*	*2004–05*	*2005–06*
Water consumption (GL)						
Dairy farming(b)	1 693	1 546	1 227	1 319	1 277	1 287
Pasture for other livestock(c)	1 534	1 425	1 116	1 230	1 094	1 284
Rice	2 418	1 978	615	814	619	1 252
Cereals (excl. rice)	751	1 015	1 230	876	844	782
Cotton	2 599	2 581	1 428	1 186	1 743	1 574
Grapes	469	479	492	489	510	515
Fruit (excl. grapes)	372	389	424	382	399	413
Vegetables	166	152	143	194	152	152
Other agriculture(d)	514	504	475	596	564	460
Total Agriculture(e)	**10 516**	**10 069**	**7 150**	**7 087**	**7 204**	**7 720**
Proportion of total Agriculture water consumption (%)						
Dairy farming(b)	16	15	17	19	18	17
Pasture for other livestock(c)	15	14	16	17	15	17
Rice	23	20	9	11	9	16
Cereals (excl. rice)	7	10	17	12	12	10
Cotton	25	26	20	17	24	20
Grapes	4	5	7	7	7	7
Fruit (excl. grapes)	4	4	6	5	6	5
Vegetables	2	2	2	3	2	2
Other agriculture(d)	5	5	7	8	8	6
Total Agriculture(e)	**100**	**100**	**100**	**100**	**100**	**100**

(a) The 2000–01 and 2001–02 data are experimental estimates. Only the irrigated area of each commodity was directly collected from the census or survey (see Explanatory Notes).

(b) Includes: irrigated pasture for grazing, hay and seed; livestock drinking; and, shed washdown.

(c) Includes irrigated pasture for grazing, hay and seed.

(d) Includes other broadacre crops, nurseries, livestock (other than dairy) drinking, and piggery washdown.

(e) Components may not add to total due to rounding.

Crop irrigation in the MDB continued

OTHER CROPS AND LIVESTOCK *continued*

3.21 AREA IRRIGATED, by agricultural commodity—Murray-Darling Basin—2000–01 to 2005–06

	2000–01	*2001–02*	*2002–03*	*2003–04*	*2004–05*	*2005–06*
Pasture for dairy and other livestock farming(a)	760	707	551	669	703	717
Rice	178	145	44	65	51	102
Cereals (excl. rice)	260	354	416	340	324	329
Cotton	405	394	218	174	258	247
Grapes	84	86	89	87	92	106
Fruit (excl. grapes)	59	62	74	59	63	75
Vegetables	37	35	31	40	35	32
Other agriculture(b)	41	34	43	67	62	46
Total Agriculture(c)	**1 824**	**1 817**	**1 466**	**1 501**	**1 588**	**1 654**

(a) Includes: irrigated pasture for grazing, hay and seed.
(b) Includes other broadacre crops, nurseries.
(c) Components may not add to total due to rounding.
Source: Source: ABS data available on request, Agricultural Census, 2000–01 and 2005–06; Agricultural Surveys 2001–02 to 2004–05

3.22 IRRIGATION APPLICATION RATES, by crops and pasture—Murray-Darling Basin—2000–01 to 2005–06

	2000–01(a)	*2001–02*(a)	*2002–03*	*2003–04*	*2004–05*	*2005–06*
	ML/ha	ML/ha	ML/ha	ML/ha	ML/ha	ML/ha
Pasture for dairy and other livestock farming(b)	4.2	4.1	4.2	3.8	3.3	3.5
Rice	13.6	13.6	14.1	12.4	12.1	12.3
Cereals (excl. rice)	2.9	2.9	3.0	2.6	2.6	2.4
Cotton	6.4	6.6	6.5	6.8	6.8	6.4
Grapes	5.6	5.6	5.5	5.6	5.5	4.9
Fruit (excl. grapes)	6.3	6.3	5.7	6.5	6.3	5.5
Vegetables	4.5	4.4	4.6	4.9	4.3	4.7
Total crops and pasture	**5.5**	**5.3**	**4.6**	**4.5**	**4.3**	**4.5**

(a) The 2000–01 and 2001–02 data are experimental estimates. Refer to Explanatory Notes.
(b) Includes irrigated pasture for grazing, hay and seed.

Source: ABS data available on request, Agricultural Census, 2000–01 and 2005–06; Agricultural Surveys 2001–02 to 2004–05

REGIONAL WATER USE

The MDB is made up of 26 river basins (see map 1.2 in Chapter 1). River basins have topographically-formed catchment boundaries, and have been used in previous Australian water use assessments, such as the *1985 Review of Australia's Water Resources and Water Use* (AWRC 1987). Some organisations (e.g. Murray-Darling Basin Commission and Bureau of Rural Sciences) disseminate water data by river basin, for example, Water Audit Monitoring reports and National Landscape Water Balance reports and mapping.

The majority of agricultural water consumption in the MDB occurs in only a few river basins. In 2005–06, the ten river basins (of the 26) with the highest water consumption in the MDB accounted for 83% of MDB agricultural water consumption (table 3.23). This pattern reflects the distribution of specific irrigated crop and pasture areas throughout the MDB. The largest single contributing river basin is the Murrumbidgee, comprising 22% of the total MDB agricultural water consumption in 2005–06.

3.23 AGRICULTURAL WATER CONSUMPTION IN SELECTED RIVER BASINS—Murray-Darling Basin—2005–06

	Water consumption	*Proportion of MDB*
	GL	%
Murrumbidgee river	1 678	22
Murray-Riverina	946	12
Loddon river	681	9
Broken river	470	6
Goulburn river	464	6
Namoi river	456	6
Condamine-Culgoa rivers	441	6
Border rivers	433	6
Mallee	433	6
Lachlan river	380	5
Other MDB river basins	1 339	17
Murray-Darling Basin(a)	**7 721**	**100**

(a) Components may not add to total due to rounding

Source: ABS data available on request, Agricultural Census, 2005–06

Irrigated agricultural activities, and resulting water consumption, vary across different regions in the MDB. The following sections examine regions of the MDB that have high water consumption.

Southern New South Wales region of the MDB

In 2005–06 in the Murrumbidgee river basin, rice consumed the most water (45% of total agricultural water consumption), followed by other cereals (21%) and pasture for other livestock (15%). This pattern was similar in the Murray-Riverina basin where rice consumed the most water (43%). Pasture for other livestock (27%) and dairy farming (14%) were also significant agricultural water users (table 3.24) in this river basin.

Southern New South Wales region of the MDB continued

3.24 WATER CONSUMPTION, by agricultural commodity–selected southern New South Wales river basins—2005–06

	Murrumbidgee		Murray-Riverina	
	Volume	*Proportion of total Agriculture*	*Volume*	*Proportion of total Agriculture*
	GL	%	GL	%
Dairy farming(a)	10	1	135	14
Pasture for other livestock(b)	244	15	256	27
Rice	762	45	407	43
Cereals (excl. rice)	345	21	107	11
Grapes	93	6	6	1
Fruit (excl. grapes)	60	4	9	1
Vegetables	31	2	7	1
Other agriculture(c)	133	7	19	2
Total Agriculture(d)	**1 678**	**100**	**946**	**100**

(a) Includes: irrigated pasture for grazing, hay and seed; livestock drinking; and, shed washdown.
(b) Includes irrigated pasture for grazing, hay and seed.
(c) Includes cotton, other broadacre crops, nurseries, livestock (other than dairy) drinking.
(d) Components may not add to total due to rounding.
Source: ABS data available on request, Agricultural Census, 2005–06

Northern Victorian region of the MDB

In 2005–06, in the Victorian section of the southern MDB, dairy farming consumed the most water (53% to 65% of total agricultural water consumption in the Goulburn, Broken, Loddon and Campaspe river basins), followed by pasture for other livestock (21% to 32%, table 3.25).

3.25 WATER CONSUMPTION, by agricultural commodity—selected northern Victorian river basins—2005–06

	Loddon		Broken		Goulburn		Campaspe	
	Volume	*Proportion of total Agriculture*	*Volume*	*Proportion of total Agriculture*	*Volume*	*Proportion of total Agriculture*	*Volume*	*Proportion of total Agriculture*
	GL	%	GL	%	GL	%	GL	%
Dairy farming(a)	360	53	287	61	300	65	78	58
Pasture for other livestock(b)	220	32	124	26	98	21	33	24
Cereals (excl. rice)	46	7	12	2	9	2	7	5
Grapes	2	—	1	—	5	1	1	1
Fruit (excl. grapes)	23	3	37	8	20	4	1	1
Vegetables	9	1	1	—	8	2	8	6
Other agriculture(c)	21	3	9	2	24	5	6	4
Total Agriculture(d)	**681**	**100**	**470**	**100**	**464**	**100**	**134**	**100**

— nil or rounded to zero (including null cells)
(a) Includes:irrigated pasture for grazing, hay and seed; livestock drinking; and shed washdown.
(b) Includes irrigated pasture for grazing, hay and seed.
(c) Includes rice, other broadacre crops, nurseries, livestock (other than dairy) drinking.
(d) Components may not add to total due to rounding.
Source: ABS data available on request, Agricultural Census, 2005–06

South western Murray-Darling Basin

In 2005–06, in the Mallee and Lower Murray river basins (located in the 'Riverland' region of South Australia and north west Victoria), horticultural crops were the major water users. Grapes (50% and 39% respectively of total agricultural water consumption), fruit (31% and 18%) and dairy farming (3% and 17%) accounted for the majority of water consumption (table 3.26).

3.26 WATER CONSUMPTION, by agricultural commodity—selected lower Murray-Darling river basins—2005–06

	Mallee		Lower Murray River	
	Volume	*Proportion of total Agriculture*	*Volume*	*Proportion of total Agriculture*
	GL	%	GL	%
Dairy farming(a)	15	3	39	17
Pasture for other livestock(b)	14	3	23	11
Cereals (excl. rice)	3	1	3	2
Grapes	218	50	81	39
Fruit (excl. grapes)	133	31	39	18
Vegetables	38	9	14	7
Other agriculture(c)	11	2	12	6
Total Agriculture(d)	**433**	**100**	**211**	**100**

(a) Includes irrigated pasture for grazing, hay and seed; livestock drinking; and, shed washdown.
(b) Includes irrigated pasture for grazing, hay and seed.
(c) Includes other broadacre crops, nurseries, livestock (other than dairy) drinking, and piggery washdown.
(d) Components may not add to total due to rounding.

Source: ABS data available on request, Agricultural Census, 2005–06

Northern Murray-Darling Basin

In the northern MDB, cotton was the predominant agricultural water user in 2005–06. Cotton consumed the most agricultural water in the Border Rivers (81% of total agricultural water consumption), Condamine-Culgoa (63%), Gwydir (87%), and Namoi (74%) river basins. Water was also used to a limited degree for irrigating cereals other than rice, mainly in the Condamine-Culgoa (14%), Namoi (10%) and Border Rivers (5%) basins (table 3.27).

3.27 WATER CONSUMPTION, by agricultural commodity–selected northern Murray-Darling river basins—2005–06

	Namoi		Condamine-Culgoa		Border Rivers		Gwydir	
	Volume	*Proportion of total Agriculture*	*Volume*	*Proportion of total Agriculture*	*Volume*	*Proportion of total Agriculture*	*Volume*	*Proportion of total Agriculture*
	GL	%	GL	%	GL	%	GL	%
Dairy farming(a)	7	2	9	2	np	—	np	—
Pasture for other livestock(b)	35	8	34	8	26	6	np	np
Cereals (excl. rice)	47	10	62	14	23	5	11	3
Cotton	337	74	278	63	351	81	276	87
Grapes	np	—	2	—	np	—	np	—
Fruit (excl. grapes)	—	—	3	1	5	1	np	np
Vegetables	np	—	5	1	5	1	np	—
Other agriculture(c)	30	7	48	11	23	5	11	5
Total Agriculture(d)	**456**	**100**	**441**	**100**	**433**	**100**	**317**	**100**

— nil or rounded to zero (including null cells)

np not available for publication but included in totals where applicable, unless otherwise indicated

(a) Includes: irrigated pasture for grazing, hay and seed; livestock drinking; and, shed washdown.

(b) Includes irrigated pasture for grazing, hay and seed.

(c) Includes other broadacre crops, nurseries, livestock (other than dairy) drinking.

(d) Components may not add to total due to rounding.

Source: ABS data available on request, Agricultural Census, 2005–06

IRRIGATION PRACTICES

The following section describes a variety of irrigation management practices that irrigators in the MDB employed in 2004–05, using data from the ABS Natural Resource Management Survey. For further detail on MDB NRM regions, refer to Chapter 5, and map 5.1.

Irrigation occurred on approximately one-third (16,600) of farms within MDB Natural Resource Management (NRM) regions in 2004–05 (table 3.28). Most irrigated farms in the MDB were located in the Goulburn Broken, South Australia (SA) Murray Darling Basin, Murrumbidgee, North Central, Mallee and Murray NRM regions (map 3.29). Each region contained more than 1,500 irrigated farms. More than 70% of MDB irrigating farms were located within those regions.

More than 50% of farms in the Lower Murray Darling, Mallee, Goulburn Broken and SA Murray Darling Basin NRM regions were irrigated. There were very few irrigating farms in the Australian Capital Territory, South West (QLD), Western, Maranoa Balonne and Wimmera regions.

3.28 IRRIGATED AND NON-IRRIGATED FARMS, by NRM region—Murray-Darling Basin—2004–05

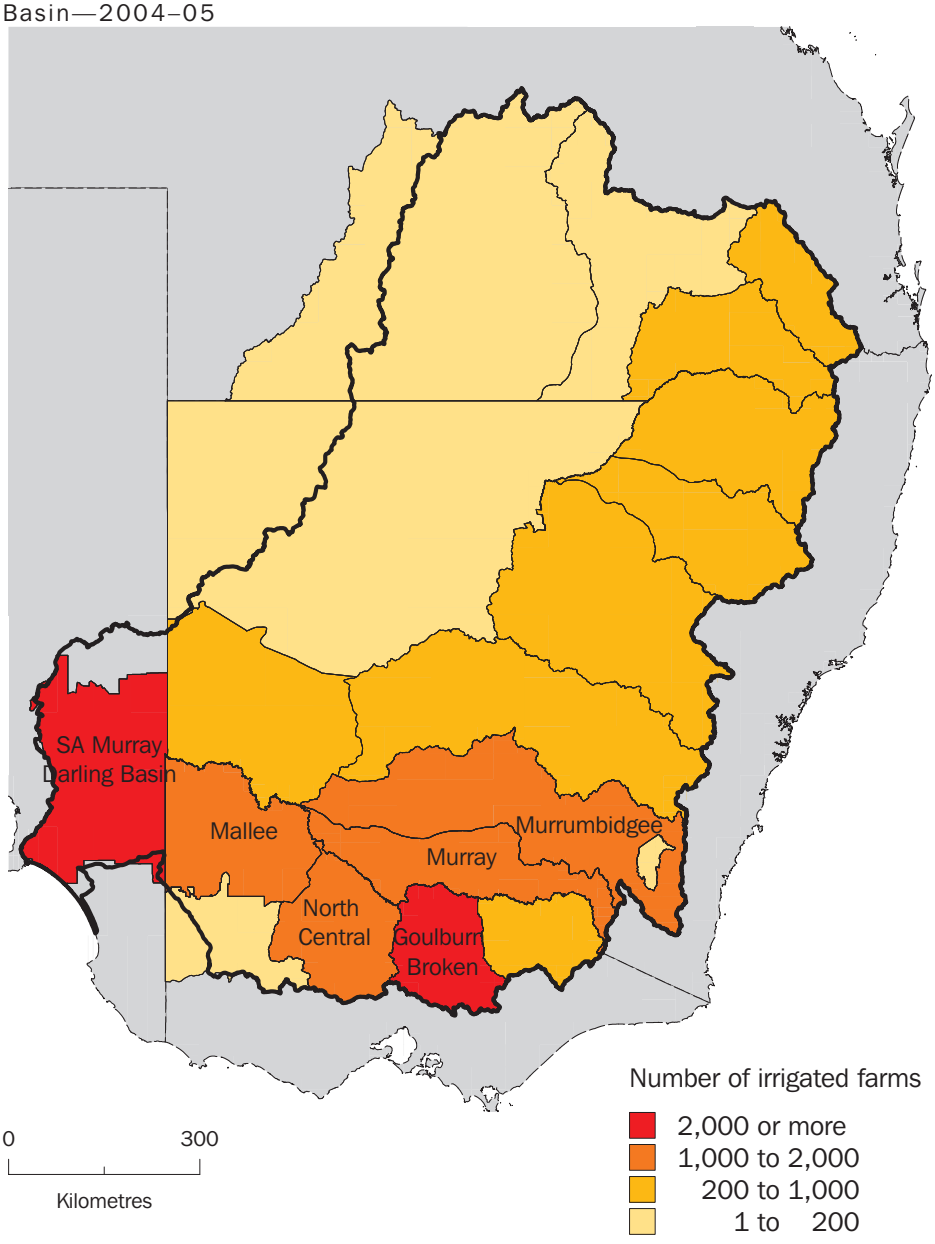
	Irrigated farms	*Proportion of total farms*	*Non-irrigated farms*	*Proportion of total farms*	*Total farms*(a)
	No.	%	No.	%	No.
Border rivers/Gwydir	300	13	2 200	87	2 600
Central West	700	13	4 700	87	5 500
Lachlan	500	9	5 000	91	5 500
Lower Murray Darling	400	62	300	38	700
Murray	1 500	48	1 600	52	3 000
Murrumbidgee	1 900	35	3 600	65	5 500
Namoi	500	19	2 300	81	2 900
Western	100	9	700	91	800
Goulburn Broken	2 700	53	2 400	47	5 000
Mallee	1 700	61	1 100	39	2 900
North Central	1 900	41	2 700	59	4 500
North East	700	33	1 500	67	2 200
Wimmera	200	7	2 100	93	2 300
Border rivers	400	41	600	59	1 000
Condamine	800	24	2 600	76	3 400
Maranoa Balonne	100	7	1 300	93	1 400
South West	—	4	500	96	500
SA Murray Darling Basin	2 200	53	1 900	47	4 100
ACT	—	15	100	85	100
Murray-Darling Basin(a)	**16 600**	**31**	**37 300**	**69**	**53 900**

— nil or rounded to zero (including null cells)

(a) Components may not add to total due to rounding.

Source: ABS data available on request, Natural Resource Management Survey 2004–05

3.29 LOCATION OF IRRIGATED FARMS, by NRM region—Murray-Darling Basin—2004–05



IRRIGATION PRACTICES *continued*

Irrigation management practices are the subject of strong interest for policy makers and water resource managers in the MDB (see Appendix). Improvements to on-farm water savings is a central part of the 2007 National Plan for Water Security (DEWHA 2007b). Through *Drought assistance and Exceptional Circumstances* support programs (see Chapter 4), several measures are available for farmers located within the MDB (DAFF 2007a). These include grants for activities related to:

- improving on-farm water management practices to increase water use efficiency;
- mitigating the effect of reduced water allocations; and
- maximising production from the water that is available.

It should be noted when analysing the data outlined below that several factors could affect these results. For example, water availability or drought could affect various regions of the MDB differently, thereby influencing irrigation practices. Further, the

IRRIGATION PRACTICES
continued

trade of water may be more feasible in some irrigation areas than others due to infrastructure or regulations. Also, the targeting of NRM funding may have been more intense in some regions compared to others, affecting the uptake of more efficient water use technologies by irrigators. Finally, by their nature, some water management practices might be implemented less frequently than others. Therefore, if irrigators implemented some practices before the reference period, the change to that practice would not have been reported for that year.

Approximately two-thirds of irrigators in the MDB changed their water management practices during 2004–05 (table 3.30). In 2004–05, the most common changes to irrigation practices in the MDB (as a proportion of total MDB irrigated farms) were:

- adopting more efficient irrigation techniques (35%);
- undertaking more efficient irrigation scheduling (27%);
- reducing area under irrigation (20%);
- laser levelling (17%); and
- purchasing extra irrigation water (16%).

The least commonly adopted irrigation management practices included: improving the quality of water run-off (3% of irrigated farms) and installing piping or covering open channels (7%).

3.30 CHANGES TO IRRIGATION PRACTICES, by irrigated farms—Murray-Darling Basin—2004–05

	Number of irrigated farms	*Proportion of total irrigated farms*
	no.	%
Did not change practices	5 900	36
Changed	10 700	64
Reduced the area under irrigation	3 300	20
Increased the area under irrigation	1 300	8
Adopted more efficient irrigation techniques	5 800	35
Adopted more efficient irrigation scheduling	4 500	27
Purchased extra irrigation water	2 700	16
Sold irrigation water	1 300	8
Installed piping and/or covered open channels to reduce water loss	1 200	7
Laser levelled areas to improve water management	2 800	17
Introduced reused or recycled irrigation water	1 800	11
Improved quality of water runoff	600	3
Installed soil moisture sensors	1 500	9
Other	500	3
Total irrigated farms(a)	**16 600**	**100**

(a) Total irrigators who changed practices does not equal the sum of the types of changes made, as farmers could report more than one type of change.

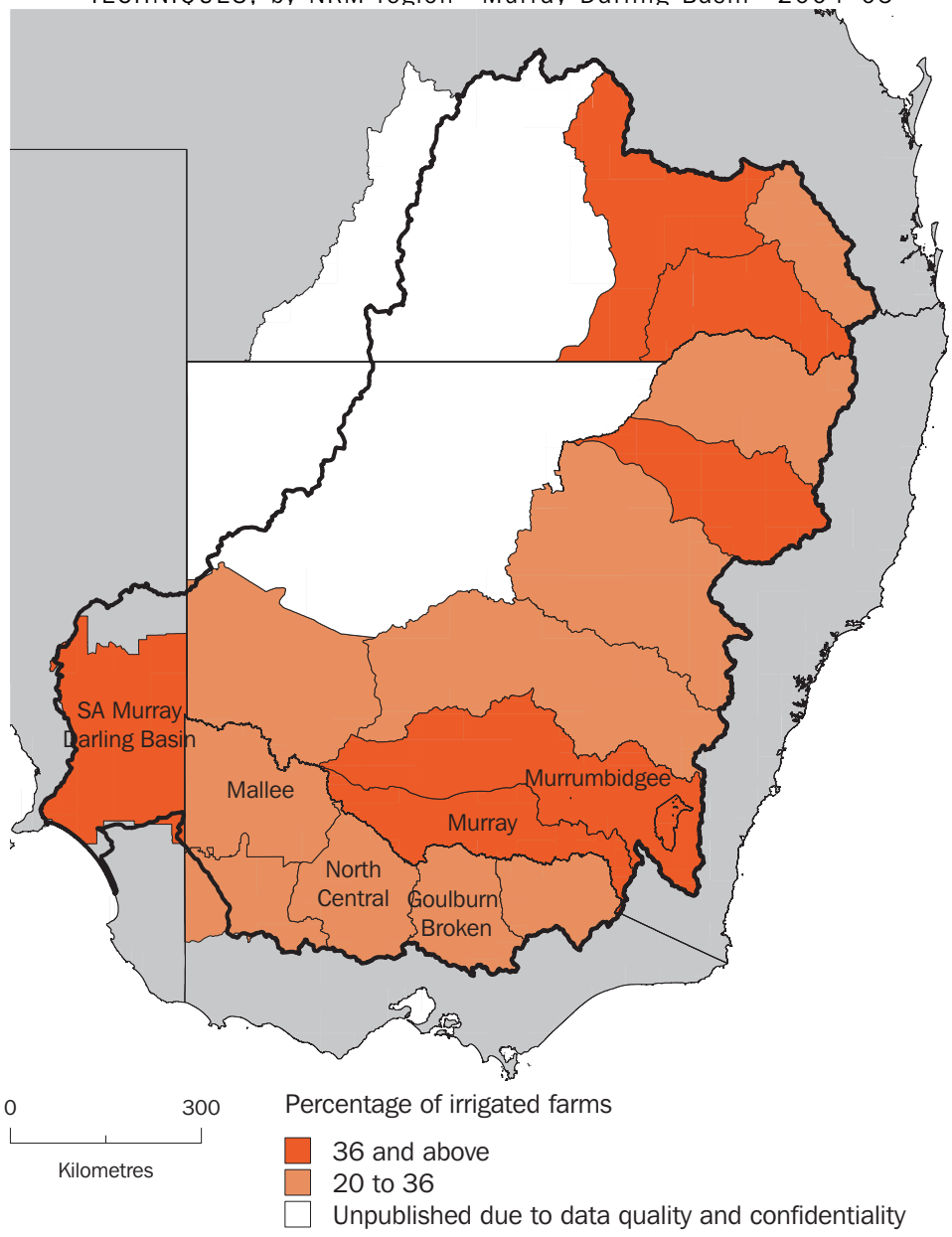
Source: ABS data available on request, Natural Resource Management Survey 2004-05

The following maps show the proportion of farms undertaking a range of irrigation practices for 2004–05. As there were significantly more irrigated farms (>1,500) in the Goulburn Broken, SA Murray Darling Basin, Murrumbidgee, North Central, Mallee and Murray NRM regions (table 3.28 above), the majority of this analysis will focus on these six NRM regions. Due to data quality and confidentiality concerns, the data have been presented in ranges, and as a proportion of the total irrigated farms in NRM regions.

IRRIGATION PRACTICES *continued*

In 2004–05, of the six NRM regions with more than 1,500 irrigated farms, 36% or more of the total irrigated farms in the Murray, Murrumbidgee and SA Murray Darling Basin NRM regions changed to more efficient irrigation techniques (map 3.31). These techniques were less commonly adopted by farms in the Goulburn Broken, North Central and Mallee NRM regions.

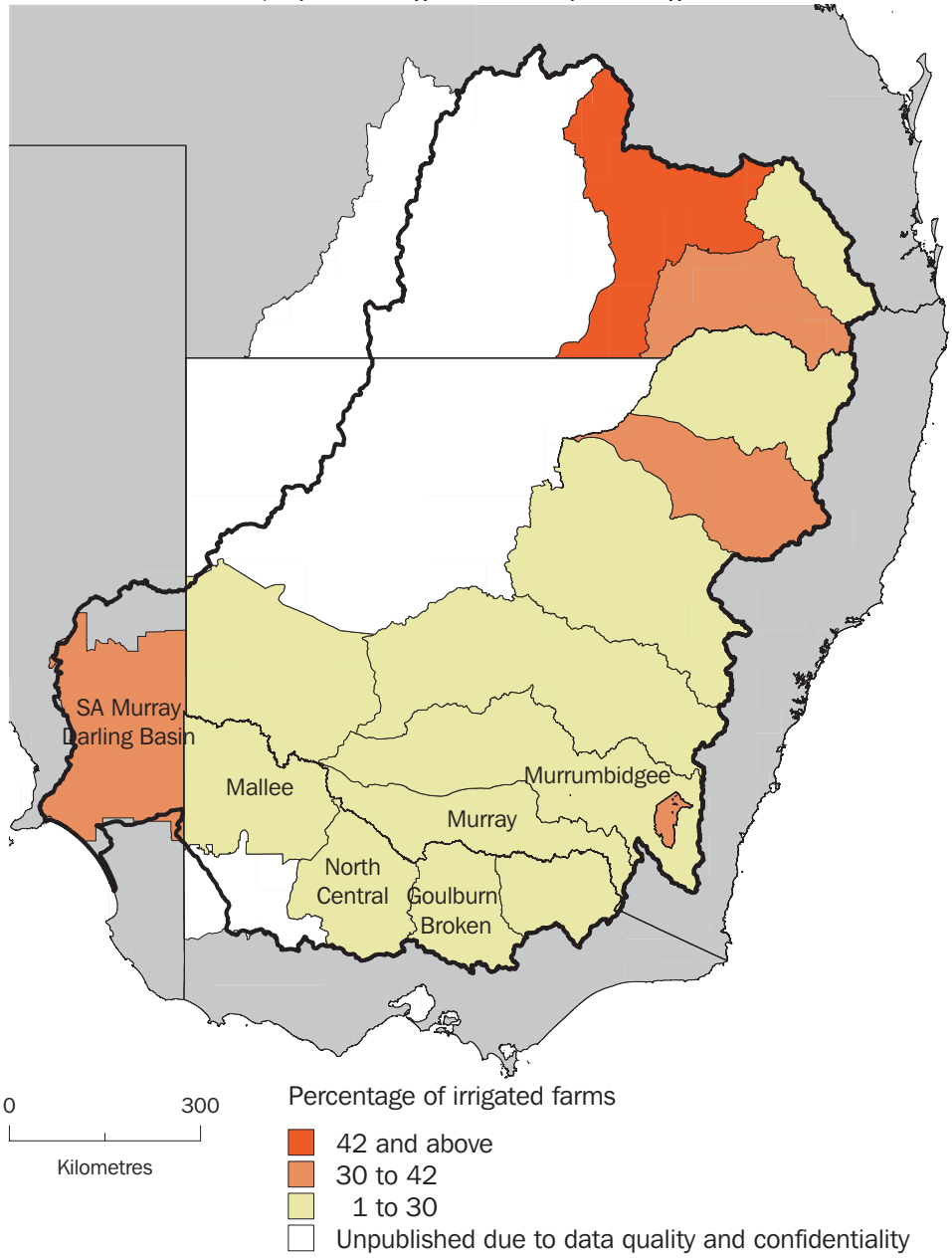
3.31 FARMS THAT CHANGED TO MORE EFFICIENT IRRIGATION TECHNIQUES, by NRM region—Murray-Darling Basin—2004–05



IRRIGATION PRACTICES
continued

In 2004–05, of the six NRM regions with more than 1,500 irrigated farms, SA Murray Darling Basin had a higher proportion of farms that changed to more efficient irrigation scheduling (30 to 42%) than in the other five NRM regions (map 3.32).

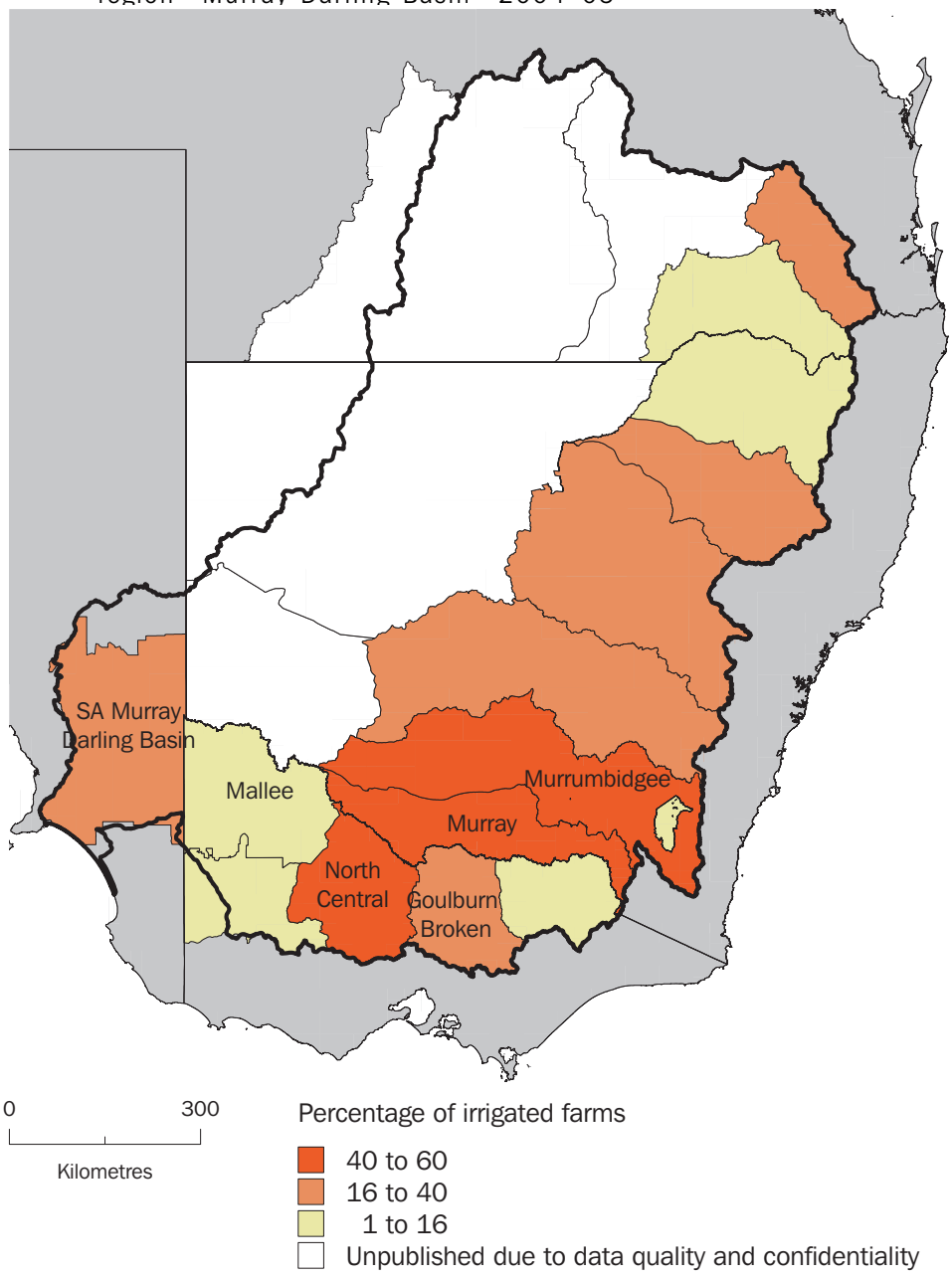
3.32 FARMS THAT CHANGED TO MORE EFFICIENT IRRIGATION SCHEDULING, by NRM region—Murray-Darling Basin—2004–05



IRRIGATION PRACTICES *continued*

In 2004–05, of the six NRM regions with more than 1,500 irrigated farms, the reduction of irrigation area was more commonly undertaken by irrigated farms in the Murray, North Central and Murrumbidgee NRM regions (between 40% and 60% of total irrigated farms). This change to irrigation practices was less commonly carried out in SA Murray Darling Basin and Goulburn Broken, and least in the Mallee (map 3.33).

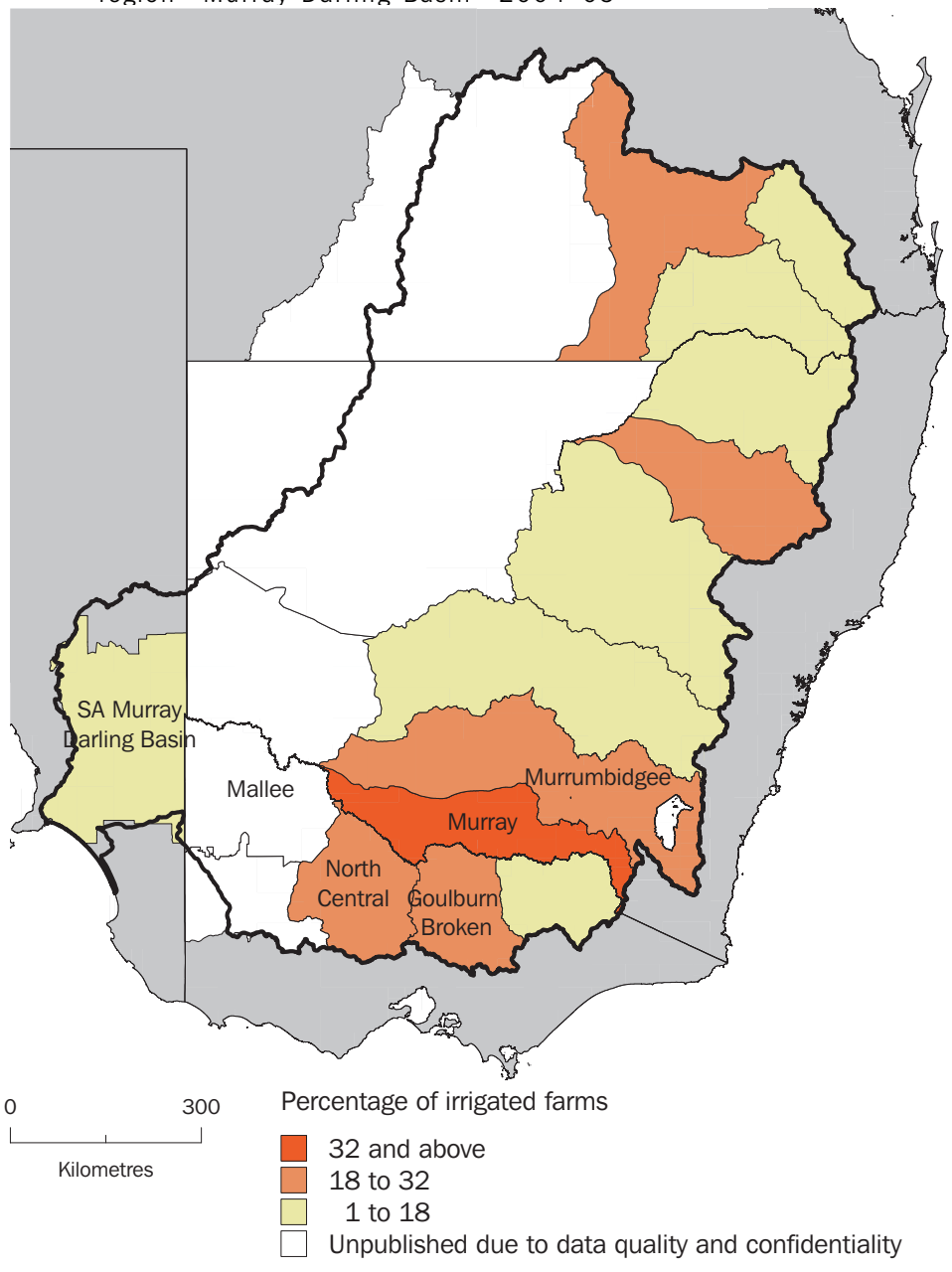
3.33 FARMS THAT REDUCED THE AREA UNDER IRRIGATION, by NRM region—Murray-Darling Basin—2004–05



IRRIGATION PRACTICES *continued*

In 2004–05, a higher proportion of irrigated farms (32% or more) in the Murray NRM region changed their irrigation practices by laser levelling than the other NRM regions with more than 1,500 irrigated farms: Murrumbidgee, Goulburn Broken, North Central and SA Murray Darling Basin (map 3.34).

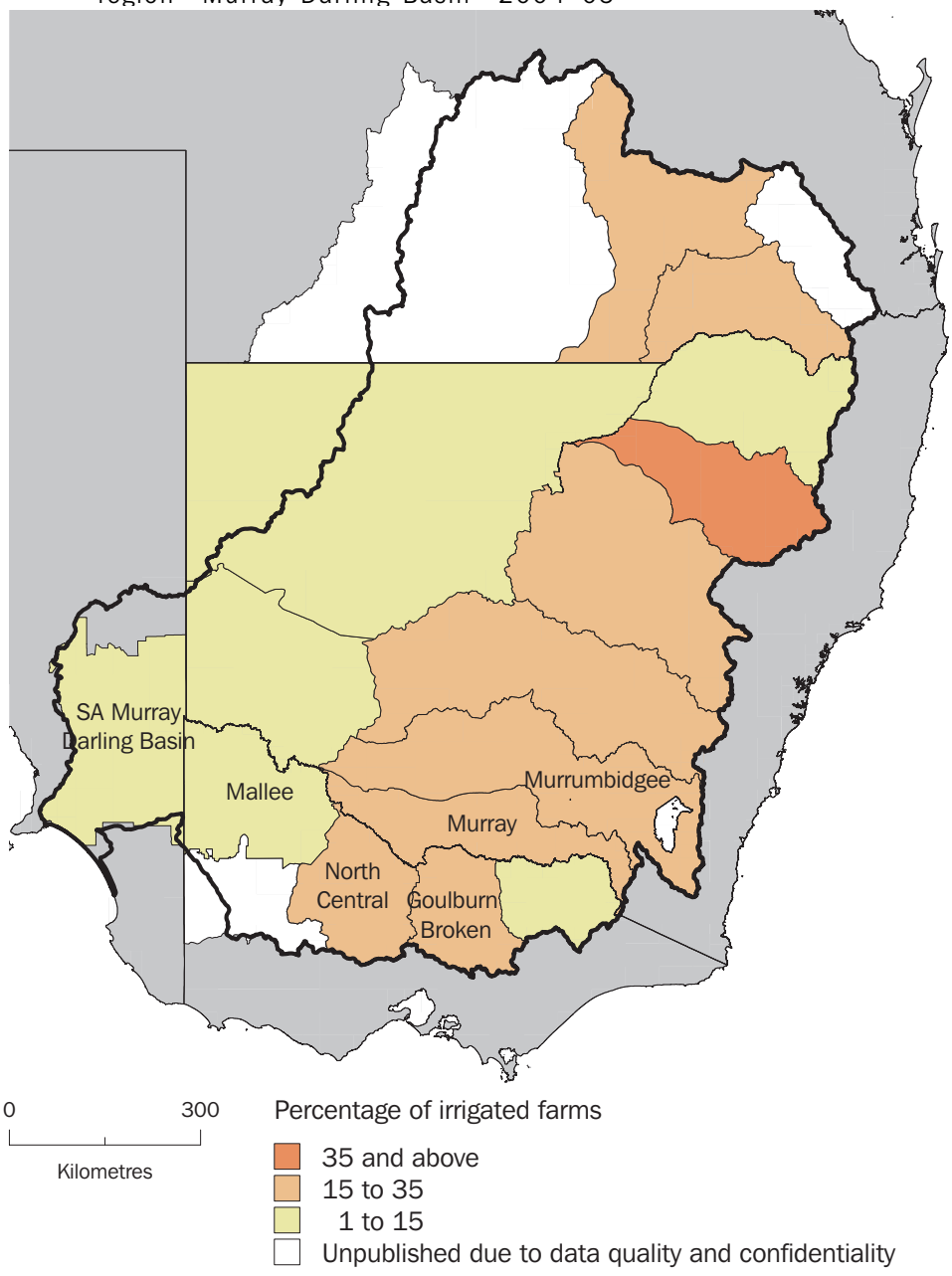
3.34 FARMS THAT CHANGED LASER LEVELLING PRACTICES, by NRM region—Murray-Darling Basin—2004–05



IRRIGATION PRACTICES *continued*

In 2004–05, of the six NRM regions with more than 1,500 irrigated farms, purchasing additional irrigation water was more commonly undertaken (15% to 35%) in the south east of the MDB in the Murray, Murrumbidgee, North Central and Goulburn Broken NRM regions. Relatively few irrigated farms (1% to 15%) purchased extra water in the south west MDB - within the SA Murray Darling Basin and Mallee NRM regions (map 3.35).

3.35 FARMS THAT PURCHASED ADDITIONAL IRRIGATION WATER, by NRM region—Murray-Darling Basin—2004–05



CHAPTER 4 AGRICULTURE IN THE MURRAY-DARLING BASIN

INTRODUCTION

The previous chapter provided details of water use by various industries, with a strong focus on agricultural water use. This chapter discusses other aspects of agricultural activity in the Murray-Darling Basin (MDB).

The chapter covers the following topics:

- the importance of agriculture in the MDB for Australia's food production;
- changes in Exceptional Circumstances declared areas over time;
- production of selected crops, and changes over time;
- irrigated and non-irrigated agriculture in the MDB;
- the location of irrigated production in the MDB; and
- the economic contribution of irrigated and total agricultural production.

Most of the data in this chapter are from the ABS Agricultural Censuses for 2000–01 and 2005–06 which collected information from Australian farmers on the areas and production of agricultural commodities. Additional information for this chapter is drawn from the ABS Apples and Pears Surveys of 2000–01 and 2005–06, and the ABS Vineyards Surveys of 2000–01 and 2005–06. Information for Exceptional Circumstances declared areas has been provided by the Australian Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF), and from the Bureau of Rural Sciences (BRS).

OVERVIEW

Agriculture is an important industry in the MDB, using 84% of the Basin's land in 2005–06 (see table 1.4 in Chapter 1). Moreover, 88.8 million hectares (ha) or 20% of Australia's agricultural land use occurred within the MDB (table 4.1). Approximately $15 billion of Australia's total value of agricultural commodities were produced in the MDB. This represented 39% of the Australian value of agricultural commodity production. Of the Basin states, New South Wales made the most significant agricultural contribution, with 51.2 million ha or 58% of the Basin's agricultural land, and almost half (49%) of the farms in 2005–06.

OVERVIEW *continued*

4.1 NUMBER OF FARMS AND AGRICULTURAL AREA—At 30 June 2006

	FARMS		AGRICULTURAL AREA	
	Number	*Proportion of Australian farms*	*Area*	*Proportion of Australian agricultural area*
	no.	%	'000 ha	%
Murray-Darling Basin				
New South Wales	29 803	19	51 214	12
Victoria	18 496	12	7 593	2
Queensland	7 881	5	23 421	5
South Australia	4 753	3	6 555	2
Australian Capital Territory	99	—	45	—
Total(a)	***61 033***	***39***	***88 828***	***20***
Balance of Australia				
New South Wales	19 034	12	10 906	3
Victoria	18 650	12	4 721	1
Queensland	24 331	16	122 098	28
South Australia	11 702	8	48 854	11
Western Australia	14 526	9	98 653	23
Tasmania	4 745	3	1 739	—
Northern Territory	659	—	59 127	14
Total(a)	***93 648***	***61***	***346 097***	***80***
Australia	**154 681**	**100**	**434 925**	**100**

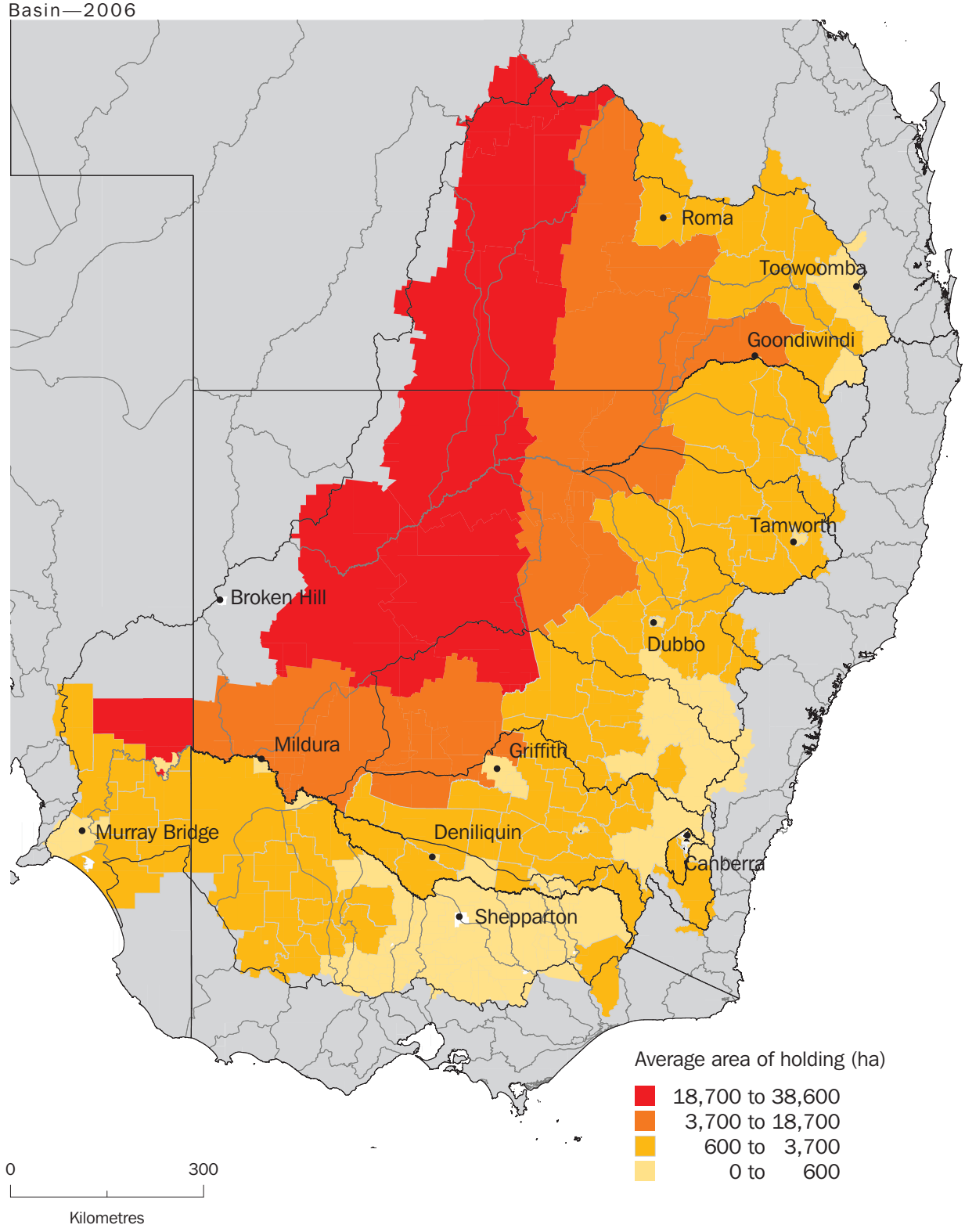
— nil or rounded to zero (including null cells)

(a) Components may not add to total due to rounding.

Source: Water Use on Australian Farms, 2005–06, ABS cat. no. 4618.0

Within the MDB, average farm size is smaller in Victoria than in the other states. Map 4.2 shows the average size of agricultural holdings across statistical local areas (SLAs) sourced from the Agricultural Census 2005–06. It illustrates that the largest farms are located in the north-west of the MDB and that farms generally have smaller areas in the south-eastern parts of the Basin.

4.2 AVERAGE AREA OF AGRICULTURAL HOLDING, by Statistical Local Area—Murray–Darling Basin—2006



Source: ABS data available on request, ABS Agricultural Census, 2005–06, Geoscience Australia 2004

IMPORTANCE OF AGRICULTURE

Australia is one of the world's major agricultural producers of grain, beef and dairy, and has large export markets for a range of other commodities including cotton, wool, wine, and other horticulture. Agriculture for food production is an important issue globally. Food shortages, a result of food consumption relative to its production, present an enormous challenge, with some 37 countries currently considered to be "in crisis, requiring external assistance" (FAO 2008). Various factors contribute to this situation. These include changes in climate and/or extreme weather events, changes in land use (e.g. reduced agricultural food production in favour of bio-fuel production and other uses), and general increases in world food prices.

The Australian Agriculture industry is subject to some of the factors listed above. The variable climate is particularly challenging and has prompted a range of policy responses by the Australian Government. An example is Australia's National Drought Policy which was developed in the early 1990s to phase out direct subsidisation and underwriting of drought. It aimed to:

- encourage primary producers and other sections of rural Australia to be more self-reliant in managing climatic variability;
- maintain the agricultural and environmental resource base during periods of high climatic stress; and
- ensure the early recovery of agricultural and rural industries, consistent with long-term sustainable levels (DAFF 2007b).

DROUGHT AND EXCEPTIONAL CIRCUMSTANCES, 2000 TO 2007

Drought and Exceptional Circumstances policies have been initiated to mitigate the affects of rare and extreme events on agricultural production. Analysing the spatial distribution of Exceptional Circumstances (EC) declared areas from July 2000 to June 2007 across Australia provides insights into which Australian areas were affected by extreme events, how wide-spread the events (e.g. drought) were, and the time periods in which farmers required the most assistance to mitigate impacts of drought. For background to this policy refer to the Appendix.

The areas that were EC declared between July 1, 2000 and June 30, 2007 are shown in map 4.3. In the 2 year period from 2000 to 2002, all EC declared areas in Australia were located in Western Australia or within the MDB in south-eastern Queensland. During 2002–03 there were more new EC declared areas located within, and outside, the MDB than in any other year between July 2000 and June 2007. Between 2003–04 and 2006–07 some new areas were added while most EC declared areas maintained their status.

4.3 EXCEPTIONAL CIRCUMSTANCES AREAS, Murray–Darling Basin—2000–02 to 2006–07

Source: Commonwealth Department of Agriculture, Fisheries and Forestry, Bureau of Rural Sciences, Exceptional Circumstances History Database, Geosciences Australia 2004

AGRICULTURAL PRODUCTION IN THE MURRAY-DARLING BASIN

Agriculture in the Murray-Darling Basin, 2005–06

The MDB is colloquially known as the nation's food bowl because of the volume of produce grown there, collectively generating a gross value of $15 billion, or 39% of Australia's total value of agricultural production. For example, livestock (excluding dairy) contributed $4 billion, cereals for grain (excluding rice) $3 billion, and fruit and nuts $1 billion (table 4.20). Although representing just 14% of Australia's total land area, the Basin contains 20% of Australia's agricultural land.

A variety of crops and pasture are grown in the MDB for food, fibre, and more recently bio-fuel for domestic consumption and export. These include:

- cereals (e.g. wheat, barley, rice, sorghum);
- cotton;
- legumes (e.g. field peas);
- fruit and nuts (e.g. apples, oranges, almonds);
- grapes;
- vegetables (e.g. tomatoes, onions);
- canola; and
- livestock fodder (e.g. pasture for grazing or hay/silage).

Growing crops and pasture through irrigation is more common in the MDB than elsewhere in Australia. Irrigated agricultural land is a relatively small proportion of total agricultural land throughout Australia (0.6%), however in the MDB, 2% of agricultural land is irrigated. The MDB accounted for 66% of Australia's agricultural water consumption in 2005–06 (table 3.1 in Chapter 3).

Change in agricultural production in the Murray-Darling Basin from 2000–01 to 2005–06

The change in agricultural production over time can be influenced by many factors. Climate, and more importantly rainfall, significantly impacts on farmers' ability to grow annual crops, or sustain existing plantings. Government policies also encourage or discourage the production of particular agricultural commodities (NWC 2008). They can also affect irrigated agricultural production through water licence buyback schemes (Wong 2008). Changes in commodity prices influence agricultural production by impacting on the amount of money farmers can afford to spend on farming inputs (such as water, fertiliser, fuel, labour) to increase production. New technologies can improve productivity and reduce the quantity of inputs (e.g. water, fertiliser) required. These factors affect overall agricultural production in the MDB, and can instigate structural change in the industry, leading farmers to increase production of some commodities and reduce the production of others.

This section reports changes in agricultural activity between 2000–01 and 2005–06, including changes in agricultural area, production of crops and pasture, and livestock numbers. All data are from ABS Agricultural Censuses.

Care should be taken when making inferences on whether comparisons between 2000–01 and 2005–06 constitute long-term trends. The production of annual crops such as cotton, rice, and other cereals can vary significantly from year to year. Additionally, some caution should be exercised when evaluating these changes, due to the methodology used to derive 2000–01 data and changes in methodology for the ABS 2005–06 Agricultural Census (see Explanatory Notes).

The total area of Australian agricultural land decreased between 2000–01 and 2005–06 from 456 million hectares (ha) to 435 million ha. Australian irrigated agricultural land

Change in agricultural production in the Murray-Darling Basin from 2000–01 to 2005–06 continued

increased by 2%, to 2.5 million ha between 2000–01 and 2005–06, while irrigated land in the Basin decreased by 9%, to 1.7 million ha (ABS 2006a). As a result, agricultural production of many crops in the MDB decreased over this period. Production of a number of commodities such as cotton, rice, canola, tomatoes, melons, onions, lemons and limes was lower in 2005–06 than 2000–01. Conversely, the production of others such as barley, grain sorghum, grapes, almonds, nectarines and cherries, increased in the same period.

In terms of livestock, between 2000–01 and 2005–06 the number of milk cattle, and sheep and lambs in the MDB decreased by 12% and 17% respectively, while the number of meat cattle and pigs increased by 8% and 10% respectively in this period (table 4.15).

Cereal crops produced for grain

2005–06

Half of all Australian agricultural land dedicated to producing cereals for grain in 2005–06 was located in the MDB, accounting for over half (53%) of all cereal for grain production in Australia (table 4.4). Wheat produced for grain is an important commodity for the Australian economy, contributing $5.1 billion to the total value of Australian crop production ($20.8 billion) in 2005–06 (ABS 2008c). The MDB is a key region for wheat production, accounting for almost half (48%) of all wheat produced in Australia in 2005–06.

The MDB produced almost half (49%) of Australia's barley crop using 52% of the nation's barley growing land. The region accounted for 80% of land dedicated to grain sorghum in Australia, but produced 89% of the total grain sorghum crop, indicating that higher productivity was achieved in the MDB than in other regions of Australia. In 2005–06, all rice produced for grain in Australia (1,003,000 tonnes) was grown in the Basin.

4.4 PRODUCTION AND AREA OF CEREALS FOR GRAIN—2005–06

	PRODUCTION			AREA		
	Aust.	*MDB*	*MDB as a proportion of Aust.*	*Aust.*	*MDB*	*MDB as a proportion of Aust.*
	'000 t	'000 t	%	'000 ha	'000 ha	%
Wheat	25 150	12 110	48	12 443	5 753	46
Barley	9 482	4 635	49	4 406	2 273	52
Grain sorghum	1 932	1 717	89	767	613	80
Rice	1 003	1 003	100	102	102	100
All other cereals	2 880	1 847	64	1 618	1 010	62
Total cereals for grain	**40 447**	**21 312**	**53**	**19 336**	**9 751**	**50**

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Census, 2005–06

Cereal crops produced for grain continued

Change from 2000–01 to 2005–06

Because cereals are annual crops, there can be significant year to year variation in both area under crop, and production levels, as a result of a number of factors such as climate conditions or commodity prices. The agricultural area for the production of cereals for grain in the MDB was 9.8 million ha in 2005–06 compared with 8.5 million ha in 2000–01 (table 4.5). The production of cereals for grain was 12% higher in 2005–06 compared with 2000–01. The production of cereals for grain in the MDB, as a proportion of Australian production, remained relatively stable between 2000–01 and 2005–06 (MDB cereal for grain production was 55% of Australian production in 2000–01; 53% in 2005–06).

In the MDB, production levels and the quantity of agricultural land used for growing wheat, barley and grain sorghum were higher in 2005–06 compared with 2000–01, but the area and production of rice was lower (table 4.5). Wheat production was slightly higher in 2005–06 (up 4%), but barley (up 44%) was significantly higher. The increase in production of grain sorghum over this period (up 44%) was significantly higher than the increase in land area devoted to sorghum, indicating an increase in productivity. Rice production was significantly lower (down 39%) reflecting reduced water availability for this water intensive crop in 2005–06 compared with 2000–01 (see Chapter 3).

4.5 PRODUCTION AND AREA OF CEREALS FOR GRAIN—Murray-Darling Basin—2000–01 and 2005–06

	PRODUCTION			AREA		
	2000–01	*2005–06*	*Change*	*2000–01*	*2005–06*	*Change*
	'000 t	000 t	%	'000 ha	'000 ha	%
Wheat	11 610	12 110	4	5 610	5 753	3
Barley	3 211	4 635	44	1 594	2 273	43
Grain sorghum	1 189	1 717	44	472	613	30
Rice	1 638	1 002	–39	176	102	–42
All other cereals	1 346	1 848	37	681	1 010	48
Total cereals for grain	**18 994**	**21 312**	**12**	**8 533**	**9 751**	**14**

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Censuses, 2000–01 and 2005–06

Selected Other crops and pasture

2005–06

The MDB accounted for almost half (47%) of Australia's land dedicated to growing hay (including pasture, cereals and other crops cut for hay) in 2005–06. Also, most Australian cotton was produced in the MDB (92%) and 93% of Australian land devoted to cotton growing was located in the Basin (table 4.6).

Field peas and canola were among other major crops produced in Australia in 2005–06. In that year, the MDB accounted for over one-third of the land dedicated to growing field peas for grain (38%) and canola (34%).

4.6 PRODUCTION AND AREA OF SELECTED OTHER CROPS AND PASTURE—2005–06

	PRODUCTION			AREA		
	Aust.	*MDB*	*MDB as a proportion of Aust.*	*Aust.*	*MDB*	*MDB as a proportion of Aust.*
	'000 t	'000 t	%	'000 ha	'000 ha	%
Pasture, cereals and other crops cut for hay	8 065	3 531	44	1 914	893	47
Cotton lint	560	516	92	327	303	93
Fieldpeas for grain	585	223	38	366	138	38
Canola	1 419	489	34	972	328	34

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Census, 2005–06

Selected Other crops and pasture continued

Change from 2000–01 to 2005–06

As cotton, canola, field peas for grain and hay are annual crops, there can be significant year to year variation in area and production levels as a result of growing conditions, commodity prices and water availability.

The area planted to cotton in the MDB was 483,000 ha in 2000–01, compared to 303,000 ha in 2005–06 (table 4.7). Cotton production was only 15% lower in 2005–06 compared to 2000–01 despite the area of cotton growing land decreasing by 37%. The production of cotton in the MDB, as a proportion of Australian production, remained relatively stable between 2000–01 and 2005–06 (MDB cotton was 91% of Australian production in 2000–01; 92% in 2005–06).

In the MDB, the area of pasture, cereals and other crops cut for hay was higher (up 16%) in 2005–06 than in 2000–01, but the field peas for grain and canola areas were significantly lower (down by 23% and 55% respectively). Interestingly, despite having a lower area of field peas in 2005–06 compared with 2000–01, the production was 8% higher.

4.7 PRODUCTION AND AREA OF SELECTED OTHER CROPS AND PASTURE—Murray-Darling Basin—2000–01 and 2005–06

	PRODUCTION			AREA		
	2000–01	*2005–06*	*Change*	*2000–01*	*2005–06*	*Change*
	'000 t	'000 t	%	'000 ha	'000 ha	%
Pasture, cereals and other crops cut for hay	3 090	3 531	14	767	893	16
Cotton lint	604	516	–15	483	303	–37
Fieldpeas for grain	207	223	8	179	138	–23
Canola	1 114	489	–56	733	328	–55

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Censuses, 2000–01 and 2005–06

Fruit and nuts

2005–06

A wide variety of fruit and nuts (hereafter referred to as 'fruit') are grown in Australia. In 2005–06, the MDB accounted for 58% of all orchard trees in Australia, and 47% of the total area of fruit grown (table 4.8). Oranges were the most significant fruit crop in the MDB and Australia in terms of production weight (507,000 tonnes in Australia). The vast majority (95%) of Australian oranges were produced in the MDB, with 92% of all trees of bearing age located in the region. In 2005–06, there were more apple trees (8.8 million) in Australia than any other fruit-bearing tree. More than half (53%) of all apple trees of bearing age were located in the MDB and the Basin produced 54% of Australia's apples. The Basin also produced the majority of Australia's almonds (93% by weight and 90% by area).

High productivity levels were evident for a wide range of fruit crops in the MDB in 2005–06. While the region accounted for 82% and 81% of all peach and apricot trees respectively, the proportions of total production were higher, at 92% and 95%. These high production levels relative to tree numbers were also reflected for nectarines, plums and prunes, lemons and limes, and cherries. The widespread use of irrigation for fruit crops in the Basin would help to explain the high productivity levels. Refer to table 4.19 for the irrigated land area used for different crops in the MDB.

4.8 PRODUCTION AND NUMBER OF FRUIT AND NUT TREES—2005–06

	PRODUCTION			NUMBER OF TREES(a)		
	Aust.	*MDB*	*MDB as a proportion of Aust.*	*Aust.*	*MDB*	*MDB as a proportion of Aust.*
	'000 t	'000 t	%	'000	'000	%
Oranges	507	482	95	6 553	6 033	92
Apples	276	148	54	(b)8 833	(b)4 682	53
Pears (incl. nashi)	142	124	87	1 776	1 485	84
Peaches	91	83	92	2 245	1 850	82
Apricots	17	16	95	587	477	81
Almonds	12	12	93	1 336	1 188	90
Nectarines	49	42	86	1 652	1 232	75
Plums and prunes	26	22	82	1 742	1 303	75
Lemons and limes	33	15	45	490	186	38
Cherries	10	7	72	1 557	947	61
Total fruit and nut trees(c)(d)	. .	. .	. .	***37 446***	***21 743***	***58***
Total area of fruit ('000 ha)(e)	**188**	**88**	**47**	. .	. .	. .

. . not applicable

(a) Data is for bearing trees aged 6 years and over.

(b) 2005–06 data for bearing apple trees is for trees aged 4 years and over.

(c) No data available for total fruit and nut production.

(d) Total number of trees includes all orchard trees, not just those of bearing age. Includes all citrus, stone, pome, nut, avocado, mango and other orchard trees. Therefore, sub-totals for number of specific trees do not add to total.

(e) Includes all fruit trees, nut trees, plantation and berry fruit.

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Census, 2005–06

Fruit and nuts continued

Change from 2000–01 to 2005–06

Between 2000–01 and 2005–06, the agricultural area in the MDB used for the production of fruit increased from 77,000 ha to 88,000 ha, an increase of 14% (table 4.9). The area of fruit in the MDB as a proportion of the Australian total fruit area remained relatively stable (at 52% and 53%) during this period.

Changes in production levels varied across the range of fruit in the MDB. For example, between 2000–01 and 2005–06 there was a decrease in the production of lemons and limes (down 29%), pears (down 18%), oranges (down 7%) and apples (down 7%). There was essentially no change in the number of bearing trees for oranges and pears, indicating that the lower production was due to reduced yields. The decrease in lemon and lime production could, at least in part, be attributed to the reduced numbers of lemon and lime bearing trees.

The production of nectarines, almonds, and cherries increased from 2000–01 to 2005–06 (67%, 32%, and 29% respectively). This was influenced primarily by increases in the number of nectarine (72%), almond (44%), and cherry (68%) bearing trees. The increase in production of almonds and cherries was proportionally much less than the increase in number of bearing trees.

4.9 PRODUCTION AND NUMBER OF FRUIT AND NUT TREES—Murray-Darling Basin—2000–01 and 2005–06

	PRODUCTION			NUMBER OF TREES(a)		
	2000–01	*2005–06*	*Change*	*2000–01*	*2005–06*	*Change*
	'000 t	'000 t	%	'000	'000	%
Oranges	516	482	–7	6 043	6 033	—
Apples	158	148	–7	3 092	(b)4 682	(c)na
Pears (incl. nashi)	152	124	–18	1 476	1 485	1
Almonds	9	12	32	824	1 188	44
Nectarines	25	42	67	715	1 232	72
Lemons and limes	21	15	–29	200	186	–7
Cherries	5	7	29	563	947	68
Total fruit and nut trees(d)(e)	. .	. .	. .	***16 862***	***21 743***	***29***
Total area of fruit ('000 ha)(f)	**77**	**88**	**14**	. .	. .	. .

. . not applicable
— nil or rounded to zero (including null cells)
na not available
(a) Data is for trees of bearing age, 6 years and over.
(b) 2005–06 data for bearing apple trees is for trees aged 4 years and over.
(c) Change between years can not be calculated because of different definitions of bearing apple trees in 2000–01 and 2005–06.
(d) No data is available for total fruit and nut production.
(e) Total number of trees includes all orchard trees, not just those of bearing age. Includes all citrus, stone, pome, nut, avocado, mango and other orchard trees. Therefore, sub-totals for number of specific trees do not add to total.
(f) Includes all fruit trees, nut trees, plantation and berry fruit.

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Censuses, 2000–01 and 2005–06, and Apples and Pears Survey, 2000–01

Grapes

2005–06

Grapes are a key horticultural crop grown in the MDB. While over half (56%) of the total area of grapevines were located in the MDB (table 4.10), a greater proportion of grapes (76%) were produced in the region, indicating higher yields in the MDB. Around three-quarters (74%) of Australia's grapes produced for winemaking were grown in the MDB in 2005–06 and the region accounted for 94% of grapes produced for other purposes, such as drying and table grapes. The high productivity of grapevines located in the MDB is likely to be related to the relatively high proportion of irrigated area for grapes in the region. In 2005–06, 93% of grape growing land was irrigated (see table 4.19) compared with 87% outside the Basin.

4.10 PRODUCTION AND AREA OF GRAPES—2005–06

	PRODUCTION(a)			AREA OF VINES(b)		
	Aust.	*MDB*	*MDB as a proportion of Aust.*	*Aust.*	*MDB*	*MDB as a proportion of Aust.*
	'000 t	'000 t	%	'000 ha	'000 ha	%
Winemaking	1 782	1 320	74	na	na	na
Drying, table and other	200	188	94	na	na	na
Total grapes(c)	**1 981**	**1 508**	**76**	**203**	**114**	**56**

na not available
(a) Fresh weight.
(b) Area of vines data is not collected by purpose of production.
(c) Components may not add to total due to rounding.

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Census, 2005–06

Grapes *continued*

Change from 2000–01 to 2005–06

Between 2000–01 and 2005–06, the agricultural area in the MDB used for growing grapes increased by 35% (from 91,000 ha to 114,000 ha) while the production of grapes increased by 25% over the same period (table 4.11). The area of grapes in the MDB as a proportion of the total Australian area of grapes decreased from 61% in 2000–01 to 56% in 2005–06.

4.11 PRODUCTION AND AREA OF GRAPES—Murray-Darling Basin—2000–01 and 2005–06

	PRODUCTION(a)			AREA OF VINES(b)		
	2000–01	*2005–06*	*Change*	*2000–01*	*2005–06*	*Change*
	'000 t	'000 t	%	'000 ha	'000 ha	%
Winemaking	972	1 320	36	na	na	na
Drying, table and other	143	188	31	na	na	na
Total grapes	**1 115**	**1 508**	**35**	**91**	**114**	**25**

na not available

(a) Fresh weight.

(b) Area of vines data is not collected by purpose of production.

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Censuses, 2000–01 and 2005–06, and Vineyards Survey 2000–01

Vegetables

2005–06

In Australia in 2005–06, around one-quarter (26%) of land dedicated to growing vegetables for human consumption was located in the MDB (table 4.12). In this period, potatoes were by far the largest Australian vegetable crop with 1.2 million tonnes produced, and around one-third (32%) of this production was in the MDB. The region accounted for more than two-thirds (68%) of total tomato production, and 56% of Australian tomato growing land area, indicating higher yields, potentially as a result of irrigation. Almost half (48%) of the land area dedicated to growing rockmelons and cantaloupes was situated in the MDB and 38% of land dedicated to growing onions (brown and white varieties) was located in the Basin.

4.12 PRODUCTION AND AREA OF VEGETABLES(a)—2005–06

	PRODUCTION			AREA		
	Aust.	*MDB*	*MDB as a proportion of Aust.*	*Aust.*	*MDB*	*MDB as a proportion of Aust.*
	'000 t	'000 t	%	'000 ha	'000 ha	%
Tomatoes	450	306	68	8	4	56
Potatoes	1 250	397	32	35	12	34
Melons (rock and cantaloupe)	85	37	44	3	2	48
Onions (brown and white)	196	66	33	3	1	38
Other vegetables	na	na	na	82	15	18
Total vegetables	na	na	na	**131**	**34**	**26**

na not available

(a) For human consumption.

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Census, 2005–06

Vegetables continued

Change from 2000–01 to 2005–06

Between 2000–01 and 2005–06, the agricultural area in the MDB used for the production of vegetables for human consumption decreased from 42,000 ha to 34,000 ha (table 4.13). In addition, the area of vegetables in the MDB as a proportion of the Australian total vegetable area decreased slightly from 30% to 26% during this period. Production levels and the area of agricultural land used for growing vegetables decreased for a range of vegetables in the MDB. For example, there was a decrease in the production of tomatoes (down 27%), melons (down 31%) and onions (down 35%), however potatoes showed no significant change over this period.

4.13 PRODUCTION AND AREA OF VEGETABLES(a)—Murray-Darling Basin—2000–01 and 2005–06

	PRODUCTION			AREA		
	2000–01	*2005–06*	*Change*	*2000–01*	*2005–06*	*Change*
	'000 t	'000 t	%	'000 ha	'000 ha	%
Tomatoes	419	306	–27	6	4	–33
Potatoes	401	397	–1	13	12	–8
Melons (rock and cantaloupe)	54	37	–31	2	2	—
Onions (brown and white)	102	66	–35	2	1	–50
Other vegetables	na	na	na	19	15	–21
Total vegetables	na	na	na	**42**	**34**	**–19**

— nil or rounded to zero (including null cells)
na not available
(a) For human consumption.
Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Censuses, 2000–01 and 2005–06

Selected livestock

2006

At 30 June 2006, there were more sheep and lambs in Australia than any other type of livestock, and 45% of these were located in the MDB. The Basin accounted for 62% of pigs and 28% of cattle at this time (table 4.14).

4.14 SELECTED LIVESTOCK NUMBERS—At 30 June 2006

	Aust.	*MDB*	*MDB as a proportion of Aust.*
	'000	'000	%
Cattle			
Milk cattle	2 788	887	32
Meat cattle	25 605	7 085	28
Total cattle	28 393	7 972	28
Sheep and lambs	91 028	40 609	45
Pigs	2 733	1 707	62

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Census, 2005–06

Change from 2001 to 2006

Between 30 June 2001 and 2006, some livestock numbers increased in the MDB while others decreased. The number of meat cattle increased by 8% (from 6.5 to 7.1 million) as did the number of pigs, by 10% (from 1.6 to 1.7 million). Numbers of dairy cattle decreased by 12% (from 1.0 to 0.9 million) and sheep and lambs decreased by 17% (48.8 to 40.6 million) (table 4.15).

4.15 SELECTED LIVESTOCK NUMBERS—Murray-Darling Basin—At 30 June 2001 and 2006

	2001	*2006*	*Change*
	'000	'000	%
Cattle			
Milk cattle	1 005	887	–12
Meat cattle	6 546	7 085	8
Total cattle(a)	7 552	7 972	6
Sheep and lambs	48 773	40 609	–17
Pigs	1 554	1 707	10

(a) Components may not add to total due to rounding.

Source: Agricultural Commodities, Australia, 2005–06, ABS cat. no. 7121.0; ABS data available on request, Agricultural Census, 2005–06

IRRIGATED AND NON-IRRIGATED AGRICULTURAL PRODUCTION

The Murray-Darling Basin is a unique region in Australia because it contains the majority of Australia's irrigated agricultural land (65% in 2005–06) (table 4.16). One reason for the proliferation of irrigated crops and pasture in the MDB is the Basin's water storage and delivery infrastructure, enabling water to be captured and transported to farms.

So far in this chapter the focus has been on total agricultural production. The following section looks more closely at irrigated agricultural production in the MDB.

Irrigated farms and area in the Murray-Darling Basin

More than 1.4 million ha (or 56%) of Australia's irrigated agricultural land is in the New South Wales and Victorian parts of the MDB (table 4.16). Approximately 90% (or 0.9 million ha) of the total New South Wales irrigated area, and 81% (or 0.5 million ha) of Victoria's total irrigated area occurs in the MDB.

4.16 IRRIGATED AND NON-IRRIGATED LAND—2005–06

	IRRIGATED		NON-IRRIGATED		TOTAL AGRICULTURE
	Area	*Proportion of Australian irrigated land*	*Area*	*Proportion of Australian non-irrigated land*	*Area*
	'000 ha	%	'000 ha	%	'000 ha
Murray-Darling Basin					
New South Wales	914	36	50 300	12	51 214
Victoria	522	20	7 071	2	7 593
Queensland	147	6	23 275	5	23 421
South Australia	71	3	6 484	1	6 555
Australian Capital Territory	—	—	45	—	45
Total(a)	***1 654***	***65***	***87 174***	***20***	***88 828***
Balance of Australia					
New South Wales	80	3	10 825	3	10 906
Victoria	126	5	4 595	1	4 721
Queensland	393	15	121 706	28	122 098
South Australia	145	6	48 708	11	48 854
Western Australia	60	2	98 592	23	98 653
Tasmania	81	3	1 658	—	1 739
Northern Territory	7	—	59 120	14	59 127
Total(a)	***893***	***35***	***345 205***	***80***	***346 097***
Australia	**2 546**	**100**	**432 378**	**100**	**434 925**

— nil or rounded to zero (including null cells)

(a) Components may not add to total due to rounding.

Source: Water Use on Australian Farms, 2005–06, ABS cat. no. 4618.0

Within the MDB, more irrigated farms are located in Victoria compared with each of the other states. This concentration of irrigators indicates that the average area of irrigated farms is smaller in the Victorian part of the MDB compared with New South Wales (table 4.17).

Irrigated farms and area in the Murray-Darling Basin continued

4.17 IRRIGATED FARMS—2005–06

	Number	Proportion of state/territory irrigated farms	Area	Proportion of state/territory irrigated area
	no.	%	'000 ha	%
Murray-Darling Basin				
New South Wales	6 651	57	914	92
Victoria	7 915	68	522	81
Queensland	1 536	16	147	27
South Australia	2 514	40	71	33
Australian Capital Territory	17	100	—	100
Total(a)	***18 634***	. .	***1 654***	. .
Balance of Australia				
New South Wales	4 936	43	80	8
Victoria	3 706	32	126	19
Queensland	8 324	84	393	73
South Australia	3 783	60	145	67
Western Australia	3 173	100	60	100
Tasmania	1 919	100	81	100
Northern Territory	351	100	7	100
Total(a)	***26 193***	. .	***892***	. .
Australia(a)	**44 826**	. .	**2 546**	. .

. . not applicable
— nil or rounded to zero (including null cells)
(a) Components may not add to total due to rounding.
Source: Water Use on Australian Farms, 2005–06, ABS cat. no. 4618.0

Irrigated and non-irrigated crops

In 2005–06, the MDB accounted for a greater proportion of Australia's non-irrigated agricultural land than it did in 2000–01 for a range of commodities including cotton (80% in 2000–01, 98% in 2005–06) and cereals other than rice (48% in 2000–01, 51% in 2005–06). In this period, the Basin's non-irrigated agricultural land decreased as a proportion of the Australian total for fruit, grapes and vegetables (table 4.18).

The MDB accounted for a lower proportion of Australia's irrigated land in 2000–01 compared with 2005–06 (decreasing from 73% to 65%). In this period, the only irrigated crop or pasture in the MDB that increased as a proportion of Australian irrigated area was fruit (from 51% to 53%).

Irrigated and non-irrigated crops continued

4.18 CONTRIBUTION OF MURRAY-DARLING BASIN IRRIGATED AND NON-IRRIGATED LAND TO AUSTRALIA, by crop(a)—2000–01 and 2005–06

	IRRIGATED		NON-IRRIGATED	
	2000–01	*2005–06*	*2000–01*	*2005–06*
	%	%	%	%
Rice	100	100	. .	. .
Cereals (excl. rice)	90	88	48	51
Cotton	93	92	80	98
Grapes	63	58	44	43
Fruit (excl. grapes)	51	53	33	12
Vegetables(b)	32	28	22	13
Total Agriculture	**73**	**65**	**18**	**20**

. . not applicable

(a) Irrigated land as a proportion of total Australian irrigated crop land; non-irrigated land as a proportion of total Australian non-irrigated crop land.

(b) For human consumption.

Source: Water Use on Australian Farms, 2005–06, ABS cat. no. 4618.0; ABS data available on request, Agricultural Census, 2000–01 and 2005–06

Many of the crops and pasture grown in the MDB rely on irrigation to facilitate production. In 2005–06, more than 80% of the MDB area of cotton and fruit, and more than 90% of grapes and vegetables for human consumption were irrigated (table 4.19).

The irrigated proportion of the total area for most crops showed minimal change between 2000–01 and 2005–06. However, for fruit crops, there was an increase from 77% to 85%.

All rice grown in Australia is irrigated and located in the MDB. The land area utilised for growing rice was less in 2005–06 than in 2000–01. Only 3% of area for cereals other than rice were irrigated in the MDB in 2005–06. While this proportion remained the same as in 2000–01, the irrigated and non-irrigated areas increased. Irrigated and non-irrigated cotton areas in the MDB both decreased in this period.

Irrigated and non-irrigated crops continued

4.19 IRRIGATED AND NON-IRRIGATED AGRICULTURAL LAND, by crop and pasture—Murray-Darling Basin—2000–01 and 2005–06

	2000–01			2005–06		
	Irrigated	*Non-irrigated*	*Irrigated proportion*	*Irrigated*	*Non-irrigated*	*Irrigated proportion*
	'000 ha	'000 ha	%	'000 ha	'000 ha	%
Pasture (native or sown)	760	na	na	717	na	na
Rice	178	. .	100	102	. .	100
Cereals (excl. rice)	260	8 835	3	329	10 053	3
Cotton	405	78	84	247	56	81
Grapes	84	7	92	106	8	93
Fruit (excl. grapes)	59	18	77	75	13	85
Vegetables(a)	37	5	89	31	3	92
Total Agriculture	**1 824**	**81 685**	**2**	**1 654**	**87 174**	**2**

. . not applicable
na not available
(a) For human consumption.
Source: Water Use on Australian Farms, 2005–06, ABS cat. no. 4618.0; ABS data available on request, Agricultural Census, 2000–01 and 2005–06

Location of irrigated agricultural production in the Murray-Darling Basin

Irrigation activity occurs over a relatively small area of the MDB; only 2% of the total agricultural land. Irrigated crops and pasture are generally grown downstream from major water storages and delivery infrastructure, adjacent to major rivers, and often within specified irrigation districts (see Map 1.16).

In 2005–06, some irrigated crops, rice and cotton for example, were grown in relatively confined areas of the MDB.

- Rice was predominantly grown in the Riverina region of southern New South Wales, around Griffith and Deniliquin.
- Approximately 39% of irrigated pasture in 2005–06 was used for dairy farming (see Chapter 3). This occurred predominantly in the northern Victorian and southern New South Wales areas of the MDB.
- Irrigated cotton was predominantly grown in the northern New South Wales and southern Queensland areas of the MDB.

Irrigated crops such as fruit, grapes, vegetables and cereals other than rice were dispersed over a larger area than cotton and rice, in 2005–06. Irrigated pasture for non-dairy livestock was also distributed over a broad area of the MDB.

- Irrigated fruit areas in the MDB followed the Murray River in the South Australian 'Riverland' region and in north-west Victoria. Irrigated fruit was also grown around Shepparton, Griffith and south-east Queensland.
- Areas of irrigated grapes were scattered along the Murray River in the 'Riverland' region of South Australia and in north western Victoria. Irrigated grapes were also grown in the southern MDB in Victoria and the eastern MDB in New South Wales.
- Irrigated vegetables were located across northern Victoria, southern New South Wales, and parts of south-east South Australia and south-east Queensland.
- Irrigated cereals other than rice were grown in northern Victoria and southern New South Wales, and around Griffith, Toowoomba, Dubbo and Tamworth.

Location of irrigated agricultural production in the Murray-Darling Basin continued

- In 2005–06, approximately 61% of irrigated pasture was used for non-dairy livestock. Irrigated pasture used for non-dairy livestock occurred broadly across much of the MDB, with particular concentration in northern Victoria and southern New South Wales.

Economic value of Agriculture in the Murray-Darling Basin

This section presents estimates of the value of agricultural production in the MDB along with estimates of the value of irrigated agricultural production. The gross value of agricultural production in 2005–06 was published in the ABS *Value of Agricultural Commodities Produced, Australia, 2005–06* (cat. no. 7503.0).

Australia's Agriculture industry not only produces food and fibre for domestic consumption and export, but in 2005–06 represented approximately 3% of Australia's Gross Domestic Product (GDP) (ABS 2006b). In 2005–06, Agriculture in the Murray-Darling Basin produced a gross value of agricultural production (GVAP) of $14,991m, 39% of Australia's total GVAP ($38,541m, see table 4.20).

Of all agricultural commodities, livestock (excluding dairy, $4,225m) and cereals other than rice ($3,436m) produced the most economic value, followed by dairy farming ($1,172m) and fruit ($1,111m).

4.20 GROSS VALUE OF AGRICULTURAL PRODUCTION(a), by commodity—2005–06

	MDB	*Aust.*	*MDB as a proportion of Aust.*
	$m	$m	%
Dairy farming	1 172	3 603	33
Other livestock	4 225	10 987	38
Rice	274	274	100
Cereals (excl. rice)	3 436	7 320	47
Cotton	861	933	92
Grapes	777	1 377	56
Fruit (excl. grapes)	1 111	2 627	42
Vegetables	602	2 923	21
Other agricultural commodities(b)	2 533	8 494	30
Total agricultural commodities(c)	**14 991**	**38 541**	**39**

(a) In current price terms, see Explanatory Notes.
(b) Includes other broadacre crops and nurseries.
(c) Components may not add to total due to rounding.
Source: ABS data available on request, Value of Agricultural Commodities Produced, Australia, 2005–06

Economic value of Agriculture in the Murray-Darling Basin continued

In the 5 years from 2000–01 to 2005–06, the GVAP in the Murray-Darling Basin increased 7.3%, from $13,964m to $14,991m in current price terms (table 4.21). This was lower than the general increase in the cost of living over this period when compared with the All Groups Consumer Price Index which increased by 14.7% between 2000–01 and 2005–06 (ABS cat. no. 6401.0). Furthermore, the increase in Australian GVAP (12%) was more than the increase in MDB GVAP over the same period (7%). From 2000–01 to 2005–06, the GVAP of some commodities increased (e.g. dairy farming, other livestock and fruit), however others decreased (e.g. rice, cotton and grapes).

4.21 GROSS VALUE OF AGRICULTURAL PRODUCTION(a), by commodity—2000–01 and 2005–06

	MURRAY-DARLING BASIN		AUSTRALIA	
	2000–01	*2005–06*	*2000–01*	*2005–06*
	$m	$m	$m	$m
Dairy farming	1 037	1 172	3 283	3 603
Other livestock	2 817	4 225	8 364	10 987
Rice	349	274	350	274
Cereals (excl. rice)	3 565	3 436	7 327	7 320
Cotton	1 184	861	1 305	933
Grapes	874	777	1 517	1 377
Fruit (exc. grapes)	839	1 111	2 020	2 627
Vegetables	603	602	2 251	2 923
Other agricultural commodities(b)	2 695	2 533	7 723	8 494
Total agricultural commodities(c)	**13 972**	**14 991**	**34 164**	**38 541**

(a) In current price terms, see Explanatory Notes.
(b) Includes other broadacre crops and nurseries.
(c) Components may not add to total due to rounding.

Source: ABS data available on request, Value of Agricultural Commodities Produced, Australia, 2005–06

Economic value of irrigated agricultural production

Maximising economic benefit from irrigation is a key theme emerging from recent water policies. There is strong interest in estimating the value generated from irrigating crops. A central component of the federal government's National Water Initiative (NWI) concerns the flow of water to its highest value use (see Appendix). Integrating the volume of water used with a measure of the return to the Australian economy provides one indication of the economic benefit obtained from applying water to certain agricultural commodities. The change over time provides an indication of whether water is being utilised by relatively higher value users.

Allocative efficiency refers to how well water is allocated across industries in terms of the production value returned to the economy per quantity of water used. Allocative efficiency is achieved when it is not possible to increase the value added for the economy as a whole by transferring water from one activity to another (The Treasury: Roberts, Mitchell and Douglas 2006).

The following section provides an analysis of the Gross Value of Irrigated Agricultural Production (GVIAP) in the MDB generated by different agricultural commodities, including a comparison with the volume of water consumed in the same period. The irrigated value of production is compared to non-irrigated value of production, and the change in GVIAP between 2000–01 and 2005–06 is also presented.

GVIAP should not be used as a proxy for determining the highest value water use, because water is not the only input to agricultural production from irrigated land (ABS 2006a). Land, fertiliser, labour, machinery and other inputs are also used, and their contribution to agricultural production cannot be separately identified. Estimates of GVIAP are derived from agricultural commodity values in the 2000–01 and 2005–06 editions of *Value of Agricultural Commodities Produced, Australia* (ABS cat. no. 7503.0). Further details on the methods used to derive the estimates are presented in the Explanatory Notes.

In 2005–06, nearly $4.6 billion, or 44% of Australia's GVIAP originated in the MDB (table 4.22). The majority of the GVIAP for rice (100%), cotton (92%), and cereals other than rice (84%) was generated in the Basin.

Economic value of irrigated agricultural production continued

4.22 GROSS VALUE OF IRRIGATED AGRICULTURAL PRODUCTION(a), by commodity—2005–06

	MDB	*Aust.*	*MDB as a proportion of Aust.*
	$m	$m	%
Dairy farming	938	1 812	52
Other livestock	132	180	73
Rice	274	274	100
Cereals (excl. rice)	92	109	84
Cotton	797	869	92
Grapes	722	1 228	59
Fruit (excl. grapes)	898	1 820	49
Vegetables	530	2 473	21
Other agricultural commodities(b)	193	1 722	11
Total agricultural commodities(c)	**4 576**	**10 486**	**44**

(a) In current price terms, see Explanatory Notes
(b) Includes sugar and other broadacre crops and nurseries.
(c) Components may not add to total due to rounding.

In 2005–06, the highest GVIAP was generated from dairy farming ($938m or 20% of the MDB GVIAP), fruit ($898 or 20%), cotton ($797m or 17%), and grapes ($722m or 16%) (table 4.23).

4.23 GROSS VALUE OF IRRIGATED AGRICULTURAL PRODUCTION(a), by commodity—Murray-Darling Basin—2005–06

	GVIAP	*Proportion of total GVIAP*
	$m	%
Dairy farming	938	20
Other livestock	132	3
Rice	274	6
Cereals (excl. rice)	92	2
Cotton	797	17
Grapes	722	16
Fruit (excl. grapes)	898	20
Vegetables	530	12
Other agricultural commodities(b)	193	4
Total agricultural commodities(c)	**4 576**	**100**

(a) In current price terms, see Explanatory Notes
(b) Includes other broadacre crops and nurseries.
(c) Components may not add to total due to rounding.

Although the MDB generated 44% of Australia's GVIAP in 2005–06, this was achieved with 66% of Australia's agricultural water consumption (see Chapter 3). Cotton consumed a significant volume of water (20% of agricultural water consumption in the MDB) to generate 17% of the MDB GVIAP. Rice also accounted for a significant volume of agricultural water consumption in the MDB (16%), but generated only 6% of GVIAP. Vegetables generated 13% of GVIAP but consumed only 2% of MDB water consumption (see table 4.24 and graph 4.25).

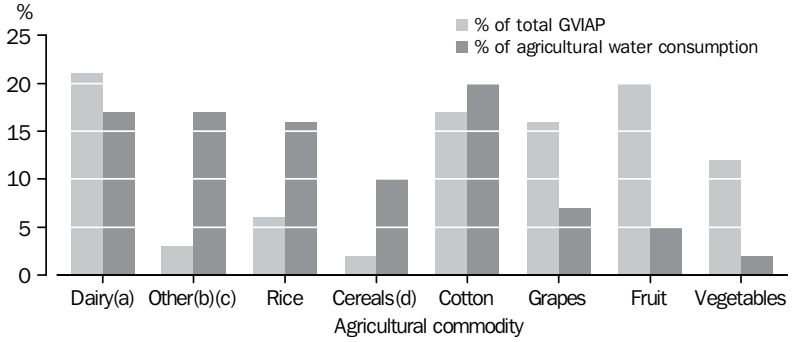
Economic value of irrigated agricultural production continued

4.24 GROSS VALUE OF IRRIGATED AGRICULTURAL PRODUCTION AND WATER CONSUMPTION, by commodity—Murray-Darling Basin—2005–06

	GVIAP(a)	*Proportion of total GVIAP*	*Water consumption*	*Proportion of total water consumption*
	$m	%	GL	%
Dairy farming	938	21	1 287	17
Other livestock	132	3	1 284	17
Rice	274	6	1 252	16
Cereals (excl. rice)	92	2	782	10
Cotton	797	17	1 574	20
Grapes	722	16	515	7
Fruit (excl. grapes)	898	20	413	5
Vegetables	530	12	152	2
Other agricultural commodities(b)	193	4	460	6
Total agricultural commodities(c)	**4 576**	**100**	**7 720**	**100**

(a) In current price terms, see Explanatory Notes.
(b) Includes other broadacre crops and nurseries.
(c) Components may not add to total due to rounding.

4.25 GROSS VALUE OF IRRIGATED AGRICULTURAL PRODUCTION AND WATER CONSUMPTION, Murray-Darling Basin—2005–06



(a) Dairy farming
(b) GVIAP represents other livestock.
(c) Water consumption represents irrigated pasture for livestock (excl. dairy).
(d) Excludes rice.

In 2005–06, the value generated from irrigated agricultural production contributed a greater proportion of the value of total agricultural production in the MDB (31%) than for the whole of Australia (27%). In the MDB, GVIAP represented 33% of the total GVAP in 2000–01, however this decreased to 30% in 2005–06. GVIAP made up 26% of Australia's total GVAP in 2000–01 and 27% in 2005–06.

In the 5 years from 2000–01 to 2005–06, the GVIAP in the MDB did not change significantly, remaining at approximately $4.6 billion in current price terms. In comparison, the GVIAP for Australia increased by 18% in this period (table 4.26).

Economic value of irrigated agricultural production continued

4.26 GROSS VALUE OF IRRIGATED AGRICULTURAL PRODUCTION AND GROSS VALUE OF AGRICULTURAL PRODUCTION(a)—2000–01 and 2005–06

	Total GVIAP	*Total GVAP*	*GVIAP as a proportion of GVAP*
	$m	$m	%
2000–01			
Murray-Darling Basin	4 585	13 972	33
Australia	8 895	34 164	26
2005–06			
Murray-Darling Basin	4 576	14 991	31
Australia	10 486	38 541	27

(a) In current price terms, see Explanatory Notes.

Changes in GVIAP between 2000–01 and 2005–06 varied for different agricultural commodities (table 4.27). Caution should be made when assessing whether the movement from 2000–01 to 2005–06 constitutes a long-term trend, because the GVIAP of annual crops like rice and cotton may fluctuate significantly from year to year depending on water availability.

4.27 GROSS VALUE OF IRRIGATED AGRICULTURAL PRODUCTION(a), by commodity—2000–01 and 2005–06

	MURRAY-DARLING BASIN		AUSTRALIA	
	2000–01	*2005–06*	*2000–01*	*2005–06*
	$m	$m	$m	$m
Dairy farming	926	938	1 811	1 812
Other livestock	62	132	83	180
Rice	349	274	350	274
Cereals (excl. rice)	106	92	118	109
Cotton	1 105	797	1 215	869
Grapes	809	722	1 352	1 228
Fruit (excl. grapes)	630	898	1 313	1 820
Vegetables	486	530	1 803	2 473
Other agricultural commodities(b)	112	193	850	1 722
Total agricultural commodities(c)	**4 585**	**4 576**	**8 895**	**10 486**

(a) In current price terms, see Explanatory Notes.
(b) Includes other sugar, broadacre crops and nurseries.
(c) Components may not add to total due to rounding.

CHAPTER 5 NATURAL RESOURCE MANAGEMENT IN THE MURRAY-DARLING BASIN

INTRODUCTION

This chapter describes Natural Resource Management (NRM) practices within the Murray-Darling Basin (MDB).

A range of NRM issues are relevant when considering land use activities in the MDB. In particular, agriculture uses natural resources, such as land and water, as well as other inputs (e.g. fertiliser, labour, physical and financial assets) to generate production. Agricultural land use can affect water quantity and quality, dryland salinity, native vegetation, weed invasion, biodiversity and soil erosion. Preventative and remedial management of these issues can lead to significant costs for farmers through the possible reduction in the area of usable agricultural land and adverse affects on the physical environment.

NRM POLICY AND IMPLEMENTATION STRATEGIES

In the past decade, there have been a range of policy initiatives aimed at improving NRM practices. The 'Natural Heritage Trust (NHT) of Australia' was established under the *Natural Heritage Trust of Australia Act 1997* to "repair and replenish Australia's natural capital infrastructure" (NHT 2007:8). Funds were allocated to projects and programs aimed at providing solutions to nationally significant environmental problems.

The Australian Government's 'Caring for our Country' program commenced on 1 July 2008, and integrates a number of existing Commonwealth programs including: the Natural Heritage Trust, the National Landcare Program, the Environmental Stewardship Program, and elements of the Working on Country program (Australian Government 2008a).

To facilitate the delivery of NRM throughout Australia, the Australian Government, in association with state and territory governments, established 56 NRM regions. In most cases, the NRM region boundaries are based on catchments or bio-regions. Integrated NRM plans have been developed for each region to assist in evaluation of the environmental, social and economic impacts of NRM decisions. The plans aim to improve the sustainable management of natural resources (Australian Government 2008b).

In order to assess the impact of individual NRM issues, natural resource managers (e.g. regional, state and national management authorities) require information to determine:

- the extent of issues;
- what practices are being (or will be) undertaken to address them;
- the time and cost required to manage them; and
- the barriers to implementing management practices.

NRM issues that affect Australia's environment and agricultural land include:

- native vegetation - the degradation in quantity and quality;

NRM POLICY AND IMPLEMENTATION STRATEGIES *continued*

- soil quality - erosion, salinity, sodicity, compaction and acidification of soils;
- water issues - quantity and quality of surface and ground water; and
- weeds and pests - the impact on biodiversity and agricultural production as a result of weeds or pests.

NRM REGIONS IN THE MURRAY-DARLING BASIN

There are fifteen NRM regions fully-contained within the MDB, while six others overlap MDB boundaries (map 5.1). Of the six regions that are partially in the Basin, four have more than 70% of their area within the MDB:

- South Australia (SA) Murray Darling Basin (98%);
- Western in New South Wales (72%);
- Wimmera in Victoria (72%); and
- South West in Queensland (71%).

The two remaining NRM regions have only a very small proportion of their total area in the MDB:

- SA South East (6%); and
- SA Arid Lands (2%).

When presenting statistics by NRM region, the fifteen regions entirely in the MDB and the four regions with the vast majority of their area within the MDB are included, however the two regions with small areas in the MDB are excluded. Therefore, in this chapter, nineteen NRM regions are aggregated to form the MDB. Map 5.1 shows the location of the NRM regions in the MDB.

5.1 NATURAL RESOURCE MANAGEMENT REGIONS FORMING THE MURRAY-DARLING BASIN

Source: Department of Environment, Water, Heritage and the Arts 2008

ISSUES IDENTIFIED IN NRM REGIONAL PLANS

Information about the delivery of major NRM initiatives and region-specific programs and plans is available on the Australian Government NRM website: http://www.nrm.gov.au/index.html. This source identifies the NRM issues which are considered to be a priority as a result of consultation between stakeholders and the regional bodies administering each region. Examples of key stakeholders include: governments (local, state/territory, commonwealth), academic and scientific communities, industry, environmental and Indigenous groups, and regional communities.

For the 19 NRM regions in the MDB, the following are identified as issues of priority:

- water quality and/or quantity (identified by 16 of the 19 NRM regions);
- salinity (irrigation and dryland) (identified by 14 of the 19 NRM regions);
- biodiversity (identified by 14 of the 19 NRM regions);
- soil health and/or soil erosion (identified by 10 of the 19 NRM regions);
- native vegetation (identified by 9 of the 19 NRM regions); and
- weeds and/or pests (identified by 8 of the 19 NRM regions).

A smaller number of regions reported that cultural heritage (5), and community capacity (4) were issues of priority.

NRM PROBLEMS AND PRACTICES DESCRIBED BY FARMERS

As 84% of land in the MDB is used for agriculture (based on the 2005–06 ABS Agricultural Census), most NRM activities are undertaken to improve economic and environmental conditions on agricultural land. For 2004–05, the ABS conducted an NRM Survey which sought information from Australian farmers about the NRM issues affecting their agricultural land holding, activities undertaken to address issues, and the financial cost and time spent to undertake preventative or remedial activities.

The main NRM issues and related problems identified in the 2004–05 NRM Survey have been divided into five broad groups: native vegetation, weeds, pests, land and soil, and water (table 5.2).

5.2 MAIN NATURAL RESOURCE MANAGEMENT ISSUES AFFECTING AUSTRALIAN FARMS—2004–05

NATIVE VEGETATION	*WEEDS*	*PESTS*	*LAND AND SOIL*	*WATER*
Vegetation thickening	Decreased production	Decreased animal or crop production	Erosion	Surface and groundwater availability
Excessive native vegetation	Decreased farm value	Damaged native vegetation	Soil acidification	Water quality
Declined quality	Increased fire risk	Decreased biodiversity	Compaction	

Source: Natural Resource Management on Australian Farms, 2004–05 (cat. no. 4620.0)

NRM issues on farms

In the MDB in 2004–05, the vast majority of farms (92% of farms) conducted some NRM activities for preventative or remedial reasons, consistent with the proportion of all Australian farms (table 5.3). This level was greater than the proportion of farms reporting NRM issues (87% in the MDB and 86% in Australia), due to farmers managing issues before they become problematic (i.e. for preventative reasons). For each NRM issue, the proportions of farms reporting NRM issues and conducting activities, as well as average expenditure and average effort, are generally similar in MDB farms compared to all Australian farms.

5.3 NRM ISSUES IDENTIFIED ON FARMS AND MANAGEMENT BY FARMERS, Murray-Darling Basin and Australia—2004–05

	Farms reporting an issue (% of total farms)(a)		Farms undertaking management activities (% of total farms)(a)(b)		NRM expenditure (average $/farm undertaking management)		NRM effort (person days/farm)	
	MDB	*Aust.*	*MDB*	*Aust.*	*MDB*	*Aust.*	*MDB*	*Aust.*
Native vegetation(c)	(d)46	(d)45	(d)61	(d)62	5 400	5 000	31	32
Weeds	76	73	83	80	12 200	11 200	41	39
Pests	71	69	78	76	8 100	7 300	43	39
Land and soil	48	46	61	58	13 200	12 000	54	51
Water(c)	42	38	35	33	9 100	7 400	27	24
Any issue	87	86	92	92	32 200	28 200	132	121

(a) Number of farms was approximately 53,900 for the MDB; 129,900 for Australia.
(b) Activities undertaken for remedial or preventative purposes.
(c) Data for the Lower Murray Darling region excluded due to confidentiality issues.
(d) This is the proportion of farms with native vegetation on their land, not the proportion of total farms. Number of farms with native vegetation was approximately 33,000 for the MDB; 81,800 for Australia.

Source: Natural Resource Management on Australian Farms, 2004–05 (Reissue), ABS cat. no. 4620.0; ABS data available on request, Natural Resource Management Survey, 2004–05

NRM activity, expenditure and effort on farms in the MDB

In 2004–05, more farms in the MDB undertook management activities for weeds (83% of farms) and pests (78%) than for other NRM issues (table 5.3). Water issues were managed least (35%). A similar management pattern is exhibited nationally and this might suggest that the control of pests and weeds is a more common farming activity and related directly to agricultural output, than problems associated with water.

Interestingly, for some issues, more NRM activity translates into more NRM expenditure, but this is not always the case (table 5.4). In 2004–05, the proportion of MDB farms managing weeds was higher than for any other NRM activity. MDB farms spent more on managing weeds ($545m), and this activity had a relatively high average expenditure per farm ($12,200), when compared with other NRM issues. By contrast, although a large number of MDB farms managed pests (42,200), they recorded a relatively low average expenditure per farm ($8,100). Average expenditure on land and soil problems was higher than any for other NRM issue ($13,200 per farm), however fewer farms needed to undertake land and soil activities, compared with activities addressing weeds and pests.

Of the estimated total 6.6 million person days spent managing NRM issues, most effort was spent managing weeds, pests, and land and soil (approximately 1.8 million person days spent on each of these three issues). Similar to the trend for average NRM expenditure, most effort (54 person days per farm undertaking NRM activities) was spent on land and soil activities. MDB farms reported the lowest effort expended on managing

NRM activity, expenditure and effort on farms in the MDB continued

water issues (27 person days per farm on average) of all the NRM issues, equivalent to half of the effort put towards land and soil activities.

5.4 NRM ISSUES IDENTIFIED ON FARMS AND MANAGEMENT BY FARMERS—Murray-Darling Basin—2004–05

	FARMS REPORTING AN ISSUE		FARMS UNDERTAKING MANAGEMENT ACTIVITIES(a)		NRM EXPENDITURE		NRM EFFORT	
	no.	*Proportion of total farms (%)*(b)	*no.*	*Proportion of total farms (%)*(b)	*Total ($m)*	*Average $/farm undertaking management*(c)	*Total person days ('000)*	*Person days/farm undertaking management*(d)
Native vegetation(e)	15 200	(f)46	20 000	(f)61	108	5 400	627	31
Weeds	41 000	76	44 600	83	545	12 200	1 842	41
Pests	38 400	71	42 200	78	340	8 100	1 824	43
Land and soil	26 000	48	32 900	61	433	13 200	1 762	54
Water(e)	22 700	42	18 600	35	170	9 100	497	27
Any issue	47 100	87	49 800	92	1 603	32 200	6 579	132

(a) Activities undertaken for remedial or preventative purposes.
(b) Number of farms was approximately 53,900 for the MDB.
(c) Average NRM expenditure per farm undertaking NRM activities.
(d) Average NRM effort (in terms of person days) per farm undertaking NRM activities.
(e) Data for the Lower Murray Darling region excluded due to confidentiality issues.
(f) This is the proportion of farms with native vegetation on their land, not the total farms. Total farms with native vegetation was approximately 33,000 for the MDB.

Source: Natural Resource Management on Australian Farms, 2004–05 (Reissue), ABS cat no. 4620.0; ABS data available on request, Natural Resource Management Survey, 2004–05

NRM issues reported by irrigated and non-irrigated farms

In 2004–05, almost 90% of MDB farms reported being affected by an NRM issue (table 5.5). Overall, irrigated and non-irrigated farms reported similar proportions of NRM issues. Non-irrigated farms were more likely than irrigated farms to report being affected by land and soil issues: 50% of non-irrigated farms, compared with 43% of irrigated farms.

Despite many farms in the MDB being affected by drought conditions in 2004–05, water issues were less commonly reported than other NRM issues (6,700) by irrigated farms in the MDB. The frequency of reporting water issues was not very different between non-irrigated and irrigated farms (43% and 40% respectively).

It is difficult to determine why irrigated farms report similar levels of water issues as non-irrigated farms. One possible reason is that farms that would normally have irrigated in 2004–05 could not irrigate, and reported themselves as a non-irrigated farm.

NRM issues reported by irrigated and non-irrigated farms continued

5.5 NRM ISSUES IDENTIFIED ON IRRIGATED AND NON-IRRIGATED FARMS—Murray-Darling Basin—2004–05

	IRRIGATED FARMS		NON-IRRIGATED FARMS	
	No. reporting an issue	*Proportion of total irrigated farms (%)* (a)	*No. reporting an issue*	*Proportion of total non-irrigated farms (%)* (b)
Native vegetation (c)	3 400	(d) 43	11 800	(d) 47
Weeds	13 100	79	27 900	75
Pests	11 100	67	27 300	73
Land and soil	7 200	43	18 800	50
Water (c)	6 700	40	16 000	43
Any issue	14 600	88	32 500	87

(a) Number of irrigated farms was approximately 16,600 for the MDB.
(b) Number of non-irrigated farms was approximately 37,300 for the MDB.
(c) Data for the Lower Murray Darling region excluded due to confidentiality issues.
(d) This is the proportion of farms reporting that they have native vegetation on their land, not the proportion of total farms.

Source: ABS data available on request, Natural Resource Management Survey, 2004–05

Water issues affecting farms

The effect of discharged water on river and wetland health is one environment issue relevant to the MDB. Saline water discharge and elevated levels of nutrients discharged from irrigation drainage into rivers or groundwater can produce algal blooms and reduced water quality. This affects not only biodiversity, but also human settlements because of a reduced ability to use the water for drinking, recreation or downstream irrigation. Water availability is another issue of importance for sustaining livestock and growing pasture and crops. Specific water issues affecting farms are described in the following section.

In 2004–05, the two most significant water-related NRM issues in the MDB identified by farms reporting water issues were the availability of surface water (69%) and groundwater (33%) (table 5.6). Other issues, like toxicity events and excess nutrient loads, were reported by less than 8% of farms identifying water issues.

Water issues affecting farms continued

5.6 WATER ISSUES ON FARMS—Murray-Darling Basin—2004–05

	FARMS REPORTING A WATER ISSUE		
	No. of farms	*Proportion of farms reporting water issues (%)* (a)	*Proportion of total farms (%)* (b)
Surface water availability	15 700	69	29
Groundwater availability	7 400	33	14
Water clarity	2 200	10	4
Excess nutrient load	1 500	7	3
Toxicity event	200	1	—
Other surface water quality problems	2 000	9	4
Other groundwater quality problems	2 100	9	4
Other issues	4 600	20	9

— nil or rounded to zero (including null cells)
(a) Number of farms reporting water issues was approximately 22,700.
(b) Number of farms was approximately 53,900.
Source: ABS data available on request, Natural Resource Management Survey, 2004–05

Farmers conducted a variety of activities to address the water issues occurring on their farms. The most common activities employed were:

- earthworks, drains and water pumping (42% of MDB farms undertaking water activities);
- planting trees and shrubs (28%); and,
- removing stock from waterways (23%).

Relatively fewer farms carried out water testing (11%) (table 5.7).

5.7 ACTIVITIES CONDUCTED TO ADDRESS WATER ISSUES ON FARMS—Murray-Darling Basin—2004–05

	FARMS REPORTING AN ACTIVITY		
	No. of farms	*Proportion of farms undertaking water activities (%)* (a)	*Proportion of total farms (%)* (b)
Earthworks, drains and water pumping	7 900	42	15
Tree and shrub planting maintenance	5 300	28	10
Removal of stock from waterways	4 300	23	8
Monitoring of groundwater table	3 300	18	6
Fencing to protect riparian zones	3 200	17	6
Water testing	2 100	11	4
Other activities	1 800	9	3

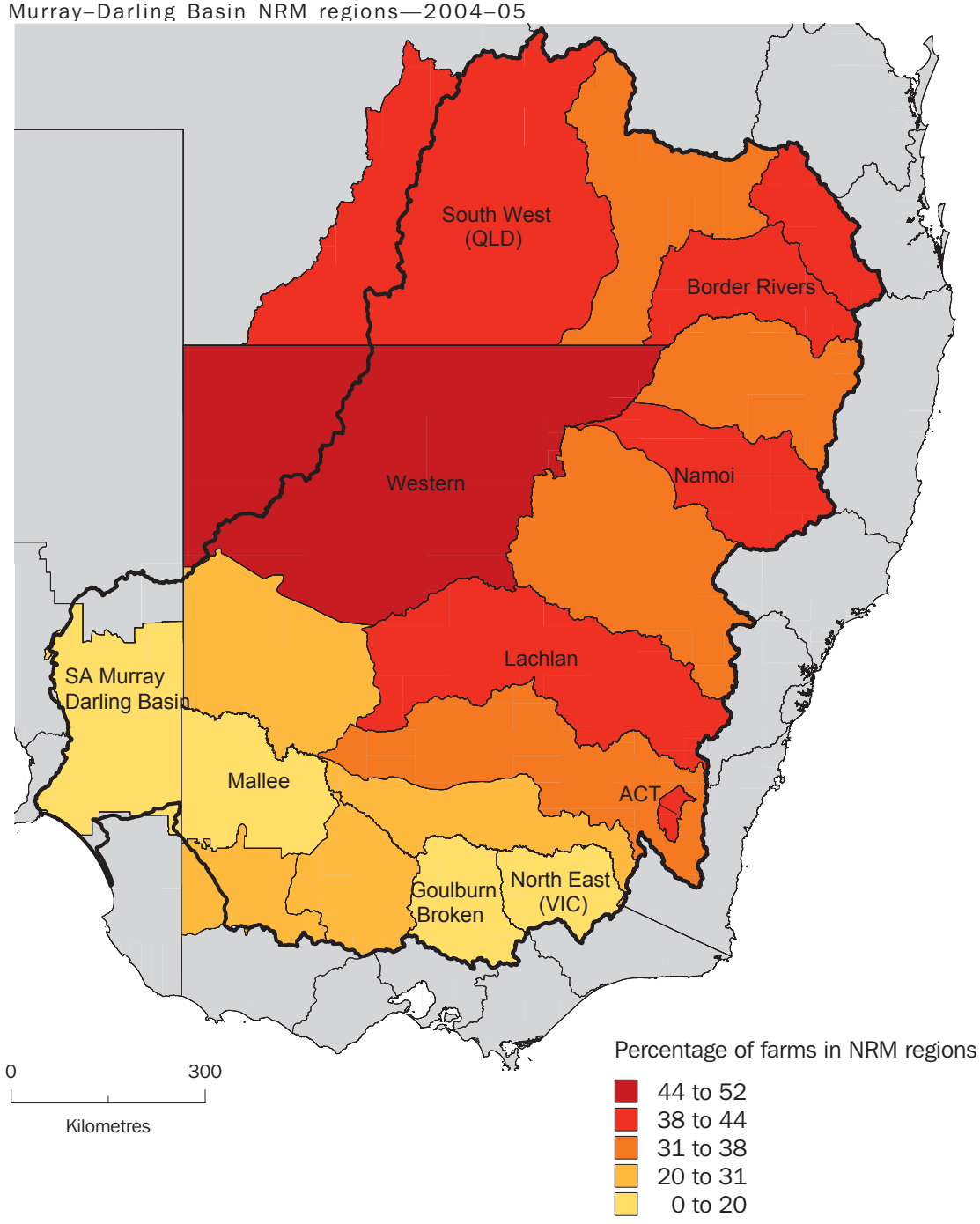
(a) Number of farms reporting water activities was approximately 18,600.
(b) Number of farms in MDB was approximately 53,900.
Source: ABS data available on request, Natural Resource Management Survey, 2004–05

Location of water issues affecting farms

The proportion of farms reporting water issues in the MDB differed depending on where in the Basin they were located. Surface water availability was more problematic for farmers located in the northern part of the MDB with more than 38% of farms reporting this as an issue in the following NRM regions: Western, Namoi, Border Rivers, Condamine and South West NRM regions, as well as in the Australian Capital Territory and Lachlan (map 5.8). By contrast, in the southern MDB, less than 20% of farms reported surface water availability as a problem, more specifically in the Mallee, SA Murray Darling Basin, North East and Goulburn-Broken NRM regions.

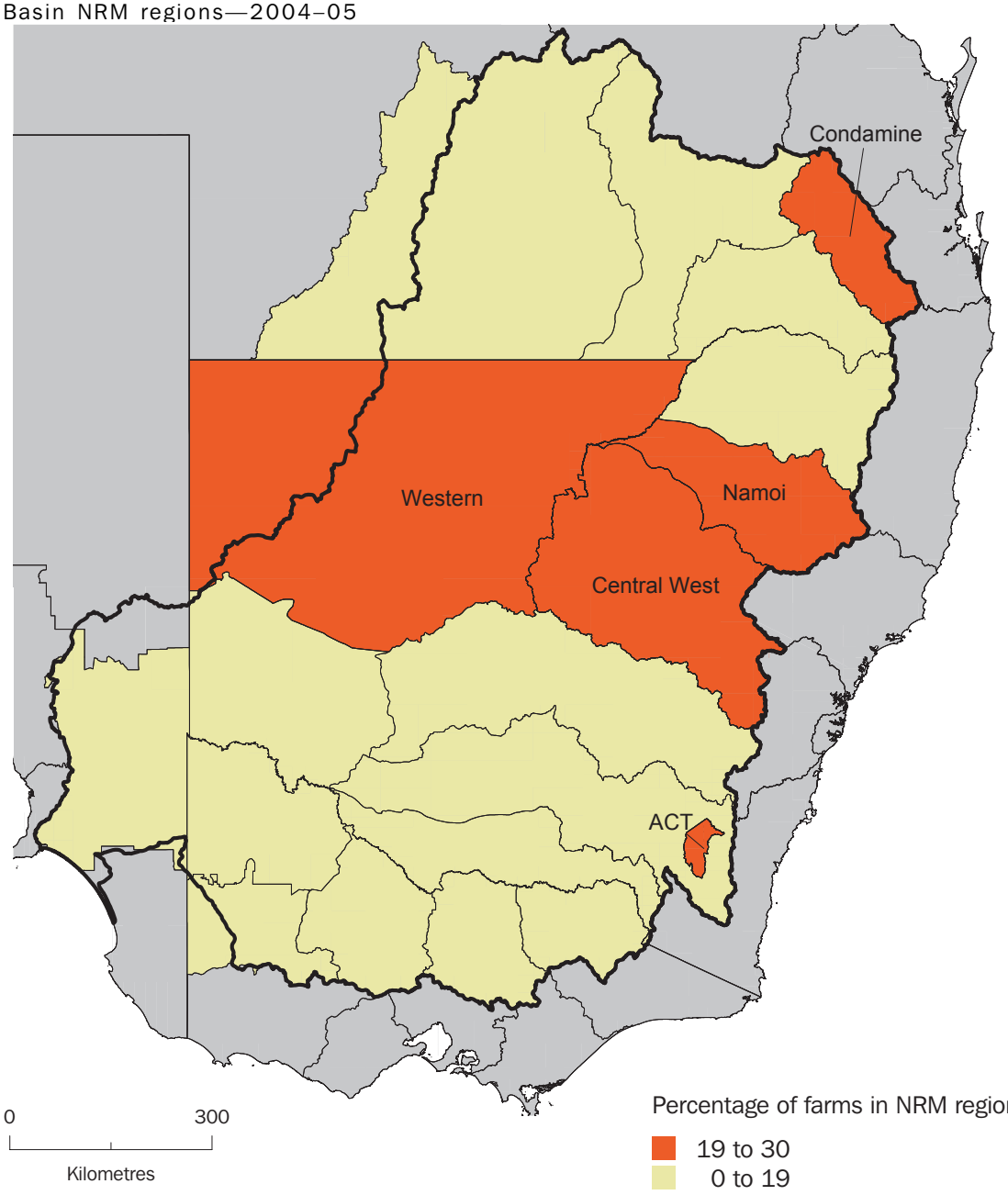
Groundwater availability was generally more problematic for farms in the northern New South Wales NRM regions. Those regions where more than 19% of farms had an issue with groundwater availability were: the Western, Namoi, Condamine, Australian Capital Territory and Central West. Less farms reported groundwater availability as an issue in the other NRM regions (map 5.9).

5.8 FARMS REPORTING PROBLEMATIC SURFACE WATER AVAILABILITY, Murray–Darling Basin NRM regions—2004–05



Source: ABS data available on request, Natural Resource Management Survey 2004–05, Geoscience Australia 2004

5.9 FARMS REPORTING PROBLEMATIC GROUNDWATER AVAILABILITY, Murray–Darling Basin NRM regions—2004–05



Source: ABS data available on request, Natural Resource Management Survey 2004–05, Geoscience Australia 2004

EXPLANATORY NOTES

INTRODUCTION

1 This publication presents a range of statistics about the Murray-Darling Basin (MDB) from 2000–01 to 2005–06, and draws on a variety of ABS and non-ABS sources. Care should be taken when comparing data from different sources and from the same sources over time because of differences in the types of collection activity undertaken and varying levels of reliability across these different sources.

CHAPTER 1

Land use and water balance data

2 The land use and water balance data for the MDB were sourced from the Bureau of Rural Sciences (BRS). The digital boundaries of Australia's river basins and drainage divisions fall under the custodianship of Geoscience Australia (Geoscience Australia 2004).

METHOD OF CALCULATION

3 The water balance data were generated for the Australian Water Availability Project, a project involving the BRS, Bureau of Meteorology (BoM) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). These agencies are working together to develop an on-line, operational system for monitoring soil moisture, run-off and other components of water balance, based on the method developed by Welsh et al. (2006). A steady-state catchment water balance model was used to generate the run-off data presented in this publication.

4 The BRS published water balance data on the 'Rural Water' website (see http://adl.brs.gov.au/water2010/index.phtml). The modelling methods used to estimate run-off, evapotranspiration and deep drainage are described in Welsh et al. (2006) and Welsh et al. (2007), and are based on the work of Zhang et al. (2004), Zhang et al. (2005), and Fu (1981).

DATA QUALITY AND RELIABILITY

5 The data on water balances are the result of complex models based on data collected by a range of agencies. Because of the complexity of the models and possible errors associated with the data used, these estimates should be used with a degree of caution. For more information please contact the BRS.

6 Differences in agricultural area data exist between the data sourced from the BRS and the data from ABS Agricultural Surveys and Censuses due to differences in concepts, methods and sources. The BRS data is modelled using satellite and other techniques and relates to land "observed to be crops or pasture". The agricultural land reported in the ABS Agricultural Census for 2005–06 is the total of land held as agricultural holdings, and can include land not used for crops or pasture (including forest plantations, wetlands, and land surrounding houses and buildings).

7 The *1985 Review of Australia's Water Resources and Water Use* (AWRC 1987), by the Australian Water Resources Council, identified 26 river basins which comprise the Murray-Darling Basin Drainage Division. There are variations in the number of river basins identified by other organisations. For example the CSIRO identified 18 catchments for the Murray-Darling Basin Sustainable Yields project and the MDBC identified 23 'valleys' for their Sustainable Rivers Audit.

Climate data

DATA SOURCES

8 Climate (rainfall and temperature) maps were sourced from the BoM National Climate Centre. Analyses are based on observational data which have undergone standard quality control procedures. For more information please contact BoM at: webclim@bom.gov.au.

Environmental Assets

DATA SOURCES

9 Data about environmental assets and biodiversity in the MDB were obtained from the Department of the Environment, Water, Heritage and the Arts (DEWHA). For an explanation of how this information was gathered, and data reliability issues, please contact DEWHA.

CHAPTER 2

Population Census data

DATA SOURCES

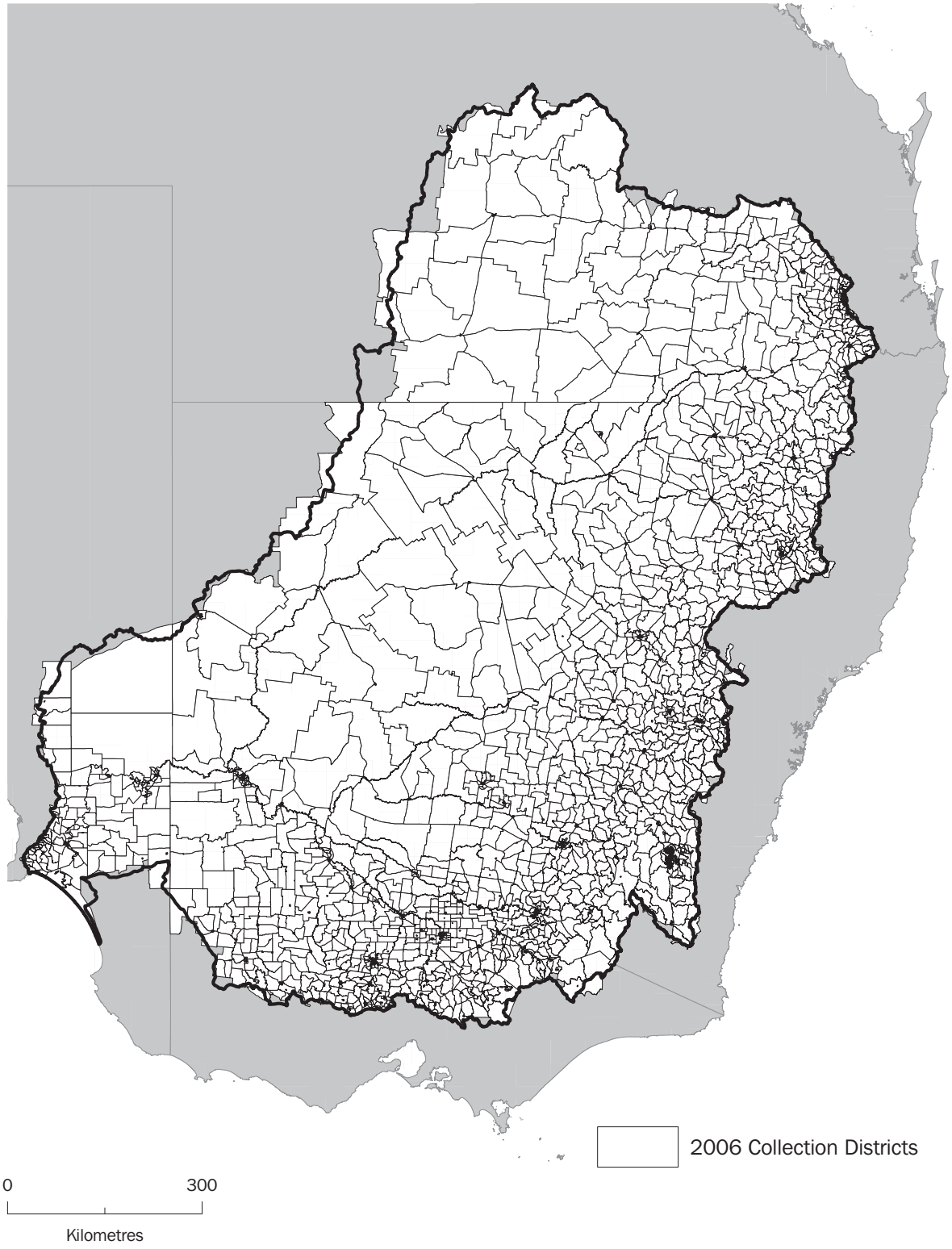
10 The 1996, 2001 and 2006 Censuses of Population and Housing were used to produce MDB estimates of population, employment, age, gender, family and education. Except for the family variable, all data were based on the place people usually live (place of usual residence) rather than the place where people were counted on Census night (place of enumeration). Although overseas visitors in Australia on Census night were included in the Census count, this chapter excludes them in all tabulations.

METHOD OF CALCULATION

11 The Collection District (CD) is the smallest geographic area for the release of Census data. Population data at the CD level were calculated for the MDB and Basin states using a CD-to-MDB concordance. The concordance was area-based; if more than 50% of a CD's area existed within the Basin, it was considered to be in. If not, it was excluded. There were 4,600 CDs determined to be in the MDB for 2006 (map E.1).

12 The relationship between 2006 CD and MDB boundaries are shown in the map below. The map demonstrates that there is a generally a good alignment of CDs to the MDB boundary except in the north western and western areas of the Basin.

E.1 CENSUS COLLECTION DISTRICTS WITH MORE THAN 50% OF THEIR AREA IN THE MURRAY-DARLING BASIN—2006



Source: Statistical Geography Volume 1 - Australian Standard Geographical Classification, July 2006, ABS cat. no. 1216.0, Geoscience Australia 2004

GEOGRAPHICAL AREAS

13 The geographical areas used in this publication are predominantly from the main structure of the Australian Standard Geographical Classification (Australia, and states and territories) but areas from the remoteness structure are also frequently used. For further information see *Australian Standard Geographical Classification (ASGC), 2007* (ABS cat. no. 1216.0).

DATA QUALITY AND RELIABILITY

14 Population Census data are used in Chapter 2 because it allows for a better approximation of the total MDB area than is possible with Labour Force Survey or Estimated Residential Population data. It also allows for more detailed analysis of variations between smaller population groups and small geographic areas. For further information see *Information Paper: Population concepts, 2008* (ABS cat. no. 3107.0.55.006) and *Australian Labour Market Statistics* (ABS cat. no. 6105.0).

15 Census data are affected by undercounting (see *Census of Population and Housing - Details of Undercount, Australia, August 2006* (ABS cat. no. 2940.0). In 2006, the net undercount rate (i.e. people missed in the Census, minus those counted more than once) for the whole of Australia was estimated at around 2.7%. This may have an impact on data presented for very remote areas. In addition, around 6% of people did not report their Indigenous status on the Census form.

NON-SCHOOL QUALIFICATION

16 Non-school qualifications refer to educational attainments other than pre-primary, primary or secondary education, and include Certificates (I–IV), Advanced diplomas and Diplomas, Bachelor degrees, Graduate certificates, and Post graduate degrees as shown in table 2.12 of Chapter 2. For further information see *Australian Standard Classification of Education (ASCED), 2001* (ABS cat. no. 1272.0).

INCOME

17 The mean equivalised gross weekly household income was used in measuring income as this variable best allows the comparison of the relative economic wellbeing of people in households of different sizes and compositions. For more information on equivalised income, see *Household Income and Income Distribution, Australia, 2005–06* (ABS cat. no. 6523.0).

Socio-Economic Indexes

DATA SOURCES

18 The Index of Relative Socio-Economic Disadvantage was used for analysis in this publication. Data were sourced from the Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia - data only 2006. For further information refer to http://www.abs.gov.au/websitedbs/D3310114.nsf/home/Seifa_entry_page.

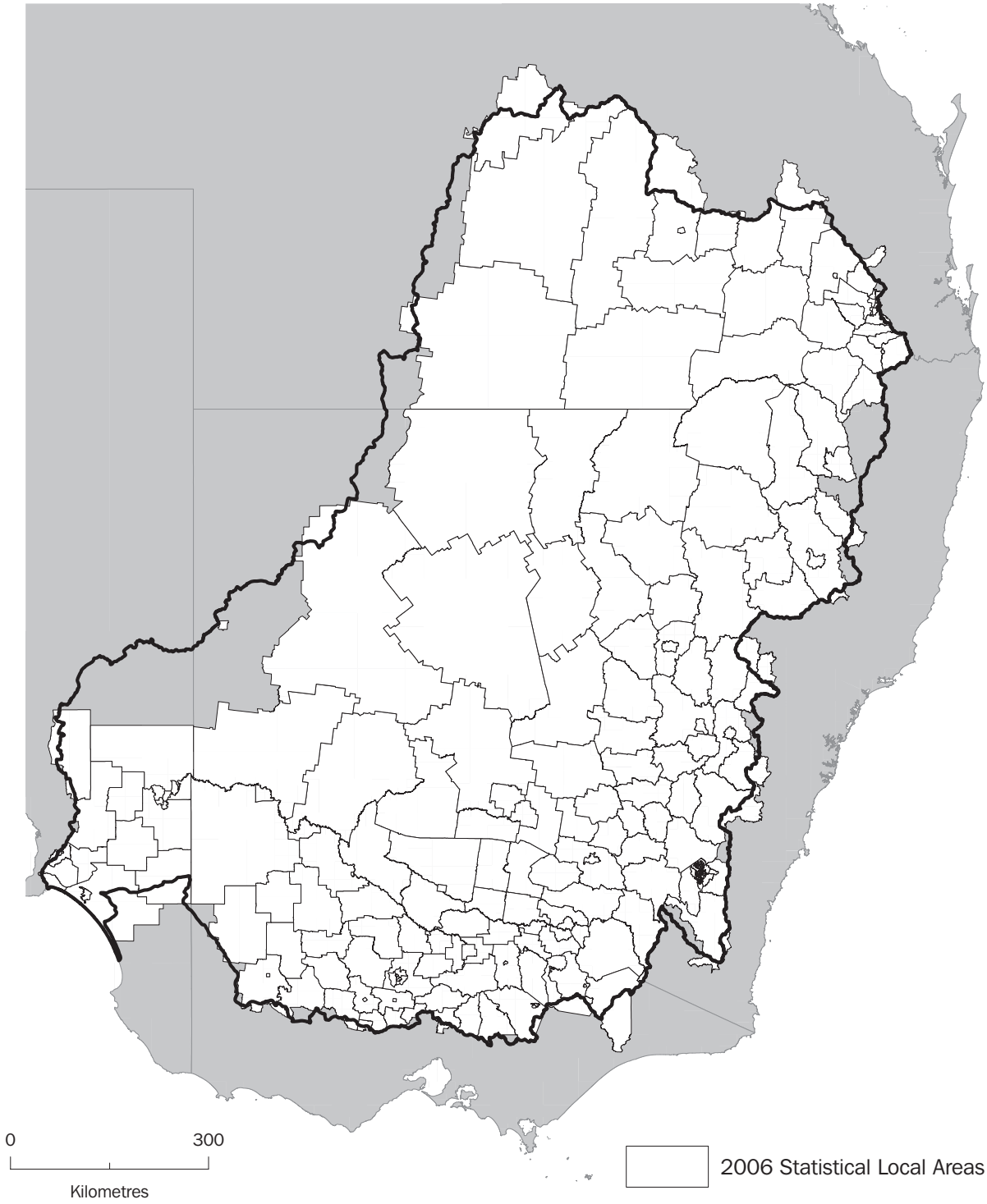
METHOD OF CALCULATION

19 SEIFA data for MDB Statistical Local Areas (SLAs) were selected based on an SLA-to-MDB concordance. The concordance was area-based; if more than 50% of an SLAs area existed within the Basin, it was considered to be inside the Basin. If not, it was excluded. There were 406 SLAs determined to be in the MDB in 2006 (map E.2).

20 For more information about the compilation of SEIFA indexes please refer to *Socio-Economic Indexes for Areas (SEIFA) - Technical Paper 2006* (ABS cat. no. 2039.0.55.001).

21 The relationship between 2006 SLA and MDB boundaries is shown in map E.2 below. The map demonstrates that there is a relatively good fit alongside the MDB boundary except in the north western and western areas of the Basin.

E.2 STATISTICAL LOCAL AREAS WITH MORE THAN 50% OF THEIR AREA IN THE MURRAY–DARLING BASIN—2006



Source: Statistical Geography Volume 1 - Australia Standard Geographical Classification, July 2006, ABS cat. no. 1216.0, Geoscience Australia 2004

CHAPTER 3

Water use by industries and households

DATA SOURCES

22 Water use by industries and households in the MDB was calculated using data published in *Experimental Estimates of Regional Water Use, Australia 2004–05* (ABS cat. no. 4610.0.55.002).

Agricultural water consumption

DATA SOURCES

23 The water use data for Agriculture were obtained from ABS Agricultural Surveys and Censuses from 2000–01 to 2005–06. These data are consistent with that presented in *Water use on Australian Farms* (ABS cat. no. 4618.0) *2002–03, 2003–04, 2004–05* and *2005–06*.

24 In 2005–06, regional Agriculture water consumption was calculated more accurately than for previous years. This was a consequence of improved collection methodologies, the complete enumeration of Australian farms in 2005–06, and the geographic coding of the location of each farm's main agricultural activity. Users should be aware that not all of the agricultural activity of the farm always occurs at one location.

METHOD OF CALCULATION

25 For 2000–01 and 2001–02, the irrigated area of individual crops and pasture was collected in the ABS Agricultural Census/Survey. This information was combined with regional crop specific application rates for 2002–03 derived from the ABS Water Survey, Agriculture 2002–03 to produce estimates of water consumption for 2000–01 and 2001–02. This was the same methodology (applying application rates to irrigated areas) as that employed for the *Water Account, Australia 2000–01* (ABS cat. no. 4610.0). From 2002–03 to 2005–06 water use data (both area irrigated and volume applied) were directly collected. Estimates for 2002–03 used data collected in the Water Survey, Agriculture, while estimates for 2003–04 and 2004–05 used data collected in the Agricultural Survey. Data for 2005–06 were collected in the 2005–06 Agricultural Census.

26 For each year from 2000–01 to 2005–06, either water use data or irrigated area data were modelled to create estimates of agricultural water use for the MDB, at the Statistical Division (SD) level. For those SDs partially within the MDB, the share of SD-based estimates attributed to the MDB were based on irrigated agricultural land use information sourced from the BRS Australian Management Land Use Programme. The model was validated by comparing modelled estimates produced for 2005–06 with geo-coded 2005–06 Agricultural Census water use data estimates for the MDB. Estimates produced using the two methodologies differed by less than 1% at the MDB level for irrigated crops and pasture.

DATA QUALITY AND RELIABILITY

27 The ABS published data relating to water consumption by the Agriculture industry in both *Water Use on Australian Farms, 2004–05* (ABS cat. no. 4618.0) in July 2006, and *Water Account, Australia 2004–05* (ABS cat. no. 4610.0) in November 2006. While both contained estimates of agricultural water use, small differences existed between the two due to different data sources and compilation methodologies. For this reason, the data compared across the economy and for households in this publication use proportions according to the Water Account methodology. Agricultural comparisons, i.e. irrigated area and volume data, use data that are consistent with *Water use on Australian Farms, 2004–05* (ABS cat. no. 4618.0). Comparisons should therefore be made with caution.

28 Due to differences in collection methodologies between the Agricultural Surveys and Censuses used to collect the 2000–01 to 2005–06 water use and area irrigated data, care should be taken when comparing water use over time.

29 The agricultural water use and irrigated area data were derived from the ABS 2005–06 Agricultural Census and can be used with a high degree of confidence. Of the

Agricultural water consumption continued

approximately 190,000 farms in scope of the Census, the response rate was 93.2%. For more details refer to *Water use on Australian Farms 2005–06* (ABS cat. no. 4618.0).

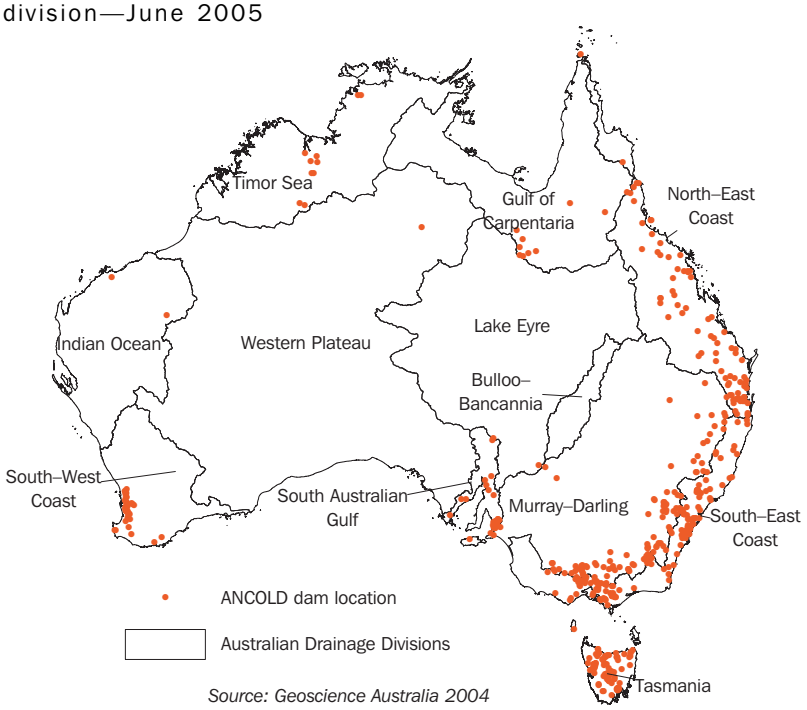
Dam storage

DATA SOURCES

30 Information on the storage capacity of large dams was sourced from the *ANCOLD Register of Large Dams* (ANCOLD 2008). Data from the register were confronted against dam owners' administrative data and adjusted accordingly. The data has been published previously in *Water Account, Australia 2004–05* (ABS cat. no. 4610.0) and *Australian Water Resources 2005* (NWC 2007).

31 The location of large dams in the Murray-Darling Basin, and other drainage divisions throughout Australia, are shown in map E.3 below.

E.3 LOCATION OF AUSTRALIA'S LARGE DAMS, by drainage division—June 2005



Source: Geoscience Australia 2004

32 Large dams are defined as dams with a crest or wall height of greater than 15 metres, or as dams with a dam wall height of greater than 10 metres while also meeting another size criteria e.g. having a crest more than 500 metres in length; creating a reservoir of no less than 1,000 ML; being able to deal with a flood discharge of no less than 2,000 cubic metres per second; or being of unusual design (ANCOLD 2008).

METHOD OF CALCULATION

33 Information on the volume of water in storage in large dams was sourced from publicly available information e.g. from state/territory governments, supplemented by a direct collection of data by the ABS. For large dams for which there was no information available, the ABS derived an estimate using a standard statistical imputation process. The imputed data contributed less than 7% of the Murray-Darling Basin total.

34 Using the large dams identified in the *Cotton Yearbook 2007* (The Australian Cottongrower 2007), dam storage levels were aggregated consistent with the method used in *Water Account, Australia 2004–05* (ABS cat. no. 4610.0). The purpose of undertaking this calculation was to enable comparison with aggregated area of cotton grown and the volume of water used.

Dam storage continued

DATA QUALITY AND RELIABILITY

35 The data on the capacity of large dams, and dam storage levels, is based on publicly available information and direct collection by the ABS. Imputed storage volumes accounted for less than 7% of the MDB total dam storage. These estimates may be used with a high degree of confidence.

36 Patterns of dam storage can be compared with changes in the area of cotton and changes in water consumption with a moderate degree of confidence. This is because the majority of cotton grown is irrigated, and the majority of water from these dams is used for growing cotton.

37 When examining the relationship between water storage in large dams servicing major cotton growing areas, and area or production of cotton, it should be noted that:

- some cotton grown is not irrigated;
- not all water used to irrigate cotton is stored in the large dams identified in the *Cotton Yearbook 2007*; and
- some of the water stored in these large dams is used for purposes other than irrigation.

CHAPTER 4

Agricultural commodities

DATA SOURCES

38 The 2000–01 and 2005–06 ABS Agricultural Censuses were used to calculate area of crops and pasture, numbers of livestock and levels of production for these time periods. The 2000–01 and 2005–06 ABS Apples and Pears Survey was used to source production data and number of trees. The 2000–01 and 2005–06 ABS Vineyards Surveys were used for grape production data by weight (tonnage).

METHOD OF CALCULATION

39 Different methods were used for deriving regional estimates for 2000–01 and 2005–06. The method used to produce 2005–06 agricultural commodity data for the MDB and other regions of interest was the ABS 'geographic coding' project. This project spatially located (geo-coded) Australian farms with an Estimated Value of Agricultural Operations (EVAO) of greater than $5,000. This resulted in the most reliable and accurate regional level agriculture statistics produced by the ABS.

40 To calculate 2000–01 MDB agricultural production and area data that were comparable with 2005–06, Statistical Local Area (SLA)-level information and an SLA-to-MDB concordance were used. To evaluate the accuracy of using the SLA-to-MDB concordance methodology, this method was also used to derive 2005–06 Agricultural Census data. This enabled an evaluation of whether the level of difference (using the SLA concordance methodology) compared to the equivalent geo-coded MDB data was significant. Where the difference was relatively small (<3%) the 2000–01 data were considered appropriate.

41 Irrigated area data for 2000–01 were compared using the SLA-concordance methodology described in paragraph 39 above, and the SD methodology described in paragraph 25 above. When the results of the two methods were compared, minor differences were observed, therefore the SD methodology was used because it was considered to be more accurate.

DATA QUALITY AND RELIABILITY

42 The 2005–06 Agricultural Census data should be used with a high degree of confidence because farms have been geo-coded to a point location, rather than classified to an area.

43 Caution should be used when comparing 2000–01 and 2005–06 agriculture data for two reasons. Firstly, 2000–01 data were calculated for the MDB using a concordance-based methodology which reduced the degree of accuracy compared to using the geo-coding methodology. Secondly, between 2000–01 and 2005–06, the

Agricultural commodities continued

method of establishing the population of agricultural holdings to be surveyed (referred to as the business "frame") was changed. In 2000–01, a register of agricultural holdings (frame) maintained by the ABS was used; in 2005–06 the ABS drew the frame from the Australian Business Register. The influence of the frame change is not thought to be significant; some analyses suggest that the frame used for 2005–06 included more small-sized farms than previously.

Gross Value of Agricultural Production

DATE SOURCES

44 Estimates of the Gross Value of Agricultural Production (GVAP) were compiled using data from *Value of Agricultural Commodities Produced 2005–06* (ABS cat. no. 7503.0).

METHOD OF CALCULATION

45 Estimates of GVAP for the MDB have been derived using similar techniques for calculating MDB agricultural commodities estimates as described in the paragraphs above. The statistics presented are in current price terms, so changes over time are affected by both inflation and changes in the volume of agricultural production.

DATA QUALITY AND RELIABILITY

46 GVAP also includes some non-irrigated commodities which are not considered in calculations of the Gross Value of Irrigated Agricultural Production (GVIAP). They include:

- sheep for wool;
- pigs;
- goats;
- poultry;
- eggs;
- domesticated buffalo; and
- all other livestock.

Gross Value of Irrigated Agricultural Production

DATA SOURCES

47 GVIAP was estimated using data from the ABS 2005–06 Agricultural Census as well as other ABS collections and administrative data used to calculate the value of agricultural commodities produced (see *Agricultural Commodities, Australia, 2005–06* (ABS cat. no. 7121.0) and *Value of Agricultural Commodities Produced, Australia, 2005–06* (ABS cat. no. 7503.0)).

METHOD OF CALCULATION

48 The methods used to estimate GVIAP in this publication are consistent with the methods used in the *Water Account, Australia 2004–05* (ABS cat. no. 4610.0), therefore the estimates are directly comparable.

49 Different methods were used for different commodities, with the method used dependent on the nature of the commodity and the availability of data. For rice, 100% of the gross value of agricultural production was attributed to irrigation. For cotton, the volume of the production from irrigated land was collected directly via the ABS Agricultural Censuses and Surveys. This volume was then applied to the value of cotton in the MDB.

50 For the remaining commodities, the value of irrigated agricultural production was determined using two general methods.

Gross Value of Irrigated Agricultural Production continued

- Method 1. The area of the commodity that was irrigated was divided by the total area of the commodity (i.e. irrigated plus non-irrigated area) and multiplied by the total value of the commodity produced. This method has an under-estimating bias as it is likely that commodities grown on irrigated land will be more productive in terms of tonnage per hectare than the same commodity grown on non-irrigated land.
- Method 2. The proportion of irrigating agricultural establishments (farms) within a particular industry (classified according to ANZSIC, see Glossary) was determined and this proportion applied to the total gross value of the particular commodities produced by that industry. This method is likely to over-estimate the value of irrigated production as not all production on all irrigated farms is from irrigated land.

51 The following approaches were taken for particular commodities:

- The simple average of these methods was used to estimate the value of irrigated production for vegetables, fruit (including nuts), grapes, other livestock, sugar and 'other agriculture'.
- Method 1 was used to estimate the value of cereals other than rice as investigations of the data revealed that the irrigated area made up only a small fraction of the production area on most farms. As such, attributing all production from irrigated farms to irrigation was likely to lead to a large over-estimate of irrigation production. A combination of methods was used for other crops.
- Method 2 was used to estimate the value of milk production from dairy pasture as data from the Victorian Dairy Industry Survey of 1999 and Armstrong et. al. (1998) indicated that where a dairy farm was irrigated, nearly all milk production can be attributed to irrigation.

52 A new method for calculating GVIAP is currently being developed by the ABS and experimental estimates for 2000–01 through to 2006–07 will be released later in 2008.

DATA QUALITY AND RELIABILITY

53 Calculation of GVIAP is based on several assumptions so these estimates should be used with caution.

54 GVIAP data for 2000–01 differs slightly from that published in the *Water Account Australia, 2000–01* (cat. no. 4610.0), due to slight changes in the methodology which were made to enable a better comparison of 2000–01 and 2005–06 data.

55 Comparisons of GVIAP between 2000–01 and 2005–06 must be made with caution for the following reasons:

- differences in the two Census forms used to collect the data impact slightly on the methodology;
- different frames were used for the two Censuses (as described above in paragraph 42); and
- inflationary factors are not taken into account (i.e. 2000–01 data are based on 2000–01 prices and 2005–06 data are based on 2005–06 prices).

56 For tables and graphs showing GVIAP estimates there were slight differences in the definitions of the commodity groups between 2000–01 and 2005–06:

- In 2000–01 'cereals (excluding rice)' included cereals for grain/seed AND cereals for hay, however in 2005–06 it only included cereals for grain/seed. In 2005–06 cereals for hay was apportioned to 'dairy farming' and 'pasture for other livestock', as explained below.
- In 2000–01, 'dairy farming' and 'pasture for other livestock' included:
  - pasture for grazing;
  - pasture for seed production; and
  - pasture for hay and silage.

Gross Value of Irrigated Agricultural Production continued

- In 2005–06, 'dairy farming' and 'pasture for other livestock' included:
  - pasture for grazing; and
  - pasture, cereal and other crops for hay,

57 Care also needs to be taken when comparing the GVIAP data with the water consumption data presented in Chapter 3 because consumption data includes livestock drinking and washdown water, whilst GVIAP data only considers irrigation water.

CHAPTER 5

Natural Resource Management data

DATA SOURCES

58 Natural Resource Management (NRM) data included in Chapter 5 and irrigation practice data included in Chapter 3 are sourced from either the ABS publication *Natural Resource Management on Australian Farms, Australia, 2004–05 (Reissue)* (cat. no. 4620.0) or unpublished data from the Natural Resource Management Survey 2004–05.

59 The NRM Survey vehicle is a biennial sample survey collecting data about NRM issues, activities, expenditure and effort from approximately 20,000 establishments (farms) conducting agricultural activity.

METHOD OF CALCULATION

60 To determine the NRM regions comprising the MDB, MDB and NRM boundaries were overlaid to assess the level of 'fit'. This analysis revealed that:

- there were fifteen regions fully contained within the MDB; and
- there were six regions partially within the MDB.
  - Of the six NRM regions partially within the MDB, four contribute more than 70% of their area to the Basin. These are: South West region in Queensland (71%); Wimmera region in Victoria (72%); Western region in New South Wales (72%); and, SA Murray Darling Basin in South Australia (98%).
  - There were two NRM regions that contributed an area of less than 10%: South East (SA) (6%) and SA Arid Lands (2%).

61 Therefore, when presenting statistics by NRM region, the fifteen regions entirely in the MDB and the four regions with the vast majority of their area within the MDB are included, however the two regions with small areas in the MDB are excluded.

62 In Chapter 5, the NRM data relates to number of farms rather than area. Therefore, given there are relatively low numbers of farms in the South West, Wimmera and Western regions, these regions have a relatively minor impact on MDB estimates. Furthermore, proportionally more farms exist within the 70% of area within the MDB, than the 30% that is located outside the MDB.

DATA QUALITY AND RELIABILITY

63 Much of the data published at the NRM region level have been presented as proportions within ranges due to data quality (i.e. level of error associated with estimates). These ranges have been set to:

- maximise the probability that data for NRM regions in one range category are significantly different from other categories; and
- maximise the functionality of the data.

64 Data at the MDB level is of suitable quality and can be used with a medium degree of confidence. Data for NRM regions should be used with caution.

MAPS

65 Each map contains a legend and shows the colour and values for each class of the mapped data. For simplicity the ranges are shown as '0 to 600', '600 to 3,700', '3,700 to 18,700' and so on. These should be read as 'from 600 to less than 3,700', and 'from 3,700 to less than 18,700' etc. Individual values appear in one range only.

EFFECTS OF ROUNDING

66 Figures have been rounded and discrepancies may occur between totals and the sums of the component items.

ABBREVIATIONS

'000	thousand
$m	million dollars
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ANCID	Australian National Committee on Irrigation and Drainage
ANZSIC	Australian and New Zealand Standard Industrial Classification
ASGC	Australian Standard Geographical Classification
Aust.	Australia
AWRC	Australian Water Resources Council
BoM	Bureau of Meteorology
BRS	Bureau of Resource Sciences
CD	collection district
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEWHA	Australian Government Department of the Environment, Water, Heritage and the Arts
excl.	excluding
EC	exceptional circumstances
GL	gigalitre
GVAP	gross value of agricultural production
GVIAP	gross value of irrigated agricultural production
GWh	gigawatt hour
ha	hectare
incl.	including
IRSD	Index of Relative Socio-economic Disadvantage
kL	kilolitre
km²	square kilometre
m	million
MDB	Murray-Darling Basin
MDBA	Murray-Darling Basin Authority
MDBC	Murray-Darling Basin Commission
ML	megalitre
ML/ha	megalitres per hectare
no.	number
NHT	National Heritage Trust
NRM	natural resource management
NSW	New South Wales
NT	Northern Territory
NWC	National Water Commission
NWI	National Water Initiative
Qld	Queensland
SA	South Australia

SEEAW	System of Environmental-Economic Accounting for Water
SLA	statistical local area
t	tonne
Tas.	Tasmania
Vic.	Victoria
WA	Western Australia

APPENDIX

POLICIES AND PROGRAMS RELEVANT TO THE MURRAY-DARLING BASIN

INTRODUCTION

There have been a number of water management policy initiatives introduced in Australia during the past 20 years that have been directly relevant to the MDB. These have been developed to address social, economic and natural resource management issues within the Basin, particularly the sharing of water resources between the environment, agriculture and other users. Some of the policies are national in scope, others are MDB-specific.

NATIONAL POLICY INITIATIVES RELEVANT TO THE MURRAY-DARLING BASIN

Water management policies

THE NATIONAL WATER INITIATIVE

In 2004, the National Water Initiative (NWI) was signed by all state and territory governments except for Western Australia and Tasmania. Tasmania signed in 2005, followed by Western Australia in 2006. The NWI is the overarching policy framework that guides current water management in Australia. It represents the Commonwealth, state and territory governments' shared commitment to water reform (NWC 2008).

The overall objective of the NWI is to achieve a nationally compatible market, regulatory and planning based system of managing surface and groundwater resources for rural and urban use that optimises economic, social and environmental outcomes (NWC 2008).

The NWI represents and extends previous key policy reforms of the past two decades including:

- integrated catchment management;
- tradeable water rights;
- full accounting of resources and use;
- regional water planning; and
- environmental allocations (Hussey and Dovers 2007).

One of the key objectives of the NWI is to facilitate the operation of efficient water markets and the trading of water within and between jurisdictions. Another objective is to establish best practice pricing and institutional arrangements to promote economically efficient and sustainable use of water resources, infrastructure and government water management resources (NWC 2008).

The purpose of implementing these measures is to:

- reduce barriers to water trade;
- more effectively allocate water between competing users;
- improve water efficiency; and
- ensure that water is allocated to its highest value use (Grafton and Peterson 2007, Wong 2008).

THE NATIONAL PLAN FOR WATER SECURITY

The National Plan for Water Security seeks to facilitate the modernisation of Australian irrigation, helping to put it on a more sustainable footing at a time of declining water resources. It seeks to address over-allocation in the MDB, to improve the health of rivers and wetlands of the MDB, and to benefit irrigators and the community (Australian Government 2007).

Under the National Plan for Water Security, the Commonwealth Government will invest up to $3 billion over ten years to address over-allocation of water in the MDB. Planned in conjunction with the modernisation programme, this will be achieved by providing

Water management policies continued

assistance to irrigation districts to reconfigure irrigation systems and retire non-viable areas, such as those at the end of isolated channels or in salt-affected areas. Assistance will be provided to help relocate non-viable or inefficient irrigators, or help them exit the industry. Where necessary, water entitlements will also be purchased on the market (Australian Government 2007).

There are three other key aspects of the National Plan for Water Security. The first is reforming governance arrangements through establishing the new Murray-Darling Basin Authority (MDBA). The MDBA will be responsible for planning the Basin's water resources in the interests of the Basin as a whole. The second is improving the accuracy, timeliness and comprehensiveness of water information, by nesting responsibility for water availability and use data collection with the Bureau of Meteorology. The third key aspect is the examination of northern Australia for future land and water development and completing the final phase of the Great Artesian Basin piping and bore-capping project (Australian Government 2007).

The National Plan for Water Security is a document of the former Australian Government. The current Australian Government's new national water plan, Water for the Future incorporates elements of the earlier plan.

WATER FOR THE FUTURE

Water for the Future is a national strategy to secure Australia's long term water supply. It is built on four key priorities:

- taking action on climate change,
- using water wisely,
- securing water supplies; and
- supporting healthy rivers (Wong 2008).

Water reforms will include:

- removing barriers to trade in water, allowing markets to operate more effectively in allocating water between competing uses, improving water use efficiency, and delivering water to its highest value uses;
- ensuring that economic settings work to promote affordable and timely investment in secure water supplies, and ensuring that alternative water supplies and water-efficient technologies can compete on a level playing field;
- improving water security in remote communities, including remote Indigenous communities; and
- making sure water planners have the best information on available water resources and the likely impacts of climate change (Wong 2008).

Water for the Future includes a commitment to a National Greywater and Rainwater Initiative. This provides direct incentives for household rainwater and greywater use, recognising the importance of water conservation and water efficiency to water planning.

The policy also aims to improve the efficiency of irrigation infrastructure. Under the Sustainable Rural Water Use and Infrastructure Program, funding is provided for investment in improving the efficiency and productivity of water use and management to reduce the amount of irrigation water lost to leakage and evaporation (Wong 2008).

In response to the challenge of securing water supplies for Australia's cities and towns, with growing water needs and declining traditional water resources, the Commonwealth, state and territory governments will work together to develop new sources of water that do not rely entirely on rainfall. An Urban Water and Desalination Program will provide funding towards new and innovative water supply projects in desalination, recycled water and stormwater harvesting (Wong 2008).

Water management policies continued

Another program, the National Water Security Plan for Towns and Cities, will target infrastructure refurbishment, new infrastructure, and practical projects to save water and reduce water losses.

Water for the Future also includes an Improving Water Information Program. Administered by the Bureau of Meteorology, this program will produce national water accounts supported by a national water monitoring and data collection network (Wong 2008).

THE WATER ACT 2007

The *Commonwealth Water Act* was initiated by the previous Australian Government in 2007 and commenced on 3 March, 2008 under the new government. The Water Act will "enable water resources in the MDB to be managed in the national interest, optimising environmental, economic and social outcomes" (DEWHA 2008c). The Act establishes the MDBA to manage water resources in the MDB in an integrated and sustainable way. The MDBA's functions include preparing a Basin Plan that sets sustainable limits on surface and groundwater that can be taken across the Basin. The MDBA will develop systems that facilitate water trading, and will be responsible for measuring and monitoring water resources in the MDB (DEWHA 2008c).

The Water Act establishes a Commonwealth Environment Water Holder. This holder will manage the the water entitlements that the Commonwealth acquires, in order to protect and restore environmental assets in the Basin (DEWHA 2008c).

The Act provides the Australian Competition and Consumer Commission (ACCC) with the role of developing and enforcing water charge and market rules. The aim of these new functions is to ensure that water markets are able to operate freely across state borders (DEWHA 2008c).

The Act also provides the Bureau of Meteorology (BoM) with water information collection and publication functions. The BoM will also be responsible for setting and implementing national water standards for water information (DEWHA 2008c).

Drought and Exceptional Circumstances

In the mid-1990s, it was recognised that there were circumstances that warranted government intervention in the form of drought assistance, and drought and Exceptional Circumstances policies were initiated to mitigate the affects of extreme events on agricultural production.

Exceptional Circumstances (EC) events are defined as rare and severe events that are outside those that farmers could normally be expected to manage using responsible farm management strategies. Specifically, they are events that occur on average once every 20 to 25 years and that have an impact on income for a prolonged period (DAFF 2007a). The framework for assessing drought was based on 6 principles: meteorological conditions, agronomic and stock conditions, water supplies, environmental impacts, farm income levels, and, scale of the event (DAFF 2008).

Operationally, an area must become 'EC declared' before farmers can apply to receive assistance (DAFF 2008).

POLICY INITIATIVES SPECIFIC TO THE MURRAY-DARLING BASIN

There are several policies that are MDB-specific. Some have regulatory and accounting imperatives, others concentrate on drought contingency planning, or deliver programmes comprising significant on-ground works. Furthermore, some programmes aim to improve resource condition while others are focussed towards improving socio-economic conditions. They are operated through establishing plans, setting targets, monitoring to determine whether targets have been achieved, and then reporting on, and evaluating, the outcomes.

Management of the Murray-Darling Basin

MURRAY-DARLING BASIN AUTHORITY

In July 2008, the Council of Australian Governments agreed to changes in the *Water Act 2007* to establish the independent Murray-Darling Basin Authority (MDBA) with the functions and powers needed to ensure that the Basin's water resources are managed in an integrated and sustainable way (DEWHA 2008c).

The key functions of the MDBA include:

- preparing a Basin Plan, including setting sustainable limits on water that can be taken from surface and ground water systems across the Basin;
- advising the Commonwealth Government on the accreditation of state water resource plans;
- developing a water rights information service to facilitate water trading across the Basin;
- measuring and monitoring water resources in the Basin;
- gathering information and undertaking research; and
- engaging the community in the management of the Basin's resources (DEWHA 2008c).

The Basin Plan will address the following range of issues:

- limits to the amounts of water (both surface and ground water) that can be taken from Basin water resources on a sustainable basis - known as long-term average sustainable diversion limits;
- identification of risks to Basin water resources, such as climate change, and strategies to manage those risks;
- the requirements that state water resource plans will need to comply with in order to be accredited under the *Water Act*;
- an environmental watering plan to optimise environmental outcomes for the Basin by specifying environmental objectives, watering priorities and targets for MDB water resources;
- a water quality and salinity management plan which may include targets; and
- rules about trading of water rights in relation to Basin water resources (DEWHA 2008d).

Water management policies

THE MURRAY-DARLING CAP ON DIVERSIONS

Because of concerns about the quantity of water being removed from the MDB for consumption, and the subsequent impact on flow regimes and river health, the NRM Ministerial Council initiated an audit of water use in the MDB in 1993. The outcome of the audit demonstrated that if the volume of water diversion continued to increase, river health would decline, and water security for irrigators and other water users in the Basin would be reduced (MDBC 2008a).

This resulted in a limit on the volume of water that could be diverted from rivers for use - this is called the Cap. The Cap is managed in accordance with a formal set of rules described in Schedule F of the MDB agreement. Each state and territory comprising the MDB is entitled to a share of the surface water resource under the Cap agreement, and this is managed for each designated Cap valley (MDBC 2008a).

Schedule F of the MDB agreement requires an annual Water Audit Monitoring Report that documents water use within the Basin and assesses the five state and territory governments' compliance with the Cap. For further information about the Cap agreement see http://www.mdbc.gov.au/nrm/the_cap.

THE LIVING MURRAY INITIATIVE

The Living Murray Initiative was launched in 2004. The aim of the initiative is to recover an annual average of 500 GL of water for environmental use at six icon sites:

- Barmah-Millewa forest;
- Gunbower and Koondrook-Perricoota Forests;

Water management policies continued

- Hattah Lakes;
- Chowilla Floodplain (including Lindsay-Wallpolla);
- Lower Lakes, Coorong and Murray Mouth; and
- River Murray Channel.

Water savings are to be achieved through a variety of approaches, for example:

- through purchasing water from willing sellers for use by the environment;
- by improving water delivery infrastructure; and
- by improving on-farm water use efficiency (MDBC 2007).

The target date for water recovery is June 30, 2009. While water has been returned to the river progressively, most is expected to become available to the environment between 2008 and 2009. As at July 2008, 133 GL of recovered water was listed on the Environmental Water Register, however the actual volume of available water is dependent on allocations. Plans to recover a further 471.4 GL were in place or being developed (MDBC 2008b).

MURRAY-DARLING BASIN DRY INFLOW CONTINGENCY PLANNING AND MDB SUSTAINABLE YIELDS PROJECT

At a Summit on the MDB on 7 November 2006, the Prime Minister and the premiers of New South Wales, Victoria and South Australia asked officials to examine contingency planning to secure urban water supplies during 2007–08. Contingency Planning Reports have been released for February 2008, April 2007, May 2007 and September 2007 and December 2007. The reports outline the volume of water available in the MDB and recommend different uses for the water given increases or decreases in water availability. They also describe the management practices that should be adopted by delivery and storage managers, and water users to conserve water during times of reduced availability.

At the MDB summit, the CSIRO were commissioned to report on the current sustainable yields of surface and groundwater in the MDB, including an analysis of the affect of climate change on future sustainable yields. In total, 18 reports have been published, one for each catchment.

Other Natural Resource Management policies

Examples of other policies specific to the MDB include:

- Basin Salinity Management Strategy;
- Native Fish Strategy;
- Algal Management Strategy;
- Floodplain Wetlands Management Strategy; and
- Human Dimension Strategy.

For further information about these policies refer to: http://www.mdbc.gov.au and http://www.environment.gov.au/water/mdb.

GLOSSARY

Anomaly	An anomaly refers to the departure of an element from its long-period average value for the location concerned. See also Temperature anomalies and Rainfall anomalies.
Australian and New Zealand Standard Industrial Classification	A classification system for identifying and grouping all producing units (both goods and services) in Australia into industries to permit compatibility of data.
Basin state	A state or territory of Australia that has part, or all, of its area located within the Murray-Darling Basin. The Basin states are New South Wales, Queensland, Victoria and South Australia and the Australian Capital Territory.
Catchment	The area of land determined by topographic features, within which rainfall will contribute to run-off at a particular point. The catchment for a major river and its tributaries is usually referred to as a river basin. See also River basin.
Consumer price index	An index of retail prices which provides a quarterly measure of variations in retail prices for goods and services representing a high proportion of the expenditure of wage-earner households. The CPI is adjusted from time to time to take account of changing patterns of consumption and aims to measure only pure price changes and exclude the effects of any changes in quality and quantity of the good concerned.
Deep drainage	The volume of water that moves below the root zone which may or may not enter the saturated zone and become recharge to the groundwater system.
Distributed water	Distributed water is water supplied to a user including through a non-natural network (piped or open channel), and where an economic transaction has occurred for the exchange of this water. The majority of distributed water is supplied by the Water supply, sewerage and drainage services industry (ANZSIC 93 group 3701). The water supply component consists of units mainly engaged in storage, purification or distribution of water by pipeline or carrier. It also includes the operation of irrigation systems that supply water to a farm and the supply of steam and fresh hot water.
Ecosystem	A system formed by the interaction of a group of organisms and their environment.
Equivalised household income	A standardised income measure which enables analysis of the relative wellbeing of households of different size and composition. For further information refer to Appendix 3 of Household Income and Income Distribution, Australia (ABS cat. no. 6523.0). See also Equivalised household income - quintiles.
Equivalised household income – quintiles	Groupings of 20% of the total population of Australia when ranked in ascending order according to equivalised gross household income. See also Equivalised household income.
Evapotranspiration	Process of moisture loss to the atmosphere from plants by transpiration and evaporation.
Gross Value of Agricultural Production (GVAP)	Gross Value of Agricultural Production estimates are derived by the multiplication of price and quantity estimates of agricultural commodities.
Gross Value of Irrigated Agricultural Production (GVIAP)	Gross value of agricultural commodity production on irrigated land. Estimates are derived by the multiplication of price and quantity estimates of agricultural commodities produced on irrigated land.
Groundwater	The supply of fresh water found beneath the earth's surface (usually in aquifers) that is often used for supplying wells and springs.
Group household	A household consisting of unrelated adults.

In-stream use	The use of freshwater in situ (e.g. within a river or stream). Can include recreation, tourism, scientific and cultural uses, ecosystem maintenance, hydro-electricity and commercial activities, and dilution of waste. The volume of water required for most in-stream uses cannot be quantified, with the exception of hydro-electricity generation.
Irrigated land	Land that is artificially supplied with water.
Mean equivalised gross weekly household income	The average equivalised gross weekly household income. See also Equivalised household income and Equivalised household income – quintiles.
Non-irrigated land	Land that is not artificially supplied with water.
Natural Resource Management (NRM) region	A region defined by the Australian Government, in association with state and territory governments, in order to facilitate the integrated delivery of NRM priority issues.
Participation rate	The labour force participation rate is the number of persons in the labour force (employed plus unemployed) expressed as a percentage of the total population aged 15 years or over. People who did not report their labour force status are excluded when calculating the participation rate.
Quintiles	See Equivalised household income and Equivalised household income - quintiles.
Rainfall anomalies	Rainfall anomalies measure the deviation from the long-term average rainfall for a given location. See also Anomaly and Temperature anomalies.
Reuse water	Drainage, waste or storm water that has been used again without first being discharged to the environment. It may be treated to some extent.
Riparian zone	The channel margins (or banks) which form part of the floodplain.
River basin	The 245 river basins in Australia are defined by the area drained by a stream and its tributaries where surface run-off collects. In an area of uncoordinated drainage, drainage patterns define a basin. Refer to map 1.2 in Chapter 1 for an illustration of the river basins that form the Murray-Darling Basin. See also Catchment.
Run-off	The part of precipitation in a given area and period of time that appears as streamflow.
Salinity	The salt content in soil or water.
Self-extracted water	Water extracted directly from the environment for use (including rivers, lakes, groundwater and other water bodies).
Silage	Green fodder preserved in a silo, silage pit, or mound.
Surface water	Water flowing or held in streams, rivers and other wetlands in the landscape.
Temperature anomalies	Temperature anomalies measure the deviation from the mean annual temperature for a given location. See also Anomaly and Rainfall anomalies.
Tributary	A stream contributing its flow to a larger stream or other body of water.
Water consumption	Water consumption is equal to distributed water use plus self-extracted water use plus reuse water use minus distributed water supplied to other users minus in-stream use (where applicable).

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