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Characteristics of Australia's Irrigated Farms

2000-01 to 2003-04

New Issue

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PREFACE

The release in 2005 of the ABS publications *Water Use on Australian Farms 2002–03* (cat. no. 4618.0) and *Water Use on Australian Farms 2003–04* (cat. no. 4618.0) represented a significant step in the provision of information to help understand how irrigated land is managed and irrigation water is used. The richness of the data and its relevance to natural resources management make it an important input into the formulation and evaluation of public policy.

To maximise the usefulness of this data to the Australian community, the Australian Statistician seconded four employees of the Productivity Commission to assist with further analysis of the data.

This report examines the diversity of farm irrigation practices and management — providing a detailed statistical description of farms which use and trade irrigation water. It also provides estimates of the contribution of selected irrigated activities to the gross value of Australia's agricultural production. It is intended that the statistical and other descriptive information provided in this report will support wider analyses to identify farm management and resource use practices that contribute to the productivity and efficiency of irrigation water use.

The report has been prepared by Rosalyn Bell (Productivity Commission) with data and statistical assistance from Steven May (Australian Bureau of Statistics). Paul Gretton, Gemma Van Halderen, Michael Vardon, John Purcell, Jyothi Gali, Ineke Redmond and referees have provided technical support and helpful comments.

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
COAG	Council of Australian Governments
EVAO	Estimated value of agricultural operations
GL	Gigalitre (1000 million litres)
GVIP	Gross value of irrigated production
GVP	Gross value of production
ha	Hectare
ML	Megalitre (1 million litres)
PC	Productivity Commission

Key Points

- In 2003–04, 2.4 million hectares of agricultural land and 10,000 gigalitres of water were used for irrigated agricultural activities.
  - This constituted only 0.5 per cent of all agricultural land, but accounted for about 70 per cent of Australia's annual use of extracted water by rural, industry and domestic users.
- The gross value of irrigated production (GVIP) in Australia is estimated to have been around $9 billion in 2003–04 — around one–quarter of the gross value of all agricultural production.
  - 52 per cent of Australia's GVIP came from irrigated horticulture, with irrigated pastures and irrigated broadacre crops each contributing around 24 per cent.
- Of the 130,500 agricultural establishments that operated in 2003–04, 40,400 irrigated.
- Farms that irrigated generated, on average, 55 per cent more output per farm in 2003–04 than farms which did not irrigate — although the average land area of irrigated farms was less than that of non-irrigated farms.
- Within irrigated agriculture, the largest 20 per cent of farms generated the majority of the GVIP. Of the output of irrigated pasture, irrigated broadacre and irrigated horticulture farms, 57, 69 and 73 per cent, respectively, was generated by the largest farms in each activity group.
- Larger irrigated farms were generally more likely than smaller farms to irrigate in successive years. Larger farms also incurred lower ongoing irrigation expenses relative to their irrigation water use and were more likely to recycle irrigation water and use irrigation scheduling equipment.
- Farms of all sizes engaged in trade of irrigation water, but trade has not been a frequent event for most farms. Farms with pastures as the main irrigated activity were the most active in water trade.
  - 43 per cent of irrigated pasture farms, 36 per cent of irrigated broadacre farms and 27 per cent of irrigated horticultural establishments traded water in at least one of the three years to 2003–04.
  - Only 13 per cent of irrigated pasture farms, 11 per cent of irrigated broadacre farms and 10 per cent of irrigated horticultural establishments traded water in every year.
- Most trade in irrigation water was on a temporary basis.
  - In 2002–03, horticultural establishments (particularly farms with irrigated vegetables) were the main sellers, while farms with irrigated pastures and irrigated broadacre activities were the main buyers.
- For trade on a permanent basis, fruit growing establishments were the main sellers of irrigation water entitlements in 2002–03, while farms with pastures, cotton or sugar were the main buyers.

CHAPTER 1 INTRODUCTION

Over the last decade, increased demands for water associated with general population and economic growth, and concerns about the environmental impacts of higher consumptive water use, have prompted significant developments in the use and management of Australia's irrigation water resources. Reflecting these changed circumstances, the National Water Initiative (2004) builds on earlier COAG water reforms aimed at increasing the productivity and efficiency of water use. Adjustments have also occurred at a farm level, with substantial changes over the past decade in the use, management and trade of irrigation water.

Earlier studies have highlighted the importance of productivity growth in maintaining agricultural production, and the influence of technology adoption and environmental conditions on farm use of land and water resources. Also explored has been the impact of changed market conditions on farming, including the influence of reduced irrigation water diversions on agricultural production returns and the role of water trade. A common thread through these studies is the diversity of Australian farming and the propensity for sectoral change in response to varying market and environmental conditions and regulatory reform.

To date, however, assessment of changes in, and the effectiveness of, on-farm water use practices and irrigation management has been inhibited by a lack of information.

To help fill this gap, the Australian Bureau of Statistics (ABS), in consultation with Commonwealth and State Government Agencies and producer organisations, has collected data on natural resource use in Australian agriculture. The first two surveys in this program were the 2002 Land Management and Salinity Survey and the 2002–03 Water Survey Agriculture.

This report uses information from these surveys and other ABS agricultural collections to examine the diversity of agricultural water use practices and management, and provide a detailed statistical description of farms which use and trade irrigation water. It is intended that the statistical and other descriptive information in this report will contribute to the consideration of a range of policy issues relating to water, and will also support wider analyses to identify farm land management and resource use practices that contribute to the productivity and efficiency of irrigation water use.

1.1 DATA AND METHODOLOGY

To facilitate the analysis in this project, the ABS has matched — at a unit record level — information about water use on Australian farms and farm management of natural resources with annual information about land use and agricultural production for the period 2000–01 to 2003–04.

This data set is drawn together from information collected in the 2000–01 Agricultural Census, the 2001–02, 2002–03 and 2003–04 Agricultural Surveys, the 2002 Land Management and Salinity Survey and the 2002–03 Water Survey Agriculture. These collections cover the activity of agricultural establishments which have an estimated value of agricultural operations (EVAO) in excess of $5,000.[1] For statistical purposes, an agricultural establishment refers to all agricultural activities at a physical location, but may consist of a group of locations within the same statistical local area or contiguous statistical local areas. In this report, the terms 'agricultural establishment' and 'farm' are used interchangeably.

The unit record information has been augmented by regional level information about environmental and economic factors (such as rainfall and agricultural prices, respectively) that may influence farm performance.

Number of farms

In 2003–04, an estimated 130,500 farms operated in Australia, down from 140,500 in 2000–01 (table 1.1). In any one year, details for these farms are collected from a survey comprising a representative sample of farms operating in that year. Statistical sampling techniques are used to select representative farms, with the size of the sample varying with the scope of the survey, the expected variability of responses, the expected incidence of non-response, and the need to provide meaningful estimates at the agricultural product and regional levels. The number of farms included in the analysis from each collection is also reported in table 1.1. Data for these farms are expanded to population totals using sample weights assigned to each farm.

The most comprehensive collection in terms of farms covered was the 2000–01 Agricultural Census — information on agricultural production activities was collected from 116,500 farms to represent the activity of the estimated 140,500 farms operating in that year. The relatively large coverage of farms in 2000–01 provided information to benchmark ensuing agriculture and natural resource surveys. Subsequent agricultural collections sourced information from about 20,000 representative farms.

1 Following standard ABS procedure, the EVAO for each farm is calculated as the sum of the volume of each commodity output in the reporting year multiplied by an average price for that commodity over the reporting and preceding two years.

Central to this study is the coverage of the natural resource surveys of 2002 and 2002–03. The Land Management and Salinity Survey for 2002 drew on a sample of 17,300 farms from the Census. It included establishments reporting as either having land affected by salinity or using salinity management strategies, plus a control group not reporting those details in the Agricultural Census. The 2002–03 Water Survey Agriculture was conducted as a supplement to that year's agricultural survey for a sample of farms which reported undertaking irrigation. The survey obtained details from over 7,500 establishments, which accounted for around one–third of all agricultural water used, and represented the activities of almost 44,000 irrigators.

The national, sectoral and regional estimates reported in this paper were obtained by aggregating information supplied by the representative farms, weighted by the relevant ABS farm-level sample survey weight.

TABLE 1.1 FARM NUMBERS BY YEAR AND ABS COLLECTION

Data year	*Estimated number of farms in Australia*	*Number of farms included in the analysis(a)*	*Source of data*
2000–01	140 516	116 452	Agricultural Census
2001–02	135 377	24 765	Agricultural Survey
2002		17 286	Land Management & Salinity Survey
2002–03	132 983	19 703	Agricultural Survey
		7 561	Water Survey Agriculture
2004–04	130 526	21 056	Agricultural Survey

(a) Farms analysed are those which have responded to a survey, operated in the sample period, contributed meaningfully to aggregate estimates and are suitable for use in this analysis.

Type of information on farms

A complete set of information for each farm was compiled by matching individual farm responses in each of the surveys in which they participated. A summary of the variables collected in the census and each of the surveys is detailed in appendix A.

Broadly, the Agricultural Census and Agricultural Surveys collected information about the production of individual agricultural commodities. The area irrigated for selected commodity groupings was collected each year and, in 2003–04, the volume of water applied to agricultural commodities irrigated was also collected. Information on irrigation methods and scheduling tools, water trade, land condition and management techniques, and general information on farm use of information, programs and technology was collected on an opportunistic basis.

The Land Management and Salinity Survey provides information on the presence of on–farm dryland salinity and farm management practices to ameliorate or manage salinity. Other summary information provided in the survey includes farmer reasons for past changes to land management practices and perceived barriers to change.

Of greatest relevance to the current paper is the Water Survey Agriculture. It provides comprehensive information for selected groupings of commodities, on areas irrigated and the volume of water applied. At a farm level, information is also provided on irrigation expenses, irrigation application methods and scheduling tools, the sources of irrigation water, the volume and value of temporary and permanent water trades, farm storage and recycling activities.

1.2 OUTLINE OF PAPER

To place the analysis of the characteristics of Australia's irrigated farms into context, Chapter 2 outlines the broad trends in agricultural water use in recent years, focussing in particular, on water used for irrigation purposes. Chapter 3 reports on the contribution of irrigated production to the value of agricultural output, highlighting the contribution of different irrigated activities and farm size groups, where farm size is indicated by the value of agricultural operations. Chapter 4 describes the attributes of farms which use irrigation water and how these vary with factors such as activity and farm size, irrigation methods and irrigation scheduling tools. Chapter 5 examines the extent and type of water trade undertaken in the different irrigation activities in recent years.

CHAPTER 2 BROAD TRENDS IN AGRICULTURAL WATER USE

Irrigation has long been a feature of agriculture in Australia, with the first large-scale irrigation schemes established in the 1880s. Up until the 1990s, supplies of irrigation water were considered to be plentiful, and expansion of irrigated agriculture was encouraged through large–scale developments such as the Murrumbidgee and Murray Irrigation Schemes in the 1930s and the Snowy Mountains Scheme in the 1970s. More recently, concerns about the expansion of diversions for irrigation, the environmental impact of irrigation and competing demands for available water have resulted in a number of policy developments and institutional changes which restricted irrigation diversions and increased the price which irrigators pay to obtain water supplies (see box 2.1).

This chapter outlines trends in agricultural water use in recent years, highlighting broad changes in the mix of irrigated activities and the incidence of irrigation in each activity.

Box 2.1 Agricultural water costs

There has been a sharp increase in the price that irrigators pay for their allocations of water over recent decades, with rises in *water charges* across all industries and regions (ANCID 1999 to 2005). In the late 1990s, some of the largest increases occurred in the sugar growing regions of Queensland and in the main rice growing areas in New South Wales. Since 2000–01, there have been further increases in water charges of up to 50 per cent per year for high reliability supplies in the irrigation regions of southern New South Wales and up to 20 per cent per year in the irrigation regions of Victoria.

In addition to payments for water allocations, *traded water prices* may be a component of irrigation water costs for some farms. In those regions where water trade is possible, farms may acquire additional water on a temporary or permanent basis. For those irrigators able to trade in water, the market price of water (rather than the charges levied by irrigation authorities) may be the key price in decisions about water use and trade. As would be expected with restrictions in the availability of irrigation water supplies, traded water prices have generally been higher in recent years than in the 1990s. Further detail on recent traded water prices is provided in chapter 5.

2.1 THE COMPOSITION OF IRRIGATED AGRICULTURE

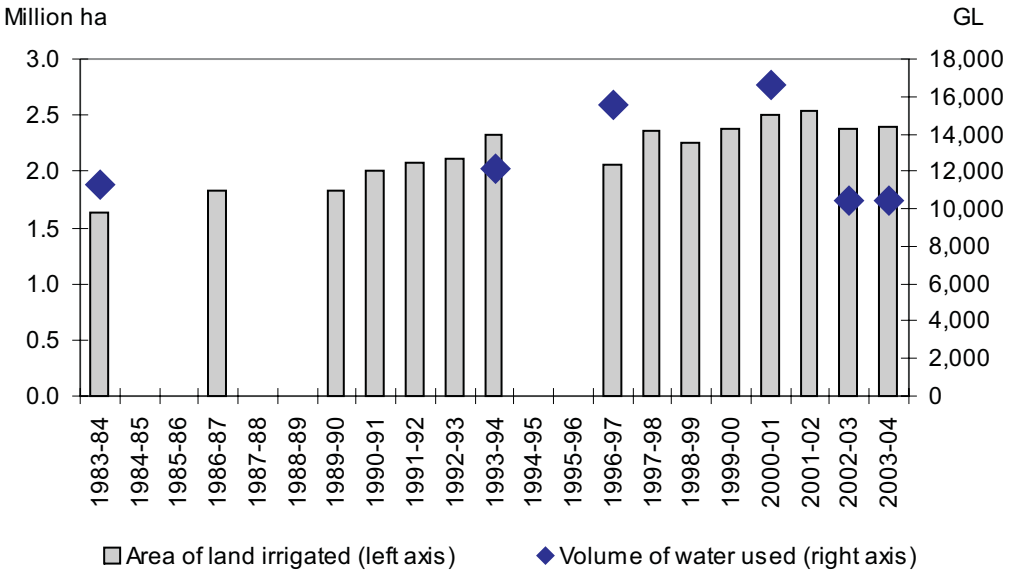
Irrigated agriculture at a national level

The quantity of extracted water used for agriculture in Australia reached a recorded peak of 16,600 gigalitres (GL) in 2000–01. About 90 per cent of this was used for *irrigation* of agricultural activities. The remainder was accounted for by water for livestock, other on-farm activities, and seepage and evaporation losses. At that time, agricultural water use accounted for almost 70 per cent of all domestic and industrial water use in Australia for consumptive purposes (ABS 2004a).

By 2003–04, the quantity of water used for irrigation had declined substantially to around 10,000 GL – although not strictly comparable, this was similar to early 1980s levels (figure 2.1). Much of that decline reflects the temporary influence of the recent drought, which has reduced the availability of water for irrigation (see appendix B).

The application of irrigation water supported agricultural production on around 2.4 million hectares in Australia in 2003–04 (figure 2.1). This represented only 0.5 per cent of all agricultural land and about 0.3 per cent of the area of Australia. Most of the area under irrigation is located within the Murray Darling Basin. The area irrigated is up from around 1.6 million hectares in the early 1980s. This increase has occurred primarily in the Burdekin catchment in north Queensland and in New South Wales catchments for the Macquarie, Lachlan and Murrumbidgee Rivers. Smaller increases occurred in the catchments for the Namoi, Gwydir and Macintyre Rivers (NLWRA 2001, p.300).

FIGURE 2.1 WATER USED IN AGRICULTURE AND IRRIGATED LAND AREAS — 1983–84 to 2003–04(a)



(a) Data on the quantity of water applied or used are collected on an opportunistic basis. Estimates prior to 2002–03 are generally based on reported areas irrigated and average application rates. These estimates may therefore overstate extracted water use in high rainfall years and understate extracted water use in low rainfall years. Estimates for water use in 2002–03 and 2003–04 do not include use of water on farms for purposes other than irrigation (eg. the cleaning of dairy sheds).

Sources: AWRC 1987; ABS Year Book Australia (cat. no. 1301.0); ABS Water account for Australia 2000–01 (cat. no. 4610.0); and ABS Water use on Australian farms 2003–04 (cat. no. 4618.0).

Trend in selected irrigated activities

These aggregate trends mask a gradual change over recent decades in the *mix* of activities for which irrigation water is used. In this report, three broad groupings of irrigated activities are discussed — irrigated pastures, irrigated broadacre crops and irrigated horticulture (see box 2.2 for details on the commodity composition of these activity groupings).

In the early 1980s, around half of Australia's irrigation water and irrigated land were used for pastures, with the remainder divided between broadacre crops and, to a lesser extent, horticultural crops (figure 2.2). Most irrigated pasture land has been used for the grazing of dairy cattle — principally in Victoria, New South Wales and South Australia — although in some areas irrigated pastures were also used for other livestock activities such as the fattening of lambs.

While the quantity of irrigation water used for pastures has declined since the early 1980s, it now supports a slightly higher area of irrigated pasture land. In contrast, irrigation water for selected broadacre and horticultural activities has increased over the 1980s and 1990s, contributing to a substantial expansion in the area irrigated.

Box 2.2 Definition and grouping of irrigated activities

For the purposes of this study, 'irrigated agriculture' is disaggregated into the following groupings:

- Irrigated *pasture* activities — includes those pastures that are irrigated for grazing, seed production, hay and silage.
- Irrigated *broadacre* activities — includes those predominantly annual crops that are irrigated to produce rice, other cereals, sugar cane, cotton, other large area crops such as soybeans and canola, vegetables for seed, and nursery production, cut flowers and cultivated turf.
- Irrigated *horticulture* activities — includes the cultivation under irrigation of fruit trees, nut trees, plantation or berry fruits, vegetables for human consumption and grape vines.

The relatively small area activities 'vegetables for seed' and 'nursery production, cut flowers and cultivated turf' are included with 'irrigated broadacre' activities because collection methods in the ABS Agricultural Census preclude disaggregation of these activities from 'other cropping' activities.

For presentation of the analysis, each farm with irrigation is grouped by its *main irrigated activity*. The main irrigated activity of a farm is defined as the irrigated activity which occupied the largest area of irrigated land on the farm. A farm is described as a 'specialist' in the activity which is its main irrigated activity.

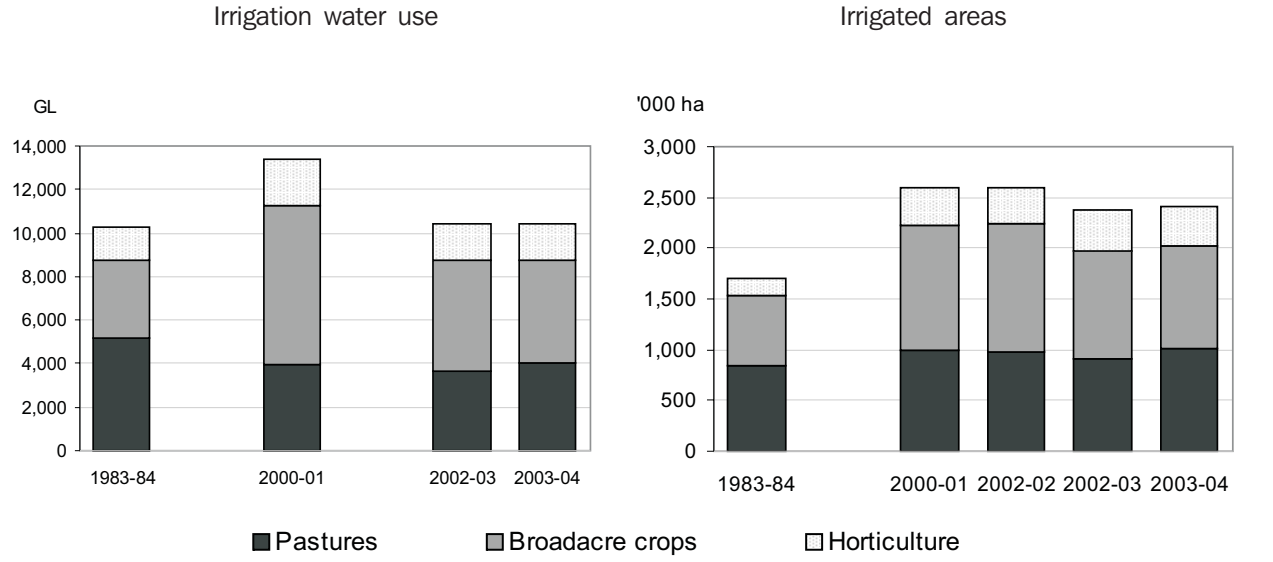
Using this classification framework, estimates are provided for farms within each of the following activities: irrigated pastures; irrigated broadacre crops — with selected estimates provided separately for farms which have rice, other cereals, sugar, or cotton as the main irrigated activity; and irrigated horticulture — with selected estimates provided separately for farms which have fruit, grapes or vegetables as the main irrigated activity.

By 2003–04, irrigated broadacre crops accounted for 45 per cent of Australia's irrigation water use and 42 per cent of irrigated area — slightly above the share of resources attributed to irrigated pastures. The remaining 16 per cent of irrigated land and irrigation water use were accounted for by horticultural activities.

Within the irrigated broadacre crops group, cereal crops is the largest cropping activity in terms of irrigated area in Australia (figure 2.3). However, those broadacre activities that have increased most since the early 1980s in terms of both irrigation water use and area cultivated are cotton, rice and sugar.[2] Compared to 1983–84 levels, these activities now use comparatively high quantities of both water and irrigated land, although several recent years of below average rainfall have substantially reduced water used for, and areas planted to, some irrigated broadacre crops including cotton and rice.

An expansion in horticultural crops over recent decades (and particularly from 1983–84 to 2000–01) has, in aggregate, been characterised by a slightly higher quantity of irrigation water applied to a substantially higher area of irrigated land. Much of the increase in irrigated land has been associated with significant growth of the wine grape industry since the mid 1980s (ABS 2005b, p.455).

FIGURE 2.2 IRRIGATION WATER USE AND IRRIGATED LAND BY ACTIVITY, Selected years(a)

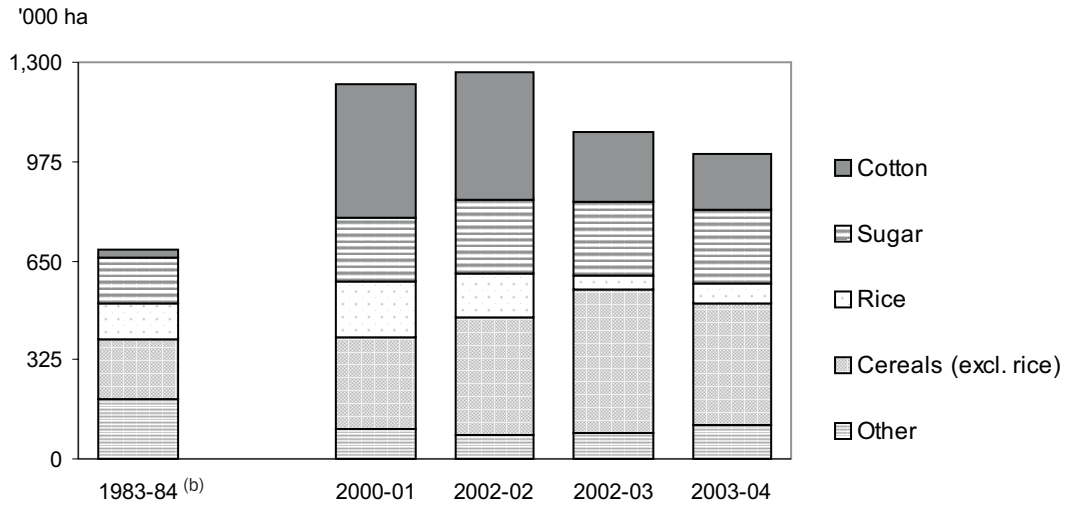


(a) Some variation over time in areas and volumes may reflect differences in the assessment methodology between sources or changes in the availability of data.

Sources: AWRC 1987; ABS Agricultural Census 2000–01; ABS Water Account Australia 2000–01 (cat. no. 4610.0); ABS Agricultural Survey 2001–02; ABS Water use on Australian farms 2003–04 (cat. no. 4618.0).

2 Some of the most significant expansions in the rice industry occurred during the 1960s and 1970s with the opening of new schemes such as the Coleambally Irrigation Scheme.

FIGURE 2.3 IRRIGATED LAND USED FOR BROADACRE CROPS, Selected years(a)



(a) Some variation over time in areas may reflect differences in the assessment methodology between sources or changes in the availability of data.
(b) Irrigated areas for rice, cotton and sugar in 1983–84 are derived as a proportion of the total areas in production of each of these crops.

Sources: AWRC 1987; ABARE 2005; ABS Agricultural Census 2000–01, ABS Year Book Australia (cat. no. 1301.0); ABS Water Account Australia 2000–01 (cat. no. 4610.0); ABS Agricultural Survey 2001–02; ABS Water use on Australian farms 2003–04 (cat. no. 4618.0); Young et al 1996.

2.2 DEPENDENCE ON IRRIGATION

Use of land in each activity

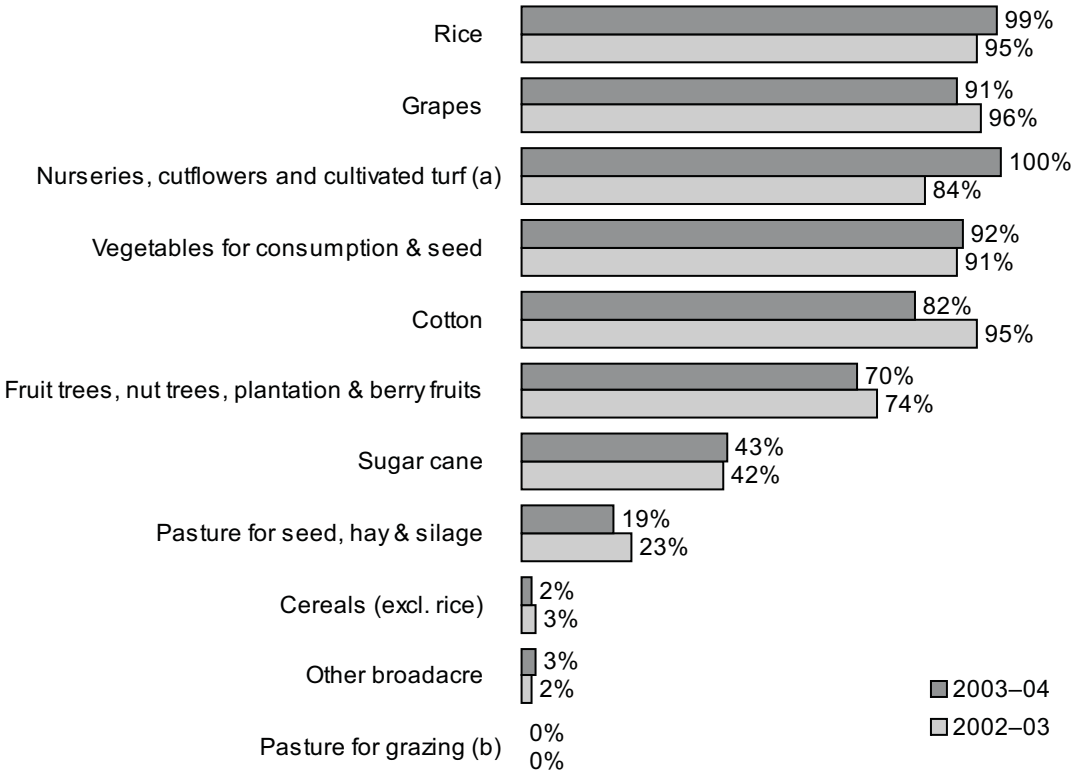
The dependence on irrigation has varied substantially between activities in recent years, with not all land planted to a given crop necessarily under irrigation (figure 2.4).

For rice, cotton, grapes, vegetables, nursery production, cut flowers and turf, more than 80 per cent of land in these activities was irrigated in 2003–04. Irrigation water was one of the main inputs to production and typically farms would not produce these crops without irrigation water.

At the other end of the scale, a large proportion of some activities rely on rainfall and may be produced with little or no irrigation. For example, less than 20 per cent of all pasture land was under irrigation in 2003–04, although irrigated pasture (primarily that for seed, hay and silage) accounted for a substantial share of Australia's irrigation water and irrigated land. Similarly, less than 5 per cent of the area planted to cereals (other than rice) was irrigated, although cereals (even excluding rice) accounted for more irrigated land than any other broadacre activity.

There was also some variability in the reliance on irrigation between years for a given activity, with differences in seasonal conditions, irrigation allocations (appendix B) and the relative cost to irrigators of irrigation water likely to have had an influence.

FIGURE 2.4 PROPORTION OF LAND IRRIGATED IN EACH ACTIVITY — 2002–03 and 2003–04



(a) A change in the format of survey questions between years is likely to have impacted on the per cent of land irrigated for nurseries, cut flowers and turf.
(b) Pasture for grazing in Australia is dominated by a substantial area of dry-land pasture.

Source: ABS Water use on Australian farms 2003-04 (cat. no. 4618.0).

Number of farms in each activity

In 2003–04, 40,400 farms — one–third of all farms in Australia — undertook some form of irrigation, with many farms irrigating more than one type of activity (table 2.2).

Around 16,900 farms (or 16 per cent of those farms that had pasture) used irrigation water on pastures in 2003–04. Similarly, around 12,500 farms (or 22 per cent of those farms that undertook broadacre activities) used irrigation water for broadacre activities in 2003–04.

Of more significance, around 17,000 farms (or 83 per cent of all farms with horticultural activities) used irrigation water for horticulture in 2003–04. Pursuit of *multiple* irrigation activities was more common for horticultural farms than for other types of irrigators, with 91 per cent of farms that undertook irrigated horticultural activities reporting this as their *main* irrigated activity — that is, less than 10 per cent of farms had irrigated horticulture as a *secondary* activity.

TABLE 2.2 NUMBER OF FARMS IRRIGATING EACH ACTIVITY — 2003–04(a)

	Farms undertaking this activity	*Farms irrigating this activity*	*Farms irrigating this activity as a percentage of all farms with this activity*	*Farms with this activity as main irrigated activity as a % of all farms with this activity(b)*
	no.	*no.*	*%*	*%*
Pastures	103 364	16 943	16	88
Broadacre crops	55 656	12 507	22	78
Horticultural crops	20 480	17 032	83	91
Total	130 526	40 400	31	

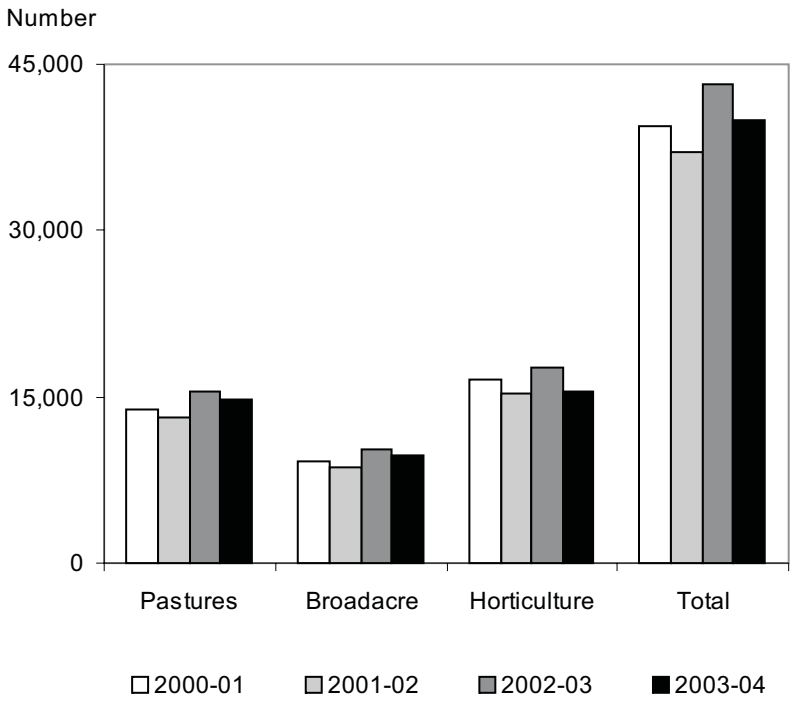
(a) The total number of farms is less than the sum of the number of farms engaged in each activity because many farms have more than one activity.

(b) The main irrigated activity is defined as that irrigated activity which occupied the largest area of irrigated land on the farm.

Sources: ABS Water use on Australian farms 2003–04 (cat. no. 4618.0) and ABS Agricultural Survey 2003–04

Although there has been a significant decline in the total number of farms in Australia in the past two decades (ABS 1990 and 2005), there is little available information to indicate how the number of farms engaged in irrigation has changed over the longer term. Nevertheless, recent information suggests that there were slightly more farms with irrigated activities in 2002–03 and 2003–04 than in 2000–01 (which was largely prior to the emergence of drought conditions). There was also some compositional changes over the period. In particular, in the latter years more farms reported pastures or broadacre crops as the main irrigated activity, but slightly fewer farms reported horticulture as the main irrigated activity (figure 2.5).

FIGURE 2.5 FARMS BY MAIN IRRIGATED ACTIVITY — 2000–01 to 2003–04



Sources: ABS Agricultural Census and Agricultural Surveys.

CHAPTER 3 THE CONTRIBUTION OF IRRIGATION TO THE GROSS VALUE OF AGRICULTURAL OUTPUT

Irrigated production contributed around one quarter of the gross value of Australia's agricultural output in 2003–04. The contributions made by individual irrigated activities and farm size groups to this aggregate are examined in this chapter.

The gross value of irrigated production (GVIP)[3] is measured as the volume of irrigated commodities produced, valued at wholesale prices.[4] Because separate details on irrigated *production* are not collected, *values* have been imputed — at the farm level — on the basis of the total (irrigated and non-irrigated) production of each activity, the area of land in each activity that was under irrigation, and the average difference in yield expected from the use of irrigation (see box 3.1).

The value of irrigated output is then aggregated across farms to show the contribution to total production made by farms in different size and activity groups (box 3.2). To place irrigation activity into context, the total value of agricultural production is also reported for each group. For this study, farms are grouped by size according to their estimated value of agricultural operations (EVAO). Selected results are also reported by region, to reflect the diversity across Australia in agro-ecological conditions (see figure C1 for region descriptions).

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3 GVIP differs from GVP for a farm in that GVIP includes only irrigated activity (rather than total farm production). In turn, GVP differs from EVAO in that it relates output prices to production in each year, rather than to an average of prices over a number of years.

4 As GVIP is estimated using current year rather than constant prices, changes over time may reflect changes in either prices or production volumes or both.

Box 3.1 Determination of the gross value of irrigated production

The value of irrigated production is calculated for each irrigated activity in which a farm engages. Reflecting differences in the use of irrigation on various activities, the calculation of GVIP is tailored to each activity.

For *cotton* farms, information on irrigated production, which is collected separately to non-irrigated production, is used directly to value irrigated production.

For farms engaged in the production of *livestock* or *livestock products* from irrigated pastures, the gross value of production is assumed to include the value of livestock products, stock sales and pastures produced. For those farms which are mainly engaged in the *dairy* industry, it is assumed that, if pastures are irrigated, then all dairy production for that farm is irrigated production. This is consistent with the approach adopted in ABS (2004a).

For *all other activities*, GVIP is derived using information on the area of the activity that is irrigated (A_i), the unit price (P) received for production, and the estimated yield on irrigated production (Yi). The estimate for the irrigated yield uses available information on the total (irrigated and non-irrigated) production of the activity (Q), the area of the activity that is non-irrigated (A_d), and the estimated ratio of irrigated to non-irrigated yield for the activity (Y_{diff}).

$$GVIP = A_i Y_i P$$

$$= A_i * \frac{Q}{A_d / Y_{diff} + A_i} * P$$

A conservative assumption for the yield difference for *cereals (excluding rice)* is that the irrigated yield is 1.5 times greater than the non–irrigated yield. This estimate is consistent with calculated long term yield differences in broadacre crops in NSW (NSW Department of Primary Industries – Agriculture 2005). For *rice* crops, farm level ABS data suggest that the yield difference is around 3.5. In low rainfall regions or during drought periods, these estimates are likely to understate the difference in yields between irrigated and non-irrigated activity.

For *non–dairy irrigated pastures*, production is scaled by the proportion of the farm pastures area which is irrigated. This simplification is equivalent to assuming there is no yield difference arising from irrigation of pastures.

For *horticulture* activities and for *sugar*, the climate for the region in which the farm is located tends to mean that irrigation is undertaken on the entire area of the activity, or not at all (that is, either A_i is zero or A_d is zero). Nevertheless, a conservative approach is taken whereby production of an activity is scaled by the proportion of the area in that activity which is irrigated. For a small number of farms which are undertaking a renovation of plant stocks and/or irrigation systems, this estimate may understate the difference in yields between irrigated and non-irrigated activity.

3.1 THE GROSS VALUE OF IRRIGATED PRODUCTION

Estimated GVIP was $8.9 billion in 2003–04 — equivalent to about one quarter of agricultural GVP in Australia at that time (figure 3.1). Around 52 per cent of Australia's GVIP was generated by irrigated horticultural activities, while irrigated pastures and irrigated broadacre crops each contributed around 24 per cent.

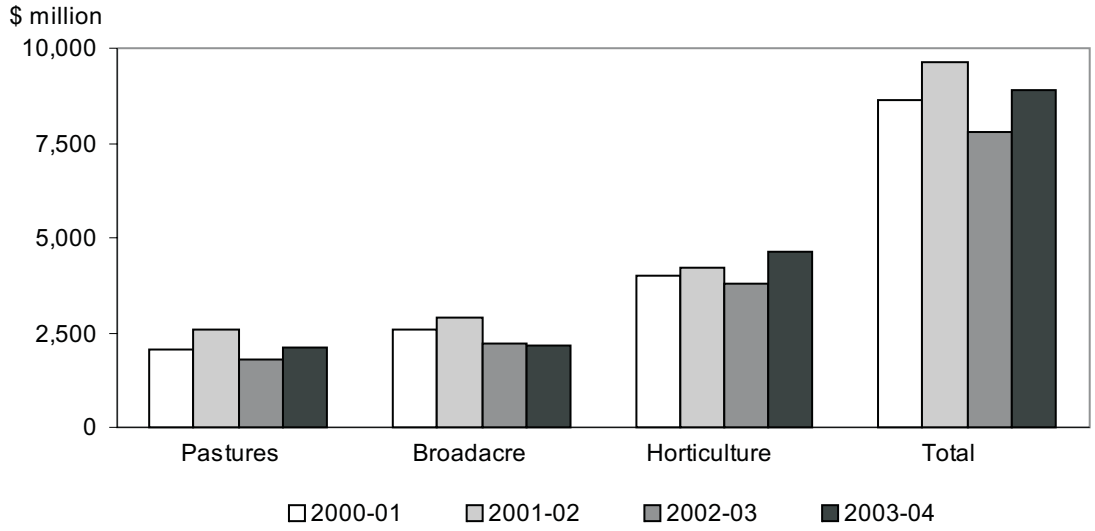
- The value of irrigated pasture production and irrigated horticultural production was slightly higher in 2003–04 than in 2002–03 and also compared to three years earlier. The increase in GVIP for these activities reflects higher prices received for some commodities and an expansion of production levels in some growing regions, particularly following the effects of drought in 2002–03.
- In contrast, the value of irrigated broadacre production was lower in 2003–04 than in earlier years — primarily reflecting lower income from rice and cotton growing. Cotton prices have declined each year since 2000–01 and the drought contributed to a sharp reduction in the area harvested in 2002–03 and 2003–04. Prices for rice in Australia have been relatively high and stable in recent years, but the drought and lower irrigation allocations have reduced both areas planted and production. This increased the importance of other irrigated activities to rice producers.

For *irrigated farms as a group*, irrigated production represented about 60 per cent of their GVP (table 3.1). Looking behind this aggregate, the degree of specialisation in irrigated agriculture varied significantly between activities.

- For example, farms with horticulture as their main irrigated activity generated 74 per cent of their production income from irrigated activities.
- In contrast, farms with pastures, rice or other cereals as their main irrigated activity had less than 50 per cent of their production income derived from irrigated activities.

In each irrigated activity, at least 75 per cent (and typically around 90 per cent) of GVIP was generated by those farms which reported the activity as their *main* irrigated activity. An exception to this was rice production. In 2003–04, 75 per cent of income from rice production was generated by farms that did not report rice as their main irrigated activity — that is, their main irrigated activity and major source of irrigated production revenue was an activity *other than rice* (typically other cereal crops or pastures).

FIGURE 3.1 GROSS VALUE OF IRRIGATED PRODUCTION BY IRRIGATED ACTIVITY — 2000–01 to 2003–04



Sources: ABS Agricultural Census and Agricultural Surveys; and Value of Agricultural Commodities Produced, Australia (cat. no. 7503.0).

TABLE 3.1 FARM SPECIALISATION AND GVIP BY MAIN IRRIGATED ACTIVITY — 2003–04

	Average per farm			*Farm specialisation*		
	GVIP for main irrigated activity	*GVIP*	*GVP*	*In main irrigation activity(a)*	*In all irrigation activities(b)*	*Activity income from specialist(c)*
	$	$	$	%	%	%
Pastures	137 823	152 539	321 010	90	48	96
Broadacre	204 603	225 701	442 932	91	51	93
Rice	187 034	198 385	456 709	94	43	25
Cereals	76 224	162 314	586 569	47	28	76
Cotton	1 183 653	1 264 716	1 794 794	94	70	91
Sugar	143 063	170 165	282 054	84	60	99
Other	160 143	174 007	260 709	92	67	86
Horticulture	279 103	282 571	382 228	99	74	93
Fruit	246 078	255 703	356 710	96	72	90
Grapes	207 645	216 630	277 381	96	78	94
Vegetables	437 311	459 963	635 577	95	72	86
All Irrigators		220 415	374 286		59	—
All Non-Irrigators			241 941			—
All farms			282 904			—

(a) GVIP from the main irrigated activity as a percentage of GVIP from all irrigated activities on the farm.

(b) GVIP as a percentage of GVP.

(c) Percentage of total GVIP for an irrigated activity that is generated by farms that have this activity as their main irrigated activity.

Sources: ABS Agricultural Survey 2003–04 and Value of Agricultural Commodities Produced, Australia (cat. no. 7503.0).

Box 3.2 Grouping of farms on the basis of income

For the presentation of results, farms are divided into five equal groups (quintiles) according to their estimated value of agricultural operations (EVAO) — a moving average measure of the gross value of all agricultural production (GVP) on a farm. A farm's EVAO is taken to be a measure of its size, on an average income basis. The division of farms into quintiles is undertaken on two separate bases.

In the first instance, each farm's EVAO is compared to that of all other farms — both irrigated and non-irrigated — in Australian agriculture. This grouping facilitates a comparison of farms between different irrigated activities and provides some information on how the size (on an income basis) of farms with irrigation varies from the size of farms with no irrigation. Farm groupings on this basis are referred to as *agriculture size groups*.

In the second instance, each farm's EVAO is compared with that of other farms with the same main irrigated activity. This division of farms facilitates a detailed portrayal of the diversity of farms within each irrigated activity grouping. Farm groupings on this basis are referred to as *irrigated activity size groups*.

Statistical estimates and standard errors of estimates for each variable by size group and for irrigated activity totals are provided in appendixes D and E.

3.2 CONTRIBUTION OF DIFFERENT SIZE FARMS TO GVIP

Farm size and GVIP

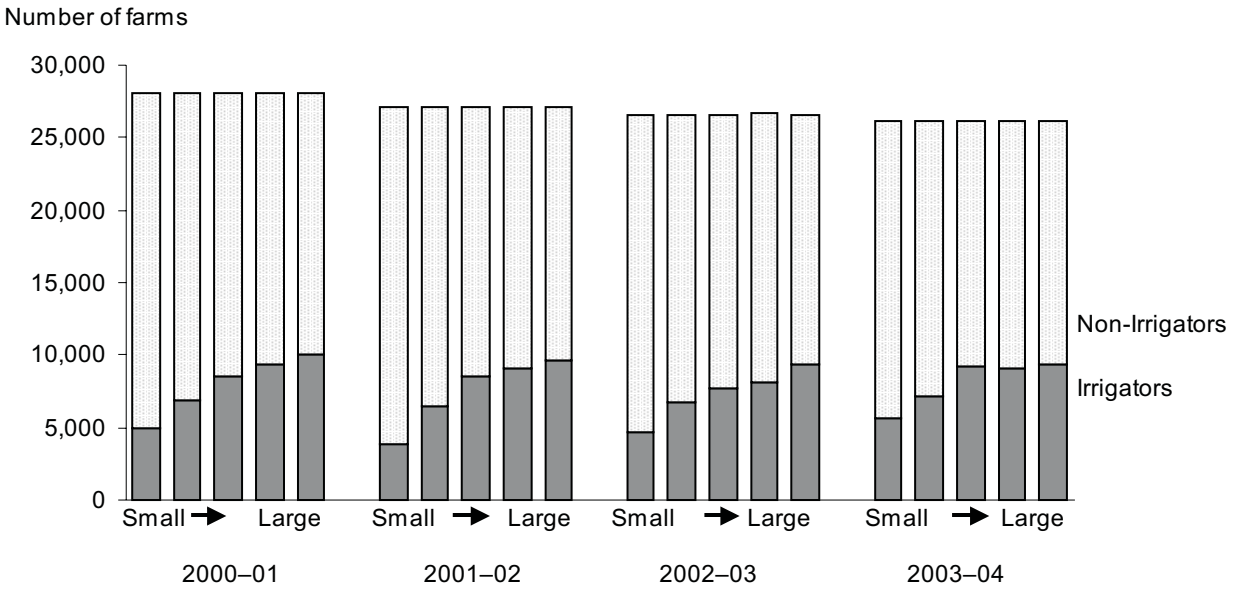
Proportionately more farms in the larger size groups undertook some irrigation activity (figure 3.2). This reflects the higher production levels (and therefore higher EVAO) achievable in many activities with the adoption of irrigation.

Nevertheless, there has been an increase in the proportion of small to medium size farms that irrigated in recent years. One factor influential in this change has been the drought — low rainfall reduced production levels (and EVAO) of non–irrigated farms relative to production on farms that irrigated.

Farms with irrigation typically generated 55 per cent more production income in 2003–04 than farms that did not irrigate (table 3.1) — although the land area of irrigated farms was smaller, on average, than that of non-irrigated farms (ABS 2005d). This is down slightly from 2002–03 (the main drought year in many regions), but is consistent with earlier years.

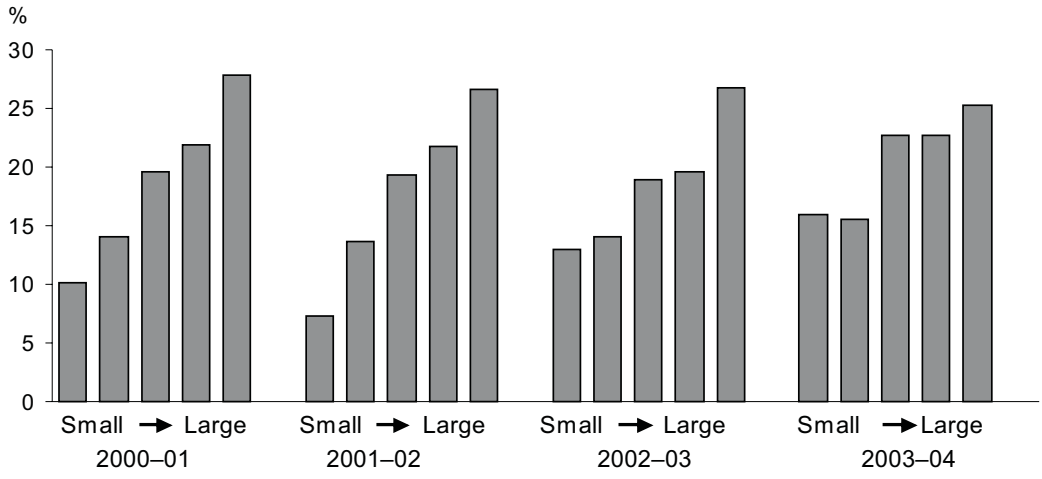
In keeping with the links between farm size and propensity to irrigate, the contribution made by irrigation income to all agricultural production income increased with farm size (figure 3.3). For example, 25 per cent of gross production income on large farms was generated by irrigated activities in 2003–04, while on the smallest farms only 16 per cent of gross production income came from irrigated activities.

FIGURE 3.2 DISTRIBUTION OF IRRIGATING AND NON-IRRIGATING FARMS BY AGRICULTURE SIZE GROUPS — 2000–01 to 2003–04(a)



(a) Some change over time in the number of farms may reflect sampling differences in the Agricultural Surveys.
Sources: ABS Agricultural Census, Agricultural Surveys, and Value of Agricultural Commodities Produced, Australia (cat. no. 7503.0).

FIGURE 3.3 GVIP AS A SHARE OF ALL AGRICULTURAL PRODUCTION INCOME BY AGRICULTURE SIZE GROUPS — 2000–01 to 2003–04(a)



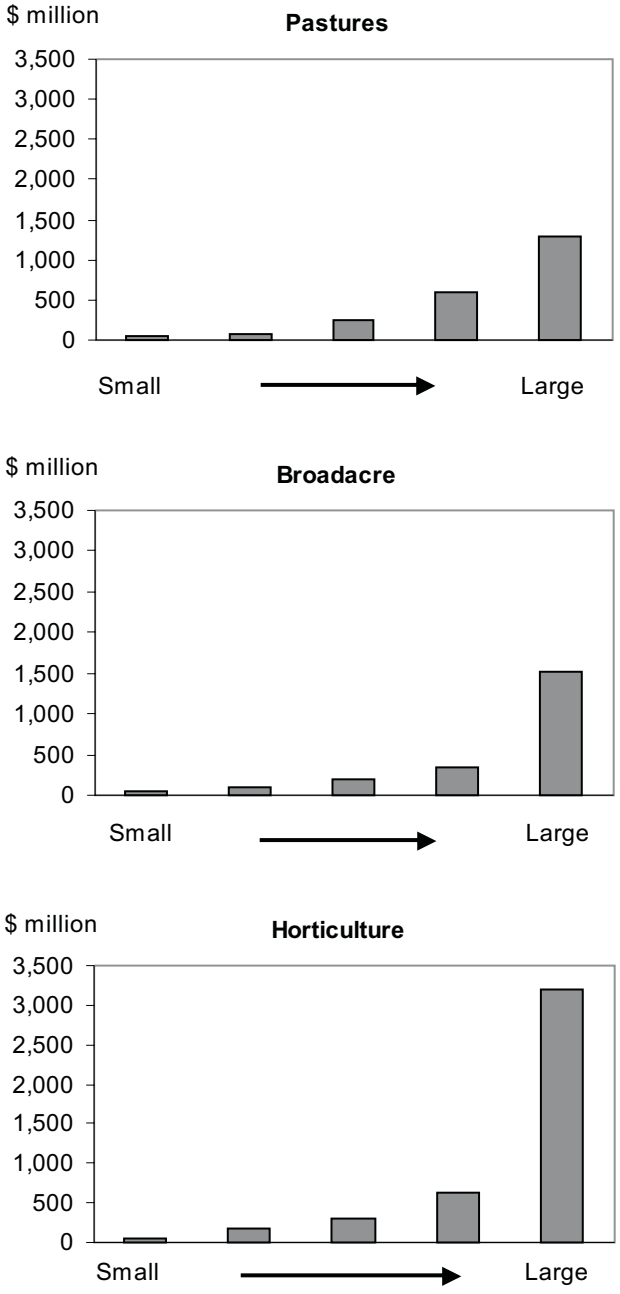
(a) Some change over time in the number of farms may reflect sampling differences in the Agricultural Surveys.
Sources: ABS Agricultural Census, Agricultural Surveys, and Value of Agricultural Commodities Produced, Australia (cat. no. 7503.0).

Farm size and irrigated activity

The contribution made by large farms at an *aggregate* level was evident in each of the *individual* irrigated activities. As would be expected, in each activity group, the largest farms generated the majority of irrigated production income (figure 3.4).

- In particular, amongst farms with *pastures* as the main irrigated activity, 57 per cent of GVIP (or $1,295 million) was generated by the largest 20 per cent of farms in 2003–04. The smallest 20 per cent of farms generated just 2 per cent of GVIP (or $40 million). The majority of GVIP from irrigated pastures was generated from dairy production in south eastern Australia.
- For farms with *broadacre* crops as their main irrigated activity, 69 per cent of GVIP (or $1,513 million) was generated by the largest 20 per cent of farms. The smallest 20 per cent of farms generated just 2 per cent of GVIP (or $40 million). Amongst the main broadacre crops, cereals (excluding rice) and cotton grown on the temperate slopes and plains of southern Australia and in the subtropical slopes and plains of eastern Australia provided the highest contribution to GVIP.
- The dominance of large farms in the generation of gross revenue for an activity was most evident amongst the *horticultural* activities. For establishments with horticulture as their main irrigated activity, 73 per cent of GVIP (or $3,193 million) was generated by the largest 20 per cent of horticultural establishments. The smallest 20 per cent of farms generated just 1 per cent of GVIP (or $56 million). The highest returns were from establishments on the wet temperate coasts of south eastern Australia and the temperate slopes and plains of southern Australia.

FIGURE 3.4 GVIP BY IRRIGATED ACTIVITY SIZE GROUPS — 2003–04



Sources: ABS Agricultural Survey 2003–04 and Value of Agricultural Commodities Produced, Australia (cat. no. 7503.0).

3.3 GVIP PER UNIT OF IRRIGATION WATER AND IRRIGATED LAND

Productivity measures are often used to assess the relationships between inputs and the value of outputs produced. They support the analysis of the impact of technical and organisational change in industry.

Differences in productivity between farms or over time can be seen as the outcome of farm level decisions on production, capital investment, land and water management, and environmental influences. As such, the average value of production per unit of irrigation water (GVIP per megalitre) or irrigated land used (GVIP per hectare) provide a means of summarising the outcome of a range of farm level decisions and indicate cases for a broader analysis at farm level. However, variations in such partial measures of farm performance do not necessarily imply variations in overall farm productivity. It is therefore important to consider the limitations when such partial measures are used (box 3.3).

As might be expected, there were substantial differences between activities in the GVIP generated per unit of irrigation water and irrigated land used. The highest GVIP per megalitre and GVIP per irrigated hectare in 2003–04 was evident for those establishments with horticulture (in particular, fruit and vegetables) as the main irrigated activity (appendix D). The average return for irrigated horticultural establishments was $10,662 per megalitre of irrigation water applied. In contrast, average returns were $2,098 per megalitre for irrigated pasture farms[5] and $7,831 per megalitre for irrigated broadacre farms[6] — farms which are typically located in different agro-ecological regions to horticultural establishments and are likely to have a very different input structure.

Box 3.3 Limitations of partial productivity measures

Partial productivity measures for farms should be considered in the context of the entire farm production system. This is because partial measures such as GVIP per unit of irrigation water or irrigated land use do *not* separately account for differences between farms or activities in the use of labour, machinery and other inputs to production or differences in the quality of resources used. It can also be difficult to attribute changes in such measures to individual activities, where there are multiple uses of the same input (such as benefits derived by subsequent crops in a rotation as a result of residual soil moisture following irrigation). The cost of inputs used in the production process is also not accounted for. Finally, although GVIP per unit of irrigation water or irrigated land use may be used to indicate an upper bound on farm willingness to pay for additional units of an input, it is unable to capture the change in GVIP that could be generated by an additional unit of irrigation water or irrigated land. For these reasons, GVIP per megalitre and GVIP per hectare *cannot* be used to assess the value of irrigation water or land resources in production or in alternative uses. Some of these limitations are discussed further in Douglas, Dwyer and Peterson (2004).

5 The estimate for GVIP per megalitre on farms with pastures as their main irrigated activity may be overstated if water used for non-irrigation activities (such as stock water or cleaning of dairy sheds) is a significant part of total water use on these farms.

6 For farms in the irrigated broadacre group, the average GVIP per unit of irrigated land used or water applied is inflated by high unit output on a small number of farms that have 'other crops' as their main irrigated activity.

There was also substantial variation in GVIP per unit of irrigation water and irrigated land used for farms of different sizes and activities within these broad groups (appendix D).

- For farms that had *pastures* as the main irrigated activity, GVIP per unit of irrigation water and irrigated land of large farms was significantly higher than that of small farms (figure 3.5).
- Amongst the *broadacre* activities, larger farms with cereals (excluding rice) or sugar as the main irrigated activity evidenced higher GVIP per unit of irrigation water and irrigated land than smaller farms. In contrast, there was little difference in GVIP per megalitre of irrigation water used on large and small farms with irrigated cotton or rice.
- For the *horticultural* activities, larger farms with fruit or vegetables as the main irrigated activity had GVIP per megalitre and GVIP per irrigated hectare that was significantly higher than that on smaller farms (appendix D). For farms with grapes as the main irrigated activity, larger farms tended to have higher GVIP per irrigated hectare but lower GVIP per megalitre than smaller grape establishments.

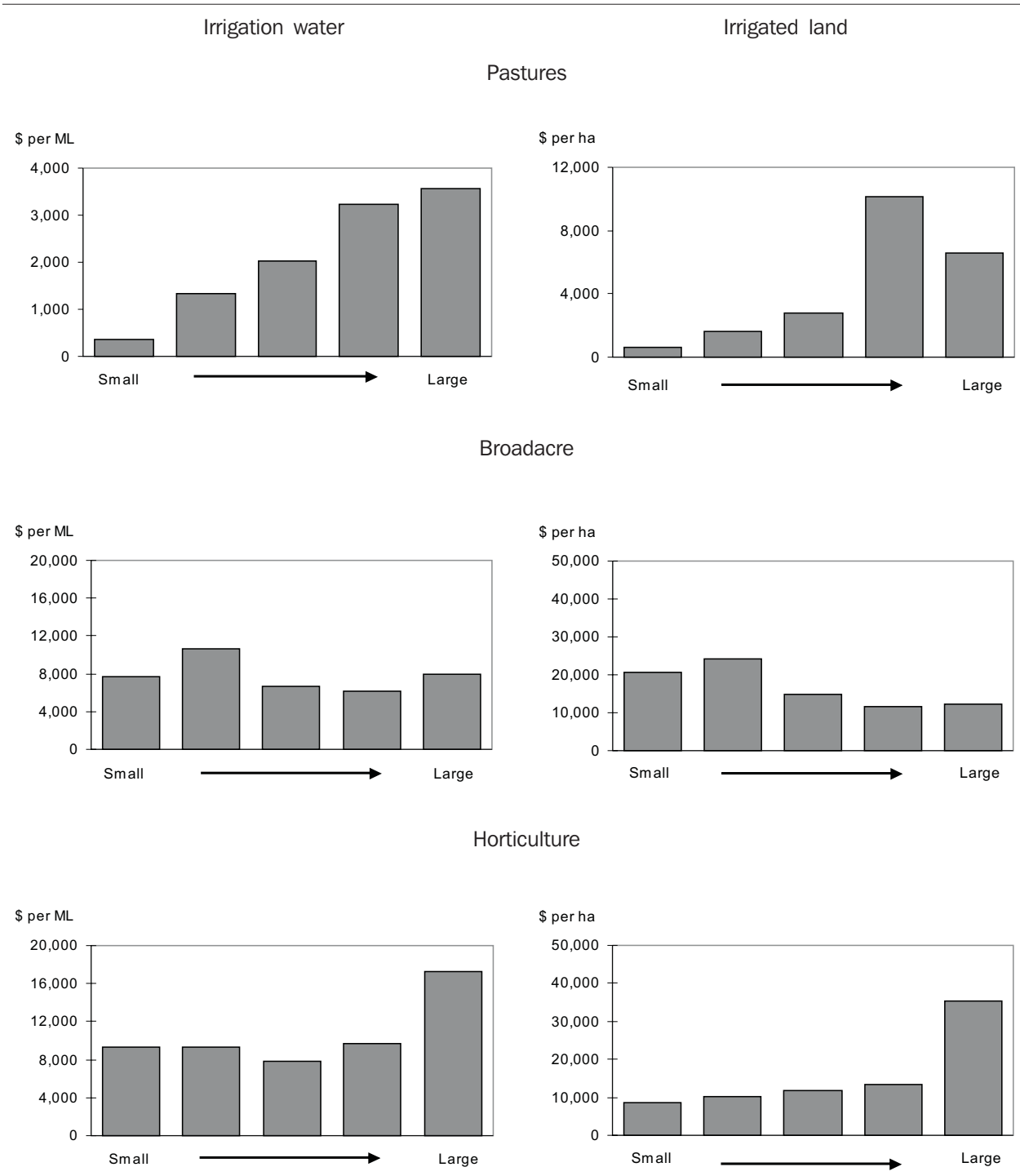
As indicated above, these variations may be partially influenced by a range of environmental and farm specific factors — for example, the higher uptake of on-farm irrigation scheduling tools on larger farms (see chapter 4).

GVIP per megalitre of irrigation water used varied substantially for farms between growing regions and irrigated activities (figure C2).

- For farms with *pastures* as the main irrigated activity, GVIP per megalitre of irrigation water used ranged from $11 per megalitre on the semi-arid plains of east-central Australia up to $4,647 per megalitre on the wet temperate coasts of southern Australia.
- For farms with *broadacre* crops as the main irrigated activity, GVIP per megalitre of irrigation water used was dominated by relatively high gross unit output on a small number of farms with 'other crops', in the northern tropics. Amongst the 'traditional' broadacre crops, GVIP per megalitre of irrigation water used ranged from $34 per megalitre for cereals (excluding rice) on the semi arid plains of east-central Australia up to $3,473 per megalitre for sugar in the north east tropics.
- For farms with *horticultural* crops as the main irrigated activity, GVIP per megalitre of irrigation water used ranged from $1,171 per megalitre for grapes in the arid interior of Australia up to $36,004 per megalitre for fruit in the north west tropics.

These substantial variations in GVIP per megalitre of irrigation water used between regions emphasise the diversity in regional economic, climatic and environmental conditions that affect Australian farms. They may also reflect factors such as difference in crop varieties between regions or disparity in the need for irrigation water in production as a supplement to rainfall.

FIGURE 3.5 GVIP PER UNIT OF IRRIGATION WATER AND IRRIGATED LAND USED BY IRRIGATED ACTIVITY SIZE GROUPS — 2003–04
Average per farm



Sources: ABS Agricultural Survey 2003–04 and Value of Agricultural Commodities Produced, Australia (cat. no. 7503.0).

CHAPTER 4 ATTRIBUTES OF FARMS THAT USE IRRIGATION WATER

Differences in the contribution to agricultural output of irrigated activities and farm size groups are likely to reflect differences in the attributes of farms that use irrigation water. This chapter examines farm attributes that specifically relate to the use and management of irrigation water. Farms are grouped by main irrigated activity and farm size — as measured by EVAO. For each activity group, information is provided on the farm use and management of water resources, sources of irrigation water, the application of alternative types of irrigation technology and scheduling tools, and irrigation-related farm expenses.

4.1 FARM RESOURCE USE AND THE CONTINUITY OF IRRIGATION

There is considerable variability in the quantity and quality of land and water resources utilised in agricultural production, between the types of irrigation activities and across different farm size groups. This variability reflects differences in the type of crops irrigated and the nature of the production process — for example, annual compared with perennial activities — as well as regional differences in soils and climatic conditions.

Farm size and the use of land and water resources

As would be expected, irrigated farms with high average incomes generally used more irrigated land and water resources than their smaller counterparts (figures 4.1 and 4.2). The commitment of land to irrigation varied substantially across irrigated activities with small grape establishments irrigating an average of 3 hectares, while larger cotton establishments irrigated an average of 1,050 hectares. Similarly, irrigation water use varied from an average of 10 megalitres on small grape establishments up to an average in excess of 7,000 megalitres on large cotton establishments.

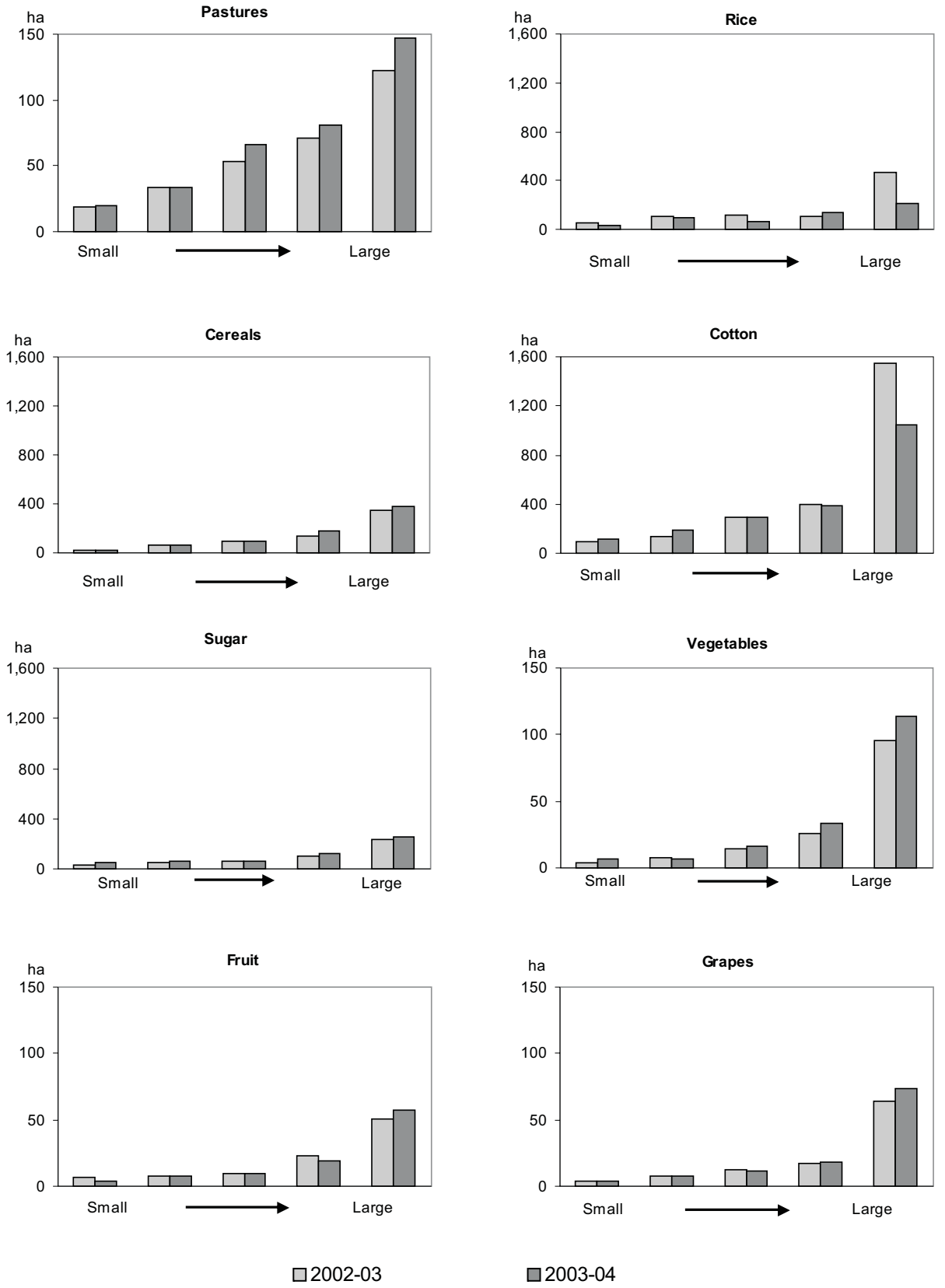
For most activities and size groups, irrigated land and irrigation water use were higher in 2003–04 than in 2002–03. The obvious exception to this was for farms with rice or cotton as the main irrigated activity — in particular, there was a substantial decline in 2003–04 in both irrigated land and irrigation water use on large farms with these activities. These declines reflect a reduction in areas planted to crops that required irrigation and were a response to an expected low level of water availability in 2003–04, given rainfall conditions and low water storage levels (appendix B).

Proportion of farm area irrigated

Farms with pastures or broadacre crops such as rice, other cereals or cotton as the main irrigated activity typically had a *proportionately* smaller area of the farm under irrigation (typically 15 to 30 per cent) than those farms that had horticulture as the main irrigated activity (generally well over 40 per cent — see figure 4.3). Within the irrigated broadacre group, farms with sugar as the main irrigated activity tended to devote a larger proportion of farm land to irrigated cropping than to other non-irrigated activities.

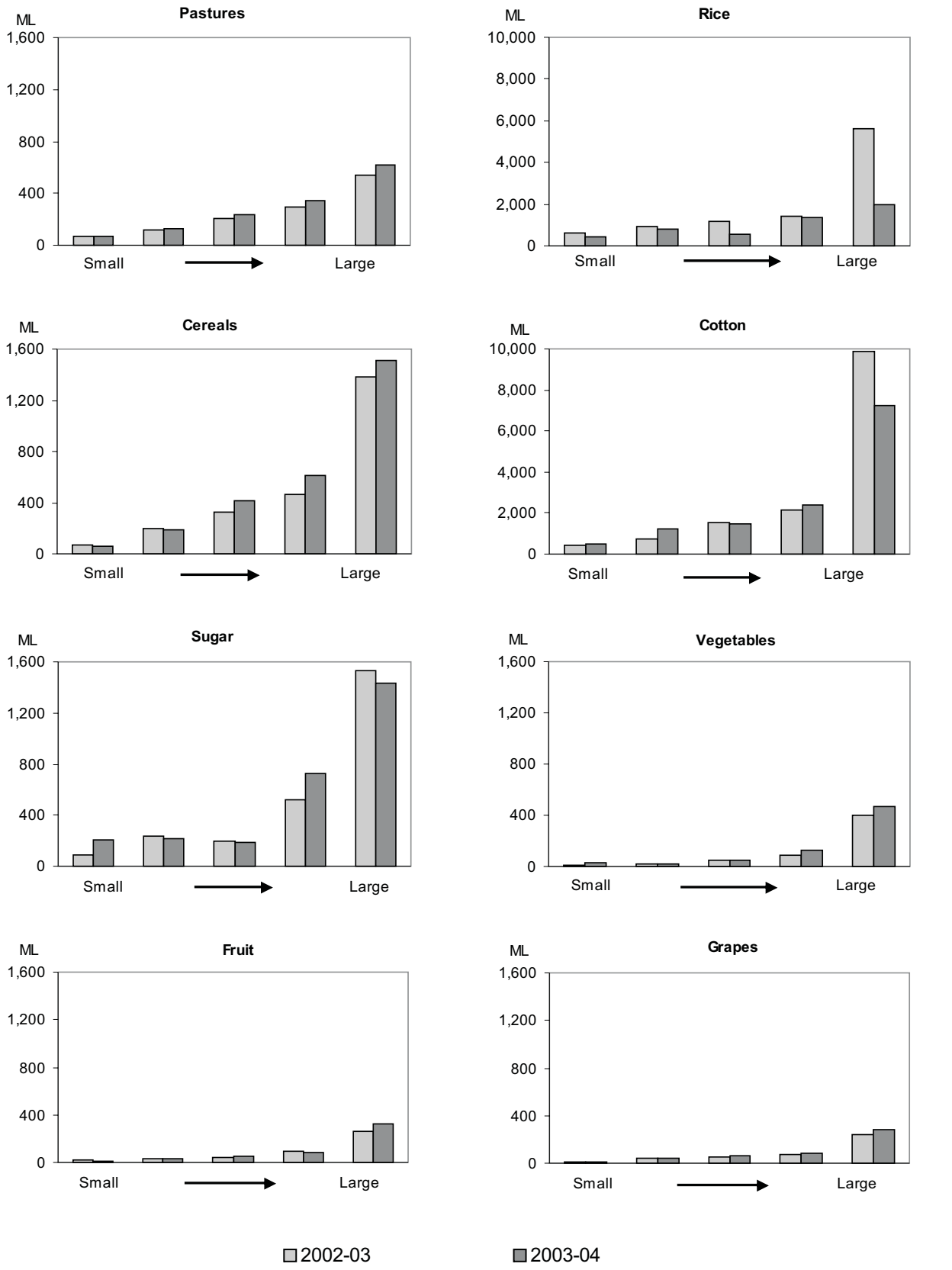
For most activities and farm size groups, the proportion of the farm area that was under irrigation was lower in 2003–04 than it was in 2000–01. As noted above, this decline in irrigated area, which was sharpest for those farms that had rice or cotton as the main irrigated activity, mainly reflects regional impacts of drought and irrigation water availability.

FIGURE 4.1 IRRIGATED AREA BY IRRIGATED ACTIVITY SIZE GROUPS — 2002–03 and 2003–04
Average per farm



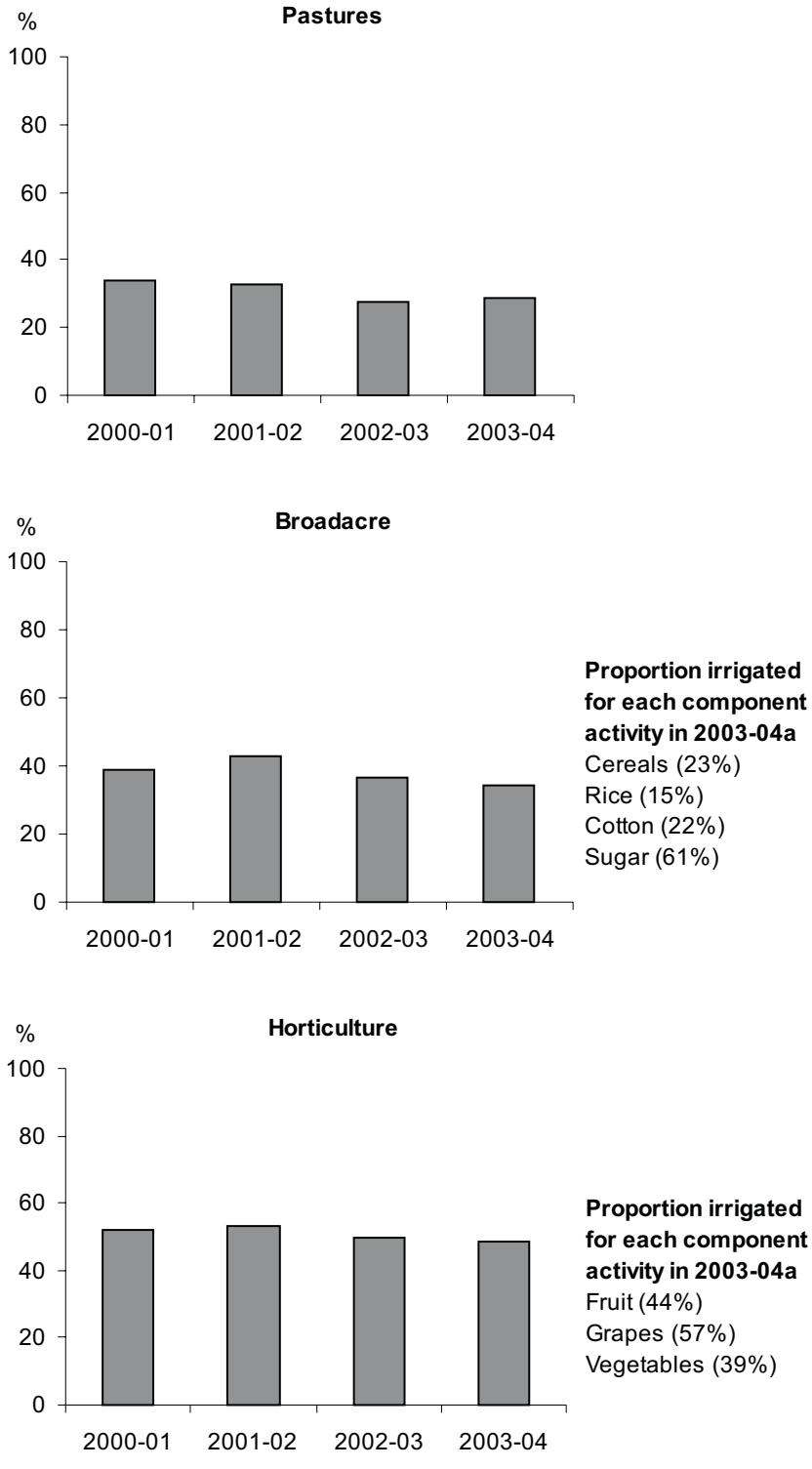
Sources: ABS Water Survey Agriculture 2002–03 and ABS Agricultural Survey 2003–04.

FIGURE 4.2 IRRIGATION WATER USE BY IRRIGATED ACTIVITY SIZE GROUPS — 2002–03 and 2003–04
Average per farm



Sources: ABS Water Survey Agriculture 2002–03 and ABS Agricultural Survey 2003–04.

FIGURE 4.3 PROPORTION OF FARM AREA IRRIGATED BY ACTIVITY — 2000–01 to 2003–04



(a) Average over all farms in each irrigated activity in 2003–04.

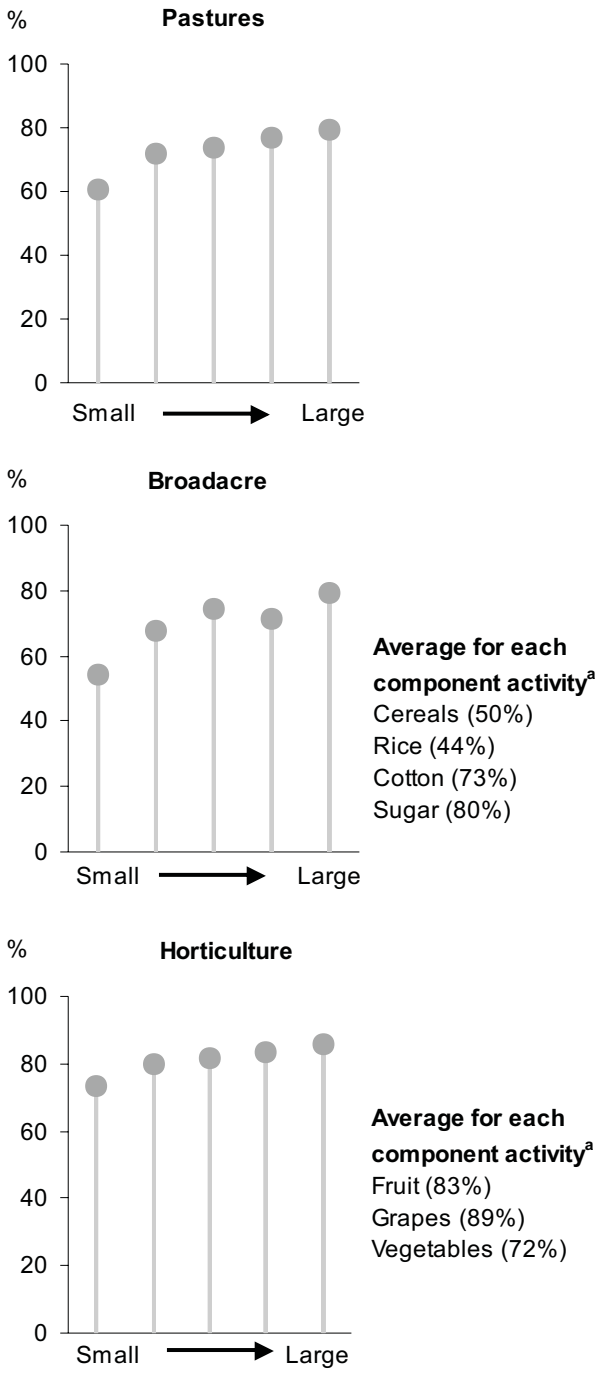
Sources: ABS Agricultural Census and Agricultural Surveys.

Continuity of irrigation over time

Across all irrigated activities, the large irrigated farms were generally more likely than smaller farms to *continue irrigation* of their main irrigated activity over successive years (figure 4.4).

- Amongst farms that had *pasture* as the main irrigated activity, nearly 80 per cent of large farms that irrigated in 2000–01 continued to irrigate pasture in the following three years. This compared with only about 60 per cent of small farms which had irrigated pasture in each year.
- Within the irrigated *broadacre* group, 80 per cent of sugar and just over 70 per cent of cotton farms that irrigated in 2000–01 reported irrigation of these crops in the following three years. Continuity of an irrigated activity was higher for medium to large sugar and cotton farms than for smaller farms. In contrast, farms with rice or other cereals as the main irrigated activity in 2000–01 were less likely to have these particular crops as their main irrigated activity in the successive three years.
- Within the irrigated *horticultural* group, medium and large establishments with grapes or fruit as the main irrigated activity were more likely than other horticultural establishments to continue irrigating their crop in each year. Almost 90 per cent of grape establishments and just over 80 per cent of fruit establishments that irrigated in 2000–01 continued to irrigate grapes and fruit, respectively, in the following three years. The high continuity of irrigation of these activities between years is consistent with the often substantial amount of capital invested in fruit trees and grape vines.

FIGURE 4.4 CONTINUITY OF IRRIGATION BY IRRIGATED ACTIVITY SIZE GROUPS — 2000–01 to 2003–04
Percentage of farms in each size group which irrigated every year



(a) Average over all farms in each irrigated activity.
Sources: ABS Agricultural Census and Agricultural Surveys.

4.2 IRRIGATION METHODS AND TECHNOLOGY

There was considerable variability between irrigated activities in the methods used to irrigate and the technology utilised by farms to regulate and improve the efficiency of irrigation. Some of these differences reflect variability in the type of crops irrigated, the size of the farm and differences between regions in soil types and climatic conditions. For horticultural activities in particular, variations also reflect differences in the most efficient technique of irrigation of perennial activities such as fruit trees and grape vines, compared with annual production of vegetable crops and nursery products.

Irrigation application methods

Irrigation application methods describe the technology used to apply irrigation water on a farm. For the presentation of results, irrigation methods are aggregated into three groups: *surface* methods, *sprinklers* (or spray), and *drip*.

Surface irrigation methods generally take the form of controlled flooding of paddocks or irrigation bays. Sprinklers or spray irrigation involves the application of water to a crop via overhead spraying. This may involve the use of micro-sprays, portable irrigators, hose irrigators, solid sets or large mobile machines. In contrast, drip irrigation applies water to individual plants or rows of crops, and includes above ground and subsurface irrigation. For all activities, the water application method was the most commonly *reported change* to irrigation practices in the five years to 2002–03 and *intended change* in the future.

The principal method used to apply irrigation water on a farm varies between activities, with some methods more suited than others for particular activities.

- The dominant approach for the application of irrigation water on farms with rice (96 per cent), other cereals (51 per cent) or cotton (95 per cent) as the main irrigated activity was surface irrigation methods (figure 4.5).
- For farms with pastures, sugar or vegetables as the main irrigated activity, 50 to 60 per cent of the area under irrigation utilised sprinklers.
- For establishments with fruit or grapes as the main irrigated activity, the dominant approach to apply irrigation water was drip irrigation — used on 80 per cent of the irrigated area of fruit establishments and 73 per cent of the irrigated area of grape establishments.

There was, however, some spatial variability in the use of alternative application methods. To some extent, this may reflect differences in the suitability of alternative application methods on different soil types.

- For example, surface irrigation methods were the dominant approach for applying irrigation water to pastures on the temperate slopes and plains of southern Australia, but were not widely used for pastures in the remainder of Australia (appendix C).

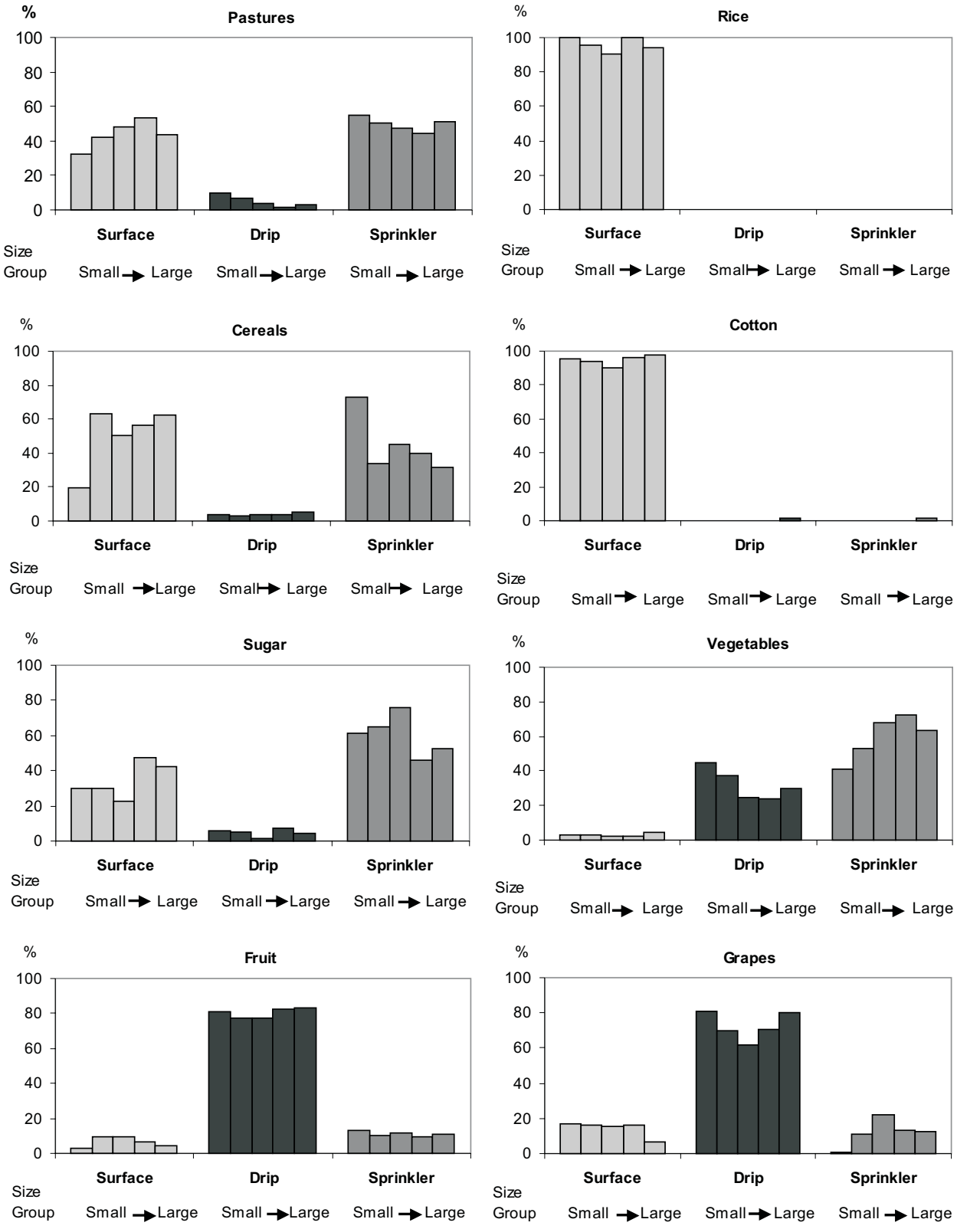
- Similarly, while surface irrigation methods were the dominant water application method for cereals (excluding rice) in the semi-arid plains of northern Australia and on the temperate slopes and plains, sprinklers were the dominant technology for irrigation of cereals (excluding rice) in the remainder of Australia.
- For sugar, surface irrigation methods tended to be adopted in the north west and north east tropics, but sprinklers were dominant in other regions.

For most activities there was little apparent link between farm size and choice of application method. Cereals (excluding rice), grapes and vegetables were the exception to this.

- Small farms with cereals (excluding rice) as the main irrigated activity tended to use sprinklers, whereas larger cereal farms had a higher area under surface irrigation.
- For irrigated grapes, while drip irrigation was the main application method, some small to medium size farms used surface irrigation technology and some medium to larger size farms used sprinklers.
- For farms with vegetables as the main irrigated activity, drip irrigation was the dominant application method on smaller farms, while sprinklers were the dominant technology on larger farms.

FIGURE 4.5 IRRIGATION WATER APPLICATION METHODS BY IRRIGATED ACTIVITY SIZE GROUPS — 2003–04(a)

Average percentage of irrigated area per farm



(a) Data for some categories are not available for publication.

Source: Agricultural Survey 2003–04.

Application rates

Water application rates varied widely across irrigated activities, ranging from an average in 2003–04 of less than 3 megalitres per hectare on cereals (excluding rice) to an average of about 4 to 5 megalitres per hectare on pastures, sugar and horticultural crops, around 6 megalitres per hectare for cotton and 13 megalitres per hectare on rice (appendix D).

For irrigated pastures, sugar and cotton, water application rates were generally higher on larger farms than on smaller farms (figure 4.6). However, for rice, other irrigated cereals and irrigated horticultural activities, there was no apparent relationship between farm size and water application rates.

Water application rates for the *main* irrigated activity on a farm often vary from application rates for the *same activity* that prevail on farms which have a *different* main irrigated activity. For example, in 2003–04, farms that had vegetables as a main irrigated activity tended to have lower water application rates on those areas of irrigated pasture and irrigated broadacre crops on their farms than farms which had these particular activities as their main irrigated activities.

Water application rates varied substantially with *agro–ecological conditions* across Australia (appendix C). Application rates were higher for most activities grown on the temperate slopes and plains of southern Australia, in the arid interior and for the small number of farms with crops in the north west tropics. For irrigated pastures, water application rates were also higher in the north east tropics. For cotton and grapes, application rates were comparatively high where these activities were undertaken on the semi-arid plains of northern Australia.

Laser levelling

Laser levelling involves the use of a laser guided land plane to smooth a paddock surface, filling low spots and removing high spots to reduce pondage and improve the technical efficiency with which irrigation water can be applied. It is most common for activities irrigated using surface irrigation methods.

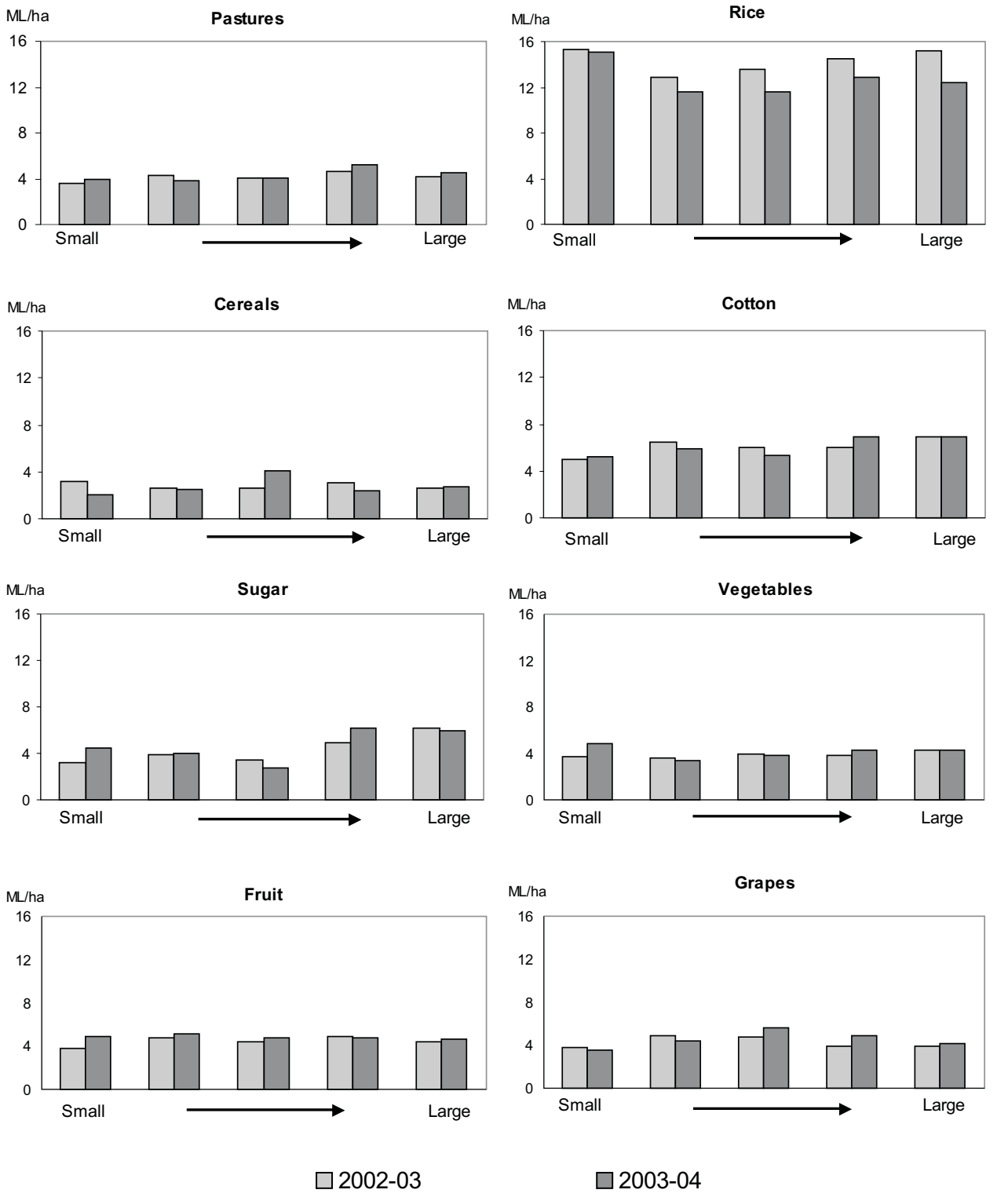
In 2002–03, around 37 and 42 per cent of land was laser levelled on farms with pasture or broadacre crops, respectively, as the main irrigated activity (appendix D).

- Amongst broadacre activities, the highest average proportion of farm area laser levelled (52 per cent) was reported by farms that had sugar as the main irrigated activity — primarily those farms located in the north west and north east tropics where surface irrigation methods were dominant.
- However, the number of farms that reported having undertaken laser levelling in the five years to 2002–03, or intending to undertake it in 2003–04, was highest for those farms that had rice or cotton as their main irrigated activity.

Across all irrigated activities, laser levelling was most prevalent on farms that had horticulture as a main irrigated activity. In particular, around 70 per cent of land on irrigated grape establishments was reported as laser levelled in 2002–03, with the highest rates (also coinciding with higher use of surface irrigation methods) evident for farms on the temperate slopes and plains of southern Australia and in the arid interior.

The relationship between farm size and laser levelling differed for each activity. While the extent of laser levelling for rice and irrigated cereal farms was highest on small and medium size farms, for sugar and cotton farms, the proportion of the farm laser levelled generally rose with farm size. There was no apparent relationship between farm size and the extent of laser levelling on horticultural establishments.

FIGURE 4.6 WATER APPLICATION RATES BY IRRIGATED ACTIVITY SIZE GROUPS — 2002–03 and 2003–04
Average per farm



Sources: ABS Water Survey Agriculture 2002–03 and ABS Agricultural Survey 2003–04.

Irrigation scheduling approaches

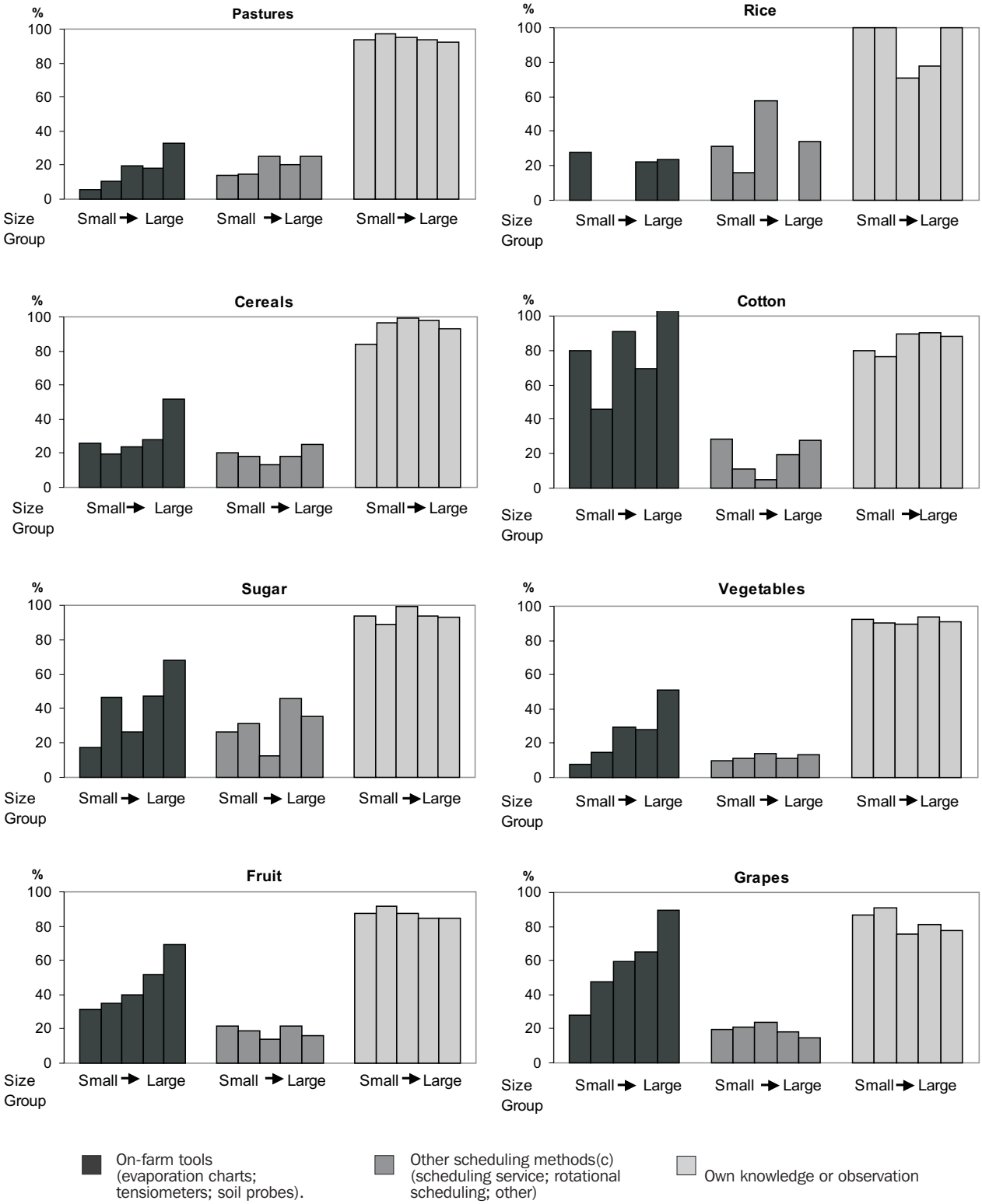
Irrigation scheduling is a process of determining when to irrigate and how much water to apply to an irrigated crop in order to maximise net returns. Some of the main tools used by irrigators include: evaporation figures or graphs; tensiometers and soil probes to test soil moisture; government or commercial scheduling services; calendar or rotational scheduling; and knowledge or observation.

The use of scheduling tools varied substantially between farms, although farmer knowledge was generally important for farms in all activities and size groups. On-farm equipment based approaches, such as evaporation charts, tensiometers and soil probes, tended to be utilised by larger farms. Use of other scheduling approaches (some of which may also be tailored to an individual farm), such as government or commercial scheduling services, rotational scheduling and farmer knowledge was not as closely related to farm size.

- For irrigated *pasture* farms, irrigation scheduling tools, apart from farmer knowledge, were reported as not being widely used for regulating the application of irrigation water (figure 4.7).
- For irrigated *broadacre* farms, the use of scheduling tools varied between activities, with on-farm tools such as evaporation charts widely used on rice and sugar farms of all sizes, and soil probes widely used on medium to large cereals (excluding rice) and cotton farms (appendix D).
- For irrigated *horticultural* establishments, the most commonly used irrigation scheduling tools, apart from farmer knowledge, were on–farm tools such as tensiometers and soil probes.

FIGURE 4.7 USE OF IRRIGATION SCHEDULING APPROACHES BY IRRIGATED ACTIVITY SIZE GROUPS — 2002–03

Per cent of farms in irrigated activity size group(a)(b)



(a) Percentages may not add to 100 as some farms use more than one irrigation scheduling approach.

(b) Data for some categories are not available for publication.

(c) Some commercial scheduling services are tailored to farms and may be considered an 'on-farm' tool.

Source: ABS Water Survey Agriculture 2002–03.

4.3 SOURCES OF IRRIGATION WATER

There was little variation in the principal off-farm source of irrigation water between irrigated activities. Surface water — water held in rivers, lakes, weirs and dams — was the main source of irrigation water for all activities in 2002–03 and 2003–04 (appendix D).

The extent to which alternative sources — such as groundwater, town or country reticulated mains supplies and on and off-farm recycled or reused water — were also important varied considerably between irrigated activities.

The availability of these alternative sources of irrigation water can impact on the reliability of overall irrigation supplies and irrigation management practices. In 2002–03, irrigation water supplies and allocation uncertainty were reported by farmers as some of the main *barriers* to changing irrigation practices by farms in all irrigated activities.

Recycled water

Off-farm recycled water — waste water that may have been treated to some extent prior to reuse — was not widely used. Where it was used, it tended to be by larger irrigated pasture farms or smaller irrigated cotton or sugar farms.

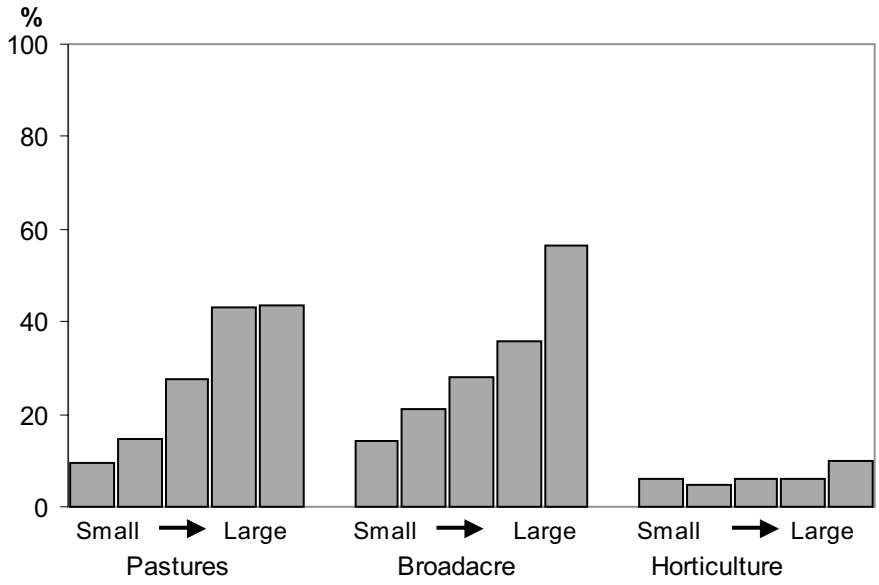
On-farm water recycling was generally more common on large farms than small and was undertaken more by farms with irrigated broadacre activities than those with irrigated pastures or irrigated horticulture (figure 4.8). Around 30 per cent of all farms with broadacre crops as their main irrigated activity, and almost all farms with cotton as the main irrigated activity, undertook some form of on-farm water recycling in 2002–03.

Farm dams

The capacity of on-farm dams varied substantially both across activities and with farm size (figure 4.9). Not surprisingly, for each activity, the highest average capacity dams were found on the largest farms. However, small farms that had pasture or horticulture as their main irrigated activity had a greater capacity to store a higher proportion of the farm's total water requirements in on–farm dams, relative to that on larger farms.

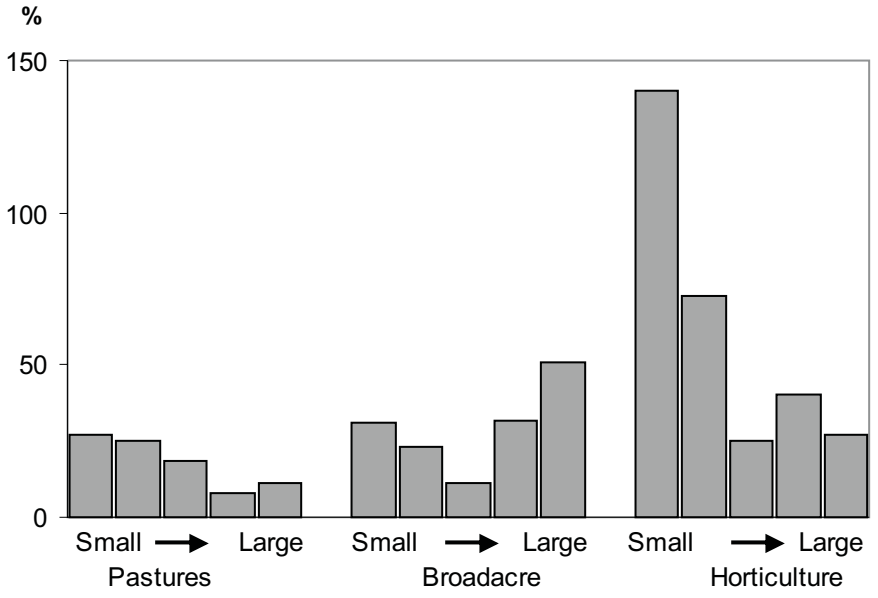
- Farm dams on irrigated *pasture* establishments ranged from an average of 32 ML capacity on smaller farms up to 111 ML capacity on large farms (appendix D).
- Among *broadacre* farms, those with cotton as the main irrigated activity had the highest capacity farm dams with an average capacity of 8,300 ML on large establishments. The lowest capacity dams were located on small to medium rice establishments and had an average capacity of just 4 ML.
- Farm dams on larger *horticultural* establishments ranged from 90 ML on fruit and grape establishments up to 300 ML on vegetable establishments.

FIGURE 4.8 ON-FARM WATER RECYCLING BY IRRIGATED ACTIVITY SIZE GROUP — 2002–03
Per cent of farms in irrigated activity size group



Source: ABS Water Survey Agriculture 2002–03.

FIGURE 4.9 FARM DAM CAPACITY BY IRRIGATED ACTIVITY SIZE GROUPS — 2002–03
Per cent of total farm water use



Source: ABS Water Survey Agriculture 2002–03.

4.4 IRRIGATION EXPENSES

A wide range of on–going and one–off irrigation related expenses can be incurred by farms and include: water licence or application charges; irrigation water volumetric or usage charges; irrigation fees and charges; purchases of irrigation equipment; irrigation operating expenses; construction of earthworks for irrigation purposes; and other irrigation expenses.

Total expenditure on irrigation

In 2002–03, irrigation expenses ranged from an average of $30 per ML on a large rice farm up to an average of almost $1,300 per ML on small grape and small to medium vegetable farms. Irrigation expenses were generally higher for small farms than for large farms, in each activity group (figure 4.10). This general pattern may reflect some economies of scale in the use of on-farm irrigation infrastructure.

The majority of irrigation expenses for farms with pastures, cereals (excluding rice), sugar or cotton as the main irrigated activity were incurred as operating expenditure in 2002–03. For rice farms, the major component was volumetric or usage charges.

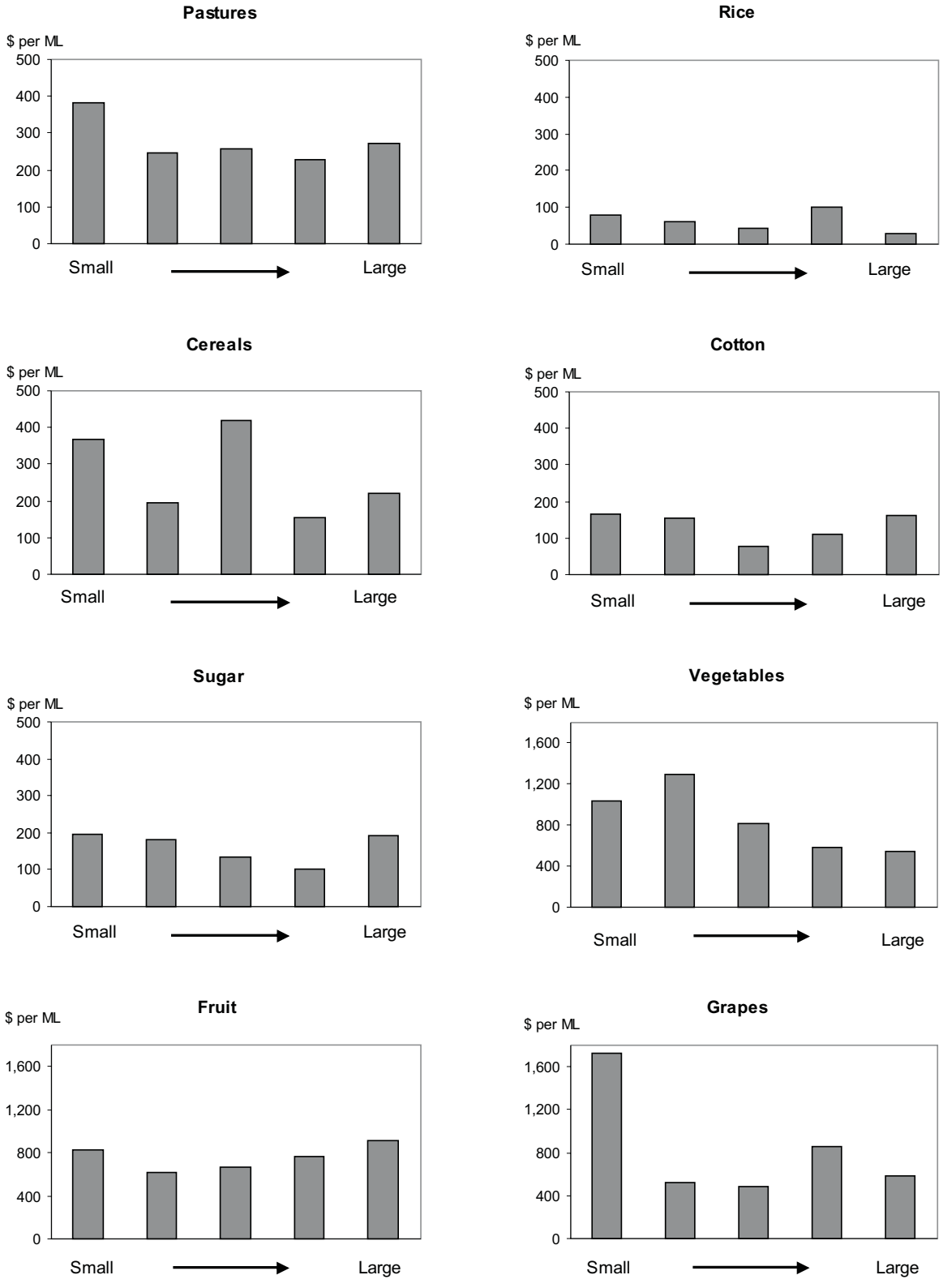
Irrigation expenses in 2002–03 for establishments with horticulture as the main irrigated activity were higher, on average, for farms with annual activities — such as vegetable production — than those with perennial production — such as fruit and grape establishments. In general, this reflected higher costs for irrigation equipment purchases and the construction of earthworks for irrigation purposes, and greater irrigation operating expenses on vegetable establishments. In addition, small vegetable establishments sourced a larger proportion of their irrigation water supplies from town water, which can be more costly than other water sources.

Irrigation expenses varied substantially across Australia in 2002–03. However, across all irrigated activities, they tended to be lowest in the irrigation regions on the temperate slopes and plains of southern Australia, and on the wet temperate and wet tropical coasts of eastern Australia (figure C3).

- For farms with *pastures* as the main irrigated activity, irrigation expenses were highest in the semi-arid plains of eastern central Australia.
- For farms with *broadacre* crops as the main irrigated activity, irrigation expenses were highest in the wet temperate coastal regions of southern Australia. This mainly reflected higher irrigation costs for nursery production and other small activities. Amongst large scale broadacre activities, irrigation expenses were generally highest for cereals (excluding rice) on the wet subtropical coast of eastern Australia and in the arid interior.

- For farms with *horticulture* as the main irrigated activity, irrigation expenses were highest for fruit and grapes grown in the subtropical slopes and plains of eastern Australia and in the temperate highlands of south eastern Australia, and for vegetables grown in the northern tropics.

FIGURE 4.10 IRRIGATION EXPENSES BY IRRIGATED ACTIVITY SIZE GROUPS — 2002–03
Average per farm



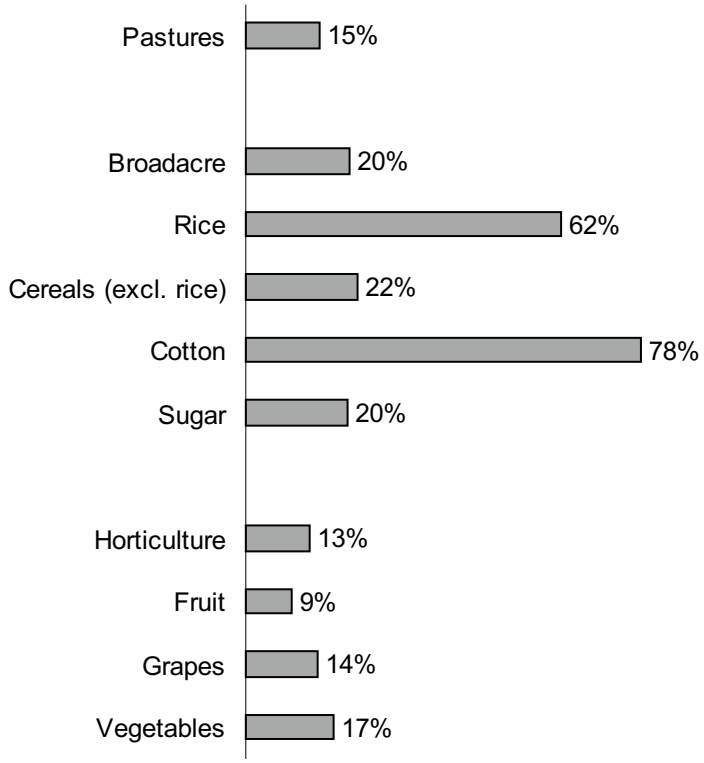
Source: ABS Water Survey Agriculture 2002–03.

Capital expenditure on irrigation

Capital expenditure on irrigation equipment and infrastructure varied considerably between activities but was generally higher for broadacre farms with rice or cotton as the main irrigated activity (figure 4.11). For example, in the five years to 2002–03, irrigation related capital expenditure was in excess of $100,000 for almost 80 per cent of irrigated cotton farms. Over the same period, less than 20 per cent of pasture or horticultural farms reported expenditure at these levels.

As would be expected, irrigation related capital expenditure tended to be consistently higher for large farms — in particular large cotton establishments (see appendix D).

FIGURE 4.11 CAPITAL EXPENDITURE ON IRRIGATION BY IRRIGATED ACTIVITY, Five years to 2002–03
% farms in activity with expenditure greater than $100,000



Source: ABS Water Survey Agriculture 2002–03

CHAPTER 5 TRADE IN IRRIGATION WATER

Trade in irrigation water now occurs at some level in all states and territories of Australia. In New South Wales, Victoria, Queensland and South Australia, markets have operated for a number of years. Water traded on a temporary basis entitles the purchaser to the use of the water allocation associated with a water entitlement for a period that is typically one (but can be up to five) irrigation seasons. Water traded on a permanent basis involves the once–off transfer of an entitlement from one entitlement holder to another.

On the *demand* side, water purchases provide a means of meeting demands for water during periods when rainfall and soil moisture are low or alternative sources — such as allocations from irrigation authorities, extractions from unregulated streams, or on-farm dam holdings — are either insufficient or comparatively costly. On the *supply* side, water sales are an alternative source of revenue for holders of irrigation water entitlements. This implies that trade returns that accrue to entitlement sellers exceed the production benefits from use of the irrigation water entitlement on–farm.

Water trade has directly facilitated at least some of the change over recent decades in the activity mix of irrigated agriculture.[7] For example, in Victoria, water has been traded on a permanent basis away from sheep and cattle grazing towards dairy farming (ABS 2004a). In recent years, water has also been traded for use in horticultural activities such as avocados, almonds and olives, and for selected types of pastures.

This chapter examines the extent to which farms have engaged in water trade in recent years. Participation by farms of different sizes and irrigated activities is reported, together with the net returns from water trade.

Information on water trade is drawn principally from the 2002–03 Water Survey Agriculture. Where possible, use is also made of the less detailed information on water trade provided by the 2001–02 and 2003–04 Agricultural Surveys.

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7 Some temporary shifting in water use between industries has also resulted from measures which alter the amount of an allocation available to particular irrigators within a season. For example, government drought assistance to particular groups of farms, and the leasing of additional subsidised irrigation water from the Snowy scheme for rice growers in the Murrumbidgee and Murray Irrigation areas during the recent drought and the subsequent return of this water to the Snowy scheme in the following years, has altered the comparative share of water resources utilised by various activities in a given year.

5.1 USE OF WATER MARKETS IN RECENT YEARS

Around 43 per cent of irrigated pasture farms, 36 per cent of irrigated broadacre farms and 27 per cent of irrigated horticulture establishments have participated in some form of trade since 2000–01 (table 5.1).

- In the irrigated *broadacre* group, farms with rice as their main irrigated activity were the most likely to have engaged in trade since 2000–01, while those farms with sugar or 'other crops' as their main irrigated activity were least likely to have traded.
- In the irrigated *horticulture* group, establishments with fruit or grapes as their main irrigated activity were more commonly engaged in some form of trade than were establishments with irrigated vegetables.

Differences between activities in the use of water markets could be influenced by a number of factors including the capacity of farms to shift between alternative activities and regional differences in the physical and administrative ease with which trade can occur.

Few farms engaged in trade on a regular basis. Over the three years to 2003–04, only 13 per cent of irrigated pasture farms, 11 per cent of irrigated broadacre farms and 10 per cent of irrigated horticulture establishments traded water in *every* year. Generally, in each activity, larger farms were more commonly engaged in water trade than smaller farms (figure 5.1).

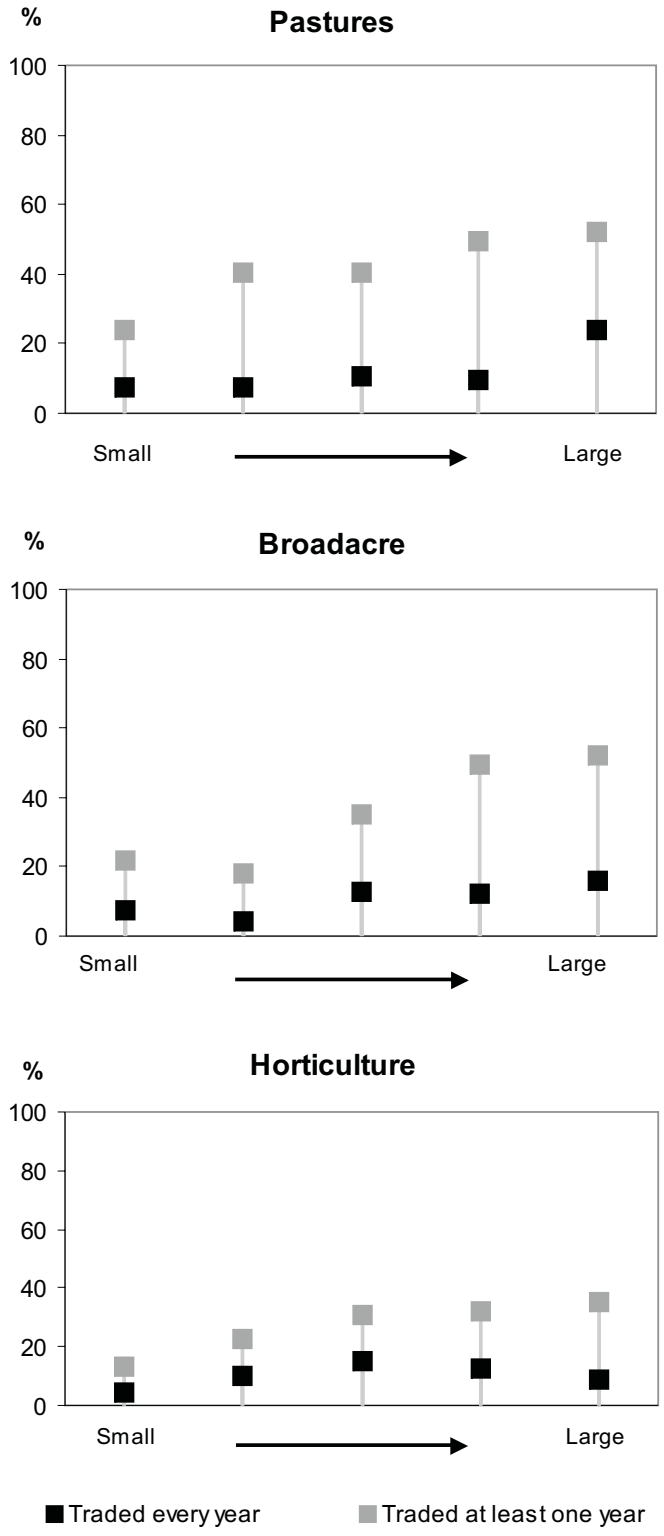
TABLE 5.1 INCIDENCE OF TRADE BY IRRIGATED ACTIVITY — 2001–02 to 2003–04(a)

	Traded any year	*Traded every year*
	%	%
Pastures	43	13
Broadacre	36	11
Rice	84	50
Cereals (excl. rice)	58	21
Cotton	54	10
Sugar	30	6
Other	21	3
Horticulture	27	10
Fruit	28	11
Grapes	31	14
Vegetables	21	3

(a) Percentage of farms which traded on a temporary or permanent basis in 2001–02, 2002–03 and 2003–04.

Sources: ABS Agricultural Survey 2001–02, ABS Water Survey Agriculture 2002–03 and ABS Agricultural Survey 2003–04.

FIGURE 5.1 INCIDENCE OF TRADE BY IRRIGATED ACTIVITY SIZE GROUPS — 2001–02 to 2003–04(a)



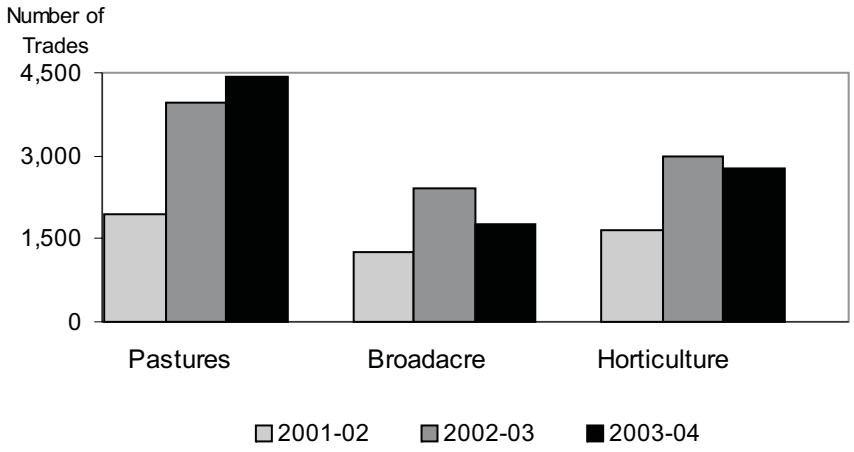
(a) Percentage of farms which traded on a temporary or permanent basis in 2001–02, 2002–03 and/or 2003–04.

Sources: ABS Agricultural Survey 2001–02, ABS Water Survey Agriculture 2002–03 and ABS Agricultural Survey 2003–04.

Participation in water markets was generally higher in 2002–03 and 2003–04 than in 2001–02 (figure 5.2). This may, in part, reflect the reduced availability of water as a result of drought and, as a consequence, potentially greater benefits associated with trade in the latter years. As expected, the majority of trade was on a temporary basis (appendix D).

The number of trades on a temporary or permanent basis was consistently higher each year for farms that had pastures rather than other activities, as their main irrigated activity. Around two–thirds of all trade, in terms of both the number of individual trades and the volume of water exchanged, occurred within the temperate slopes and plains region of southern Australia.

FIGURE 5.2 FARMS ENGAGED IN WATER TRADE ON TEMPORARY OR PERMANENT BASIS BY IRRIGATED ACTIVITY — 2001–02 to 2003–04



Sources: ABS Agricultural Survey 2001–02, ABS Water Survey Agriculture 2002–03 and ABS Agricultural Survey 2003–04.

5.2 TRADE BETWEEN IRRIGATED ACTIVITIES

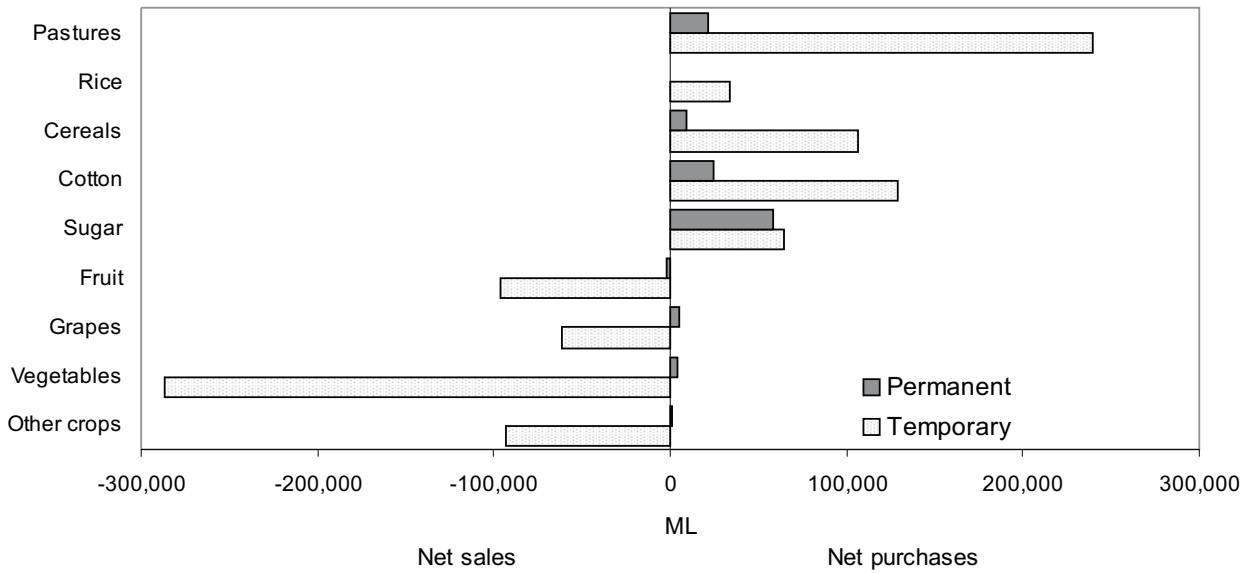
Overall in 2002–03 (the year for which the most detailed data are available), irrigation water was traded on a *temporary* basis into irrigated pasture and broadacre activities and out of irrigated horticultural activities (particularly vegetables) and other cropping activities (figure 5.3). This may, in part, reflect the differential availability of irrigation water between industries, as a result of either the drought or differences in water use efficiency.

Within individual activities, there was considerable variability in trade by different size farms (figure 5.4). Farms in all activity groups made *temporary purchases* of irrigation water and the average quantity purchased generally increased with farm size. Overall, temporary purchases were highest for large farms with pastures, cereals (excluding rice) or cotton as the main irrigated activity.

Given the widespread occurrence of drought in 2002–03, it is of interest to note which farms and activities chose to *sell* water on a temporary basis in that year. The data show that there were a comparatively high number of small irrigated pasture farms selling relatively low quantities of irrigation water. Among the broadacre activities, apart from temporary sales by a number of cereal farms, there were several large rice farms selling small quantities of irrigation water, in addition to a small number of large cotton farms selling substantial quantities on a temporary basis (see appendix D). Temporary trade by irrigated horticultural establishments in 2002–03 was characterised by net sales of water by fruit and grape establishments (of all sizes) and large vegetable establishments.

Consistent with earlier years of water trade in Australia (MDBC 2005), comparatively little trade on a *permanent* basis occurred in 2002–03. The largest net purchases on a permanent basis were by larger farms with irrigated sugar, cotton or pastures.

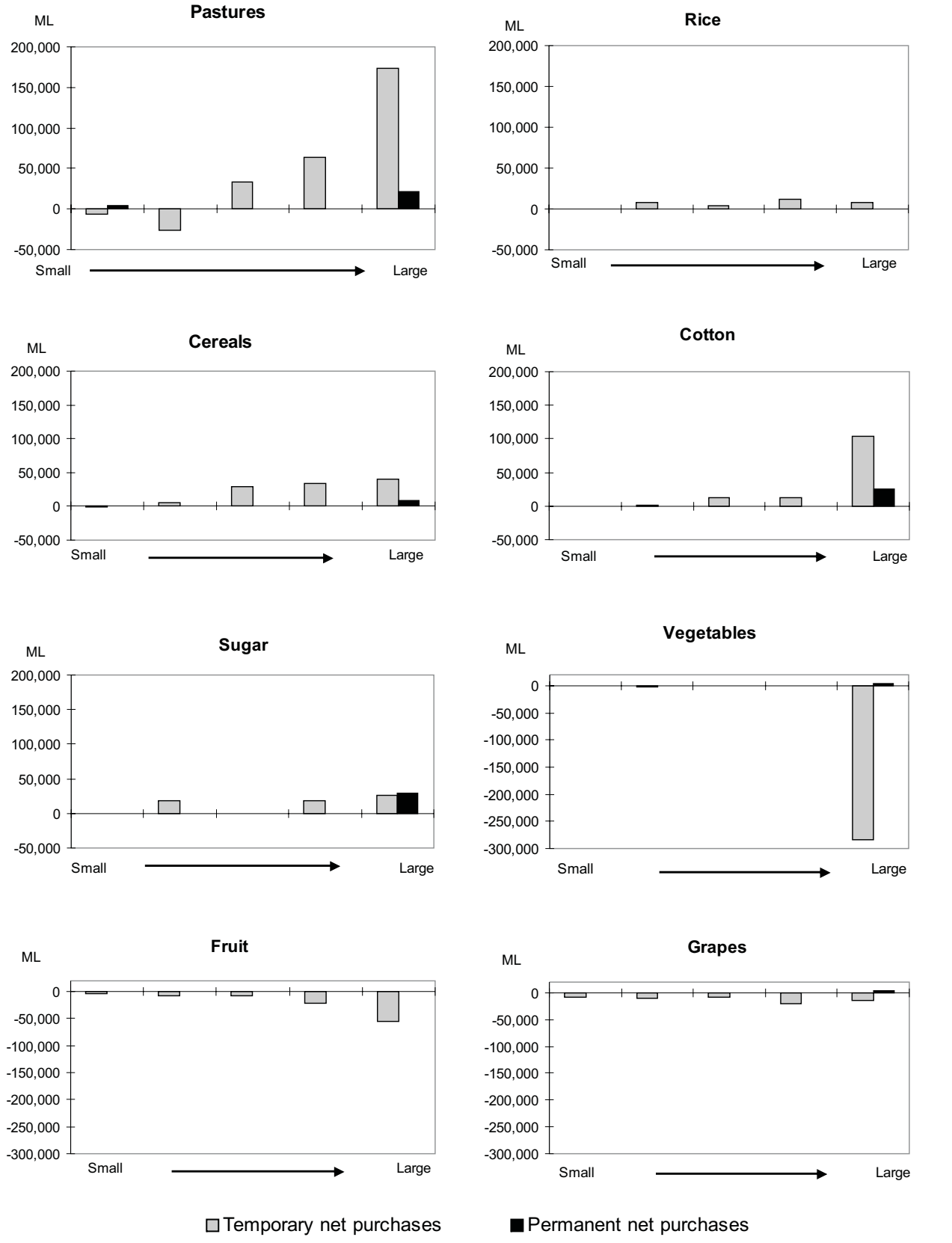
FIGURE 5.3 BALANCE OF WATER TRADE BY IRRIGATED ACTIVITY — 2002–03(a)



(a) Net trades do not add to zero due to sampling errors and unaccounted trades with non-irrigating agricultural establishments and with non-agricultural water users and suppliers.

Source: ABS Water Survey Agriculture 2002–03.

FIGURE 5.4 FARM SIZE AND TOTAL VOLUME OF WATER TRADE BY IRRIGATED ACTIVITY SIZE GROUPS — 2002–03(a)



(a) Data for some categories are not available for publication.

Source: ABS Water Survey Agriculture 2002–03.

5.3 WATER TRADE FINANCIAL INFORMATION

Net revenue from water trade

For farms with pastures as their main irrigated activity, smaller farms received additional revenue as a direct result of water trade while larger farms tended to be purchasers of water in 2002–03. Across all farm size groups, farms with pastures as the main irrigated activity expended around $48 million in 2002–03, or an average 29 per cent of the GVP of those who traded, on net purchases of additional irrigation water.

Irrigated broadacre farms expended around $51 million, or an average 4 per cent of their GVP in 2002–03, on net purchases of additional irrigation water. Although some farms sold water, irrigated broadacre activities overall were net purchasers in 2002–03. Farms with cereals (excluding rice) as the main irrigated activity differed from those with other broadacre activities in that, on average, they received a higher return per unit of water sold than that expended per unit of water purchased. This may be partially due to the timing of their sales and purchases during the irrigation season.[8]

Net water sales by horticultural establishments directly added $91 million to farm income, or an average 36 per cent to their GVP, in 2002–03. Sales by large vegetable establishments accounted for a significant proportion of that revenue.

Water trade prices

Variability in trade prices between activities

There was considerable variability between irrigated activities in the prices received and paid from trade in irrigation water in 2002–03 (appendix D).[9]

For *purchases* of additional water, the highest prices were paid, on average, by establishments with irrigated fruit (temporary purchases) and irrigated grapes (permanent purchases). The lowest prices paid, on average, for temporary and permanent trades, were by farms with irrigated rice, other cereals or sugar.

From *sales* of water, the highest prices were received, on average, by establishments with irrigated vegetables (temporary sales) and irrigated grapes (permanent sales). The lowest prices received from sales of water were by farms with irrigated sugar (temporary sales) and irrigated pastures (permanent sales).

Variability in trade prices between regions

Some of the variability in water trade prices between activities is likely to reflect regional differences in the demand for, and availability of, irrigation water.

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8 For example, Brennan (2004) noted that in the 2002-03 irrigation season in northern Victoria, traded water prices peaked during the summer months.

9 Differences between purchase and sale prices may reflect small survey samples, averaging of prices over each region and activity, and/or unrecorded trade with non–agricultural establishments.

For *temporary purchases*, trade prices ranged from an average of $8 per ML paid by some irrigated pasture farms on the wet tropical coasts of north east Australia up to an average price of $1,508 per ML paid by some irrigated fruit growing establishments in the arid interior of Australia (figure C4).

For *temporary sales*, trade prices ranged from $13 per ML received by irrigated sugar farms on the wet tropical coasts of north east Australia up to $587 per ML received by vegetable growers on the wet temperate coasts of southern Australia. Non–ABS data sources indicate that, at least in some parts of Australia, the prices for temporary trade in 2002–03 were likely to have been slightly higher than prices that prevailed in other recent years (see box 5.1).

For *permanent trade*, some of the highest average prices were recorded on the wet temperate coasts of southern Australia. Comparatively high average prices of $4,819 per ML were paid by irrigated grape growing establishments trading in this region. In contrast, the lowest average prices for permanent trade of irrigation water entitlements were recorded for irrigated fruit establishments with an average price paid of $135 per ML on the wet subtropical coasts of east Australia and $80 per ML on the wet temperate coasts of southern Australia.

Box 5.1 Traded water prices in selected irrigation regions over recent years

While the ABS Water Survey Agriculture 2002–03 provides a snapshot of traded water prices, complementary information to indicate how water prices have changed over recent years is available only for selected irrigation regions.

In the greater Goulburn region of Victoria, the average price of temporary trades increased three-fold in 2001–02 and rose further in the drought year 2002–03 (Watermove 2006). With a return to more normal rainfall conditions, the trade price has subsequently fallen to levels prevailing in the late 1990s. Prices of permanent water trades, which appear to vary less with seasonal conditions, peaked in 2003–04 and have since remained comparatively high.

Although water markets are largely separate in each State, price movements similar to those in Victoria have also occurred in other states in recent years (ANCID 2001 to 2005). There was a peak in the average price of temporary trades in 2002–03 in New South Wales and South Australia, and in 2001–02 in Western Australia, before a subsequent easing. For permanent trades, prices have risen steadily in New South Wales, South Australia and Western Australia over recent years.

APPENDIX A ABS FARM LEVEL DATA

TABLE A.1 INFORMATION AVAILABLE BY SOURCE — 2000–01 TO 2003–04

	2000–01	*2001–02*	*2002*	*2002–03*		*2003–04*
	Agricultural Census	*Agricultural Survey*	*Land Management & Salinity Survey*	*Agricultural Survey*	*Water Survey Agriculture*	*Agricultural Survey*
Production						
Area in production	✓	✓		✓		✓
Production quantity	✓	✓		✓		✓
Use of water & land resources						
Area irrigated	✓	✓		✓	✓	✓
Volume applied					✓	✓
Irrigation methods & practices						
Application methods			✓			
Scheduling tools	✓				✓	✓
Water source					✓	✓
Management changes made/intended			(a)✓		(b)✓	
Laser levelling					✓	
On-farm water recycling					✓	
Irrigation expenses					✓	
Water trade						
Number of trades		(c)✓			✓	(d)✓
Volume traded					✓	
Revenue from trade					✓	

(a) Focus on salinity.

(b) Focus on irrigation.

(c) Purchases and sales not reported separately.

(d) Permanent and temporary trade not reported separately.

APPENDIX B SEASONAL CONDITIONS AND THE AVAILABILITY OF IRRIGATION WATER

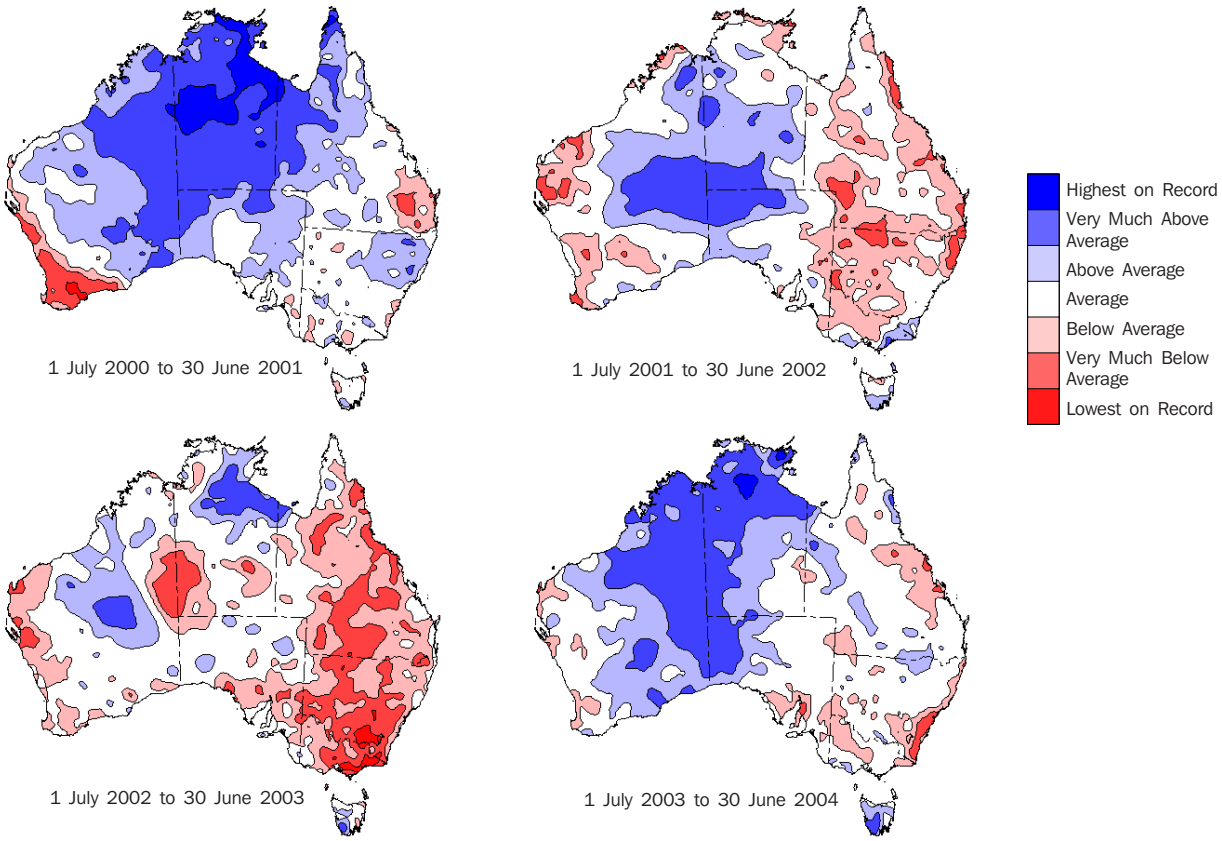
B.1 SEASONAL CONDITIONS

Comparisons on an industry basis and between time periods are complicated by a number of years of below average rainfall, which coincide with the ABS survey data used in this study.

Relatively normal seasonal conditions were evident in much of Australia's agricultural areas during 2000–01 (figure B.1). In 2001–02, rainfall was slightly below average in Australia's main agricultural areas, and around half the average level in far north west New South Wales and south west Queensland. By 2002–03, most of mainland eastern Australia was experiencing rainfall levels well below average, but by 2003–04, the severity of this had reduced to just a few isolated pockets (primarily affecting beef grazing areas and Queensland sugar cane growing regions).

The effects of below average rainfall and drought are reflected in the water use and trade data from the Water Survey Agriculture 2002–03, and the production and irrigation information from the Agricultural surveys of 2001–02, 2002–03 and 2003–04.

FIGURE B.1 RAINFALL DECILE MAPS — 2000–01 to 2003–04
Per cent of long term annual average



Source: Bureau of Meteorology (2005)

B.2 IRRIGATION WATER AVAILABILITY

There are two aspects to the availability of irrigation water in a given year. The first is long term underlying factors. For example, allocations of water entitlements that are based on historical agricultural conditions and irrigation requirements, combined with increased demand for water associated with general economic growth and the emergence of environmental objectives, may contribute to a fundamental change over time in the way in which water is allocated. The second aspect is seasonal fluctuations in availability, based on variability in rainfall, evaporation and irrigation water storage levels.

There has been considerable variability in some irrigation areas in the availability of irrigation water in recent years (table B.1). For example, in the NSW Murray region, irrigation allocations dropped to 8 per cent of irrigation entitlements in 2002–03. In Victoria, allocations have tended to remain high in recent years, but reflecting low irrigation storage levels and below average rainfall in many areas, there have been reductions in the availability of sales water. For example, water in excess of irrigator entitlements was made available as sales water to irrigators in the Campaspe and Murray catchments in 2000–01 and 2001–02. In 2002–03 and 2003–04, sales water was only available to some irrigators in the Broken River catchment.

TABLE B.1 IRRIGATION ALLOCATIONS RELATIVE TO ENTITLEMENTS IN VICTORIA AND NEW SOUTH WALES — 2000–01 to 2003–04

	2000–01	*2001–02*	*2002–03*	*2003–04*
Irrigation water supplier or area	*%*	*%*	*%*	*%*
Victoria				
Goulburn system	100	100	57	100
Broken system	. .	100	100	(a)100
Campaspe system	(a)100	(a)100	100	100
Murray system	(a)100	(a)100	129	100
Loddon system	. .	. .	. .	67
New South Wales				
Murray Irrigation	78	86	8	45
Murray and Lower Darling(b)		100	0	
Lower Darling River(b)		100	100	

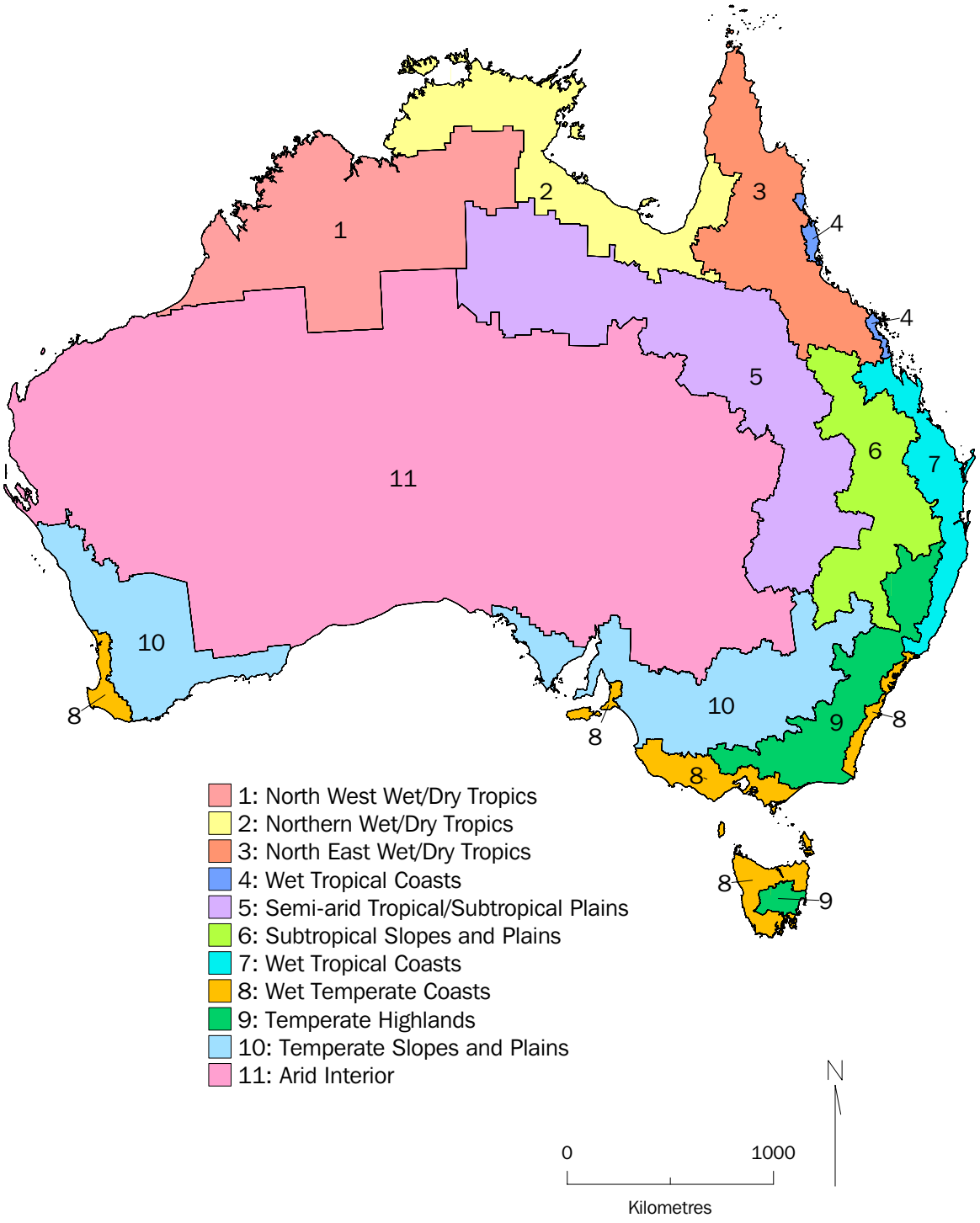
(a) In Victoria, irrigation allocations have been supplemented in some years by sales water — additional supplies made available to irrigators under certain conditions, that are in excess of, but proportional to, annual entitlements.

(b) General security allocations.

Sources: Murray Irrigation 2006; DPI Victoria 2006; DLWC NSW 2002.

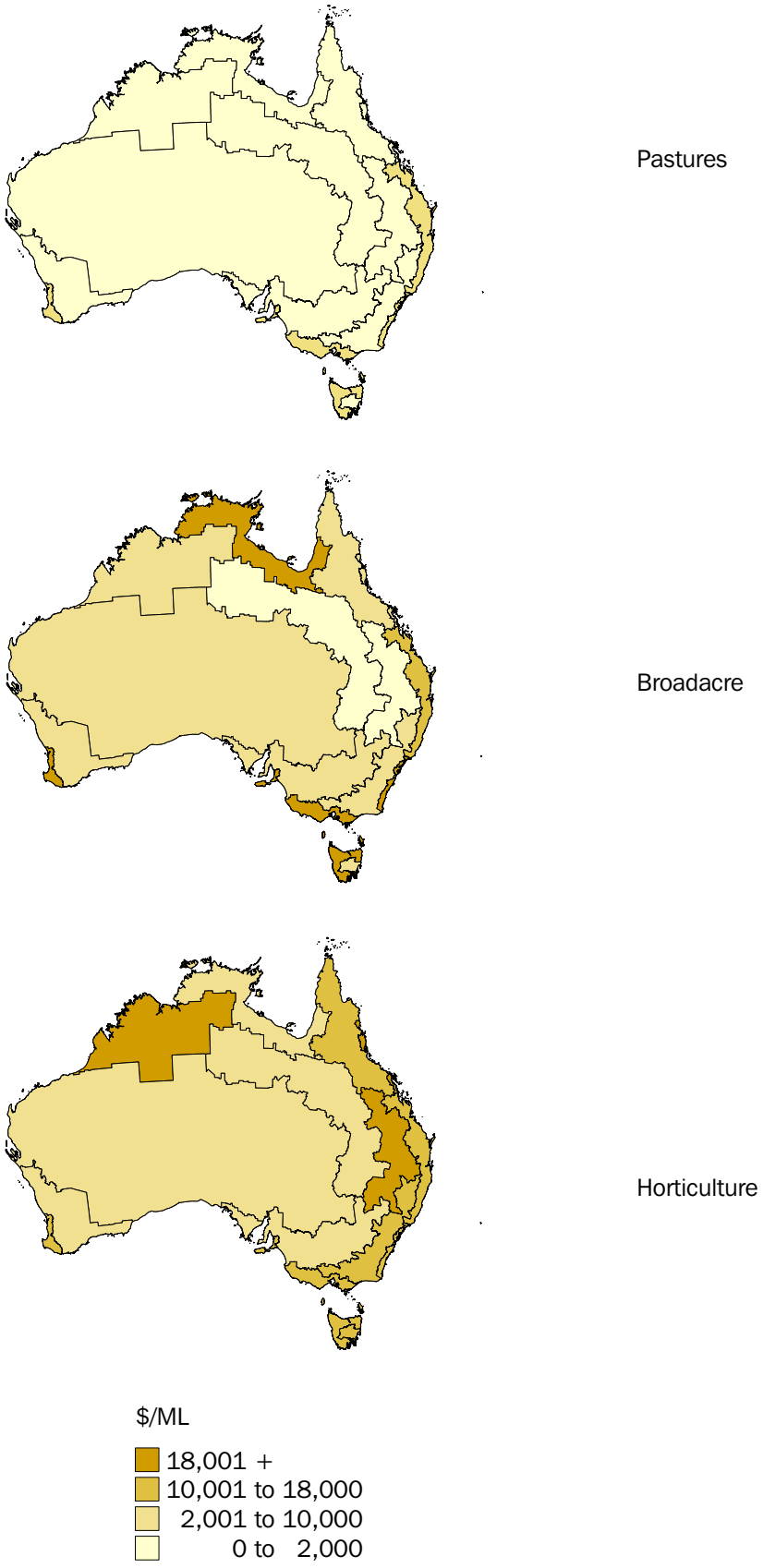
APPENDIX C REGIONAL RESULTS

FIGURE C.1 AGRO–ECOLOGICAL REGION CLASSIFICATION



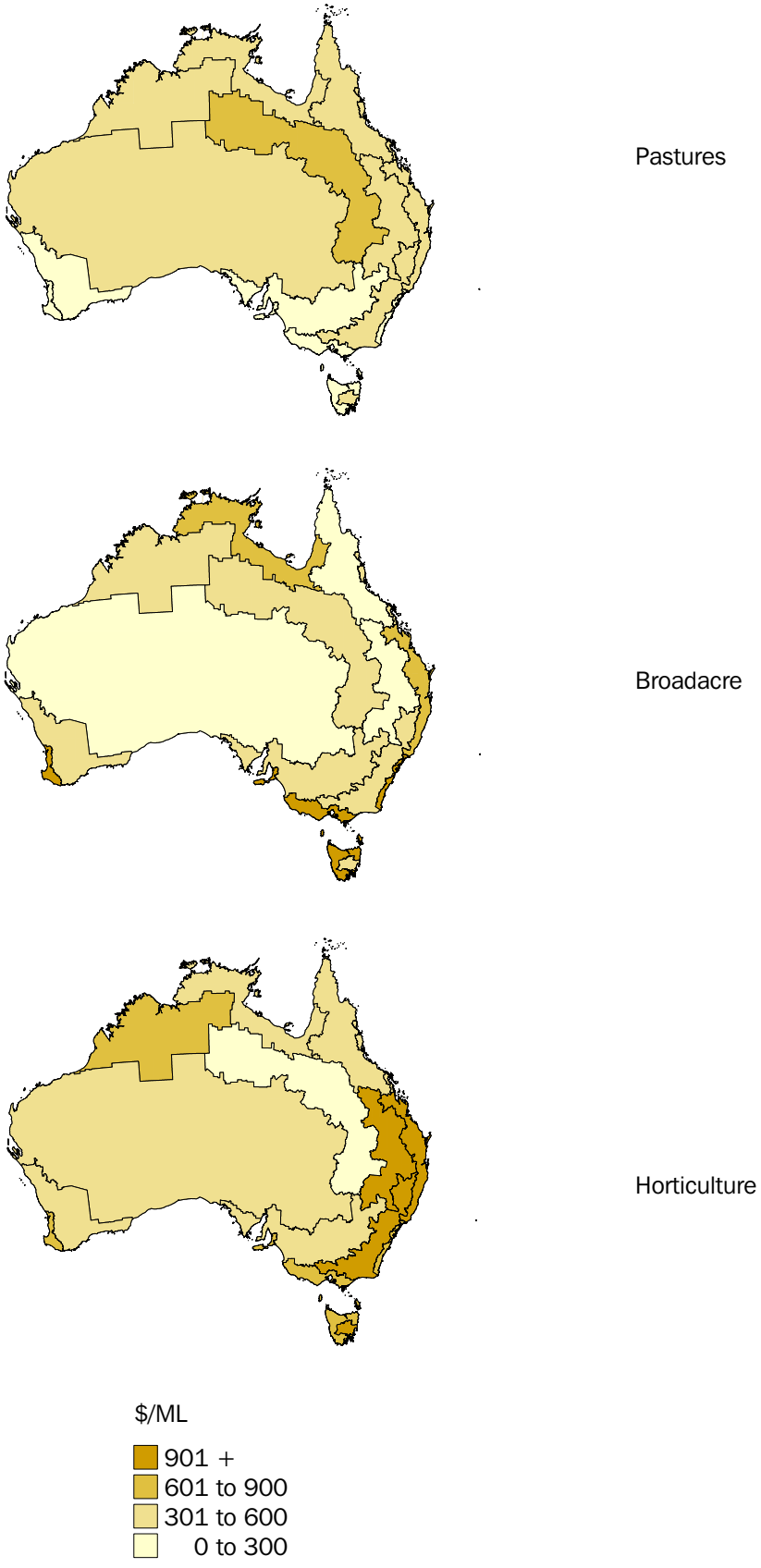
Source: SCARM 1998

FIGURE C.2 GEOGRAPHICAL VARIABILITY IN GVIP PER ML — 2003–04



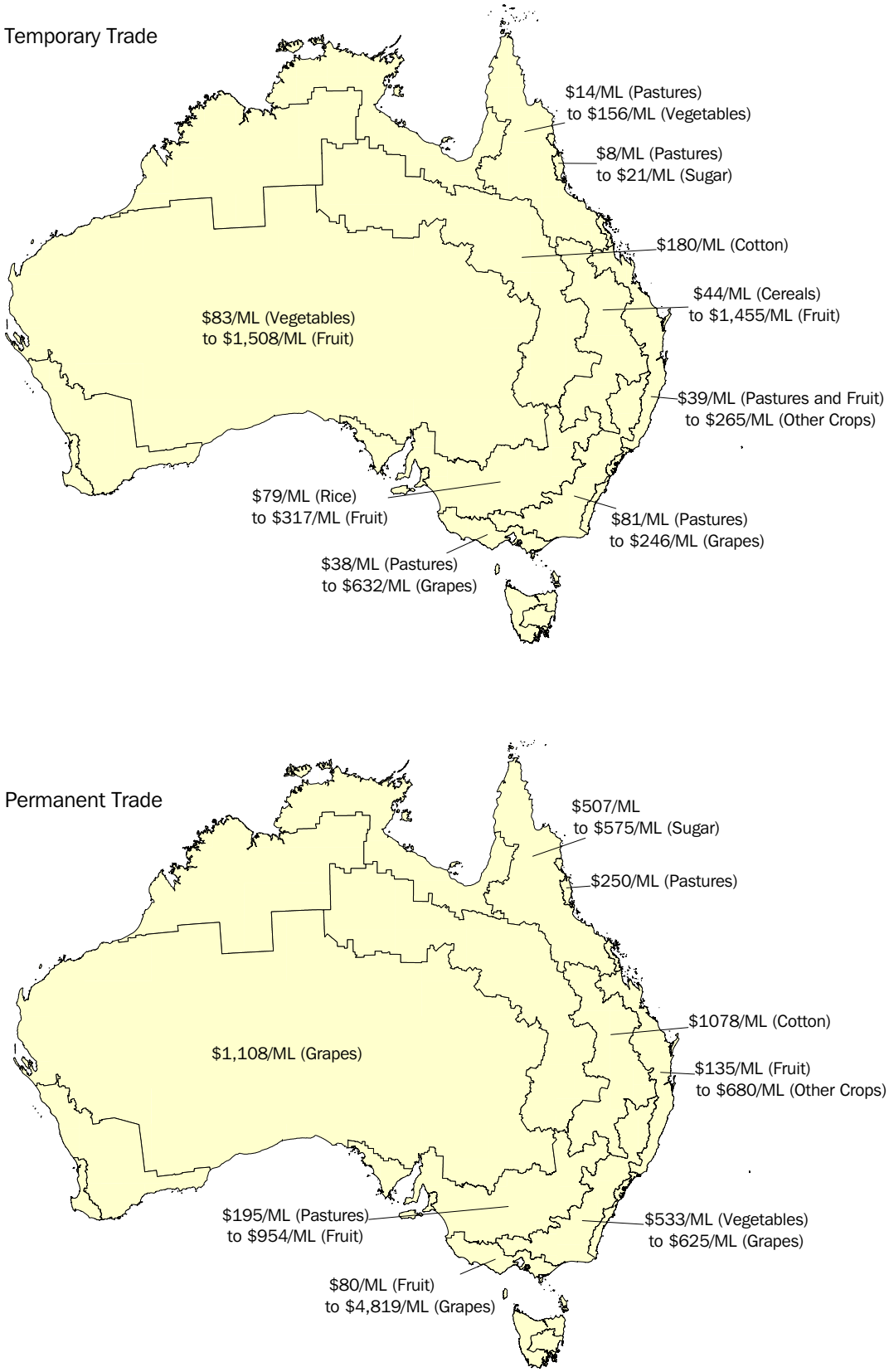
Source: ABS Agricultural Survey 2003–04

FIGURE C.3 GEOGRAPHICAL VARIABILITY IN IRRIGATION EXPENSES — 2002–03



Source: ABS Water Survey Agriculture 2002–03

FIGURE C.4 RANGE IN AVERAGE TRADE PRICES BY REGION — 2002–03(a)



(a) For each region, the lowest and highest average trade prices are shown and the main irrigated activity of farms which received or paid these prices. Regions with a single trade price or no prices do not have sufficient trade activity to report a range of prices.

Source: ABS Water Survey Agriculture 2002–03

APPENDIX D DETAILED QUINTILE RESULTS

TABLE D.1 IRRIGATION CHARACTERISTICS OF FARMS WITH PASTURE AS THE MAIN IRRIGATED ACTIVITY — 2002–03

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	3 081	3 100	3 071	3 168	2 985	—	15 406
Use of land & water resources								
Area of holding	ha	153	408	605	872	1 695	741	11 413 170
Area irrigated (farm)	ha	18	34	53	71	122	59	912 560
Area irrigated (main activity)	ha	18	32	46	65	111	54	829 902
Water use (farm)	ML	67	115	204	293	539	242	3 725 386
Water use (main activity)	ML	65	110	179	272	485	221	3 398 493
Water use intensity (main activity)	ML/ha	3.5	4.3	4.1	4.7	4.2	4.2	—
Farm dam capacity	ML	32	60	74	42	111	63	521 702
Gross production returns & expenses								
EVAO (farm)	$'000	19	69	161	295	751	256	3 944 195
GVP (farm)	$'000	34	80	182	330	850	292	4 495 731
GVIP (main activity)	$'000	13	24	87	193	412	145	2 226 488
GVIP (farm)	$'000	14	28	97	200	449	156	2 400 915
	$/ha	597	1 632	5 929	5 366	8 404	4 362	—
	$/ML	252	657	2 852	2 318	11 087	3 376	—
Irrigation expenses	$/ML	384	247	258	227	272	277	—
Water licence	% total	15	16	10	8	8	11	—
Volumetric charges	% total	14	21	24	29	19	21	—
Irrigation fees	% total	2	2	4	4	2	3	—
Equipment purchase	% total	21	12	17	14	18	16	—
Operating expenses	% total	43	44	39	40	45	42	—
Construction	% total	3	3	4	4	3	4	—
Irrigation investment greater than $10,000	% farms in 5 years to 2002–03	39	43	72	65	82	60	—
Irrigation investment greater than $100,000	% farms in 5 years to 2002–03	5	5	10	17	37	15	—
Irrigation methods & practices								
Surface methods	% area irrigated	36	42	48	51	38	43	—
Drip/trickle methods	% area irrigated	2	4	1	2	1	2	—
Sprinkler methods	% area irrigated	59	54	51	46	60	54	—
Laser levelled land	% farm area	44	30	38	39	36	37	—
Water recycling	% farms in size group	9	15	28	43	44	28	—
Scheduling techniques	number of farms							
Evaporation figures		127	212	288	217	450	—	1 294
Tensiometres		15	69	107	120	178	—	488
Soil probes		39	40	202	249	353	—	882
Scheduling service		51	86	148	64	152	—	500
Rotation scheduling		278	335	527	510	552	—	2 202
Local knowledge		2 887	3 010	2 918	2 967	2 761	—	14 543
Changes to irrigation practices(a)	number of farms							
Application method		936	944	1 451	1 589	1 622	—	6 542
Scheduling		754	788	1 041	1 059	1 268	—	4 909
Piping		287	291	153	253	295	—	1 279
Levees & drains		210	376	589	452	455	—	2 083
Laser levelling		416	475	943	1 198	919	—	3 952
Reuse/recycling		229	279	649	703	766	—	2 626
Soil moisture monitoring		60	132	293	213	402	—	1 100
Farm water plan		83	125	419	307	392	—	1 326

For footnotes see end of table. ...continued

TABLE D.1 IRRIGATION CHARACTERISTICS OF FARMS WITH PASTURE AS THE MAIN IRRIGATED ACTIVITY — 2002–03 — *continued*

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Intended changes(b)	number of farms							
Application method		588	389	765	792	686	—	3 220
Scheduling		601	329	445	428	592	—	2 395
Piping		37	142	73	161	116	—	528
Levees & drains		100	73	126	104	193	—	596
Laser levelling		195	320	458	542	427	—	1 942
Reuse/recycling		73	92	119	135	280	—	699
Soil moisture monitoring		103	115	240	275	208	—	942
Farm water plan		105	73	188	192	178	—	738
Barriers to change	number of farms							
Water quality		286	172	222	133	246	—	1 059
Allocation uncertainty		702	836	1 341	1 446	1 406	—	5 730
Financial		1 499	1 542	1 775	1 879	1 558	—	8 253
Time		235	475	393	713	502	—	2 319
Information		118	125	114	90	88	—	534
Success uncertainty		216	190	228	213	186	—	1 033
Age/health		599	622	465	352	344	—	2 382
Water availability		810	822	754	1 395	1 112	—	4 893
Water source	% total water supplied to size group							
Surface water		68	75	80	76	63	—	70
Groundwater		np	19	18	23	33	—	27
Town water		np	np	np	—	0	—	0
Recycled/reused water		np	np	np	1	3	—	3

(a) Changes to irrigation practices in the five years to 2002–03.

(b) Intention in 2002–03 to change irrigation practices in 2003–04.

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

TABLE D.2 IRRIGATION CHARACTERISTICS OF FARMS WITH PASTURE AS THE MAIN IRRIGATED ACTIVITY — 2003–04

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	2 975	2 978	2 956	2 969	2 966	—	14 843
Use of land & water resources								
Area of holding	ha	156	403	1 014	1 172	3 532	1 254	18 617 136
Area irrigated (farm)	ha	20	33	66	81	147	69	1 029 829
Area irrigated (main activity)	ha	19	31	61	72	133	63	939 278
Water use (farm)	ML	69	123	231	345	617	277	4 107 063
Water use (main activity)	ML	68	115	207	318	553	252	3 738 637
Water use intensity (main activity)	ML/ha	4.0	3.8	4.1	5.2	4.6	4.3	—
Irrigated every year from 2000–01 to 2003–04	% farms	61	72	74	77	79	75	—
Gross production returns								
EVAO (farm)	$'000	19	76	161	296	850	280	4 160 112
GVP (farm)	$'000	35	78	183	343	967	321	4 764 736
GVIP (main activity)	$'000	13	22	76	191	387	138	2 045 707
GVIP (farm)	$'000	13	25	84	203	437	153	2 264 126
	$/ha	590	1 598	2 779	10 105	6 554	4 323	—
	$/ML	360	1 322	2 025	3 231	3 559	2 098	—
Irrigation methods & practices								
Surface methods	% area irrigated	32	42	48	53	44	44	—
Drip/trickle methods	% area irrigated	10	7	3	2	3	5	—
Sprinkler methods	% area irrigated	55	50	47	45	51	50	—
Water source	% total water supplied to size group							
Surface water		69	83	68	72	65	—	69
Groundwater		26	16	25	25	30	—	27
Town water		np	0	0	0	0	—	0
Recycled/reused water		np	0	3	2	3	—	3

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

TABLE D.3 WATER TRADE BY FARMS WITH PASTURE AS THE MAIN IRRIGATED ACTIVITY, Selected years

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Farms trading in 2001–02	number	320	406	354	320	531	—	1 932
Farms trading in 2002–03	number	474	572	887	1 024	993	—	3 951
Farms trading in 2003–04	number	570	666	852	1 167	1 167	—	4 422
Traded any year (2001–02 to 2003–04)	% farms	24	40	40	49	52	—	43
Traded every year (2001–02 to 2003–04)	% farms	7	7	10	10	24	—	13
Irrigation water entitlement in 2002–03	% farms in size group	74	85	88	87	91	—	85
Trade magnitude in 2002–03								
Temporary sales	ML	58	104	90	190	174	117	133 001
Permanent sales	ML	—	—	—	np	np	475	11 302
Temporary purchases	ML	60	39	66	146	267	143	372 738
Permanent purchases	ML	134	—	np	np	272	174	32 883
Trade prices in 2002–03								
Temporary sales	$/ML	200	170	234	181	192	191	—
Permanent sales	$/ML	—	—	—	np	662	217	—
Temporary purchases	$/ML	75	49	177	205	146	158	—
Permanent purchases	$/ML	731	—	np	278	751	565	—
Net trade revenue in 2002–03	$'000	1	9	–4	–11	–45	–13	–48 401
	% contribution to trader GVP	243	10	–2	1	–6	29	—

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

TABLE D.4 IRRIGATION CHARACTERISTICS OF FARMS WITH BROADACRE CROPS AS THE MAIN IRRIGATED ACTIVITY — 2002–03

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	2 061	2 064	2 055	2 058	2 056	—	10 293
Use of land & water resources								
Area of holding	ha	160	229	368	851	2 973	915	9 420 035
Area irrigated (farm)	ha	18	39	52	94	308	102	1 050 459
Area irrigated (main activity)	ha	15	36	47	87	290	95	979 893
Water use (farm)	ML	49	132	208	358	1 668	483	4 966 394
Water use (main activity)	ML	43	123	192	330	1 602	458	4 710 364
Water use intensity (main activity)	ML/ha	4.2	3.8	4.1	4.0	5.0	4.2	—
Farm dam capacity	ML	30	68	47	197	1 259	381	2 120 231
Gross production returns & expenses								
EVAO (farm)	$'000	33	98	175	309	1 275	378	3 888 201
GVP (farm)	$'000	48	113	198	319	1 432	421	4 337 126
GVIP (main activity)	$'000	21	67	110	156	754	221	2 278 496
GVIP (farm)	$'000	22	73	117	168	838	243	2 505 298
	$/ha	17 776	20 841	18 425	12 452	14 389	16 779	—
	$/ML	8 315	11 764	11 380	5 182	7 905	8 910	—
Irrigation expenses	$/ML	706	613	765	497	338	584	—
Water licence	% total	12	5	10	9	6	8	—
Volumetric charges	% total	14	15	21	16	19	17	—
Irrigation fees	% total	2	2	2	3	2	2	—
Equipment purchase	% total	21	19	17	19	19	19	—
Operating expenses	% total	44	51	44	46	43	46	—
Construction	% total	3	4	3	4	8	4	—
Irrigation investment greater than $10,000	% farms in 5 years to 2002–03	35	53	68	75	88	64	—
Irrigation investment greater than $100,000	% farms in 5 years to 2002–03	4	6	14	27	51	20	—
Irrigation methods & practices								
Surface methods	% area irrigated	15	29	33	37	51	33	—
Drip/trickle methods	% area irrigated	27	23	14	10	9	16	—
Sprinkler methods	% area irrigated	57	47	50	52	40	49	—
Laser levelled land	% farm area	42	43	45	40	40	42	—
Water recycling	% farms in size group	14	21	28	36	57	31	—
Scheduling techniques	number of farms							
Evaporation figures		181	295	191	283	420	—	1 370
Tensiometres		52	67	149	128	207	—	603
Soil probes		169	90	150	267	582	—	1 257
Scheduling service		63	71	40	90	68	—	332
Rotation scheduling		307	291	182	299	303	—	1 382
Local knowledge		1 879	1 970	1 941	1 968	1 871	—	9 629
Changes to irrigation practices(a)	number of farms							
Application method		840	1 030	879	1 084	1 311	—	5 144
Scheduling		608	765	801	885	999	—	4 058
Piping		145	192	198	387	315	—	1 237
Levees & drains		107	220	314	441	639	—	1 721
Laser levelling		200	593	600	781	1 062	—	3 236
Reuse/recycling		154	312	458	486	799	—	2 210
Soil moisture monitoring		52	119	147	304	592	—	1 214
Farm water plan		101	140	153	223	374	—	991

For footnotes see end of table.

...continued

TABLE D.4 IRRIGATION CHARACTERISTICS OF FARMS WITH BROADACRE CROPS AS THE MAIN IRRIGATED ACTIVITY — 2002–03 — *continued*

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Intended changes(b)	number of farms							
Application method		423	498	459	658	637	—	2 676
Scheduling		217	453	342	439	550	—	2 001
Piping		61	91	94	104	89	—	439
Levees & drains		48	140	90	187	279	—	745
Laser levelling		125	230	239	377	623	—	1 593
Reuse/recycling		75	196	223	208	333	—	1 035
Soil moisture monitoring		62	124	196	187	316	—	885
Farm water plan		105	79	124	141	268	—	717
Barriers to change	number of farms							
Water quality		196	122	98	140	219	—	774
Allocation uncertainty		563	662	749	678	1 007	—	3 660
Financial		998	999	1 167	1 156	1 143	—	5 464
Time		256	318	176	304	311	—	1 365
Information		50	45	76	58	102	—	331
Success uncertainty		130	236	264	200	246	—	1 076
Age/health		270	291	149	204	96	—	1 009
Water availability		682	722	626	692	792	—	3 514
Water source	% total water supplied to size group							
Surface water		67	49	63	64	65	—	64
Groundwater		23	47	36	36	33	—	35
Town water		1	0	0	0	0	—	0
Recycled/reused water		9	3	0	0	1	—	1

(a) Changes to irrigation practices in the five years to 2002–03.

(b) Intention in 2002–03 to change irrigation practices in 2003–04.

TABLE D.5 IRRIGATION CHARACTERISTICS OF FARMS WITH BROADACRE CROPS AS THE MAIN IRRIGATED ACTIVITY — 2003–04

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	1 950	1 968	1 925	1 948	1 948	—	9 738
Use of land & water resources								
Area of holding	ha	129	339	760	763	4 189	1 235	12 027 269
Area irrigated (farm)	ha	15	30	58	98	296	99	965 811
Area irrigated (main activity)	ha	14	28	53	90	275	92	895 122
Water use (farm)	ML	57	92	213	468	1 529	471	4 590 871
Water use (main activity)	ML	52	85	195	438	1 448	443	4 317 458
Water use intensity (main activity)	ML/ha	4.2	4.2	4.6	4.6	4.9	4.5	—
Irrigated every year from 2000–01 to 2003–04	% farms	54	68	74	71	79	73	—
Gross production returns								
EVAO (farm)	$'000	29	95	182	333	1 424	413	4 017 825
GVP (farm)	$'000	38	97	177	333	1 571	443	4 313 291
GVIP (main activity)	$'000	20	53	93	165	693	205	1 992 431
GVIP (farm)	$'000	21	55	99	177	777	226	2 197 881
	$/ha	20 714	24 056	14 803	11 688	12 146	16 702	—
	$/ML	7 736	10 640	6 687	6 099	7 952	7 831	—
Irrigation methods & practices								
Surface methods	% area irrigated	10	25	30	41	56	33	—
Drip/trickle methods	% area irrigated	38	26	11	13	9	19	—
Sprinkler methods	% area irrigated	48	45	58	45	34	46	—
Water source	% total water supplied to size group							
Surface water		66	73	62	58	66	—	65
Groundwater		18	23	35	38	30	—	32
Town water		1	1	0	0	0	—	0
Recycled/reused water		0	0	0	2	1	—	1

TABLE D.6 WATER TRADE BY FARMS WITH BROADACRE CROPS AS THE MAIN IRRIGATED ACTIVITY, Selected years

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Farms trading in 2001–02	number	134	135	233	330	417	—	1 249
Farms trading in 2002–03	number	187	414	590	536	669	—	2 396
Farms trading in 2003–04	number	137	157	321	521	626	—	1 762
Traded any year (2001–02 to 2003–04)	% farms	22	18	35	49	52	—	36
Traded every year (2001–02 to 2003–04)	% farms	7	4	13	12	16	—	11
Irrigation water entitlement in 2002–03	% farms in size group	57	61	72	74	80	69	—
Trade magnitude in 2002–03								
Temporary sales	ML	94	119	94	188	2 010	468	275 618
Permanent sales	ML	—	np	np	—	np	52	3 214
Temporary purchases	ML	48	88	188	242	667	323	517 930
Permanent purchases	ML	np	np	451	147	1 186	677	96 420
Trade prices in 2002–03								
Temporary sales	$/ML	183	190	165	110	133	150	—
Permanent sales	$/ML	—	np	np	—	np	584	—
Temporary purchases	$/ML	178	76	62	67	113	89	—
Permanent purchases	$/ML	np	np	619	307	704	622	—
Net trade revenue in 2002–03	$'000	0	0	–38	–3	–53	–24	–50 805
	% contribution to trader GVP	25	0	–24	2	–5	–4	—

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

TABLE D.7 IRRIGATION CHARACTERISTICS OF FARMS WITH RICE AS THE MAIN IRRIGATED ACTIVITY — 2002–03

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	26	26	17	23	21	—	114
Use of land & water resources								
Area of holding	ha	328	381	459	2 049	10 992	2 699	307 269
Area irrigated (farm)	ha	48	105	112	109	470	162	18 449
Area irrigated (main activity)	ha	40	63	73	92	282	106	12 074
Water use (farm)	ML	641	911	1 147	1 396	5 592	1 858	211 493
Water use (main activity)	ML	626	801	999	1 342	4 779	1 644	187 087
Water use intensity (main activity)	ML/ha	15.3	12.8	13.5	14.5	15.2	14.3	—
Farm dam capacity	ML	10	np	np	37	2 580	201	—
Gross production returns & expenses								
EVAO (farm)	$'000	124	176	252	365	1 569	474	53 973
GVP (farm)	$'000	167	301	335	509	2 014	637	72 543
GVIP (main activity)	$'000	133	187	206	311	967	348	39 625
GVIP (farm)	$'000	137	209	219	325	1 236	409	46 585
	$/ha	2 901	1 989	2 765	3 104	2 762	2 685	—
	$/ML	224	236	227	237	251	235	—
Irrigation expenses	$/ML	80	60	42	100	30	64	—
Water licence	% total	np	np	np	13	6	9	—
Volumetric charges	% total	61	80	np	45	21	53	—
Irrigation fees	% total	np	np	—	np	—	3	—
Equipment purchase	% total	np	np	5	np	—	3	—
Operating expenses	% total	np	np	28	7	57	18	—
Construction	% total	np	np	—	31	16	14	—
Irrigation investment greater than $10,000	% farms in 5 years to 2002–03	100	np	100	100	100	87	—
Irrigation investment greater than $100,000	% farms in 5 years to 2002–03	72	np	np	68	76	62	—
Irrigation methods & practices								
Surface methods	% area irrigated	100	100	100	78	100	96	—
Drip/trickle methods	% area irrigated	—	—	—	22	—	4	—
Sprinkler methods	% area irrigated	—	—	—	—	—	—	—
Laser levelled land	% area holding	49	61	32	17	20	38	—
Water recycling	% farms in size group	np	72	np	91	53	59	—
Scheduling techniques	number of farms							
Evaporation figures		7	np	np	5	4	—	28
Tensiometres		—	—	—	—	—	—	—
Soil probes		—	—	—	np	np	—	np
Scheduling service		—	4	5	—	5	—	14
Rotation scheduling		np	—	5	np	np	—	10
Local knowledge		26	26	12	18	21	—	104
Changes to irrigation practices(a)	number of farms							
Application method		11	15	5	19	8	—	58
Scheduling		7	11	—	14	6	—	39
Piping		—	—	—	9	—	—	9
Levees & drains		11	4	5	13	12	—	46
Laser levelling		19	19	17	23	17	—	95
Reuse/recycling		4	22	12	23	16	—	78
Soil moisture monitoring		—	—	—	5	6	—	11
Farm water plan		4	15	—	6	4	—	29

For footnotes see end of table. *...continued*

TABLE D.7 IRRIGATION CHARACTERISTICS OF FARMS WITH RICE AS THE MAIN IRRIGATED ACTIVITY — 2002–03 — *continued*

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Intended changes(b)	number of farms							
Application method		15	15	—	—	13	—	43
Scheduling		15	15	—	—	9	—	38
Piping		—	—	—	—	np	—	np
Levees & drains		4	4	—	3	2	—	13
Laser levelling		—	11	5	5	19	—	41
Reuse/recycling		19	11	—	3	7	—	40
Soil moisture monitoring		—	—	—	—	np	—	np
Farm water plan		15	7	—	9	9	—	41
Barriers to change	number of farms							
Water quality		—	—	—	—	—	—	—
Allocation uncertainty		26	26	5	13	21	—	92
Financial		11	26	5	13	5	—	61
Time		—	—	—	—	np	—	np
Information		15	4	—	—	—	—	19
Success uncertainty		7	7	—	np	np	—	17
Age/health		—	—	—	—	—	—	—
Water availability		26	7	—	16	7	—	56
Water source	% total water supplied to size group							
Surface water		100	72	np	100	30	—	52
Groundwater		—	np	np	—	70	—	48
Town water		—	—	—	—	—	—	—
Recycled/reused water		—	—	—	—	—	—	—

(a) Changes to irrigation practices in the five years to 2002–03.

(b) Intention in 2002–03 to change irrigation practices in 2003–04.

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

TABLE D.8 IRRIGATION CHARACTERISTICS OF FARMS WITH RICE AS THE MAIN IRRIGATED ACTIVITY — 2003–04

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	46	44	44	45	43	—	222
Use of land & water resources								
Area of holding	ha	226	413	796	2 155	4 557	1 600	355 508
Area irrigated (farm)	ha	31	92	61	137	213	106	23 460
Area irrigated (main activity)	ha	26	62	58	105	140	77	17 208
Water use (farm)	ML	409	801	528	1 377	1 981	1 010	224 411
Water use (main activity)	ML	387	726	519	1 297	1 834	944	209 735
Water use intensity (main activity)	ML/ha	15.0	11.6	11.6	12.8	12.4	12.7	—
Irrigated every year from 2000–01 to 2003–04	% farms	22	67	35	35	50	44	—
Gross production returns								
EVAO (farm)	$'000	99	166	251	468	973	385	85 607
GVP (farm)	$'000	115	190	270	592	1 152	457	101 477
GVIP (main activity)	$'000	63	130	106	285	359	187	41 557
GVIP (farm)	$'000	65	143	106	301	386	198	44 079
	$/ha	2 263	1 620	2 383	2 245	2 106	2 125	—
	$/ML	178	245	216	217	214	214	—
Irrigation methods & practices								
Surface methods	% area irrigated	100	95	91	100	94	96	—
Drip/trickle methods	% area irrigated	—	—	np	—	np	np	—
Sprinkler methods	% area irrigated	—	—	np	—	np	np	—
Water source	% total water supplied to size group							
Surface water		91	80	70	84	61	—	74
Groundwater		—	np	np	5	39	—	20
Town water		—	np	np	np	—	—	np
Recycled/reused water		—	—	—	np	—	—	np

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

TABLE D.9 WATER TRADE BY FARMS WITH RICE AS THE MAIN IRRIGATED ACTIVITY, Selected years

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Farms trading in 2001–02	number	38	33	49	33	42	—	195
Farms trading in 2002–03	number	11	19	17	16	13	—	77
Farms trading in 2003–04	number	15	29	29	45	37	—	156
Traded any year (2001–02 to 2003–04)	% farms	51	84	96	89	88	—	84
Traded every year (2001–02 to 2003–04)	% farms	109	29	37	46	64	—	50
Irrigation water entitlement in 2002–03	% farms in size group	100	100	100	100	100	100	—
Trade magnitude in 2002–03								
Temporary sales	ML	—	—	—	—	np	np	np
Permanent sales	ML	—	—	—	—	—	—	—
Temporary purchases	ML	np	398	227	774	727	450	33 546
Permanent purchases	ML	—	—	—	—	—	—	—
Trade prices in 2002–03								
Temporary sales	$/ML	—	—	—	—	np	np	—
Permanent sales	$/ML	—	—	—	—	—	—	—
Temporary purchases	$/ML	np	60	74	66	140	79	—
Permanent purchases	$/ML	—	—	—	—	—	—	—
Net trade revenue in 2002–03	$'000	np	–22	–17	–44	–64	–30	–2 252
Net trade revenue in 2002–03	% contribution to trader GVP	np	–7	–5	–9	–3	–6	—

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

TABLE D.10 IRRIGATION CHARACTERISTICS OF FARMS WITH CEREALS AS THE MAIN IRRIGATED ACTIVITY — 2002–03

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	713	704	706	697	702	—	3 521
Use of land & water resources								
Area of holding	ha	258	539	779	1 774	4 088	1 482	5 218 628
Area irrigated (farm)	ha	23	65	91	133	351	132	465 712
Area irrigated (main activity)	ha	20	52	66	103	256	99	348 906
Water use (farm)	ML	64	198	327	466	1 381	486	1 710 564
Water use (main activity)	ML	53	149	195	283	782	291	1 025 886
Water use intensity (main activity)	ML/ha	3.2	2.6	2.6	3.1	2.6	2.8	—
Farm dam capacity	ML	25	123	64	129	617	202	—
Gross production returns & expenses								
EVAO (farm)	$'000	23	78	162	307	1 214	356	1 252 160
GVP (farm)	$'000	52	97	202	342	1 534	444	1 563 565
GVIP (main activity)	$'000	8	25	50	65	215	72	254 206
GVIP (farm)	$'000	9	34	84	115	519	152	534 533
	$/ha	320	589	1 382	757	1 775	963	—
	$/ML	188	273	970	378	1 076	576	—
Irrigation expenses	$/ML	368	194	420	153	222	272	—
Water licence	% total	17	10	10	11	5	11	—
Volumetric charges	% total	10	15	30	22	19	19	—
Irrigation fees	% total	3	2	5	5	3	3	—
Equipment purchase	% total	21	13	10	15	17	15	—
Operating expenses	% total	43	43	36	40	41	41	—
Construction	% total	3	12	6	4	11	7	—
Irrigation investment greater than $10,000	% farms in 5 years to 2002–03	41	65	59	80	86	66	—
Irrigation investment greater than $100,000	% farms in 5 years to 2002–03	2	14	16	24	53	22	—
Irrigation methods & practices								
Surface methods	% area irrigated	19	46	67	51	64	50	—
Drip/trickle methods	% area irrigated	2	6	np	0	3	2	—
Sprinkler methods	% area irrigated	79	48	np	47	33	48	—
Laser levelled land	% area holding	45	37	43	35	30	37	—
Water recycling	% farms in size group	11	30	36	39	62	35	—
Scheduling techniques	number of farms							
Evaporation figures		65	57	78	78	153	—	431
Tensiometres		24	17	np	np	42	—	102
Soil probes		95	65	88	98	171	—	518
Scheduling service		30	25	19	12	32	—	117
Rotation scheduling		79	70	71	81	95	—	395
Local knowledge		598	678	702	683	654	—	3 316
Changes to irrigation practices(a)	number of farms							
Application method		288	281	272	307	396	—	1 544
Scheduling		207	146	134	168	283	—	938
Piping		38	54	101	96	110	—	399
Levees & drains		46	93	237	133	255	—	763
Laser levelling		88	177	364	258	411	—	1 298
Reuse/recycling		70	128	298	176	313	—	985
Soil moisture monitoring		32	32	31	80	145	—	320
Farm water plan		44	73	87	88	176	—	467

For footnotes see end of table.

...continued

TABLE D.10 IRRIGATION CHARACTERISTICS OF FARMS WITH CEREALS AS THE MAIN IRRIGATED ACTIVITY — 2002–03 — *continued*

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Intended changes(b)	number of farms							
Application method		185	147	202	222	231	—	987
Scheduling		87	94	129	88	168	—	567
Piping		41	54	45	30	18	—	189
Levees & drains		21	70	88	85	99	—	363
Laser levelling		60	169	230	175	249	—	883
Reuse/recycling		41	85	154	138	94	—	513
Soil moisture monitoring		3	15	41	55	137	—	252
Farm water plan		17	92	84	71	76	—	341
Barriers to change	number of farms							
Water quality		133	38	20	41	60	—	292
Allocation uncertainty		323	288	370	377	420	—	1 779
Financial		363	298	386	374	373	—	1 796
Time		33	103	67	124	111	—	438
Information		12	12	4	19	29	—	75
Success uncertainty		27	72	113	69	95	—	377
Age/health		137	81	47	60	22	—	346
Water availability		350	276	300	326	313	—	1 564
Water source	% total water supplied to size group							
Surface water		80	56	68	71	55	—	60
Groundwater		19	34	np	np	43	—	38
Town water		np	np	np	np	np	—	0
Recycled/reused water		np	np	np	—	np	—	1

(a) Changes to irrigation practices in the five years to 2002–03.

(b) Intention in 2002–03 to change irrigation practices in 2003–04.

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

TABLE D.11 IRRIGATION CHARACTERISTICS OF FARMS WITH CEREALS AS THE MAIN IRRIGATED ACTIVITY — 2003–04

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	576	558	559	563	562	—	2 819
Use of land & water resources								
Area of holding	ha	238	869	2 070	1 321	8 133	2 517	7 093 005
Area irrigated (farm)	ha	23	68	98	178	379	149	419 111
Area irrigated (main activity)	ha	18	57	75	122	259	106	298 834
Water use (farm)	ML	56	191	418	615	1 506	555	1 564 931
Water use (main activity)	ML	34	127	259	290	776	296	833 966
Water use intensity (main activity)	ML/ha	2.1	2.5	4.0	2.4	2.7	2.7	—
Irrigated every year from 2000–01 to 2003–04	% farms	41	41	59	46	53	50	—
Gross production returns								
EVAO (farm)	$'000	34	106	215	386	1 708	488	1 375 966
GVP (farm)	$'000	41	118	244	444	2 096	587	1 653 254
GVIP (main activity)	$'000	6	24	48	87	218	76	214 840
GVIP (farm)	$'000	9	37	80	203	486	162	457 484
	$/ha	393	518	840	989	1 361	818	—
	$/ML	223	313	263	372	615	357	—
Irrigation methods & practices								
Surface methods	% area irrigated	20	63	51	56	63	51	—
Drip/trickle methods	% area irrigated	4	3	4	4	5	4	—
Sprinkler methods	% area irrigated	73	34	45	40	32	44	—
Water source	% total water supplied to size group							
Surface water		70	85	58	74	66	—	68
Groundwater		25	14	38	22	32	—	30
Town water		1	np	np	np	0	—	0
Recycled/reused water		1	np	np	np	1	—	1

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

TABLE D.12 WATER TRADE BY FARMS WITH CEREALS AS THE MAIN IRRIGATED ACTIVITY, Selected years

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Farms trading in 2001–02	number	47	71	70	100	108	—	397
Farms trading in 2002–03	number	115	189	248	281	289	—	1 122
Farms trading in 2003–04	number	75	75	181	220	261	—	811
Traded any year (2001–02 to 2003–04)	% farms	19	56	73	68	61	—	58
Traded every year (2001–02 to 2003–04)	% farms	16	11	21	22	30	—	21
Irrigation water entitlement in 2002–03	% farms in size group	72	73	93	92	88	—	—
Trade magnitude in 2002–03								
Temporary sales	ML	97	131	124	175	1 336	391	138 039
Permanent sales	ML	—	np	—	—	809	487	3 102
Temporary purchases	ML	35	141	202	275	689	327	244 060
Permanent purchases	ML	np	—	—	—	1 001	752	11 958
Trade prices in 2002–03								
Temporary sales	$/ML	171	198	261	123	147	176	—
Permanent sales	$/ML	—	np	—	—	748	657	—
Temporary purchases	$/ML	197	110	74	90	94	100	—
Permanent purchases	$/ML	np	—	—	—	668	492	—
Net trade revenue in 2002–03	$'000	0	5	–3	–6	10	1	757
	% contribution to trader GVP	37	4	0	–1	1	4	—

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

TABLE D.13 IRRIGATION CHARACTERISTICS OF FARMS WITH COTTON AS THE MAIN IRRIGATED ACTIVITY — 2002–03

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	106	102	105	101	103	—	516
Use of land & water resources								
Area of holding	ha	1 647	2 490	3 109	3 873	10 873	4 387	2 261 636
Area irrigated (farm)	ha	96	133	296	402	1 551	494	254 830
Area irrigated (main activity)	ha	89	115	228	313	1 330	414	213 309
Water use (farm)	ML	405	719	1 513	2 149	9 869	2 922	1 506 488
Water use (main activity)	ML	384	675	1 300	1 943	9 223	2 697	1 390 345
Water use intensity (main activity)	ML/ha	5.0	6.5	6.0	6.1	6.9	6.1	—
Farm dam capacity	ML	486	1 461	2 307	2 632	8 345	3 269	—
Gross production returns & expenses								
EVAO (farm)	$'000	280	518	780	1 357	4 890	1 559	803 853
GVP (farm)	$'000	280	602	712	1 593	5 730	1 776	915 511
GVIP (main activity)	$'000	175	422	517	1 179	4 973	1 447	746 107
GVIP (farm)	$'000	189	443	569	1 260	5 172	1 520	783 784
	$/ha	1 977	3 793	2 273	3 171	3 785	2 990	—
	$/ML	512	715	461	812	722	642	—
Irrigation expenses	$/ML	165	153	76	111	160	133	—
Water licence	% total	21	14	8	6	4	11	—
Volumetric charges	% total	9	14	27	9	27	17	—
Irrigation fees	% total	1	4	4	3	3	3	—
Equipment purchase	% total	17	29	7	15	8	15	—
Operating expenses	% total	41	28	34	48	43	39	—
Construction	% total	10	11	18	12	12	13	—
Irrigation investment greater than $10,000	% farms in 5 years to 2002–03	100	100	100	99	100	100	—
Irrigation investment greater than $100,000	% farms in 5 years to 2002–03	72	68	78	75	94	78	—
Irrigation methods & practices								
Surface methods	% area irrigated	98	75	95	100	98	93	—
Drip/trickle methods	% area irrigated	—	—	np	np	1	0	—
Sprinkler methods	% area irrigated	np	25	np	np	1	6	—
Laser levelled land	% area holding	26	31	39	35	36	34	—
Water recycling	% farms in size group	97	64	96	95	100	90	—
Scheduling techniques	number of farms							
Evaporation figures		21	np	np	13	30	—	75
Tensiometres		11	5	—	—	9	—	25
Soil probes		52	39	86	57	92	—	326
Scheduling service		18	—	—	3	3	—	24
Rotation scheduling		10	5	5	14	16	—	50
Local knowledge		85	78	94	91	91	—	437
Changes to irrigation practices(a)	number of farms							
Application method		67	63	79	63	76	—	348
Scheduling		76	36	54	79	80	—	325
Piping		20	5	4	8	14	—	51
Levees & drains		86	50	49	46	63	—	294
Laser levelling		86	61	84	91	86	—	407
Reuse/recycling		58	58	42	53	63	—	274
Soil moisture monitoring		49	35	67	57	73	—	281
Farm water plan		19	41	9	37	23	—	128

For footnotes see end of table.

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TABLE D.13 IRRIGATION CHARACTERISTICS OF FARMS WITH COTTON AS THE MAIN IRRIGATED ACTIVITY — 2002–03 — *continued*

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Intended changes(b)	number of farms							
Application method		41	23	39	40	47	—	191
Scheduling		24	23	32	39	43	—	161
Piping		—	—	4	6	6	—	17
Levees & drains		26	26	22	29	23	—	127
Laser levelling		28	31	29	68	45	—	200
Reuse/recycling		—	26	23	12	12	—	73
Soil moisture monitoring		8	22	12	17	14	—	73
Farm water plan		—	15	38	7	28	—	89
Barriers to change	number of farms							
Water quality		16	—	8	np	np	—	26
Allocation uncertainty		61	64	98	81	75	—	379
Financial		62	54	75	47	62	—	300
Time		—	25	6	—	8	—	40
Information		—	—	—	—	11	—	11
Success uncertainty		13	16	12	14	14	—	69
Age/health		—	—	4	—	5	—	9
Water availability		56	54	61	52	27	—	250
Water source	% total water supplied to size group							
Surface water		71	72	78	58	80	—	76
Groundwater		29	28	22	41	19	—	24
Town water		—	—	—	np	—	—	—
Recycled/reused water		—	—	—	np	1	—	1

(a) Changes to irrigation practices in the five years to 2002–03.

(b) Intention in 2002–03 to change irrigation practices in 2003–04.

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

TABLE D.14 IRRIGATION CHARACTERISTICS OF FARMS WITH COTTON AS THE MAIN IRRIGATED ACTIVITY — 2003–04

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	104	98	100	93	99	—	494
Use of land & water resources								
Area of holding	ha	1 278	1 942	4 010	4 620	10 342	4 404	2 176 440
Area irrigated (farm)	ha	119	190	291	384	1 049	404	199 464
Area irrigated (main activity)	ha	91	174	251	303	906	343	169 264
Water use (farm)	ML	502	1 198	1 473	2 373	7 268	2 541	1 255 592
Water use (main activity)	ML	428	1 165	1 384	2 180	6 616	2 334	1 153 335
Water use intensity (main activity)	ML/ha	5.2	5.9	5.3	6.9	7.0	6.0	—
Irrigated every year from 2000–01 to 2003–04	% farms	51	57	61	76	83	73	—
Gross production returns								
EVAO (farm)	$'000	336	670	1 003	1 575	4 668	1 636	808 575
GVP (farm)	$'000	482	852	1 257	1 776	4 678	1 795	886 890
GVIP (main activity)	$'000	291	617	861	1 169	3 030	1 184	584 897
GVIP (farm)	$'000	317	636	937	1 275	3 211	1 265	624 954
	$/ha	2 500	3 125	3 577	3 389	3 353	3 180	—
	$/ML	728	829	926	699	625	762	—
Irrigation methods & practices								
Surface methods	% area irrigated	96	94	90	96	97	95	—
Drip/trickle methods	% area irrigated	np	np	np	np	1	3	—
Sprinkler methods	% area irrigated	np	np	np	np	1	2	—
Water source	% total water supplied to size group							
Surface water		67	68	53	69	68	—	66
Groundwater		21	23	43	31	29	—	30
Town water		—	—	np	—	—	—	—
Recycled/reused water		3	6	np	—	—	—	1

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

TABLE D.15 WATER TRADE BY FARMS WITH COTTON AS THE MAIN IRRIGATED ACTIVITY, Selected years

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Farms trading in 2001–02	number	25	41	32	50	28	—	176
Farms trading in 2002–03	number	5	12	41	30	85	—	173
Farms trading in 2003–04	number	17	26	11	25	36	—	116
Traded any year (2001–02 to 2003–04)	% farms	23	56	48	65	61	—	54
Traded every year (2001–02 to 2003–04)	% farms	—	23	—	10	9	—	10
Irrigation water entitlement in 2002–03	% farms in size group	87	100	100	91	95	95	—
Trade magnitude in 2002–03								
Temporary sales	ML	—	—	—	—	np	np	np
Permanent sales	ML	—	—	—	—	—	—	—
Temporary purchases	ML	np	100	289	403	1 909	942	139 669
Permanent purchases	ML	—	—	—	—	1 123	1 123	24 859
Trade prices in 2002–03								
Temporary sales	$/ML	—	—	—	—	np	np	—
Permanent sales	$/ML	—	—	—	—	—	—	—
Temporary purchases	$/ML	np	176	97	145	132	131	—
Permanent purchases	$/ML	—	—	—	—	1 078	1 078	—
Net trade revenue in 2002–03	$'000	np	–12	–23	–45	–610	–265	–39 605
	% contribution to trader GVP	np	–2	–6	–3	–16	–9	—

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

TABLE D.16 IRRIGATION CHARACTERISTICS OF FARMS WITH SUGAR AS THE MAIN IRRIGATED ACTIVITY — 2002–03

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	521	518	527	510	509	—	2 585
Use of land & water resources								
Area of holding	ha	61	170	118	187	1 250	353	913 092
Area irrigated (farm)	ha	29	55	60	102	231	94	244 228
Area irrigated (main activity)	ha	29	53	58	99	220	91	235 206
Water use (farm)	ML	91	235	193	516	1 529	508	1 311 945
Water use (main activity)	ML	90	230	189	506	1 478	494	1 275 685
Water use intensity (main activity)	ML/ha	3.2	3.9	3.5	4.9	6.2	4.3	—
Farm dam capacity	ML	27	54	53	248	250	143	—
Gross production returns & expenses								
EVAO (farm)	$'000	65	125	189	286	870	304	786 937
GVP (farm)	$'000	64	146	194	271	790	291	751 001
GVIP (main activity)	$'000	48	101	105	172	368	158	407 567
GVIP (farm)	$'000	48	105	116	183	466	182	470 582
	$/ha	1 677	2 135	2 074	2 062	2 407	2 069	—
	$/ML	1 427	995	1 205	810	955	1 080	—
Irrigation expenses	$/ML	197	181	134	101	192	161	—
Water licence	% total	9	5	13	8	6	8	—
Volumetric charges	% total	15	15	21	16	24	18	—
Irrigation fees	% total	np	3	np	2	1	2	—
Equipment purchase	% total	10	10	10	14	15	12	—
Operating expenses	% total	61	62	52	57	48	56	—
Construction	% total	np	np	np	1	2	1	—
Irrigation investment greater than $10,000	% farms in 5 years to 2002–03	37	75	77	77	89	71	—
Irrigation investment greater than $100,000	% farms in 5 years to 2002–03	—	np	20	31	42	20	—
Irrigation methods & practices								
Surface methods	% area irrigated	38	35	28	37	43	36	—
Drip/trickle methods	% area irrigated	6	8	2	7	7	6	—
Sprinkler methods	% area irrigated	55	51	66	56	49	56	—
Laser levelled land	% area holding	43	47	56	48	61	52	—
Water recycling	% farms in size group	19	np	26	26	40	23	—
Scheduling techniques	number of farms							
Evaporation figures		92	162	75	124	191	—	643
Tensiometres		—	80	54	84	99	—	317
Soil probes		—	—	10	35	56	—	102
Scheduling service		—	36	8	47	23	—	113
Rotation scheduling		104	89	41	125	119	—	478
Local knowledge		488	462	523	477	474	—	2 424
Changes to irrigation practices(a)	number of farms							
Application method		261	242	150	290	324	—	1 267
Scheduling		153	319	263	318	259	—	1 311
Piping		68	38	23	154	141	—	425
Levees & drains		np	56	np	139	141	—	387
Laser levelling		174	317	183	306	346	—	1 325
Reuse/recycling		70	17	69	101	180	—	437
Soil moisture monitoring		31	24	38	111	131	—	335
Farm water plan		32	7	41	55	38	—	173

For footnotes see end of table.

...continued

TABLE D.16 IRRIGATION CHARACTERISTICS OF FARMS WITH SUGAR AS THE MAIN IRRIGATED ACTIVITY — 2002–03 — *continued*

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Intended changes(b)	number of farms							
Application method		91	142	20	208	105	—	566
Scheduling		37	182	85	151	160	—	615
Piping		—	21	3	63	28	—	115
Levees & drains		—	39	3	53	73	—	169
Laser levelling		29	17	41	100	203	—	391
Reuse/recycling		—	17	34	19	116	—	186
Soil moisture monitoring		58	56	36	32	72	—	255
Farm water plan		—	17	3	16	70	—	106
Barriers to change	number of farms							
Water quality		38	—	27	23	125	—	213
Allocation uncertainty		175	219	246	83	197	—	921
Financial		384	285	414	343	424	—	1 849
Time		36	57	38	77	108	—	316
Information		—	—	—	13	28	—	41
Success uncertainty		7	72	44	48	54	—	223
Age/health		94	53	62	96	46	—	351
Water availability		240	198	214	140	237	—	1 029
Water source	% total water supplied to size group							
Surface water		44	42	44	51	62	—	56
Groundwater		51	58	55	48	34	—	41
Town water		—	—	np	np	np	—	0
Recycled/reused water		5	—	np	np	np	—	3

(a) Changes to irrigation practices in the five years to 2002–03.

(b) Intention in 2002–03 to change irrigation practices in 2003–04.

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

TABLE D.17 IRRIGATION CHARACTERISTICS OF FARMS WITH SUGAR AS THE MAIN IRRIGATED ACTIVITY — 2003–04

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	468	448	455	450	450	—	2 272
Use of land & water resources								
Area of holding	ha	198	164	153	224	1 608	467	1 060 737
Area irrigated (farm)	ha	54	58	65	122	256	111	251 336
Area irrigated (main activity)	ha	50	56	64	116	238	104	236 748
Water use (farm)	ML	208	216	184	728	1 434	551	1 251 394
Water use (main activity)	ML	192	205	178	700	1 375	527	1 197 096
Water use intensity (main activity)	ML/ha	4.4	4.0	2.8	6.2	5.9	4.7	—
Irrigated every year from 2000–01 to 2003–04	% farms	28	83	84	78	83	80	—
Gross production returns								
EVAO (farm)	$'000	79	143	209	322	908	330	750 006
GVP (farm)	$'000	96	115	153	255	798	282	640 777
GVIP (main activity)	$'000	68	76	80	162	334	143	325 013
GVIP (farm)	$'000	71	78	87	178	442	170	386 585
	$/ha	1 328	1 496	1 483	1 712	2 022	1 606	—
	$/ML	624	754	2 012	858	6 109	2 062	—
Irrigation methods & practices								
Surface methods	% area irrigated	30	30	22	47	42	34	—
Drip/trickle methods	% area irrigated	6	5	2	7	5	5	—
Sprinkler methods	% area irrigated	61	65	76	46	53	60	—
Water source	% total water supplied to size group							
Surface water		58	54	69	43	61	—	56
Groundwater		26	46	30	54	34	—	40
Town water		np	np	np	np	np	—	0
Recycled/reused water		np	np	np	np	np	—	2

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

TABLE D.18 WATER TRADE BY FARMS WITH SUGAR AS THE MAIN IRRIGATED ACTIVITY, Selected years

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Farms trading in 2001–02	number	18	46	94	67	85	—	310
Farms trading in 2002–03	number	89	248	72	113	171	—	693
Farms trading in 2003–04	number	35	32	56	120	98	—	341
Traded any year (2001–02 to 2003–04)	% farms	30	13	29	31	50	—	30
Traded every year (2001–02 to 2003–04)	% farms	—	2	34	—	7	—	6
Irrigation water entitlement in 2002–03	% farms in size group	75	74	66	60	76	70	—
Trade magnitude in 2002–03								
Temporary sales	ML	np	—	87	np	387	161	18 333
Permanent sales	ML	—	np	—	—	—	np	np
Temporary purchases	ML	np	130	121	213	337	186	82 909
Permanent purchases	ML	—	np	—	np	1 620	746	58 357
Trade prices in 2002–03								
Temporary sales	$/ML	np	—	53	—	30	75	—
Permanent sales	$/ML	—	np	—	—	—	np	—
Temporary purchases	$/ML	np	22	88	28	45	31	—
Permanent purchases	$/ML	—	np	—	np	291	496	—
Net trade revenue in 2002–03	$'000	0	–123	1	–4	–104	–59	–33 093
	% contribution to trader GVP	1	–82	0	–1	–13	–23	—

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

TABLE D.19 IRRIGATION CHARACTERISTICS OF FARMS WITH HORTICULTURE AS THE MAIN IRRIGATED ACTIVITY — 2002–03

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	3 541	3 486	3 542	3 482	3 512	—	17 563
Use of land & water resources								
Area of holding	ha	49	67	122	264	657	232	4 066 461
Area irrigated (farm)	ha	6	7	12	21	65	22	388 360
Area irrigated (main activity)	ha	5	7	11	20	61	21	368 010
Water use (farm)	ML	18	31	52	84	280	93	1 632 330
Water use (main activity)	ML	17	31	51	81	265	89	1 564 874
Water use intensity (main activity)	ML/ha	3.9	4.5	4.6	4.3	4.2	4.3	—
Farm dam capacity	ML	51	51	31	63	151	71	600 924
Gross production returns & expenses								
EVAO (farm)	$'000	21	63	121	256	1 182	328	5 765 000
GVP (farm)	$'000	27	63	120	244	1 201	331	5 812 035
GVIP (main activity)	$'000	16	45	87	155	791	219	3 840 339
GVIP (farm)	$'000	16	45	87	160	804	222	3 902 779
	$/ha	6 620	10 187	10 913	12 397	20 512	12 117	—
	$/ML	4 866	7 091	8 029	6 335	11 554	7 574	—
Irrigation expenses	$/ML	1 030	881	597	772	719	800	—
Water licence	% total	10	13	8	8	7	9	—
Volumetric charges	% total	13	19	20	16	12	16	—
Irrigation fees	% total	8	5	8	4	4	6	—
Equipment purchase	% total	24	20	20	24	27	23	—
Operating expenses	% total	41	38	37	42	43	40	—
Construction	% total	3	3	3	3	4	3	—
Irrigation investment greater than $10,000	% farms in 5 years to 2002–03	30	43	55	71	83	57	—
Irrigation investment greater than $100,000	% farms in 5 years to 2002–03	1	3	6	13	40	13	—
Irrigation methods & practices								
Surface methods	% area irrigated	8	12	13	5	4	9	—
Drip/trickle methods	% area irrigated	75	69	62	66	62	67	—
Sprinkler methods	% area irrigated	13	17	24	26	32	23	—
Laser levelled land	% area holding	47	67	64	61	51	58	—
Water recycling	% farms in size group	6	5	6	6	10	7	—
Scheduling techniques	number of farms							
Evaporation figures		212	222	257	320	500	—	1 510
Tensiometres		454	545	586	664	744	—	2 993
Soil probes		342	499	733	816	1 234	—	3 624
Scheduling service		52	33	87	38	66	—	275
Rotation scheduling		447	504	366	433	310	—	2 061
Local knowledge		3 136	3 106	2 996	2 919	2 976	—	15 133
Changes to irrigation practices(a)	number of farms							
Application method		1 229	1 542	1 597	1 786	2 098	—	8 251
Scheduling		1 086	1 158	1 502	1 442	1 824	—	7 011
Piping		236	375	361	355	268	—	1 595
Levees & drains		101	131	128	126	203	—	689
Laser levelling		38	82	175	156	326	—	777
Reuse/recycling		105	42	100	119	142	—	508
Soil moisture monitoring		412	528	827	968	1 319	—	4 054
Farm water plan		170	169	169	209	435	—	1 152

For footnotes see end of table.

...continued

TABLE D.19 IRRIGATION CHARACTERISTICS OF FARMS WITH HORTICULTURE AS THE MAIN IRRIGATED ACTIVITY — 2002–03 — *continued*

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Intended changes(b)	number of farms							
Application method		410	594	793	703	1 080	—	3 580
Scheduling		457	447	600	653	821	—	2 978
Piping		45	48	94	98	109	—	394
Levees & drains		31	18	56	18	75	—	198
Laser levelling		19	62	41	53	113	—	288
Reuse/recycling		39	48	72	70	121	—	349
Soil moisture monitoring		196	365	438	450	566	—	2 017
Farm water plan		184	277	178	90	268	—	996
Barriers to change	number of farms							
Water quality		286	183	265	172	281	—	1 187
Allocation uncertainty		362	407	581	561	911	—	2 822
Financial		1 321	1 497	1 379	1 322	1 542	—	7 063
Time		366	383	296	337	363	—	1 746
Information		63	108	157	179	179	—	686
Success uncertainty		342	272	261	212	349	—	1 436
Age/health		443	400	294	294	171	—	1 601
Water availability		567	490	616	601	713	—	2 987
Water source	% total water supplied to size group							
Surface water		47	76	75	81	73	—	74
Groundwater		43	13	12	14	23	—	20
Town water		10	9	12	4	3	—	5
Recycled/reused water		0	1	0	0	1	—	1

(a) Changes to irrigation practices in the five years to 2002–03.

(b) Intention in 2002–03 to change irrigation practices in 2003–04.

TABLE D.20 IRRIGATION CHARACTERISTICS OF FARMS WITH HORTICULTURE AS THE MAIN IRRIGATED ACTIVITY — 2003–04

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	3 091	3 100	3 083	3 087	3 090	—	15 450
Use of land & water resources								
Area of holding	ha	313	80	586	320	586	377	5 823 143
Area irrigated (farm)	ha	3	8	12	20	77	24	373 787
Area irrigated (main activity)	ha	3	8	11	19	73	23	355 713
Water use (farm)	ML	12	35	54	88	341	106	1 640 239
Water use (main activity)	ML	12	35	53	85	325	102	1 579 812
Water use intensity (main activity)	ML/ha	4.3	4.7	4.9	4.6	4.4	4.6	—
Irrigated every year from 2000–01 to 2003–04	% farms	73	80	82	84	86	83	—
Gross production returns								
EVAO (farm)	$'000	21	66	130	263	1 745	445	6 878 261
GVP (farm)	$'000	28	88	135	280	1 380	382	5 905 546
GVIP (main activity)	$'000	18	59	98	201	1 019	279	4 312 230
GVIP (farm)	$'000	18	59	99	203	1 033	283	4 365 819
	$/ha	8 495	10 337	11 735	13 302	35 333	15 839	—
	$/ML	9 316	9 260	7 811	9 673	17 248	10 662	—
Irrigation methods & practices								
Surface methods	% area irrigated	8	12	11	9	5	9	—
Drip/trickle methods	% area irrigated	75	68	65	64	63	67	—
Sprinkler methods	% area irrigated	13	16	22	25	31	22	—
Water source	% total water supplied to size group							
Surface water		54	64	77	78	73	—	73
Groundwater		34	23	11	12	23	—	20
Town water		9	8	7	7	2	—	4
Recycled/reused water		0	1	0	0	1	—	1

TABLE D.21 WATER TRADE BY FARMS WITH HORTICULTURE AS THE MAIN IRRIGATED ACTIVITY, Selected years

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Farms trading in 2001–02	number	145	269	399	408	445	—	1 666
Farms trading in 2002–03	number	328	434	732	640	857	—	2 991
Farms trading in 2003–04	number	420	400	554	629	766	—	2 768
Traded any year (2001–02 to 2003–04)	% farms	13	23	31	32	35	—	27
Traded every year (2001–02 to 2003–04)	% farms	4	10	15	12	9	—	10
Irrigation water entitlement in 2002–03	% farms in size group	57	60	69	71	72	66	—
Trade magnitude in 2002–03								
Temporary sales	ML	48	63	68	126	1 412	319	532 355
Permanent sales	ML	np	np	35	86	223	85	4 019
Temporary purchases	ML	5	12	14	28	152	74	85 226
Permanent purchases	ML	—	14	np	51	148	90	11 145
Trade prices in 2002–03								
Temporary sales	$/ML	187	97	157	140	151	146	—
Permanent sales	$/ML	np	np	1 093	633	586	687	—
Temporary purchases	$/ML	439	287	344	233	220	268	—
Permanent purchases	$/ML	—	481	np	1 003	1 523	1 103	—
Net trade revenue in 2002–03	$'000	7	3	5	11	101	33	90 997
	% contribution to trader GVP	125	7	72	3	8	36	—

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

TABLE D.22 IRRIGATION CHARACTERISTICS OF FARMS WITH FRUIT AS THE MAIN IRRIGATED ACTIVITY — 2002–03

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	1 346	1 337	1 332	1 337	1 333	—	6 684
Use of land & water resources								
Area of holding	ha	33	122	208	306	740	281	1 880 191
Area irrigated (farm)	ha	7	8	10	23	50	20	131 068
Area irrigated (main activity)	ha	6	8	9	22	47	18	122 480
Water use (farm)	ML	18	35	43	95	259	90	600 141
Water use (main activity)	ML	15	34	41	85	243	83	556 933
Water use intensity (main activity)	ML/ha	3.8	4.7	4.4	4.9	4.4	4.4	—
Farm dam capacity	ML	86	84	22	48	93	67	—
Gross production returns & expenses								
EVAO (farm)	$'000	17	56	120	260	1 108	311	2 081 957
GVP (farm)	$'000	16	56	129	257	1 206	332	2 219 456
GVIP (main activity)	$'000	8	36	84	148	778	210	1 406 774
GVIP (farm)	$'000	8	38	88	161	802	219	1 463 181
	$/ha	4 112	9 574	14 381	16 202	24 552	13 745	—
	$/ML	2 182	6 567	11 618	7 292	15 960	8 709	—
Irrigation expenses	$/ML	823	622	663	770	915	758	—
Water licence	% total	10	9	6	8	5	8	—
Volumetric charges	% total	8	12	14	16	16	13	—
Irrigation fees	% total	7	5	3	4	3	4	—
Equipment purchase	% total	29	27	23	28	28	27	—
Operating expenses	% total	44	45	48	39	42	43	—
Construction	% total	2	2	2	4	4	3	—
Irrigation investment greater than $10,000	% farms in 5 years to 2002–03	27	37	48	65	79	51	—
Irrigation investment greater than $100,000	% farms in 5 years to 2002–03	1	2	3	8	31	9	—
Irrigation methods & practices								
Surface methods	% area irrigated	2	7	11	6	4	6	—
Drip/trickle methods	% area irrigated	86	80	74	80	82	80	—
Sprinkler methods	% area irrigated	10	12	14	11	13	12	—
Laser levelled land	% area holding	52	48	58	56	42	51	—
Water recycling	% farms in size group	5	4	4	6	8	6	—
Scheduling techniques	number of farms							
Evaporation figures		64	112	117	141	181	—	615
Tensiometres		216	226	281	310	325	—	1 358
Soil probes		140	131	136	244	420	—	1 070
Scheduling service		—	14	20	13	43	—	89
Rotation scheduling		224	166	161	229	110	—	889
Local knowledge		1 176	1 223	1 168	1 129	1 127	—	5 823
Changes to irrigation practices(a)	number of farms							
Application method		507	510	574	743	836	—	3 171
Scheduling		526	408	452	504	749	—	2 638
Piping		112	102	113	115	93	—	534
Levees & drains		21	44	42	33	85	—	226
Laser levelling		14	22	78	84	68	—	266
Reuse/recycling		14	12	27	67	61	—	181
Soil moisture monitoring		152	152	276	347	501	—	1 427
Farm water plan		60	59	81	95	115	—	409

For footnotes see end of table. *...continued*

TABLE D.22 IRRIGATION CHARACTERISTICS OF FARMS WITH FRUIT AS THE MAIN IRRIGATED ACTIVITY — 2002–03 — *continued*

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Intended changes(b)	number of farms							
Application method		199	204	321	299	450	—	1 473
Scheduling		206	139	202	264	286	—	1 097
Piping		12	26	29	49	55	—	171
Levees & drains		—	—	25	3	32	—	60
Laser levelling		8	8	39	28	19	—	102
Reuse/recycling		22	—	15	28	33	—	98
Soil moisture monitoring		81	81	160	158	208	—	688
Farm water plan		80	136	75	59	88	—	437
Barriers to change	number of farms							
Water quality		99	114	88	71	99	—	472
Allocation uncertainty		86	175	183	204	400	—	1 048
Financial		476	594	520	591	590	—	2 771
Time		138	204	152	99	162	—	755
Information		34	64	106	41	54	—	299
Success uncertainty		83	149	123	118	148	—	622
Age/health		151	134	116	138	66	—	604
Water availability		254	262	263	259	275	—	1 313
Water source	% total water supplied to size group							
Surface water		60	60	84	81	84	—	80
Groundwater		27	34	12	14	13	—	16
Town water		np	6	np	4	3	—	4
Recycled/reused water		np	1	np	0	0	—	0

(a) Changes to irrigation practices in the five years to 2002–03.

(b) Intention in 2002–03 to change irrigation practices in 2003–04.

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

TABLE D.23 IRRIGATION CHARACTERISTICS OF FARMS WITH FRUIT AS THE MAIN IRRIGATED ACTIVITY — 2003–04

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	1 148	1 134	1 141	1 139	1 139	—	5 701
Use of land & water resources								
Area of holding	ha	716	55	340	211	615	388	2 213 597
Area irrigated (farm)	ha	4	8	10	19	58	20	111 414
Area irrigated (main activity)	ha	4	7	10	18	54	18	105 333
Water use (farm)	ML	15	29	48	89	320	100	570 953
Water use (main activity)	ML	15	28	47	82	300	94	536 681
Water use intensity (main activity)	ML/ha	4.9	5.1	4.7	4.7	4.6	4.8	—
Irrigated every year from 2000–01 to 2003–04	% farms	71	83	80	82	86	83	—
Gross production returns								
EVAO (farm)	$'000	16	55	118	270	1 742	440	2 506 880
GVP (farm)	$'000	17	54	124	292	1 299	357	2 033 647
GVIP (main activity)	$'000	9	34	87	190	912	246	1 402 925
GVIP (farm)	$'000	9	35	91	200	944	256	1 457 797
	$/ha	4 829	9 229	14 544	15 892	26 783	14 247	—
	$/ML	3 803	6 915	9 097	12 003	16 735	9 705	—
Irrigation methods & practices								
Surface methods	% area irrigated	3	10	9	6	5	6	—
Drip/trickle methods	% area irrigated	81	78	77	82	83	80	—
Sprinkler methods	% area irrigated	13	11	12	10	11	11	—
Water source	% total water supplied to size group							
Surface water		46	72	81	77	84	—	80
Groundwater		48	19	14	13	13	—	15
Town water		np	np	3	5	2	—	3
Recycled/reused water		np	np	1	0	0	—	0

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

TABLE D.24 WATER TRADE BY FARMS WITH FRUIT AS THE MAIN IRRIGATED ACTIVITY, Selected years

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Farms trading in 2001–02	number	59	107	106	195	157	—	624
Farms trading in 2002–03	number	95	172	258	312	344	—	1 182
Farms trading in 2003–04	number	147	151	230	214	273	—	1 016
Traded any year (2001–02 to 2003–04)	% farms	17	20	27	38	35	—	28
Traded every year (2001–02 to 2003–04)	% farms	—	8	11	17	11	—	11
Irrigation water entitlement in 2002–03	% farms in size group	56	51	64	67	62	60	—
Trade magnitude in 2002–03								
Temporary sales	ML	56	55	70	144	624	196	131 009
Permanent sales	ML	np	—	np	np	np	90	3 278
Temporary purchases	ML	8	17	25	31	142	79	34 283
Permanent purchases	ML	—	np	np	np	49	22	928
Trade prices in 2002–03								
Temporary sales	$/ML	150	94	141	119	125	124	—
Permanent sales	$/ML	np	—	np	np	752	644	—
Temporary purchases	$/ML	415	190	364	305	303	316	—
Permanent purchases	$/ML	—	np	np	np	795	509	—
Net trade revenue in 2002–03	$'000	5	4	5	20	33	17	18 101
	% contribution to trader GVP	116	9	201	5	9	60	—

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

TABLE D.25 IRRIGATION CHARACTERISTICS OF FARMS WITH GRAPES AS THE MAIN IRRIGATED ACTIVITY — 2002–03

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	1 417	1 390	1 367	1 390	1 391	—	6 955
Use of land & water resources								
Area of holding	ha	70	34	52	249	697	220	1 532 999
Area irrigated (farm)	ha	4	8	13	18	64	21	147 063
Area irrigated (main activity)	ha	3	7	12	17	60	20	138 248
Water use (farm)	ML	13	41	55	73	245	85	593 275
Water use (main activity)	ML	12	39	52	67	214	77	532 748
Water use intensity (main activity)	ML/ha	3.7	4.9	4.8	4.0	3.9	4.2	—
Farm dam capacity	ML	33	14	16	44	93	43	—
Gross production returns & expenses								
EVAO (farm)	$'000	26	66	105	193	881	254	1 764 755
GVP (farm)	$'000	36	68	104	171	856	247	1 714 757
GVIP (main activity)	$'000	20	50	80	119	462	146	1 015 109
GVIP (farm)	$'000	20	51	82	126	507	157	1 092 068
	$/ha	7 196	7 838	7 733	7 391	7 949	7 619	—
	$/ML	8 072	5 314	5 912	5 904	6 082	6 265	—
Irrigation expenses	$/ML	1 720	519	483	851	583	836	—
Water licence	% total	14	16	8	11	11	12	—
Volumetric charges	% total	16	29	29	22	14	22	—
Irrigation fees	% total	12	4	15	8	7	9	—
Equipment purchase	% total	18	13	18	17	20	17	—
Operating expenses	% total	32	34	26	36	40	34	—
Construction	% total	3	3	3	3	1	3	—
Irrigation investment greater than $10,000	% farms in 5 years to 2002–03	31	48	59	67	87	58	—
Irrigation investment greater than $100,000	% farms in 5 years to 2002–03	1	3	7	15	44	14	—
Irrigation methods & practices								
Surface methods	% area irrigated	21	19	15	11	5	14	—
Drip/trickle methods	% area irrigated	74	64	65	73	78	71	—
Sprinkler methods	% area irrigated	5	17	20	15	16	14	—
Laser levelled land	% area holding	np	79	71	65	67	70	—
Water recycling	% farms in size group	1	4	6	3	6	4	—
Scheduling techniques	number of farms							
Evaporation figures		76	114	127	136	249	—	702
Tensiometres		170	243	233	232	284	—	1 161
Soil probes		148	306	457	531	710	—	2 153
Scheduling service		50	9	73	18	8	—	159
Rotation scheduling		214	260	148	123	117	—	861
Local knowledge		1 228	1 263	1 028	1 132	1 078	—	5 729
Changes to irrigation practices(a)	number of farms							
Application method		508	682	580	731	773	—	3 274
Scheduling		427	599	637	708	782	—	3 154
Piping		44	207	157	190	75	—	672
Levees & drains		—	38	15	50	50	—	153
Laser levelling		5	57	68	40	60	—	230
Reuse/recycling		5	10	47	13	18	—	93
Soil moisture monitoring		203	296	382	546	696	—	2 123
Farm water plan		72	123	27	114	221	—	557

For footnotes see end of table.

...continued

TABLE D.25 IRRIGATION CHARACTERISTICS OF FARMS WITH GRAPES AS THE MAIN IRRIGATED ACTIVITY — 2002–03 — *continued*

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Intended changes(b)	number of farms							
Application method		132	295	207	332	414	—	1 381
Scheduling		186	233	198	297	450	—	1 364
Piping		18	—	28	16	21	—	83
Levees & drains		—	5	15	3	17	—	40
Laser levelling		56	—	—	3	12	—	71
Reuse/recycling		4	23	43	4	34	—	109
Soil moisture monitoring		78	239	203	183	274	—	977
Farm water plan		51	145	59	45	94	—	395
Barriers to change	number of farms							
Water quality		111	58	124	40	91	—	423
Allocation uncertainty		141	175	185	217	208	—	926
Financial		637	627	393	574	623	—	2 854
Time		116	119	96	141	122	—	594
Information		13	33	12	60	66	—	184
Success uncertainty		112	54	39	33	76	—	314
Age/health		89	119	104	46	56	—	413
Water availability		138	114	190	109	144	—	695
Water source	% total water supplied to size group							
Surface water		53	80	67	83	79	—	77
Groundwater		37	6	12	5	14	—	12
Town water		np	np	20	11	6	—	10
Recycled/reused water		np	np	—	1	1	—	1

(a) Changes to irrigation practices in the five years to 2002–03.

(b) Intention in 2002–03 to change irrigation practices in 2003–04.

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

TABLE D.26 IRRIGATION CHARACTERISTICS OF FARMS WITH GRAPES AS THE MAIN IRRIGATED ACTIVITY — 2003–04

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	1 291	1 253	1 276	1 265	1 268	—	6 353
Use of land & water resources								
Area of holding	ha	90	88	97	468	518	252	1 599 101
Area irrigated (farm)	ha	3	8	11	18	73	23	145 270
Area irrigated (main activity)	ha	3	8	11	18	68	22	137 021
Water use (farm)	ML	10	40	60	82	285	95	604 789
Water use (main activity)	ML	10	39	58	76	253	87	552 506
Water use intensity (main activity)	ML/ha	3.5	4.3	5.6	4.9	4.2	4.5	—
Irrigated every year from 2000–01 to 2003–04	% farms	82	92	90	96	86	89	—
Gross production returns								
EVAO (farm)	$'000	26	70	122	201	835	250	1 589 359
GVP (farm)	$'000	39	122	122	218	889	277	1 762 256
GVIP (main activity)	$'000	29	77	93	171	670	208	1 319 207
GVIP (farm)	$'000	29	79	95	176	707	217	1 376 290
	$/ha	9 045	9 401	9 015	9 932	9 348	9 346	—
	$/ML	14 620	12 783	5 994	5 809	7 543	9 358	—
Irrigation methods & practices								
Surface methods	% area irrigated	17	16	15	16	7	14	—
Drip/trickle methods	% area irrigated	81	70	62	71	80	73	—
Sprinkler methods	% area irrigated	1	11	22	13	12	12	—
Water source	% total water supplied to size group							
Surface water		72	47	84	80	78	—	76
Groundwater		11	32	6	5	16	—	14
Town water		np	np	7	np	4	—	6
Recycled/reused water		np	np	0	np	1	—	1

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

TABLE D.27 WATER TRADE BY FARMS WITH GRAPES AS THE MAIN IRRIGATED ACTIVITY, Selected years

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Farms trading in 2001–02	number	59	133	154	245	246	—	838
Farms trading in 2002–03	number	196	225	308	295	328	—	1 352
Farms trading in 2003–04	number	228	205	172	372	345	—	1 323
Traded any year (2001–02 to 2003–04)	% farms	14	27	26	39	47	—	31
Traded every year (2001–02 to 2003–04)	% farms	6	15	23	18	12	—	14
Irrigation water entitlement in 2002–03	% farms in size group	63	70	80	76	81	74	—
Trade magnitude in 2002–03								
Temporary sales	ML	53	69	51	96	201	94	81 114
Permanent sales	ML	—	np	—	np	—	np	np
Temporary purchases	ML	2	8	7	29	118	45	19 627
Permanent purchases	ML	—	np	—	np	162	105	5 284
Trade prices in 2002–03								
Temporary sales	$/ML	209	96	188	137	137	152	—
Permanent sales	$/ML	—	np	—	np	—	np	—
Temporary purchases	$/ML	464	325	313	141	163	260	—
Permanent purchases	$/ML	—	np	—	np	2 522	1 805	—
Net trade revenue in 2002–03	$'000	10	4	4	7	–25	–1	–1 293
	% contribution to trader GVP	145	5	4	3	–1	24	—

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

TABLE D.28 IRRIGATION CHARACTERISTICS OF FARMS WITH VEGETABLES AS THE MAIN IRRIGATED ACTIVITY — 2002–03

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	730	725	731	719	725	—	3 630
Use of land & water resources								
Area of holding	ha	23	60	127	158	521	178	644 907
Area irrigated (farm)	ha	4	7	14	26	95	29	106 423
Area irrigated (main activity)	ha	3	7	11	22	79	24	88 295
Water use (farm)	ML	14	24	48	88	398	114	414 508
Water use (main activity)	ML	13	22	41	76	328	96	348 029
Water use intensity (main activity)	ML/ha	3.7	3.6	3.9	3.9	4.3	3.9	—
Farm dam capacity	ML	24	56	79	97	311	116	—
Gross production returns & expenses								
EVAO (farm)	$'000	21	81	197	422	1 871	517	1 878 228
GVP (farm)	$'000	32	76	194	440	1 796	507	1 839 411
GVIP (main activity)	$'000	23	48	122	269	1 265	345	1 251 400
GVIP (farm)	$'000	24	51	135	288	1 327	364	1 322 900
	$/ha	12 316	15 835	13 895	21 940	26 266	18 030	—
	$/ML	6 317	10 547	6 157	9 972	8 998	8 389	—
Irrigation expenses	$/ML	1 041	1 295	820	576	539	855	—
Water licence	% total	6	6	6	5	5	6	—
Volumetric charges	% total	17	10	8	6	10	10	—
Irrigation fees	% total	3	2	1	3	1	2	—
Equipment purchase	% total	24	24	28	25	32	27	—
Operating expenses	% total	45	51	49	54	42	48	—
Construction	% total	5	4	5	5	5	5	—
Irrigation investment greater than $10,000	% farms in 5 years to 2002–03	39	56	69	76	90	66	—
Irrigation investment greater than $100,000	% farms in 5 years to 2002–03	2	5	8	18	53	17	—
Irrigation methods & practices								
Surface methods	% area irrigated	4	2	3	2	4	3	—
Drip/trickle methods	% area irrigated	52	38	31	23	24	34	—
Sprinkler methods	% area irrigated	35	53	63	72	70	59	—
Laser levelled land	% area holding	38	55	53	51	55	53	—
Water recycling	% farms in size group	18	12	10	9	15	13	—
Scheduling techniques	number of farms							
Evaporation figures		14	9	32	38	64	—	157
Tensiometres		16	62	116	91	142	—	426
Soil probes		27	33	68	72	163	—	363
Scheduling service		np	np	6	4	9	—	23
Rotation scheduling		41	46	73	58	68	—	286
Local knowledge		674	654	656	672	657	—	3 313
Changes to irrigation practices(a)	number of farms							
Application method		192	288	346	342	465	—	1 633
Scheduling		99	162	263	241	330	—	1 095
Piping		63	67	72	66	83	—	351
Levees & drains		80	70	45	36	59	—	289
Laser levelling		20	5	33	58	151	—	268
Reuse/recycling		80	27	46	29	47	—	230
Soil moisture monitoring		34	48	94	101	196	—	473
Farm water plan		np	np	38	42	74	—	172

For footnotes see end of table.

...continued

TABLE D.28 IRRIGATION CHARACTERISTICS OF FARMS WITH VEGETABLES AS THE MAIN IRRIGATED ACTIVITY — 2002–03 — *continued*

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Intended changes(b)	number of farms							
Application method		64	97	130	157	219	—	667
Scheduling		73	67	78	107	150	—	475
Piping		17	22	25	25	37	—	125
Levees & drains		31	23	np	np	22	—	97
Laser levelling		7	np	np	24	69	—	107
Reuse/recycling		12	30	41	27	31	—	141
Soil moisture monitoring		34	30	63	83	118	—	327
Farm water plan		7	33	13	31	55	—	139
Barriers to change	number of farms							
Water quality		36	66	46	51	81	—	280
Allocation uncertainty		109	125	154	136	252	—	776
Financial		185	281	253	235	318	—	1 272
Time		117	61	77	70	67	—	393
Information		—	31	58	55	56	—	200
Success uncertainty		122	95	96	70	93	—	475
Age/health		179	187	96	53	43	—	559
Water availability		152	180	187	171	242	—	932
Water source	% total water supplied to size group							
Surface water		43	64	63	65	57	—	59
Groundwater		45	33	36	33	40	—	39
Town water		np	np	1	2	1	—	1
Recycled/reused water		np	np	0	0	1	—	1

(a) Changes to irrigation practices in the five years to 2002–03.

(b) Intention in 2002–03 to change irrigation practices in 2003–04.

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

TABLE D.29 IRRIGATION CHARACTERISTICS OF FARMS WITH VEGETABLES AS THE MAIN IRRIGATED ACTIVITY — 2003–04

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Number of farms	number	662	652	654	656	655	—	3 279
Use of land & water resources								
Area of holding	ha	94	153	1 932	272	614	612	2 006 908
Area irrigated (farm)	ha	7	6	16	33	114	35	115 281
Area irrigated (main activity)	ha	7	5	13	28	94	29	96 136
Water use (farm)	ML	25	19	53	123	473	139	454 267
Water use (main activity)	ML	25	16	46	108	390	117	383 596
Water use intensity (main activity)	ML/ha	4.8	3.4	3.8	4.3	4.3	4.1	—
Irrigated every year from 2000–01 to 2003–04	% farms	54	48	71	76	78	72	—
Gross production returns								
EVAO (farm)	$'000	25	89	207	494	3 398	842	2 760 008
GVP (farm)	$'000	29	85	233	549	2 284	636	2 084 056
GVIP (main activity)	$'000	16	51	142	338	1 641	437	1 433 944
GVIP (farm)	$'000	17	57	149	353	1 725	460	1 508 219
	$/ha	14 848	15 245	14 640	27 906	83 989	31 314	—
	$/ML	8 524	11 782	10 557	12 026	32 644	15 098	—
Irrigation methods & practices								
Surface methods	% area irrigated	3	3	2	2	5	3	—
Drip/trickle methods	% area irrigated	45	38	25	24	30	32	—
Sprinkler methods	% area irrigated	41	53	68	72	64	60	—
Water source	% total water supplied to size group							
Surface water		77	71	68	65	57	—	61
Groundwater		15	27	29	32	39	—	36
Town water		np	2	1	1	2	—	2
Recycled/reused water		np	0	0	1	2	—	1

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

TABLE D.30 WATER TRADE BY FARMS WITH VEGETABLES AS THE MAIN IRRIGATED ACTIVITY, Selected years

		Average per farm by activity size group					*Irrigated Activity*	
	unit	*0–20%*	*20–40%*	*40–60%*	*60–80%*	*80–100%*	*Average*	*Total*
Farms trading in 2001–02	number	28	24	28	34	71	—	185
Farms trading in 2002–03	number	24	39	68	71	200	—	401
Farms trading in 2003–04	number	28	45	66	122	137	—	398
Traded any year (2001–02 to 2003–04)	% farms	15	15	16	19	32	—	21
Traded every year (2001–02 to 2003–04)	% farms	0	—	4	3	5	—	3
Irrigation water entitlement in 2002–03	% farms in size group	44	50	56	73	78	60	—
Trade magnitude in 2002–03								
Temporary sales	ML	71	95	70	104	10 572	3 492	317 560
Permanent sales	ML	—	np	—	—	np	111	633
Temporary purchases	ML	np	29	20	29	191	113	31 114
Permanent purchases	ML	—	np	np	np	173	159	4 509
Trade prices in 2002–03								
Temporary sales	$/ML	284	445	153	150	263	273	—
Permanent sales	$/ML	—	np	—	—	np	791	—
Temporary purchases	$/ML	np	699	182	238	160	204	—
Permanent purchases	$/ML	—	np	np	np	690	758	—
Net trade revenue in 2002–03	$'000	2	8	–5	–7	430	201	74 260
	% contribution to trader GVP	60	7	–4	–1	22	13	—

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

APPENDIX E RELIABILITY OF THE DATA

The data in this report are subject to sampling and non–sampling errors which affect the reliability of the estimates.

E.1 SAMPLING ERRORS

The estimates in this publication are based on information obtained from a sample drawn from the total farm population in scope of the collection, and are subject to sampling variability; that is, they may differ from figures that would have been produced if all farms had been included in the survey. One measure of the likely difference is given by the standard error, which indicates the extent to which an estimate might have varied by chance because only a sample of units was included. There are about two chances in three that a 'sample' estimate will differ by less than one standard error from the figure that would have been obtained if a census had been conducted, and approximately nineteen chances in twenty that the difference will be less than two standard errors.

In this publication, 'sampling' variability of the estimates is measured by the relative standard error which is obtained by expressing the standard error as a percentage of the estimates to which it refers.

The following table contains estimates of relative standard error for a selection of the statistics presented in this publication.

TABLE E.1 RELATIVE STANDARD ERRORS OF SELECTED ESTIMATES BY IRRIGATED ACTIVITY

	Area irrigated 2003–04 ha			*Volume applied 2003–04 ML*	*GVIP 2003–04 %/ML*	*Irrigation expenses 2002–03 $/ML*	*Water trade — temporary purchases 2002–03 ML*	*Water trade — permanent purchases 2002–03 ML*
	small	*large*	*all sizes*	*all sizes*	*all sizes*	*all sizes*	*all sizes*	*all sizes*
Farm size group(a)	%	%	%	%	%	%	%	%
Pastures	18	5	6	6	14	10	15	34
Broadacre	21	6	7	10	7	14	19	27
Rice	25	15	12	12	13	14	21	n/a
Cereals	8	6	10	13	11	22	12	18
Cotton	16	13	14	17	12	14	36	19
Sugar	21	13	17	21	17	12	94	40
Horticulture	6	4	8	10	81	3	18	9
Fruit	4	5	7	11	11	6	27	9
Grapes	11	12	19	23	22	4	58	19
Vegetables	3	4	4	5	3	4	8	3

(a) Farm size by EVAO: "small" indicates lowest 20% of farms in each main irrigated activity group; "large" indicates highest 20% of farms in each group.

E.2 Non–sampling errors

Errors other than those due to sampling may occur because of deficiencies in the list of units from which the sample was selected, non-response, and errors in reporting by providers. Inaccuracies of this kind are referred to as non-sampling error, which may occur in any collection, whether it be a census or a sample. Every effort has been made to reduce non-sampling error to a minimum by careful design and testing of questionnaires, operating procedures and systems used to compile the statistics.

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