



Irrigation in the Murray-Darling Basin: Input costs, receipts and net returns in 2006-07

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Foreword

The prolonged drought affecting much of the Murray-Darling Basin has resulted in significant reductions in water allocations to irrigation farms within the Basin. The effect of these reductions on the financial performance of irrigators has varied across the Basin by region and industry. One of the factors affecting the response of irrigators to this situation will be the differing returns from various land uses.

ABARE was commissioned by the Australian Government Department of the Environment, Water, Heritage and the Arts to undertake analysis of the returns for various agricultural enterprises, including rice, cotton, wheat, horticultural crops and livestock. The purpose of this study was to demonstrate the financial incentives faced by irrigators in making cropping and water use decisions in 2006-07.



Phillip Glyde
Executive Director
December 2009

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Summary

In this report, data from ABARE's 2006-07 survey of irrigation farms in the Murray-Darling Basin were used to examine the net returns for various agricultural enterprises (i.e. land use activities), for example rice, cotton, wheat, horticultural crops and livestock. The analysis of average returns contained in this report provides a baseline from which changes in irrigation industries over time can be monitored.

The financial performance of irrigators was severely affected by drought and historical low water allocations in 2006-07. It is likely that the prevailing seasonal conditions and water allocation situation may have inflated costs and lowered receipts on some farms. Also, there are likely to have been other factors which may have affected farm costs, and hence returns, during the survey year.

Using farm survey data to estimate costs of production for individual enterprises is difficult when there is more than one enterprise on a farm. As a consequence, a quantile regression technique was used in this analysis to allocate farm costs among individual enterprises for each farm. A detailed discussion of the quantile regression technique is provided in appendix A.

The resulting estimated net returns (unit receipts minus unit cash costs) provide a measure of the short-term cash return to each activity, excluding capital costs, fixed operating costs and non-cash items such as depreciation.

Overall, the results of the analysis show there was wide variation in unit costs, unit receipts and net returns across enterprises and farms. The analysis showed that vegetables and pome fruit generated the highest average net returns per hectare in 2006-07. At the same time, there were average net losses for cotton and rice. Care should be taken when interpreting these results as the single year on which they were based reflected the significant effect of drought and historically low water allocations.

The analytical technique used did not perform well for several enterprises, including beef cattle, sheep and dryland crops. Alternative techniques also produced poor results for these enterprises. Generally, the analysis performed well for those farms with relatively few enterprises and where the sample size was relatively large. As a consequence, results are not shown for beef cattle, sheep or dryland crops.

1 Introduction

Prolonged and severe drought throughout much of the Murray-Darling Basin has reduced inflows into river systems to record lows, while the volume of water held in many major water storages has also fallen to record lows. Consequently, allocations of irrigation water were historically low in most regulated river valleys in 2006-07. The effect of these reductions on the financial performance of irrigators has varied across the Basin by region and industry.

The current and likely future water situation in the Basin has focused attention on a range of challenging and often interrelated water issues, including government administrative responsibility for water management, the environment, efficient water use and trade-offs between water uses. To make well-informed policy decisions regarding these issues, it is important that government and industry decision-makers have access to good information on the economic characteristics of irrigators at the farm level.

One of the factors affecting irrigators' responses to the current water situation will be the differing returns from various land uses. The allocation of land and water among farm enterprises is determined in part by the relative expected returns to the different enterprises. An irrigator seeking to maximise farm profits will allocate land and water according to that combination of enterprises which yields the highest expected marginal return.

The Australian Government Department of the Environment, Water, Heritage and the Arts commissioned ABARE to undertake an analysis of the returns from different land uses, including irrigated versus dryland activities. The purpose of this study is to show the economic incentives, including relative enterprise returns, faced by irrigators in 2006-07. In particular, cross-sectional data from ABARE's survey of irrigation farms in the Murray-Darling Basin were used to estimate average net returns (unit receipts minus unit cash costs) for a number of farm enterprises in 2006-07.

2 Methodology

Estimated returns for a range of enterprises on irrigation farms throughout the Murray-Darling Basin are examined in this report. The analysis was based on data from ABARE's 2006-07 survey of irrigation farms in the Basin.

Estimated returns per hectare are defined as farm cash receipts less estimated unit costs for individual enterprises, and provide a measure of the short-term cash return to each enterprise. This measure does not account for capital costs, fixed operating costs and non-cash expenses such as depreciation. Enterprise returns are a key driver of the types and size of enterprises adopted by farmers (refer to box 1).

An individual farmer would not consider the relative returns from all irrigated enterprises, but rather would consider a suite of enterprises that suits each farm's resource base (including soil capability and existing investment in on-farm infrastructure) and the farmer's management experience and capabilities. The farm survey data can reveal the mix of enterprises present on individual farms in a given year, but it is not possible to identify or draw conclusions about potential alternative crops farmers might be able to consider.

box 1 Resource allocation considerations/framework

Economic goals for farm business decision-making relate to costs, revenues and profits, where profits are defined as the excess of revenues over costs. The short-term problem for a farmer is one of maximising profits over a particular time horizon by utilising existing resources across a range of enterprises. The allocation of land and water among competing uses is determined in part by the relative returns to the different uses. A landowner seeking to maximise profits will allocate land and water to the use that yields the highest expected marginal return, where marginal return is the change in total revenue less change in total cost that results from a one-unit increase in quantity produced.

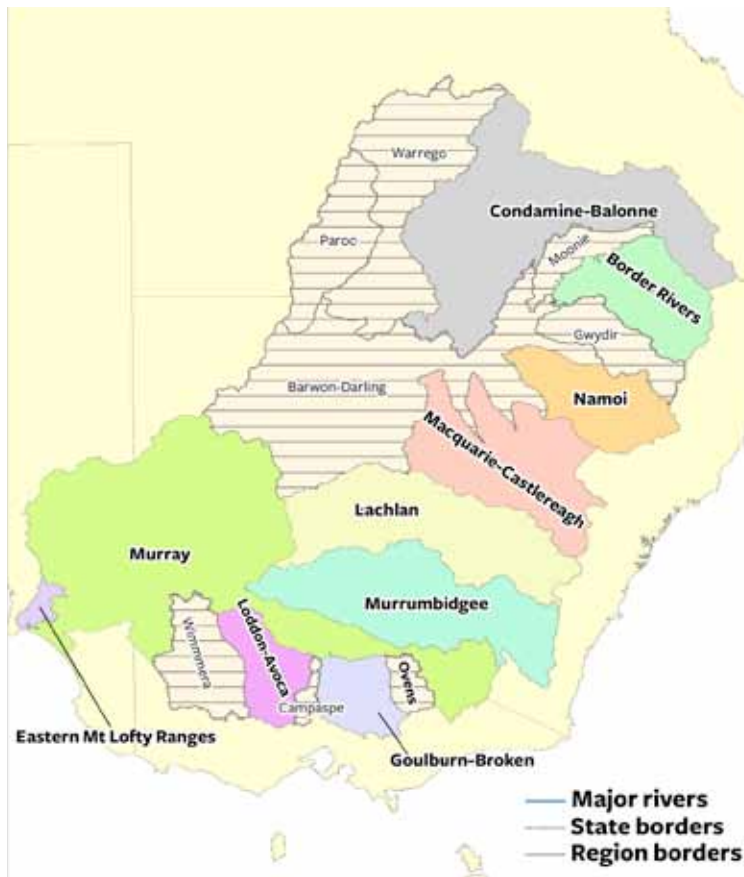
As relative returns change over time (because of changes in input costs, output prices or the technical relationship between inputs and outputs), land and water use patterns will adjust accordingly. Land uses with similar requirements, such as soil characteristics, irrigation infrastructure etc., will be closer substitutes than those land uses with dissimilar requirements.

Ideally, it is the marginal returns from various land uses which are important in farm decision-making, rather than average returns. However, estimating marginal returns from farm survey data is difficult, particularly when there is only one year of data. Nevertheless, the analysis of average returns contained in this report provides a baseline from which changes in irrigation industries can be monitored over time.

Farm survey data

The ABARE survey provided coverage of irrigation farms in three industries (broadacre, dairy and horticulture) in 10 regions across the Murray-Darling Basin (map 1). The survey regions were chosen to cover the major irrigation regions in the Basin and were based on those defined by CSIRO in its 'Sustainable yields project' (CSIRO 2007). The regions covered are: Condamine-Balonne, Border Rivers, Namoi, Macquarie-Castlereagh, Lachlan, Murrumbidgee, Murray, Goulburn-Broken, Loddon-Avoca and Eastern Mount Lofty Ranges.

map 1 Murray-Darling Basin regions



Sample farms were selected on the basis of data provided by the Australian Bureau of Statistics. Using these data, target farms were identified by an irrigation flag (defined as farms that irrigated in 2005-06), location and industry classification. Individual farm data are weighted in producing averages, so surveyed farms are representative of an industry in a particular region.

Information collected from each farm in the survey included details of area sown, area harvested, quantity produced, quantity sold, gross receipts and the volume of water used for each crop (with dryland and irrigated crops identified separately). Unit prices received per hectare were calculated for each crop from these data.

For livestock enterprises, information collected from each farm included livestock numbers, number purchased and sold, wool produced and sold, milk produced and sold and gross receipts for each output. From these data, unit prices received per hectare were calculated for beef cattle, sheep and dairy (milk and cattle). The area for livestock enterprises was defined as total farm area less the area of permanent horticultural plantings and two-thirds of the area of other crops.

Estimating unit costs

ABARE surveys collect physical and financial data from each farm interviewed. While farm cash receipts data are available at the enterprise level, farm cash cost data are only available at the farm level. Further details on cost items collected are provided in appendix B.

A major hurdle in the estimation of costs of production for individual enterprises using farm survey data is the allocation of costs to the various enterprises when there is more than one enterprise on a farm. Since many irrigation farms have more than one crop or livestock enterprise, statistical analysis was required to estimate the unit costs and returns for each enterprise.

The technique of quantile regression was used in this analysis to allocate farm costs among individual enterprises for each farm. A detailed discussion of the quantile regression technique is provided in appendix A.

3 Results

Farm enterprise mix

In this analysis, 13 agricultural enterprises were defined: beef, sheep, dairy, pome fruit, stone fruit, citrus, table grapes, wine grapes, vegetables, cotton, rice, irrigated wheat and dryland wheat. These 13 enterprises account for the majority of agricultural activity throughout the Basin. Table 1 shows the estimated proportions of irrigation farms in the Murray-Darling Basin undertaking each enterprise in 2006-07. The low proportion of farms with rice and cotton enterprises reflects the drought conditions prevailing during 2006-07.

Table 1 also shows the average proportion of total cash receipts which were generated by each primary enterprise. A primary enterprise is defined as one that generated the highest proportion of a farm's total cash receipts in 2006-07. In this analysis, farms are classified as being specialists according to their primary enterprise. In general, primary enterprises accounted for more than 70 per cent of total cash receipts for most specialist farms.

1 Irrigation farm enterprises, Murray-Darling Basin, 2006-07

enterprise	percentage of farms	percentage of farms	percentage of
	with enterprise	specialising in enterprise	total cash receipts for
	%	%	primary enterprise ^a
			%
Beef	27	11	43
Sheep ^b	19	10	54
Dairy	19	19	89
Pome fruit	4	3	79
Stone fruit	8	4	71
Citrus	10	5	76
Table grapes	9	5	88
Wine grapes	27	22	81
Vegetables	9	7	81
Cotton	2	2	50
Rice	3	2	39
Irrigated wheat	8	2	33
Dryland wheat	14	1	25

^a Estimate for farms where the enterprise is their primary activity. ^b Sheep for any purpose, including prime lambs, adult sheep and wool.

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

An indication of the mix of activities on individual farms is provided in table 2 and table 3. Forty per cent of farms undertook a single activity in 2006-07 with a further 28 per cent of farms having two enterprises (table 2). Around 32 per cent of farms managed three or more enterprises.

Consistent with the results in table 1, broadacre farms tended to have more secondary enterprises than dairy farms and horticulture farms (table 3). Secondary enterprises on broadacre farms were mainly field crops or livestock activities.

Vegetable growers were more likely to have broadacre type activities as their secondary enterprise, rather than other horticulture activities. Farms with pome fruit as their primary enterprise were likely to also have a stone fruit enterprise (and vice versa). A similar relationship existed between farms with citrus and wine grapes.

2 Proportion of irrigation farms by number of enterprises, 2006-07

		number of enterprises			
		one	two	three	four or more
Proportion of farms with	%	40	28	17	15

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

Unit cash receipts

Distributions of unit cash receipts per hectare for each enterprise are shown as percentile rankings (table 4). The mean for each enterprise group is also shown.

The 25th percentile means that only 25 per cent of the sample have an estimate less than that value (e.g. 25 per cent of farms with a pome fruit enterprise recorded gross receipts of less than \$5247 per hectare for that enterprise). Similarly the 75th percentile means that 75 per cent of the sample had an estimate less than that value, or equivalently that only 25 per cent of the sample had an estimate greater than the value. The 50th percentile (also called the median) means that 50 per cent of the sample had an estimate less than that value and 50 per cent had an estimate greater than that value.

The mean and median (50th percentile) tend to be similar where the sample distribution is symmetric. Divergences between mean and median values are because of asymmetric distributions. In the case of vegetables, the mean is skewed by a relatively small number of farms with extremely large values.

Significant variation is observed in cash receipts per hectare across farms for each of the defined enterprises. This variation may be the result of various factors which influence yields and prices received, for example, regional variation in climate (temperature/rainfall) and access to irrigation water, as well as differences in farm technologies, management practices and crop/livestock varieties within defined enterprise classes.

3 Proportions of irrigation farms by primary and secondary enterprises, 2006-07

primary enterprise	secondary enterprise												
	beef	sheep	dairy	pome fruit	stone fruit	citrus	table grapes	wine grapes	vegetables	cotton	rice	irrigated wheat	dryland wheat
Beef	100	40	9	5	6	2	1	6	13	9	3	22	33
Sheep	57	100	1	1	5	2	2	11	8	4	10	30	47
Dairy	14	1	100	0	0	0	0	0	0	0	0	1	6
Pome fruit	21	4	0	100	65	10	2	12	2	0	0	0	0
Stone fruit	15	11	0	40	100	17	7	22	6	0	0	0	0
Citrus	4	3	0	5	14	100	21	48	6	0	0	1	5
Table grapes	3	4	0	1	9	30	100	56	9	0	0	1	4
Wine grapes	7	8	0	3	9	22	19	100	6	1	1	1	7
Vegetables	33	14	0	1	5	6	6	14	100	0	0	6	16
Cotton	53	18	0	0	0	0	0	3	0	100	3	29	45
Rice	26	74	0	0	0	0	0	4	0	4	100	65	13
Irrigated wheat	59	58	1	0	0	1	1	3	7	13	17	100	40
Dryland wheat	53	53	7	0	0	3	2	10	10	12	2	24	100

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

Certain enterprises tended to display greater variation in returns across farms, in particular vegetables and dryland wheat. In contrast, relatively less variation in receipts per hectare is observed across dairy farms. On average, horticultural crops generally recorded higher receipts per hectare than broadacre crops and dairy, with the highest mean receipts per hectare occurring in pome fruit and vegetables.

The drought conditions and low water allocations prevailing in 2006-07 are likely to have negatively affected the cash receipts per hectare of many farms. The effect of the drought is observed in the significant numbers of farms reporting very low receipts per hectare in a number of enterprise categories. For example, for dryland wheat more than 25 per cent of farms reported zero receipts (a failed crop).

4 Percentile distributions of cash receipts per hectare, by enterprise, 2006-07

	25th percentile	50th percentile	75th percentile	mean
	\$/ha	\$/ha	\$/ha	\$/ha
Beef cattle	100	184	337	272
Sheep a	256	372	571	474
Dairy b	3 612	4 625	5 645	4 636
Pome fruit	5 247	13 539	19 739	17 242
Stone fruit	3 242	7 918	15 624	10 286
Citrus	3 529	6 801	10 964	7 920
Table grapes	2 984	6 490	13 629	9 969
Wine grapes	3 550	5 250	7 422	5 355
Vegetables	4 091	11 180	21 624	14 744
Cotton	2 514	3 735	4 064	3 696
Rice	2 000	2 305	3 967	2 874
Irrigated wheat	354	817	1 200	822
Dryland wheat	0	40	183	144

a Includes sales of sheep, lambs and wool. **b** Includes sales of milk and dairy cattle.

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

Unit cash costs

Distributions of estimated unit cash costs are shown in table 5, for those enterprises in which the estimation procedure was deemed to have performed adequately. A summary of the estimation procedure is contained in appendix A.

Care should be taken when interpreting these unit costs given they are the result of an estimation procedure subject to some statistical error. The drought conditions prevailing in 2006-07 are also likely to have inflated cash costs per hectare for many farms. In addition, the drought conditions meant that relatively small farm sample sizes were available for the cotton and rice enterprises.

The unit cost estimates demonstrate the presence of significant variation in estimated unit costs per hectare across farms, for each agricultural enterprise. However, this variation is substantially less than the variation observed in unit receipts across farms.

Variation in cash costs per hectare across farms may be the result of various factors, including: regional variation in climate (temperature/rainfall) and availability/price of irrigation water; differences in other input prices; differences in farm technologies and management practices; and differences in efficiency levels, for example because of economies of scale or scope or differences in labour productivity. As discussed previously, no attempt is made in this paper to examine the causal factors behind differences in unit costs across farms.

On average, costs per hectare were generally higher for horticultural activities, although estimated mean unit costs for citrus and wine grapes were lower than for dairy and cotton. Vegetables, pome fruit and stone fruit were among the highest estimated mean unit costs, while the lowest was irrigated wheat.

5 Percentile distributions of estimated cash costs per hectare, by enterprise, 2006-07 ^a

	25th percentile \$/ha	50th percentile \$/ha	75th percentile \$/ha	mean \$/ha
Dairy	4 166	4 771	5 434	4 741
Pome fruit	7 291	7 382	8 665	9 580
Stone fruit	6 446	8 920	12 011	9 411
Citrus	3 251	3 441	5 516	4 634
Table grapes	4 078	4 725	4 877	5 766
Wine grapes	2 780	3 792	4 750	4 207
Vegetables	6 396	9 791	13 890	10 381
Cotton	4 335	4 761	5 483	4 982
Rice	3 277	4 010	4 367	3 896
Irrigated wheat	631	1 068	1 242	965

^a Quantile regression estimate of cash costs per hectare.

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

Unit returns

Farm level returns per hectare are calculated by subtracting the estimated farm level costs per hectare from farm level receipts per hectare. Distributions of estimated unit returns are shown in table 6.

Care should be taken when interpreting these return estimates. These estimates represent short-term cash returns to specific enterprises, excluding fixed operating and capital costs. In practice there will be significant differences in fixed operating and capital costs between different enterprises. Also, as discussed, both farm cash receipts and cash costs will have been substantially affected by the drought conditions and low water allocations in 2006-07.

Significant variation in returns across farms is observed for each enterprise. In particular for all enterprises a significant proportion of farms were estimated to have obtained negative returns. This is not surprising given the effects of drought during 2006-07.

The highest mean returns were estimated for pome fruit and vegetables, although significant variation in returns across farms was observed for both these enterprises.

Returns for citrus were also strong on average and tended to be less variable across farms, with a relatively smaller proportion of farms having negative returns. Mean negative returns were estimated for cotton, rice and irrigated wheat, which is not unexpected given these broadacre activities are likely to be more exposed in the short run to reductions in the availability of water. The estimated mean return for dairy was also marginally negative.

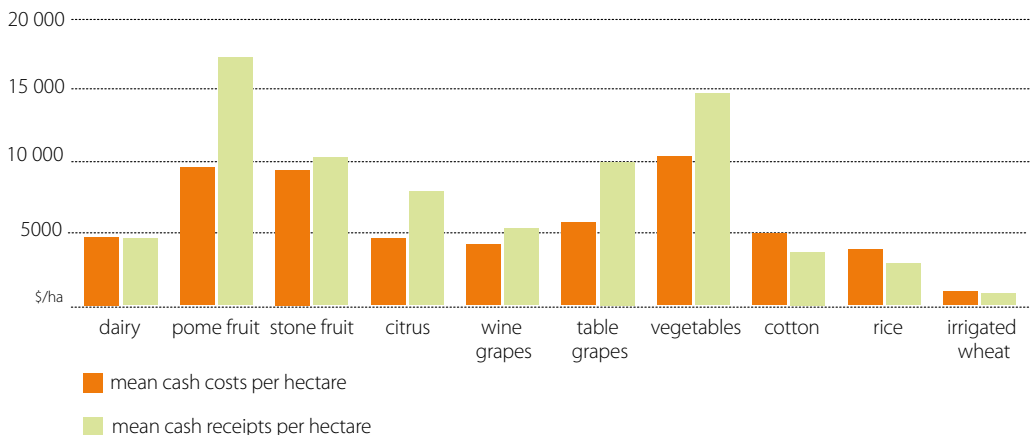
The enterprise level returns presented here will tend to exaggerate differences in performance across farms and across enterprises relative to whole of farm estimates. In general, whole farm estimates will tend to minimise variation in performance because of the extent to which different enterprises on the same farm offset each other.

6 Percentile distributions of estimated returns per hectare, by enterprise, 2006-07

	25th percentile \$/ha	50th percentile \$/ha	75th percentile \$/ha	mean \$/ha
Dairy	-857	-189	781	-105
Pome fruit	-5 255	3 788	11 747	7 662
Stone fruit	-5 796	-1 333	4 911	875
Citrus	-530	2 054	6 143	3 287
Wine grapes	-1 056	1 113	3 259	1 148
Table grapes	-1 548	1 664	8 386	4 202
Vegetables	-5 698	600	9 470	4 364
Cotton	-2 240	-1 618	-850	-1 286
Rice	-2 300	-1 231	-513	-1 022
Irrigated wheat	-509	-220	192	-144

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

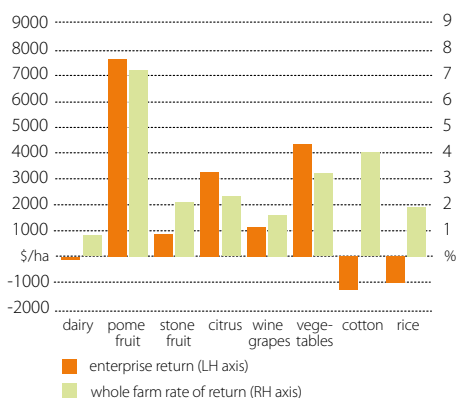
a Mean unit cash receipts and estimated mean unit cash costs, by enterprise, 2006-07



Comparison with whole farm performance

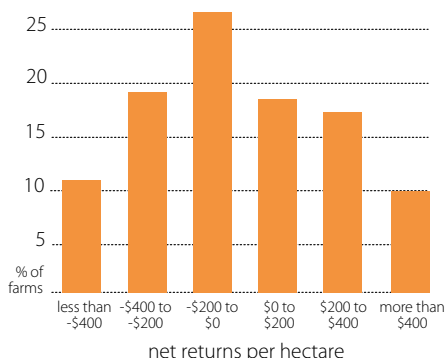
In this section the enterprise level costs and return estimates derived in this report are compared with whole of farm financial results for farms undertaking that enterprise. The farm

b Average enterprise returns and whole of farm return on capital



financial performance indicators considered in this section, including farm cash income, farm business profit and return on capital, are defined in appendix b. In general the enterprise level results are broadly consistent with corresponding whole farm financial performance indicators, see for example figure b. However, for rice and cotton whole of farm returns are significantly positive, while estimated average enterprise returns are significantly negative. This is not unexpected given that farms with cotton and rice are in general highly diversified. Farms with rice and cotton typically undertake a range of other livestock and cropping activities and returns from these activities are likely to have offset any losses made on rice and cotton crops.

C Distribution of returns for dairy, 2006-07



Dairy

Dairy farms had the smallest range of enterprises in 2006-07, with 14 per cent having beef cattle, sheep (1 per cent) and dryland wheat (6 per cent). Overall, dairy farms recorded an average rate of return to capital of 0.8 per cent in 2006-07 (table 7). Sales of milk and dairy cattle accounted for an estimated 89 per cent of total cash receipts, while fodder was the largest component of total costs, accounting for around 37 per cent of total cash costs in 2006-07.

Using the quantile regression method, the dairy enterprise is estimated to have accounted for around 89 per cent of total cash costs in 2006-07. Net returns for dairy enterprises averaged a loss of around \$105 a hectare in 2006-07, although there was some variation in returns around this average (figure c).

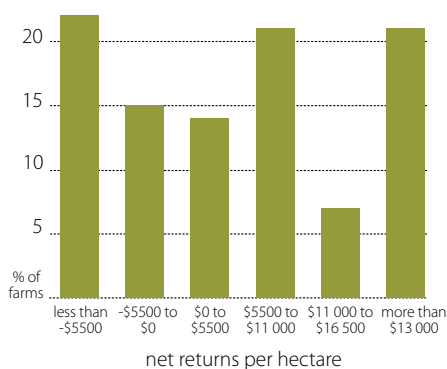
7 Selected estimates, dairy farms, Murray-Darling Basin, 2006-07
average per farm

		dairy enterprise estimates
Cash receipts	\$/ha	4 636
Cash costs	\$/ha	4 741
Net return	\$/ha	-105
		whole farm estimates (all farms with dairy)
Area for dairy cattle	ha	106
Dairy receipts	\$	537 851
Total cash receipts	\$	605 685
Total cash costs	\$	562 449
Farm cash income	\$	43 235
Farm business profit	\$	-54 966
Rate of return ^a	%	0.8

^a Excluding capital appreciation.

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

d Distribution of returns for pome fruit, 2006-07



Pome fruit

Farms with pome fruit had a range of other agricultural enterprises in 2006-07, including stone fruit, citrus, wine grapes and beef cattle. Overall, pome fruit farms recorded an average rate of return to capital of 7.2 per cent in 2006-07 (table 8). Pome fruit accounted for an estimated 53 per cent of total cash receipts, while hired labour was the largest single component of total costs, accounting for an estimated 33 per cent of total cash costs in 2006-07.

Using the quantile regression method, the pome fruit enterprise is estimated to have accounted for around 53 per cent of total cash costs for pome fruit growers in 2006-07. Net returns for pome fruit enterprises averaged around \$7662 a hectare in 2006-07, although there was wide variation in returns around this average including negative returns for some pome fruit growers (figure d).

8 Selected estimates, pome fruit growers, Murray-Darling Basin, 2006-07

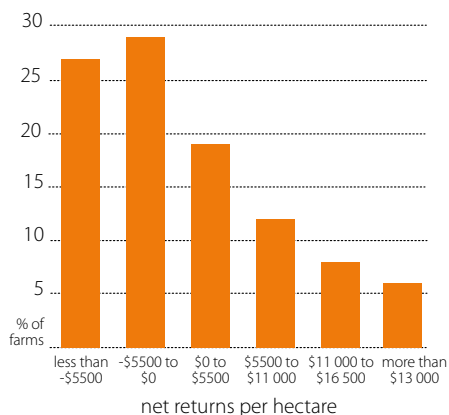
average per farm

		pome fruit enterprise estimates
Cash receipts	\$/ha	17 242
Cash costs	\$/ha	9 680
Net return	\$/ha	7 662
		whole farm estimates (all farms with pome fruit)
Area of pome fruit	ha	18
Pome fruit receipts	\$	290 959
Total cash receipts	\$	543 981
Total cash costs	\$	352 478
Farm cash income	\$	191 503
Farm business profit	\$	120 010
Rate of return ^a	%	7.2

^a Excluding capital appreciation.

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

e Distribution of returns for stone fruit, 2006-07



Stone fruit

Farms with stone fruit had a range of agricultural enterprises in 2006-07, including pome fruit, citrus, wine grapes and beef cattle. Overall, stone fruit farms recorded an average rate of return to capital of 2.1 per cent in 2006-07 (table 9). Stone fruit accounted for an estimated 33 per cent of total cash receipts, while hired labour was the largest single component of total costs, accounting for an estimated 32 per cent of total cash costs in 2006-07.

Using the quantile regression method to estimate costs, the stone fruit enterprise is estimated to have accounted for around 35 per cent of total cash costs for farms with stone fruit in 2006-07. Net returns for stone fruit enterprises averaged around \$875 a hectare in 2006-07, although there was wide variation in returns around this average including negative returns for some farms (figure e).

9 Selected estimates, stone fruit growers, Murray-Darling Basin, 2006-07

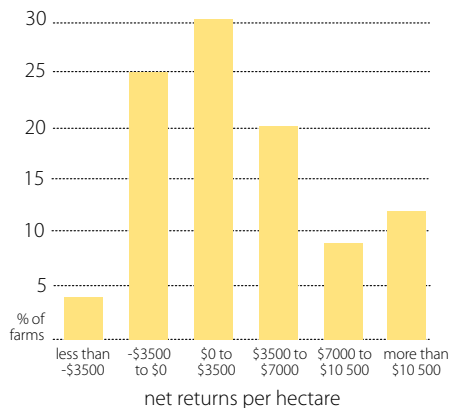
average per farm

		stone fruit enterprise estimates
Cash receipts	\$/ha	10 286
Cash costs	\$/ha	9 411
Net return	\$/ha	875
		whole farm estimates (all farms with stone fruit)
Area of stone fruit	ha	8
Stone fruit receipts	\$	90 181
Total cash receipts	\$	274 397
Total cash costs	\$	215 596
Farm cash income	\$	58 801
Farm business profit	\$	8 154
Rate of return ^a	%	2.1

^a Excluding capital appreciation.

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

f Distribution of returns for citrus, 2006-07



Citrus

Farms with citrus had a range of agricultural enterprises in 2006-07, including wine grapes and stone fruit. Overall, farms with citrus recorded an average rate of return to capital of 2.3 per cent in 2006-07 (table 10). Citrus accounted for an estimated 44 per cent of total cash receipts, while hired labour and contracts were the largest components of total costs, accounting for an estimated 27 per cent and 10 per cent of total cash costs, respectively, in 2006-07.

Using the quantile regression method, the citrus enterprise is estimated to have accounted for around 29 per cent of total cash costs for farms with citrus in 2006-07. Net returns for citrus enterprises averaged around \$3287 a hectare in 2006-07, although there was wide variation in returns around this average (figure f).

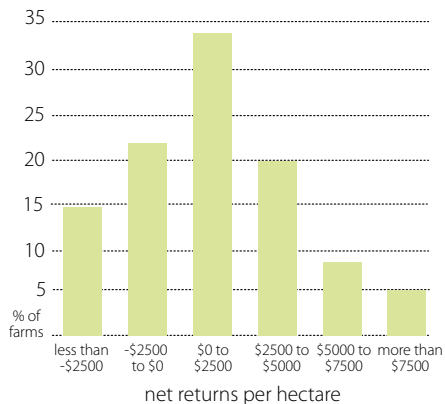
10 Selected estimates, citrus growers, Murray-Darling Basin, 2006-07 average per farm

			citrus enterprise estimates
Cash receipts	\$/ha		7 920
Cash costs	\$/ha		4 634
Net return	\$/ha		3 287
			whole farm estimates (all farms with citrus)
Area of citrus fruit	ha		14
Citrus fruit receipts	\$		125 554
Total cash receipts	\$		287 157
Total cash costs	\$		223 534
Farm cash income	\$		63 623
Farm business profit	\$		9 613
Rate of return ^a	%		2.3

^a Excluding capital appreciation.

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

g Distribution of returns for wine grapes, 2006-07



Wine grapes

Wine grape growers had a range of agricultural enterprises in 2006-07, including citrus. Overall, farms with wine grapes recorded an average rate of return to capital of 1.6 per cent in 2006-07 (table 11). Wine grapes accounted for an estimated 63 per cent of total cash receipts, while hired labour and contracts were the largest components of total costs, accounting for an estimated 16 per cent and 10 per cent of total cash costs, respectively, in 2006-07.

Using the quantile regression method, the wine grape enterprise accounted for around 46 per cent of total cash costs in 2006-07. Net returns for wine grape enterprises averaged around \$1148 a hectare in 2006-07, although there was wide variation in returns around this average (figure g).

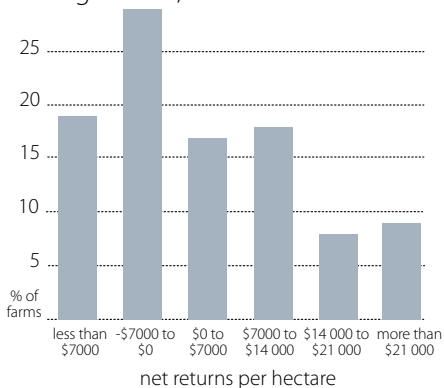
11 Selected estimates, wine grape growers, Murray-Darling Basin, 2006-07 average per farm

		wine grape enterprise estimates
Cash receipts	\$/ha	5 335
Cash costs	\$/ha	4 207
Net return	\$/ha	1 148
		whole farm estimates (all farms with wine grapes)
Area of wine grapes	ha	31
Wine grapes receipts	\$	198 725
Total cash receipts	\$	315 408
Total cash costs	\$	283 486
Farm cash income	\$	31 921
Farm business profit	\$	-20 539
Rate of return ^a	%	1.6

^a Excluding capital appreciation.

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

h Distribution of returns for vegetables, 2006-07



Vegetables

Farms growing vegetables had a range of agricultural enterprises in 2006-07, including beef cattle, sheep and wine grapes. Overall, vegetable growers recorded an average rate of return to capital of 3.2 per cent in 2006-07 (table 12). Vegetables accounted for an estimated 79 per cent of total cash receipts, while hired labour and fertiliser were the largest components of total costs, accounting for an estimated 17 per cent and 10 per cent of total cash costs, respectively, in 2006-07.

Using the quantile regression method to estimate costs, the vegetable enterprise accounted for an estimated 60 per cent of total cash costs in 2006-07. Net returns for vegetable enterprises averaged around \$4364 a hectare in 2006-07, although there was wide variation in returns around this average (figure h).

12 Selected estimates, vegetable growers, Murray-Darling Basin, 2006-07

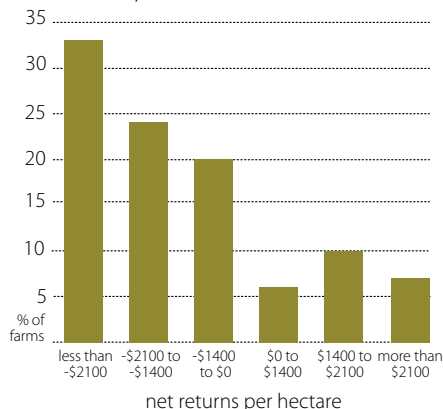
average per farm

		vegetable enterprise estimates
Cash receipts	\$/ha	14 744
Cash costs	\$/ha	10 381
Net return	\$/ha	4 364
		whole farm estimates (all farms with vegetable)
Area of vegetables	ha	33
Vegetable receipts	\$	541 602
Total cash receipts	\$	687 486
Total cash costs	\$	569 798
Farm cash income	\$	117 688
Farm business profit	\$	38 189
Rate of return ^a	%	3.2

^a Excluding capital appreciation.

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

i Distribution of returns for cotton, 2006-07



Cotton

Farms growing cotton had a range of agricultural enterprises in 2006-07, including wheat (both irrigated and dryland), beef cattle and sheep. Overall, farms with cotton recorded an average rate of return to capital of 4 per cent in 2006-07 (table 13). Cotton accounted for an estimated 44 per cent of total cash receipts, while hired labour was the largest component of total costs, accounting for an estimated 12 per cent of total cash costs in 2006-07.

Using the quantile regression method, the cotton enterprise is estimated to have accounted for around 72 per cent of total cash costs in 2006-07. Net returns for cotton enterprises averaged a loss of around \$1286 a hectare in 2006-07, although there was wide variation in returns around this average (figure i).

13 Selected estimates, cotton growers, Murray-Darling Basin, 2006-07

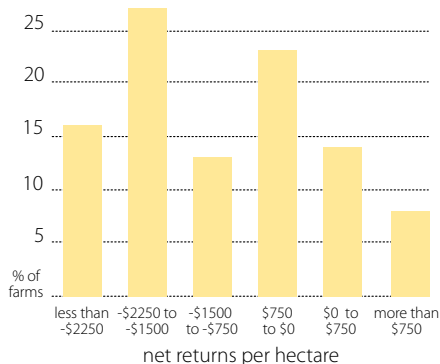
average per farm

		cotton enterprise estimates
Cash receipts	\$/ha	3 696
Cash costs	\$/ha	4 982
Net return	\$/ha	-1 286
		whole farm estimates (all farms with cotton)
Area of cotton	ha	220
Cotton receipts	\$	791 100
Total cash receipts	\$	1 796 626
Total cash costs	\$	1 524 275
Farm cash income	\$	272 351
Farm business profit	\$	92 581
Rate of return ^a	%	4.0

^a Excluding capital appreciation.

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

j Distribution of returns for rice, 2006-07



Rice

Farms growing rice had a range of agricultural enterprises in 2006-07, including wheat (both irrigated and dryland) and sheep. Overall, farms with rice recorded an average rate of return to capital of 1.9 per cent in 2006-07 (table 14). Rice accounted for an estimated 27 per cent of total cash receipts, while fuel and fertiliser were the largest components of total costs, accounting for an estimated 13 per cent and 10 per cent of total cash costs, respectively, in 2006-07.

Using the quantile regression method, the rice enterprise is estimated to have contributed around 37 per cent of total cash costs in 2006-07. Net returns for rice enterprises averaged a loss of around \$1022 a hectare in 2006-07, although there was wide variation in returns around this average (figure j).

14 Selected estimates, rice growers, Murray-Darling Basin, 2006-07

average per farm

		rice enterprise estimates
Cash receipts	\$/ha	2 874
Cash costs	\$/ha	3 896
Net return	\$/ha	-1 022
		whole farm estimates (all farms with rice)
Area of rice	ha	75
Rice receipts	\$	219 185
Total cash receipts	\$	797 930
Total cash costs	\$	785 807
Farm cash income	\$	12 123
Farm business profit	\$	-85 586
Rate of return ^a	%	1.9

^a Excluding capital appreciation.

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

4 Conclusion

Prolonged and severe drought and historical low irrigation water allocations throughout much of the Murray-Darling Basin adversely affected the financial performance of irrigators in 2006-07. The effect of these reductions on the performance of irrigators has varied across the Basin by region and industry.

One of the factors affecting the short-term responses of irrigators to the current water situation will be the differing returns from various land uses.

The analysis in this report shows there is wide variation in unit receipts, costs and net returns per hectare across enterprises and farms within the Murray-Darling Basin. Some industries (such as vegetables) tended to show greater variation in returns across farms than others (such as dairy). The variation in returns is likely to be the result of several factors including availability of irrigation water, prices received and crop yields. However, detailed analysis to explain the variation in net returns has not been undertaken in this study. Overall, the results show that vegetables and pome fruit generated the highest average net returns per hectare in 2006-07, while there were estimated net losses, on average, for cotton and rice.

When there is more than one enterprise on a farm it is difficult to allocating costs to individual enterprises using farm survey data. The results of the analysis suggest that the regression technique used worked well in some cases but not in others. Generally, the quantile regression analysis performed best for those farms with relatively few enterprises and where the sample size was relatively large.

The estimation of cost curves to relate unit costs with farm size was not attempted in this analysis. However, there is potential for further research to be undertaken in this area once sufficient time series data is collected for irrigation farms.

A Regression analysis for estimating unit costs

Ordinary least squares regression

An aggregate cost function as shown below was first estimated using the method of ordinary least squares regression, to provide an estimate of the average fixed operating cost and average unit costs for each activity across all farms.

For simplicity, a linear cost function was assumed where total cash costs are a function of fixed costs, variable costs and activity level. The activity level was defined as the area of particular crops planted or livestock numbers for farm i and activity j .

$$C_i = \hat{\beta}^* + \sum_j \hat{\beta}_j Q_{i,j} + \varepsilon_i$$

β^* = fixed operating costs

β_j = unit cost of activity j

Average unit receipts for each activity were then estimated directly from the data for each farm, to derive average returns for each activity. Net returns were derived as the difference between average receipts and average costs. However, because this approach averages costs and receipts over all farms, it smooths the diversity in unit costs and receipts between individual farms.

Quantile regression

Quantile regression is an alternative estimation technique which has the potential to capture variation in parameter estimates (e.g. unit costs). The quantile regression technique has been used extensively in previous ABARE research (see for example Kokic et al. 1993 and Kokic et al. 2004). The quantile regression technique allows specific farm level unit cost estimates to be generated. Under quantile regression, relationships are fitted to specific quantiles of the conditional distribution of y given x such that:

$$pr\{y_i \leq x_i \beta_q | x_i\} = q$$

Where:

y_i = the dependent variable

x_i = the explanatory variable

q = the relevant quantile [0,1]

β_q = the regression coefficient for quantile q

pr = probability.

Using a series of quantile regression equations over a subset of quantiles q , a relationship between β_q and q can be estimated. Given this relationship, each individual data point can be assigned a unique estimate of β_q .

As with the ordinary least squares regression above, the estimated quantile regression equation used total cash costs (C) less interest costs as the dependent variable and the crop areas/livestock numbers (Q) as the independent variables. To estimate unit costs, a series of quantile regressions (of the form shown below) were estimated for a range of quantiles for the distribution of farm cash costs. The results of these regressions are shown in table 14.

$$C_i = \hat{\beta}^* + \sum_j \hat{\beta}_{q,j} Q_{i,j} + \varepsilon_i$$

For each enterprise, an estimate of $\beta_{q'j}$ was obtained for each q . A continuous relationship between $\beta_{q'j}$ and q was then estimated for each activity using a polynomial approximation. Each farm has a specific q value that reflects the position of that farm in the distribution of farm cash costs. Given the approximated relationship between $\beta_{q'j}$ and q , each farm was assigned a unique cost estimate for each enterprise.

15 Quantile regression results, unit costs per hectare

	q = 0.1	q = 0.2	q = 0.3	q = 0.4	q = 0.5	q = 0.6	q = 0.7	q = 0.8	q = 0.9
Beef	176 (44)	245 (37)	240 (45)	252 (74)	373 (102)	415 (63)	400 (40)	518 (59)	777 (727)
Sheep	19 (13)	27 (7)	31 (17)	34 (12)	40 (13)	48 (3)	46 (4)	34 (4)	48 (37)
Dairy	592 (60)	861 (75)	1 017 (47)	1 085 (45)	1 189 (43)	1 267 (59)	1 402 (71)	1 556 (103)	1 655 (82)
Pome fruit	7 321 (144)	7 269 (168)	7 241 (163)	7 226 (196)	8 591 (883)	8 549 (821)	10 488 (1 445)	12 721 (16 861)	22 434 (8 192)
Stone fruit	6 119 (1 745)	9 301 (3 234)	10 431 (705)	10 779 (577)	10 924 (2 127)	13 502 (5 542)	14 910 (492)	14 823 (584)	14 568 (578)
Citrus	3 094 (761)	3 772 (665)	3 848 (781)	4 226 (1 098)	5 629 (1 078)	6 194 (1 392)	6 750 (7 770)	8 559 (4 075)	9 770 (739)
Table grapes	4 192 (1 121)	4 664 (1 333)	4 687 (1 387)	4 906 (1 962)	6 294 (3 575)	11 240 (4 845)	19 294 (2 124)	27 171 (285)	27 030 (291)
Wine grapes	3 047 (428)	3 920 (744)	3 984 (34)	4 207 (1 696)	5 310 (835)	5 741 (88)	5 760 (42)	6 810 (525)	8 070 (237)
Vegetables	3 963 (457)	6 416 (3 962)	7 648 (472)	9 378 (3 534)	10 917 (9 474)	14 024 (1 496)	15 391 (1 559)	15 096 (416)	19 909 (2 745)
Other hort.	1 705 (134)	1 719 (157)	4 183 (1 539)	5 132 (703)	7 747 (1 046)	7 701 (1 098)	9 737 (18 549)	11 681 (187)	11 322 (161)
Cotton	2 634 (376)	3 269 (393)	3 443 (286)	3 626 (789)	4 279 (130)	4 223 (107)	4 151 (116)	4 289 (944)	6 019 (4 525)
Rice	4 101 (218)	3 968 (326)	4 440 (1 307)	4 467 (1 278)	4 660 (777)	4 467 (645)	3 938 (1 115)	3 100 (1 203)	4 978 (5 096)
Irrigated wheat	430 (141)	518 (56)	440 (59)	980 (717)	1 104 (207)	1 069 (145)	1 151 (253)	1 144 (296)	1 321 (980)
Dryland wheat	132 (50)	107 (64)	148 (66)	183 (123)	204 (38)	187 (35)	214 (220)	254 (138)	405 (500)
Other crops	69 (41)	50 (29)	162 (62)	184 (95)	145 (57)	168 (116)	263 (200)	506 (275)	414 (616)

Note: Figures in parentheses are standard errors.

B Definition of terms

Total cash receipts: Total of revenues received by the business during the financial year, including revenues from the sale of sugarcane, other crops, livestock and livestock products. It includes revenue received from royalties, rebates, refunds, plant hire, contracts, insurance claims and compensation, and government assistance payments.

Total cash costs: Payments made by the business for materials and services and for permanent and casual hired labour (excluding partner and other family labour). It includes the value of any lease payments on capital, produce purchased for resale, rent, interest, cropping and livestock related purchases. Capital and household expenditures are excluded from total cash costs. Handling and marketing expenses include commission, levies etc. for business produce sold. Administration costs include accountancy fees, banking and legal expenses, postage, stationery, subscriptions and telephone. Other cash costs include relatively small cost items like stores, advisory services and travelling expenses.

Farm cash income: Total cash receipts minus total cash costs.

Depreciation: Estimated by applying the diminishing value depreciation method to the market value of capital items at 30 June 2007. Capital items are categorised into several groups and relevant depreciation rates are applied. The capital groups include vehicles; handling, harvesting and packing equipment; cultivation and sowing equipment; computers, electronic and communications equipment; other plant and equipment; and buildings on the business premises.

Imputed labour cost: Payments for owner manager and family labour may bear little relationship to the actual work input. An estimate of the labour input of the owner manager, partners and their families is calculated in work-weeks and a value is imputed at the relevant Federal Pastoral Industry Award rates.

Farm business profit: Cash operating surplus plus buildup in trading stocks, less depreciation, less the imputed value of the owner manager, partner(s) and family labour.

Profit at full equity: Return to capital and management plus interest, rent and finance lease payments. It is the return produced by all the resources used in the business.

Rate of return: Return to all capital used. It is computed by expressing profit at full equity as a percentage of the total opening capital of the business.

Total livestock purchases: Total expenditure on purchases of beef cattle, dairy cattle, sheep and other livestock.

Hired labour: Total cost of hired labour, including wages paid to hired permanent and casual workers, shearing and crutching and cost of rations for employees.

Produce purchased: Cost of crops and other produce purchased for resale.

Materials: Payments made by the farm business for materials such as fodder, seed, fertiliser, fuel, electricity and repairs.

Services: Payments made by the farm business for services such as rates, insurance, freight, handling and marketing, contracts, packing charges, cool storage, administrative costs, insurance, plant hire, rates, water charges, temporary water purchases and lease payments.

Interest: Total interest paid on farm business debt.

Land rent: Total rent paid on land rented or leased.

Payment to sharefarmers: Total payments to on-farm sharefarmers where those sharefarmers expenses were not included in the accounts for the survey farm.

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02.09

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CRC Plant Biosecurity

CSIRO (Commonwealth Scientific and Industrial
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Dairy Australia

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