

The Economic Impact of Aquaculture on the South Australian State and Regional Economies, 2006/07

A report prepared for
PIRSA Aquaculture

Prepared by



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Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
AFMA	Australian Fisheries Management Authority
fte	full-time equivalent
PIRSA	Primary Industries and Resources South Australia
SA	South Australia
SARDI	South Australian Research and Development Institute
GRP	gross regional product
GSP	gross state product

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Executive Summary

The aim of this study was to estimate the economic impact of aquaculture activity in South Australia in 2006/07. The results reported here update and expand on those provided in previous studies (EconSearch 1997, 1998, 1999, 2001, 2002a, 2003, 2004, 2006a, 2006b and 2007). This report provides estimates of economic impact for 2006/07 by aquaculture sector (tuna, oysters, abalone, mussels, barramundi and yabby/marron farming and other aquaculture enterprises) at the state and regional (Eyre Peninsula, Limestone Coast and balance of South Australia) levels.

The results of this study illustrate clearly the significance of aquaculture in South Australia in terms of business activity, household income and contribution to the state's growth and employment levels.

Some previous studies have only included the first level of processing, marketing or handling of aquaculture production in the overall economic impact (EconSearch 1997, 1998, 1999, 2001 and 2002a). However, for the purpose of this, the previous five (EconSearch 2003, 2004, 2006a, 2006b and 2007) and future analyses, the following stages in the marketing chain are included in the quantifiable economic impact:

- the farm gate value of production;
- the net value of local (SA) processing;
- the net value of local retail and food service trade; and
- the value of local transport services at all stages of the marketing chain.

In addition, other facets of regional economic development associated with the aquaculture industry are qualitatively assessed.

The results of the analysis, at the state level, are summarised in Table E.1. The **direct impact** measures on-farm and aquaculture related downstream activities (fish processing, transport, retail and food services). The **flow-on impact** measures the economic effects in other sectors of the economy (trade, transport, etc) generated by the aquaculture industry, that is, the ripple or multiplier effects.

Value of output is a measure of the business turnover or gross revenue of an activity. **Direct output** equates to the **PIRSA Scorecard** estimate of **net food revenue**, estimated to be \$290m (\$209m on-farm and \$81m in downstream activities) in 2006/07 (Table E.1). **Total output** (\$594m) needs to be used with care as it includes elements of double counting. Approximately 66 per cent of the output impact was generated in regional South Australia (Table E.2).

Contribution to gross state or regional product (GSP/GRP) is measured as value of output less the cost of goods and services (including imports) used in producing the output. As such, it provides an estimate of the net contribution of aquaculture to the state's economy. In 2006/07, aquaculture's **total contribution to GSP** (\$282m) (Table E.1) represented 0.41 per cent of the total GSP for South Australia (\$69,540m)¹. Approximately 69 per cent of the contribution to GSP was generated in regional South Australia (Table E.2). Contribution to GSP/GRP, as a measure of economic impact, avoids the problem of double counting that arises from using output for this purpose.

¹ ABS (2007).

Table E.1 The economic impact of aquaculture in South Australia, 2006/07

	Tuna	Oysters	Abalone	Mussels	Barramundi	Yabby/ Marron	Other ^a	Total
Output (\$m)								
Direct								
<i>On-farm</i>	137.7	39.0	7.2	1.9	3.7	0.7	18.8	208.9
<i>Downstream</i>	13.6	55.3	0.3	2.2	1.0	0.3	8.1	80.7
Total Direct	151.3	94.3	7.4	4.1	4.7	1.0	26.9	289.7
Total Flow-on	155.0	99.7	10.5	5.2	4.2	0.6	29.0	304.1
Total	306.3	193.9	18.0	9.2	8.9	1.6	55.9	593.8
Contribution to GSP (\$m)								
Direct								
<i>On-farm</i>	50.4	26.3	2.8	1.3	1.9	0.5	8.1	91.3
<i>Downstream</i>	3.7	20.9	0.1	0.8	0.3	0.1	3.1	29.0
Total Direct	54.1	47.2	2.9	2.1	2.2	0.7	11.2	120.3
Total Flow-on	90.9	47.4	5.0	2.5	2.0	0.3	13.9	162.1
Total	145.0	94.6	7.9	4.6	4.2	0.9	25.1	282.4
Employment (fte)								
Direct								
<i>On-farm</i>	305	382	67	66	27	41	179	1,066
<i>Downstream</i>	45	376	1	14	5	3	52	497
Total Direct	350	758	68	80	32	43	231	1,563
Total Flow-on	799	537	68	29	24	3	170	1,629
Total	1,149	1,295	136	109	56	47	400	3,192
Household income (\$m)								
Direct								
<i>On-farm</i>	11.5	15.9	2.5	1.3	1.2	0.1	6.7	39.2
<i>Downstream</i>	2.4	13.8	0.0	0.5	0.2	0.1	2.1	19.1
Total Direct	13.8	29.6	2.6	1.9	1.4	0.1	8.8	58.3
Total Flow-on	40.0	26.8	3.1	1.4	1.1	0.2	8.1	80.6
Total	53.8	56.4	5.7	3.3	2.5	0.3	16.9	138.9

^a Other aquaculture production is comprised of yellowtail kingfish, rainbow trout, other marine finfish (e.g. mullet) and other aquaculture enterprises (e.g. algae production).

Source: EconSearch analysis.

Employment is a measure of the number of working proprietors, managers, directors and other employees, in terms of the number of full-time equivalent (fte) jobs. Direct employment was estimated to be almost 1,600 fte (1,066 on-farm and 497 in downstream activities) in 2006/07 with over 1,600 flow-on jobs, giving **total employment** of 3,192 fte (Table E.1). Almost 67 per cent of these jobs were generated in regional South Australia (Table E.2).

Household income is a measure of wages and salaries paid in cash and in kind, drawings by owner operators and other payments to labour including overtime payments, employer's superannuation contributions and income tax, but excluding payroll tax. Direct household income was estimated to be around \$58m in 2006/07 and flow-on income approximately \$81m, giving a **total household income** impact of almost \$139m (Table E.1). Approximately 62 per cent of the household income impact was generated in regional South Australia (Table E.2).

In regional areas, the impact of the aquaculture industry in 2006/07 was concentrated in the Eyre Peninsula region, reflecting the dominance of tuna farming in the total (Table E.2).

Table E.2 The total regional economic impact (direct and flow-on) of aquaculture in South Australia, 2006/07

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Eyre Peninsula	372.4	95%	185.8	96%	1,964	92%	81.4	94%
Limestone Coast	4.7	1%	2.3	1%	32	2%	1.5	2%
Balance of SA	12.9	3%	6.3	3%	133	6%	3.9	4%
Total Regional Impact	389.9	100%	194.4	100%	2,130	100%	86.8	100%
Regional Impact as a Proportion of Total	-	66%	-	69%	-	67%	-	62%

Source: EconSearch analysis.

Respondents to the survey of aquaculture licence holders undertaken by PIRSA for 2006/07 provided projections of their production and employment over the three year period, 2006/07 to 2008/09. The projections for each sector are summarised in Table E.3².

Table E.3 Projected growth in South Australian aquaculture production and employment, 2007/08 to 2009/10^a

	Estimated cumulative change relative to 2006/07					
	Production			Employment		
	2007/08	2008/09	2009/10	2007/08	2008/09	2009/10
Tuna	5%	5%	5%	3%	3%	3%
Oysters	10%	15%	16%	3%	6%	7%
Barramundi	8%	13%	13%	0%	0%	0%
Marron	-3%	2%	2%	3%	4%	4%
Blue Mussels	47%	66%	68%	35%	46%	47%
Abalone	20%	57%	95%	23%	31%	38%
Yabbies	11%	17%	22%	16%	18%	18%
Rainbow Trout	2%	41%	113%	1%	6%	12%
Marine finfish ^b	25%	25%	25%	23%	26%	28%
Other ^c	8%	13%	14%	2%	4%	4%

^a Based on an analysis of PIRSA Aquaculture's 2006/07 survey responses.

^b Predominantly yellowtail kingfish and mullet production. Confidentiality requirements prevent the publication of production and value of production estimates for this sector.

^c Other aquaculture includes a diverse range of enterprises including cockle and algae production.

² These estimates were based on survey responses only (i.e. no 'validation' with industry representatives) and could, therefore, be subject to some sample bias.

Based on two sets of price assumptions, namely a 'no price' response and a 'generic small but negative price' effect, high and low projections of gross value of aquaculture production (GVP) for the period 2007/08 to 2009/10 have been imputed from the production projections. These GVP projections are presented in Table E.4.

The low estimate of GVP is based on a small but negative price effect for that proportion of the growth that is likely to be supplied to the South Australian domestic market. It was assumed that 100 per cent of the growth in tuna and abalone production would be exported to interstate and overseas markets (i.e. low and high estimates of GVP identical) and 50 per cent of the growth in other sectors would be exported. The high estimate of GVP is based on no price response over the projection period (i.e. prices remain at 2006/07 levels).

Table E.4 Projected growth in South Australian aquaculture value of production, 2007/08 to 2009/10 ^a

	Actual GVP (\$m)	Low GVP Forecast (\$m)			High GVP Forecast (\$m)		
	2006/07	2007/08	2008/09	2009/10	2007/08	2008/09	2009/10
Tuna	137.7	144.5	144.6	144.6	144.5	144.6	144.6
Oysters ^b	37.8	40.7	41.8	42.1	41.7	43.4	43.9
Barramundi	3.7	4.0	4.1	4.1	4.0	4.2	4.2
Marron	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Blue Mussels	1.9	2.5	2.7	2.7	2.8	3.2	3.2
Abalone	7.2	8.6	11.2	14.0	8.6	11.2	14.0
Yabbies	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Rainbow Trout	0.3	0.3	0.4	0.4	0.3	0.4	0.6
Other ^c	18.5	21.4	21.5	21.5	22.7	22.8	22.8
Total	207.8	222.5	226.9	230.2	225.3	230.6	234.1

^a All estimates are in 2007 dollars.

^b Adult oysters only (i.e. excludes spat).

^c Other aquaculture is comprised of yellowtail kingfish, Atlantic salmon, other marine finfish (e.g. mulloway) and other aquaculture enterprises (e.g. algae production).

1. Introduction

The aim of this study was to estimate the economic impact of aquaculture activity in South Australia in 2006/07. The results reported here update and expand on those provided in previous studies (EconSearch 1997, 1998, 1999, 2001, 2002a, 2003, 2004, 2006a, 2006b and 2007). Estimates of the economic impact of aquaculture activity in South Australia in 2006/07 are provided for the following aquaculture sectors:

- tuna;
- oysters;
- abalone;
- mussels;
- barramundi;
- yabbies/marron; and
- other aquaculture.

The impacts of these sectors are presented at both the regional and state levels. Regional impacts are based on the following disaggregation:

- Eyre Peninsula;
- Limestone Coast; and
- the balance of SA.

The report is structured as follows.

- Section 2: The general approach to the study is outlined.
- Section 3: A summary of aquaculture production in South Australia.
- Sections 4 to 7: The economic impacts of each aquaculture sector are presented at the state and regional levels.
- Section 8: Other facets of regional economic development associated with aquaculture activity in SA are presented.
- Section 9: Summary of the results.

2. Study Approach

2.1 Method of Analysis

The presence of a large industry or set of enterprises has considerable effects on the character of the local economy in which it is embedded. In the case of an aquaculture development, the enterprise, to support its own activities, makes purchases of spat or fingerlings, feedstuffs, other material inputs, labour, energy and services. Much of the expenditure goes to persons and companies situated in the local region.

The principle of this expenditure dependence is clearly defined. If aquaculture activity were to cease, there would be consequent reductions in the gross revenues of other sectors in the region. Conversely, if aquaculture activity were to increase, there would be increases in the gross revenues of other sectors. The extent of this type of economic impact can be measured through input-output modelling. This study applies input-output analytical procedures to measure the impact of aquaculture development on the South Australian state and regional economies.

Economic impacts at the state and regional levels were based on input-output models prepared for the Regional Communities Consultative Council, Local Government Association of South Australia and Regional Development SA (EconSearch 2005). For a technical description of the input-output modelling procedure refer to Appendix 1 and for a glossary of input-output terminology refer to Appendix 2.

In terms of scope, some previous studies (EconSearch 1997, 1998, 1999, 2001 and 2002a) have only included the first level of processing, marketing or handling of aquaculture production in the overall economic impact. Estimates of the economic impact of aquaculture presented in this report (i.e. for 2006/07) and for the period 2001/02 to 2005/06 (EconSearch 2003, 2004, 2006a, 2006b and 2007) are consistent with the 'message' and method in³:

- South Australian Aquaculture Council (2002), *Final Draft State Aquaculture Action Plan*;
- PIRSA's *Food for the Future* value chain analysis 2006/07 (Seafood Scorecard); and
- the overview of PIRSA Aquaculture's strategic direction for South Australian marine and land based aquaculture industries.

To this end, the following stages in the marketing chain have been included in the quantifiable economic impact:

- the farm gate value of production⁴;
- the net value of local (SA) processing;
- the net value of local retail and food service trade; and
- the value of local transport services at all stages of the marketing chain.

³ As discussed at the State Aquaculture Plan Working Group meeting at the Hilton Hotel on 19 November 2002.

⁴ For tuna this will include the net value of farm gate production and the gross value of tuna fishing.

In addition, other facets of regional economic development associated with the aquaculture industry were qualitatively assessed. The table below illustrates the change in scope of the economic impact assessment.

Table 2.1 Change in scope of the economic impact assessment

Stage in Market Chain	Scope of Impact Analysis In Earlier Studies ^a	Scope of Impact Analysis in Recent and Future Studies ^b
Farm gate production	Yes	Yes
Processing	Yes	Yes
Retail	No	Yes
Food Service	No	Yes
Transport between stages	Part	Yes
Other aspects of the economic impact of aquaculture		
Regional investment	Yes (tuna only)	Yes – qualitative only
Tourism	No	Yes – qualitative only
Education and training	No	Yes – qualitative only

^a For the years 1996/97, 1997/98, 1998/99, 1999/00 and 2000/01 (EconSearch 1997, 1998, 1999, 2001 and 2002a).

^b For the years 2001/02, 2002/03, 2004/05, 2005/06 and 2006/07 (EconSearch 2003, 2004, 2006a and 2006b).

As with previous reports, estimates of direct and flow-on economic impact are presented in terms of the following indicators:

- output;
- contribution to gross state or regional product⁵;
- employment; and
- household income.

(Value of) Output is a measure of the gross revenue of goods and services produced by commercial organisations (e.g. farm-gate value of tuna production) and gross expenditure by government agencies. Total output needs to be used with care as it includes elements of double counting (e.g. the value of tuna farm output includes the gross value of tuna fishing).

Contribution to gross state or regional product (GSP or GRP) is a measure of the net contribution of an activity to the state or regional economy. Contribution to GSP/GRP is measured as value of output less the cost of goods and services (including imports) used in producing the output. In other words, it can be measured as household income plus other value added (gross operating surplus and all taxes, less subsidies). It represents payments to the primary inputs of production (labour, capital and land). Using contribution to GRP/GSP as a measure of economic impact avoids

⁵ The terminology 'contribution to gross state or regional product' and 'value added' can be used interchangeably. 'Value added' was used in some previous reports (EconSearch 1997 to 2004).

the problem of double counting that may arise from using value of output for this purpose.

Employment is a measure of the number of working proprietors, managers, directors and other employees, in terms of the number of full-time equivalent (fte) jobs.

Household income is a component of GSP/GRP and is a measure of wages and salaries paid in cash and in kind, drawings by owner operators and other payments to labour including overtime payments, employer's superannuation contributions and income tax, but excluding payroll tax.

Estimates of economic impact are presented in terms of

- direct impacts;
- flow-on (or indirect) impacts; and
- total impacts.

Direct impacts are the initial round of output, employment and household income generated by an economic activity. Estimates of the direct economic impact of aquaculture on the South Australian state and regional economies are consistent with the method employed in PIRSA's *Food for the Future* value-chain analysis, 2006/07, as outlined above⁶.

Flow-on (or indirect) impacts are the sum of production-induced effects and consumption-induced effects. Production-induced effects are additional output, employment and household income resulting from re-spending by firms (e.g. transport contractors) that receive payments from the sale of services to firms undertaking, for example, oyster production. Consumption-induced effects are additional output, employment and household income resulting from re-spending by households that receive income from employment in direct and indirect activities.

Total impacts are the sum of direct and flow-on impacts.

2.2 Data

Survey-based value of output estimates for South Australian aquaculture for 2006/07 were prepared by PIRSA Aquaculture and validated by industry representatives before being provided to the consultants for use in this study⁷.

Representative cost structures and other relevant information for enterprises operating in individual sectors of the aquaculture and fishing industries⁸ were updated from 2002/03 to 2006/07 using a range of indicators, including data derived from the survey undertaken by PIRSA Aquaculture. These data, included:

- number of employees and unpaid individuals (including owner-operator) - average per enterprise;
- proportion of stock (i.e. spat or fingerlings) sourced from local region, other SA or interstate - average per enterprise; and

⁶ Note that direct output equates to the PIRSA Seafood Scorecard estimate of net food revenue.

⁷ EconSearch coordinated the compilation, analysis and validation of these data.

⁸ The original data were obtained from consultation with key industry contacts in 2003 (EconSearch 2003) and from EconSearch (2002b and 2002c).

- proportion of feed sourced from local region, other SA or interstate - average per enterprise

The representative cost structures were applied to industry value of output estimates to obtain estimates of aggregate expenditures on a regional and state basis.

Estimates of the net value of local (SA and regional) processing margins, the net value of local retail and food service trade margins and the value of local transport margins at all stages of the marketing chain were imputed for each aquaculture sector on the basis of discussions with a range of relevant industry contacts in each sector (EconSearch 2006a). For the years 2001/02 and 2002/03, these margins were based on estimates presented in PIRSA's Seafood Scorecard.

3. Aquaculture Production in South Australia

3.1 Production and Value of Production

Estimates of tuna, oyster and other aquaculture production and value of production from SARDI Aquatic Sciences and PIRSA Aquaculture for the six-year period, 2001/02 to 2006/07, are provided in Table 3.1. Some description of these data is provided below. Similar data for the period 1994/95 to 2006/07 are provided in Appendix 1 of the report.

Table 3.1 Aquaculture production and value of production, South Australia, 2001/02 to 2006/07

	2001/02		2002/03		2003/04		2004/05		2005/06		2006/07	
	Weight ('000kg)	Value (\$m)	Weight ('000kg)	Value (\$m)	Weight ('000kg)	Value (\$m)	Weight ('000kg)	Value (\$m)	Weight ('000kg)	Value (\$m)	Weight ('000kg)	Value (\$m)
Tuna	9,245	260.500	9,102	266.907	9,290	151.000	7,458	139.955	8,806	155.795	7,486	137.650
Oysters												
adult ^a	3,464	13.303	3,865	15.116	4,644	19.959	4,650	19.995	5,397	23.879	7,720	37.841
spat	-	0.856	-	1.002	-	1.193	-	1.195	-	0.957	-	1.143
Barramundi	255	2.653	471	6.166	216	2.255	217	2.265	400	3.370	385	3.727
Marron	11	0.282	22	0.533	18	0.480	22	0.587	10	0.282	24	0.633
Blue Mussels	171	0.371	254	0.466	400	0.697	377	0.657	469	0.950	1,032	1.914
Abalone	34	1.901	59	3.080	105	3.155	177	5.318	250	8.222	196	7.155
Yabbies	8	0.095	7	0.093	10	0.153	20	0.306	2	0.036	5	0.089
Rainbow Trout	26	0.192	18	0.156	40	0.330	66	0.545	53	0.356	38	0.291
Other ^b	334	3.375	1,077	8.769	894	7.533	2,019	17.015	2,148	17.591	1,953	18.514
Total	13,548	283.528	14,875	302.288	15,617	186.755	15,006	187.838	17,535	211.438	18,838	208.957

^a The weight for adult oysters is an approximation on the basis that a dozen oysters weighs one kilogram.

^b Other aquaculture production is comprised of yellowtail kingfish, Atlantic salmon (in earlier years), other marine finfish (e.g. mulloway) and other aquaculture enterprises (e.g. algae production).

Source: SARDI Aquatic Sciences, PIRSA Aquaculture.

- The value of tuna farm output decreased by 12 per cent between 2005/06 and 2006/07, a function of the 15 per cent decline in the volume of tuna farm output and a 4 per cent increase in the per unit value of farmed tuna. Gross value of production over the period 2003/04 to 2006/07 was well below the values recorded in 2001/02 and 2002/03 due to a combination of increased supplies of farmed tuna from Mediterranean countries being sold on the Japanese market and an appreciation of the Australian dollar against the Japanese yen.
- The gross value of adult oyster production has increased at an average rate of 25 per cent per annum over the six-year period 2001/02 to 2006/07, with a 58 per cent increase between 2005/06 and 2006/07.
- Of the other aquaculture sectors, the most significant growth in production and value of production, in both relative and absolute terms, has been

experienced in the 'other aquaculture'⁹, blue mussels and abalone sectors. Over the period 2001/02 to 2006/07, the value of production of the 'other aquaculture' sector increased by almost 450 per cent, largely as a result of growth in the marine finfish sector. For the blue mussels and abalone sectors, value of production over this period increased by 416 per cent and 276 per cent, respectively.

- Note that confidentiality requirements have prevented the publication of production and value of production estimates for the marine finfish sector in 2006/07 and earlier years. However, given the significant historical and projected growth in production and employment in this sector and its increasing relative importance within the aquaculture industry in South Australia, it is likely that production and economic impact estimates will be published for this sector in future reports.

3.2 Projected Growth in Production and Employment

Respondents to the survey of aquaculture licence holders undertaken by PIRSA for 2006/07 provided projections of their production and employment over the three year period, 2007/08 to 2009/10 (Table 3.2)¹⁰. The projections for each sector can be summarised as follows:

- Tuna - low production (5 per cent) and employment (3 per cent) growth between 2006/07 and 2007/08 and no projected growth in 2008/09 or 2009/10.;
- Oysters - modest production (16 per cent) and employment (7 per cent) growth between 2006/07 and 2009/10;
- Barramundi - modest production growth (13 per cent) but no employment growth between 2006/07 and 2009/10;
- Marron - low production (2 per cent) and employment (4 per cent) growth between 2006/07 and 2009/10;
- Mussels - significant production (68 per cent) and employment (47 per cent) growth between 2006/07 and 2009/10;
- Abalone - significant production (95 per cent) and employment (38 per cent) growth between 2006/07 and 2009/10;
- Yabby - notable production (22 per cent) and employment (18 per cent) growth between 2006/07 and 2009/10;
- Rainbow trout - significant production (113 per cent) and modest employment growth (12 per cent) between 2006/07 and 2009/10;
- Marine finfish - significant production (25 per cent) and employment (28 per cent) growth between 2006/07 and 2009/10; and
- Other aquaculture - modest production growth (14 per cent) and low employment (4 per cent) growth between 2006/07 and 2009/10.

⁹ Includes yellowtail kingfish, Atlantic salmon (in earlier years), rainbow trout, other marine finfish (e.g. mullet) and other aquaculture enterprises (e.g. algae production).

¹⁰ These estimates were based on survey responses only (i.e. no 'validation' with industry representatives) and could, therefore, be subject to some sample bias.

Table 3.2 Projected growth in South Australian aquaculture production and employment, 2007/08 to 2009/10 ^a

	Estimated cumulative change relative to 2006/07					
	Production			Employment		
	2007/08	2008/09	2009/10	2007/08	2008/09	2009/10
Tuna	5%	5%	5%	3%	3%	3%
Oysters	10%	15%	16%	3%	6%	7%
Barramundi	8%	13%	13%	0%	0%	0%
Marron	-3%	2%	2%	3%	4%	4%
Blue Mussels	47%	66%	68%	35%	46%	47%
Abalone	20%	57%	95%	23%	31%	38%
Yabbies	11%	17%	22%	16%	18%	18%
Rainbow Trout	2%	41%	113%	1%	6%	12%
Marine finfish ^b	25%	25%	25%	23%	26%	28%
Other ^c	8%	13%	14%	2%	4%	4%

^a Based on an analysis of PIRSA Aquaculture's 2006/07 survey responses.

^b Predominantly yellowtail kingfish and mullet production. Confidentiality requirements prevent the publication of production and value of production estimates for this sector.

^c Other aquaculture includes a diverse range of enterprises including cockle and algae production, for example.

Under the assumption that aquaculture producers in the state are price takers and that changes in industry supply will have little effect on prices received, then the effect of the projected production changes (Table 3.2) could be translated directly into changes in gross value of production (GVP). Even if a negative price response were to arise from production increases, it could be argued that consumer demand pressures for seafood will have an offsetting, positive impact on price. Indeed, in a comprehensive analysis (Delgado et al. 2003) of the global seafood market it was forecast under baseline (most likely) assumptions that, while global aquaculture production would increase by 84 per cent over the period 1997 to 2020 (19 per cent increase in wild catch), real prices are expected to increase by around 15 per cent for crustaceans and high-value finfish and by 4-6 per cent for molluscs and low value food fish.

Nevertheless, the projected production increases summarised in Table 3.2 are significant in some sectors and, other things being equal, the prices received would tend to decrease as the quantity supplied increases. This relationship can be measured using a price flexibility coefficient, that is, the percentage change in price given a one percent change in the quantity supplied. This can, in turn, be approximated using the reciprocal of the price elasticity of demand¹¹.

Short-run elasticities of demand for primary products are generally relatively price inelastic¹². In the longer run, however, with opportunities for exports and substitution

¹¹ The percentage change in the quantity demanded resulting from a 1 per cent increase in price (Pindyck and Rubinfeld 1995).

¹² As used in the Monash General Equilibrium Model of the Australian economy, for example (Glyn Wittwer, Centre of Policy Studies, Monash University, pers. comm.).

with other products, elasticities of demand for primary products are generally relatively price elastic (i.e. less than -1.0). In the absence of empirically estimated elasticities for aquaculture products, it was assumed for the purpose of this analysis that the medium-run price elasticity of demand for aquacultural products is -2.0 and the reciprocal, the price flexibility coefficient, is -0.5 ¹³.

It is likely that a price response of this magnitude would apply only to that proportion of the growth in aquaculture production that is supplied to the South Australian domestic market. For the purpose of this analysis it was assumed that 100 per cent of the growth in tuna and abalone production would be exported to interstate and overseas markets and 50 per cent of the growth in other sectors would be exported. For that proportion of production growth that is exported from the state to interstate or overseas markets, it was assumed that the producers are price takers and that changes in industry supply will have little effect on prices received.

These two sets of price assumptions, namely a 'no price' response and a 'generic small but negative price' effect, were used as the basis for high and low projections of gross value of aquaculture production for the period 2007/08 to 2009/10. These projections are presented in Table 3.3.

Table 3.3 Projected growth in South Australian aquaculture value of production, 2007/08 to 2009/10^a

	Actual GVP (\$m)	Low GVP Forecast (\$m)			High GVP Forecast (\$m)		
	2006/07	2007/08	2008/09	2009/10	2007/08	2008/09	2009/10
Tuna	137.7	144.5	144.6	144.6	144.5	144.6	144.6
Oysters ^b	37.8	40.7	41.8	42.1	41.7	43.4	43.9
Barramundi	3.7	4.0	4.1	4.1	4.0	4.2	4.2
Marron	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Blue Mussels	1.9	2.5	2.7	2.7	2.8	3.2	3.2
Abalone	7.2	8.6	11.2	14.0	8.6	11.2	14.0
Yabbies	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Rainbow Trout	0.3	0.3	0.4	0.4	0.3	0.4	0.6
Other ^c	18.5	21.4	21.5	21.5	22.7	22.8	22.8
Total	207.8	222.5	226.9	230.2	225.3	230.6	234.1

^a All estimates are in 2007 dollars.

^b The low estimate of gross value of production (GVP) is based on a small but negative price effect for that proportion of the growth that is likely to be supplied to the SA domestic market. It was assumed that 100 per cent of the growth in tuna and abalone production would be exported to interstate and overseas markets (i.e. low and high estimates of GVP identical) and 50 per cent of the growth in other sectors would be exported.

^c The high estimate of GVP is based on no price response over the projection period (i.e. prices remain at 2006/07 levels).

^d Adult oysters only (i.e. excludes spat).

^e Other aquaculture is comprised of yellowtail kingfish, Atlantic salmon, other marine finfish (e.g. mulloway) and other aquaculture enterprises (e.g. algae production).

¹³ That is, there would be a 0.5 per cent decrease in price given a one per cent increase in the quantity supplied.

3.3 The Value of Aquaculture and Wild Catch Fisheries in South Australia

In aggregate, tuna is the largest single sector in the state's aquaculture industry, accounting for approximately 66 per cent of the state's gross value of aquaculture production in 2006/07 (Table 3.4). The state's total value of seafood production (landed) in 2006/07 was almost \$429 million. Of this, tuna farming contributed approximately 32 per cent and aquaculture as a whole, approximately 49 per cent (Table 3.4).

Table 3.4 Value of aquaculture production and wild fisheries catch, South Australia, 2006/07

	Value of production or catch (\$m)	Contribution to aquaculture production	Contribution to total seafood production or catch
Aquaculture			
Tuna	137.650	65.9%	32.1%
Oysters	38.984	18.7%	9.1%
Barramundi	3.727	1.8%	0.9%
Marron	0.633	0.3%	0.1%
Blue Mussels	1.914	0.9%	0.4%
Abalone	7.155	3.4%	1.7%
Yabbies	0.089	0.0%	0.0%
Rainbow Trout	0.291	0.1%	0.1%
Other ^a	18.514	8.9%	4.3%
Total Aquaculture	208.957	100.0%	48.8%
Wild Catch Fisheries ^b			
Rock Lobster	96.745	-	22.6%
Abalone	31.529	-	7.4%
Prawns	42.656	-	10.0%
Sardines	18.517	-	4.3%
Other Marine Fisheries	24.760	-	5.8%
Inland Water Fisheries	5.458	-	1.3%
Total Wild Catch	219.665	-	51.2%
Total Seafood	428.622	-	100.0%

^a Other aquaculture production is comprised of yellowtail kingfish, other marine finfish (e.g. mulloway) and other aquaculture enterprises (e.g. algae production).

^b Excludes catch from the Commonwealth managed fisheries.

Source: SARDI Aquatic Sciences and PIRSA Aquaculture.

4. The Economic Impact of Aquaculture in South Australia, 2006/07

Estimates of the direct economic impact of aquaculture production, aquaculture processing, the transport of aquaculture products and the sale of aquaculture products to the retail and food service sectors in South Australia in 2006/07 are provided in this section of the report. Complementary estimates of the flow-on effects generated by these activities through the purchase of materials, services and labour are also provided.

4.1 The Economic Impact of Tuna Farming in South Australia, 2006/07

Estimates of the economic impact generated by the tuna farming industry in SA on a sector-by-sector basis for 2006/07 are provided in Table 4.1 and Figures 4.1 to 4.4. Impacts are measured in terms of value of output, contribution to gross state product (GSP), employment and household income.

Table 4.1 The economic impact of tuna farming in South Australia, 2006/07

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Tuna farming ^a	137.7	45%	50.4	35%	305	27%	11.5	21%
Processing	11.6	4%	2.7	2%	36	3%	1.7	3%
Transport	2.0	1%	1.0	1%	9	1%	0.7	1%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.0	0%	0.0	0%	0	0%	0.0	0%
Total Direct	151.3	49%	54.1	37%	350	30%	13.8	26%
Flow-on effects								
Tuna fishing	41.0	13%	33.8	23%	229	20%	7.9	15%
Property and business serv.	20.6	7%	12.0	8%	69	6%	4.3	8%
Manufacturing	19.2	6%	4.5	3%	60	5%	2.8	5%
Trade	14.8	5%	6.8	5%	145	13%	5.4	10%
Sardines	17.6	6%	10.8	7%	60	5%	6.3	12%
Transport	6.6	2%	3.1	2%	30	3%	2.1	4%
Finance	7.4	2%	4.9	3%	30	3%	1.8	3%
Other Sectors	27.8	9%	15.1	10%	176	15%	9.3	17%
Total Flow-on	155.0	51%	90.9	63%	799	70%	40.0	74%
Total	306.3	100%	145.0	100%	1,149	100%	53.8	100%
Total/Direct	2.02		2.68		3.28		3.89	

^a Note the double counting in the output impact which also includes the value of tuna fishing.

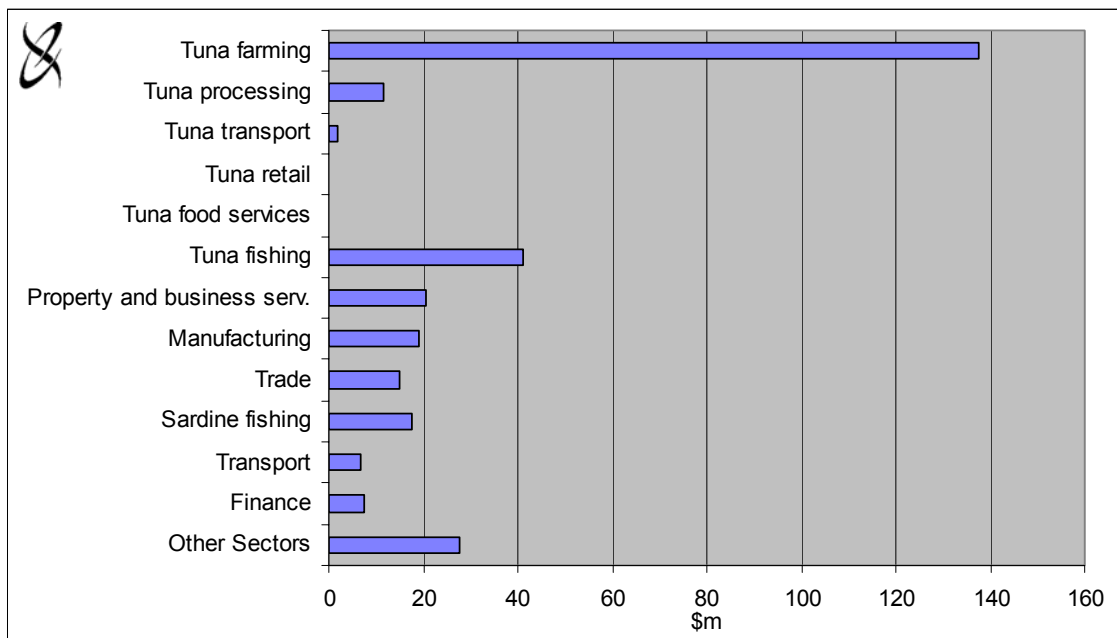
Source: EconSearch analysis.

Output impacts...

There are substantial economic impacts from the tuna farming industry in South Australia. Direct output (business turnover) generated in South Australia by tuna farms summed to \$138 million and in other sectors (processing and transport), \$14 million in 2006/07. Flow-on output in other sectors of the state economy summed to \$155 million (Table 4.1). The sectors most affected were the tuna fishing (tuna capture¹⁴), sardine fishing, manufacturing, trade, business and property services, transport and finance sectors (Figure 4.1).

The bottom row of Table 4.1 gives the total impact/direct impact ratio for each economic indicator. For output, the ratio of 2.02 indicates that for each dollar of sales generated by the tuna industry (farming and downstream) there was a total of \$2.02 of in output generated by businesses throughout the state, \$1.00 in the tuna industry (farming and downstream) and \$1.02 in other sectors of the economy.

Figure 4.1 Tuna farming in South Australia, output impacts by sector, 2006/07



Source: EconSearch analysis.

Contribution to gross state product...

Contribution to gross state product (GSP) is calculated as the value of output less the cost of goods and services used in producing the output. GSP provides an assessment of the net contribution to state economic growth of a particular enterprise or activity¹⁵.

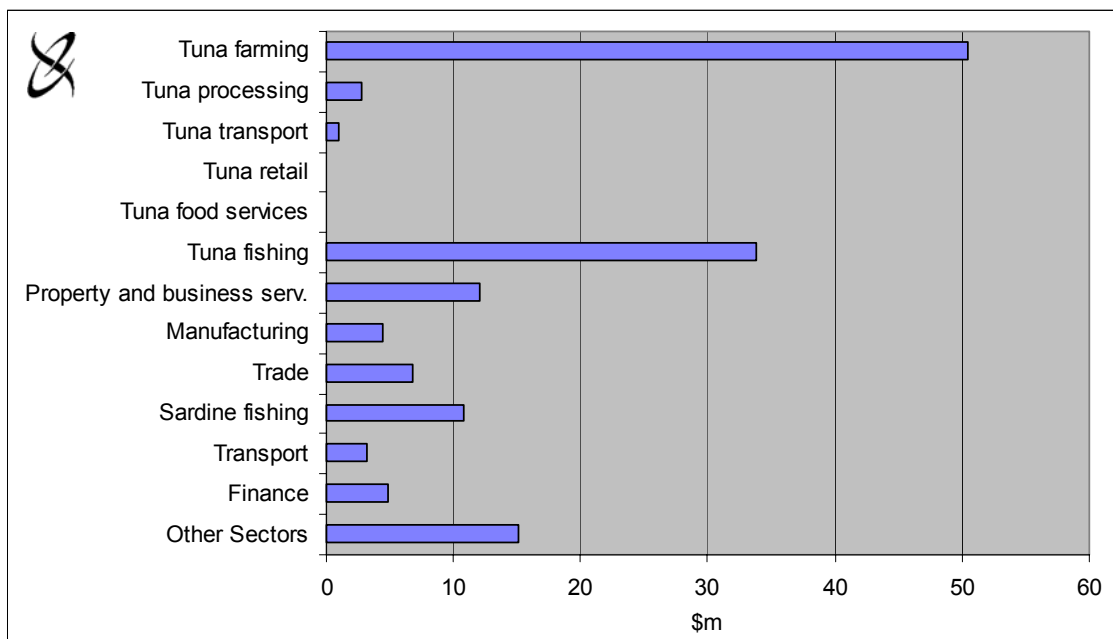
¹⁴ Note that the value of tuna fishing is also included in the direct impact of tuna farming.

¹⁵ The use of 'contribution to GSP' (or GRP) as a measure of economic impact overcomes the problem of double counting that arises from using 'value of output' for this purpose.

The direct contribution to GSP by the tuna industry (i.e. farming, processing and transport) was approximately \$54 million in 2006/07. Associated with this was flow-on GSP in the other sectors of the state economy of \$91 million (Table 4.1).

The flow-ons were greatest in the tuna fishing (\$34m), sardine fishing (\$11m), property and business services (\$12m), manufacturing (\$5m), trade (\$7m) and finance (\$5m) sectors (Figure 4.2). The bottom row in Table 4.1 shows that for each one dollar contribution to GSP by the tuna industry there was an additional \$1.68 (\$2.68 in total) contribution to GSP in other sectors of the state economy.

Figure 4.2 Tuna farming in South Australia, contribution to GSP by sector, 2006/07



Source: EconSearch analysis.

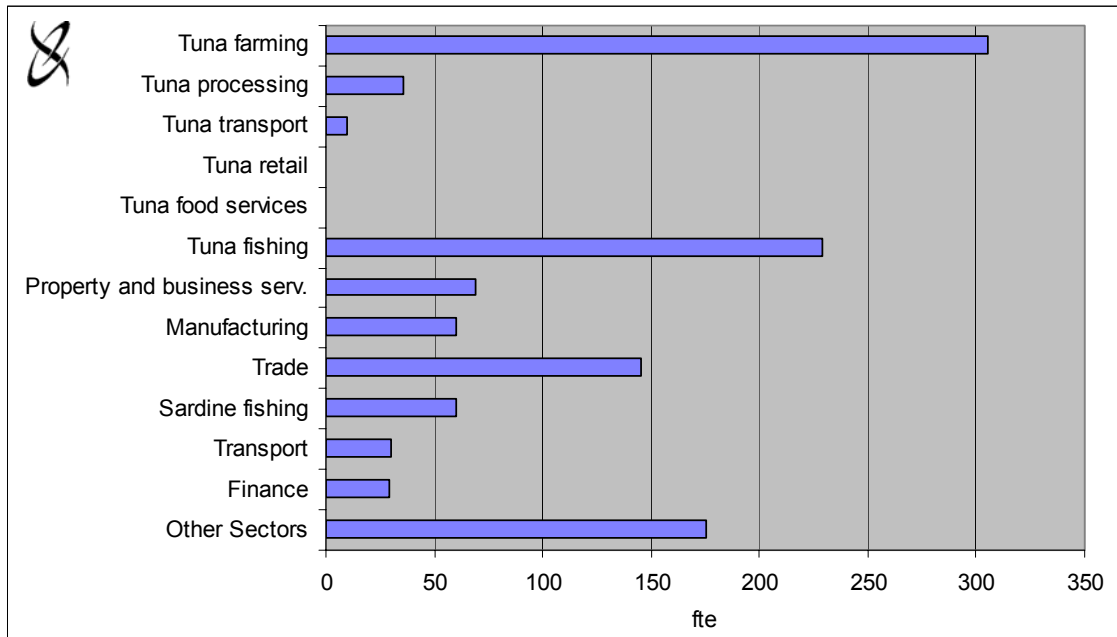
Employment and household income...

A significant number of jobs were created as a result of the flow-on business activity associated with tuna farming, processing and transport. The tuna farms were responsible for the direct employment of approximately 300¹⁶ full-time equivalents (fte) and, through associated processing and transport activities, another 45 fte in 2006/07 (Table 4.1). Flow-on business activity was estimated to generate a further 800 fte to give total employment of approximately 1,150 fte in the state. The sectors of the economy with employment flow-ons from tuna farming, processing and transport include the tuna fishing (229 fte), trade (145), manufacturing (60), property and business services (69), sardine fishing (60) and transport (30) sectors (Figure 4.3).

The bottom row in Table 4.1 shows that for each fte job generated directly in tuna farming, processing and transport there were an additional 2.28 jobs (3.28 jobs in total) in the rest of the state.

¹⁶ Note that this estimate is significantly less than that for 2005/06 (502 fte). Whilst there may have been some productivity improvements in the sector, it is likely that the majority of this difference is a function of improvements in the quality of the PIRSA Aquaculture survey data. It is probable that direct employment in tuna farming in 2005/06 and previous years has been overestimated.

Figure 4.3 Tuna farming in South Australia, employment impacts by sector, 2006/07

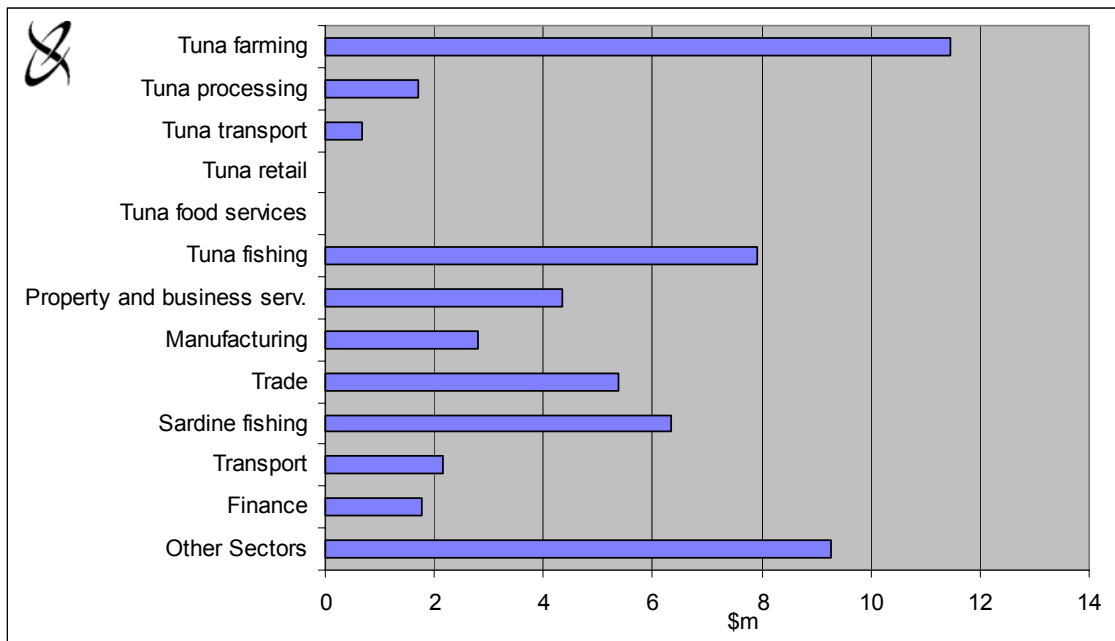


Source: EconSearch analysis.

It was estimated that personal income of approximately \$12 million was earned in the tuna farming sector in 2006/07, comprising both wages by employees and drawings by owner/operators. An additional \$8 million was earned by licence holders and crew in the tuna fishing sector and a further \$34 million by wage and salary earners in all other sectors of the state economy (Figure 4.4).

For each \$1.00 of household income generated directly by tuna farming, processing and transport in 2006/07 there was an additional 2.89 (\$3.89 in total) generated in other sectors of the state economy (Table 4.1).

Figure 4.4 Tuna farming in South Australia, household income impacts by sector, 2006/07



Source: EconSearch analysis.

4.2 The Economic Impact of Oyster Farming in South Australia, 2006/07

Table 4.2 provides estimates of the economic impact generated by oyster farming in South Australia on a sector-by-sector basis in 2006/07. As for tuna in the previous section, impacts are measured in terms of output (business turnover), contribution to GSP, employment and household income.

Output impacts...

Direct output (business turnover) generated in SA by oyster farming enterprises summed to \$39 million in 2006/07 while output generated in SA by associated downstream activities (processing, transport, retail and food service) summed to \$55 million. Flow-ons to other sectors of the state economy added another \$100 million in output in 2006/07. The sectors most affected were the trade, manufacturing and property and business services sectors.

Contribution to gross state product...

As noted above, contribution to GSP is calculated as the value of output less the cost of goods and services used in producing the output. In 2006/07, total oyster farming-related contribution to GSP in South Australia was almost \$95 million, \$26 million generated by oyster farming directly, \$21 million generated directly by downstream activities and \$47 million generated in other sectors of the state economy.

Table 4.2 The economic impact of oyster farming in South Australia, 2006/07 ^a

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Oyster farming ^b	39.0	20%	26.3	28%	382	29%	15.9	28%
Processing	9.6	5%	2.3	2%	30	2%	1.4	3%
Transport	9.0	5%	4.3	5%	41	3%	3.0	5%
Retail	0.5	0%	0.2	0%	5	0%	0.2	0%
Food services	36.0	19%	14.1	15%	300	23%	9.2	16%
Total Direct	94.3	49%	47.2	50%	758	59%	29.6	53%
Flow-on effects								
Property and business serv	23.3	12%	13.4	14%	83	6%	5.2	9%
Manufacturing	21.2	11%	4.9	5%	66	5%	3.1	5%
Trade	15.2	8%	6.9	7%	149	11%	5.5	10%
Transport	4.5	2%	2.2	2%	21	2%	1.5	3%
Finance	6.7	3%	4.4	5%	27	2%	1.6	3%
Other Sectors	28.8	15%	15.6	16%	192	15%	10.0	18%
Total Flow-on	99.7	51%	47.4	50%	537	41%	26.8	47%
Total Impact	193.9	100%	94.6	100%	1,295	100%	56.4	100%
Total/Direct	2.06		2.00		1.71		1.90	

^a Constitutes an upper estimate of the flow-on effects given the likelihood of some double counting of consumption induced effects in the retail and food services margins.

^b Includes sales of spat.

Source: EconSearch analysis.

Employment and household income...

In 2006/07, SA oyster farming was responsible for the direct employment of around 380 fte and downstream activities created employment for around 375¹⁷ fte. Flow-on business activity was estimated to generate a further 537 fte. These jobs were concentrated in the trade (149), manufacturing (66) and property and business services (83) sectors.

Personal income of approximately \$16 million was earned in the oyster farming sector and another \$14 million in downstream activities. This comprised both wages by employees and estimated drawings by owner/operators. An additional \$27 million of household income was earned in other businesses in the state as a result of oyster farming and downstream activities. The total household income impact was approximately \$56 million.

¹⁷ Note that this estimate is significantly less than that for 2005/06 (511 fte). Whilst there may have been some productivity improvements in the sector, it is likely that the majority of this difference is a function of improvements in the quality of the PIRSA Aquaculture survey data. It is probable that direct employment in oyster farming in 2005/06 and previous years has been overestimated.

4.3 The Economic Impact of Other Aquaculture in South Australia, 2006/07

The economic impacts of other aquaculture sectors in South Australia in 2006/07 (abalone, mussels, barramundi, marron/yabbies and other aquaculture) are reported in Tables to 4.3 to 4.7, respectively.

These results are reported without comment, as the interpretation is identical to that for oysters and tuna farming described in the previous sections.

For some of the other aquaculture sectors, the impacts in terms of flow-on employment and household income are relatively low. As these sectors grow and sales increase, household income and flow-on employment impacts generated by recurrent expenditure are expected to increase as well. The flow-on effects constitute an upper estimate given the likelihood of some double counting of consumption-induced effects in the retail and food services margins.

Table 4.3 The economic impact of abalone farming in South Australia, 2006/07

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Abalone farming	7.2	40%	2.8	36%	67	49%	2.5	45%
Processing	0.3	1%	0.1	1%	1	1%	0.0	1%
Transport	0.0	0%	0.0	0%	0	0%	0.0	0%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.0	0%	0.0	0%	0	0%	0.0	0%
Total Direct	7.4	41%	2.9	37%	68	50%	2.6	46%
Flow-on effects								
Property and business serv	1.8	10%	1.1	14%	5	4%	0.3	6%
Manufacturing	1.3	7%	0.3	4%	4	3%	0.2	3%
Trade	1.3	7%	0.6	7%	13	9%	0.5	8%
Transport	0.3	2%	0.1	2%	1	1%	0.1	2%
Finance	0.5	3%	0.4	4%	2	2%	0.1	2%
Other Sectors	5.4	30%	2.6	33%	43	32%	1.9	34%
Total Flow-on	10.5	59%	5.0	63%	68	50%	3.1	54%
Total	18.0	100%	7.9	100%	136	100%	5.7	100%
Total/Direct	2.41		2.73		2.01		2.20	

Source: EconSearch analysis.

Table 4.4 The economic impact of mussel farming in South Australia, 2006/07

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Mussel farming	1.9	21%	1.3	28%	66	61%	1.3	40%
Processing	0.5	6%	0.1	3%	2	2%	0.1	2%
Transport	0.3	4%	0.2	3%	2	1%	0.1	3%
Retail	0.3	3%	0.1	3%	3	2%	0.1	3%
Food services	1.0	11%	0.4	9%	8	8%	0.3	8%
Total Direct	4.1	44%	2.1	46%	80	74%	1.9	57%
Flow-on effects								
Property and business serv	1.2	13%	0.7	15%	4	3%	0.2	7%
Manufacturing	1.0	11%	0.2	5%	3	3%	0.1	5%
Trade	0.8	8%	0.4	8%	8	7%	0.3	9%
Transport	0.2	3%	0.1	2%	1	1%	0.1	2%
Finance	0.4	4%	0.2	5%	1	1%	0.1	3%
Other Sectors	1.7	18%	0.9	19%	12	11%	0.6	18%
Total Flow-on	5.2	56%	2.5	54%	29	26%	1.4	43%
Total	9.2	100%	4.6	100%	109	100%	3.3	100%
Total/Direct	2.27		2.18		1.36		1.76	

Source: EconSearch analysis.

Table 4.5 The economic impact of barramundi farming in South Australia, 2006/07

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Barramundi farming	3.7	42%	1.9	45%	27	48%	1.2	47%
Processing	0.5	6%	0.1	3%	2	3%	0.1	3%
Transport	0.0	0%	0.0	0%	0	0%	0.0	0%
Retail	0.1	1%	0.0	1%	1	1%	0.0	1%
Food services	0.4	4%	0.1	3%	3	5%	0.1	4%
Total Direct	4.7	53%	2.2	52%	32	58%	1.4	55%
Flow-on effects								
Property and business serv	0.9	10%	0.5	12%	3	5%	0.2	7%
Manufacturing	0.8	9%	0.2	4%	2	4%	0.1	4%
Trade	0.7	8%	0.3	8%	7	13%	0.3	10%
Transport	0.2	2%	0.1	2%	1	1%	0.1	2%
Finance	0.3	3%	0.2	4%	1	2%	0.1	3%
Other Sectors	1.4	15%	0.7	17%	10	17%	0.5	19%
Total Flow-on	4.2	47%	2.0	48%	24	42%	1.1	45%
Total	8.9	100%	4.2	100%	56	100%	2.5	100%
Total/Direct	1.89		1.93		1.73		1.82	

Source: EconSearch analysis.

Table 4.6 The economic impact of yabby/marron farming in South Australia, 2006/07

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Yabby/marron farming	0.7	44%	0.5	57%	41	88%	0.1	21%
Processing	0.0	0%	0.0	0%	0	0%	0.0	0%
Transport	0.0	2%	0.0	2%	0	0%	0.0	4%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.3	17%	0.1	11%	2	5%	0.1	23%
Total Direct	1.0	64%	0.7	71%	43	93%	0.1	49%
Flow-on effects								
Property and business serv	0.1	9%	0.1	8%	1	1%	0.0	11%
Manufacturing	0.1	8%	0.0	3%	0	1%	0.0	6%
Trade	0.1	6%	0.0	5%	1	2%	0.0	11%
Transport	0.0	2%	0.0	1%	0	0%	0.0	3%
Finance	0.0	2%	0.0	3%	0	0%	0.0	3%
Other Sectors	0.2	10%	0.1	9%	1	2%	0.1	18%
Total Flow-on	0.6	36%	0.3	29%	3	7%	0.2	51%
Total	1.6	100%	0.9	100%	47	100%	0.3	100%
Total/Direct	1.57		1.41		1.07		2.06	

Source: EconSearch analysis.

Table 4.7 The economic impact of other aquaculture in South Australia, 2006/07 ^a

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Other aquaculture	18.8	34%	8.1	32%	179	45%	6.7	40%
Processing	1.8	3%	0.4	2%	6	1%	0.3	2%
Transport	1.9	3%	0.9	4%	9	2%	0.6	4%
Retail	0.5	1%	0.2	1%	5	1%	0.2	1%
Food services	3.9	7%	1.5	6%	32	8%	1.0	6%
Total Direct	26.9	48%	11.2	45%	231	58%	8.8	52%
Flow-on effects								
Property and business serv	5.8	10%	3.5	14%	18	5%	1.1	7%
Manufacturing	5.0	9%	1.2	5%	16	4%	0.7	4%
Trade	4.6	8%	2.1	8%	45	11%	1.7	10%
Transport	1.1	2%	0.5	2%	5	1%	0.4	2%
Finance	1.8	3%	1.2	5%	7	2%	0.4	3%
Other Sectors	10.6	19%	5.5	22%	79	20%	3.8	22%
Total Flow-on	29.0	52%	13.9	55%	170	42%	8.1	48%
Total	55.9	100%	25.1	100%	400	100%	16.9	100%
Total/Direct	2.08		2.25		1.74		1.92	

^a Other aquaculture production is comprised of yellowtail kingfish, rainbow trout, other marine finfish (e.g. mulloway) and other aquaculture enterprises (e.g. algae production).

Source: EconSearch analysis.

5. The Economic Impact of Aquaculture in the Eyre Peninsula Region, 2006/07

5.1 The Economic Impact of Tuna Farming in the Eyre Peninsula Region, 2006/07

Estimates of the economic impact of tuna farming in the Eyre Peninsula region¹⁸ of South Australia in 2006/07 are reported in Table 5.1. The interpretation of these results is identical to the state-level impacts described in Section 4 of the report.

Table 5.1 The economic impact of tuna farming in the Eyre Peninsula Region, 2006/07

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Tuna farming ^a	137.7	53%	50.4	41%	305	31%	11.5	27%
Processing	11.6	4%	2.7	2%	36	4%	1.7	4%
Transport	2.0	1%	1.0	1%	9	1%	0.7	2%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.0	0%	0.0	0%	0	0%	0.0	0%
Total Direct	151.3	58%	54.1	43%	350	36%	13.8	33%
Flow-on effects								
Tuna fishing	41.0	16%	33.8	27%	229	23%	7.9	19%
Property and business serv.	10.7	4%	6.6	5%	32	3%	1.7	4%
Manufacturing	6.0	2%	1.7	1%	27	3%	1.1	3%
Trade	9.7	4%	4.5	4%	111	11%	3.5	8%
Sardines	17.6	7%	10.8	9%	60	6%	6.3	15%
Transport	4.3	2%	2.2	2%	24	2%	1.5	3%
Finance	2.6	1%	1.8	1%	13	1%	0.7	2%
Other Sectors	15.8	6%	9.0	7%	134	14%	5.8	14%
Total Flow-on	107.6	42%	69.7	57%	611	64%	28.0	67%
Total	258.9	100%	124.4	100%	980	100%	42.3	100%
Total/Direct	1.71		2.30		2.80		3.06	

^a Note the double counting in the output impact, also includes the value of tuna fishing.

Source: EconSearch analysis.

¹⁸ Defined as the Eyre Statistical Division which is comprised of the following Statistical Local Areas: Ceduna (DC), Cleve (DC), Elliston (DC), Franklin Harbour (DC), Kimba (DC), Le Hunte (DC), Lower Eyre Peninsula (DC), Port Lincoln (C), Streaky Bay (DC), Tumby Bay (DC), Unincorp. Lincoln and Unincorp. West Coast.

Output impacts...

Direct output (business turnover) generated locally by tuna farms summed to \$138 million and in other sectors (processing and transport), \$14 million in 2006/07. Flow-on output in other sectors summed to \$108 million. The sectors most affected were the tuna fishing (tuna capture¹⁹), sardine fishing, manufacturing, trade, property and business services, transport, and finance sectors (Table 5.1).

The bottom row of Table 5.1 gives the total impact/direct impact ratio for each economic indicator. For output, the ratio of 1.71 indicates that for each dollar of sales generated directly by tuna farming, processing and transport there was a total of \$1.71 of output generated by businesses throughout the Eyre Peninsula region, \$1.00 in tuna farming, processing and transport and \$0.71 in other sectors of the regional economy.

Contribution to gross regional product...

The direct contribution to gross regional product (GRP) in the Eyre Peninsula region by tuna farming, processing and transport was approximately \$54 million in 2006/07. Flow-on GRP generated in the other sectors of the regional economy was approximately \$70 million in 2006/07. The flow-ons were greatest in the tuna fishing (\$34m), sardine fishing (\$11m), property and business services (\$7m), trade (\$5m) and manufacturing (\$2m) sectors.

The bottom row in Table 5.1 shows that for each dollar of GRP generated directly in tuna farming, processing and transport there was an additional \$1.30 (\$2.30 in total) generated in other sectors of the regional economy.

Employment and household income...

A significant number of jobs are created as a result of the flow-on business activity. The tuna farms were responsible for the direct employment of around 300²⁰ fte and associated processing and transport, approximately 45 fte in the Eyre Peninsula region in 2006/07. Flow-on business activity was estimated to have generated a further 611 fte jobs locally to give total employment of almost 980 fte in the region. The sectors of the local economy with employment flow-ons from tuna farming, processing and transport included the tuna fishing (229 fte), sardine fishing (60), trade (111), manufacturing (27), property and business services (32) and transport (24) sectors.

The bottom row in Table 5.1 shows that for each job generated directly in tuna farming, processing and transport there was an additional 1.80 jobs (2.80 jobs in total) in the rest of the region.

It was estimated that personal income of \$12 million was earned directly in the tuna farming sector in 2006/07, comprising both wages by employees and drawings by owner/operators. An additional \$8 million of household income was earned by licence holders and crew in the tuna fishing sector and a further \$23 million in other sectors of the regional economy. For each \$1.00 of household income generated directly by tuna

¹⁹ Note that the value of tuna fishing is also included in the direct impact of tuna farming.

²⁰ Note that this estimate is significantly less than that for 2005/06 (502 fte). Whilst there may have been some productivity improvements in the sector, it is likely that the majority of this difference is a function of improvements in the quality of the PIRSA Aquaculture survey data. It is probable that direct employment in tuna farming in 2005/06 and previous years has been overestimated.

farming, processing and transport in 2006/07 there was an additional \$2.06 (\$3.06 in total) generated in other sectors of the Eyre Peninsula regional economy.

5.2 The Economic Impact of Oyster Farming in the Eyre Peninsula Region, 2006/07

Estimates of the economic impact of oyster farming in the Eyre Peninsula region in 2006/07 are reported in Table 5.2. The interpretation of these results is identical to the state-level impacts described in Section 4 of the report.

Output impacts...

Direct output (business turnover) generated by oyster enterprises in the Eyre Peninsula region summed to approximately \$38 million in 2006/07 while output generated in the Eyre Peninsula region by associated downstream activities (processing, transport, retail and food service) summed to \$13 million. Flow-ons to other sectors of the regional economy added another \$22 million in output in 2006/07. The sectors most affected were the trade, transport, manufacturing and property and business services sectors (Table 5.2).

Table 5.2 The economic impact of oyster farming in the Eyre Peninsula region, 2006/07 ^a

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Oyster farming ^b	38.1	52%	25.6	60%	372	62%	15.4	60%
Processing	2.4	3%	0.7	2%	11	2%	0.4	2%
Transport	8.8	12%	4.5	10%	50	8%	3.0	12%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	1.8	2%	0.7	2%	17	3%	0.5	2%
Total Direct	51.1	70%	31.5	73%	451	75%	19.3	76%
Flow-on effects								
Property and business serv.	5.4	7%	3.5	8%	12	2%	0.6	2%
Manufacturing	1.8	2%	0.5	1%	8	1%	0.3	1%
Trade	4.4	6%	2.1	5%	51	9%	1.6	6%
Transport	1.0	1%	0.5	1%	5	1%	0.3	1%
Finance	1.1	1%	0.7	2%	5	1%	0.3	1%
Other Sectors	8.0	11%	4.2	10%	67	11%	3.0	12%
Total Flow-on	21.6	30%	11.5	27%	149	25%	6.2	24%
Total	72.7	100%	42.9	100%	600	100%	25.5	100%
Total/Direct	1.47		1.39		1.38		1.35	

^a Constitutes an upper estimate of the flow-on effects given the likelihood of some double counting of consumption-induced effects in the retail and food services margins.

^b Includes sales of spat.

Source: EconSearch analysis.

Contribution to gross regional product...

Total oyster farming-related contribution to GRP in the Eyre Peninsula region was almost \$43 million in 2006/07, \$26 million generated by oyster farming directly, \$6 million generated by downstream activities and almost \$12 million generated in other sectors of the regional economy.

Employment and household income...

In 2006/07 in the Eyre Peninsula region, oyster farming was responsible for the direct employment of approximately 370²¹ fte and associated downstream activities created employment for an additional 79 fte. Flow-on business activity was estimated to generate a further 149 fte. The total employment impact was 600 fte.

In 2006/07, personal income of over \$19 million was earned in oyster farming and downstream activities in the Eyre Peninsula region comprising both wages by employees and estimated drawings by owner/operators. An additional \$6 million of household income was earned in other local businesses as a result of oyster industry operations. The total household income impact was almost \$26 million.

5.3 The Economic Impact of Other Aquaculture in the Eyre Peninsula Region, 2006/07

The economic impacts of other aquaculture sectors in the Eyre Peninsula region in 2006/07 (i.e. abalone, mussel, yellowtail kingfish farming and other aquaculture enterprises) are reported in aggregate in Table 5.3. These results are reported without comment, as the interpretation is identical to that for oysters and tuna farming described in the previous sections.

Note that for most of the other aquaculture sectors, the impacts in terms of flow-on employment and household income are relatively low. As these sectors grow and sales increase, household income and flow-on employment impacts generated by recurrent expenditure are expected to increase as well. The flow-on effects constitute an upper estimate given the likelihood of some double counting of consumption-induced effects in the retail and food services margins.

²¹ Note that this estimate is significantly less than that for 2005/06 (490 fte). Whilst there may have been some productivity improvements in the sector, it is likely that the majority of this difference is a function of improvements in the quality of the PIRSA Aquaculture survey data. It is probable that direct employment in oyster farming in 2005/06 and previous years has been overestimated.

Table 5.3 The economic impact of other aquaculture ^a in the Eyre Peninsula region, 2006/07 ^b

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)	%	(\$m)	%	(fte)	%	(\$m)	%
Direct effects								
Other Aquaculture	17.4	56%	7.5	53%	167	64%	6.3	62%
Processing	1.7	5%	0.5	3%	8	3%	0.3	3%
Transport	1.7	6%	0.9	6%	10	4%	0.6	6%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.2	1%	0.1	0%	2	1%	0.0	0%
Total Direct	21.0	68%	8.9	63%	187	72%	7.2	71%
Flow-on effects								
Property and business serv.	2.0	6%	1.3	9%	4	2%	0.2	2%
Manufacturing	0.9	3%	0.2	2%	4	2%	0.2	2%
Trade	2.3	7%	1.0	7%	26	10%	0.8	8%
Transport	0.4	1%	0.2	1%	2	1%	0.1	1%
Finance	0.4	1%	0.3	2%	2	1%	0.1	1%
Other Sectors	4.1	13%	2.1	15%	35	13%	1.5	15%
Total Flow-on	10.0	32%	5.2	37%	73	28%	2.9	29%
Total	31.0	100%	14.1	100%	259	100%	10.2	100%
Total/Direct	1.48		1.58		1.39		1.41	

^a Includes abalone, mussel, yellowtail kingfish farming and other aquaculture enterprises.

^b Constitutes an upper estimate of the flow-on effects given the likelihood of some double counting of consumption-induced effects in the retail and food services margins.

Source: EconSearch analysis.

6. The Economic Impact of Aquaculture in the Limestone Coast Region, 2006/07

Estimates of the economic impact of aquaculture in the Limestone Coast region²² in 2006/07 (i.e. barramundi, yabby/marron farming and other aquaculture enterprises) are reported in aggregate in Table 6.1. The interpretation of these results is identical to the state and regional level impacts described in Sections 4 and 5 of the report.

Note that for most of the aquaculture sectors in the Limestone Coast region the impacts in terms of flow-on employment and household income are relatively low. As these sectors grow and sales increase, household income and flow-on employment impacts generated by recurrent expenditure are expected to increase as well. The flow-on effects constitute an upper estimate given the likelihood of some double counting of consumption-induced effects in the retail and food services margins.

Table 6.1 The economic impact of aquaculture^a in the Limestone Coast region, 2006/07^b

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(jobs)		(\$m)	
Direct effects								
Aquaculture	2.7	57%	1.3	55%	20	62%	0.9	61%
Processing	0.1	2%	0.0	1%	0	1%	0.0	1%
Transport	0.4	8%	0.2	8%	2	8%	0.1	9%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.0	0%	0.0	0%	0	0%	0.0	0%
Total Direct	3.1	66%	1.5	64%	23	71%	1.0	71%
Flow-on effects								
Property and business serv.	0.3	7%	0.2	9%	1	2%	0.0	2%
Manufacturing	0.2	4%	0.1	2%	1	2%	0.0	2%
Trade	0.2	5%	0.1	5%	2	7%	0.1	6%
Transport	0.0	1%	0.0	1%	0	1%	0.0	1%
Finance	0.1	1%	0.0	2%	0	1%	0.0	1%
Other Sectors	0.7	16%	0.4	17%	5	16%	0.2	17%
Total Flow-on	1.6	34%	0.8	36%	9	29%	0.4	29%
Total	4.7	100%	2.3	100%	32	100%	1.5	100%
Total/Direct	1.52		1.56		1.42		1.41	

^a Includes barramundi, yabby/marron farming and other aquaculture enterprises.

^b Constitutes an upper estimate of the flow-on effects given the likelihood of some double counting of consumption-induced effects in the retail and food services margins.

Source: EconSearch analysis.

²² Defined as the South East South Australia Statistical Division which is comprised of the following Statistical Local Areas: Grant (DC), Lacedpede (DC), Mount Gambier (C), Naracoorte and Lucindale (DC), Robe (DC), Tatiara (DC), Wattle Range (DC)-East and Wattle Range (DC)-West.

Output impacts...

Direct output (business turnover) generated by aquaculture summed to \$2.7 million and associated downstream activities, \$0.5 million in the Limestone Coast region in 2006/07. Flow-on output in other sectors of the regional economy summed to \$1.6 million in 2006/07. The sectors most affected were the manufacturing, trade and property and business services sectors (Table 6.1).

Contribution to gross regional product...

Total aquaculture-related contribution to GRP in the Limestone Coast region was \$2.3 million in 2006/07, \$1.3 million generated by aquaculture directly, \$0.2 million generated in associated downstream activities and \$0.8 million generated in other sectors of the regional economy.

Employment and household income...

Aquaculture and downstream activities were responsible for the direct employment of 23 fte in 2006/07 in the Limestone Coast region. Flow-on business activity was estimated to generate a further 9 fte.

In 2006/07, personal income of \$1.0 million was earned in aquaculture and downstream activities in the Limestone Coast region comprising both wages by employees and estimated drawings by owner/operators. An additional \$0.4 million of household income was earned in other local businesses as a result of aquaculture industry operations.

7. The Economic Impact of Aquaculture in the Balance of South Australia, 2006/07

Estimates of the economic impact of aquaculture in the balance of SA²³ in 2006/07 (i.e. oysters, abalone, mussels, barramundi, yellowtail kingfish, yabby/marron farming and other aquaculture enterprises) are reported in aggregate in Table 7.1.

Note that for some of the aquaculture sectors in the balance of SA, the impacts in terms of flow-on employment and household income are relatively low. As these sectors grow and sales increase, household income and flow-on employment impacts generated by recurrent expenditure are expected to increase as well. The flow-on effects constitute an upper estimate given the likelihood of some double counting of consumption-induced effects in the retail and food services margins.

Table 7.1 The economic impact of aquaculture ^a in the balance of SA, 2006/07 ^b

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(jobs)		(\$m)	
Direct effects								
Aquaculture	8.5	66%	4.1	65%	112	84%	2.9	74%
Processing	0.3	2%	0.1	1%	1	1%	0.0	1%
Transport	0.6	5%	0.3	4%	3	3%	0.2	5%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.1	1%	0.0	0%	1	0%	0.0	0%
Total Direct	9.5	74%	4.5	72%	117	88%	3.1	80%
Flow-on effects								
Property and business serv.	0.9	7%	0.6	10%	1	1%	0.1	2%
Manufacturing	0.5	4%	0.1	2%	1	1%	0.1	2%
Trade	0.1	1%	0.1	1%	1	1%	0.0	1%
Transport	0.1	1%	0.0	1%	1	0%	0.0	1%
Finance	0.2	2%	0.2	2%	1	1%	0.1	1%
Other Sectors	1.5	12%	0.8	13%	12	9%	0.5	13%
Total Flow-on	3.4	26%	1.8	28%	16	12%	0.8	20%
Total	12.9	100%	6.3	100%	133	100%	3.9	100%
Total/Direct	1.36		1.41		1.15		1.25	

^a Includes oysters, abalone, mussels, barramundi, yellowtail kingfish, yabby/marron farming and other aquaculture enterprises.

^b Constitutes an upper estimate of the flow-on effects given the likelihood of some double counting of consumption-induced effects in the retail and food services margins.

Source: EconSearch analysis.

²³ Defined as South Australia net of the Eyre and Limestone Coast regions and the Adelaide Statistical Division (or broader metropolitan area).

Output impacts...

Direct output (business turnover) generated by aquaculture summed to \$8.5 million and associated downstream activities, \$1.0 million in the balance of SA in 2006/07. Flow-on output in other sectors of the regional economy summed to \$3.4 million in 2006/07. The sectors most affected were the manufacturing, trade and property and business services sectors (Table 7.1).

Contribution to gross regional product...

Total aquaculture-related contribution to gross regional product in the balance of SA was \$6.3 million in 2006/07, \$4.1 million generated by aquaculture directly, \$0.4 million generated in associated downstream activities and \$1.8 million generated in other sectors of the regional economy.

Employment and household income...

Aquaculture and downstream activities were responsible for the direct employment of 117 fte in 2006/07 in the balance of SA. Flow-on business activity was estimated to generate a further 16 fte.

In 2006/07, personal income of \$3.1 million was earned in aquaculture and downstream activities in the balance of SA comprising both wages by employees and estimated drawings by owner/operators. An additional \$0.8 million of household income was earned in other local businesses as a result of aquaculture industry operations.

8. Other Facets of Regional Economic Development Associated with Aquaculture Activity in South Australia

In addition to the quantifiable economic impacts outlined above there are a number of other facets of regional economic development associated with aquaculture activity in South Australia.

Increasing the diversity and complexity of regional economies

Many of the small regional towns in South Australia are characterised by a heavy reliance on one or a small number of major industries, combined with a set of other "fundamental" activities that provide basic services and infrastructure to those industries. They lack the diversity and complexity of larger economic units.

The aquaculture industry has developed rapidly in recent years. Through its relatively large requirement for labour and material inputs, the industry has shown the potential to increase the complexity and diversity of local economies. The demand for local labour, goods and services assists in offsetting the contraction of other local industry and may help avoid a range of other economic and social pressures associated with declining regional economies.

Re-investment of profits in local enterprises

In addition to the regional impacts generated by recurrent expenditures in the aquaculture sector, further economic impacts are generated by the investment of profits in new or under-resourced local ventures by aquaculture operators.

For example, the current profitability in the tuna farming sector underpins the very substantial local investment by tuna farmers in the local cannery, shipyard, marinas, property (e.g. hotels) and other industries (e.g. yellowtail kingfish aquaculture and viticulture) (Brian Jeffries, pers. comm.)

Tourism

Tourism activities associated with the aquaculture sector (e.g. recreational fishing and farm tours) provide a further source of income and employment for regional economies with a well-developed aquaculture sector (e.g. the Eyre Peninsula region).

Education and Research

The aquaculture sector, particularly the tuna industry, is characterised by a high level of innovation. These innovative ideas have been directed towards value adding opportunities in the tuna industry itself (e.g. fresh fish direct marketed to Japan) and to the development of new aquaculture industries (e.g. yellowtail kingfish farming).

The success of the tuna industry, in particular, has been a catalyst for the development of significant research (e.g. CRC for Sustainable Aquaculture of Finfish) and education resources (e.g. the Marine Science Centre at Port Lincoln) within South Australia.

9. Summary

9.1 Economic Impact of Aquaculture in SA, 2006/07

The results of the economic impact analysis are summarised in Tables 9.1 to 9.5. For the state as a whole, the aquaculture industry in 2006/07 was estimated to have had a farm gate value of \$209 million with associated direct output impacts in the processing, transport, retail and food service sectors of \$81 million (Table 9.1). In total, the direct value of aquaculture industry output was estimated to have been approximately \$290 million. This activity generated flow-on output of \$304 million in other South Australian industries. In terms of employment, there were almost 1,070 fte jobs generated directly in aquaculture, almost 500 fte generated in downstream activities (total direct of 1,563 fte) and approximately 1,630 flow-on fte generated in other sectors of the state's economy in 2006/07.

Table 9.1 The economic impact of aquaculture in South Australia, 2006/07

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Aquaculture production	208.9	35%	91.3	32%	1,066	33%	39.2	28%
Aquaculture downstream ^a	80.7	14%	29.0	10%	497	16%	19.1	14%
<i>Total Direct</i>	<i>289.7</i>	<i>49%</i>	<i>120.3</i>	<i>43%</i>	<i>1,563</i>	<i>49%</i>	<i>58.3</i>	<i>42%</i>
Flow-on effects								
Tuna Fishing	41.0	7%	33.8	12%	229	7%	7.9	6%
Other Sectors	263.2	44%	128.3	45%	1,400	44%	72.7	52%
<i>Total Flow-on</i>	<i>304.1</i>	<i>51%</i>	<i>162.1</i>	<i>57%</i>	<i>1,629</i>	<i>51%</i>	<i>80.6</i>	<i>58%</i>
Total	593.8	100%	282.4	100%	3,192	100%	138.9	100%

^a Processing, transport, retail and food services.

Source: EconSearch analysis.

For the Eyre Peninsula region the aquaculture industry in 2006/07 was estimated to have had a farm gate value of \$198 million with associated direct output impacts in the processing, transport, retail and food service sectors of \$31 million (Table 9.2). In total, the direct value of aquaculture industry output was estimated to have been approximately \$229 million. This activity generated flow-on output of \$143 million in other regional industries. In terms of employment, there were approximately 930 fte jobs generated directly in aquaculture, almost 150 fte generated in downstream activities (total direct of 1,081 fte) and 883 flow-on fte generated in other sectors of the region's economy in 2006/07.

Table 9.2 The economic impact of aquaculture in the Eyre Peninsula region, 2006/07

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Aquaculture production	197.7	53%	85.4	46%	932	47%	35.1	43%
Aquaculture downstream ^a	31.2	8%	11.3	6%	149	8%	7.5	9%
<i>Total Direct</i>	<i>229.0</i>	<i>61%</i>	<i>96.8</i>	<i>52%</i>	<i>1,081</i>	<i>55%</i>	<i>42.6</i>	<i>52%</i>
Flow-on effects								
Tuna Fishing	41.0	11%	33.8	18%	229	12%	7.9	10%
Other Sectors	102.4	28%	55.2	30%	654	33%	30.9	38%
<i>Total Flow-on</i>	<i>143.4</i>	<i>39%</i>	<i>89.0</i>	<i>48%</i>	<i>883</i>	<i>45%</i>	<i>38.9</i>	<i>48%</i>
Total	372.4	100%	185.8	100%	1,964	100%	81.4	100%

^a Processing, transport, retail and food services.

Source: EconSearch analysis.

For the Limestone Coast region the aquaculture industry in 2006/07 was estimated to have had a farm gate value of \$2.7 million with associated direct output impacts in the processing, transport, retail and food service sectors of \$0.5 million (Table 9.3). This activity generated flow-on output of \$1.6 million in other regional industries. In terms of employment, there were 23 fte jobs generated directly in aquaculture and downstream activities and approximately 9 flow-on fte generated in other sectors of the region's economy in 2006/07.

Table 9.3 The economic impact of aquaculture in the Limestone Coast region, 2006/07

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(jobs)		(\$m)	
Direct effects								
Aquaculture production	2.7	57%	1.3	55%	20	62%	0.9	61%
Aquaculture downstream ^a	0.5	10%	0.2	9%	3	9%	0.2	11%
<i>Total Direct</i>	<i>3.1</i>	<i>66%</i>	<i>1.5</i>	<i>64%</i>	<i>23</i>	<i>71%</i>	<i>1.0</i>	<i>71%</i>
Other Sectors (flow-on)	1.6	34%	0.8	36%	9	29%	0.4	29%
Total	4.7	100%	2.3	100%	32	100%	1.5	100%

^a Processing, transport, retail and food services.

Source: EconSearch analysis.

For the balance of SA region the aquaculture industry in 2006/07 was estimated to have had a farm gate value of almost \$9 million with associated direct output impacts in the processing, transport, retail and food service sectors of \$1 million (Table 9.4). This activity generated flow-on output of over \$3 million in other regional industries. In terms of employment, there were almost 120 fte jobs generated directly in aquaculture and downstream activities and 16 flow-on fte generated in other sectors of the region's economy in 2006/07.

Table 9.4 The economic impact of aquaculture in the balance of SA, 2006/07

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(jobs)		(\$m)	
Direct effects								
Aquaculture production	8.5	66%	4.1	65%	112	84%	2.9	74%
Aquaculture downstream ^a	1.0	8%	0.4	6%	5	4%	0.3	7%
<i>Total Direct</i>	9.5	74%	4.5	72%	117	88%	3.1	80%
Other Sectors (flow-on)	3.4	26%	1.8	28%	16	12%	0.8	20%
Total	12.9	100%	6.3	100%	133	100%	3.9	100%

^a Processing, transport, retail and food services.

Source: EconSearch analysis.

For the state as a whole the aquaculture industry is dominated by the tuna-farming sector (Table 9.5). In 2006/07, it accounted for just over 50 per cent of total aquaculture industry related (direct and flow-on) output and GSP and between 35 and 40 per cent of aquaculture related employment and household income²⁴.

²⁴ Similar estimates to those presented in Table 9.5 are presented in Appendix 4 for the years 2001/02 to 2005/06. When using these time series data it is important to acknowledge the influence of methodological changes in accounting for variability between years (see section 9.2 for further detail).

Table 9.5 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2006/07

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Tuna farming	306.3	51.6%	145.0	51.4%	1,149	36.0%	53.8	38.7%
Oyster farming	193.9	32.7%	94.6	33.5%	1,295	40.6%	56.4	40.6%
Abalone farming	18.0	3.0%	7.9	2.8%	136	4.3%	5.7	4.1%
Mussels farming	9.2	1.6%	4.6	1.6%	109	3.4%	3.3	2.3%
Barramundi farming	8.9	1.5%	4.2	1.5%	56	1.8%	2.5	1.8%
Yabby/Marron farming	1.6	0.3%	0.9	0.3%	47	1.5%	0.3	0.2%
Other aquaculture ^a	55.9	9.4%	25.1	8.9%	400	12.5%	16.9	12.2%
Total (SA)	593.8	100.0%	282.4	100.0%	3,192	100.0%	138.9	100.0%

^a Other aquaculture production is comprised of yellowtail kingfish, Atlantic salmon, other marine finfish (e.g. mulloway), rainbow trout and other aquaculture enterprises (e.g. algae production).

Source: EconSearch analysis.

9.2 Economic Impact of Aquaculture in SA, Time Series, 1997/98 to 2006/07

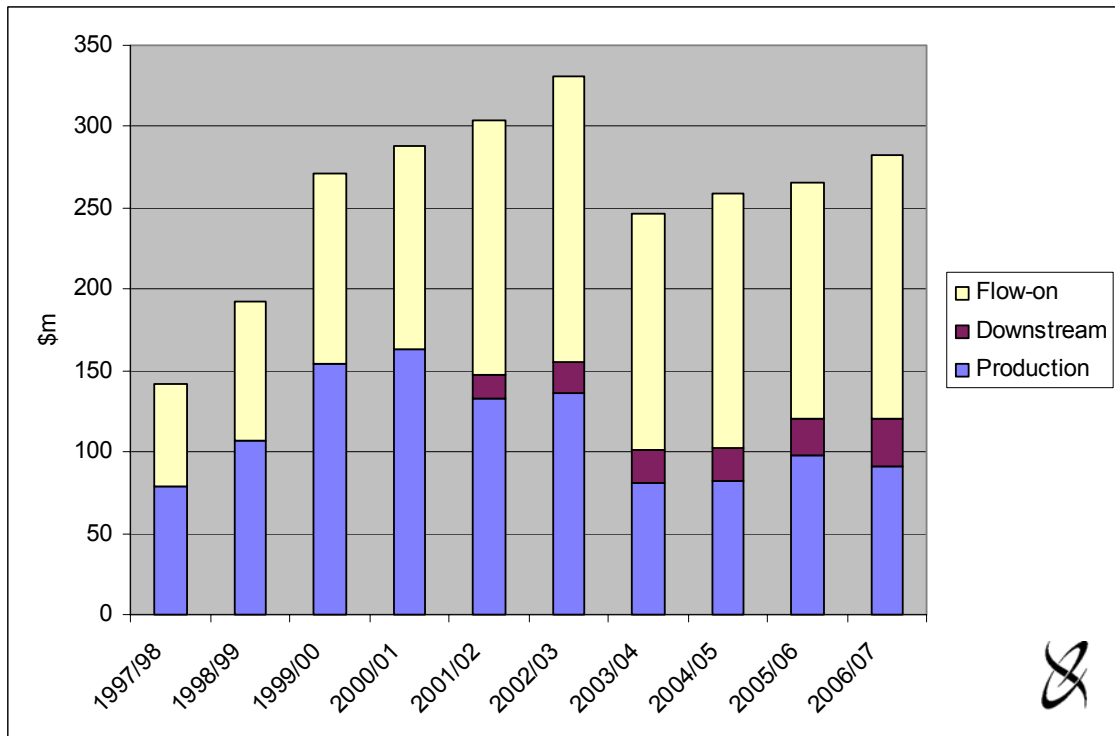
Estimates of the economic impact of aquaculture on the South Australian economy for the period 1997/98 to 2006/07, in terms of contribution to GSP and employment, are provided in Figures 9.1 and 9.2, respectively.

It is important to note that some of the variability in the GSP and employment impacts of SA aquaculture over the period 1997/98 to 2006/07 is a function of changes in methodology. Most significantly, as discussed in Section 2.1 of the report, estimates for the period 1997/98 to 2000/01 exclude some of the downstream impacts associated with aquaculture activity in SA²⁵. Other methodological and data-related influences include:

- the use of revised input-output tables;
- updates of the representative cost structures for individual aquaculture sectors;
- revisions to the processing, transport, retail and food service trade margins used in the analysis; and
- improvements in the quality of PIRSA Aquaculture's survey data.

²⁵ See Table 2.1 for further details.

Figure 9.1 Total GSP impact of aquaculture in SA, 1997/98 to 2006/07 ^a



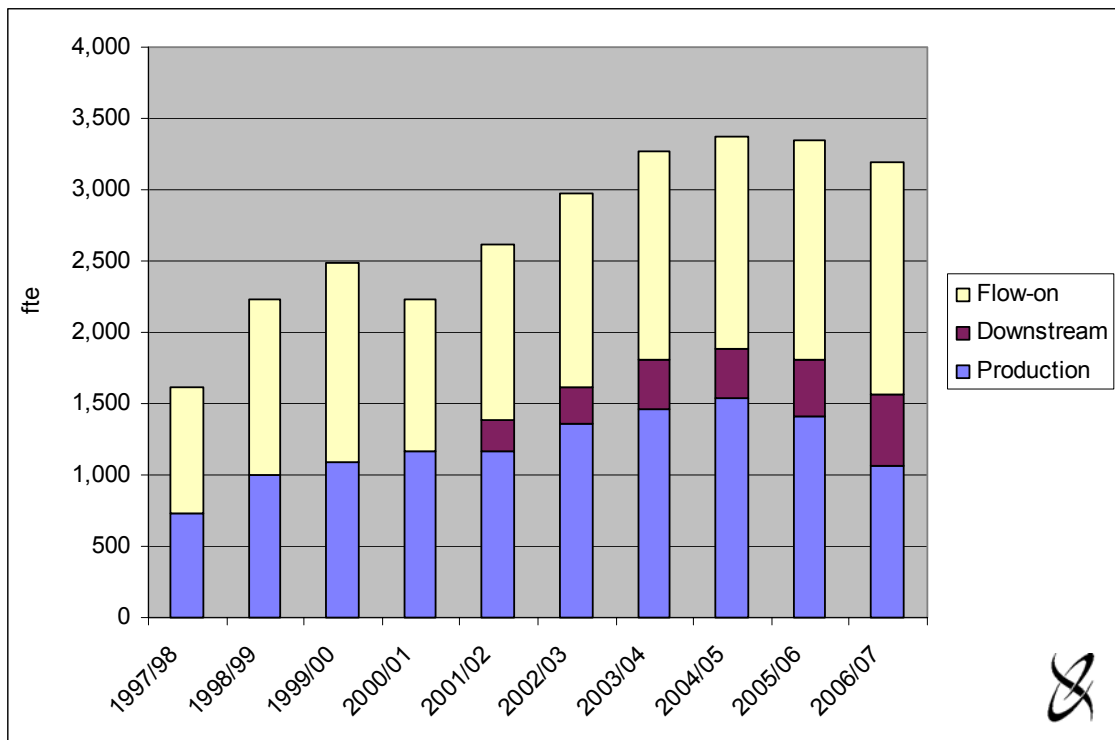
^a Total GSP impacts for the period 1997/98 to 2000/01 exclude some downstream activities (including some transport and all retail and food services).

Source: EconSearch (1997, 1998, 1999, 2001, 2002a, 2003, 2004, 2006a, 2006b and 2007) and Table 9.1.

Total contribution to GSP attributable to aquaculture in SA exhibited a rising trend over the period 1997/98 to 2002/03 (Figure 9.1). The significant reduction in the GSP impact between 2002/03 and 2003/04 is primarily a function of the decline in the per unit value of farmed tuna (45 per cent) over this period. Total contribution to GSP since 2003/04 has continued its rising trend.

The total employment impact attributable to aquaculture in SA exhibited a rising trend over the period 1997/98 to 2004/05, reflecting an expansion in capacity and production growth across most aquaculture sectors over this period (Figure 9.2). The reduction in direct employment in farming (i.e. production) activities between 2004/05 and 2006/07 is likely to be a function of improvements in on-farm labour productivity as well as a reflection of the improved quality of PIRSA Aquaculture’s survey data.

Figure 9.2 Total employment impact of aquaculture in SA, 1997/98 to 2006/07 ^a



^a Total employments impacts for the period 1997/98 to 2000/01 exclude some downstream activities (including some transport and all retail and food services).

Source: EconSearch (1997, 1998, 1999, 2001, 2002a, 2003, 2004, 2006a, 2006b and 2007) and Table 9.1.

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Appendix 1 Input-Output Methodology

Overview of Input-Output Analysis

Input-output analysis provides a comprehensive economic framework that is extremely useful in the resource planning process. Broadly, there are two ways in which the input-output method can be used.

First, the input-output table provides a numerical picture of the size and shape of the economy and its essential features. The input-output transactions table can be used to describe some of the important features of an economy, the interrelationships between sectors, and the relative importance of the individual sectors.

Second, input-output analysis provides a standard approach for the estimation of the economic impact of a particular activity. The input-output model is used to calculate industry multipliers that can then be applied to various development scenarios.

Linkages between sectors

The standard approach for the estimation of the regional economic impact of a particular activity, such as wine production, is to employ *input-output analysis*. The input-output model conceives the economy of the region as being divided up into a number of sectors, and this allows the analyst to trace expenditure flows.

To illustrate this, consider the example of a winery that, in the course of its operation, purchases goods and services from other sectors. These goods and services would include grapes, bottles, and corks and, of course, labour. The direct employment created is regarded in the model as an expenditure flow into the household sector, which is one of several non-industrial sectors recognised in the input-output model.

Upon receiving expenditure by the winery, the other sectors in the state economy engage in their own expenditures. For example, as a consequence of winning a contract for work with a winery, a bottle manufacturer buys materials from its suppliers and labour from its own employees. Suppliers and employees in turn engage in further expenditure, and so on. These *indirect effects*, as they are called, are part of the impact of the winery on the regional or state economy. They must be added to the *direct effects* (which are expenditures made in immediate support of the winery itself) in order to arrive at a measure of the total impact of the winery.

It may be thought that these indirect effects go on indefinitely, and that their amount adds up without limit, the presence of *leakages*, however, prevents this from occurring. In the context of the impact on a *regional or state* economy, an important leakage is expenditure on imports, that is, products or services that originate from *outside the region, state or country* (e.g. French oak barrels).

Thus some of the expenditure for imports to the region is lost to the local economy. Consequently, the indirect effects get smaller and smaller in successive expenditure rounds, due to this and other leakages. Hence the total expenditure created in the local economy is limited in amount, and so (in principle) it can be measured.

The performance of the input-output analysis calculations require a great deal of information. The analyst needs to know the magnitude of various expenditures and where they occur. Also needed is information on how the sectors that receive this expenditure share *their* expenditures among the various sectors from whom they buy, and so on for the further expenditure rounds.

In applying the input-output model, the standard procedure is to determine the direct or first-round expenditures only. No attempt is made to pursue such inquiries on expenditure in subsequent rounds, not even (for example) to trace the effects in the local economy on household expenditures by winery employees on food, clothing, entertainment, and so on, as it is impracticable to measure these effects for an individual case, here the winery.

The input-output model is instead based on a set of assumptions about constant and uniform proportions of expenditure. If households in general in the local economy spend (say) 13.3 per cent of their income on food and non-alcoholic beverages, it is assumed that those working in wineries do likewise. Indeed, the effects of all expenditure rounds after the first are calculated by using such standard proportions (*multiplier* calculations).

Multipliers

Multipliers are an indication of the strength of the linkages between a particular sector and the rest of the regional economy. As well, they can be used to estimate the impact of a change in that particular sector on the rest of the economy. As noted above, detailed explanations on calculating input-output multipliers (and the underlying assumptions) are provided in any regional economics or input-output analysis textbook (see for example Hewings (1985), Jensen and West (1986), Midmore and Harrison-Mayfield (1996), Powell et al. (1985), and West (1993)). Suffice to note that they are calculated through a routine set of mathematical operations based on coefficients derived from the input-output transactions table.

Input-output transactions table

The structure and linkages of a local economy can be described with the aid of input-output analysis. Input-output analysis, as an accounting system of inter-industry transactions, is based on the notion that no industry exists in isolation.

This assumes, within any economy, each firm depends on the existence of other firms to purchase inputs from, or sell products to, for further processing. The firms also depend on final consumers of the product and labour inputs to production. An input-output transactions table is a convenient way to illustrate the purchases and sales of goods and services taking place in an economy at a given time.

Input-output tables provide a numerical picture of the size and shape of the economy and its essential features. Products produced in the economy are aggregated into a number of groups of industries and the transactions between them recorded in the transactions table. The rows and columns of the input-output table can be interpreted in the following way:

- The rows of the input-output table illustrate sales for intermediate usage (to other firms) and for final demand (consumers, exports, capital formation).

- The columns show the origin of the inputs and hence the purchases made at that time (labour, capital and intermediate inputs).
- Each item is shown as a purchase by one sector and a sale by another, thus constructing two sides of a double accounting schedule.

In summary, the input-output transactions table can be used to describe some of the important features of a regional economy, the interrelationships between sectors, and the relative importance of the individual sectors. The table is also used for the calculation of sector multipliers and the estimation of economic impacts arising from some change in the local economy.

Appendix 2 Glossary of Input-Output Terminology

Basic value is the price received for a good or service by the producer. It is also known as *producers' price*. It excludes indirect taxes and transport, trade and other margins.

Consumption-induced effects are additional output, employment and income resulting from re-spending by households that receive income from employment in direct and indirect activities. Consumption-induced effects are sometimes referred to as "induced effects".

Contribution to gross state/regional product is calculated as the value of output less the cost of goods and services (including imports) used in producing the output. It represents payments to the primary inputs of production (labour, capital and land). Contribution to GSP/GRP is consistent with standard measures of economic activity, such as gross domestic, State or regional product and it provides an assessment of the net contribution to regional economic growth of a particular enterprise or activity.

Direct effects are the initial round of output, employment and income generated by an economic activity.

Employment is the number of working proprietors, managers, directors and other employees, in terms of the number of full-time equivalent jobs.

Exports refers to the sale of goods and services to final consumers outside the region of interest. In a state input-output table, exports refers to the sale of goods and services interstate and overseas. In a regional input-output table exports refers to the sale of goods and services interstate, overseas and to other regions within the state.

Flow-on effects are the sum of the production-induced effects and the consumption-induced effects.

Household income is a measure of wages and salaries paid in cash and in kind, drawings by owner operators and other payments to labour including overtime payments, employer's superannuation contributions and income tax, but excluding payroll tax.

Input-output analysis is an accounting system of inter-industry transactions based on the notion that no industry exists in isolation.

Input-output table is a transactions table that illustrates and quantifies the purchases and sales of goods and services taking place in an economy at a given point in time. It provides a numerical picture of the size and shape of the economy and its essential features. Each item is shown as a purchase by one sector and a sale by another, thus constructing two sides of a double accounting schedule.

Multiplier is an index (ratio) indicating the overall change in the level of activity that results from an initial change in economic activity. They are an indication of the strength of the linkages between a particular sector and the rest of the regional economy. They can be used to estimate the impact of a change in that particular sector on the rest of the economy.

Other Final Demand includes government expenditure, private and public sector investment (gross fixed capital formation) and change in stocks (inventories).

Other Value Added includes gross operating surplus and all taxes, less subsidies.

Output is gross revenue of goods and services produced by commercial organisations plus gross expenditure by government agencies.

Purchasers' price is the price paid for a good or service paid by the purchaser. It includes indirect taxes and transport, trade and other margins.

Production-induced effects are additional output, employment and income resulting from re-spending by firms that receive income from the sale of goods and services to firms undertaking, for example, agricultural activities. Production-induced effects are sometimes referred to as "indirect effects".

Total impact is the sum of the direct effects and the flow-on effects.

Type I multiplier is calculated as $(\text{direct effects} + \text{production-induced effects}) / \text{direct effects}$.

Type II multiplier is calculated as $(\text{direct effects} + \text{production-induced effects} + \text{consumption-induced effects}) / \text{direct effects}$.

Appendix 3 Aquaculture Production and Value of Production, South Australia, 1994/95 to 2006/07

Appendix Table 3.1 Farmed tuna production, South Australia, 1995/96 to 2006/07

	Into Farms		Farm Output
	Whole Weight	Processed Weight	Farm Gate Value
	'000kg	'000kg	\$m
1995/96	3,362	1,170	29.3
1996/97	2,498	4,069	91.5
1997/98	3,610	4,927	120.7
1998/99	4,991	6,805	166.7
1999/00	5,133	7,750	240.0
2000/01	5,282	9,051	263.8
2001/02	5,296	9,245	260.5
2002/03	5,409	9,102	266.9
2003/04	5,080	9,290	151.0
2004/05	5,421	7,458	140.0
2005/06	5,220	8,806	155.8
2006/07	n.a. ^a	7,486	137.7

^a Not available until publication of ABARE's *Australian Fisheries Statistics 2007* report (Paul Newton ABARE, pers. comm.).

Source: SARDI Aquatic Sciences and PIRSA Aquaculture.

Appendix Table 3.2 Oyster production, South Australia, 1994/95 to 2006/07 ^a

	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
Production (adult only):													
Weight ('000 kg)	855	976	1,359	na	na	na	na	na	na	na	na	na	na
Number ('000 doz.)	na	na	1,336	1,298	1,441	2,516	2,936	3,464	3,865	4,644	4,650	5,397	7,720
Value:													
Adult oysters (\$'000)	3,535	3,950	5,205	4,908	5,489	9,389	11,011	13,303	15,116	19,959	19,995	23,879	37,841
Spat (\$'000) ^b	na	na	610	1,168	997	800	579	856	1,002	1,193	1,195	957	1,143
Total (\$'000)	3,535	3,950	5,815	6,076	6,486	10,189	11,590	14,159	16,118	21,152	21,190	24,836	38,984

^a All figures have been rounded to the nearest thousand. Individual figures provided in the columns may not sum to the 'Total' for this reason.

^b An estimate the value of spat production in 2006/07 was imputed on the basis of the change in adult oyster production between 2003/04 and 2006/07.

Source: SARDI Aquatic Sciences and PIRSA Aquaculture.

Appendix Table 3.3 Other aquaculture production, South Australia, 1994/95 to 2006/07 ^a

	1994/95		1995/96		1996/97		1997/98		1998/99		1999/00		2000/01		2001/02		2002/03		2003/04		2004/05		2005/06		2006/07	
	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)	Whole Weight ('000kg)	Value (\$'000)
Barramundi	na	na	na	na	138	1,642	193	2,681	249	3,192	279	3,330	264	2,743	255	2,653	471	6,166	216	2,255	217	2,265	400	3,370	385	3,727
Marron	5	99	6	141	5	116	6	131	7	160	12	304	8	196	11	282	22	533	18	480	22	587	10	282	24	633
Blue Mussels	na	na	na	na	na	na	na	na	84	183	81	173	111	260	171	371	254	466	400	697	377	657	469	950	1,032	1,914
Abalone	na	na	na	na	na	na	na	na	21	856	40	2,000	53	2,677	34	1,901	59	3,080	105	3,155	177	5,318	250	8,222	196	7,155
Yabbies	9	86	17	175	10	111	11	115	27	231	16	156	17	172	8	95	7	93	10	153	20	306	2	36	5	89
Rainbow Trout	32	188	21	158	25	191	23	118	14	101	8	49	13	176	26	192	18	156	40	330	66	545	53	356	38	291
Other ^b	296	2,629	323	3,158	280	2,012	379	3,041	412	3,259	337	2,828	480	4,322	334	3,375	1,077	8,769	894	7,533	2,019	17,015	2,148	17,591	1,953	18,514
Total	342	3,002	367	3,632	458	4,072	612	6,086	814	7,982	773	8,840	946	10,546	839	8,869	1,908	19,263	1,683	14,603	2,898	26,693	3,332	30,808	3,633	32,324

^a All figures have been rounded to the nearest thousand. Individual figures provided in the columns may not sum to the 'Total' for this reason.

^b Other aquaculture production is comprised of yellowtail kingfish, Atlantic salmon, other marine finfish (e.g. mulloway) and other aquaculture enterprises (e.g. algae production).

Source: SARDI Aquatic Sciences and PIRSA Aquaculture.

Appendix 4 The Total Economic Impact of Aquaculture in South Australia, by Aquaculture Sector, 2001/02 to 2005/06²⁶

Appendix Table 4.1 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2001/02

Sector	Output		Value Added		Employment		Household Income	
	(\$m)		(\$m)		(jobs)		(\$m)	
Tuna farming	490.8	85.0%	260.1	85.6%	1,806	69.0%	69.8	73.9%
Oyster farming	57.6	10.0%	28.9	9.5%	514	19.7%	15.5	16.4%
Abalone farming	5.6	1.0%	3.0	1.0%	64	2.4%	1.7	1.8%
Mussels farming	1.6	0.3%	0.9	0.3%	31	1.2%	0.7	0.8%
Barramundi farming	8.7	1.5%	4.4	1.4%	74	2.8%	2.6	2.8%
Yabby/Marron farming	1.1	0.2%	0.6	0.2%	13	0.5%	0.2	0.2%
Other aquaculture	12.1	2.1%	6.0	2.0%	115	4.4%	3.9	4.1%
Total (SA)	577.5	100.0%	303.8	100.0%	2,617	100.0%	94.4	100.0%

Source: EconSearch (2003).

Appendix Table 4.2 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2002/03

Sector	Output		Value Added		Employment		Household Income	
	(\$m)		(\$m)		(jobs)		(\$m)	
Tuna farming	508.5	79.3%	266.2	80.5%	1,791	60.3%	71.6	66.7%
Oyster farming	64.8	10.1%	32.4	9.8%	582	19.6%	17.4	16.2%
Abalone farming	9.6	1.5%	4.9	1.5%	97	3.3%	2.6	2.4%
Mussels farming	2.3	0.4%	1.2	0.4%	44	1.5%	1.1	1.0%
Barramundi farming	22.7	3.5%	11.1	3.4%	162	5.5%	6.6	6.1%
Yabby/Marron farming	2.0	0.3%	1.0	0.3%	22	0.7%	0.4	0.4%
Other aquaculture	31.6	4.9%	13.9	4.2%	270	9.1%	7.8	7.2%
Total (SA)	641.5	100.0%	330.8	100.0%	2,969	100.0%	107.4	100.0%

Source: EconSearch (2004).

²⁶ Other aquaculture production is comprised of yellowtail kingfish, Atlantic salmon, other marine finfish (e.g. mullocky), rainbow trout and other aquaculture enterprises (e.g. algae production).

Appendix Table 4.3 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2003/04

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Tuna farming	347.9	69.2%	171.9	69.8%	1,759	53.9%	76.9	62.1%
Oyster farming	117.1	23.3%	56.4	22.9%	1,028	31.5%	34.2	27.6%
Abalone farming	9.0	1.8%	4.0	1.6%	149	4.6%	3.7	3.0%
Mussels farming	4.2	0.8%	2.1	0.9%	76	2.3%	2.0	1.6%
Barramundi farming	5.4	1.1%	3.0	1.2%	52	1.6%	1.7	1.4%
Yabby/Marron farming	1.5	0.3%	0.8	0.3%	19	0.6%	0.3	0.3%
Other aquaculture	17.8	3.5%	8.0	3.2%	182	5.6%	5.1	4.1%
Total (SA)	502.9	100.0%	246.2	100.0%	3,264	100.0%	123.9	100.0%

Source: EconSearch (2006a).

Appendix Table 4.4 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2004/05

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Tuna farming	333.3	64.3%	171.9	66.4%	1,535	45.6%	69.5	54.9%
Oyster farming	118.5	22.9%	56.6	21.9%	1,023	30.4%	35.0	27.7%
Abalone farming	15.5	3.0%	6.6	2.5%	255	7.6%	6.3	5.0%
Mussels farming	4.0	0.8%	2.0	0.8%	72	2.1%	1.9	1.5%
Barramundi farming	6.0	1.2%	3.1	1.2%	55	1.6%	2.2	1.8%
Yabby/Marron farming	2.1	0.4%	1.2	0.5%	28	0.8%	0.4	0.4%
Other aquaculture	38.8	7.5%	17.4	6.7%	397	11.8%	11.1	8.8%
Total (SA)	518.2	100.0%	258.7	100.0%	3,366	100.0%	126.5	100.0%

Source: EconSearch (2006b).

Appendix Table 4.5 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2005/06

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Tuna farming	331.6	60.3%	163.0	61.5%	1,425	42.6%	60.8	49.7%
Oyster farming	133.7	24.3%	64.4	24.3%	1,180	35.3%	38.6	31.5%
Abalone farming	18.8	3.4%	7.8	2.9%	151	4.5%	4.1	3.4%
Mussels farming	4.9	0.9%	2.5	1.0%	81	2.4%	2.2	1.8%
Barramundi farming	9.8	1.8%	4.6	1.7%	65	1.9%	4.0	3.3%
Yabby/Marron farming	0.7	0.1%	0.4	0.2%	41	1.2%	0.1	0.1%
Other aquaculture ^a	50.5	9.2%	22.4	8.5%	406	12.1%	12.5	10.2%
Total (SA)	550.1	100.0%	265.1	100.0%	3,348	100.0%	122.4	100.0%

Source: EconSearch (2007).