

The Economic Impact of Aquaculture on the South Australian State and Regional Economies, 2009/10

A report prepared for
PIRSA Fisheries and Aquaculture

Prepared by



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Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
AFMA	Australian Fisheries Management Authority
FRDC	Fisheries Research and Development Corporation
fte	full-time equivalent
KI	Kangaroo Island
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 2009/10. The results reported here update and expand on those provided in previous studies (EconSearch 1997, 1998, 1999, 2001, 2002a, 2003, 2004, 2006a, 2006b, 2007, 2008, 2009a and 2010). This report provides estimates of economic impact for 2009/10 by aquaculture sector (tuna, oysters, mussels, abalone, freshwater finfish, marine finfish, marron/yabbies farming and other aquaculture enterprises) at the state and regional (West Coast, Eyre Peninsula, Yorke Peninsula to Kangaroo Island and Murraylands and South East) 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 eight (EconSearch 2003, 2004, 2006a, 2006b, 2007, 2008, 2009a and 2010) 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.

Value of output and production estimates for South Australian aquaculture for 2009/10 were based on PIRSA Fisheries and Aquaculture's *2009/10 Production Returns*. The consultants coordinated the compilation, analysis and validation of these data. Estimates of SA aquaculture production and value of production for the years 2008/09 and 2009/10 are provided in Table E.1.

The state's total value of seafood production (landed) in 2009/10 was approximately \$396 million, of which aquaculture contributed approximately 49 per cent (\$194m) and wild-catch fisheries¹, the balance (\$202m). In aggregate, tuna is the largest single sector in the state's aquaculture industry, accounting for approximately 53 per cent of the state's gross value of aquaculture production in 2009/10. The other two main sectors are oysters (18 per cent) and marine finfish (14 per cent).

¹ Excludes catch from the Commonwealth managed fisheries and the charter boat fishery.

Table E.1 Aquaculture production and value of production, South Australia, 2008/09 and 2009/10

	Weight ('000kg)			Value (\$m)		
	2008/09	2009/10	Change	2008/09	2009/10	Change
Southern Bluefin Tuna	8,786	7,284	-17%	157.777	102.175	-35%
Marine Finfish	3,382	3,757	11%	29.209	27.133	-7%
Oysters						
adult ^a	5,848	6,123	5%	32.231	35.027	9%
spat	-	-	-	0.320	0.444	39%
Mussels	1,340	1,343	0%	2.519	2.530	0%
Abalone	227	286	26%	8.121	10.341	27%
Freshwater Finfish	424	415	-2%	4.501	4.897	9%
Marron and Yabbies	23	23	2%	0.606	0.645	6%
Other ^b	1,402	1,319	-6%	10.892	10.260	-6%
Total	21,431	20,549	-4%	246.175	193.452	-21%

Note: Totals may contain rounding errors.

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

^b Other aquaculture production in 2009/10 was comprised predominantly of algae and brine shrimp production.

Source: PIRSA Fisheries and Aquaculture 2009/10 Production Returns.

The results of the impact analysis, at the state level, are summarised in Table E.2. The direct impacts measure on-farm and aquaculture related downstream activities (fish processing, transport, retail and food services). The flow-on impacts measure the economic effects in other sectors of the economy (trade, transport, etc.) generated by the aquaculture industry, that is, the multiplier effects.

The direct output² impact was estimated to be \$272m (\$194m on-farm and \$78m in downstream activities) in 2009/10 (Table E.2). Total output (\$629m) needs to be used with care as it includes elements of double counting. Approximately 68 per cent of the output impact was generated in regional South Australia (Table E.3).

In 2009/10, aquaculture's total contribution to gross state product (GSP)³ (\$278m) (Table E.2) represented 0.35 per cent of the total GSP for South Australia (\$80,356m)⁴. Approximately 66 per cent of the contribution to GSP was generated in regional South Australia (Table E.3).

² 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.

³ Contribution to gross state (GSP) is measured as value of output less the cost of goods and services (including imports) used in producing the output. Contribution to GSP, as a measure of economic impact, avoids the problem of double counting that arises from using output for this purpose.

⁴ ABS (2010).

Table E.2 The economic impact of aquaculture in South Australia, 2009/10

	Tuna	Marine Finfish	Mussels	Oysters	Abalone	Freshwater Finfish	Marron and Yabbies	Other ^a	Total
Output (\$m)									
Direct									
<i>On-farm</i>	102.2	27.1	2.5	35.5	10.3	4.9	0.6	10.3	193.5
<i>Downstream</i>	13.3	15.7	2.8	44.6	0.4	1.1	0.3	0.0	78.2
Total Direct	115.4	42.9	5.3	80.0	10.8	6.0	0.9	10.3	271.6
Total Flow-on	172.7	52.0	8.1	92.4	19.9	6.4	0.6	5.4	357.6
Total ^b	288.1	94.8	13.5	172.4	30.7	12.4	1.5	15.7	629.2
Contribution to GSP (\$m)									
Direct									
<i>On-farm</i>	14.7	4.3	1.7	25.0	3.5	2.7	0.5	5.2	57.6
<i>Downstream</i>	4.5	6.4	1.1	18.4	0.1	0.5	0.1	0.0	31.2
Total Direct	19.2	10.7	2.8	43.5	3.6	3.2	0.7	5.2	88.8
Total Flow-on	100.1	23.1	4.2	46.4	9.2	3.3	0.3	2.8	189.4
Total	119.3	33.8	7.0	89.9	12.8	6.5	0.9	8.0	278.3
Employment (fte)									
Direct									
<i>On-farm</i>	382	97	115	560	75	73	21	42	1,365
<i>Downstream</i>	47	82	16	257	1	6	2	0	411
Total Direct	429	179	131	817	76	79	23	42	1,776
Total Flow-on	750	243	55	442	112	33	3	27	1,665
Total	1,179	422	185	1,259	189	112	26	69	3,441
Household income (\$m)									
Direct									
<i>On-farm</i>	14.6	3.9	1.7	13.6	3.0	2.0	0.0	1.7	40.5
<i>Downstream</i>	3.0	3.9	0.7	11.1	0.1	0.3	0.1	0.0	19.2
Total Direct	17.6	7.8	2.4	24.7	3.1	2.3	0.1	1.7	59.7
Total Flow-on	44.6	13.5	2.4	25.4	5.7	1.8	0.2	1.5	95.1
Total	62.2	21.2	4.8	50.1	8.8	4.1	0.3	3.2	154.8

Note: Totals may contain rounding errors.

^a Other aquaculture is comprised predominantly algae and brine shrimp production.

^b Note there is double counting in the total output impact.

Source: EconSearch analysis.

Direct employment⁵ was estimated to be almost 1,800 fte (1,365 on-farm and 411 in downstream activities) in 2009/10 with almost 1,700 flow-on jobs, giving total employment of 3,441 fte (Table E.2). Approximately 71 per cent of these jobs were generated in regional South Australia (Table E.3).

⁵ 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 household income⁶ was estimated to be around \$60m in 2009/10 and flow-on income approximately \$95m, giving a total household income impact of approximately \$155m (Table E.2). Approximately 62 per cent of the household income impact was generated in regional South Australia (Table E.3).

In regional areas, the impact of the aquaculture industry in 2009/10 was concentrated in the Eyre Peninsula region, reflecting the dominance of tuna farming in the total (Table E.3).

Table E.3 The total regional economic impact (direct and flow-on) of aquaculture in South Australia, 2009/10

	Output ^a		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
West Coast	30.5	7%	16.9	9%	408	17%	9.3	10%
Eyre Peninsula	374.9	88%	155.6	85%	1,820	74%	80.6	84%
Yorke Peninsula to KI	17.5	4%	8.5	5%	180	7%	4.6	5%
Murraylands and SE	3.9	1%	2.1	1%	45	2%	1.4	1%
Total Regional Impact	426.8	100%	183.0	100%	2,453	100%	95.8	100%
Regional Impact as a Proportion of Total	-	68%	-	66%	-	71%	-	62%

Note: Totals may contain rounding errors.

^a Note there is double counting in the total output impact.

Source: EconSearch analysis.

Projections for each sector in terms of production and on-farm employment over the three year period, 2010/11 to 2012/13, are summarised in Table E.4. These projections were based on PIRSA Fisheries and Aquaculture's 2009/10 Production Return responses and, where possible, validation with industry representatives and other sources of information.

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 2010/11 to 2012/13 have been imputed from the production projections. These GVP projections are presented in Table E.5.

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 any growth in tuna and abalone production would be exported to interstate and overseas markets (i.e. low and high estimates of GVP identical) and 75 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 2009/10 levels).

⁶ 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.

Table E.4 Projected growth in South Australian aquaculture production and employment, 2010/11 to 2012/13 ^a

	Estimated cumulative change relative to 2009/10					
	Production			On-farm employment		
	2010/11	2011/12	2012/13	2010/11	2011/12	2012/13
Southern Bluefin Tuna	-10%	10%	20%	-5%	10%	15%
Marine Finfish ^b	0%	0%	0%	0%	0%	0%
Oysters	9%	10%	11%	5%	7%	14%
Mussels	12%	31%	36%	8%	14%	15%
Abalone	6%	12%	20%	19%	20%	22%
Freshwater Finfish ^c	7%	8%	9%	1%	1%	1%
Marron and Yabbies	11%	13%	14%	2%	3%	13%
Other ^d	10%	20%	20%	0%	16%	14%

^a Based on an analysis of PIRSA Fisheries and Aquaculture's 2009/10 Production Return responses. The plausibility of the projections for tuna, oysters and abalone have been validated or modified by industry representatives (pers. comm.).

^b Predominantly Yellowtail Kingfish and Mulloway production.

^c Predominantly Barramundi and Rainbow Trout production.

^d Predominantly algae and brine shrimp production.

Table E.5 Projected growth in South Australian aquaculture value of production, 2010/11 to 2012/13 ^a

	Actual GVP (\$m)	Low GVP Forecast (\$m)			High GVP Forecast (\$m)		
	2009/10	2010/11	2011/12	2012/13	2010/11	2011/12	2012/13
Southern Bluefin Tuna	102.2	92.0	112.4	122.6	92.0	112.4	122.6
Marine Finfish	27.1	27.1	27.1	27.1	27.1	27.1	27.1
Oysters	35.5	38.1	38.4	38.7	38.5	38.9	39.2
Mussels	2.5	2.8	3.2	3.3	2.8	3.3	3.4
Abalone	10.3	11.0	11.5	12.4	11.0	11.5	12.4
Freshwater Finfish	4.9	5.2	5.2	5.3	5.2	5.3	5.3
Marron and Yabbies	0.6	0.7	0.7	0.7	0.7	0.7	0.7
Other	10.3	11.1	12.0	12.0	11.3	12.3	12.3
Total	193.5	188.0	210.6	222.1	188.6	211.6	223.2

Note: Totals may contain rounding errors.

^a All estimates are in 2010 dollars.

1. Introduction

The aim of this study was to estimate the economic impact of aquaculture activity in South Australia in 2009/10. The results reported here update and expand on those provided in previous studies (EconSearch 1997, 1998, 1999, 2001, 2002a, 2003, 2004, 2006a, 2006b, 2007, 2008, 2009a and 2010). Estimates of the economic impact of aquaculture activity in South Australia in 2009/10 are provided for the following aquaculture sectors:

- tuna (Southern Bluefin Tuna, *Thunnus maccoyii*);
- marine finfish (predominantly Yellowtail Kingfish, *Seriola lalandi* and Mulloway, *Argyrosomus japonicus*);
- oysters (predominantly Pacific Oyster, *Crassostrea gigas* and Native Oyster, *Ostrea angasi*);
- mussels (Blue Mussel, *Mytilus galloprovincialis*);
- abalone (predominantly *Greenlip Abalone*);
- freshwater finfish (predominantly Barramundi, *Lates calcarifer* and Rainbow Trout, *Oncorhynchus mykiss*);
- marron (*Cherax tenuimanus*) and yabbies (*Cherax destructor*); and
- other aquaculture (predominantly algae Beta carotene, *Dunaliella salina* and Brine Shrimp, *Artemia spp.*).

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

- West Coast (WA border to Elliston including Wuddina);
- Eyre Peninsula (Lower Eyre Peninsula to Port Augusta, including Kimba);
- Yorke Peninsula to Kangaroo Island (covers Flinders Ranges, Yorke and Mid North, Barossa, Adelaide, Adelaide Hills, Fleurieu and KI); and
- Murraylands and South East (Riverland, Murraylands and Limestone Coast).

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 8: The economic impacts of each aquaculture sector are presented at the state and regional levels.
- Section 9: Other facets of regional economic development associated with aquaculture activity in SA are presented.
- Section 10: Impacts over time.

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, farming equipment, 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 Department of Trade and Economic Development (EconSearch 2009b and 2009c). 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 2009/10) and for the period 2001/02 to 2008/09 (EconSearch 2003, 2004, 2006a, 2006b, 2007, 2008, 2009a and 2010) are consistent with the 'message' and method in:

- PIRSA's *Food for the Future* value chain analysis 2009/10 (Seafood Scorecard); and
- South Australian Seafood Industry Federation Inc. (2009) *South Australian Seafood Industry Food Plan 2010-2015*.

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

- the farm gate value of production⁷;
- 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 were qualitatively assessed. The table below illustrates the change in scope of the economic impact assessment.

⁷ For tuna this will include the net value of farm gate production and the gross value of tuna fishing.

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 to 2000/01 (EconSearch 1997, 1998, 1999, 2001 and 2002a).

^b For the years 2001/02 to 2008/09 (EconSearch 2003, 2004, 2006a, 2006b, 2007, 2008, 2009a and 2010).

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 product⁸;
- 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 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.

⁸ 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).

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, 2009/10, as outlined above⁹.

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

Value of output and production estimates for South Australian aquaculture for 2009/10 were based on PIRSA Fisheries and Aquaculture's *2009/10 Production Returns*¹⁰. Representative cost structures and other relevant information for enterprises operating in individual sectors of the aquaculture and fishing industries¹¹ were updated from 2002/03 to 2009/10 using a range of indicators, including data derived from the *Production Returns*. 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
- 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.

⁹ Note that direct output equates to the PIRSA Seafood Scorecard estimate of net food revenue.

¹⁰ EconSearch coordinated the compilation, analysis and validation of these data.

¹¹ These original data were obtained from consultation with key industry contacts in 2003 (EconSearch 2003) and from EconSearch (2002b and 2002c).

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).

3. Aquaculture Production and Employment in South Australia

3.1 Production and Value of Production

Estimates of South Australian tuna, oyster and other aquaculture production and value of production for the years 2008/09 and 2009/10 are provided in Table 3.1. Some description of these data is provided below. Similar data for the period 1995/96 to 2008/09 are provided in Appendix 3 of the report.

Table 3.1 Aquaculture production and value of production, South Australia, 2008/09 and 2009/10

	Weight ('000kg)			Value (\$m)		
	2008/09	2009/10	Change	2008/09	2009/10	Change
Southern Bluefin Tuna	8,786	7,284	-17%	157.777	102.175	-35%
Marine Finfish	3,382	3,757	11%	29.209	27.133	-7%
Oysters						
adult ^a	5,848	6,123	5%	32.231	35.027	9%
spat	-	-	-	0.320	0.444	39%
Mussels	1,340	1,343	0%	2.519	2.530	0%
Abalone	227	286	26%	8.121	10.341	27%
Freshwater Finfish	424	415	-2%	4.501	4.897	9%
Marron and Yabbies	23	23	2%	0.606	0.645	6%
Other ^b	1,402	1,319	-6%	10.892	10.260	-6%
Total	21,431	20,549	-4%	246.175	193.452	-21%

Note: Totals may contain rounding errors.

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

^b Other aquaculture production in 2009/10 was comprised predominantly of algae and brine shrimp production.

Source: PIRSA Fisheries and Aquaculture *2009/10 Production Returns*.

Between 2008/09 and 2009/10 the following changes in production and value of production are apparent.

- The value of tuna farm output decreased by 35 per cent as a result of a 17 per cent decrease in the volume of tuna farm output and 22 per cent decrease in the per unit value of farmed tuna. The supply reduction in 2009/10 was due to the quota cut for SBT and increased farm mortalities. The fall in price was largely due to the increase in stocks that was built up under pre-GFC prices higher than the market was subsequently willing to pay. The reluctance of Japanese traders to write down the value of the stock and because of the effect on demand from the GFC held stocks at higher than normal levels which had a dampening impact on price.
- The value of marine finfish production decreased by 7 per cent as a result of a 16 per cent decrease in the per unit value of marine finfish and despite an 11 per cent increase in the volume of marine finfish production. This was the

result of a conscious decision by the major producer in the sector to increase the volume of fish and put them on the market at a reduced price.

- The value of adult oyster production increased by 9 per cent as a result of a 5 per cent increase in the volume of production and a 4 per cent increase in the per unit value of adult oyster production. The value of spat production increased by 39 per cent between 2008/09 and 2009/10.
- There was no significant change in the value of mussels production between 2008/09 and 2009/10, due to a reduced availability in spat for the sector (Andy Dyer, South Australian Mussel Growers Association President, 3 June 2011, pers. comm.).
- The value of abalone production increased by 27 per cent as a result of a 26 per cent increase in the volume of abalone production and 1 per cent increase in the per unit value of abalone. The increased volume was largely due to an increase in productivity per square unit area (Tom Hyde, Manager of SAM Abalone Pty Ltd and Shane McLidden, 3 June 2011, pers. comm.).
- The value of freshwater finfish production increased by 9 per cent as a result of an 11 per cent increase in the per unit value of freshwater finfish and despite a 2 per cent decrease in the volume of freshwater finfish production. Fish volumes decreased in SA over this time period because there was a problem with supply of fingerlings into SA early in 2009/10, however due to a major loss for a significant competitor of freshwater fish in Victoria, the value of SA fish increased (Steven Mawer, 6 June 2011, pers. comm.).
- The value of marron/yabbies production increased by 6 per cent as a result of a 2 per cent increase in the volume of marron/yabbies production and 5 per cent increase in the per unit value of marron/yabbies. A decline in the volume of the lesser valued yabby in 2009/10 has led to an overall increase in the per unit value for this sector (John Luckens, 6 June 2011, pers. comm.).
- The value of other aquaculture production decreased by 6 per cent as a result of a 6 per cent decrease in the volume of other aquaculture production. The average per unit value of other aquaculture remained unchanged.

A breakdown of aquaculture value of production by region is detailed in Tables 3.2 and 3.3. Similar data for aquaculture production are detailed in Tables 3.4 and 3.5. Activity in the tuna, marine finfish, mussels and other aquaculture sectors is concentrated in the Eyre Peninsula region. The production of other aquaculture species (i.e. oysters, abalone, freshwater finfish and marron/yabbies) is more widely distributed across SA.

There are only minor differences in the regional distribution by species of production and value of production. For example, The Eyre Peninsula region was estimated to produce 52 per cent of abalone by volume but 59 per cent by value (Tables 3.3 and 3.5).

Table 3.2 Aquaculture value of production by sector and region, South Australia, 2009/10 (\$'000)

	West Coast	Eyre Peninsula	Yorke Peninsula to KI	Murraylands and South East	All regions
Southern Bluefin Tuna	0	102,175	0	0	102,175
Marine Finfish	1,998	25,135	0	0	27,133
Oysters ^a	12,504	22,374	593	0	35,471
Mussels	0	2,283	247	0	2,530
Abalone ^a	483	6,050	3,808	0	10,341
Freshwater Finfish ^a	0	4	2,716	2,177	4,897
Marron and Yabbies	0	112	512	21	645
Other	0	9,718	542	0	10,260
Total	14,985	167,851	8,419	2,198	193,452

^a Includes the value of local spat and fingerling sales.

Source: PIRSA Fisheries and Aquaculture 2009/10 Production Returns.

Table 3.3 Proportion of aquaculture value of production by region, South Australia, 2009/10

	West Coast	Eyre Peninsula	Yorke Peninsula to KI	Murraylands and South East	All regions
Southern Bluefin Tuna	0%	100%	0%	0%	100%
Marine Finfish	7%	93%	0%	0%	100%
Oysters ^a	35%	63%	2%	0%	100%
Mussels	0%	90%	10%	0%	100%
Abalone ^a	5%	59%	37%	0%	100%
Freshwater Finfish ^a	0%	0%	55%	44%	100%
Marron and Yabbies	0%	17%	79%	3%	100%
Other	0%	95%	5%	0%	100%
Total	8%	87%	4%	1%	100%

^a Includes the value of local spat and fingerling sales.

Source: PIRSA Fisheries and Aquaculture 2009/10 Production Returns.

Table 3.4 Aquaculture production by sector and region, South Australia, 2009/10 ('000 kg)

	West Coast	Eyre Peninsula	Yorke Peninsula to KI	Murraylands and South East	All regions
Southern Bluefin Tuna	0	7,284	0	0	7,284
Marine Finfish	200	3,557	0	0	3,757
Oysters	2,231	3,827	65	0	6,123
Mussels	0	1,213	130	0	1,343
Abalone	14	150	122	0	286
Freshwater Finfish	0	0	207	208	415
Marron and Yabbies	0	4	18	1	23
Other	0	1,299	19	0	1,319
Total	2,445	17,334	562	209	20,549

Source: PIRSA Fisheries and Aquaculture 2009/10 Production Returns.

Table 3.5 Proportion of aquaculture production by region, South Australia, 2009/10

	West Coast	Eyre Peninsula	Yorke Peninsula to KI	Murraylands and South East	All regions
Southern Bluefin Tuna	0%	100%	0%	0%	100%
Marine Finfish	5%	95%	0%	0%	100%
Oysters	36%	63%	1%	0%	100%
Mussels	0%	90%	10%	0%	100%
Abalone	5%	52%	43%	0%	100%
Freshwater Finfish	0%	0%	50%	50%	100%
Marron and Yabbies	0%	17%	79%	4%	100%
Other	0%	99%	1%	0%	100%
Total	12%	84%	3%	1%	100%

Source: PIRSA Fisheries and Aquaculture 2009/10 Production Returns.

3.2 Employment in South Australian Aquaculture

Estimates of direct employment in South Australian aquaculture for the years 2008/09 and 2009/10 are provided in Table 3.6. Consistent with previous analyses undertaken by EconSearch, these estimates include employment on inactive, undeveloped and underdeveloped leases. As for the production data, these employment estimates have been derived from PIRSA Fisheries and Aquaculture's *2009/10 Production Returns*.

These data should be interpreted with caution as they are estimates. PIRSA Fisheries and Aquaculture will continue to refine the process currently used to prepare these estimates.

Table 3.6 Direct employment by aquaculture sector, South Australia, 2008/09 and 2009/10

	2008/09	2009/10	
	Total (fte)	Total (fte)	Change from 2008/09
Southern Bluefin Tuna	348	382	10%
Marine Finfish	108	97	-10%
Oysters	529	560	6%
Mussels ^a	114	115	0%
Abalone	64	75	18%
Freshwater Finfish	73	73	0%
Marron and Yabbies	34	21	-40%
Other ^b	44	42	-4%
Total	1,314	1,364	4%

Note: Totals may contain rounding errors.

^a In order to remove apparent double counting of employment in the mussels sector, employees attached to licences without any recorded production were not included in the analysis (PIRSA Fisheries and Aquaculture, pers. comm.).

^b 'Other aquaculture' includes land-based and miscellaneous licences which cannot be allocated to specific sectors.

Source: PIRSA Fisheries and Aquaculture *2009/10 Production Returns*.

A breakdown of direct employment in SA aquaculture by region is detailed in Tables 3.7 and 3.8. There are some notable differences in the recorded regional distribution of production and employment. For example, The West Coast region was estimated to produce 5 per cent of marine finfish and abalone by volume but was responsible for 44 per cent of marine finfish employment and 36 per cent of abalone employment (Table 3.5 and 3.8). These differences may reflect a large proportion of, as yet, unproductive leases in this region (i.e. currently under development).

Table 3.7 Direct employment by aquaculture sector and region, South Australia, 2009/10 (fte)

	West Coast	Eyre Peninsula	Yorke Peninsula to KI	Murraylands and South East	All regions
Southern Bluefin Tuna	0	382	0	0	382
Marine Finfish	42	54	1	0	97
Oysters	242	282	36	0	560
Mussels	0	110	5	0	115
Abalone	27	27	22	0	75
Freshwater Finfish	0	3	37	33	73
Marron and Yabbies	0	2	17	1	21
Other	0	20	17	5	42
Total	311	879	134	39	1,364

Source: PIRSA Fisheries and Aquaculture 2009/10 Production Returns.

Table 3.8 Proportion of direct employment by region, South Australia, 2009/10

	West Coast	Eyre Peninsula	Yorke Peninsula to KI	Murraylands and South East	All regions
Southern Bluefin Tuna	0%	100%	0%	0%	100%
Marine Finfish	44%	56%	1%	0%	100%
Oysters	43%	50%	6%	0%	100%
Mussels	0%	96%	4%	0%	100%
Abalone	36%	35%	28%	0%	100%
Freshwater Finfish	0%	4%	51%	45%	100%
Marron and Yabbies	0%	10%	84%	6%	100%
Other	0%	47%	41%	12%	100%
Total	23%	64%	10%	3%	100%

Source: PIRSA Fisheries and Aquaculture 2009/10 Production Returns.

3.3 Projected Growth in Production and Employment

Aquaculture licence holders are required to provide projections of their production and on-farm employment¹² over the three year period, 2010/11 to 2012/13. The projections from the PIRSA Fisheries and Aquaculture *2009/10 Production Returns* are summarised in Table 3.9. Where possible, these data have been validated or modified on the basis of discussions with industry representatives and other sources of information. The implied production (tonnes or '000 doz.) and on-farm employment (full-time equivalents) levels are provided in Tables 3.10 and 3.11, respectively.

The projections for each sector in 2012/13, relative to 2009/10, can be summarised as follows.

- Tuna production - modest decline in production (10 per cent) in 2010/11 before recovering to an expected increase in production of 20 per cent in 2012/13 (over 2009/10 figures). The Australian catch quota reduction of 23.7 per cent for calendar year 2010 was partially felt in the 2009/10 fiscal year and partly in 2010/11, as shown in Table 3.9. A number of factors will lead to a turnaround in the value of farmed production in 2011/12 and 2012/13 including:
 - the recovery in Japanese demand, increasing demand from elsewhere (e.g. Korea, China), promotion of Australian product and improving Australian quality. These factors will all have a positive impact on price providing an incentive for increased supply.
 - Australian industry and researchers have successfully adopted strategies to reduce in-farm mortalities. These strategies, already effective in 2011 and expected to be fully adopted by industry in 2012, not only reduce mortality but also result in better fish growth rates.
 - From 2011 the SBT quota will largely be set by a Management Procedure rather than the traditional Operating Model. This change could see, from 2013, a recovery of the quota lost in 2010.
- Tuna employment - modest decline in on-farm employment (5 per cent) in 2010/11 before recovering to expected growth in employment of around 15 per cent in 2012/13. The total effect of the quota cut was a reduction in employment of around 10 per cent, approximately half of which is expected to be felt in 2010/11. A number of factors will lead to a turnaround in employment in 2011/12 and 2012/13 including:
 - A shift from on-farm gilling and gutting and passing direct to freezer boats (accounting for around 80 per cent of frozen production up prior to 2010) to on-shore processing and shipping to Japan by container (accounting for around 65 per cent of frozen production from 2010).
 - In 2010, the inaugural aquaculture award was introduced which has shifted the incentive to employ permanents rather than casual employees which has increased FTE's.
 - The reduction in mortalities will not increase on-farm employment but will increase jobs in on-shore processing, sales, etc.

¹² Note that on-farm employment includes employment on inactive, undeveloped and underdeveloped leases.

- Marine finfish – unlikely to be any significant growth in production or employment over the forecast period (Clifford Ashby, CEO, Clean Seas Tuna Ltd, 6 June 2011, pers. comm.).
- Oysters - consistent with production return data, modest growth in production (11 per cent) and employment (14 per cent) over the three years to 2012/13 is expected in the Oyster industry (Steve Bowley, Chairman, South Australian Oyster Research Council, 1 June, 2011, pers. comm.).
- Mussels - consistent with production return data, significant growth in production (36 per cent) and modest growth in employment (15 per cent) is expected by this sector (Andy Dyer, South Australian Mussel Growers Association President, 3 June 2011, pers. comm.).

Table 3.9 Projected growth in South Australian aquaculture production and on-farm employment, 2010/11 to 2012/13 (percentage change) ^a

	Estimated cumulative change relative to 2009/10					
	Production			On-farm employment		
	2010/11	2011/12	2012/13	2010/11	2011/12	2012/13
Southern Bluefin Tuna	-10%	10%	20%	-5%	10%	15%
Marine Finfish ^b	0%	0%	0%	0%	0%	0%
Oysters	9%	10%	11%	5%	7%	14%
Mussels	12%	31%	36%	8%	14%	15%
Abalone	6%	12%	20%	19%	20%	22%
Freshwater Finfish ^c	7%	8%	9%	1%	1%	1%
Marron and Yabbies	11%	13%	14%	2%	3%	13%
Other ^d	10%	20%	20%	0%	16%	14%

^a Based on an analysis of PIRSA Fisheries and Aquaculture's 2009/10 *Production Return* responses. The plausibility of the projections for tuna, oysters and abalone have been validated or modified by industry representatives (pers. comm.).

^b Predominantly Yellowtail Kingfish and Mulloway production.

^c Predominantly Barramundi and Rainbow Trout production.

^d Predominantly algae and brine shrimp production.

- Abalone - modest growth in production (20 per cent) and employment (22 per cent). The production projection for SA abalone (average annual growth rate of approximately 6 per cent/annum over the three year period 2009/10 to 2012/13, see Table 3.10) is conservative when compared with projections for the sector nationally in FRDC (2010)¹³.
- Freshwater finfish - modest growth in production (9 per cent) and low growth in employment (1 per cent).
- Marron and yabbies - modest growth in production (14 per cent) and employment (13 per cent).
- Other aquaculture - modest growth in production (20 per cent) and employment (14 per cent).

Table 3.10 Projected growth in South Australian aquaculture production, 2010/11 to 2012/13 (t or '000 doz.)

	Actual Production ^a	Forecast Production ^b			Av. annual growth rate
	2009/10	2010/11	2011/12	2012/13	
Southern Bluefin Tuna (t)	7,284	6,555	8,012	8,740	6.3%
Marine Finfish (t)	3,757	3,757	3,757	3,757	0.0%
Oysters ('000 doz.)	6,123	6,674	6,746	6,799	3.6%
Mussels (t)	1,343	1,504	1,758	1,823	10.7%
Abalone (t)	286	304	319	343	6.3%
Freshwater Finfish (t)	415	444	448	452	2.9%
Marron and Yabbies (t)	23	26	26	26	4.5%
Other (t)	1,319	1,447	1,579	1,580	6.2%
Total	20,549	20,709	22,645	23,520	4.6%

Note: Totals may contain rounding errors.

^a See Table 3.1.

^b Based on the projections summarised in Table 3.9.

Source: PIRSA Fisheries and Aquaculture and EconSearch analysis.

¹³ Fisheries Research and Development Corporation (2010) forecasts a growth rate for the abalone sector of 17 per cent/annum over the period 2008/09 to 2014/15 (Figure 48).

Table 3.11 Projected growth in South Australian aquaculture on-farm employment, 2010/11 to 2012/13 (full-time equivalents)

	Actual Employment (fte) ^a	Forecast Employment (fte) ^b			Av. annual growth rate
	2009/10	2010/11	2011/12	2012/13	
Southern Bluefin Tuna	382	363	420	439	4.8%
Marine Finfish	97	97	97	97	0.0%
Oysters	560	590	598	640	4.6%
Mussels	115	125	131	132	4.8%
Abalone	75	89	90	92	6.9%
Freshwater Finfish	73	74	74	74	0.4%
Marron and Yabbies	21	21	22	24	4.1%
Other	42	42	49	48	4.5%
Total	1,365	1,401	1,481	1,546	4.2%

Note: Totals may contain rounding errors.

^a Derived from PIRSA Fisheries and Aquaculture's 2009/10 Production Returns responses. Includes employment on inactive, undeveloped and underdeveloped leases.

^b Based on the projections summarised in Table 3.9.

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 3.9) 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 per cent change in the quantity supplied. This can, in turn, be approximated using the reciprocal of the price elasticity of demand¹⁴.

Short-run elasticities of demand for primary products are generally relatively price inelastic¹⁵. In the longer run, however, with opportunities for exports and substitution 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-

¹⁴ The percentage change in the quantity demanded resulting from a 1 per cent increase in price (Pindyck and Rubinfeld 1995).

¹⁵ As used in the Monash General Equilibrium Model of the Australian economy, for example (Glyn Wittwer, Centre of Policy Studies, Monash University, pers. comm.).

run price elasticity of demand for aquaculture products is -2.0 and the reciprocal, the price flexibility coefficient, is -0.5 ¹⁶.

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 75 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 2010/11 to 2012/13. These projections are presented in Table 3.12.

Table 3.12 Projected growth in South Australian aquaculture value of production, 2010/11 to 2012/13^a

	Actual GVP (\$m)	Low GVP Forecast (\$m) ^b			High GVP Forecast (\$m) ^c		
	2009/10	2010/11	2011/12	2012/13	2010/11	2011/12	2012/13
Southern Bluefin Tuna	102.2	92.0	112.4	122.6	92.0	112.4	122.6
Marine Finfish ^d	27.1	27.1	27.1	27.1	27.1	27.1	27.1
Oysters	35.5	38.1	38.4	38.7	38.5	38.9	39.2
Mussels	2.5	2.8	3.2	3.3	2.8	3.3	3.4
Abalone	10.3	11.0	11.5	12.4	11.0	11.5	12.4
Freshwater Finfish	4.9	5.2	5.2	5.3	5.2	5.3	5.3
Marron and Yabbies	0.6	0.7	0.7	0.7	0.7	0.7	0.7
Other	10.3	11.1	12.0	12.0	11.3	12.3	12.3
Total ^e	193.5	188.0	210.6	222.1	188.6	211.6	223.2

^a All estimates of gross value of production (GVP) are in 2010 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 75 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 2009/10 levels).

^d It was assumed, for the purpose of this analysis, that the default projections for marine finfish are zero growth in production and employment (see Table 3.9).

^e Totals may contain rounding errors.

¹⁶ That is, there would be a 0.5 per cent decrease in price given a one per cent increase in the quantity supplied.

3.4 Other Indicators from the Production Returns

It was possible to derive a range of other data from the *2009/10 Production Returns*. Estimates are provided below for the following indicators for SA for 2009/10.

- Proportion of aquaculture production, value of production and employment by sector (Table 3.13).
- The number of aquaculture licences by sector and type (Table 3.14).
- Aquaculture spat and fingerling introductions and sales (Table 3.15)

Table 3.13 Proportion of aquaculture production, value of production and employment by sector, South Australia, 2009/10

	Weight	Value	Direct employment
Southern Bluefin Tuna	35%	53%	28%
Marine Finfish	18%	14%	7%
Oysters	30%	18%	41%
Mussels	7%	1%	8%
Abalone	1%	5%	6%
Freshwater Finfish	2%	3%	5%
Marron and Yabbies	0%	0%	2%
Other	6%	5%	3%
Total	100%	100%	100%

Source: PIRSA Fisheries and Aquaculture *2009/10 Production Returns*.

Table 3.14 Number of aquaculture licences by sector and response type, South Australia, 2009/10

	No. licences			Total licences	
	Production reported	No production reported	Superseded, cancelled, expired, etc.	no.	%
Southern Bluefin Tuna	36	4	0	40	6%
Marine Finfish	29	11	0	40	6%
Oysters	283	55	7	345	53%
Mussels	30	14	3	47	7%
Abalone ^a	12	13	5	30	5%
Freshwater Finfish	19	3	0	22	3%
Marron and Yabbies	17	0	0	17	3%
Other ^b	8	104	0	112	17%
Total	434	204	15	653	100%
By response type	66%	31%	2%	100%	-

^a Of the 12 Abalone licences with production reported, 5 are marine-based and 7 are land-based.

^b Other licences for which no production was reported (104 in total) were either land-based or miscellaneous licences held by individuals, companies, schools and research organisations.

Source: PIRSA Fisheries and Aquaculture *2009/10 Production Returns*.

Table 3.15 Aquaculture spat and fingerling introductions and sales, South Australia, 2009/10

	All licence holders		Spat/fingerling sales		
	No. spat/fingerlings introduced ('000)	Proportion sourced from SA	No. spat/fingerlings sold ('000)	Value (\$'000)	No. of respondents
Southern Bluefin Tuna ^a	190	100%	-	-	-
Marine Finfish ^b	633	100%	-	-	-
Oysters ^c	151,833	11%	19,500	444	2
Mussels ^d	43,700	100%	-	-	-
Abalone ^e	7,888	100%	2,581	831	2
Freshwater Finfish	1,357	72%	977	453	4
Marron and Yabbies ^f	21,070	5%	-	-	-
Other ^g	25	0%	-	-	-
Total	226,696		23,058	1,728	8

^a Wild caught, on-grown product sourced from Commonwealth waters off SA.

^b Self-produced, on-grown fingerlings.

^c Excludes stock sourced from other producers in SA for on-growing.

^d Wild spat caught on-site.

^e Includes self-produced, on-grown spat.

^f There was a poor response rate in the production returns to spat/fingerlings introductions for these species.

^g Other aquaculture is dominated by algae and brine production for which juvenile introduction is not reported or not relevant.

Source: PIRSA Fisheries and Aquaculture 2009/10 Production Returns.

3.5 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 53 per cent of the state's gross value of aquaculture production in 2009/10. The other two main sectors are oysters (18 per cent) and marine finfish (14 per cent) (Table 3.16). The state's total value of seafood production (landed) in 2009/10 was approximately \$396 million. Of this, tuna farming contributed approximately 26 per cent and aquaculture as a whole, 49 per cent.

Table 3.16 Value of aquaculture production and wild fisheries catch, South Australia, 2009/10

	Production or catch ('000kg)	Value of production or catch (\$m)	Contribution to aquaculture value of production	Contribution to total seafood value of production or catch
Aquaculture				
Southern Bluefin Tuna	7,284	102.2	52.8%	25.8%
Marine Finfish	3,757	27.1	14.0%	6.9%
Oysters	6,123	35.5	18.3%	9.0%
Mussels	1,343	2.5	1.3%	0.6%
Abalone	286	10.3	5.3%	2.6%
Freshwater Finfish	415	4.9	2.5%	1.2%
Marron and Yabbies	23	0.6	0.3%	0.2%
Other ^a	1,319	10.3	5.3%	2.6%
Total Aquaculture	20,549	193.5	100.0%	48.9%
Wild Catch Fisheries ^b				
Rock Lobster	1,642	86.4	-	21.8%
Abalone	855	28.1	-	7.1%
Prawns	2,702	31.5	-	8.0%
Sardines	36,573	23.0	-	5.8%
Other Marine Fisheries	3,893	27.3	-	6.9%
Inland Water Fisheries	1,916	5.7	-	1.4%
Total Wild Catch	47,581	202.1	-	51.1%
Total Seafood	68,130	395.6	-	100.0%

Note: Totals may contain rounding errors.

^a Other aquaculture production is comprised predominantly of algae and brine shrimp production.

^b Excludes catch from the Commonwealth managed fisheries and the charter boat fishery. SARDI Aquatic Sciences estimates.

Source: SARDI Aquatic Sciences and PIRSA Fisheries and Aquaculture *2009/10 Production Returns*.

4. The Economic Impact of Aquaculture in South Australia, 2009/10

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 2009/10 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, 2009/10

Estimates of the economic impact generated by the tuna farming industry in SA on a sector-by-sector basis for 2009/10 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, 2009/10

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Tuna farming	102.2	35%	14.7	12%	382	32%	14.6	23%
Processing	11.3	4%	3.6	3%	40	3%	2.5	4%
Transport	2.0	1%	0.9	1%	7	1%	0.5	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%
<i>Total Direct</i>	<i>115.4</i>	<i>40%</i>	<i>19.2</i>	<i>16%</i>	<i>429</i>	<i>36%</i>	<i>17.6</i>	<i>28%</i>
Flow-on effects								
Tuna fishing	37.4	13%	30.2	25%	168	14%	6.8	11%
Property and business serv.	24.6	9%	15.9	13%	64	5%	5.2	8%
Manufacturing	22.2	8%	7.2	6%	78	7%	5.0	8%
Trade	19.3	7%	9.1	8%	154	13%	6.3	10%
Sardines	21.9	8%	12.5	10%	46	4%	6.7	11%
Transport	7.8	3%	3.4	3%	29	2%	1.8	3%
Finance	9.5	3%	5.9	5%	32	3%	3.0	5%
Other Sectors	30.1	10%	16.0	13%	179	15%	9.9	16%
<i>Total Flow-on</i>	<i>172.7</i>	<i>60%</i>	<i>100.1</i>	<i>84%</i>	<i>750</i>	<i>64%</i>	<i>44.6</i>	<i>72%</i>
Total ^a	288.1	100%	119.3	100%	1,179	100%	62.2	100%
Total/Direct	2.50		6.21		2.75		3.54	

Note: Totals may contain rounding errors.

^a Note there is double counting in the total output impact.

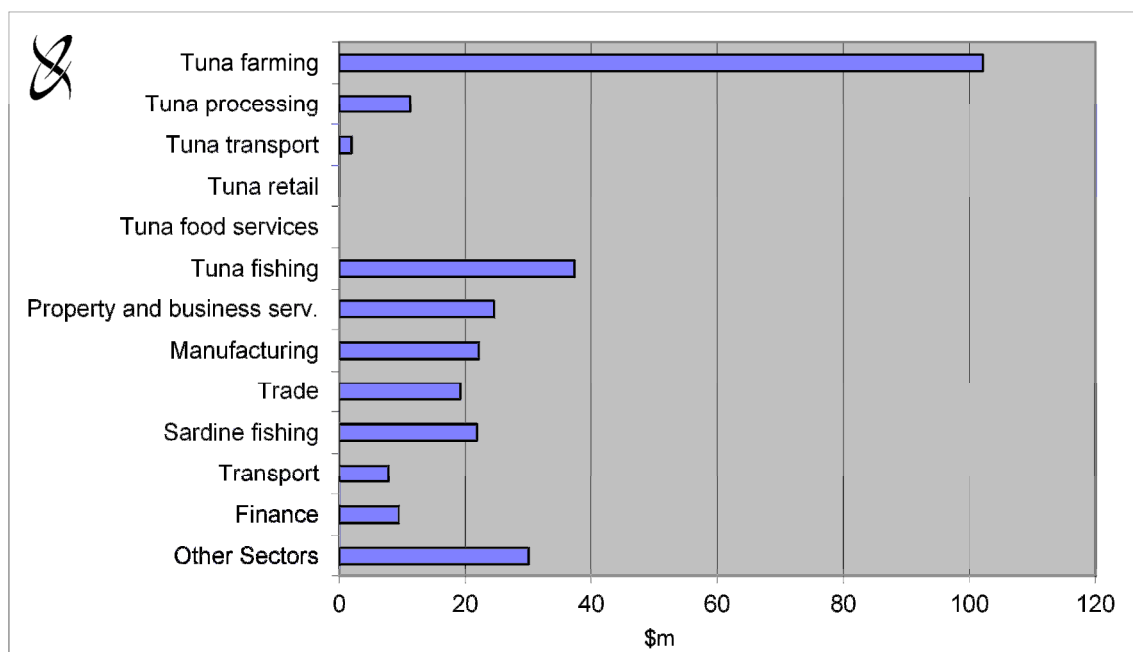
Source: EconSearch analysis.

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 \$102 million and in other sectors (processing and transport), \$13 million in 2009/10. Flow-on output in other sectors of the state economy summed to \$173 million (Table 4.1). The sectors most affected were the tuna fishing (tuna capture), 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 2.50 indicates that for each dollar of sales generated by the tuna industry (farming and downstream) there was a total of \$2.50 of output generated by businesses throughout the state, \$1.00 in the tuna industry (farming and downstream) and \$1.50 in other sectors of the economy.

Figure 4.1 Tuna farming in South Australia, output impacts by sector, 2009/10 ^a



^a Note there is double counting in the output impacts.

Source: EconSearch analysis.

Contribution to gross state product...

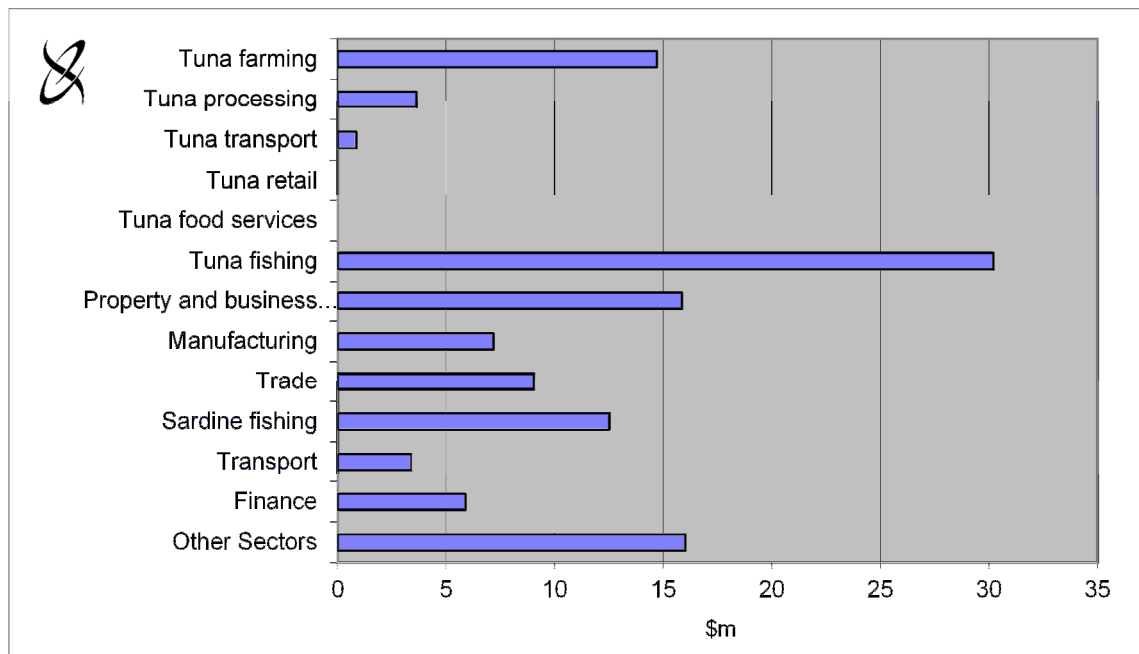
Contribution to gross state product (GSP) is calculated as the value of output less the cost of goods and services used in producing the output. GSP provides an assessment of the net contribution to state economic growth of a particular enterprise or activity¹⁷.

¹⁷ 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 \$19 million in 2009/10. Associated with this was flow-on GSP in the other sectors of the state economy of \$100 million (Table 4.1).

The flow-ons were greatest in the tuna fishing (\$30m), property and business services (\$16m), sardine fishing (\$13m), trade (\$9m), manufacturing (\$7m), and finance (\$6m) 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 \$5.21 (\$6.21 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, 2009/10



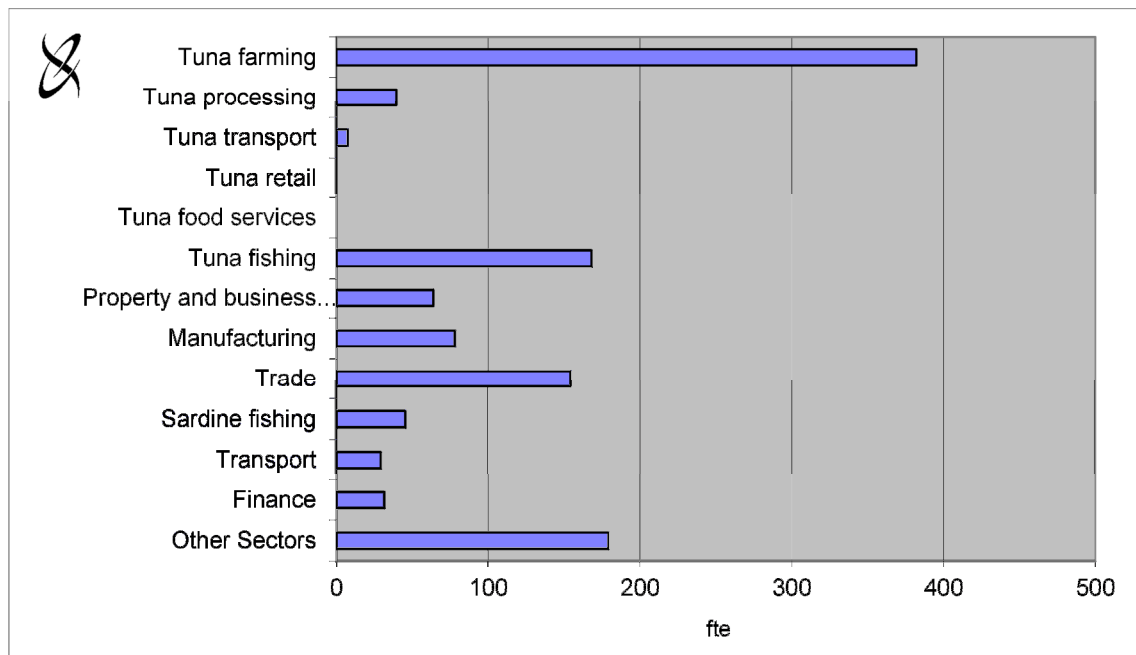
Source: EconSearch analysis.

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 380 full-time equivalents (fte) and, through associated processing and transport activities, another 47 fte in 2009/10 (Table 4.1). Flow-on business activity was estimated to generate a further 750 fte to give total employment of approximately 1,179 fte in the state. The sectors of the economy with employment flow-ons from tuna farming, processing and transport include the tuna fishing (168 fte), trade (154), manufacturing (78), property and business services (64), sardine fishing (46), finance (32) and transport (29) 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 1.75 jobs (2.75 jobs in total) in the rest of the state.

Figure 4.3 Tuna farming in South Australia, employment impacts by sector, 2009/10

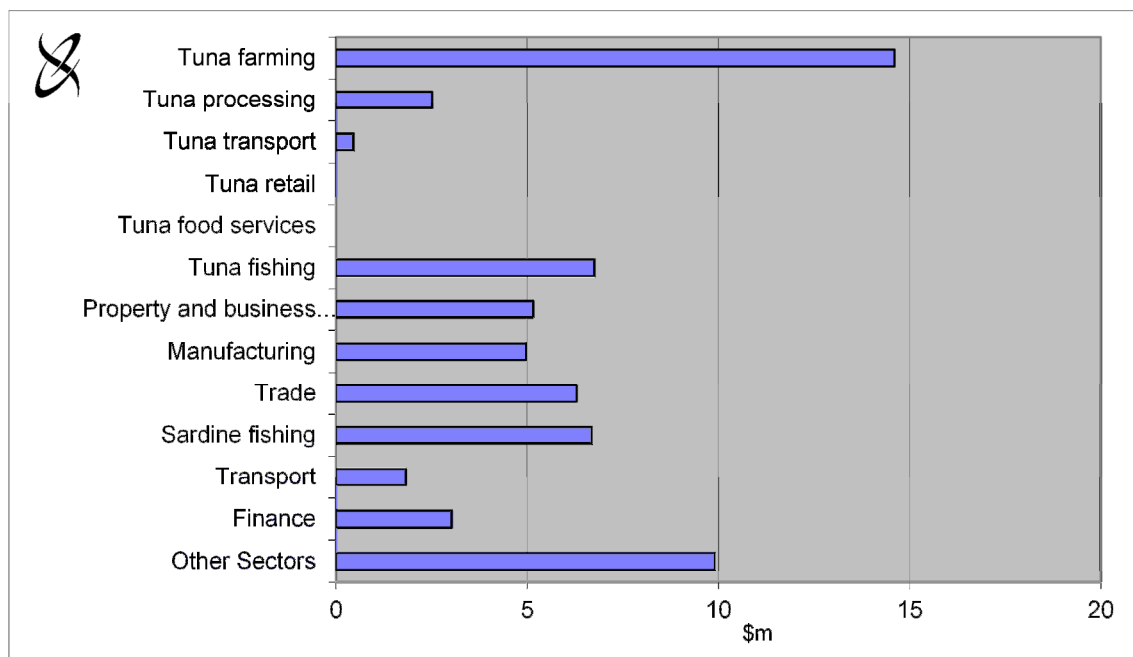


Source: EconSearch analysis.

It was estimated that personal income of approximately \$15 million was earned in the tuna farming sector in 2009/10, comprising both wages by employees and drawings by owner/operators. An additional \$7 million was earned by licence holders and crew in the tuna fishing sector and a further \$41 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 2009/10 there was an additional \$2.54 (\$3.54 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, 2009/10



Source: EconSearch analysis.

4.2 The Economic Impact of Oyster Farming in South Australia, 2009/10

Table 4.2 provides estimates of the economic impact generated by oyster farming in South Australia on a sector-by-sector basis in 2009/10. 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 \$36 million in 2009/10 while output generated in SA by associated downstream activities (processing, transport, retail and food service) summed to \$45 million. Flow-ons to other sectors of the state economy added another \$92 million in output in 2009/10. 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 2009/10, total oyster farming-related contribution to GSP in South Australia was almost \$90 million, \$25 million generated by oyster farming directly, \$18 million generated directly by downstream activities and \$46 million generated in other sectors of the state economy.

Table 4.2 The economic impact of oyster farming in South Australia, 2009/10 ^a

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Oyster farming ^b	35.5	21%	25.0	28%	560	44%	13.6	27%
Processing	7.7	4%	2.5	3%	27	2%	1.7	3%
Transport	7.2	4%	3.1	3%	27	2%	1.7	3%
Retail	0.5	0%	0.2	0%	4	0%	0.2	0%
Food services	29.2	17%	12.6	14%	199	16%	7.6	15%
<i>Total Direct</i>	<i>80.0</i>	<i>46%</i>	<i>43.5</i>	<i>48%</i>	<i>817</i>	<i>65%</i>	<i>24.7</i>	<i>49%</i>
Flow-on effects								
Property and business serv	21.0	12%	13.3	15%	57	4%	4.6	9%
Manufacturing	18.9	11%	6.1	7%	67	5%	4.2	8%
Trade	15.3	9%	7.2	8%	123	10%	5.0	10%
Transport	4.9	3%	2.1	2%	18	1%	1.2	2%
Finance	6.6	4%	4.1	5%	22	2%	2.1	4%
Other Sectors	25.5	15%	13.5	15%	156	12%	8.3	17%
<i>Total Flow-on</i>	<i>92.4</i>	<i>54%</i>	<i>46.4</i>	<i>52%</i>	<i>442</i>	<i>35%</i>	<i>25.4</i>	<i>51%</i>
Total ^c	172.4	100%	89.9	100%	1,259	100%	50.1	100%
Total/Direct	2.15		2.07		1.54		2.03	

Note: Totals may contain rounding errors.

^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.

^c Note there is double counting in the total output impact.

Source: EconSearch analysis.

Employment and household income...

In 2009/10, SA oyster farming was responsible for the direct employment of around 560 fte and downstream activities created employment for around 260 fte. Flow-on business activity was estimated to generate a further 442 fte. These jobs were concentrated in the trade (123 fte), manufacturing (67) and property and business services (57) sectors.

Personal income of approximately \$14 million was earned in the oyster farming sector and another \$11 million in downstream activities. This comprised both wages by employees and estimated drawings by owner/operators. An additional \$25 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 \$50 million.

4.3 The Economic Impact of Other Aquaculture in South Australia, 2009/10

The economic impacts of other aquaculture sectors in South Australia in 2009/10 (i.e. marine finfish, mussels, abalone, freshwater finfish, marron/yabbies and other aquaculture) are reported in Tables to 4.3 to 4.8, 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 marine finfish farming in South Australia, 2009/10

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Marine finfish farming	27.1	29%	4.3	13%	97	23%	3.9	18%
Processing	4.1	4%	1.3	4%	15	3%	0.9	4%
Transport	4.1	4%	1.8	5%	15	4%	1.0	5%
Retail	0.9	1%	0.4	1%	7	2%	0.3	1%
Food services	6.6	7%	2.8	8%	45	11%	1.7	8%
<i>Total Direct</i>	<i>42.9</i>	<i>45%</i>	<i>10.7</i>	<i>32%</i>	<i>179</i>	<i>42%</i>	<i>7.8</i>	<i>37%</i>
Flow-on effects								
Property and business serv	9.5	10%	5.9	18%	27	6%	2.1	10%
Manufacturing	8.3	9%	2.7	8%	29	7%	1.9	9%
Trade	8.5	9%	4.0	12%	68	16%	2.8	13%
Transport	2.3	2%	1.0	3%	9	2%	0.5	3%
Finance	3.1	3%	1.9	6%	10	2%	1.0	5%
Other Sectors	20.2	21%	7.6	22%	100	24%	5.2	24%
<i>Total Flow-on</i>	<i>52.0</i>	<i>55%</i>	<i>23.1</i>	<i>68%</i>	<i>243</i>	<i>58%</i>	<i>13.5</i>	<i>63%</i>
Total ^a	94.8	100%	33.8	100%	422	100%	21.2	100%
Total/Direct	2.21		3.17		2.36		2.73	

Note: Totals may contain rounding errors.

^a Note there is double counting in the total output impact.

Source: EconSearch analysis.

Table 4.4 The economic impact of mussels farming in South Australia, 2009/10

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Mussel farming	2.5	19%	1.7	24%	115	62%	1.7	35%
Processing	0.7	5%	0.2	3%	2	1%	0.2	3%
Transport	0.4	3%	0.2	3%	2	1%	0.1	2%
Retail	0.3	3%	0.2	2%	3	2%	0.1	2%
Food services	1.3	10%	0.6	8%	9	5%	0.3	7%
<i>Total Direct</i>	<i>5.3</i>	<i>40%</i>	<i>2.8</i>	<i>40%</i>	<i>131</i>	<i>71%</i>	<i>2.4</i>	<i>50%</i>
Flow-on effects								
Property and business serv	1.8	13%	1.2	17%	5	2%	0.4	8%
Manufacturing	1.5	11%	0.5	7%	5	3%	0.3	7%
Trade	1.3	10%	0.6	9%	11	6%	0.4	9%
Transport	0.4	3%	0.2	3%	2	1%	0.1	2%
Finance	0.6	4%	0.4	5%	2	1%	0.2	4%
Other Sectors	2.5	19%	1.4	20%	31	17%	1.0	20%
<i>Total Flow-on</i>	<i>8.1</i>	<i>60%</i>	<i>4.2</i>	<i>60%</i>	<i>55</i>	<i>29%</i>	<i>2.4</i>	<i>50%</i>
Total ^a	13.5	100%	7.0	100%	185	100%	4.8	100%
Total/Direct	2.53		2.49		1.42		2.00	

Note: Totals may contain rounding errors.

^a Note there is double counting in the total output impact.

Source: EconSearch analysis.

Table 4.5 The economic impact of abalone farming in South Australia, 2009/10

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects ^a								
Abalone farming	10.3	34%	3.5	27%	75	40%	3.0	34%
Processing	0.4	1%	0.1	1%	1	1%	0.1	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%
<i>Total Direct</i>	<i>10.8</i>	<i>35%</i>	<i>3.6</i>	<i>28%</i>	<i>76</i>	<i>41%</i>	<i>3.1</i>	<i>36%</i>
Flow-on effects								
Property and business serv	3.2	10%	2.1	17%	8	4%	0.6	7%
Manufacturing	2.1	7%	0.7	5%	8	4%	0.5	5%
Trade	2.3	7%	1.1	8%	18	10%	0.7	8%
Transport	0.6	2%	0.2	2%	2	1%	0.1	2%
Finance	1.0	3%	0.6	5%	3	2%	0.3	4%
Other Sectors	10.8	35%	4.4	35%	73	39%	3.4	38%
<i>Total Flow-on</i>	<i>19.9</i>	<i>65%</i>	<i>9.2</i>	<i>72%</i>	<i>112</i>	<i>59%</i>	<i>5.7</i>	<i>64%</i>
Total ^b	30.7	100%	12.8	100%	189	100%	8.8	100%
Total/Direct	2.85		3.54		2.47		2.82	

Note: Totals may contain rounding errors.

^a There are small direct effects in the transport sector.

^b Note there is double counting in the total output impact.

Source: EconSearch analysis.

Table 4.6 The economic impact of freshwater finfish farming in South Australia, 2009/10

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Freshwater finfish farming	4.9	39%	2.7	41%	73	65%	2.0	49%
Processing	0.0	0%	0.0	0%	0	0%	0.0	0%
Transport	0.6	5%	0.3	4%	2	2%	0.1	3%
Retail	0.1	1%	0.0	1%	1	1%	0.0	1%
Food services	0.4	4%	0.2	3%	3	3%	0.1	3%
<i>Total Direct</i>	<i>6.0</i>	<i>48%</i>	<i>3.2</i>	<i>49%</i>	<i>79</i>	<i>70%</i>	<i>2.3</i>	<i>56%</i>
Flow-on effects								
Property and business serv	1.4	11%	1.0	15%	3	3%	0.3	7%
Manufacturing	1.1	9%	0.4	5%	4	3%	0.2	6%
Trade	1.2	10%	0.6	9%	10	9%	0.4	10%
Transport	0.3	2%	0.1	2%	1	1%	0.1	2%
Finance	0.5	4%	0.3	5%	2	1%	0.2	4%
Other Sectors	1.9	16%	1.0	16%	14	12%	0.7	17%
<i>Total Flow-on</i>	<i>6.4</i>	<i>52%</i>	<i>3.3</i>	<i>51%</i>	<i>33</i>	<i>30%</i>	<i>1.8</i>	<i>44%</i>
Total ^a	12.4	100%	6.5	100%	112	100%	4.1	100%
Total/Direct	2.07		2.05		1.42		1.79	

Note: Totals may contain rounding errors.

^a Note there is double counting in the total output impact.

Source: EconSearch analysis.

Table 4.7 The economic impact of marron/yabbies farming in South Australia, 2009/10

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects ^a								
Marron/yabbies farming	0.6	43%	0.5	57%	21	82%	0.0	16%
Processing	0.0	0%	0.0	0%	0	0%	0.0	0%
Transport	0.0	2%	0.0	1%	0	0%	0.0	3%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.3	17%	0.1	12%	2	7%	0.1	24%
<i>Total Direct</i>	<i>0.9</i>	<i>62%</i>	<i>0.7</i>	<i>70%</i>	<i>23</i>	<i>89%</i>	<i>0.1</i>	<i>43%</i>
Flow-on effects								
Property and business serv	0.1	8%	0.1	8%	0	1%	0.0	11%
Manufacturing	0.1	8%	0.0	4%	0	2%	0.0	10%
Trade	0.1	6%	0.0	5%	1	3%	0.0	12%
Transport	0.0	2%	0.0	1%	0	0%	0.0	2%
Finance	0.0	3%	0.0	3%	0	1%	0.0	5%
Other Sectors	0.2	11%	0.1	9%	1	3%	0.1	18%
<i>Total Flow-on</i>	<i>0.6</i>	<i>38%</i>	<i>0.3</i>	<i>30%</i>	<i>3</i>	<i>11%</i>	<i>0.2</i>	<i>57%</i>
Total ^b	1.5	100%	0.9	100%	26	100%	0.3	100%
Total/Direct	1.61		1.43		1.12		2.32	

Note: Totals may contain rounding errors.

^a There are small direct effects in the transport and retail sectors.

^b Note there is double counting in the total output impact.

Source: EconSearch analysis.

Table 4.8 The economic impact of other aquaculture in South Australia, 2009/10 ^a

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects ^b								
Other aquaculture	10.3	65%	5.2	65%	42	61%	1.7	53%
Processing	0.0	0%	0.0	0%	0	0%	0.0	0%
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%
<i>Total Direct</i>	<i>10.3</i>	<i>65%</i>	<i>5.2</i>	<i>65%</i>	<i>42</i>	<i>61%</i>	<i>1.7</i>	<i>53%</i>
Flow-on effects								
Property and business serv	1.2	8%	0.8	10%	3	4%	0.2	7%
Manufacturing	0.9	6%	0.3	4%	3	5%	0.2	6%
Trade	1.1	7%	0.5	6%	9	13%	0.4	11%
Transport	0.2	1%	0.1	1%	1	1%	0.1	2%
Finance	0.4	3%	0.3	3%	1	2%	0.1	4%
Other Sectors	1.6	10%	0.8	10%	10	14%	0.5	17%
<i>Total Flow-on</i>	<i>5.4</i>	<i>35%</i>	<i>2.8</i>	<i>35%</i>	<i>27</i>	<i>39%</i>	<i>1.5</i>	<i>47%</i>
Total ^c	15.7	100%	8.0	100%	69	100%	3.2	100%
Total/Direct	1.53		1.54		1.64		1.90	

Note: Totals may contain rounding errors.

^a Other aquaculture production is comprised predominantly of algae and brine shrimp production.

^b The downstream impacts of other aquaculture production are unknown and have been excluded from the analysis.

^c Note there is double counting in the total output impact.

Source: EconSearch analysis.

5. The Economic Impact of Aquaculture in the Eyre Peninsula Region, 2009/10

5.1 The Economic Impact of Tuna Farming in the Eyre Peninsula Region, 2009/10

Estimates of the economic impact of tuna farming in the Eyre Peninsula region¹⁸ of South Australia in 2009/10 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, 2009/10

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Tuna farming	102.2	41%	14.7	15%	382	38%	14.6	29%
Processing	11.3	59%	3.6	36%	40	32%	2.5	39%
Transport	2.0	11%	0.9	8%	7	6%	0.5	7%
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%
<i>Total Direct</i>	<i>115.4</i>	<i>111%</i>	<i>19.2</i>	<i>59%</i>	<i>429</i>	<i>76%</i>	<i>17.6</i>	<i>75%</i>
Flow-on effects								
Tuna fishing	37.4	15%	30.2	30%	168	17%	6.8	13%
Property and business serv.	16.1	6%	10.9	11%	37	4%	2.7	5%
Manufacturing	13.2	5%	4.1	4%	36	4%	2.8	6%
Trade	14.3	6%	6.8	7%	122	12%	4.7	9%
Sardines	21.9	9%	12.5	13%	46	5%	6.7	13%
Transport	6.5	3%	2.8	3%	27	3%	1.7	3%
Finance	4.3	2%	2.9	3%	18	2%	1.2	2%
Other Sectors	18.9	8%	10.3	10%	123	12%	6.5	13%
<i>Total Flow-on</i>	<i>132.6</i>	<i>53%</i>	<i>80.5</i>	<i>81%</i>	<i>576</i>	<i>57%</i>	<i>33.0</i>	<i>65%</i>
Total ^a	248	165%	100	139%	1,005	134%	51	140%
Total/Direct	2.15		5.19		2.34		2.87	

Note: Totals may contain rounding errors.

^a Note there is double counting in the total output impact.

Source: EconSearch analysis.

¹⁸ Elliston to Port Augusta.

Output impacts...

Direct output (business turnover) generated locally by tuna farms summed to \$102 million and in other sectors (processing and transport), \$13 million in 2009/10. Flow-on output in other sectors summed to \$133 million. The sectors most affected were the tuna fishing (tuna capture), 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 2.15 indicates that for each dollar of sales generated directly by tuna farming, processing and transport there was a total of \$2.15 of output generated by businesses throughout the Eyre Peninsula region, \$1.00 in tuna farming, processing and transport and \$1.15 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 \$19 million in 2009/10. Flow-on GRP generated in the other sectors of the regional economy was approximately \$81 million in 2009/10. The flow-ons were greatest in the tuna fishing (\$30m), property and business services (\$11m), sardine fishing (\$13m), trade (\$7m) and manufacturing (\$4m) 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 \$4.19 (\$5.19 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 380 fte and associated processing and transport, approximately 47 fte in the Eyre Peninsula region in 2009/10. Flow-on business activity was estimated to have generated a further 576 fte jobs locally to give total employment of approximately 1,000 fte in the region. The sectors of the local economy with employment flow-ons from tuna farming, processing and transport included the tuna fishing (168 fte), sardine fishing (46), trade (122), manufacturing (36), property and business services (37) and transport (27) 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 1.34 jobs (2.34 jobs in total) in the rest of the region.

It was estimated that personal income of \$15 million was earned directly in the tuna farming sector in 2009/10, comprising both wages by employees and drawings by owner/operators. An additional \$7 million of household income was earned by licence holders and crew in the tuna fishing sector and a further \$30 million in other sectors of the regional economy. For each \$1.00 of household income generated directly by tuna farming, processing and transport in 2009/10 there was an additional \$1.87 (\$2.87 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, 2009/10

Estimates of the economic impact of oyster farming in the Eyre Peninsula region in 2009/10 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 \$22 million in 2009/10 while output generated in the Eyre Peninsula region by associated downstream activities (processing, transport, retail and food service) summed to \$7 million. Flow-ons to other sectors of the regional economy added another \$16 million in output in 2009/10. 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, 2009/10 ^a

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Oyster farming ^b	22.4	50%	15.8	58%	282	71%	8.6	59%
Processing	1.2	3%	0.4	1%	3	1%	0.3	2%
Transport	4.5	10%	2.0	7%	19	5%	1.2	8%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.9	2%	0.4	1%	7	2%	0.2	2%
<i>Total Direct</i>	<i>29.0</i>	<i>65%</i>	<i>18.5</i>	<i>68%</i>	<i>311</i>	<i>79%</i>	<i>10.2</i>	<i>70%</i>
Flow-on effects								
Property and business serv.	4.0	9%	2.8	10%	8	2%	0.6	4%
Manufacturing	2.1	5%	0.6	2%	6	1%	0.4	3%
Trade	3.5	8%	1.7	6%	30	8%	1.1	8%
Transport	1.0	2%	0.4	2%	4	1%	0.3	2%
Finance	0.7	2%	0.5	2%	3	1%	0.2	1%
Other Sectors	4.5	10%	2.6	9%	34	9%	1.7	12%
<i>Total Flow-on</i>	<i>15.8</i>	<i>35%</i>	<i>8.6</i>	<i>32%</i>	<i>85</i>	<i>21%</i>	<i>4.3</i>	<i>30%</i>
Total ^c	44.8	100%	27.1	100%	396	100%	14.5	100%
Total/Direct	1.59		1.50		1.30		1.45	

Note: Totals may contain rounding errors.

^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.

^c Note there is double counting in the total output impact.

Source: EconSearch analysis.

Contribution to gross regional product...

Total oyster farming-related contribution to GRP in the Eyre Peninsula region was over \$27 million in 2009/10, \$16 million generated by oyster farming directly, \$3 million generated by downstream activities and almost \$9 million generated in other sectors of the regional economy.

Employment and household income...

In 2009/10 in the Eyre Peninsula region, oyster farming was responsible for the direct employment of approximately 282 fte and associated downstream activities created employment for an additional 30 fte. Flow-on business activity was estimated to generate a further 85 fte. The total employment impact was almost 400 fte.

In 2009/10, personal income of over \$10 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 \$4 million of household income was earned in other local businesses as a result of oyster industry operations. The total household income impact was almost \$15 million.

5.3 The Economic Impact of Other Aquaculture in the Eyre Peninsula Region, 2009/10

The economic impacts of other aquaculture sectors in the Eyre Peninsula region in 2009/10 (i.e. marine finfish, freshwater finfish, mussels, abalone, marron/yabby 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 some of these 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 5.3 The economic impact of other aquaculture ^a in the Eyre Peninsula region, 2009/10 ^b

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Other aquaculture	41.9	51%	12.1	42%	228	54%	6.1	39%
Processing	4.6	6%	1.4	5%	12	3%	1.0	6%
Transport	4.2	5%	1.8	6%	18	4%	1.1	7%
Retail	0.1	0%	0.0	0%	0	0%	0.0	0%
Food services	0.4	0%	0.2	1%	3	1%	0.1	1%
<i>Total Direct</i>	<i>51.2</i>	<i>62%</i>	<i>15.6</i>	<i>54%</i>	<i>262</i>	<i>62%</i>	<i>8.3</i>	<i>54%</i>
Flow-on effects								
Property and business serv.	4.8	6%	3.3	11%	11	3%	0.8	5%
Manufacturing	3.3	4%	1.0	4%	9	2%	0.7	5%
Trade	6.1	7%	2.9	10%	52	12%	2.0	13%
Transport	1.3	2%	0.6	2%	6	1%	0.3	2%
Finance	0.9	1%	0.6	2%	4	1%	0.3	2%
Other Sectors	14.5	18%	4.7	16%	77	18%	3.1	20%
<i>Total Flow-on</i>	<i>30.9</i>	<i>38%</i>	<i>13.1</i>	<i>46%</i>	<i>158</i>	<i>38%</i>	<i>7.2</i>	<i>46%</i>
Total ^c	82.1	100%	28.7	100%	420	100%	15.5	100%
Total/Direct	1.61		1.86		1.62		1.89	

Note: Totals may contain rounding errors.

^a Includes marine finfish, freshwater finfish, mussels, abalone, marron/yabby 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.

^c Note there is double counting in the total output impact.

Source: EconSearch analysis.

6. The Economic Impact of Aquaculture in the West Coast Region, 2009/10

Estimates of the economic impact of aquaculture in the West Coast region of SA¹⁹ in 2009/10 (i.e. oysters, abalone and marine finfish farming) are reported in aggregate in Table 6.1.

Note that for some of the aquaculture sectors in the West 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 West Coast region, 2009/10
_b

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Other aquaculture	15.0	49%	9.3	55%	311	76%	5.3	56%
Processing	1.0	3%	0.3	2%	3	1%	0.2	2%
Transport	2.8	9%	1.2	7%	12	3%	0.7	8%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.5	2%	0.2	1%	4	1%	0.1	1%
<i>Total Direct</i>	<i>19.4</i>	<i>63%</i>	<i>11.1</i>	<i>66%</i>	<i>330</i>	<i>81%</i>	<i>6.3</i>	<i>68%</i>
Flow-on effects								
Property and business serv.	2.6	8%	1.8	11%	5	1%	0.4	4%
Manufacturing	1.4	5%	0.4	3%	4	1%	0.3	3%
Trade	2.4	8%	1.2	7%	21	5%	0.8	8%
Transport	0.6	2%	0.3	2%	3	1%	0.2	2%
Finance	0.5	2%	0.3	2%	2	0%	0.1	1%
Other Sectors	3.7	12%	1.8	11%	44	11%	1.2	13%
<i>Total Flow-on</i>	<i>11.1</i>	<i>37%</i>	<i>5.8</i>	<i>34%</i>	<i>78</i>	<i>19%</i>	<i>3.0</i>	<i>32%</i>
Total ^c	30.5	100%	16.9	100%	408	100%	9.3	100%
Total/Direct	1.62		1.55		1.25		1.50	

Note: Totals may contain rounding errors.

^a Includes oysters, abalone and marine finfish farming.

^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.

^c Note there is double counting in the total output impact.

Source: EconSearch analysis.

¹⁹ WA border to Elliston.

Output impacts...

Direct output (business turnover) generated by aquaculture summed to \$15 million and associated downstream activities, \$4.4 million in the West Coast region in 2009/10. Flow-on output in other sectors of the regional economy summed to \$11.1 million in 2009/10. 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 gross regional product in the West Coast region was almost \$17 million in 2009/10, \$9.3 million generated by aquaculture directly, \$1.8 million generated in associated downstream activities and \$5.8 million generated in other sectors of the regional economy.

Employment and household income...

Aquaculture and downstream activities were responsible for the direct employment of 330 fte in 2009/10 in the West Coast region. Flow-on business activity was estimated to generate a further 78 fte.

In 2009/10, personal income of \$6.3 million was earned in aquaculture and downstream activities in the West Coast region comprising both wages by employees and estimated drawings by owner/operators. An additional \$3.0 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 Yorke Peninsula to KI Region, 2009/10

Estimates of the economic impact of aquaculture in the Yorke Peninsula to KI region of SA²⁰ in 2009/10 (i.e. oysters, abalone, mussels, freshwater finfish, marron/yabby farming and other aquaculture enterprises) are reported in aggregate in Table 7.1.

Note that for some of the aquaculture sectors in the Yorke Peninsula to KI 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 7.1 The economic impact of aquaculture ^a in the Yorke Peninsula to KI region, 2009/10 ^b

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Other aquaculture	8.4	48%	4.1	48%	134	74%	2.2	49%
Processing	0.2	1%	0.1	1%	1	0%	0.1	1%
Transport	0.5	3%	0.2	3%	2	1%	0.1	3%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.1	0%	0.0	0%	0	0%	0.0	0%
<i>Total Direct</i>	<i>9.2</i>	<i>53%</i>	<i>4.4</i>	<i>52%</i>	<i>137</i>	<i>76%</i>	<i>2.4</i>	<i>53%</i>
Flow-on effects								
Property and business serv.	1.7	10%	1.1	13%	4	2%	0.3	7%
Manufacturing	1.1	6%	0.4	4%	4	2%	0.3	6%
Trade	1.3	8%	0.6	7%	11	6%	0.4	9%
Transport	0.3	2%	0.1	2%	1	1%	0.1	2%
Finance	0.5	3%	0.3	4%	2	1%	0.2	4%
Other Sectors	3.2	19%	1.5	18%	21	12%	0.9	19%
<i>Total Flow-on</i>	<i>8.2</i>	<i>47%</i>	<i>4.1</i>	<i>48%</i>	<i>43</i>	<i>24%</i>	<i>2.1</i>	<i>47%</i>
Total ^c	17.5	100%	8.5	100%	180	100%	4.6	100%
Total/Direct	1.90		1.94		1.32		1.90	

Note: Totals may contain rounding errors.

^a Includes oysters, abalone, mussels, freshwater finfish, marron/yabby 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.

^c Note there is double counting in the total output impact.

Source: EconSearch analysis.

²⁰ Port Augusta to Goolwa.

Output impacts...

Direct output (business turnover) generated by aquaculture summed to \$8.4 million and associated downstream activities, \$0.8 million in the Yorke Peninsula to KI region in 2009/10. Flow-on output in other sectors of the regional economy summed to \$8.2 million in 2009/10. 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 gross regional product in the Yorke Peninsula to KI region was approximately \$8.5 million in 2009/10, \$4.1 million generated by aquaculture directly, \$0.3 million generated in associated downstream activities and \$4.1 million generated in other sectors of the regional economy.

Employment and household income...

Aquaculture and downstream activities were responsible for the direct employment of 137 fte in 2009/10 in the Yorke Peninsula to KI region. Flow-on business activity was estimated to generate a further 43 fte.

In 2009/10, personal income of \$2.4 million was earned in aquaculture and downstream activities in the Yorke Peninsula to KI region comprising both wages by employees and estimated drawings by owner/operators. An additional \$2.1 million of household income was earned in other local businesses as a result of aquaculture industry operations.

8. The Economic Impact of Aquaculture in the Murraylands and South East Region, 2009/10

Estimates of the economic impact of aquaculture in the Murraylands and South East region of SA²¹ in 2009/10 (i.e. freshwater finfish and marron/yabby farming) are reported in aggregate in Table 8.1.

Note that for some of the aquaculture sectors in the Murraylands and South East 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 8.1 The economic impact of aquaculture ^a in the Murraylands and South East region, 2009/10 ^b

Sector	Output		Contribution to GRP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Direct effects								
Other aquaculture	2.2	56%	1.2	57%	34	76%	0.9	66%
Processing	0.0	0%	0.0	0%	0	0%	0.0	0%
Transport	0.3	7%	0.1	5%	1	3%	0.1	5%
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%
<i>Total Direct</i>	<i>2.5</i>	<i>63%</i>	<i>1.3</i>	<i>63%</i>	<i>35</i>	<i>79%</i>	<i>1.0</i>	<i>71%</i>
Flow-on effects								
Property and business serv.	0.3	8%	0.2	11%	0	1%	0.0	2%
Manufacturing	0.2	5%	0.1	3%	1	2%	0.0	3%
Trade	0.4	10%	0.2	9%	4	8%	0.1	10%
Transport	0.1	1%	0.0	1%	0	1%	0.0	1%
Finance	0.1	2%	0.0	2%	0	1%	0.0	2%
Other Sectors	0.4	11%	0.2	11%	4	9%	0.2	11%
<i>Total Flow-on</i>	<i>1.5</i>	<i>37%</i>	<i>0.8</i>	<i>37%</i>	<i>9</i>	<i>21%</i>	<i>0.4</i>	<i>29%</i>
Total ^c	3.9	100%	2.1	100%	45	100%	1.4	100%
Total/Direct	1.60		1.60		1.26		1.41	

Note: Totals may contain rounding errors.

^a Includes freshwater finfish and marron/yabby farming.

^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.

^c Note there is double counting in the total output impact.

Source: EconSearch analysis.

²¹ Riverland, Murraylands and Limestone Coast.

Output impacts...

Direct output (business turnover) generated by aquaculture summed to \$2.2 million and associated downstream activities, \$0.3 million in the Murraylands and South East region in 2009/10. Flow-on output in other sectors of the regional economy summed to \$1.5 million in 2009/10. 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 gross regional product in the Murraylands and South East region was over \$2 million in 2009/10, \$1.2 million generated by aquaculture directly, \$0.1 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 35 fte in 2009/10 in the Murraylands and South East region. Flow-on business activity was estimated to generate a further 9 fte.

In 2009/10, personal income of \$1.0 million was earned in aquaculture and downstream activities in the Murraylands and South East 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.

9. 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 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, Southern Bluefin Tuna breeding).

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

10. Economic Impact of Aquaculture in SA, Time Series, 1997/98 to 2009/10

Estimates of the economic impact of aquaculture on the South Australian economy for the period 1997/98 to 2009/10, in terms of contribution to GSP and employment, are provided in Figures 8.1 and 8.2, respectively.

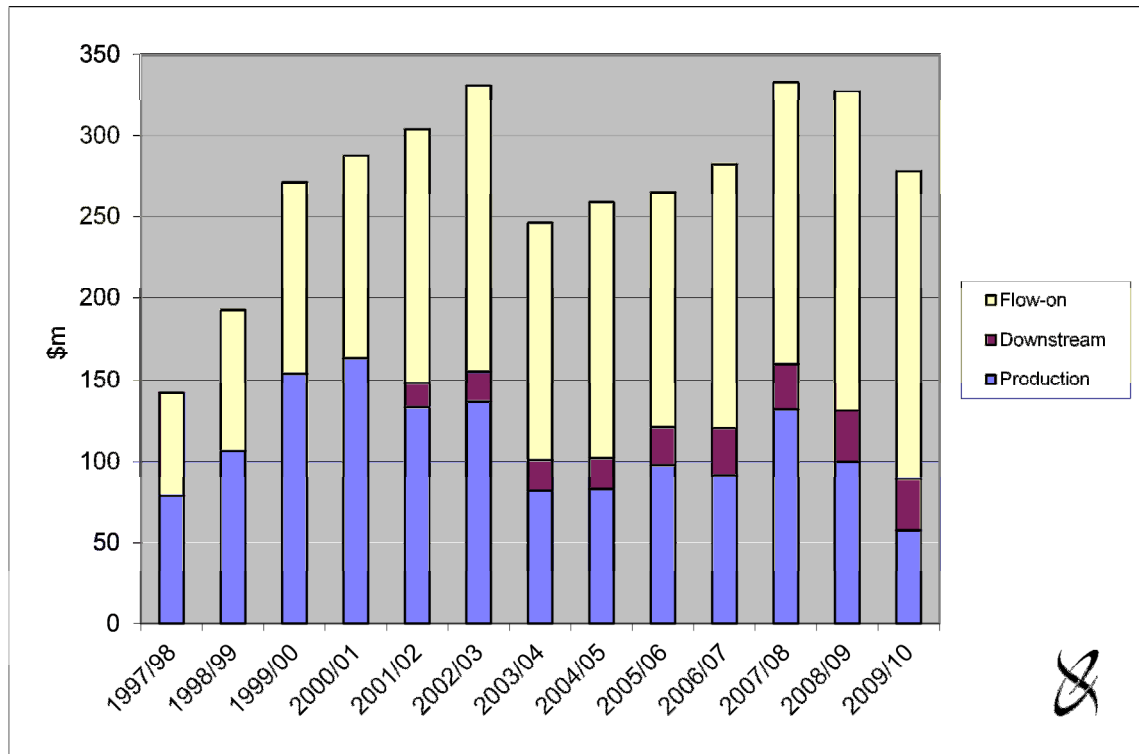
It is important to note that some of the variability in the GSP and employment impacts of SA aquaculture over the period 1997/98 to 2009/10 is a function of changes in methodology. Most significantly, as discussed in Section 2.1 of the report, estimates for the period 1997/98 to 2000/01 exclude some of the downstream impacts associated with aquaculture activity in SA²². 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 the responses and response rate to the PIRSA Fisheries and Aquaculture *Production Returns*.

²² See Table 2.1 for further details.

Total contribution to GSP attributable to aquaculture in SA exhibited a rising trend over the period 1997/98 to 2002/03 (Figure 8.1). 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 resumed its rising trend over the period 2003/04 to 2007/08 with the subsequent decline attributable primarily to reductions in the production and value of farmed tuna.

Figure 10.1 Total GSP impact of aquaculture in SA, 1997/98 to 2009/10 ^a

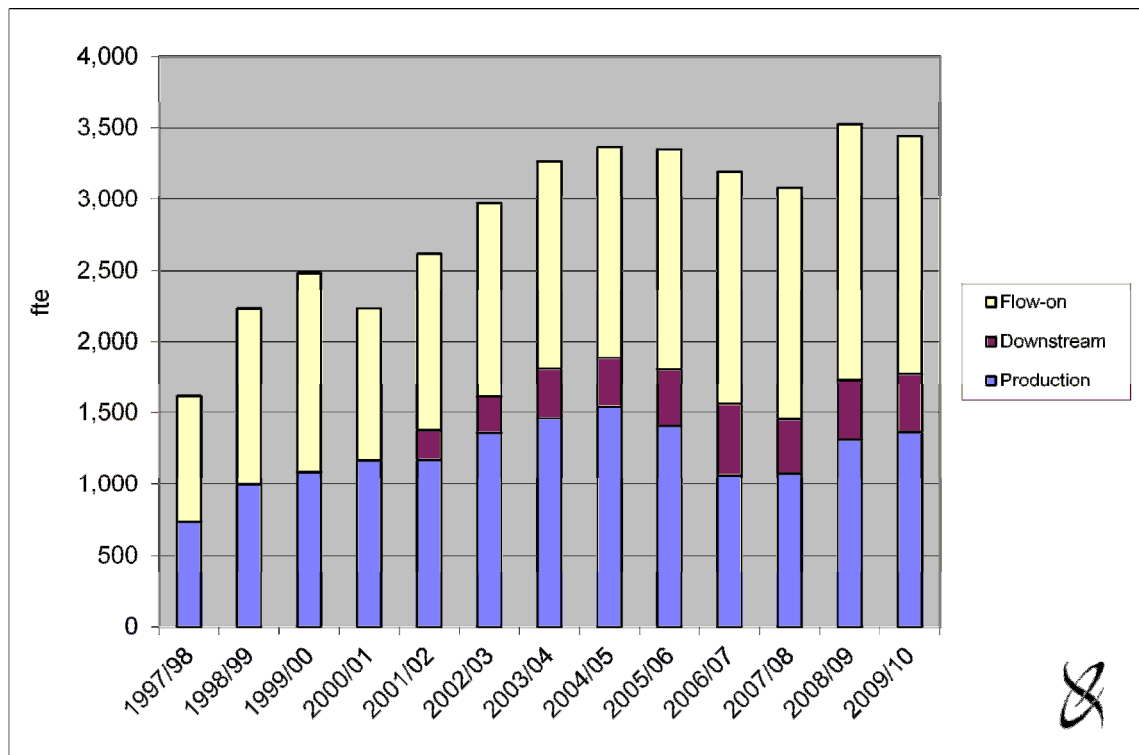


^a Total GSP impacts for the period 1997/98 to 2000/01 exclude some downstream activities (including some transport and all retail and food services).

Source: EconSearch (1997, 1998, 1999, 2001, 2002a, 2003, 2004, 2006a, 2006b, 2007, 2008, 2009a and 2010) and Table 4.1.

The total employment impact attributable to aquaculture in SA exhibited a rising trend over the period 1997/98 to 2009/10, reflecting an expansion in capacity and production growth across most aquaculture sectors over this period (Figure 8.2). The increase in direct employment in farming (i.e. production) activities between 2007/08 and 2009/10 is most likely a function of improvements in the quality of the responses and response rate to the PIRSA Fisheries and Aquaculture *Production Returns*, as well as actual employment growth.

Figure 10.2 Total employment impact of aquaculture in SA, 1997/98 to 2009/10 ^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, 2007, 2008, 2009a and 2010) and Table 4.1.

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Appendix 1 An Overview of Economic Impact Analysis using the Input-Output Method

Economic impact analysis based on an input-output (I-O) model provides a comprehensive economic framework that is extremely useful in the resource planning process. Broadly, there are two ways in which the I-O method can be used.

First, the I-O model provides a numerical picture of the size and shape of an economy and its essential features. The I-O model 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, I-O analysis provides a standard approach for the estimation of the economic impact of a particular activity. The I-O model is used to calculate industry multipliers that can then be applied to various development or change scenarios.

The input-output database

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 I-O database is a convenient way to illustrate the purchases and sales of goods and services taking place in an economy at a given point in time.

As noted above, I-O models provide a numerical picture of the size and shape of the economy. 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 I-O table can be interpreted in the following way:

- The rows of the I-O table illustrate sales for intermediate usage (i.e. to other firms in the region) and for final demand (e.g. household consumption, exports or capital formation).
- The columns of the I-O table illustrate purchases of intermediate inputs (i.e. from other firms in the region), imported goods and services and purchases of primary inputs (i.e. labour, land and capital).
- 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 I-O model can be used to describe some of the important features of a state or regional economy, the interrelationships between sectors and the relative importance of the individual sectors. The model is also used for the calculation of sector multipliers and the estimation of economic impacts arising from some change in the economy.

Using input-output analysis for estimation of economic impacts

The I-O 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 vineyard that, in the course of its operation, purchases goods and services from other sectors. These goods and services would include fertiliser, chemicals, transport services, and, of course, labour. The direct employment created by the vineyard is regarded in the model as an expenditure flow into the household sector, which is one of several non-industrial sectors recognised in the I-O model.

Upon receiving expenditure by the vineyard, the other sectors in the regional economy engage in their own expenditures. For example, as a consequence of winning a contract for work with vineyard, a spraying contractor 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 and induced (or flow-on) effects²³, as they are called, are part of the impact of the vineyard on the regional economy. They must be added to the direct effects (which are expenditures made in immediate support of the vineyard itself) in order to arrive at a measure of the total impact of the vineyard.

It may be thought that these flow-on effects (or impacts) 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 economy, an important leakage is expenditure on imports, that is, products or services that originate from outside the region, state or country (e.g. machinery).

Thus, some of the expenditure by the vineyard (i.e. expenditure on imports to the region) is lost to the regional economy. Consequently, the flow-on effects get smaller and smaller in successive expenditure rounds due to this and other leakages. Hence the total expenditure created in the regional economy is limited in amount, and so (in principle) it can be measured.

Using I-O analysis for estimation of regional economic impacts requires 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 receiving this expenditure share their expenditures among the various sectors from whom they buy, and so on, for the further expenditure rounds.

In applying the I-O model to economic impact analysis, 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 regional economy on household expenditures by vineyard employees on food, clothing, entertainment, and so on, as it is impracticable to measure these effects for an individual case, here the vineyard.

The I-O model is instead based on a set of assumptions about constant and uniform proportions of expenditure. If households in general in the regional economy spend, for example, 13.3 per cent of their income on food and non-alcoholic beverages, it is assumed that those working in vineyards do likewise. Indeed, the effects of all expenditure rounds after the first are calculated by using such standard proportions (i.e. multiplier calculations). Once a transactions table has been compiled, simple mathematical procedures can be applied to derive multipliers for each sector in the economy.

²³ A glossary of I-O terminology is provided in Appendix 3.

Input-output multipliers

Input-output multipliers are an indication of the strength of the linkages between a particular sector and the rest of the state or 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.

Detailed explanations on calculating I-O multipliers, including the underlying assumptions, are provided in any regional economics or I-O analysis textbook (see, for example, Jensen and West (1986)). They are calculated through a routine set of mathematical operations based on coefficients derived from the I-O transactions model, as outlined below.

The transactions table may be represented by a series of equations thus:

$$\begin{aligned} X_1 &= X_{11} + X_{12} + \dots + X_{1n} + Y_1 \\ X_2 &= X_{21} + X_{22} + \dots + X_{2n} + Y_2 \\ X_n &= X_{n1} + X_{n2} + \dots + X_{nn} + Y_n \end{aligned}$$

where X_i = total output of intermediate sector i (row totals);

X_{ij} = output of sector i purchased by sector j (elements of the intermediate quadrant); and

Y_j = total final demand for the output of sector i .

It is possible, by dividing the elements of the columns of the transactions table by the respective column totals to derive coefficients, which represent more clearly the purchasing pattern of each sector. These coefficients, termed 'direct' or 'I-O' coefficients, are normally denoted as a_{ij} , and represent the direct or first round requirements from the output of each sector following an increase in output of any sector.

In equation terms the model becomes:

$$\begin{aligned} X_1 &= a_{11} X_1 + a_{12} X_2 + \dots + a_{1n} X_n + Y_1 \\ X_2 &= a_{21} X_1 + a_{22} X_2 + \dots + a_{2n} X_n + Y_2 \\ X_n &= a_{n1} X_1 + a_{n2} X_2 + \dots + a_{nn} X_n + Y_n \end{aligned}$$

where a_{ij} (the direct coefficient) = X_{ij}/X_j . This may be represented in matrix terms:

$$X = AX + Y$$

where $A = [a_{ij}]$, the matrix of direct coefficients.

The previous equation can be extended to:

$$(I-A)X = Y$$

where $(I-A)$ is termed the Leontief matrix,

or $X = (I-A)^{-1}Y$

where $(I-A)^{-1}$ is termed the 'general solution', the 'Leontief inverse' or simply the inverse of the open model.

The general solution is often represented by:

$$Z = (I-A)^{-1} = [z_{ij}]$$

The I-O table can be 'closed' with respect to certain elements of the table. Closure involves the transfer of items from the exogenous portions of the table (final demand and primary input quadrants) to the endogenous section of the table (intermediate quadrant). This implies that the analyst considers that the transferred item is related more to the level of local activity than to external influences. Closure of I-O tables with respect to households is common and has been adopted in this project.

The 'closed' direct coefficients matrix may be referred to as A^* . The inverse of the Leontief matrix formed from A^* is given by:

$$Z^* = (I - A^*)^{-1} = [z^*_{ij}]$$

Z^* is referred to as the 'closed inverse' matrix.

A multiplier is essentially a measurement of the impact of an economic stimulus. In the case of I-O multipliers the stimulus is normally assumed to be an increase of one dollar in sales to final demand by a sector. The impact in terms of output, contribution to gross regional product, household income and employment can be identified in the categories discussed below.

- (i) The initial impact: refers to the assumed dollar increase in sales. It is the stimulus or the cause of the impacts. It is the unity base of the output multiplier and provides the identity matrix of the Leontief matrix. Associated directly with this dollar increase in output is an own-sector increase in household income (wages and salaries, drawings by owner operators etc.) used in the production of that dollar. This is the household income coefficient h_j . Household income, together with other value added (OVA), provide the total gross regional product from the production of that dollar of output. The gross regional product coefficient is denoted v_j . Associated also will be an own-sector increase in employment, represented by the size of the employment coefficient. This employment coefficient e_j represents an employment/output ratio and is usually calculated as 'employment per million dollars of output'.
- (ii) The first round impact: refers to the effect of the first round of purchases by the sector providing the additional dollar of output. In the case of the output multiplier this is shown by the direct coefficients matrix $[a_{ij}]$. The disaggregated effects are given by individual a_{ij} coefficients and the total first-round effect by $\sum a_{ij}$. First-round household income effects are calculated by multiplying the first-round output effects by the appropriate household income coefficient (h_j). Similarly, the first-round gross regional product and employment effects are calculated by multiplying the first-round output effects by the appropriate gross regional product (v_j) and employment (e_j) coefficients.
- (iii) Industrial-support impacts. This term is applied to 'second and subsequent round' effects as successive waves of output increases occur in the economy to provide

industrial support, as a response to the original dollar increase in sales to final demand. The term excludes any increases caused by increased household consumption. Output effects are calculated from the open Z inverse, as a measure of industrial response to the first-round effects. The industrial-support output requirements are calculated as the elements of the columns of the Z inverse, less the initial dollar stimulus and the first-round effects. The industrial support household income, gross regional product and employment effects are defined as the output effects multiplied by the respective household income, gross regional product and employment coefficients. The first-round and industrial-support impacts are together termed the production-induced impacts.

- (iv) Consumption-induced impacts: are defined as those induced by increased household income associated with the original dollar stimulus in output. The consumption-induced output effects are calculated in disaggregated form as the difference between the corresponding elements in the open and closed inverse (i.e. $z_{ij}^* - z_{ij}$, and in total as $\Sigma(z_{ij}^* - z_{ij})$). The consumption-induced household income, gross regional product and employment effects are simply the output effects multiplied by the respective household income, gross regional product and employment coefficients.
- (v) Flow-on impacts: are calculated as total impact less the initial impact. This allows for the separation of 'cause and effect' factors in the multipliers. The cause of the impact is given by the initial impact (the original dollar increase in sales to final demand), and the effect is represented by the first-round, industrial-support and consumption-induced effects, which together constitute the flow-on effects.

Each of the five impacts are summarised in Appendix Table 2.1. It should be noted that household income, gross regional product and employment multipliers are parallel concepts, differing only by their respective coefficients h_j , v_j and e_j .

The output multipliers are calculated on a 'per unit of initial effect' basis (i.e. output responses to a one dollar change in output). Household income, gross regional product and employment multipliers, as described above, refer to changes in household income per initial change in output, changes to gross regional product per initial change in output and changes in employment per initial change in output. These multipliers are conventionally converted to ratios, expressing a 'per unit' measurement, and described as Type I and Type II ratios. For example, with respect to employment:

Type I employment ratio = [initial + first round + industrial support]/initial

and

Type II employment ratio = [initial + production induced²⁴ + consumption induced]/initial

²⁴ Where (first round + industrial support) = production induced.

Appendix Table 1.1 The structure of input-output multipliers for sector i ^a

Impacts	General formula
<i>Output multipliers (\$)</i>	
Initial	1
First-round	$\sum_i a_{ij}$
Industrial-support	$\sum_i z_{ij}^* - \sum_i a_{ij}$
Consumption-induced	$\sum_i z_{ij}^* - \sum_i z_{ij}$
Total	$\sum_i z_{ij}^*$
Flow-on	$\sum_i z_{ij}^* - 1$
<i>Household Income multipliers (\$)</i>	
Initial	h_j
First-round	$\sum_i a_{ij} h_i$
Industrial-support	$\sum_i z_{ij} h_i - h_j - \sum_i a_{ij} h_i$
Consumption-induced	$\sum_i z_{ij}^* h_i - \sum_i z_{ij} h_i$
Total	$\sum_i z_{ij}^* h_i$
Flow-on	$\sum_i z_{ij}^* h_i - h_j$
<i>Gross regional product multipliers (\$)</i>	
Initial	v_j
First-round	$\sum_i a_{ij} v_i$
Industrial-support	$\sum_i z_{ij} v_i - v_j - \sum_i a_{ij} v_i$
Consumption-induced	$\sum_i z_{ij}^* v_i - \sum_i z_{ij} v_i$
Total	$\sum_i z_{ij}^* v_i$
Flow-on	$\sum_i z_{ij}^* v_i - v_j$
<i>Employment multipliers (full time equivalents)</i>	
Initial	e_j
First-round	$\sum_i a_{ij} e_i$
Industrial-support	$\sum_i z_{ij} e_i - e_j - \sum_i a_{ij} e_i$
Consumption-induced	$\sum_i z_{ij}^* e_i - \sum_i z_{ij} e_i$
Total	$\sum_i z_{ij}^* e_i$
Flow-on	$\sum_i z_{ij}^* e_i - e_j$

^a In a DECON model, Z^* (the 'closed inverse' matrix), includes a population and an unemployed row and column (see below for details).

Model assumptions

There are a number of important assumptions in the I-O model that are relevant in interpreting the analytical results.

- Industries in the model have a linear production function, which implies constant returns to scale and fixed input proportions.
- Another model assumption is that firms within a sector are homogeneous, which implies they produce a fixed set of products that are not produced by any other sector and that the input structure of the firms are the same. Thus it is preferable to have as many sectors as possible specified in the models and the standard models for this study were compiled with 66 sectors (see Appendix 1 for further detail).

- The model is a static model that does not take account of the dynamic processes involved in the adjustment to an external change, such as a permanent change in natural resources management.

Extending the standard economic impact model as a DECON model

Based on work undertaken by EconSearch (2009) and consistent with Mangan and Phibbs (1989), the I-O model developed for this project was extended as demographic-economic (DECON) model. The two key characteristics of the DECON model, when compared with a standard economic model, are as follows.

1. The introduction of a population 'sector' (or row and column in the model) makes it possible to estimate the impact on local population levels of employment growth or decline.
2. The introduction of an unemployed 'sector' makes it possible to account for the consumption-induced impact of the unemployed in response to economic growth or decline.

The population 'sector'

The introduction of a population 'sector' to the standard I-O model allows for the calculation of population multipliers. These multipliers measure the flow-on population impact resulting from an initial population change attributable to employment growth or decline in a particular sector of the regional economy.

Calculation of population multipliers is made possible by inclusion of a population row and column in the 'closed' direct coefficients matrix of the I-O model.

Population row: the population coefficient (p_j) for sector j of the DECON model is represented as:

$$p_j = -rho_j * e_j * family\ size_j$$

where rho_j = the proportion of employees in sector j who remain in the region after they lose their job (negative employment impact) or the proportion of new jobs in sector j filled by previously unemployed locals (positive employment impact);

e_j = the employment coefficient for sector j ; and

$family\ size_j$ = average family size for sector j .

Population column: the population column of the DECON model is designed to account for growth or decline in those sectors of the economy that are primarily population-driven (i.e. influenced by the size of the population) rather than market-driven (i.e. dependent upon monetary transactions). Clearly, many of the services provided by the public sector fit this description and, for the purpose of this analysis, it was assumed that the following intermediate sectors were primarily population-driven:

- public administration and defence;
- education;
- health and community services; and
- cultural and recreational services.

Thus, the non-market coefficient for sector j of the DECON model is represented as expenditure on that non-market service (by governments) in \$million per head of population.

The population multiplier for sector j is represented as: z_{pj}^* / ρ_{pj}

where z_{pj}^* = coefficient of the 'closed inverse' matrix in the population row for sector j ; and

ρ_{pj} = coefficient of the direct coefficients matrix in the population row for sector j .

Sources of local data for the population sector of the DECON models used in this project included the following.

- rho: little or no published data are available to assist with estimation of this variable, particularly at a regional level. The DECON models have been constructed to enable the analyst to estimate this variable on the basis of the availability superior data or assumptions.
- Family size: in order to estimate average family size by industry, relevant data were extracted from the Australian Bureau of Statistics *2006 Census of Population and Housing* using the *TableBuilder* database. These data were modified by the consultants in order to ensure consistency with the specification and conventions of the I-O models.

The unemployed 'sector'

As outlined above, the introduction of an unemployed 'sector' to the standard I-O model makes it possible to account for the consumption-induced impact of the unemployed in response to economic growth or decline.

Through the inclusion of an unemployed row and column in the 'closed' direct coefficients matrix of the standard I-O model it is possible to calculate Type III multipliers (for output, gross regional product, household income and employment).

The key point to note is that, in the situation where at least some of the unemployed remain in a region after losing their job (negative employment impact) or some of the new jobs in a region are filled by previously unemployed locals (positive employment impact), Type III multipliers will be smaller than the more frequently used Type II multipliers.

Unemployed row: the unemployed coefficient (u_j) for sector j of the DECON model is represented as:

$$u_j = -\rho_j * (1-ess_j) * e_j$$

where ρ_j = the proportion of employees in sector j who remain in the region after they lose their job (negative employment impact) or the proportion of new jobs in sector j filled by previously unemployed locals (positive employment impact);

ess_j = the proportion of employed in sector j who are not eligible for welfare benefits when they lose their job; and

e_j = the employment coefficient for sector j .

Unemployed column: the unemployed column of the DECON model is an approximation of total consumption expenditure and the consumption pattern of the unemployed. It is represented as dollars per unemployed person rather than \$million for the region as a whole, as is the case for the household expenditure column in a standard I-O model.

Sources of local (i.e. state and regional) data for the unemployed sector of the DECON models used in this study included the following.

- **ess:** in order to estimate the proportion of employed by industry who are not eligible for welfare benefits when they lose their job, relevant data were extracted from the Australian Bureau of Statistics *2006 Census of Population and Housing* using the *TableBuilder* database. These data were modified by the consultants in order to ensure consistency with the specification and conventions of the I-O models.
- **Unemployed consumption:** total consumption expenditure by the unemployed was based on an estimate of the *Newstart Allowance* whilst the pattern of consumption expenditure was derived from household income quintiles in the *2003/04 Household Expenditure Survey* (ABS 2006).

Incorporating a tourism demand profile in the I-O model

Tourism expenditure is a measure of the value of sales of goods and services to visitors to the state or region. The following method and data sources were used to estimate tourism expenditure by industry sector for the region.

- The primary data were sourced from Tourism Research Australia (TRA).
- Base datasets included total tourism expenditure by TRA tourism region and average expenditure profiles, by region, across a range of goods and services (e.g. food and drink, fuel, shopping, etc.).
- Estimates were available for domestic day, domestic overnight and international visitor expenditure.
- The first adjustment to the base data was the development of a concordance between the TRA tourism regions and I-O model regions and the allocation of these base data to the relevant I-O model region. These allocations were based, in turn, on an ABS concordance between TRA tourism regions and SLAs.
- The second adjustment to the base data was the application of a more detailed expenditure breakdown from the ABS *Australian National Accounts: Tourism Satellite Account* for both domestic and international visitor expenditure (ABS 2010b).
- The third adjustment to the base data was the conversion of tourism expenditure estimates from purchasers' to basic prices (i.e. reallocation of net taxes (taxes minus subsidies) and marketing and transport margins) to make the data consistent with accounting conventions used in the national, state and regional I-O models. Purchasers' to basic price ratios for tourism expenditure categories were derived from ABS data.
- The final adjustment to the base data was the allocation of the tourism expenditure data in basic prices to the relevant input-output sectors (intermediate sectors, taxes less subsidies or imports) in which the expenditure occurred, thus compiling a profile of sales to final demand. This process was undertaken for each type of tourism expenditure (domestic day, domestic

overnight and international visitor) and the results aggregated to form a single tourism demand profile. Profiles were developed at the state and regional levels.

Constructing a RISE v3.0 economic impact model

In the final model construction stage the data described above were incorporated into a *Microsoft Excel*® spreadsheet based economic impact model for the region (i.e. *RISE v3.0*). This model allows for description of the structure of the economy. It can also be used for the estimation of economic impacts over time in response to the introduction of a new industry or a change in the final demand for the output of one or many sectors. Model assumptions can be modified to account for:

- price changes between the model construction year (2009/10) and the base year for the analysis;
- labour productivity change over time (as above and for the subsequent 10 years);
- the level of regional migration (e.g. for a positive employment impact, the proportion of new jobs filled by previously unemployed locals).

Appendix 2 Glossary of Input-Output Terminology

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

Changes in inventories (stocks) "consist of stocks of outputs that are held at the end of a period by the units that produced them prior to their being further processed, sold, delivered to other units or used in other ways and stocks of products acquired from other units that are intended to be used for intermediate consumption or for resale without further processing" (ABS 2008b).

Consumption-induced impacts are additional output and employment 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'.

DECON model is a demographic-economic model based on a traditional input-output model. The introduction of a population 'sector' (or row and column in the model) makes it possible to estimate the impact on local population levels of employment growth or decline. The introduction of an unemployed 'sector' makes it possible to account for the consumption-induced impact of the unemployed in response to economic growth or decline.

Direct (or initial) impacts are an estimate of the change in final demand or level of economic activity that is the stimulus for the total impacts.

Employment is a measure of the number of working proprietors, managers, directors and other employees, in terms of the number of full-time equivalents and total (i.e. full-time and part-time) jobs. Employment is measured by place of remuneration rather than place of residence.

ess is an estimate of the proportion of employed who are not eligible for welfare benefits when they lose their job.

Exports (other) are a measure of the value of goods and services sold from the region/state of interest to consumers in other regions, interstate and overseas, net of sales to visitors to the region.

Final demand quadrant (components of) includes household and government consumption expenditure, gross fixed capital formation, changes in inventories (stocks), tourism expenditure and 'other' exports.

First-round impacts are estimates of the requirement for (or purchases of) goods and services from other sectors in the economy generated by the initial economic activity.

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

Government consumption expenditure includes "net expenditure on goods and services by public authorities, other than those classified as public corporations, which does not result in the creation of fixed assets or inventories or in the acquisition of land and existing buildings or second-hand assets. It comprises expenditure on compensation of employees (other than those charged to capital works, etc.), goods and services (other than fixed assets and inventories) and consumption of fixed capital. Expenditure on repair and maintenance of roads is included. Fees, etc., charged by general government bodies for goods sold and services rendered are offset against purchases. Net expenditure overseas by general government bodies and purchases from public corporations are included. Expenditure on defence assets that are used in a fashion similar to civilian assets is classified as gross fixed capital formation; expenditure on weapons of destruction and weapon delivery systems is classified as final consumption expenditure" (ABS 2008b).

Gross fixed capital formation (GFCF) includes government, private and public corporation expenditure on new fixed assets plus net expenditure on second-hand fixed assets, including both additions and replacements (see ABS 2008b for further detail).

Gross operating surplus and gross mixed income. Gross operating surplus (GOS) is a measure of the operating surplus accruing to all enterprises, except unincorporated enterprises. It is the excess of gross output over the sum of intermediate consumption, household income and taxes less subsidies on production and imports. Gross mixed income (GMI) is a measure of the surplus or deficit accruing from production by unincorporated enterprises (ABS 2008b). The National Accounts definition of this indicator, as specified in the 2004/05 National I-O table (ABS 2008a), includes drawings by owner operators (or managers). In the state model used in this project, drawings by owner operators have been included in household income.

Gross regional/state product (GRP/GSP) is a measure of the net contribution of an activity to the regional/state economy. GRP/GSP 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 the sum of household income, 'gross operating surplus and gross mixed income net of payments to owner managers' and 'taxes less subsidies on products and production'. It represents payments to the primary inputs of production (labour, capital and land). Using GRP/GSP as a measure of economic impact avoids the problem of double counting that may arise from using value of output for this purpose.

Household consumption expenditure includes "net expenditure on goods and services by persons and expenditure of a current nature by private non-profit institutions serving households. This item excludes expenditures by unincorporated businesses and expenditures on assets by non-profit institutions (included in gross fixed capital formation). Also excluded is expenditure on maintenance of dwellings (treated as intermediate expenses of private enterprises), but personal expenditure on motor vehicles and other durable goods and the imputed rent of owner-occupied dwellings are included. The value of 'backyard' production (including food produced and consumed on farms) is included in household final consumption expenditure and the payment of wages and salaries in kind (e.g. food and lodging supplied free to employees) is counted in both household income and household final consumption expenditure" (ABS 2008b).

Household income is a component of GRP/GSP 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.

Imports are a measure of the value of goods and services purchased by intermediate sectors and by components of final demand in the region/state of interest from other regions, interstate and overseas.

Industrial-support impacts are output and employment resulting from second, third and subsequent rounds of spending by firms.

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

Input-output model 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 state or regional economy. They can be used to estimate the impact of a change in that particular sector on the rest of the economy.

Offsetting consumption effects are 'lost' consumption expenditure by the local unemployed before taking a job or 'new' consumption expenditure of those losing a job as they shift to welfare payments.

Output (Value of) is a measure of the gross revenue of goods and services produced by commercial organisations (e.g. farm-gate value of production) and gross expenditure by government agencies. Total output needs to be used with care as it can include elements of double counting when the output of integrated industries is added together (e.g. the value of winery output includes the farm-gate value of grapes). For sectors where superior regional data are not available, value of output by industry is allocated across regions on an employment basis, rather than in terms of the location of other factors of production such as land and capital.

Population impacts are a measure of the change in the number of people resident in the region as a result of employment growth or decline.

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.

Primary input quadrant (components of) includes household income, gross operating surplus and gross mixed income net of payments to owner managers, taxes less subsidies on products and production and imports.

Production-induced impacts are the sum of first-round and industrial support impacts. Production-induced impacts are sometimes referred to as 'indirect effects'.

rho is an estimate of the proportion of employees who remain in the region after they lose their job (negative employment impact) or the proportion of new jobs filled by previously unemployed locals (positive employment impact).

Taxes less subsidies on products and production (TLSP) is defined as 'taxes on products' plus 'other taxes on production' less 'subsidies on products' less 'other subsidies on production'. Taxes on products are taxes payable per unit of some good or service. Other taxes on production consist of all taxes that enterprises incur as a result of engaging in production, except taxes on products. Subsidies on products are subsidies payable per unit of a good or service. Other subsidies on production consist of all subsidies, except subsidies on products, which resident enterprises may receive as a consequence of engaging in production (ABS 2008b).

Tourism expenditure is a measure of the value of sales of goods and services to visitors to the state or region.

Total impacts are the sum of initial (or direct) and flow-on impacts.

Type I multiplier is calculated as (direct effects + production-induced effects)/direct effects.

Type II multiplier is calculated as (direct effects + production-induced effects + consumption-induced effects)/direct effects.

Type III multiplier is a modified Type II multiplier, calculated by including a population and unemployed row and column in the 'closed' direct coefficients matrix of the standard I-O model. Calculated as (direct effects + production-induced effects + consumption-induced effects + offsetting consumption effects)/direct effects.

Appendix 3 Aquaculture Production and Value of Production, South Australia, 1995/96 to 2009/10

Appendix Table 3.1 Farmed tuna production, South Australia, 1995/96 to 2009/10

	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	4,992	6,805	166.7
1999/00	5,131	7,750	240.0
2000/01	5,162	9,051	263.8
2001/02	5,234	9,245	260.5
2002/03	5,375	9,102	266.9
2003/04	5,002	9,290	151.0
2004/05	5,215	7,458	140.0
2005/06	5,189	8,806	155.8
2006/07	5,342	7,486	137.7
2007/08	5,221	9,757	186.7
2008/09	3,931	8,786	157.8
2009/10	n.a. ^a	7,284	102.2

^a Not available until publication of ABARE's *Australian Fisheries Statistics 2010* report (ABARE, pers. comm.).

Source: SARDI Aquatic Sciences and Brian Jeffriess (pers. comm.).

Appendix Table 3.2 Oyster production, South Australia, 1995/96 to 2009/10 ^a

	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Production (adult only):															
Weight ('000 kg)	976	1,359	na	na	na	na	na	na	na	na	na	na	na	na	na
Number ('000 doz.)	na	1,336	1,298	1,441	2,516	2,936	3,464	3,865	4,644	4,650	5,397	7,720	5,448	5,848	6,123
Value:															
Adult oysters (\$'000)	3,950	5,205	4,908	5,489	9,389	11,011	13,303	15,116	19,959	19,995	23,879	37,841	30,132	32,231	35,027
Spat (\$'000)	na	610	1,168	997	800	579	856	1,002	1,193	1,195	957	1,143	1,469	320	444
Total (\$'000)	3,950	5,815	6,076	6,486	10,189	11,590	14,159	16,118	21,152	21,190	24,836	38,984	31,601	32,551	35,471

^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.

Source: SARDI Aquatic Sciences and PIRSA Fisheries and Aquaculture.

Appendix Table 3.3 Other aquaculture production, South Australia, 1996/97 to 2009/10 ^a

	1996/97		1997/98		1998/99		1999/00		2000/01		2001/02		2002/03		2003/04		2004/05		2005/06		2006/07		2007/08		2008/09		2009/10	
	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)	Whole Weight ('000kg)	Value (\$'000)
Marine Finfish	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2,074	17,674	3,382	29,209	3,757	27,133
Mussels	na	na	na	na	84	183	81	173	111	260	171	371	254	466	400	697	377	657	469	950	1,032	1,914	1,369	2,591	1,340	2,519	1,343	2,530
Abalone	na	na	na	na	21	856	40	2000	53	2677	34	1901	59	3080	105	3155	177	5318	250	8,222	196	7,155	167	5,151	227	8,121	286	10,341
Freshwater Finfish	163	1833	216	2799	263	3293	287	3379	277	2919	281	2845	489	6322	256	2585	283	2810	453	3,726	423	4,019	421	4,513	424	4,501	415	4,897
Marron and Yabbies	15	227	17	246	34	391	28	460	25	368	19	377	29	626	28	633	42	893	12	318	29	721	22	559	23	606	23	645
Other ^b	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	1,707	13,533	1,402	10,892	1,319	10,260
Total	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	30,807	3,633	32,323	5,759	44,022	6,798	55,847	7,143	55,807

^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 predominantly of algae and brine shrimp production.

Source: SARDI Aquatic Sciences and PIRSA Fisheries and Aquaculture.

Appendix 4 Total Economic Impact of Aquaculture in South Australia, by Aquaculture Sector, 2001/02 to 2008/09²⁵

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%

Note: Totals may contain rounding errors.

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%

Note: Totals may contain rounding errors.

Source: EconSearch (2004).

²⁵ Other aquaculture production over the time period 2001/02 to 2006/07 is comprised of Yellowtail Kingfish, Atlantic salmon (some years), other marine finfish (e.g. mulloway), rainbow trout and other aquaculture enterprises (i.e. predominantly ornamental fish, brine shrimp and 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%

Note: Totals may contain rounding errors.

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%

Note: Totals may contain rounding errors.

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	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%

Note: Totals may contain rounding errors.

Source: EconSearch (2007).

Appendix Table 4.6 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	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%

Note: Totals may contain rounding errors.

Source: EconSearch (2008).

Appendix Table 4.7 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2007/08

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Tuna farming	383.2	58.3%	198.8	59.7%	1,229	39.9%	70.2	48.9%
Marine finfish farming	57.6	8.8%	24.0	7.2%	287	9.3%	13.8	9.6%
Oyster farming	152.8	23.3%	79.8	23.9%	1,105	35.8%	43.9	30.5%
Mussels farming	13.7	2.1%	7.2	2.2%	148	4.8%	4.9	3.4%
Abalone farming	16.4	2.5%	6.0	1.8%	112	3.6%	4.3	3.0%
Freshwater finfish farming	10.9	1.7%	5.5	1.7%	86	2.8%	3.1	2.2%
Marron and yabbies farming	1.3	0.2%	0.8	0.2%	46	1.5%	0.2	0.2%
Other aquaculture ^a	21.1	3.2%	10.9	3.3%	70	2.3%	3.3	2.3%
Total (SA)	656.9	100.0%	333.0	100.0%	3,083	100.0%	143.7	100.0%

Note: Totals may contain rounding errors.

^a Other aquaculture production in 2007/08 was comprised predominantly of ornamental fish, brine shrimp and algae production. Marine finfish (i.e. Yellowtail Kingfish and Mulloway) and Freshwater finfish (i.e. Barramundi and Rainbow Trout) are separately specified.

Source: EconSearch (2009a).

Appendix Table 4.8 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2008/09

Sector	Output		Contribution to GSP		Employment		Household Income	
	(\$m)		(\$m)		(fte)		(\$m)	
Tuna farming	360.4	52.3%	168.6	51.5%	1,291	36.7%	70.5	43.0%
Marine finfish farming	95.6	13.9%	39.8	12.2%	438	12.4%	23.4	14.3%
Oyster farming	162.5	23.6%	84.4	25.8%	1,211	34.4%	47.2	28.8%
Mussels farming	13.4	1.9%	7.0	2.1%	185	5.3%	4.8	2.9%
Abalone farming	24.8	3.6%	10.5	3.2%	161	4.6%	7.7	4.7%
Freshwater finfish farming	12.3	1.8%	6.2	1.9%	114	3.2%	4.4	2.7%
Marron and yabbies farming	1.4	0.2%	0.9	0.3%	38	1.1%	0.3	0.2%
Other aquaculture ^a	18.9	2.7%	10.0	3.1%	84	2.4%	5.6	3.4%
Total (SA)	689.2	100.0%	327.6	100.0%	3,523	100.0%	163.8	100.0%

Note: Totals may contain rounding errors.

^a Other aquaculture production in 2008/09 was comprised predominantly of ornamental fish, brine shrimp and algae production. Marine finfish (i.e. Yellowtail Kingfish and Mulloway) and Freshwater finfish (i.e. Barramundi and Rainbow Trout) are separately specified.

Source: EconSearch (2010).