The Economic Impact of Aquaculture on the South Australian State and Regional Economies, 2014/15

A report to

PIRSA Fisheries and Aquaculture

Prepared by

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ABBREVIATIONS

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
fte	full-time equivalent
KI	Kangaroo Island
PIRSA	Primary Industries and Regions South Australia
SA	South Australia
SARDI	South Australian Research and Development Institute
GRP	gross regional product
GSP	gross state product
SBT	Southern Bluefin Tuna

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EXECUTIVE SUMMARY

The aim of this study was to estimate the economic impact of aquaculture activity in South Australia in 2014/15. The results reported here update and expand on those provided in previous studies (EconSearch 2015b). This report provides estimates of economic impact for 2014/15 by aquaculture sector (Tuna, Oysters, Mussels, Abalone, Freshwater Finfish, Marine Finfish, Marron/Yabbies farming, other aquaculture and aquaculture tourism enterprises) at the state and regional (West Coast, Eyre Peninsula, Yorke Peninsula, Kangaroo Island, Adelaide and Hills 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. However, for the purpose of this, the previous 12 (EconSearch 2015b) 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
- 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 2014/15 were based on PIRSA Fisheries and Aquaculture's 2014/15 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 2013/14 and 2014/15 are provided in Table ES-1.

The state's total value of seafood production (landed) in 2014/15 was around $468.9 million, of which aquaculture contributed 49 per cent ($227.8m) and wild-catch fisheries, the balance ($241.1m). In aggregate, Tuna is the largest single sector in the state's aquaculture industry, accounting for approximately 57 per cent of the state's gross value of aquaculture production in 2014/15. The other four main sectors are Other (14 per cent), Oysters (13 per cent), Marine Finfish (8 per cent) and Abalone (5 per cent).

Table ES-1 Aquaculture production and value of production, South Australia, 2013/14 and 2014/15

	Weight ('000kg)			Value ($m)		
	2013/14	2014/15	Change	2013/14	2014/15	Change
Southern Bluefin Tuna	7,544	8,418	12%	122.40	130.67	7%
Marine Finfish [a]	579	1,098	90%	8.01	18.18	127%
Oysters						
adult [b]	4,900	3,891	-21%	32.08	28.39	-12%
on-grown [c]	1,423	474	-67%	2.34	0.82	-65%
spat [d]	-	-	-	0.23	0.33	-
Mussels	1,619	1,577	-3%	3.45	3.07	-11%
Abalone	330	334	1%	10.89	11.40	5%
Freshwater Finfish	233	272	17%	2.37	4.11	73%
Marron and Yabbies	12	13	4%	0.43	0.45	5%
Other [e]	230	4,160	1707%	1.74	31.21	1694%
Total [f]	**15,447**	**19,763**	**28%**	**181.59**	**227.82**	**25%**
Tourism (visitors) [g]	8,303	9,732	17%	0.51	-	-

[a] Includes production of fingerlings.

[b] The weight for adult Oysters is an approximation on the basis that a dozen Oysters weighs one kilogram.

[c] The volume and value of juvenile Oysters sold for on-growing are excluded from the total volume and value of aquaculture as it is considered an input to production for the final sales of adult Oysters.

[d] The value of spat is included in the total. Some spat is sold in SA and some interstate but the exact proportions are uncertain due to incomplete production returns. No sales reported in 2014/15.

[e] Other aquaculture production in 2014/15 was comprised of Algae, Silver Perch (including fingerlings and spat), Shortfin Eel and Barcoo Grunter production.

[f] Totals may contain rounding errors.

[g] Value of tourism for 2014/15 was not reported by the industry.

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

In addition, data were collected for aquaculture tourism ventures offering the opportunity to swim with tuna and interact with other marine organisms, resulting in an estimated 9,700 visitors in 2014/15.

A large proportion of the South Australian aquaculture production, particularly Tuna, is considered a premium high value product, and is exported overseas to high end markets. Accordingly, the value of the Australian dollar can have a significant impact on the economic performance of the industry. Significant changes in the value of the Australian dollar also have the potential to influence the demand for Australian aquaculture exports. The Australian dollar steadily depreciated throughout 2014/15 beginning at US$0.94 in July 2014 and falling to US$0.77 in June 2015.

The results of the impact analysis, at the state level, are summarised in Table ES-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 output impact was estimated to be $272.6m ($227.8m on-farm and $44.7m in downstream activities) in 2014/15 (Table ES-2). Total output ($549.4m) needs to be used with care as it includes elements of double counting. Approximately 72 per cent of the output impact was generated in regional South Australia (Table ES-3).

In 2014/15, aquaculture's total contribution to gross state product (GSP) ($279.5m) (Table ES-2) represented 0.28 per cent of the total GSP for South Australia ($98,539m in 2014/15). As with output, around 72 per cent of the contribution to GSP was generated in regional South Australia (Table ES-3).

Table ES-2 The economic impact of aquaculture in South Australia, 2014/15

	Tuna	Marine Finfish	Mussels	Oysters	Abalone	Freshwater Finfish	Marron and Yabbies	Other [a]	**Total**
Output ($m)									
Direct									
On-farm	*130.7*	*18.2*	*3.1*	*28.7*	*11.4*	*4.1*	*0.5*	*31.2*	***227.8***
Downstream	*5.7*	*7.2*	*3.3*	*27.0*	*0.4*	*1.0*	*0.1*	*0.0*	***44.7***
Total Direct	136.4	25.4	6.4	55.7	11.8	5.1	0.6	31.2	**272.6**
Total Flow-on	136.2	21.2	9.1	58.2	23.2	6.5	0.2	22.1	**276.8**
Total [b]	**272.6**	**46.6**	**15.5**	**113.9**	**35.0**	**11.6**	**0.8**	**53.3**	**549.4**
Contribution to GSP ($m)									
Direct									
On-farm	*51.6*	*9.4*	*2.1*	*20.4*	*2.3*	*1.8*	*0.4*	*16.7*	***104.7***
Downstream	*2.0*	*3.5*	*1.5*	*12.9*	*0.1*	*0.5*	*0.1*	*0.0*	***20.6***
Total Direct	53.6	12.9	3.6	33.3	2.4	2.3	0.5	16.7	**125.3**
Total Flow-on	82.2	11.2	4.9	31.0	9.1	3.5	0.1	12.1	**154.2**
Total	**135.8**	**24.2**	**8.5**	**64.3**	**11.6**	**5.8**	**0.6**	**28.8**	**279.5**
Employment (fte)									
Direct									
On-farm	*160*	*38*	*43*	*242*	*43*	*25*	*8*	*10*	***570***
Downstream	*20*	*42*	*18*	*159*	*1*	*6*	*1*	*0*	***248***
Total Direct	180	80	61	402	44	31	9	10	**817**
Total Flow-on	485	76	39	218	88	25	1	84	**1,016**
Total	**665**	**156**	**100**	**620**	**133**	**56**	**10**	**94**	**1,833**
Household income ($m)									
Direct									
On-farm	*4.5*	*2.6*	*2.0*	*10.9*	*1.8*	*2.2*	*0.0*	*9.5*	***33.3***
Downstream	*1.4*	*2.3*	*1.0*	*8.5*	*0.1*	*0.3*	*0.0*	*0.0*	***13.7***
Total Direct	5.8	4.9	3.0	19.4	1.9	2.5	0.1	9.5	**47.0**
Total Flow-on	38.3	5.8	2.8	16.9	5.7	2.0	0.1	6.6	**78.2**
Total [c]	**44.2**	**10.7**	**5.8**	**36.3**	**7.6**	**4.5**	**0.1**	**16.1**	**125.2**

[a] Other aquaculture production in 2014/15 was comprised of Algae, Silver Perch (including fingerlings and spat), Shortfin Eel and Barcoo Grunter production.

[b] Note there is double counting in the total output impact (see Section 2.2 for an explanation).

[c] Totals may contain rounding errors.

Source: EconSearch analysis

Direct employment was estimated to be 817 fte (570 on-farm and 248 in downstream activities) in 2014/15 with 1,016 flow-on jobs, giving total employment of 1,833 fte (Table ES-2). Around

65 per cent of these jobs were generated in regional South Australia (Table ES-3). Direct household income was estimated to be approximately $47.0m in 2014/15 and flow-on income approximately $78.2m, giving a total household income impact of around $125.2m (Table ES-2). Around 57 per cent of the household income impact was generated in regional South Australia (Table ES-3).

In regional areas, the impact of the aquaculture industry in 2014/15 was concentrated in the Eyre Peninsula region, reflecting the dominance of Tuna farming in the total (Table ES-3).

Table ES-3 The total regional economic impact (direct and flow-on) of aquaculture in South Australia, 2014/15

	Output [a]		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
West Coast	16.4	4%	10.2	5%	136	11%	5.6	8%
Eyre Peninsula	361.5	91%	183.6	91%	956	81%	60.2	85%
Yorke Peninsula	0.1	0%	0.1	0%	6	1%	0.0	0%
Kangaroo Island	8.8	2%	2.7	1%	41	3%	1.7	2%
Adelaide and Hills [b]	3.1	1%	1.5	1%	17	1%	1.3	2%
Murraylands and SE	5.3	1%	2.5	1%	29	2%	2.2	3%
Total Regional Impact [c]	**395.3**	**100%**	**200.7**	**100%**	**1,186**	**100%**	**71.0**	**100%**
Regional Impact as a Proportion of Total	-	**72%**	-	**72%**	-	**65%**	-	**57%**

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

[b] Includes Adelaide metropolitan area.

[c] Totals may contain rounding errors.

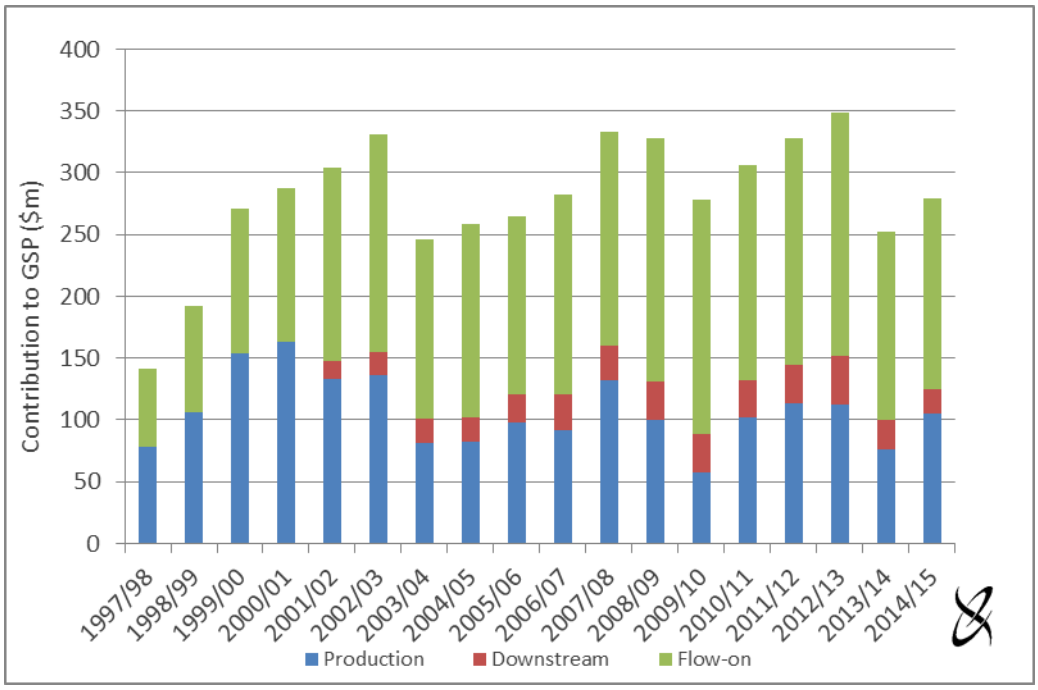
Source: EconSearch analysis

Total contribution to GSP attributable to aquaculture in SA exhibited a rising trend over the period 1997/98 to 2002/03 (Figure ES-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 2012/13 with fluctuations attributable primarily to changes in the production and value of farmed Tuna. GSP fell by 28 per cent between 2012/13 and 2013/14 as a result of a fall in value for a number of sectors including Tuna, Marine Finfish, Oysters, Freshwater Finfish and other aquaculture. The 11 per cent increase in contribution to GSP in 2014/15 resulted primarily from increases in Other, Tuna and Marine Finfish value of production.

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 ES-2). The significant fall in employment in 2010/11 was due to the use of a refined data collection form which resulted in improvements in the quality and accuracy of the responses from licence holders in the PIRSA Fisheries and Aquaculture Production Returns. The data collected in 2010/11 show that employment was inadvertently overstated in previous years. The fall in employment results in a reduction in household income and, due to the consequences from the modelled economic impacts, there

are also fewer people being employed in downstream and flow-on activities. This matter has now been resolved through the use of the refined Production Return forms. Total employment was fairly stable between 2010/11 and 2012/13, at around 2,600 fte but fell to around 1,900 in 2013/14 and 2014/15 in line with the fall in total value of production (Figure ES-2).

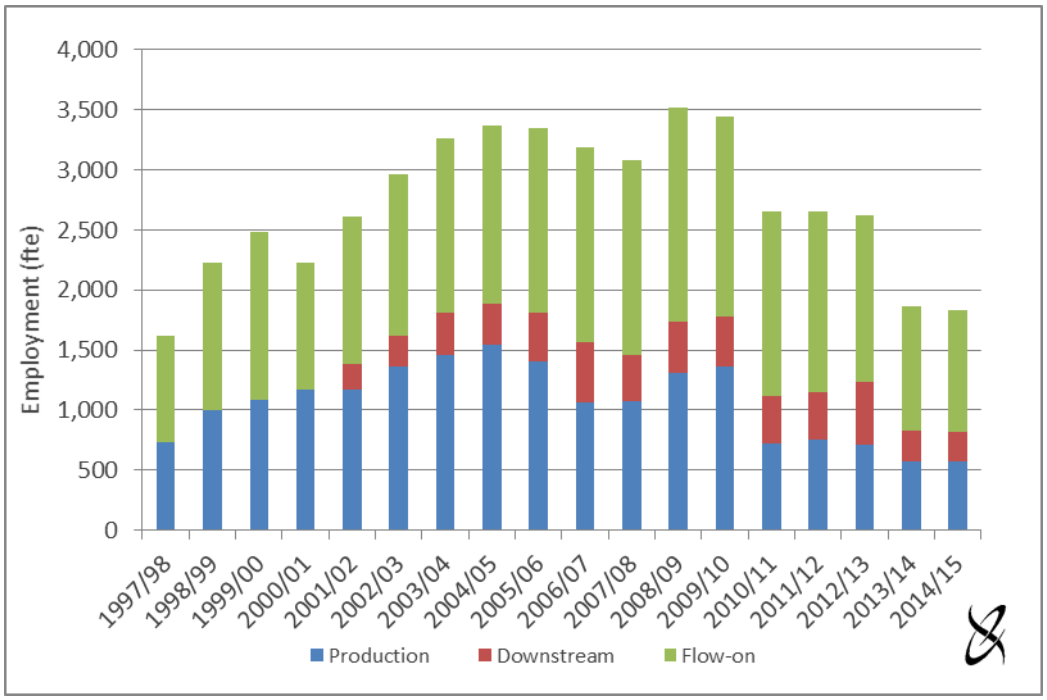
Figure ES-1 Total **GSP** impact of aquaculture in SA, 1997/98 to 2014/15 [a]



[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: Figure 12-1

Figure ES-2 Total **employment** impact of aquaculture in SA, 1997/98 to 2014/15 [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: Figure 12-2

From 1997/98 to 2000/01 only the first level of processing, marketing and handling of aquaculture production (i.e. production impacts) was included in the overall economic impact. Estimates of the economic impact of aquaculture presented in this report (i.e. for 2014/15) and for the previous 12 years include retail and food service trade and local transport services at all stages of the marketing chain (i.e. downstream impacts).

Projections for each sector in terms of production and on-farm employment over the three year period, 2015/16 to 2017/18, are summarised in Table ES-4 by species and in Table ES-5 by region. These projections were based on PIRSA Fisheries and Aquaculture's 2014/15 Production Return responses. Where possible, these data were validated and improved by industry representatives and with other sources of information. The projections for the larger production sectors through to 2017/18, relative to 2014/15, are detailed in Section 3.3 and can be summarised as follows.

- Tuna production – only minor changes to production and employment are projected through to 2017/18. There are a number of uncertainties which may influence production, especially market conditions such as the exchange rate for Japanese Yen, opening markets in China and reducing supply from other countries due to low prices (Brian Jeffriess pers. comm.). It is reasonable to assume that the change in employment will be in line with the expected change in production. There will be downward pressure on employment from production and other efficiencies, but this will be offset by job growth from value adding.
- Marine Finfish – Clean Seas increased their biomass by 76 per cent and its sales by 92 per cent between 2013/14 and 2014/15. They expect to almost double their 2014/15

level of sales (1,098t)) in 2015/16 and continue increasing sales towards 3,000t (Clean Seas 2015).

- Oysters – low growth in production as business confidence is currently low. Lower growth in employment as growers are investing more of their own time and employing minimal additional workers in an effort to save costs. These effects continue the trend from 2013/14. (Trudy McGowan, Executive Officer, South Australian Oyster Growers Association, pers. comm.).
- Mussels – an increase in demand is expected to bring a 7 per cent increase in production for 2015/16. Moderate increases in production are expected in 2016/17 and 2017/18 with production in 2017/18 expected to be around 17 per cent higher than in 2014/15. Employment is expected to increase by around 6 per cent by 2017/18 (Andy Dyer, SA Mussel Growers Association, pers. comm.).
- Abalone – growth in production of 13 per cent is expected in 2015/16 and only 3 per cent (relative to 2014/15) by 2017/18. Employment is expected to increase at roughly half the rate of production over the same period (Nick Savva, Executive Officer, Australian Abalone Growers Association, pers. comm.).
- Freshwater Finfish – low growth in production (7 per cent) in 2015/16 before decreasing towards current levels through to 2017/18. No significant change in employment is expected before 2017/18.
- Other aquaculture and Tourism – no growth in production or employment expected between 2014/15 and 2017/18.

Table ES-4 Projected growth in South Australian aquaculture production and employment, by species, 2015/16 to 2017/18 [a]

	Estimated cumulative change relative to 2014/15					
	Production			On-farm employment		
	2015/16	2016/17	2017/18	2015/16	2016/17	2017/18
Southern Bluefin Tuna	1%	-1%	-1%	1%	-1%	-1%
Marine Finfish [b]	82%	127%	173%	5%	5%	5%
Oysters	7%	13%	9%	2%	3%	4%
Mussels	7%	12%	17%	5%	9%	6%
Abalone	13%	9%	3%	9%	8%	2%
Freshwater Finfish [c]	7%	4%	2%	0%	0%	0%
Marron and Yabbies	14%	23%	34%	-2%	0%	0%
Other [d]	0%	0%	0%	0%	0%	0%
Tourism	0%	0%	0%	0%	0%	0%

[a] Based on an analysis of PIRSA Fisheries and Aquaculture's 2014/15 Production Return responses. The plausibility of the projections for Tuna, Marine Finfish, Mussels, Oysters, Abalone and Marron and Yabbies have been validated or modified by industry representatives and annual reports (pers. comm., Clean Seas 2015).

[b] Predominantly Yellowtail Kingfish production.

[c] Predominantly Barramundi production.

[d] Other aquaculture production in 2014/15 was comprised of Algae, Silver Perch (including fingerlings and spat), Shortfin Eel and Barcoo Grunter production.

Table ES-5 Projected growth in South Australian aquaculture production and employment, by region, 2015/16 to 2017/18 [a]

	Estimated cumulative change relative to 2014/15					
	Production			On-farm employment		
	2015/16	2016/17	2017/18	2015/16	2016/17	2017/18
Adelaide and Hills [b]	20%	13%	15%	0%	0%	0%
Eyre Peninsula	14%	24%	29%	5%	5%	5%
Kangaroo Island	0%	0%	1%	-1%	0%	0%
Murraylands and South East	2%	3%	0%	0%	0%	0%
West Coast	11%	6%	8%	1%	3%	4%
Yorke Peninsula	0%	0%	0%	0%	0%	0%

[a] See notes to Table ES-4. Changes are assumed to occur within the same region as current operations as plans to expand into other regions are not collected in the Production Returns.

[b] While high production growth is expected the base level is low so the expected amount of additional production is small.

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 2015/16 to 2017/18 have been imputed from the production projections. These GVP projections are presented in Table ES-6.

Table ES-6 Projected growth in South Australian aquaculture value of production, 2015/16 to 2017/18 [a]

	Actual GVP ($m)	Low GVP Forecast ($m) [b]			High GVP Forecast ($m) [c]		
	2014/15	2015/16	2016/17	2017/18	2015/16	2016/17	2017/18
Southern Bluefin Tuna	130.7	120.0	120.0	145.0	120.0	120.0	145.0
Marine Finfish	18.2	29.7	34.8	38.9	33.1	41.3	49.6
Oysters	28.7	30.2	31.8	30.7	30.5	32.3	31.0
Mussels	3.1	3.3	3.4	3.5	3.3	3.4	3.6
Abalone	11.4	12.9	12.4	11.7	12.9	12.4	11.7
Freshwater Finfish	4.1	4.3	4.3	4.2	4.4	4.3	4.2
Marron and Yabbies	0.5	0.5	0.5	0.6	0.5	0.6	0.6
Other	31.2	31.2	31.2	31.2	31.2	31.2	31.2
Total [d]	227.8	232.2	238.4	265.8	235.9	245.6	276.9
Tourism [e]	-	-	-	-	-	-	-

[a] All estimates of gross value of production (GVP) are in 2016 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 2014/15 levels).

[d] Totals may contain rounding errors.

[e] Value of tourism for 2014/15 was not reported by the industry.

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 are 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 2014/15 levels)

1. INTRODUCTION

The aim of this study was to estimate the economic impact of aquaculture activity in South Australia in 2014/15. The results reported here update and expand on those provided in previous studies (EconSearch 2015b). Estimates of the economic impact of aquaculture activity in South Australia in 2014/15 are provided for the following aquaculture sectors:

- Tuna (Southern Bluefin Tuna, *Thunnus maccoyii*)
- Marine Finfish (predominantly Yellowtail Kingfish, *Seriola lalandi*)
- Oysters (predominantly Pacific Oyster, *Crassostrea gigas*)
- Mussels (Blue Mussel*, Mytilus galloprovincialis*)
- Abalone (predominantly Greenlip Abalone, *Haliotis laevigata*)
- Freshwater Finfish (predominantly Barramundi, *Lates calcarifer* and Rainbow Trout, *Oncorhynchus mykiss*)
- Marron (*Cherax tenuimanus*) and Yabbies (*Cherax destructor*)
- Other aquaculture (comprised of Algae, *Dunaliella salina*; Silver Perch, *Bidyanus bidyanus*; Shortfin Eel, *Anguilla australis;* and Barcoo Grunter, *Scortum barcoo*).

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 Wudinna)
- Eyre Peninsula (Lower Eyre Peninsula to Port Augusta, including Kimba)
- Yorke Peninsula (covers Yorke Peninsula, Mid North and Barossa)
- Kangaroo Island
- Adelaide and Adelaide Hills (including Fleurieu peninsula)
- Murraylands (Riverland and Murraylands) and the South East (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 10:	The economic impacts of each aquaculture sector are presented at the state and regional levels.
Section 11:	Other facets of regional economic development associated with aquaculture activity in SA are presented.
Section 12:	Economic impacts of aquaculture over time.

2. METHOD

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 the Premier and Cabinet (EconSearch 2015a). 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 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 2014/15) and for the period 2001/02 to 2012/13 (EconSearch 2015b) are consistent with the 'message' and method in:

- PIRSA's Food for the Future value chain analysis 2009/10 (Seafood Scorecard)
- 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 production[1]
- the net value of local (SA) processing
- the net value of local retail and food service trade
- the value of local transport services at all stages of the marketing chain.

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

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

Table 2-1 Change in scope of the economic impact assessment

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

[a] For the years 1996/97 to 2000/01.

[b] For the years 2001/02 to 2014/15 (EconSearch 2015b).

2.2 Indicators of Economic Impact

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 product
- employment
- 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.

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
- 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 above.

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.

2.3 Data

Value of output and production estimates for South Australian aquaculture for 2014/15 were based on PIRSA Fisheries and Aquaculture's 2014/15 Production Returns. Representative cost structures and other relevant information for enterprises operating in individual sectors of the aquaculture and fishing industries were updated from 2002/03 to 2014/15 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
- proportion of feed sourced from local region, other SA or interstate - average per enterprise

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

Estimates of the net value of local (SA and regional) processing margins, the net value of local retail and food service trade margins and the value of local transport margins at all stages of the marketing chain were imputed for each aquaculture sector on the basis of discussions with a range of relevant industry contacts in each sector.

3. AQUACULTURE PRODUCTION & EMPLOYMENT IN SA

3.1 Production and Value of Production

Estimates of South Australian Tuna, Oyster and remaining aquaculture production and value of production for the years 2013/14 and 2014/15 are presented in Table 3-1. Some description of these data is provided below. Similar data for the period 1995/96 to 2014/15 are provided in Appendix 3 of the report. Overall, total production increased by 28 per cent between 2013/14 (15,447t) and 2014/15 (19,763t) and total value increased by 25 per cent (from $181.6m to $227.8) (Table 3-1).

Table 3-1 Aquaculture production and value of production, SA, 2013/14 and 2014/15

	Weight ('000kg)			Value ($m)		
	2013/14	2014/15	Change	2013/14	2014/15	Change
Southern Bluefin Tuna	7,544	8,418	12%	122.40	130.67	7%
Marine Finfish [a]	579	1,098	90%	8.01	18.18	127%
Oysters						
adult [b]	4,900	3,891	-21%	32.08	28.39	-12%
on-grown [c]	1,423	474	-67%	2.34	0.82	-65%
spat [d]	-	-	-	0.23	0.33	-
Mussels	1,619	1,577	-3%	3.45	3.07	-11%
Abalone	330	334	1%	10.89	11.40	5%
Freshwater Finfish	233	272	17%	2.37	4.11	73%
Marron and Yabbies	12	13	4%	0.43	0.45	5%
Other [e]	230	4,160	1707%	1.74	31.21	1694%
Total [f]	**15,447**	**19,763**	**28%**	**181.59**	**227.82**	**25%**
Tourism (visitors) [g]	8,303	9,732	17%	0.51	-	-

[a] Includes production of fingerlings.

[b] The weight for adult Oysters is an approximation on the basis that a dozen Oysters weighs one kilogram.

[c] The volume and value of juvenile Oysters sold for on-growing are excluded from the total volume and value of aquaculture as it is considered an input to production for the final sales of adult Oysters.

[d] The value of spat is included in the total. Some spat is sold in SA and some interstate but the exact proportions are uncertain due to incomplete production returns. No sales reported in 2014/15.

[e] Other aquaculture production in 2014/15 was comprised of Algae, Silver Perch (including fingerlings and spat), Shortfin Eel and Barcoo Grunter production.

[f] Totals may contain rounding errors.

[g] Value of tourism for 2014/15 was not reported by the industry.

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

Between 2013/14 and 2014/15 the following changes in production and value of production are apparent.

- The value of Tuna farm output increased by 7 per cent as a result of a 12 per cent increase in volume of farmed tuna produced and despite a 4 per cent reduction in the price for farmed Tuna (provided by ABARES, verified by Brian Jeffriess, Australian Southern Bluefin Tuna Industry Association (ASBTIA), pers. comm.). The 4 per cent reduction in price received in Australian dollars in 2014/15 was partly due to a fall in price in terms of Yen, exacerbated by an appreciation of the Australian dollar against the Yen.
- The value of Marine Finfish production increased by 127 per cent as a result of several favourable factors including better biological performance and survival rate, an expanding market and a higher per unit price (up 20 per cent from 2013/14). The success of a second product line (smaller sized Kingfish) from the leading producer has also contributed to growth in sales (Clean Seas 2015).
- The value of Oyster production decreased by 12 per cent as a result of a 21 per cent decrease in volume and despite an 11 per cent increase in price for adult Oysters (Trudy McGowan, Executive Officer, South Australian Oyster Growers Association, pers. comm.). These changes continue the trend of decreasing volume and increasing per unit price from the 2013/14 period.
- The value of Mussel production decreased by 11 per cent due to a 3 per cent decrease in production and a 9 per cent decrease in the per unit price of Mussels (validated by Andy Dyer, SA Mussel Growers Association, pers. comm.).
- The value of Abalone production increased by 5 per cent as a result of a 1 per cent increase in the volume of Abalone production and a 3 per cent increase in the per unit price (Nicholas Savva, Executive Officer, Australian Abalone Growers Association, pers. comm.).
- The value of Freshwater Finfish production increased by 73 per cent as a result of a 17 per cent increase in the volume of Freshwater Finfish production and a 49 per cent increase in the per unit price.
- The value of Marron/Yabbies production increased by 5 per cent as a result of a 4 per cent increase in the volume of Marron/Yabbies production and a 1 per cent increase in the per unit price of Marron/Yabbies (verified by John Luckens, Australian Freshwater Crayfish Growers Association (SA), pers. comm.).
- After a 93 per cent decrease in the value of Other aquaculture production between 2012/3 and 2013/14, the value of production recovered such that in 2014/15 ($31.2m) it exceeded that of 2012/13 ($25.7m). This recovery accounted for over half of the increase in value of aquaculture production between 2013/14 and 2014/15. Other aquaculture includes algae production, which can vary from year to year depending on global market effects. It is therefore likely that production will continue to fluctuate in South Australia into the future.

- Aquaculture tourism operators offer the opportunity to swim with tuna and interact with other marine organisms, resulting in an estimated 9,700 visitors in 2014/15. This was a 17 per cent increase from 2013/14.

A breakdown of aquaculture value of production in 2014/15 by region is detailed in Table 3-2 and Table 3-3. Similar data for aquaculture production in 2014/15 are detailed in Table 3-4 and Table 3-5. Activity in the Tuna, Marine Finfish, Oysters, Mussels, Abalone and tourism is concentrated in the Eyre Peninsula region. The production of remaining aquaculture species (i.e. Freshwater Finfish and Marron/Yabbies) is more widely distributed across SA.

Table 3-2 Aquaculture value of production by sector and region, South Australia, 2014/15 ($'000)

	West Coast	Eyre Peninsula	Yorke Peninsula	Kangaroo Island	Adelaide and Hills	Murraylands and South East	All regions
Southern Bluefin Tuna	0	130,669	0	0	0	0	130,669
Marine Finfish[a]	0	18,185	0	0	0	0	18,185
Oysters [a]	8,927	19,640	37	115	0	0	28,718
Mussels	0	3,069	0	0	0	0	3,069
Abalone [a]	181	6,600	0	4,620	0	0	11,401
Freshwater Finfish [a]	0	1	0	14	1,319	2,774	4,108
Marron and Yabbies	0	5	51	365	29	4	455
Other	0	31,196	0	0	11	5	31,212
Total	9,109	209,365	88	5,113	1,359	2,784	227,818
Tourism [b]	0	-	0	0	0	0	-

[a] Includes the value of local spat and fingerling sales but excludes on-grown sales.

[b] Value of tourism for 2014/15 was not reported by the industry.

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

Table 3-3 Proportion of aquaculture value of production by sector and region, South Australia, 2014/15

	West Coast	Eyre Peninsula	Yorke Peninsula	Kangaroo Island	Adelaide and Hills	Murraylands and South East	All regions
Southern Bluefin Tuna	0%	100%	0%	0%	0%	0%	100%
Marine Finfish	0%	100%	0%	0%	0%	0%	100%
Oysters	31%	68%	0%	0%	0%	0%	100%
Mussels	0%	100%	0%	0%	0%	0%	100%
Abalone	2%	58%	0%	41%	0%	0%	100%
Freshwater Finfish	0%	0%	0%	0%	32%	68%	100%
Marron and Yabbies	0%	1%	11%	80%	6%	1%	100%
Other	0%	100%	0%	0%	0%	0%	100%
Total	4%	92%	0%	2%	1%	1%	100%
Tourism	0%	100%	0%	0%	0%	0%	100%

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

Table 3-4 Aquaculture production by sector and region, South Australia, 2014/15 ('000kg)

	West Coast	Eyre Peninsula	Yorke Peninsula	Kangaroo Island	Adelaide and Hills	Murraylands and South East	All regions
Southern Bluefin Tuna	0	8,418	0	0	0	0	8,418
Marine Finfish	0	1,098	0	0	0	0	1,098
Oysters	1,324	2,546	4	17	0	0	3,891
Mussels	0	1,577	0	0	0	0	1,577
Abalone	4	165	0	165	0	0	334
Freshwater Finfish	0	0	0	1	60	211	272
Marron and Yabbies	0	0	2	9	1	0	13
Other	0	4,159	0	0	0	1	4,160
Total	1,328	17,963	7	192	60	212	19,763
Tourism ('000 visitors)	0	10	0	0	0	0	10

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

Table 3-5 Proportion of aquaculture production by sector and region, South Australia, 2014/15

	West Coast	Eyre Peninsula	Yorke Peninsula	Kangaroo Island	Adelaide and Hills	Murraylands and South East	All regions
Southern Bluefin Tuna	0%	100%	0%	0%	0%	0%	100%
Marine Finfish	0%	100%	0%	0%	0%	0%	100%
Oysters	34%	65%	0%	0%	0%	0%	100%
Mussels	0%	100%	0%	0%	0%	0%	100%
Abalone	1%	49%	0%	49%	0%	0%	100%
Freshwater Finfish	0%	0%	0%	0%	22%	78%	100%
Marron and Yabbies	0%	1%	16%	75%	6%	2%	100%
Other	0%	100%	0%	0%	0%	0%	100%
Total	7%	91%	0%	1%	0%	1%	100%
Tourism	0%	100%	0%	0%	0%	0%	100%

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

There are only minor differences in the regional distribution by species of production and value of production. For example, Adelaide and Hills was estimated to produce 22 per cent of Freshwater Finfish by volume but 32 per cent by value (Table 3-3 and Table 3-5).

3.2 Employment in SA Aquaculture

Estimates of direct employment in South Australian aquaculture for the years 2013/14 and 2014/15 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 2014/15 Production Returns. Overall, direct employment in aquaculture

operations increased by less than 1 per cent between 2013/14 (569 fte) and 2014/15 (570 fte). In 2014/15 there were 4 jobs associated with aquaculture tourism operations up from 3 fte jobs in 2013/14 (28 per cent higher).

Some notable differences in direct employment between 2013/14 and 2014/15 by species are:

- 45 per cent increase in Other aquaculture. This is a small industry so the absolute change of 3 fte jobs appears as a large percentage.
- 37 per cent decrease for Marron and Yabbies. This is also a small industry with most work carried out by proprietors. Fluctuations in production, therefore, lead to large fluctuations in ftes as proprietors vary the amount of effort they make.
- 16 per cent increase for Abalone, returning to the level of employment in 2012/13.
- 13 per cent decrease for Freshwater Finfish, continuing a downward trend.

Table 3-6 Direct employment by aquaculture sector, South Australia, 2013/14 and 2014/15

	Employment (fte)		
	2013/14	2014/15	Change from 2013/14
Southern Bluefin Tuna	163	160	-2%
Marine Finfish	39	38	-3%
Oysters	240	242	1%
Mussels	41	43	5%
Abalone	37	43	16%
Freshwater Finfish	29	25	-13%
Marron and Yabbies	13	8	-37%
Other [a]	7	10	45%
Total	569	570	0%
Tourism	3	4	28%

[a] 'Other aquaculture' also includes land-based and miscellaneous licences which cannot be allocated to specific sectors.

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

A breakdown of direct employment in 2014/15 in SA aquaculture by region is detailed in Table 3-7 and Table 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 34 per cent of Oysters by volume but was responsible for 38 per cent of Oyster employment (Table 3-5 and Table 3-8). These differences may reflect a large proportion of, as yet, unproductive leases in this region (i.e. currently under development) or the total number of leases in the Eyre Peninsula region are operated by a smaller number of owners and the workers cover more leases compared to West Coast where leases may be spread over more individual owners and therefore more workers.

Table 3-7 Direct employment by aquaculture sector and region, South Australia, 2014/15 (fte)

	West Coast	Eyre Peninsula	Yorke Peninsula	Kangaroo Island	Adelaide and Hills	Murraylands and South East	All regions
Southern Bluefin Tuna	0	160	0	0	0	0	160
Marine Finfish	0	38	0	0	0	0	38
Oysters	91	141	6	4	0	0	242
Mussels	0	43	0	0	0	0	43
Abalone	11	13	0	18	0	0	43
Freshwater Finfish	0	2	0	0	8	15	25
Marron and Yabbies	0	1	0	4	4	1	8
Other	0	7	1	0	2	0	10
Total	103	405	7	27	13	15	570
Tourism	0	4	0	0	0	0	4

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

Table 3-8 Proportion of direct employment by region, South Australia, 2014/15

	West Coast	Eyre Peninsula	Yorke Peninsula	Kangaroo Island	Adelaide and Hills	Murraylands and South East	All regions
Southern Bluefin Tuna	0%	100%	0%	0%	0%	0%	100%
Marine Finfish	0%	100%	0%	0%	0%	0%	100%
Oysters	38%	58%	2%	2%	0%	0%	100%
Mussels	0%	100%	0%	0%	0%	0%	100%
Abalone	27%	30%	0%	43%	0%	0%	100%
Freshwater Finfish	0%	9%	0%	0%	32%	58%	100%
Marron and Yabbies	0%	6%	0%	46%	42%	6%	100%
Other	0%	73%	10%	0%	17%	0%	100%
Total	18%	71%	1%	5%	2%	3%	100%
Tourism	0%	100%	0%	0%	0%	0%	100%

[a] Rounding of figures results in totals for all regions +/- 1 per cent.

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

3.3 Projected Growth in Production and Employment

Aquaculture licence holders were required to provide projections of their production and on-farm employment over the three year period, 2015/16 to 2017/18. The projections from the PIRSA Fisheries and Aquaculture 2014/15 Production Returns are summarised in Table 3-9 by species and in Table 3-10 by region. Where possible, these data were validated and improved by industry representatives and with other sources of information. The implied production (tonnes or '000 doz.) and on-farm employment (full-time equivalents) levels by species are provided in Table 3-11 and Table 3-12, respectively.

Table 3-9 Projected growth in South Australian aquaculture production and on-farm employment, by species, 2015/16 to 2017/18 (percentage change) [a]

	Estimated cumulative change relative to 2014/15					
	Production			On-farm employment		
	2015/16	2016/17	2017/18	2015/16	2016/17	2017/18
Southern Bluefin Tuna	1%	-1%	-1%	1%	-1%	-1%
Marine Finfish [b]	82%	127%	173%	5%	5%	5%
Oysters	7%	13%	9%	2%	3%	4%
Mussels	7%	12%	17%	5%	9%	6%
Abalone	13%	9%	3%	9%	8%	2%
Freshwater Finfish [c]	7%	4%	2%	0%	0%	0%
Marron and Yabbies	14%	23%	34%	-2%	0%	0%
Other [d]	0%	0%	0%	0%	0%	0%
Tourism	0%	0%	0%	0%	0%	0%

[a] Based on an analysis of PIRSA Fisheries and Aquaculture's 2014/15 Production Return responses. The plausibility of the projections for Tuna, Marine Finfish, Mussels, Oysters, Abalone and Marron and Yabbies have been validated or modified by industry representatives and annual reports (pers. comm., Clean Seas 2015).

[b] Predominantly Yellowtail Kingfish production.

[c] Predominantly Barramundi production.

[d] Other aquaculture production in 2014/15 was comprised of Algae, Silver Perch (including fingerlings and spat), Shortfin Eel and Barcoo Grunter production.

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns, Brian Jeffries pers. comm., Clean Seas 2015

Table 3-10 Projected growth in South Australian aquaculture production and on-farm employment, by region, 2015/16 to 2017/18 (percentage change) [a]

	Estimated cumulative change relative to 2014/15					
	Production			On-farm employment		
	2015/16	2016/17	2017/18	2015/16	2016/17	2017/18
Adelaide and Hills [b]	20%	13%	15%	0%	0%	0%
Eyre Peninsula	14%	24%	29%	5%	5%	5%
Kangaroo Island	0%	0%	1%	-1%	0%	0%
Murraylands and South East	2%	3%	0%	0%	0%	0%
West Coast	11%	6%	8%	1%	3%	4%
Yorke Peninsula	0%	0%	0%	0%	0%	0%

[a] See notes to Table 3-10. Changes are assumed to occur within the same region as current operations as plans to expand into other regions are not collected in the Production Returns.

[b] While a high production growth rate is expected in the Adelaide and Hills region, the base level is low so the expected amount of additional production is small.

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns, Brian Jeffries pers. comm., Clean Seas 2015

The projections for each sector through to 2017/18, relative to 2014/15, can be summarised as follows.

- Tuna production – only minor changes to production and employment are projected through to 2017/18. There are a number of uncertainties which may influence production, especially market conditions (Brian Jeffriess pers. comm.):

  - The volatility in the Australian dollar and Japanese Yen (JPY) exchange rate. For example, the JPY was 14 per cent stronger against the Australian dollar in August 2015 (the month of major shipment and customs calculation) than at the same time in 2014.
  - The product price in Japan is expected to increase in 2017.
  - Cold store stocks of tuna in Japan almost doubled between 2013 and 2015. This is likely to moderate any short term positive demand shocks in Japan.
  - The currently depressed prices in the industry are expected to lead to declines in supply from multi-year grow-outs in other countries around 2017/18.
  - The industry has continued the trend of reducing farm mortalities.
  - The SBT industry is expecting to develop their market in China which will increase demand and allow for volume increases beyond the projections presented in the report.

- Tuna employment – it is reasonable to assume that the change in employment will be in line with the expected change in production. There will be downward pressure on employment from production and other efficiencies, but this will be offset by job growth from value adding (e.g. return to more fresh fish and a higher proportion of the frozen harvest processed onshore).
- Marine Finfish – Clean Seas increased their biomass by 76 per cent and its sales by 92 per cent between 2013/14 and 2014/15. They expect to almost double their 2014/15 level of sales (1,098t)) in 2015/16 and continue increasing sales towards 3,000t (Clean Seas 2015). After a period of consolidation, employment is projected to increase only slightly through 2014/15 to 2017/18.
- Oysters – low growth in production as business confidence is currently low. Lower growth in employment as growers are investing more of their own time and employing minimal additional workers in an effort to save costs. These effects continue the trend from 2013/14. (Trudy McGowan, Executive Officer, South Australian Oyster Growers Association, pers. comm.).
- Mussels – an increase in demand is expected to bring a 7 per cent increase in production for 2015/16. Moderate increases in production are expected in 2016/17 and 2017/18 with production in 2017/18 expected to be around 17 per cent higher than in 2014/15. Employment is expected to increase by around 6 per cent by 2017/18 (Andy Dyer, SA Mussel Growers Association, pers. comm.).
- Abalone – growth in production of 13 per cent is expected in 2015/16 and only 3 per cent (relative to 2014/15) by 2017/18. Employment is expected to increase at roughly half the rate of production over the same period (Nick Savva, Executive Officer, Australian Abalone Growers Association, pers. comm.).
- Freshwater Finfish – low growth in production (7 per cent) in 2015/16 before decreasing towards current levels through to 2017/18. No significant change in employment is expected before 2017/18.

- Marron and Yabbies – strong growth in production (14 per cent) and little change in employment is expected through to 2017/18. Production growth figures are optimistic and, if realised, will likely come from major Marron producers only (John Luckens, Australian Freshwater Crayfish Growers Association (SA), pers. comm.).
- Other aquaculture and Tourism – no growth in production or employment expected between 2014/15 and 2017/18.

Table 3-11 Projected growth in South Australian aquaculture production, 2015/16 to 2017/18 (t or '000 doz.)

	Actual Production [a]	Forecast Production [b]			Av. annual growth rate
	2014/15	2015/16	2016/17	2017/18	
Southern Bluefin Tuna (t)	8,418	8,480	8,300	8,350	-0.3%
Marine Finfish (t)	1,098	1,997	2,495	2,994	39.7%
Oysters ('000 doz.)	3,891	4,146	4,401	4,225	2.8%
Mussels (t)	1,577	1,689	1,764	1,839	5.3%
Abalone (t)	334	379	364	344	0.9%
Freshwater Finfish (t)	272	290	283	277	0.7%
Marron and Yabbies (t)	13	14	16	17	10.2%
Other (t)	4,160	4,160	4,160	4,160	0.0%
Total	19,763	21,155	21,783	22,206	4.0%
Toursim ('000 visitors)	10	10	10	10	0.0%

[a] See Table 3.1.

[b] Based on the projections summarised in Table 3.9. Figures rounded to the nearest thousand so small percentage changes are not reflected in the absolute values.

Source: PIRSA Fisheries and Aquaculture and EconSearch analysis

Table 3-12 Projected growth in South Australian aquaculture on-farm employment, 2015/16 to 2017/18 (full-time equivalents)

	Actual Employment (fte) [a]	Forecast Employment (fte) [b]			Av. annual growth rate
	2014/15	2015/16	2016/17	2017/18	
Southern Bluefin Tuna	160	161	158	159	-0.3%
Marine Finfish	38	40	40	40	1.6%
Oysters	242	246	250	252	1.3%
Mussels	43	45	47	46	2.1%
Abalone	43	47	46	43	0.5%
Freshwater Finfish	25	25	25	25	0.0%
Marron and Yabbies	8	8	8	8	0.0%
Other	10	10	10	10	0.0%
Total	570	582	584	583	0.8%
Tourism	4	4	4	4	0.0%

[a] Derived from PIRSA Fisheries and Aquaculture's 2014/15 Production Returns responses. Includes employment on inactive, undeveloped and underdeveloped leases.

[b] Based on the projections summarised in Table 3.9.

Source: PIRSA Fisheries and Aquaculture and EconSearch analysis

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 3-10 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 demand.

Short-run elasticities of demand for primary products are generally relatively price inelastic. 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-run price elasticity of demand for aquaculture products is –2.0 and the reciprocal, the price flexibility coefficient, is -0.5.

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 2015/16 to 2017/18. These projections are presented in Table 3-13.

Table 3-13 Projected growth in South Australian aquaculture value of production, 2015/16 to 2017/18 [a]

	Actual GVP ($m)	Low GVP Forecast ($m) [b]			High GVP Forecast ($m) [c]		
	2014/15	2015/16	2016/17	2017/18	2015/16	2016/17	2017/18
Southern Bluefin Tuna	130.7	120.0	120.0	145.0	120.0	120.0	145.0
Marine Finfish	18.2	29.7	34.8	38.9	33.1	41.3	49.6
Oysters	28.7	30.2	31.8	30.7	30.5	32.3	31.0
Mussels	3.1	3.3	3.4	3.5	3.3	3.4	3.6
Abalone	11.4	12.9	12.4	11.7	12.9	12.4	11.7
Freshwater Finfish	4.1	4.3	4.3	4.2	4.4	4.3	4.2
Marron and Yabbies	0.5	0.5	0.5	0.6	0.5	0.6	0.6
Other	31.2	31.2	31.2	31.2	31.2	31.2	31.2
Total [d]	227.8	232.2	238.4	265.8	235.9	245.6	276.9
Tourism [e]	-	-	-	-	-	-	-

[a] All estimates of gross value of production (GVP) are in 2016 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 2014/15 levels).

[d] Totals may contain rounding errors.

[e] Value of tourism for 2014/15 was not reported by the industry.

Source: PIRSA Fisheries and Aquaculture and EconSearch analysis

3.4 Other Indicators from the Production Returns

It was possible to derive a range of other data from the 2014/15 Production Returns. Estimates are provided below for the following indicators for SA for 2014/15.

- Proportion of aquaculture production, value of production and employment by sector (Table 3-14).
- The number of aquaculture licences by sector (Table 3-15).
- Aquaculture spat and fingerling introductions and sales (Table 3-16).
- Reasons provided for nil returns (Table 3-17).

Table 3-14 Proportion of aquaculture production, value of production and employment by sector, South Australia, 2014/15

	Production	Value	Direct employment
Southern Bluefin Tuna	43%	57%	28%
Marine Finfish	6%	8%	7%
Oysters	20%	13%	43%
Mussels	8%	1%	8%
Abalone	2%	5%	7%
Freshwater Finfish	1%	2%	4%
Marron and Yabbies	0%	0%	1%
Other	21%	14%	2%
Total	100%	100%	100%

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

Table 3-15 Number of aquaculture licences reporting activity [a], by sector, South Australia, 2014/15

	Number of Licences	
Southern Bluefin Tuna	13	3%
Marine Finfish	7	2%
Oysters	156	41%
Mussels	24	6%
Abalone	7	2%
Freshwater Finfish	11	3%
Marron and Yabbies	11	3%
Other	8	2%
Tourism	2	1%
No production or employment reported	140	37%
Total	379	100%

[a] Licences are only included if production and/or employment was reported in the 2014/15 Production Returns. This is not the total number of licences in each sector as not every licence holder submitted a production return. Licences are counted twice if they produced in two sectors in 2014/15.

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

Table 3-16 Aquaculture spat and fingerling introductions and sales, South Australia, 2014/15

	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]	166	100%	0	0	0
Marine Finfish [b]	443	100%	30	59	1
Oysters [c]	144,841	15%	475	1,150	3
Mussels [d]	6,000	0%	0	0	0
Abalone [e]	3,581	100%	2	97	1
Freshwater Finfish	787	77%	232	3,615	10
Marron and Yabbies	0	-	0	0	0
Other	4	3%	1	14	3
Total	155,821	17%	740	4,935	39

[a] Wild caught juveniles, 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 or sourced from hatcheries.

[e] Includes self-produced at a land-based hatchery, on-grown spat.

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

Table 3-17 Reasons provided for nil returns, 2014/15

Reason provided for nil returns	Number of licences	
None provided / ambiguous / personal	51	33%
Normal operation does not involve sales [a]	30	19%
Ownership/regulatory [b]	26	17%
No infrastructure on site	21	14%
Stock levels too low	12	8%
Maintainance only	7	5%
Other	4	3%
Poor market conditions	3	2%
High mortality	1	1%
Total	155	100%

[a] For example, the licence may be used for research, holding stock, catching spat, or growing juveniles which are transferred to another licence before selling.

[b] For example, the licence is for sale, currently being transferred, or under another regulatory process.

Source: PIRSA Fisheries and Aquaculture 2014/15 Production Returns

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

The state's total value of seafood production (landed) in 2014/15 was around $468.9 million, of which aquaculture contributed 49 per cent ($227.2m) and wild-catch fisheries, the balance ($241.1m) (Table 3-18). In aggregate, Tuna is the largest single sector in the state's aquaculture industry, accounting for approximately 57 per cent of the state's gross value of aquaculture

production in 2014/15. The other three main sectors are Other (14 per cent), Oysters (13 per cent), Marine Finfish (8 per cent) and Abalone (5 per cent).

Table 3-18 Value of aquaculture production and wild fisheries catch, South Australia, 2014/15

	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	8,418	130.7	57.4%	27.9%
Marine Finfish	1,098	18.2	8.0%	3.9%
Oysters	3,891	28.7	12.6%	6.1%
Mussels	1,577	3.1	1.3%	0.7%
Abalone	334	11.4	5.0%	2.4%
Freshwater Finfish	272	4.1	1.8%	0.9%
Marron and Yabbies	13	0.5	0.2%	0.1%
Other [a]	4,160	31.2	13.7%	6.7%
Total Aquaculture	**19,763**	**227.8**	**100.0%**	**48.6%**
Wild Catch Fisheries [b]				
Rock Lobster [c]	1,635	125.3	-	26.7%
Abalone	744	25.2	-	5.4%
Prawns	2,123	35.8	-	7.6%
Sardines	36,020	21.6	-	4.6%
Other Marine Fisheries	3,180	27.1	-	5.8%
Inland Water Fisheries	1,598	6.0	-	1.3%
Total Wild Catch	**45,300**	**241.1**	**-**	**51.4%**
Total Seafood	**65,063**	**468.9**	**-**	**100.0%**

[a] Other aquaculture production in 2014/15 was comprised of Algae, Silver Perch (including fingerlings and spat), Shortfin Eel and Barcoo Grunter production.

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

[c] Rock Lobster production includes winter trials data.

Source: SARDI Aquatic Sciences and PIRSA Fisheries and Aquaculture 2014/15 Production Returns

3.6 Exchange Rates

A large proportion of the South Australian aquaculture production, particularly Tuna, is exported overseas. Accordingly, the value of the Australian dollar can have a significant impact on the economic performance of the industry. The value of the Australian dollar influences the price of Australian exports overseas. Significant changes in the value of the Australian dollar have the potential to influence the demand for Australian aquaculture exports. The Australian dollar steadily depreciated throughout 2014/15 beginning at US$0.94 in July 2014 and falling to US$0.77 in June 2015.

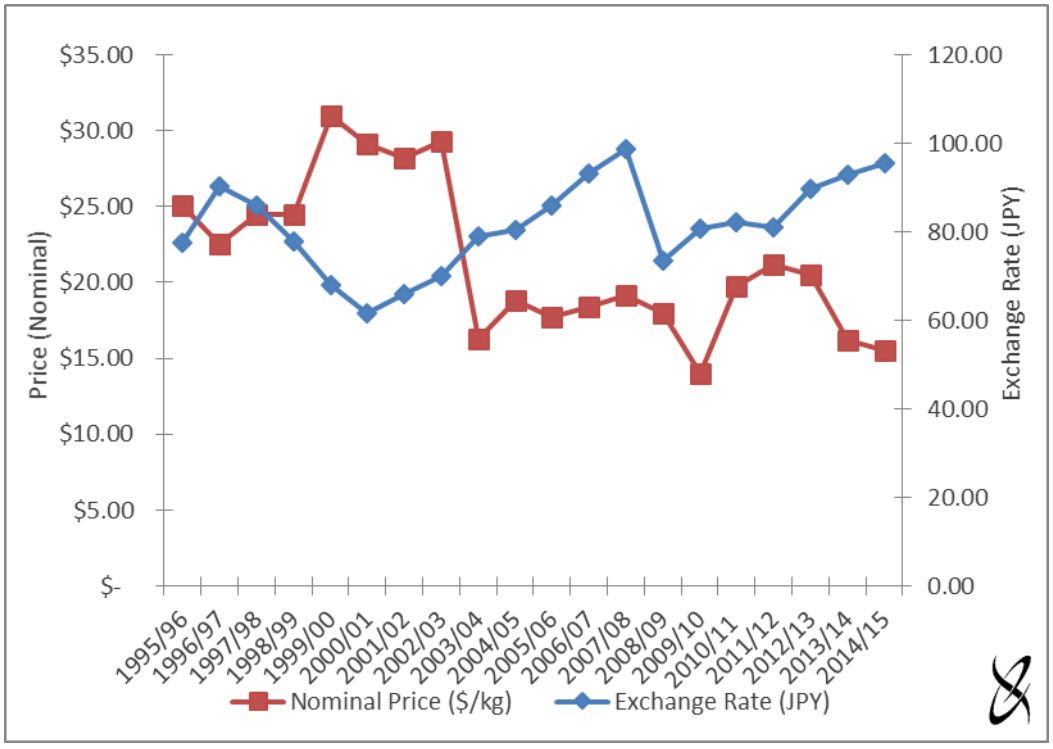
The average exchange rate in 2014/15 was US$0.84, a decrease of 9 per cent compared to the average for the previous year (RBA 2016). Other things held equal, a fall in the value of the

currency would have the effect of increasing the price of aquaculture product received by Australian exporters between 2013/14 and 2014/15.

A significant export destination for South Australian Tuna is Japan. Thus it may be useful to compare the value of the Australian dollar with the Japanese Yen (JPY). The average rate of exchange in 2013/14 was 92.77 JPY increasing to 95.55 (JPY) in 2014/15 (Figure 3-1).

The relationship between the price of Tuna and the exchange rate (JPY) between 1995/96 and 2014/15 can be readily observed in Figure 3-1. A widely used measure of the relationship between two variables, such as price and exchange rate, is the coefficient of correlation. The coefficient of correlation can range in value from +1.0 for a perfect positive correlation to –1.0 for a perfect inverse correlation. The coefficient of correlation between the exchange rate (JPY) and the price for SA farmed Tuna for the period 1995/96 to 2014/15 is –0.68. This indicates that there is a strong inverse relationship between the two variables. Thus, when the Australian dollar appreciates against the JPY, as it did between 2013/14 and 2014/15, there is, generally, a corresponding decline in the average price of SA farmed Tuna.

Figure 3-1 Exchange rate (JPY) and price for Tuna, 1995/96 to 2014/15



Source: RBA (2016)

4. THE ECONOMIC IMPACT OF AQUACULTURE IN SA, 2014/15

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 2014/15 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. These flow-on effects have been estimated using input-output analysis. Input-output analysis is widely used in economic impact analysis and is a practicable method for measuring economic impacts at regional and state levels. In order to compile a representative cost structure for each sector, costs were derived from data provided by operators in 2002/03 and updated to 2014/15, as described earlier. On an item-by-item basis, the expenditures were allocated between those occurring in South Australia and those goods and services imported from outside the state. These data were then incorporated into the state input-output model to estimate the flow-on or indirect economic impacts.

4.1 The Economic Impact of Tuna Farming in South Australia, 2014/15

Estimates of the economic impact generated by the Tuna farming industry in SA on a sector-by-sector basis for 2014/15 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.

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 $130.7 million and in other sectors (processing and transport), $5.8 million in 2014/15. Flow-on output in other sectors of the state economy summed to $136.2 million (Table 4-1). The sectors most affected were the Tuna fishing (Tuna capture), Sardine fishing, property and business services, manufacturing, trade, finance and transport 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 2.00 indicates that for each dollar of sales generated by the Tuna industry (farming and downstream) there was a total of $2.00 of output generated by businesses throughout the state, $1.00 in the Tuna industry (farming and downstream) and $1.00 in other sectors of the economy (e.g. tuna fishing, property and business services, manufacturing, Sardine fishing, trade, finance and transport sectors).

Table 4-1 The economic impact of Tuna farming in South Australia, 2014/15

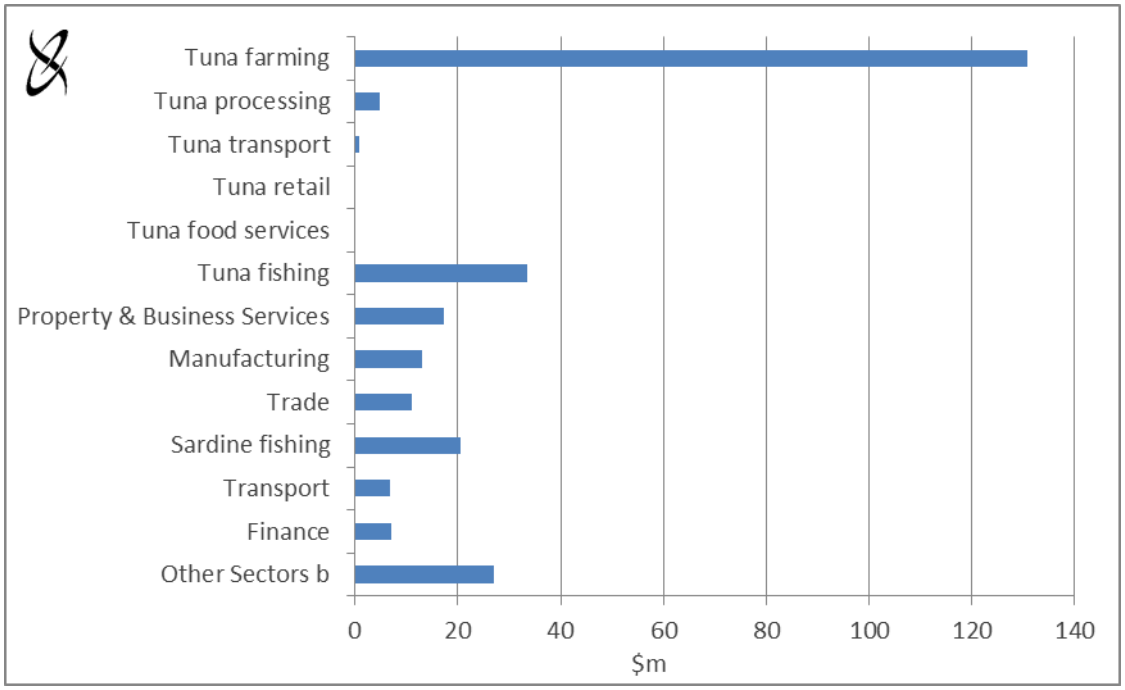
Sector	Output		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Tuna farming	130.7	48%	51.6	38%	160	24%	4.5	10%
Processing	4.9	2%	1.6	1%	17	3%	1.1	2%
Transport	0.9	0%	0.4	0%	3	0%	0.3	1%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.0	0%	0.0	0%	0	0%	0.0	0%
Total Direct	*136.4*	*50%*	*53.6*	*39%*	*180*	*27%*	*5.8*	*13%*
Flow-on effects								
Tuna fishing	33.4	12%	26.2	19%	142	21%	7.8	18%
Property and business serv.	17.2	6%	10.7	8%	41	6%	4.5	10%
Manufacturing	13.0	5%	4.2	3%	46	7%	2.9	7%
Trade	11.1	4%	6.1	4%	62	9%	3.9	9%
Sardines	20.5	8%	12.7	9%	35	5%	6.5	15%
Transport	6.8	2%	3.0	2%	23	3%	2.0	4%
Finance	7.0	3%	4.7	3%	10	2%	1.5	3%
Other Sectors [b]	27.1	10%	14.7	11%	125	19%	9.2	21%
Total Flow-on	*136.2*	*50%*	*82.2*	*61%*	*485*	*73%*	*38.3*	*87%*
Total [a]	**272.6**	**100%**	**135.8**	**100%**	**665**	**100%**	**44.2**	**100%**
Total/Direct	2.00		2.53		3.69		7.59	

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

[b] E.g. accommodation, restaurants and cafes, utilities, communications, agriculture, forestry and fishing sectors.

Source: EconSearch analysis

Figure 4-1 Tuna farming in South Australia, **output** impacts by sector, 2014/15 [a]



[a] Note there is double counting in the output impact.

[b] E.g. accommodation, restaurants and cafes, utilities, communications, agriculture, forestry and fishing sectors.

Source: EconSearch analysis

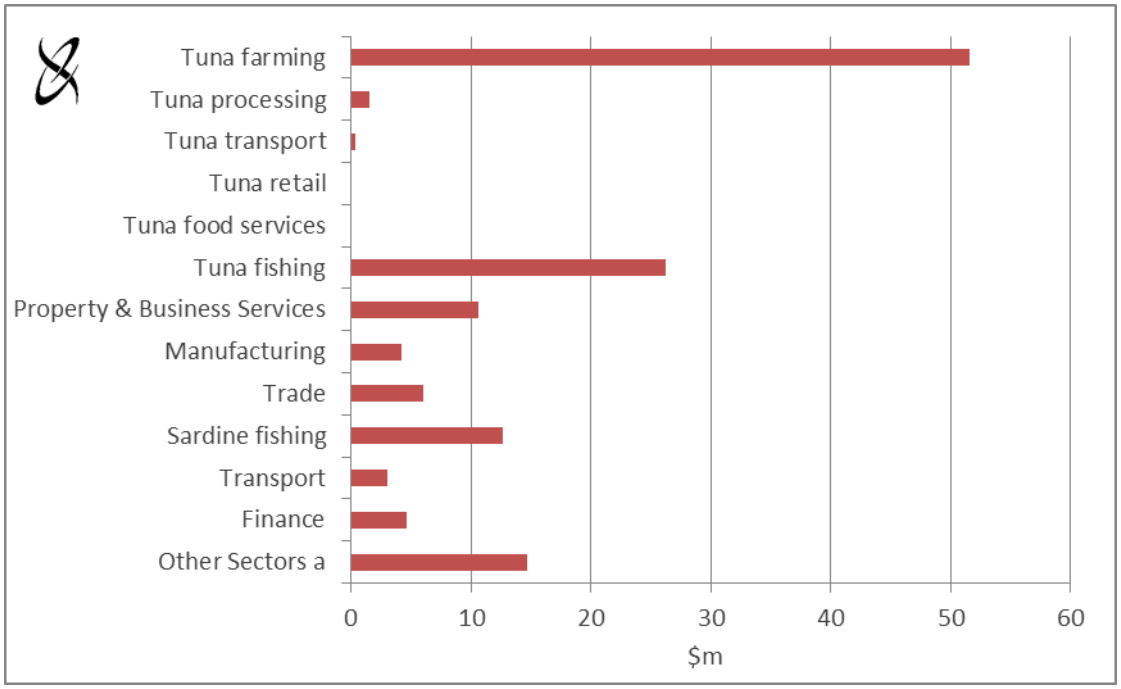
Contribution to gross state product...

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 activity[2].

The direct contribution to GSP by the Tuna industry (i.e. farming, processing and transport) was $53.6 million in 2014/15 ($51.6m from tuna farming and $2.0m from downstream activities). Associated with this was flow-on GSP in the other sectors of the state economy of $82.2m (Table 4-1).

The flow-ons were greatest in the Tuna fishing ($26.2m), Sardine fishing ($12.7m), property and business services ($10.7m), trade ($6.1m), finance ($4.7m) and manufacturing ($4.2m) sectors (Figure 4-2). The bottom row in Table 4-1 shows that for each one dollar contribution to GSP by the Tuna industry there was an additional $1.53 ($2.53 in total) contribution to GSP in other sectors of the state economy (e.g. tuna fishing, property and business services, Sardine fishing, trade, manufacturing and finance sectors).

Figure 4-2 Tuna farming in South Australia, **contribution to GSP** by sector, 2014/15



[a] E.g. accommodation, restaurants and cafes, utilities, communications, agriculture, forestry and fishing sectors.

Source: EconSearch analysis

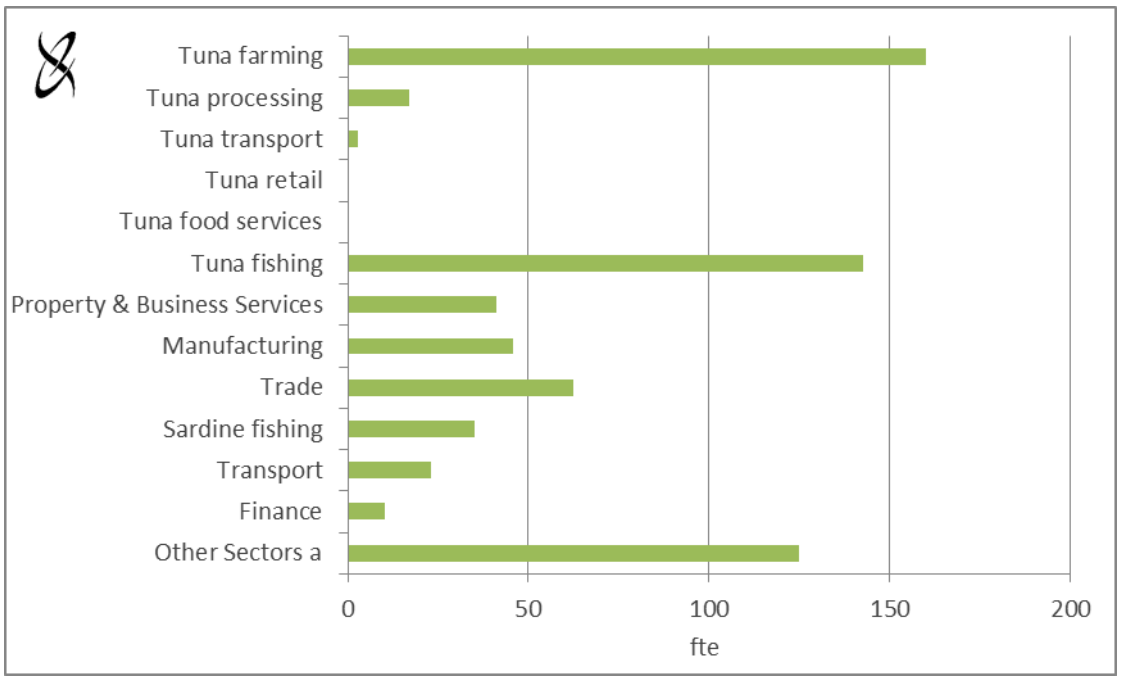
[2] The use of 'contribution to GSP' (or GRP) as a measure of economic impact overcomes the problem of double counting that arises from using 'value of output' for this purpose.

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 160 full-time equivalents (fte) and, through associated processing and transport activities, another 20 fte in 2014/15 (Table 4-1). Flow-on business activity was estimated to generate a further 485 fte to give total employment of 665 fte in the state. The sectors of the economy with employment flow-ons from Tuna farming, processing and transport include the Tuna fishing (142 fte), trade (62), manufacturing (46), property and business services (41) and Sardine fishing (35) sectors (Figure 4-3).

The bottom row in Table 4-1 shows that for each fte job generated directly in Tuna farming, processing and transport there were an additional 2.69 jobs (3.69 jobs in total) in the rest of the state.

Figure 4-3 Tuna farming in South Australia, **employment** impacts by sector, 2014/15



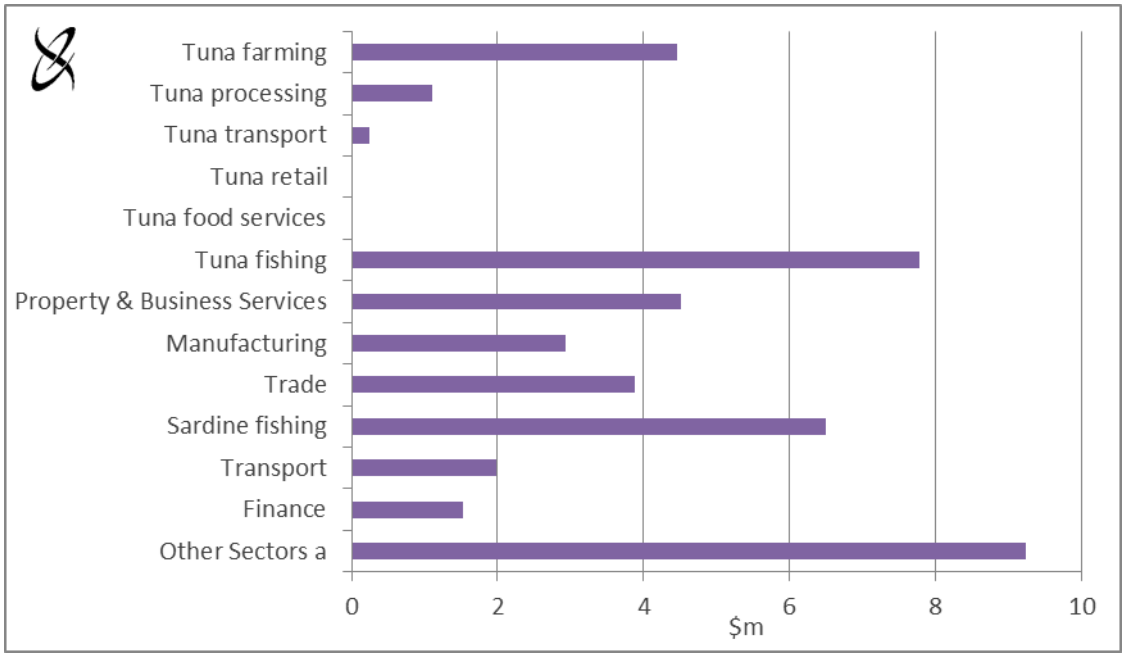
[a] E.g. accommodation, restaurants and cafes, utilities, communications, agriculture, forestry and fishing sectors.

Source: EconSearch analysis

Personal income of $4.5 million was earned in the Tuna farming sector and another $1.4 million in downstream activities. This comprised both wages by employees and estimated drawings by owner/operators. An additional $38.3 million of household income was earned in other businesses in the state as a result of Tuna farming and downstream activities. The total household income impact was around $44.2 million (Figure 4-4).

For each $1.00 of household income generated directly by Tuna farming, processing and transport in 2014/15 there was an additional $6.59 ($7.59 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, 2014/15



[a] E.g. accommodation, restaurants and cafes, utilities, communications, agriculture, forestry and fishing sectors.

Source: EconSearch analysis

4.2 The Economic Impact of Oyster Farming in South Australia, 2014/15

Table 4-2 provides estimates of the economic impact generated by Oyster farming in South Australia on a sector-by-sector basis in 2014/15. As for Tuna in the previous section, impacts are measured in terms of output (business turnover), contribution to GSP, employment and household income.

It should be noted that the gross value of production includes the value of spat and adult oyster sales. Approximately $0.8m of sales from on-grown oysters have been excluded as it is considered an input to production for the final sales of adult oysters.

Output impacts...

Direct output (business turnover) generated in SA by Oyster farming enterprises summed to $28.7 million in 2014/15 while output generated in SA by associated downstream activities (processing, transport, retail and food service) summed to $27.0 million. Flow-ons to other sectors of the state economy added another $58.2 million in output in 2014/15. The sectors most affected were the property and business services, manufacturing, trade and finance sectors.

Table 4-2 The economic impact of Oyster farming in South Australia, 2014/15 [a]

Sector	Output		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Oyster farming [b]	28.7	25%	20.4	32%	242	39%	10.9	30%
Processing	4.6	4%	1.5	2%	16	3%	1.0	3%
Transport	4.3	4%	1.9	3%	15	2%	1.3	3%
Retail	0.3	0%	0.2	0%	2	0%	0.1	0%
Food services	17.7	16%	9.3	14%	127	20%	6.1	17%
Total Direct	*55.7*	*49%*	*33.3*	*52%*	*402*	*65%*	*19.4*	*53%*
Flow-on effects								
Property and business serv	13.2	12%	8.3	13%	29	5%	3.1	9%
Manufacturing	9.0	8%	3.0	5%	32	5%	2.0	6%
Trade	7.1	6%	3.9	6%	40	6%	2.5	7%
Transport	3.9	3%	1.8	3%	13	2%	1.1	3%
Finance	4.5	4%	3.0	5%	6	1%	1.0	3%
Other Sectors	20.5	18%	11.1	17%	98	16%	7.1	20%
Total Flow-on	*58.2*	*51%*	*31.0*	*48%*	*218*	*35%*	*16.9*	*47%*
Total [c]	**113.9**	**100%**	**64.3**	**100%**	**620**	**100%**	**36.3**	**100%**
Total/Direct	2.05		1.93		1.54		1.87	

[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 and adults but excludes sales of on-grown oysters.

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

Source: EconSearch analysis

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 2014/15, total Oyster farming-related contribution to GSP in South Australia was approximately $64.3 million, $20.4 million generated by Oyster farming directly, $12.9 million generated directly by downstream activities and $31.0 million generated in other sectors of the state economy.

Employment and household income...

In 2014/15, SA Oyster farming was responsible for the direct employment of around 242 fte and downstream activities created employment for around 175 fte. Flow-on business activity was estimated to generate a further 218 fte to give total employment of 620 fte in the state. The flow-on jobs were concentrated in the trade (40 fte), manufacturing (32) and property and business services (29).

Personal income of around $10.9 million was earned in the Oyster farming sector and another $8.5 million in downstream activities. This comprised both wages by employees and estimated

drawings by owner/operators. An additional $16.9 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 $36.3 million.

4.3 The Economic Impact of the Remaining Aquaculture Sectors in South Australia, 2014/15

The economic impacts of the remaining individual aquaculture sectors in South Australia in 2014/15 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 following 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, 2014/15

Sector	Output		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Marine finfish farming	18.2	39%	9.4	39%	38	24%	2.6	24%
Processing	1.2	3%	0.4	2%	4	3%	0.3	3%
Transport	1.2	3%	0.5	2%	4	3%	0.3	3%
Retail	0.6	1%	0.3	1%	3	2%	0.2	2%
Food services	4.2	9%	2.2	9%	30	20%	1.5	14%
Total Direct	*25.4*	*54%*	*12.9*	*54%*	*80*	*51%*	*4.9*	*46%*
Flow-on effects								
Property and business serv	4.0	9%	2.5	10%	9	6%	1.0	9%
Manufacturing	2.8	6%	0.9	4%	10	6%	0.6	6%
Trade	2.7	6%	1.5	6%	15	10%	0.9	9%
Transport	1.2	3%	0.5	2%	4	3%	0.3	3%
Finance	1.4	3%	0.9	4%	2	1%	0.3	3%
Other Sectors	9.2	20%	4.9	20%	36	23%	2.6	25%
Total Flow-on	*21.2*	*46%*	*11.2*	*46%*	*76*	*49%*	*5.8*	*54%*
Total [a]	**46.6**	**100%**	**24.2**	**100%**	**156**	**100%**	**10.7**	**100%**
Total/Direct	1.84		1.87		1.94		2.20	

[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, 2014/15

Sector	Output		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Mussel farming	3.1	20%	2.1	24%	43	43%	2.0	34%
Processing	0.8	5%	0.3	3%	3	3%	0.2	3%
Transport	0.5	3%	0.2	3%	2	2%	0.1	3%
Retail	0.4	3%	0.2	3%	2	2%	0.1	2%
Food services	1.5	10%	0.8	9%	11	11%	0.5	9%
Total Direct	*6.4*	*41%*	*3.6*	*42%*	*61*	*61%*	*3.0*	*51%*
Flow-on effects								
Property and business serv	2.0	13%	1.3	15%	4	4%	0.5	8%
Manufacturing	1.3	8%	0.4	5%	5	5%	0.3	5%
Trade	1.1	7%	0.6	7%	6	6%	0.4	6%
Transport	0.6	4%	0.3	3%	2	2%	0.2	3%
Finance	0.7	4%	0.5	5%	1	1%	0.2	3%
Other Sectors	3.5	23%	2.0	23%	21	21%	1.4	24%
Total Flow-on	*9.1*	*59%*	*4.9*	*58%*	*39*	*39%*	*2.8*	*49%*
Total [a]	**15.5**	**100%**	**8.5**	**100%**	**100**	**100%**	**5.8**	**100%**
Total/Direct	2.44		2.38		1.63		1.95	

[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, 2014/15

Sector	Output		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Abalone farming	11.4	33%	2.3	20%	43	32%	1.8	24%
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%
Total Direct	*11.8*	*34%*	*2.4*	*21%*	*44*	*33%*	*1.9*	*25%*
Flow-on effects								
Property and business serv	3.2	9%	1.9	17%	8	6%	0.9	12%
Manufacturing	1.6	4%	0.5	4%	5	4%	0.4	5%
Trade	1.7	5%	0.9	8%	10	7%	0.6	8%
Transport	0.7	2%	0.3	3%	2	2%	0.2	3%
Finance	0.9	3%	0.6	5%	1	1%	0.2	3%
Other Sectors	15.2	43%	4.8	42%	62	46%	3.4	45%
Total Flow-on	*23.2*	*66%*	*9.1*	*79%*	*88*	*67%*	*5.7*	*75%*
Total [a]	**35.0**	**100%**	**11.6**	**100%**	**133**	**100%**	**7.6**	**100%**
Total/Direct	2.97		4.74		2.99		3.98	

[a] 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, 2014/15

Sector	Output		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Freshwater finfish farming	4.1	35%	1.8	31%	25	45%	2.2	48%
Processing	0.0	0%	0.0	0%	0	0%	0.0	0%
Transport	0.4	3%	0.2	3%	1	2%	0.1	2%
Retail	0.1	1%	0.0	1%	0	1%	0.0	1%
Food services	0.6	5%	0.3	5%	4	7%	0.2	4%
Total Direct	*5.1*	*44%*	*2.3*	*39%*	*31*	*55%*	*2.5*	*56%*
Flow-on effects								
Property and business serv	1.4	12%	0.9	16%	3	5%	0.3	7%
Manufacturing	0.8	7%	0.3	5%	3	5%	0.2	4%
Trade	0.9	8%	0.5	9%	5	10%	0.3	7%
Transport	0.4	3%	0.2	3%	1	2%	0.1	2%
Finance	0.5	4%	0.3	6%	1	1%	0.1	3%
Other Sectors	2.4	21%	1.3	22%	12	22%	0.9	21%
Total Flow-on	*6.5*	*56%*	*3.5*	*61%*	*25*	*45%*	*2.0*	*44%*
Total [a]	**11.6**	**100%**	**5.8**	**100%**	**56**	**100%**	**4.5**	**100%**
Total/Direct	2.26		2.53		1.81		1.79	

[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, 2014/15

Sector	Output		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Marron/yabbies farming	0.5	56%	0.4	68%	8	83%	0.0	20%
Processing	0.0	0%	0.0	0%	0	0%	0.0	0%
Transport	0.0	1%	0.0	1%	0	0%	0.0	2%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.1	13%	0.1	10%	1	8%	0.0	26%
Total Direct	*0.6*	*70%*	*0.5*	*78%*	*9*	*91%*	*0.1*	*49%*
Flow-on effects								
Property and business serv	0.1	7%	0.0	6%	0	1%	0.0	10%
Manufacturing	0.0	5%	0.0	2%	0	1%	0.0	7%
Trade	0.0	4%	0.0	3%	0	2%	0.0	8%
Transport	0.0	2%	0.0	1%	0	1%	0.0	3%
Finance	0.0	2%	0.0	2%	0	0%	0.0	3%
Other Sectors	0.1	10%	0.0	8%	0	4%	0.0	21%
Total Flow-on	*0.2*	*30%*	*0.1*	*22%*	*1*	*9%*	*0.1*	*51%*
Total [a]	**0.8**	**100%**	**0.6**	**100%**	**10**	**100%**	**0.1**	**99%**
Total/Direct	1.42		1.28		1.10		2.06	

[a] 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, 2014/15 [a]

Sector	Output		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Other aquaculture	31.2	59%	16.7	58%	10	11%	9.5	59%
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%
Total Direct	*31.2*	*59%*	*16.7*	*58%*	*10*	*11%*	*9.5*	*59%*
Flow-on effects								
Property and business serv	5.1	10%	3.2	11%	10	11%	1.1	7%
Manufacturing	2.8	5%	0.9	3%	10	10%	0.6	4%
Trade	3.4	6%	1.9	6%	19	20%	1.2	7%
Transport	1.1	2%	0.5	2%	4	4%	0.3	2%
Finance	1.8	3%	1.2	4%	3	3%	0.4	2%
Other Sectors	7.8	15%	4.3	15%	38	41%	2.9	18%
Total Flow-on	*22.1*	*41%*	*12.1*	*42%*	*84*	*89%*	*6.6*	*41%*
Total [b]	**53.3**	**100%**	**28.8**	**100%**	**94**	**100%**	**16.1**	**100%**
Total/Direct	1.71		1.72		9.42		1.69	

[a] Other aquaculture production in 2014/15 was comprised of Algae, Silver Perch (including fingerlings and spat), Shortfin Eel and Barcoo Grunter production. The downstream impacts of other aquaculture production are unknown and have been excluded from the analysis.

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

Source: EconSearch analysis

5. THE ECONOMIC IMPACT OF AQUACULTURE IN THE EYRE PENINSULA REGION, 2014/15

5.1 The Economic Impact of Tuna Farming in the Eyre Peninsula Region, 2014/15

Estimates of the economic impact of Tuna farming in the Eyre Peninsula region of South Australia in 2014/15 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, 2014/15

Sector	Output		Contribution to GRP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Tuna farming	130.7	54%	51.7	43%	160	29%	4.5	13%
Processing	4.9	2%	1.1	1%	16	3%	1.0	3%
Transport	0.9	0%	0.4	0%	3	1%	0.3	1%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.0	0%	0.0	0%	0	0%	0.0	0%
Total Direct	*136.4*	*57%*	*53.2*	*45%*	*179*	*32%*	*5.7*	*16%*
Flow-on effects								
Tuna fishing	33.4	14%	26.3	22%	143	26%	7.8	22%
Property and business serv.	11.1	5%	6.8	6%	27	5%	2.8	8%
Manufacturing	7.5	3%	1.7	1%	25	4%	1.5	4%
Trade	8.6	4%	4.7	4%	48	9%	3.0	9%
Sardines	20.0	8%	12.4	10%	34	6%	6.4	18%
Transport	5.5	2%	2.6	2%	19	3%	1.6	5%
Finance	3.5	1%	2.5	2%	5	1%	0.7	2%
Other Sectors	15.4	6%	9.2	8%	76	14%	5.5	16%
Total Flow-on	*105.0*	*43%*	*66.1*	*55%*	*376*	*68%*	*29.2*	*84%*
Total [a]	**241.4**	**100%**	**119.3**	**100%**	**555**	**100%**	**34.9**	**100%**
Total/Direct	1.77		2.24		3.10		6.15	

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

Source: EconSearch analysis

Output impacts...

Direct output (business turnover) generated locally by Tuna farms summed to $130.7 million and in other sectors (processing and transport), $5.8 million in 2014/15. Flow-on output in other sectors summed to $105.0 million. The sectors most affected were the Tuna fishing (Tuna

capture), Sardine fishing, property and business services, trade and manufacturing sectors (Table 5-1).

The bottom row of Table 5-1 gives the total impact/direct impact ratio for each economic indicator. For output, the ratio of 1.77 indicates that for each dollar of sales generated directly by Tuna farming, processing and transport there was a total of $1.77 of output generated by businesses throughout the Eyre Peninsula region, $1.00 in Tuna farming, processing and transport and $0.77 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 $53.2 million in 2014/15 ($51.7m directly by Tuna farming and $1.5m by downstream businesses). Flow-on GRP generated in the other sectors of the regional economy was $66.1 million in 2014/15. The flow-ons were greatest in the Tuna fishing ($26.3m), Sardine fishing ($12.4m), property and business services ($6.8m) and trade ($4.7m) sectors.

The bottom row in Table 5-1 shows that for each dollar of GRP generated directly in Tuna farming, processing and transport there was an additional $1.24 ($2.24 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 160 fte and associated processing and transport, approximately 19 fte in the Eyre Peninsula region in 2014/15. Flow-on business activity was estimated to have generated a further 376 fte jobs locally to give total employment of approximately 555 fte in the region. The sectors of the local economy with employment flow-ons from Tuna farming, processing and transport included the Tuna fishing (143 fte), trade (48), Sardine fishing (34), property and business services (27) and manufacturing (25) 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 2.10 jobs (3.10 jobs in total) in the rest of the region.

Personal income of $4.5 million was earned in the Tuna farming sector and another $1.3 million in downstream activities. This comprised both wages by employees and estimated drawings by owner/operators. An additional $29.2 million of household income was earned in other businesses in the region as a result of Tuna farming and downstream activities. The total household income impact was almost $34.9 million. For each $1.00 of household income generated directly by Tuna farming, processing and transport in 2014/15 there was an additional $5.15 ($6.15 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, 2014/15

Estimates of the economic impact of Oyster farming in the Eyre Peninsula region in 2014/15 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.

Table 5-2 The economic impact of Oyster farming in the Eyre Peninsula region, 2014/15 [a]

Sector	Output		Contribution to GRP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Oyster farming [b]	19.6	56%	13.9	63%	141	69%	7.4	62%
Processing	0.8	2%	0.2	1%	3	1%	0.2	1%
Transport	3.0	8%	1.4	6%	10	5%	0.9	7%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.6	2%	0.3	1%	4	2%	0.2	2%
Total Direct	*24.0*	*68%*	*15.8*	*71%*	*158*	*77%*	*8.7*	*72%*
Flow-on effects								
Property and business serv.	3.0	8%	1.9	9%	5	3%	0.6	5%
Manufacturing	1.0	3%	0.2	1%	3	2%	0.2	2%
Trade	2.0	6%	1.1	5%	11	5%	0.7	6%
Transport	0.8	2%	0.4	2%	3	1%	0.2	2%
Finance	0.6	2%	0.4	2%	1	0%	0.1	1%
Other Sectors	3.9	11%	2.4	11%	23	11%	1.6	13%
Total Flow-on	*11.3*	*32%*	*6.4*	*29%*	*47*	*23%*	*3.4*	*28%*
Total	**35.3**	**100%**	**22.3**	**100%**	**204**	**100%**	**12.1**	**100%**
Total/Direct	1.47		1.41		1.30		1.40	

[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 and adults but excludes sales of on-grown oysters.

[c] Note there is double counting in the total output impact. Totals may contain rounding errors.

Source: EconSearch analysis

Output impacts...

Direct output (business turnover) generated by Oyster enterprises in the Eyre Peninsula region summed to approximately $19.6 million in 2014/15 while output generated in the Eyre Peninsula region by associated downstream activities (processing, transport, retail and food service) summed to $4.4 million. Flow-ons to other sectors of the regional economy added another $11.3 million in output in 2014/15. The sectors most affected were the property and business services, trade and manufacturing sectors (Table 5-2).

Contribution to gross regional product...

Total Oyster farming-related contribution to GRP in the Eyre Peninsula region was $22.3 million in 2014/15, $13.9 million generated by Oyster farming directly, $1.9 million generated by downstream activities and $6.4 million generated in other sectors of the regional economy.

Employment and household income...

In 2014/15 in the Eyre Peninsula region, Oyster farming was responsible for the direct employment of approximately 141 fte and associated downstream activities created employment for an additional 17 fte. Flow-on business activity was estimated to generate a further 47 fte. The total employment impact was 204 fte.

In 2014/15, personal income of $8.7 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 $3.4 million of household income was earned in other local businesses as a result of Oyster industry operations. The total household income impact was around $12.1 million.

5.3 The Economic Impact of the Remaining Aquaculture Sectors in the Eyre Peninsula Region, 2014/15

The economic impacts of other aquaculture sectors in the Eyre Peninsula region in 2014/15 (i.e. Marine 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 remaining aquaculture sectors [a] in the Eyre Peninsula region, 2014/15 [b]

Sector	Output		Contribution to GRP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Remaining aquaculture	59.1	70%	29.6	70%	101	51%	6.3	48%
Processing	2.2	3%	0.5	1%	7	4%	0.4	3%
Transport	1.7	2%	0.8	2%	6	3%	0.5	4%
Retail	0.1	0%	0.0	0%	0	0%	0.0	0%
Food services	0.3	0%	0.2	0%	2	1%	0.1	1%
Total Direct	*63.3*	*75%*	*31.1*	*74%*	*116*	*59%*	*7.4*	*56%*
Flow-on effects								
Property and business serv.	3.8	4%	2.3	6%	8	4%	0.9	7%
Manufacturing	1.5	2%	0.3	1%	5	2%	0.3	2%
Trade	3.9	5%	2.1	5%	22	11%	1.4	10%
Transport	1.1	1%	0.5	1%	4	2%	0.3	2%
Finance	0.8	1%	0.6	1%	1	1%	0.2	1%
Other Sectors	10.4	12%	5.1	12%	41	21%	2.8	22%
Total Flow-on	*21.4*	*25%*	*10.9*	*26%*	*80*	*41%*	*5.8*	*44%*
Total [c]	**84.7**	**100%**	**42.0**	**100%**	**196**	**100%**	**13.2**	**100%**
Total/Direct	1.34		1.36		1.72		1.81	

[a] Includes Marine 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, 2014/15

Estimates of the economic impact of aquaculture in the West Coast region of SA in 2014/15 (i.e. Oysters and Abalone) 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, 2014/15 [b]

Sector	Output		Contribution to GRP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Aquaculture	9.1	55%	6.4	62%	102	75%	3.4	61%
Processing	0.4	2%	0.1	1%	1	1%	0.1	1%
Transport	1.4	8%	0.6	6%	5	3%	0.4	7%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.3	2%	0.1	1%	2	1%	0.1	2%
Total Direct	*11.1*	*68%*	*7.2*	*71%*	*110*	*81%*	*4.0*	*71%*
Flow-on effects								
Property and business serv.	1.4	8%	0.9	9%	3	2%	0.3	5%
Manufacturing	0.5	3%	0.1	1%	2	1%	0.1	2%
Trade	0.9	6%	0.5	5%	5	4%	0.3	6%
Transport	0.4	2%	0.2	2%	1	1%	0.1	2%
Finance	0.3	2%	0.2	2%	0	0%	0.1	1%
Other Sectors	1.9	11%	1.1	11%	16	11%	0.8	14%
Total Flow-on	*5.3*	*32%*	*3.0*	*29%*	*26*	*19%*	*1.6*	*29%*
Total [c]	**16.4**	**100%**	**10.2**	**100%**	**136**	**100%**	**5.6**	**100%**
Total/Direct	1.52		1.44		1.26		1.44	

[a] Includes Oysters and Abalone.

[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

Output impacts...

Direct output (business turnover) generated by aquaculture summed to $9.1 million and associated downstream activities, $2.1 million in the West Coast region in 2014/15. Flow-on output in other sectors of the regional economy summed to $5.3 million in 2014/15. The sectors most affected were the property and business services, trade, and manufacturing sectors (Table 6-1).

Contribution to gross regional product...

Total aquaculture-related contribution to gross regional product in the West Coast region was approximately $10.2 million in 2014/15, $6.4 million generated by aquaculture directly, $0.8 million generated in associated downstream activities and $3.0 million generated in other sectors of the regional economy.

Employment and household income...

Aquaculture and downstream activities were responsible for the direct employment of 110 fte in 2014/15 in the West Coast region. Flow-on business activity was estimated to generate a further 26 fte. The total employment impact was 136 fte.

In 2014/15, personal income of $4.0 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 $1.6 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 REGION, 2014/15

Estimates of the economic impact of aquaculture in the Yorke Peninsula region[3] of SA in 2014/15 (i.e. Oysters, Freshwater Finfish and Marron/Yabby farming enterprises) are reported in aggregate in Table 7-1.

Note that for some of the aquaculture sectors in the Yorke Peninsula 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.

Output impacts...

Direct output (business turnover) generated by aquaculture summed to $0.1 million and associated downstream activities, less than $0.1 million in the Yorke Peninsula region in 2014/15. Flow-on output in other sectors of the regional economy summed to less than $0.1 million in 2014/15. The sectors most affected were the property and business services, trade and manufacturing sectors (Table 7-1).

Contribution to gross regional product...

Total aquaculture-related contribution to gross regional product in the Yorke Peninsula region was approximately $0.1 million in 2014/15, $0.1 million generated by aquaculture directly and less than $0.1 million generated in associated downstream activities and in other sectors of the regional economy.

Employment and household income...

Aquaculture and downstream activities were responsible for the direct employment of 6 fte in 2014/15 in the Yorke Peninsula region. Flow-on business activity was estimated to generate less than 1 fte. The total employment impact was 6 fte.

In 2014/15, personal income of less than $0.1 million was earned in aquaculture and downstream activities in the Yorke Peninsula region comprising both wages by employees and

[3] Includes production recorded in the Yorke Peninsula, Mid North and Barossa.

estimated drawings by owner/operators. Less than $0.1m of household income was earned in other local businesses as a result of aquaculture industry operations.

Table 7-1 The economic impact of aquaculture [a] in the Yorke Peninsula region, 2014/15 [b]

Sector	Output		Contribution to GRP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Aquaculture	0.1	69%	0.1	77%	6	94%	0.0	54%
Processing	0.0	2%	0.0	0%	0	0%	0.0	0%
Transport	0.0	5%	0.0	4%	0	0%	0.0	8%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.0	2%	0.0	1%	0	0%	0.0	0%
Total Direct	*0.1*	*77%*	*0.1*	*83%*	*6*	*95%*	*0.0*	*62%*
Flow-on effects								
Property and business serv.	0.0	5%	0.0	4%	0	0%	0.0	4%
Manufacturing	0.0	3%	0.0	1%	0	0%	0.0	0%
Trade	0.0	4%	0.0	3%	0	1%	0.0	8%
Transport	0.0	2%	0.0	1%	0	0%	0.0	4%
Finance	0.0	1%	0.0	1%	0	0%	0.0	0%
Other Sectors	0.0	9%	0.0	7%	0	4%	0.0	19%
Total Flow-on	*0.0*	*23%*	*0.0*	*17%*	*0*	*5%*	*0.0*	*35%*
Total [c]	**0.1**	**100%**	**0.1**	**100%**	**6**	**100%**	**0.0**	**96%**
Total/Direct	1.32		1.23		1.05		1.63	

[a] Includes Oysters, Freshwater Finfish and Marron/Yabby farming 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

8. THE ECONOMIC IMPACT OF AQUACULTURE ON KI, 2014/15

Estimates of the economic impact of aquaculture on KI[4] of SA in 2014/15 (i.e. Oysters, Abalone, Freshwater Finfish and Marron/Yabby farming enterprises) are reported in aggregate in Table 8-1.

Note that for some of the aquaculture sectors in the 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.

Output impacts...

Direct output (business turnover) generated by aquaculture summed to $5.1 million and associated downstream activities, $0.2 million on KI in 2014/15. Flow-on output in other sectors of the regional economy summed to $3.5 million in 2014/15. The sectors most affected were the property and business services, trade and manufacturing sectors (Table 8-1).

Contribution to gross regional product...

Total aquaculture-related contribution to gross regional product on KI was approximately $2.7 million in 2014/15, $1.3 million generated by aquaculture directly, $0.1 million generated in associated downstream activities and $1.3 million generated in other sectors of the regional economy.

Employment and household income...

Aquaculture and downstream activities were responsible for the direct employment of 27 fte in 2014/15 on KI region. Flow-on business activity was estimated to generate a further 15 fte. The total employment impact was 41 fte.

In 2014/15, personal income of $0.8 million was earned in aquaculture and downstream activities on KI comprising both wages by employees and estimated drawings by owner/operators. An additional $0.9 million of household income was earned in other local businesses as a result of aquaculture industry operations.

[4] Includes production recorded on Kangaroo Island.

Table 8-1 The economic impact of aquaculture [a] on KI region, 2014/15 [b]

Sector	Output		Contribution to GRP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Aquaculture	5.1	58%	1.3	49%	26	63%	0.8	47%
Processing	0.2	2%	0.1	2%	1	1%	0.0	2%
Transport	0.0	0%	0.0	1%	0	0%	0.0	1%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.0	0%	0.0	0%	0	0%	0.0	0%
Total Direct	*5.3*	*60%*	*1.4*	*52%*	*27*	*65%*	*0.8*	*50%*
Flow-on effects								
Property and business serv.	0.5	6%	0.3	11%	2	4%	0.2	10%
Manufacturing	0.1	1%	0.0	1%	0	1%	0.0	1%
Trade	0.3	4%	0.2	7%	2	5%	0.1	7%
Transport	0.1	1%	0.0	2%	0	1%	0.0	2%
Finance	0.0	0%	0.0	1%	0	0%	0.0	0%
Other Sectors	2.5	28%	0.7	27%	10	25%	0.5	30%
Total Flow-on	*3.5*	*40%*	*1.3*	*48%*	*15*	*35%*	*0.9*	*50%*
Total [c]	**8.8**	**100%**	**2.7**	**100%**	**41**	**100%**	**1.7**	**100%**
Total/Direct	1.67		1.93		1.55		2.02	

[a] Includes Oysters, Abalone, Freshwater Finfish and Marron/Yabby farming 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

9. THE ECONOMIC IMPACT OF AQUACULTURE IN THE ADELAIDE AND HILLS REGION, 2014/15

Estimates of the economic impact of aquaculture in the Adelaide and Hills region[5] of SA in 2014/15 (i.e. Freshwater Finfish, Marron/Yabby farming and other aquaculture enterprises) are reported in aggregate in Table 9-1.

Note that for some of the aquaculture sectors in the Adelaide and Hills 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.

Output impacts...

Direct output (business turnover) generated by aquaculture summed to $1.3 million and associated downstream activities, $0.1 million in the Adelaide and Hills region in 2014/15. Flow-on output in other sectors of the regional economy summed to $1.6 million in 2014/15. The sectors most affected were the property and business services, trade and manufacturing sectors (Table 9-1).

Contribution to gross regional product...

Total aquaculture-related contribution to gross regional product in the Adelaide and Hills region was approximately $1.5 million in 2014/15, $0.6 million generated by aquaculture directly, $0.1 million generated in associated downstream activities and $0.9 million generated in other sectors of the regional economy.

Employment and household income...

Aquaculture and downstream activities were responsible for the direct employment of 11 fte in 2014/15 in the Adelaide and Hills region. Flow-on business activity was estimated to generate a further 6 fte. The total employment impact was 17 fte.

In 2014/15, personal income of $0.7 million was earned in aquaculture and downstream activities in the Adelaide and Hills region comprising both wages by employees and estimated

[5] Includes production recorded in the Adelaide, Adelaide Hills and Fleurieu peninsula.

drawings by owner/operators. An additional $0.5 million of household income was earned in other local businesses as a result of aquaculture industry operations.

Table 9-1 The economic impact of aquaculture [a] in the Adelaide and Hills region, 2014/15 [b]

Sector	Output		Contribution to GRP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Aquaculture	1.3	43%	0.6	37%	10	60%	0.7	56%
Processing	0.0	0%	0.0	0%	0	0%	0.0	0%
Transport	0.1	4%	0.1	4%	0	2%	0.0	3%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.0	0%	0.0	0%	0	0%	0.0	0%
Total Direct	*1.5*	*47%*	*0.6*	*41%*	*11*	*63%*	*0.7*	*59%*
Flow-on effects								
Property and business serv.	0.4	13%	0.3	16%	1	5%	0.1	7%
Manufacturing	0.2	5%	0.1	4%	1	4%	0.0	3%
Trade	0.3	9%	0.1	10%	2	9%	0.1	8%
Transport	0.1	3%	0.0	2%	0	2%	0.0	2%
Finance	0.1	5%	0.1	6%	0	1%	0.0	2%
Other Sectors	0.6	19%	0.3	21%	3	18%	0.2	19%
Total Flow-on	*1.6*	*53%*	*0.9*	*59%*	*6*	*37%*	*0.5*	*41%*
Total [c]	**3.1**	**100%**	**1.5**	**100%**	**17**	**100%**	**1.3**	**100%**
Total/Direct	2.14		2.44		1.61		1.72	

[a] Includes 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 and totals may not sum correctly due to rounding errors.

Source: EconSearch analysis

10. THE ECONOMIC IMPACT OF AQUACULTURE IN THE MURRAYLANDS AND SOUTH EAST REGION, 2014/15

Estimates of the economic impact of aquaculture in the Murraylands and South East region[6] of SA in 2014/15 (i.e. Freshwater Finfish, Marron/Yabby farming and other aquaculture enterprises) are reported in aggregate in Table 10-1.

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.

Output impacts...

Direct output (business turnover) generated by aquaculture summed to $2.8 million and associated downstream activities, $0.3 million in the Murraylands and South East region in 2014/15. Flow-on output in other sectors of the regional economy summed to $2.3 million in 2014/15. The sectors most affected were the trade, property and business services and manufacturing sectors (Table 10-1).

Contribution to gross regional product...

Total aquaculture-related contribution to gross regional product in the Murraylands and South East region was $2.5 million in 2014/15, $1.2 million generated by aquaculture directly, $0.1 million generated in associated downstream activities and $1.2 million generated in other sectors of the regional economy.

Employment and household income...

Aquaculture and downstream activities were responsible for the direct employment of 17 fte in 2014/15 in the Murraylands and South East region. Flow-on business activity was estimated to generate a further 11 fte. The total employment impact was 29 fte.

[6] Includes production recorded in the Murraylands (Riverland and Murraylands) and the South East (Limestone Coast).

In 2014/15, personal income of $1.5 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. $0.7 million of household income was earned in other local businesses as a result of aquaculture industry operations.

Table 10-1 The economic impact of aquaculture [a] in the Murraylands and South East region, 2014/15 [b]

Sector	Output		Contribution to GRP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Direct effects								
Aquaculture	2.8	52%	1.2	47%	16	56%	1.5	65%
Processing	0.0	0%	0.0	0%	0	0%	0.0	0%
Transport	0.3	5%	0.1	5%	1	4%	0.1	3%
Retail	0.0	0%	0.0	0%	0	0%	0.0	0%
Food services	0.0	0%	0.0	0%	0	1%	0.0	0%
Total Direct	*3.1*	*58%*	*1.3*	*52%*	*17*	*61%*	*1.5*	*69%*
Flow-on effects								
Property and business serv.	0.5	9%	0.3	12%	1	2%	0.1	3%
Manufacturing	0.3	6%	0.1	4%	1	4%	0.1	3%
Trade	0.5	9%	0.3	10%	3	12%	0.2	8%
Transport	0.1	2%	0.0	2%	0	1%	0.0	1%
Finance	0.1	2%	0.1	3%	0	1%	0.0	1%
Other Sectors	0.8	15%	0.4	17%	5	19%	0.3	16%
Total Flow-on	*2.3*	*42%*	*1.2*	*48%*	*11*	*39%*	*0.7*	*31%*
Total [c]	**5.3**	**100%**	**2.5**	**100%**	**29**	**100%**	**2.2**	**100%**
Total/Direct	1.75		1.94		1.66		1.46	

[a] Includes Freshwater Finfish, Marron/Yabby farming and other aquaculture production.

[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

11. OTHER FACETS OF REGIONAL ECONOMIC DEVELOPMENT ASSOCIATED WITH AQUACULTURE ACTIVITY IN SA

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 (EconSearch 2015b). 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 processors, shipyard, marinas, property (e.g. hotels), tourism and other industries (e.g. Yellowtail Kingfish aquaculture and viticulture) (Brian Jeffriess, pers. comm.).

Tourism

Tourism activities associated with the aquaculture sector provide a further source of income and employment for regional economies with a well-developed aquaculture sector (e.g. the Eyre Peninsula region). In 2014/15 there were 2 businesses undertaking tourism activities with direct employment of approximately 4 fte (9 total jobs).

Education and Research

The aquaculture sector is characterised by a high level of innovation. These innovative ideas have been directed towards value adding opportunities in the Tuna industry (e.g. fresh fish direct marketed to Japan), finfish industry (e.g. creating a new market segment for smaller sized Yellowtail Kingfish), Oyster industry (e.g. marketing 'King' oysters that are larger in size), the mussel industry (e.g. exploring innovative packaging for product) among other new research and development opportunities.

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 and the South Australian Research and Development Institute) within South Australia.

There are a number of schools involved in the aquaculture industry which hold land-based or marine based licences for educational purposes of the students. The Eyre Peninsula's Cowell Area School, for example, offers a structured course in aquaculture which is conducted over two years by senior secondary students on their land-based facility (incorporating aquaponics and Barramundi farming), in addition to a fully operational marine Oyster licence. Education and research opportunities also exist at a higher level where South Australian based universities and vocational education providers offer marine biology and aquaculture related science certificates and degrees.

12. ECONOMIC IMPACT OF AQUACULTURE IN SA, TIME SERIES, 1997/98 TO 2014/15

Estimates of the economic impact of aquaculture on the South Australian economy for the period 1997/98 to 2014/15, in terms of contribution to GSP and employment, are provided in Figure 12-1 and Figure 12-2, 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 2014/15 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 SA (see Table 2.1 for further details). Other methodological and data-related influences include:

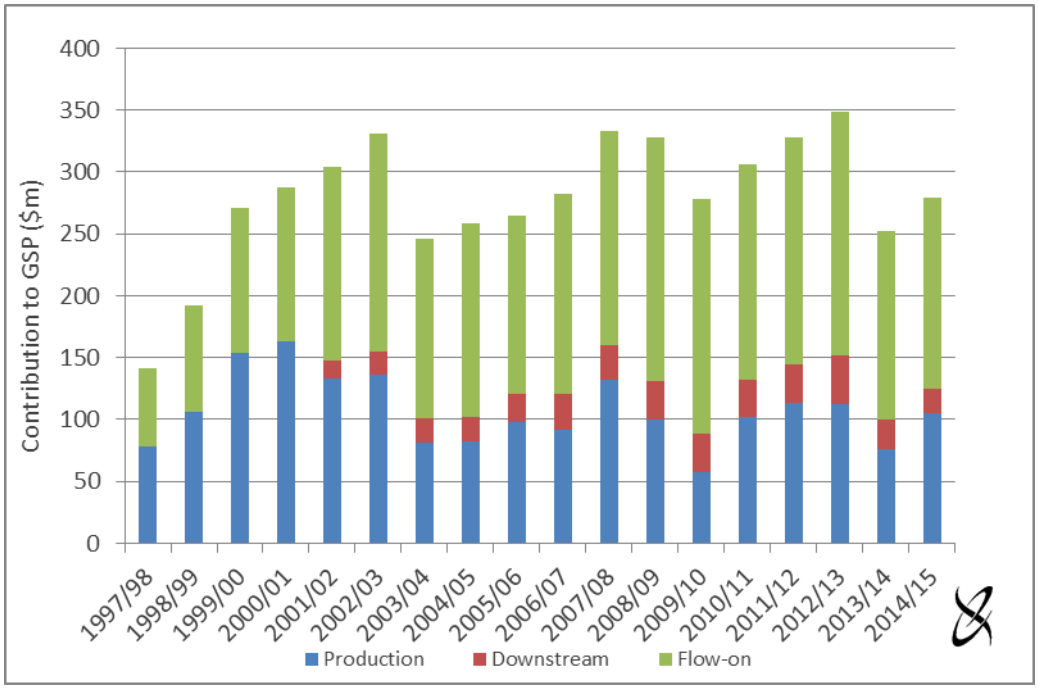
- the use of revised input-output tables
- updates of the representative cost structures for individual aquaculture sectors
- revisions to the processing, transport, retail and food service trade margins used in the analysis
- improvements in the quality of the responses and response rate to the PIRSA Fisheries and Aquaculture Production Returns.

Total contribution to GSP attributable to aquaculture in SA exhibited a rising trend over the period 1997/98 to 2002/03 (Figure 12-1). 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 2012/13 with fluctuations attributable primarily to changes in the production and value of farmed Tuna. GSP fell by 28 per cent between 2012/13 and 2013/14 as a result of a fall in value for a number of sectors including Tuna, Marine Finfish, Oysters, Freshwater Finfish and other aquaculture. The 11 per cent increase in contribution to GSP in 2014/15 resulted from increases in Other, Tuna and Marine Finfish value of production.

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 12-2). The significant fall in employment in 2010/11 was due to the use of a refined data collection form which resulted in improvements in the quality and accuracy of the responses from licence holders in the PIRSA Fisheries and Aquaculture Production Returns. The data collected in 2010/11 show that employment was inadvertently overstated in previous years. The fall in employment results in a reduction in household income and, due to the consequences from the modelled economic impacts, there are fewer people being employed in downstream and flow-on activities. This matter has now been resolved through the use of the refined Production Return forms. Total employment was

fairly stable between 2010/11 and 2012/13, at around 2,600 fte but fell to around 1,900 in 2013/14 and 2014/15 in line with the fall in total value of production.

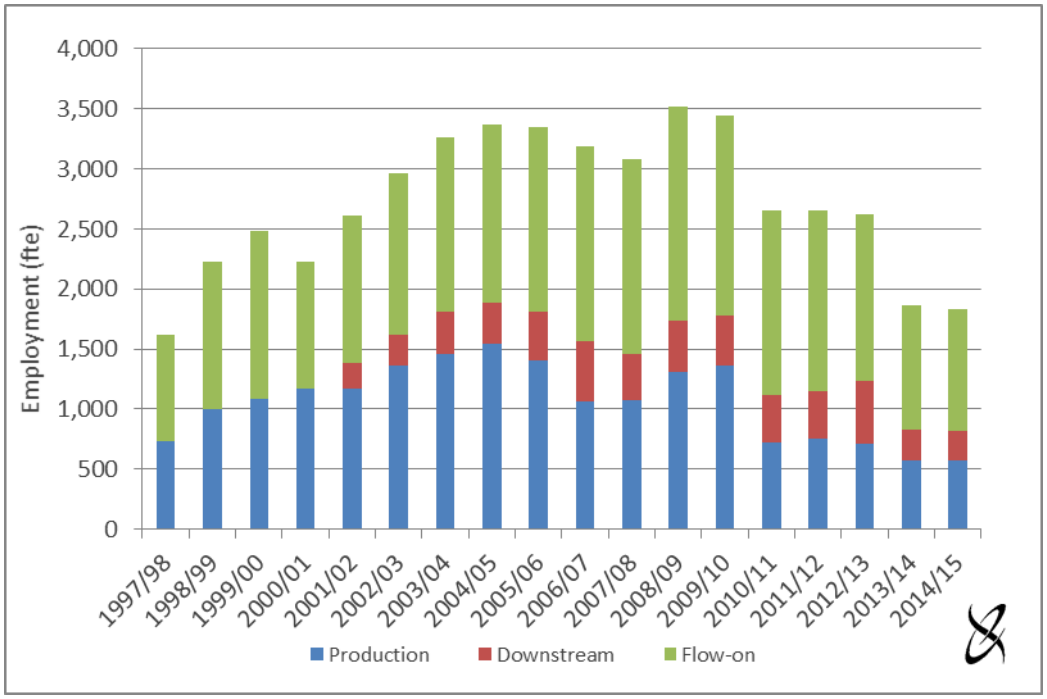
Figure 12-1 Total **GSP** impact of aquaculture in SA, 1997/98 to 2014/15 [a]



[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 (2015b) and Table ES-2

Figure 12-2 Total **employment** impact of aquaculture in SA, 1997/98 to 2014/15 [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 (2015b) and Table ES-2

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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) effects7, 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

[7] A glossary of I-O terminology is provided in Appendix 3.

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.

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)[8]). 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:

$$X_1 = X_{11} + X_{12} + \ldots\ldots\ldots\ldots\ldots + X_{1n} + Y_1$$
$$X_2 = X_{21} + X_{22} + \ldots\ldots\ldots\ldots\ldots + X_{2n} + Y_2$$
$$X_n = X_{n1} + X_{n2} + \ldots\ldots\ldots\ldots\ldots + X_{nn} + Y_n$$

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 aij, and represent the direct or first round requirements from the output of each sector following an increase in output of any sector.

[8] Jensen, R.C. and West, G.R. 1986, *Input-Output for Practitioners, Vol.1, Theory and Applications*, Office of Local Government, Department of Local Government and Administrative Services, AGPS, Canberra.

In equation terms the model becomes:

$$X_1 = a_{11}X_1 + a_{12}X_2 + \ldots\ldots\ldots\ldots\ldots + a_{1n}X_n + Y_1$$
$$X_2 = a_{21}X_1 + a_{22}X_2 + \ldots\ldots\ldots\ldots\ldots + a_{2n}X_n + Y_2$$
$$X_n = a_{n1}X_{11} + a_{n2}X_2 + \ldots\ldots\ldots\ldots\ldots + a_{nn}X_n + Y_n$$

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:

$(I\text{-}A)X = Y$

where $(I\text{-}A)$ is termed the Leontief matrix,

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

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

The general solution is often represented by:

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

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:

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

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 Σa_{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 induced[9] + consumption induced]/initial

Appendix Table 1-1 The structure of input-output multipliers for sector *i* [a]

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

[9] Where (first round + industrial support) = production induced.

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 2010a) and consistent with Mangan and Phibbs (1989)[10], 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.

[10] Mangan, J. and Phibbs, P. 1989, Demo-Economic Input-Output Modelling with Special Reference to the Wollongong Economy, Australian Regional Developments 20, AGPS, Canberra.

Population row: the population coefficient (pj) 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} / p_{pj}

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

p_{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 2011 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:

$u_j = -\text{rho}_j * (1-ess_j) * e_j$

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);

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 were extracted from the Australian Bureau of Statistics 2011 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 2009/10 Household Expenditure Survey.

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.
- 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 and state (i.e. *RISE v3.0*)[11]. 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

[11] For further details on the use and application of this type of model see EconSearch (2010b).

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 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".

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".

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.

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. The National Accounts definition of this indicator, as specified in the 2004/05 National I-O table, 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".

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.

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 (TLSPP) 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.

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, SA, 1995/96 TO 2014/15

Appendix Table 3-1 Farmed Tuna production, South Australia, 1995/96 to 2014/15

	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	5,017	8,786	157.8
2009/10	4,124	7,284	102.2
2010/11	3,786	5,800	114.5
2011/12	4,570	7,087	150.0
2012/13	4198	7,486	153.5
2013/14	5,050	7,544	122.4
2014/15	5,447	8,418	130.7

Source: ABARES 2015 and Brian Jeffriess (pers. comm. 04/04/15)

Appendix Table 3-2 Oyster production, South Australia, 1995/96 to 2014/15 [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	2010/11	2011/12	2012/13	2013/14	2014/15
Production (adult only):																				
Weight ('000 kg)	976	1,359	na	na	na	na	na	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	6,154	5,241	5,710	4,900	3,891
Value:																				
Adult oysters ($'000)	3,950	5,205	4,908	5,489	9,389	11,011	13,303	15,116	19,959	19,995	23,879	37,841	30,132	32,231	35,027	35,205	30,972	35,002	32,077	28,385
Spat ($'000)	na	610	1,168	997	800	579	856	1,002	1,193	1,195	957	1,143	1,469	320	444	1,267	271	298	227	333
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	36,472	31,243	35,300	32,303	28,718

[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. Excludes the volume and value of juvenile oysters sold for on-growing.

Source: SARDI Aquatic Sciences and PIRSA Fisheries and Aquaculture

Appendix Table 3-3 Remaining aquaculture sector production, South Australia, 1996/97 to 2004/05 [a]

	1994/95		1995/96		1996/97		1997/98		1998/99		1999/00		2000/01		2001/02		2002/03		2003/04		2004/05	
	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
Mussels	na	na	na	na	na	na	na	na	84	183	81	173	111	260	171	371	254	466	400	697	377	657
Abalone	na	na	na	na	na	na	na	na	21	856	40	2000	53	2677	34	1901	59	3080	105	3155	177	5318
Freshwater Finfish	32	188	21	158	163	1833	216	2799	263	3293	287	3379	277	2919	281	2845	489	6322	256	2585	283	2810
Marron and Yabbies	14	185	23	316	15	227	17	246	34	391	28	460	25	368	19	377	29	626	28	633	42	893
Other [b]	296	2,629	323	3,158	280	2,012	379	3,041	412	3,259	337	2,828	480	4,322	334	3,375	1,077	8,769	894	7,533	2,019	17,015
Total	**342**	**3,002**	**367**	**3,632**	**458**	**4,072**	**612**	**6,086**	**814**	**7,982**	**773**	**8,840**	**946**	**10,546**	**839**	**8,869**	**1,908**	**19,263**	**1,683**	**14,603**	**2,898**	**26,693**
Tourism (visitors)					na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na

[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 Table 3-4 Other aquaculture production, South Australia, 2005/06 to 2014/15 [a]

	2005/06		2006/07		2007/08		2008/09		2009/10		2010/11		2011/12		2012/13		2013/14		2014/15	
	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	2,074	17,674	3,382	29,209	3,757	27,133	3,620	27,909	1,504	16,121	889	11,262	579	8,013	1,076	18,185
Mussels	469	950	1,032	1,914	1,369	2,591	1,340	2,519	1,343	2,530	1,174	2,425	1,277	2,677	1,480	2,935	1,619	3,446	1,577	3,069
Abalone	250	8,222	196	7,155	167	5,151	227	8,121	286	10,341	317	10,842	178	6,410	236	8,600	330	10,890	334	11,401
Freshwater Finfish	453	3,726	423	4,019	421	4,513	424	4,501	415	4,897	168	2,323	234	2,676	311	5,386	233	2,368	272	4,108
Marron and Yabbies	12	318	29	721	22	559	23	606	23	645	37	1,032	12	343	11	383	12	434	8	455
Other [b]	2,148	17,591	1,953	18,514	1,707	13,533	1,402	10,892	1,319	10,260	2,977	22,471	2,647	19,321	3,407	25,673	230	1,740	4,160	31,212
Total	**3,332**	**30,807**	**3,633**	**32,323**	**5,759**	**44,022**	**6,798**	**55,847**	**7,143**	**55,807**	**8,293**	**67,003**	**5,852**	**47,549**	**6,335**	**54,240**	**3,004**	**26,892**	**7,426**	**68,430**
Tourism (visitors)	na	na	na	na	na	na	na	na	na	na	na	na	11,959	623	9,284	511	8,303	511	9,732	-

[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 SA, BY AQUACULTURE SECTOR, 2001/02 TO 2013/14

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%**

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%**

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%**

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%**

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%**

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%**

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	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%**

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	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%**

Appendix Table 4-9 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2009/10

Sector	Output [b]		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Tuna farming	288.1	45.8%	119.3	42.9%	1,179	34.3%	62.2	40.2%
Marine finfish farming	94.8	15.1%	33.8	12.1%	422	12.3%	21.2	13.7%
Oyster farming	172.4	27.4%	89.9	32.3%	1,259	36.6%	50.1	32.4%
Mussels farming	13.5	2.1%	7.0	2.5%	185	5.4%	4.8	3.1%
Abalone farming	30.7	4.9%	12.8	4.6%	189	5.5%	8.8	5.7%
Freshwater finfish farming	12.4	2.0%	6.5	2.3%	112	3.3%	4.1	2.7%
Marron and yabbies farming	1.5	0.2%	0.9	0.3%	26	0.7%	0.3	0.2%
Other aquaculture	15.7	2.5%	8.0	2.9%	69	2.0%	3.2	2.1%
Total (SA)	**629.2**	**100.0%**	**278.3**	**100.0%**	**3,441**	**100.0%**	**154.8**	**100.0%**

Appendix Table 4-10 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2010/11

Sector	Output [b]		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Tuna farming	283.2	44.2%	140.2	45.8%	868	32.8%	49.7	34.9%
Marine finfish farming	95.9	15.0%	35.0	11.4%	425	16.0%	21.8	15.3%
Oyster farming	176.1	27.5%	91.5	29.9%	966	36.5%	51.8	36.4%
Mussels farming	12.1	1.9%	6.4	2.1%	73	2.8%	4.3	3.0%
Abalone farming	33.7	5.3%	12.6	4.1%	185	7.0%	8.8	6.2%
Freshwater finfish farming	7.2	1.1%	3.8	1.3%	53	2.0%	2.7	1.9%
Marron and yabbies farming	2.4	0.4%	1.5	0.5%	27	1.0%	0.4	0.3%
Other aquaculture	29.7	4.6%	15.1	4.9%	52	2.0%	2.8	1.9%
Total (SA)	**640.3**	**100.0%**	**306.1**	**100.0%**	**2,649**	**100.0%**	**142.4**	**100.0%**

Appendix Table 4-11 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2011/12

Sector	Output [b]		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Tuna farming	328.4	50.0%	162.5	49.6%	964	36.3%	56.4	37.9%
Marine finfish farming	49.9	7.6%	22.5	6.9%	257	9.7%	12.8	8.6%
Oyster farming	210.9	32.1%	109.2	33.3%	1,077	40.5%	63.0	42.3%
Mussels farming	13.3	2.0%	7.0	2.1%	85	3.2%	4.7	3.1%
Abalone farming	20.8	3.2%	8.4	2.6%	139	5.2%	6.6	4.4%
Freshwater finfish farming	8.2	1.2%	4.1	1.3%	74	2.8%	3.1	2.1%
Marron and yabbies farming	0.8	0.1%	0.5	0.2%	19	0.7%	0.1	0.1%
Other aquaculture	25.2	3.8%	13.4	4.1%	42	1.6%	2.2	1.5%
Total (SA)	**657.4**	**100.0%**	**327.6**	**100.0%**	**2,656**	**100.0%**	**149.0**	**100.0%**

Appendix Table 4-12 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2012/13

Sector	Output [b]		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Tuna farming	339.3	48.0%	166.7	47.8%	954	36.3%	56.9	36.4%
Marine finfish farming	30.6	4.3%	14.9	4.3%	112	4.3%	6.0	3.8%
Oyster farming	249.5	35.3%	122.8	35.2%	1,240	47.2%	76.1	48.6%
Mussels farming	15.8	2.2%	8.3	2.4%	77	2.9%	5.5	3.5%
Abalone farming	25.5	3.6%	9.6	2.8%	112	4.3%	5.6	3.6%
Freshwater finfish farming	13.0	1.8%	7.5	2.2%	73	2.8%	4.0	2.6%
Marron and yabbies farming	0.9	0.1%	0.6	0.2%	22	0.8%	0.2	0.1%
Other aquaculture [a]	32.1	4.5%	18.5	5.3%	35	1.3%	2.1	1.3%
Total (SA)	**706.7**	**100.0%**	**348.9**	**100.0%**	**2,625**	**100.0%**	**156.4**	**100.0%**

Appendix Table 4-13 The total economic impact (direct and flow-on) of aquaculture in South Australia, by aquaculture sector, 2013/14

Sector	Output [b]		Contribution to GSP		Employment		Household Income	
	($m)		($m)		(fte)		($m)	
Tuna farming	288.4	55.8%	136.0	54.0%	776	41.6%	50.0	42.7%
Marine finfish farming	21.4	4.1%	10.9	4.3%	94	5.1%	4.9	4.2%
Oyster farming	144.5	28.0%	78.7	31.2%	699	37.5%	44.9	38.3%
Mussels farming	17.1	3.3%	9.3	3.7%	99	5.3%	6.3	5.4%
Abalone farming	34.1	6.6%	11.1	4.4%	120	6.4%	7.2	6.2%
Freshwater finfish farming	7.3	1.4%	3.6	1.4%	49	2.6%	2.7	2.3%
Marron and yabbies farming	1.0	0.2%	0.6	0.3%	15	0.8%	0.2	0.2%
Other aquaculture [a]	3.0	0.6%	1.6	0.6%	12	0.6%	0.9	0.8%
Total (SA)	**516.7**	**100.0%**	**251.9**	**100.0%**	**1,865**	**100.0%**	**117.1**	**100.0%**

Source: EconSearch (2015b)