



ECONOMIC CONTRIBUTION OF AQUACULTURE TO NEW SOUTH WALES

A Report for NSW Department of
Primary Industries

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ABBREVIATIONS

Fte	full-time equivalent
GRP	gross regional product
GSP	gross state product
GVP	gross value of production
IO	input-output
LGA	local government area
NSW	New South Wales
NSW DPI	New South Wales Department of Primary Industries
RISE	Regional Industry Structure & Employment

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EXECUTIVE SUMMARY

The New South Wales Department of Primary Industries (NSW DPI) is seeking updated estimates of the economic contribution of the New South Wales (NSW) aquaculture industry to the state and regions. These estimates will be used by the aquaculture industry for event recovery response and industry development initiatives. These data will also be routinely used by NSW DPI to demonstrate the significance of the aquaculture industry in NSW and its regions. To provide this information, BDO EconSearch was contracted by NSW DPI to estimate the economic contribution of aquaculture in NSW and its regions, and to describe and quantify, where possible, the ecosystem services provided by shellfish aquaculture.

Scope

In-scope activities include all activities associated with operating aquaculture businesses within the state of NSW. This includes aquaculture farming activity up to the point where product is sold by the aquaculture farming business (i.e. where ‘farmgate prices’ can be evaluated) and all associated business operations and administration activity. On-site processing (such as freezing, cleaning, etc.) is also in-scope as an aquaculture activity. Post-harvest (on-land) processing is included in the economic contribution indicators as well as the remainder of the supply chain (i.e. transport, wholesale, retail and food service). Direct economic contribution of each of these supply chain nodes will be separately identified in the report and total flow-on economic contribution from all direct activity will be estimated.

The supply chain of commercial fisheries seafood and imported seafood is out of scope. The study includes NSW aquaculture seafood only.

While all aquaculture sectors in the jurisdiction of NSW DPI are in scope, not every sector has been reported on separately. The aquaculture sectors reported on separately are lease based, land based and hatchery. Tourism and processing activity associated with aquaculture businesses has also been reported separately.

The economic contribution indicators produced in this study are provided by Local Government Area (LGA) according to where production occurs. Some grouping of LGAs was required to preserve confidentiality. Contributions by LGA were then attributed to estuaries (for those estuary based sectors, i.e. Class A permits) based on the proportion of production in the LGA that falls into the estuary.

Direct economic contribution indicators are reported in terms of output, gross state or regional product (GSP or GRP), household income and employment (full time equivalent jobs). Complementary estimates of the flow-on effects generated by these activities through the purchase of materials, services and labour, and expenditure of wages are also provided.

Approach

For each permit class and species (as per the production return report) produced within a given LGA (and estuary for lease based businesses) the data obtained from NSW DPI included information on production (weight/quantity, prices and total value), permit holders and businesses. For Oysters (Class A Permit) data on breakdown of size, species, farm stock and spat production was also sourced.

A survey of NSW aquaculture permits holders was undertaken to collect representative cost structures and other relevant information for enterprises operating in individual aquaculture sectors for 2021/22. This survey was tailored to each permit class.

The method employed for estimation of economic contributions was extended input-output (IO) analysis which is the analytical basis of the RISE model. IO analysis is widely used in economic contribution analysis

and is a practical method for measuring economic contributions at regional and state levels. The expenditure profiles were run through the RISE models to generate economic contribution results for the aquaculture industry and, where possible, contribution by sector, supply-chain stage and region.

Results

The total value of aquaculture production in NSW in 2021/22, as detailed in Table ES-1, was \$101.9m (excluding the value of spat which is an input into the final value of oyster production (i.e. excluded to avoid double counting)).

Table ES-1 NSW Aquaculture production and value of production, 2021/22

Sector	Production	Value of Production (\$)
Lease (doz) ^a	5,593,998	55,833,906
Land (kg)	1,887,574	35,550,878
Hatchery (no. individuals)	22,686,852	10,516,796
Total ^b		101,901,580

^a Excludes oyster spat production and value of production. Includes blue mussel value of production but excludes the production quantity.

Source: NSW DPI 2023

State level

Estimates of the direct economic contribution of aquaculture production (lease, land, hatchery and tourism sectors), aquaculture processing activities, aquaculture wholesaling, the transport of aquaculture products and the sale of aquaculture products to the retail and food service sectors in NSW in 2021/22 are provided for 2021/22 in Table ES-2. Contributions are measured in terms of value of output, contribution to gross state product (GSP), employment and household income.

Table ES-2 The economic contribution of Aquaculture to NSW, 2021/22

	Output (\$m)	GSP (\$m)	Employment (fte)	Household Income (\$m)
Direct On-farm				
Lease	55.8	31.0	472	30.1
Land	35.5	10.3	156	6.7
Hatchery	10.5	5.1	59	3.0
Tourism	4.9	2.5	36	1.6
Direct Downstream				
Processing	25.4	12.7	151	11.3
Wholesale	12.6	6.6	103	4.1
Retail Trade	7.7	4.5	260	2.9
Food Service	14.9	7.2	191	5.6
Road Transport	8.1	3.4	35	2.1
Total Direct	175.5	83.3	1,464	67.3
Flow-on	249.6	136.3	858	77.8
Total Contribution	425.2	219.7	2,321	145.1

Source: BDO EconSearch analysis

The total NSW aquaculture contribution to GSP in 2021/22 was estimated to be \$219.7m, consisting of \$48.9m in on-farm activities, \$34.5m in downstream activities (processing, wholesaling, retailing, food service and transport) and \$136.3m in flow-on economic activity in other sectors of the economy.

The total NSW employment attributable to aquaculture in 2021/22 was estimated to be 2,321 fte jobs, consisting of 724 on-farm fte jobs, 740 downstream fte jobs (e.g. in processing, wholesaling, retailing, food service and transport) and 858 flow-on fte jobs in other sectors of the economy.

Lease based sector

The total contribution to GSP by the lease based sector of the NSW aquaculture industry including flow-on effects to other sectors of the state economy was \$78.8m in 2021/22. This was primarily comprised of the total gross regional product (GRP) contributed by the Bega Valley LGA (\$15.4m), Mid Coast LGA (\$12.7m), Eurobodalla LGA (\$9.4m), Port Stephens LGA (\$7.5m), and the additional flow-on activity throughout the state. The major contributing estuary to GRP in the Bega Valley LGA was the Merimbula Lake estuary, with \$9.7m in total. In the Mid Coast LGA it was the Wallis Lake estuary (\$9.7m), in the Eurobodalla LGA it was the Clyde River estuary (\$4.9m) and Wagonga Inlet estuary (\$3.7m), and in the Port Stephens LGA it was the Port Stephens estuary (\$7.5m).

The NSW aquaculture lease based sector supported 472 fte direct on farm jobs in 2021/22. Flow-on business activity was estimated to generate a further 312 fte jobs, summing to 784 fte jobs in total throughout the state. This was primarily comprised of the fte jobs supported by the Bega Valley LGA (177 total fte jobs), Mid Coast LGA (151 total fte jobs), Eurobodalla LGA (110 total fte jobs) and Port Stephens LGA (86 total fte jobs), and the associated flow-on activity of the production in these regions. The major contributing estuary to total employment in the Bega Valley LGA was the Merimbula Lake estuary, with 111 fte jobs in total. In the Mid Coast LGA it was the Wallis Lake estuary (116 total fte jobs), in the Eurobodalla LGA it was the Clyde River estuary (58 total fte jobs) and Wagonga Inlet estuary (43 total fte jobs), and in the Port Stephens LGA it was the Port Stephens estuary (86 total fte jobs).

Land based sector

The total contribution to GSP by the land based sector of the NSW aquaculture industry including flow-on effects to other sectors of the state economy was \$30.9m in 2021/22. This was primarily comprised of the total gross regional product (GRP) contributed by the Clarence Valley LGA (\$9.1m), Griffith LGA (\$3.4m), Leeton LGA (\$2.4m), and the additional flow-on activity throughout the state.

The NSW aquaculture land based sector supported 156 fte direct on farm jobs in 2021/22. Flow-on business activity was estimated to generate a further 135 fte jobs, summing to 291 fte jobs in total throughout the state. This was primarily comprised of the fte jobs supported by the Clarence Valley LGA (102 total fte jobs), Griffith LGA (36 total fte jobs), Leeton LGA (26 total fte jobs), and the additional flow-on activity throughout the state.

Hatchery

The total contribution to GSP by the hatchery sector of the NSW aquaculture industry including flow-on effects to other sectors of the state economy was \$11.8m in 2021/22. This was primarily comprised of the total gross regional product (GRP) contributed by the Narrandera LGA (\$2.6m), Armidale LGA (\$1.9m), Snowy Monaro LGA (\$1.4m), and the additional flow-on activity throughout the state.

The NSW aquaculture hatchery sector supported 59 fte direct on farm jobs in 2021/22. Flow-on business activity was estimated to generate a further 42 fte jobs, summing to 101 fte jobs in total throughout the state. This was primarily comprised of the fte jobs supported by the Narrandera LGA (25 total fte jobs),

Armidale LGA (19 total fte jobs), Snowy Monaro LGA (14 total fte jobs), and the additional flow-on activity throughout the state.

Ecosystem Services Provided by Aquaculture

A brief literature review was undertaken to identify ecosystem services provided by the aquaculture species produced in NSW and to identify appropriate methods and data to quantify a limited set of ecosystem services. The ecosystem services that could be quantified were nitrogen and phosphorus removal by farmed oysters and mussels.

A number of ecosystem services are provided by aquaculture, which are described in Table ES-3.

Table ES-3 Ecosystem services provided by aquaculture

Service category	Service	Potential species providing service
Provisioning	Food production	Bivalves, Fish, Crustacea
	Other products (pharmaceuticals, construction, etc)	Bivalves, Fish, Crustacea
Regulating	Carbon sequestration	Bivalves
	Acidification regulation	Algae
	Coastal protection	Bivalves, Fish
	Nutrient removal	Bivalves
Supporting	Improve water clarity	Bivalves
	Provision of artificial habitat	Bivalves, Fish
Cultural	Livelihoods	Bivalves, Fish, Crustacea
	Tourism	Bivalves, Fish, Crustacea

Sources: Gentry et al. (2020) and van der Schatte Olivier et al. (2018)

The total value of nutrient removal services by oyster and mussel aquaculture in NSW in 2021/22 was estimated to be \$5.6 million (Table ES-4). These results are for oysters and mussels only. They do not include other aquaculture species, some of which may contribute to excess nutrients in adjacent waters. The net result for the whole sector is unknown.

Table ES-4 Estimated value of nutrient removal services by oyster and mussel aquaculture, NSW, 2021/22

Nutrient	Value of nutrient removal (\$m)		
	Oysters	Mussels	Total
Total nitrogen	3.9	0.4	4.3
Total phosphorus	1.3	<0.1	1.3
Total	5.2	0.4	5.6

Source: BDO EconSearch analysis.

1. INTRODUCTION

Aquaculture in New South Wales (NSW) is a diverse and valuable industry that draws on natural resources to generate livelihoods, food and purpose for those involved directly and indirectly. The New South Wales Department of Primary Industries (NSW DPI) is seeking updated estimates of the economic contribution of the NSW aquaculture industry to the state and regions. These estimates will be used by the aquaculture industry for event recovery response and industry development initiatives. These data will also be routinely used by NSW DPI to demonstrate the significance of the aquaculture industry in NSW and its regions.

The most recent study on the economic contribution of aquaculture in NSW was the *Social and Economic Evaluation of NSW Coastal Aquaculture for 2014/15* (Barclay et al. 2016). NSW DPI and the aquaculture industry now require updated economic data on the NSW aquaculture industry for 2021/22. As such, BDO EconSearch was contracted by NSW DPI to estimate the economic contribution of aquaculture in NSW and its regions, and to describe and quantify, where possible, the ecosystem services provided by shellfish aquaculture. The scope of the study is outlined further in this section in terms of activity, aquaculture sectors, regions and indicators.

1.1. Activity

In-scope activities include all activities associated with operating aquaculture businesses within the state of NSW. This includes aquaculture farming activity up to the point where product is sold by the aquaculture farming business (i.e. where ‘farmgate prices’ can be evaluated) and all associated business operations and administration activity. On-site processing (such as freezing, cleaning, etc.) is in-scope as an aquaculture activity. Post-harvest (on-land) processing is included in the economic contribution indicators as well as the remainder of the supply chain (i.e. transport, wholesale, retail and food service). The direct economic contribution of each of these supply chain nodes will be separately identified in the report and total flow-on economic contribution from all direct activity will be estimated.

The supply chain of commercial fisheries seafood and imported seafood is out of scope. The study includes NSW aquaculture seafood only.

1.2. Aquaculture Sectors

While all aquaculture sectors in the jurisdiction of NSW DPI are in scope, not every sector has been reported on separately. The aquaculture sectors reported on separately are described in Table 1-1. Tourism and processing activity associated with aquaculture businesses has also been reported separately.

Table 1-1 Aquaculture sector classifications

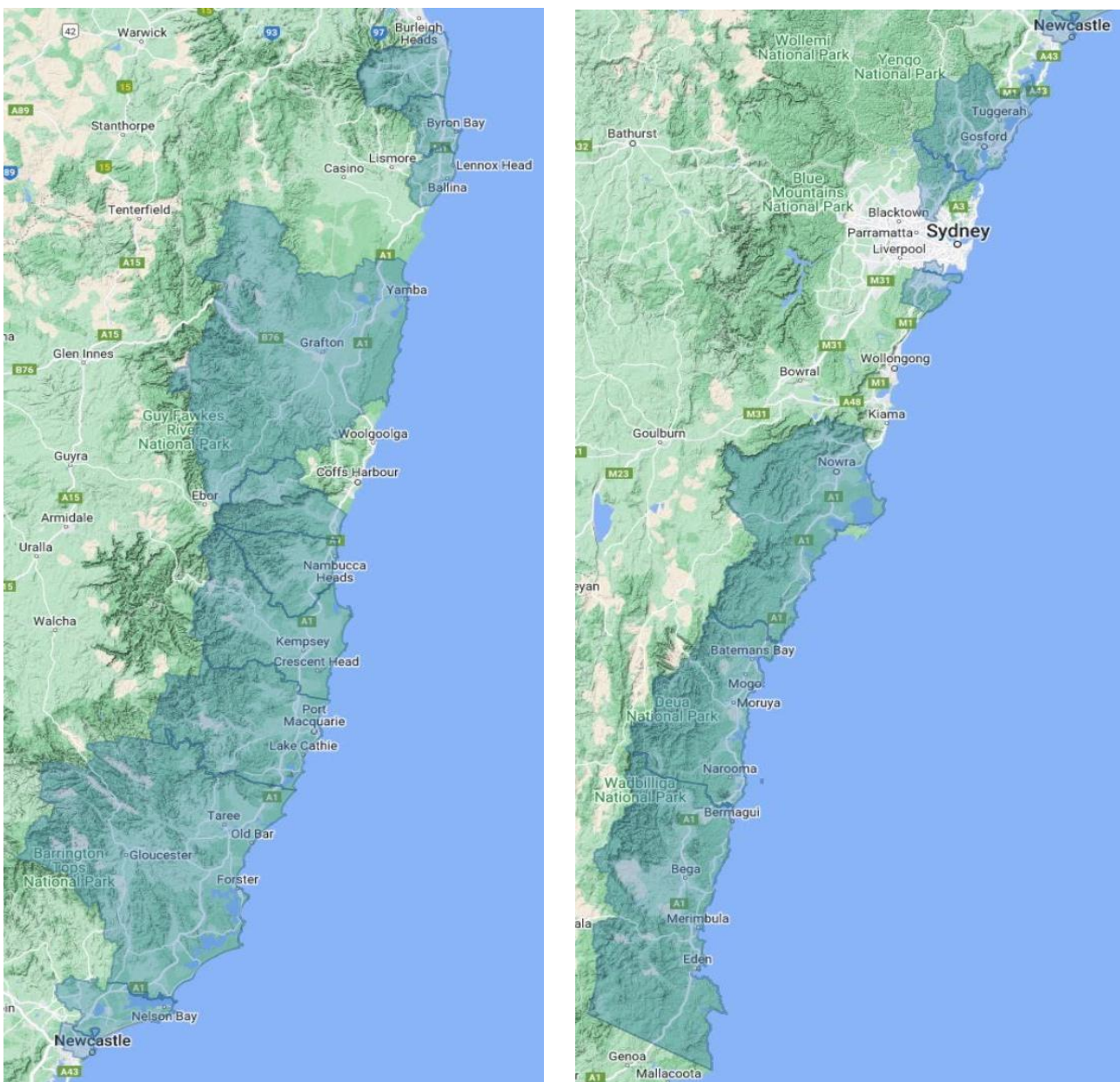
Aquaculture Sector	Permit Class	Sector Definition	Key Species	Sector Reported Separately
Extensive Lease Based	Class A	Based in leased areas of public estuarine waters allowing stock to grow off natural food sources and conditions, without the need to add/supplement food sources.	Oysters (Sydney Rock Oyster, Pacific Oyster, Native Oyster and Akoya Oyster) and Mussels (Blue Mussel).	Yes.
Extensive Land Based	Class C and Class E	Based on land that is the subject of freehold ownership or a Crown Land licence/lease, i.e. not public water land. Nutritional requirements come from the natural productivity of the water body in which they are held. Permit Class E allows extensive freshwater aquaculture at a number of different sites and landholder permission sought when the land that the dams are on is not owned by the permit holder.	Freshwater Prawn, Freshwater Mussel, Yabby, Fish species (Golden Perch, Australian Bass and Murray Cod), and Oyster Spat.	No, combined with Intensive Land Based and Fish-out sectors.
Intensive Land Based	Class D	Intensive land-based aquaculture on freehold or leasehold land. It involves higher stocking densities of fish and regular feeding providing supplementary food for the species being cultivated (whether or not naturally occurring food is available also). There is a significantly higher component of management required than extensive land-based projects.	Murray Cod, Silver Perch, Barramundi, Trout, Prawns, Golden Perch, Silver Perch, Australian Bass and Yabby.	No, combined with Extensive Land Based and Fish-out sectors.
Fish-out	Class F	Tank, pond or structure which members of the public are charged for the right to fish in. The farms are located on privately owned land.	Trout species, Silver Perch, Golden Perch, Murray Cod and Australian Bass.	No, combined with Extensive Land Based and Intensive Land Based sectors.
Hatchery	Class H	The breeding of juveniles of various species including both fish and invertebrates. Farming activity is usually undertaken on privately owned land but may be Crown land lease in the case of an oyster hatchery.	Shellfish, Prawn, Murray Cod, Golden Perch, Silver Perch, Australian Bass and Trout.	Yes

Source: NSW DPI pers. comm.

1.3. Regions

The economic contribution indicators produced in this study are provided by Local Government Area (LGA) according to where production occurs. Note some grouping of LGAs was required to preserve confidentiality. Contributions by LGA were then attributed to estuaries (for those estuary based sectors, i.e. Class A permits) based on the proportion of production in the LGA that falls into the estuary. Information on how to distribute production by LGA to estuaries was provided by NSW DPI. Aquaculture production activity occurs in the majority of LGAs throughout the state. A map of the aquaculture producing LGAs for Class A permits is presented in Figure 1-1. Note that the LGAs where land based production occurs under Class C, D, E and H permits are not included in the figure below.

Figure 1-1 Local Government Areas and estuaries where Class A permit production are reported



Source: NSW DPI and BDO EconSearch Analysis

1.4. Indicators

The reported economic contribution indicators are described in this section including their calculation, interpretation and the reason for including them. All data for all indicators were subject to confidentiality constraints and agreed sector and region definitions (Sections 1.2 and 1.3).

Economic contribution indicators, detailed in Table 1-2, are reported by aquaculture sector by region in terms of output, gross state or regional product (GSP or GRP), household income and employment (full time equivalent jobs).

Table 1-2 Economic contribution indicators

Indicator	Reason	Interpretation/Calculation
Output	The total contribution of the aquaculture sector to the state/regional economy	The gross revenue of goods and services produced by commercial organisations plus gross expenditure by government agencies. This indicator needs to be used with care as it includes elements of double counting.
Gross state/regional product (GSP/GRP)	The net contribution of the aquaculture sector to the state/regional economy.	The net contribution of an activity to the state/regional economy. Contribution to GSP or GRP is measured as value of output less the cost of goods and services (including imports) used in producing the output. It can also 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 GSP or GRP as a measure of economic contribution avoids the problem of double counting that may arise from using value of output for this purpose. GSP is used when referring to state level contributions and GRP is used when referring to regional level contributions. GSP and GRP are state and regional level equivalents of gross domestic product (GDP).
Employment	The total employment contribution of the aquaculture sector to the state/regional economy.	The number of working proprietors, managers, directors and other employees, in terms of the number of full-time equivalent jobs.
Household income	A measure of the wages and salaries attributable to the employment contribution of the aquaculture sector.	A component of GSP and GRP and is a measure of wages and salaries, drawings by owner operators and other payments to labour including overtime payments and income tax, but excluding payroll tax.

Direct contribution is reported by region for the following activities:

- On-farm activity including capital expenditure by aquaculture businesses (by sector)
- the net value of (NSW) processing and wholesaling
- the net value of retail and food service trade
- the value of transport services at all stages of the marketing chain.

Total employment contribution is reported for the top 10 of 78 sectors specified in the RISE economic models and for 'other sectors'.

2. APPROACH

This section of the report describes the data used in the study, both the industry level data provided by NSW DPI and the business level data provided by NSW aquaculture businesses. Following this is a description of the method used to generate the economic contribution results.

2.1. Data

For each permit class and species (as per the production return report) produced within a given LGA (and Estuary for lease based businesses) the data obtained from NSW DPI included:

- Production (weight/quantity)
- Production (average price)
- Production (total \$ value)
- Total number of permit holders
- Number of reporting permit holders (including those with nil returns)
- Number of active reporting permit holders (i.e. those with non-nil returns)
- Number of businesses (some businesses may hold multiple permits).

For Oysters (Class A Permit) data on breakdown of size, species, farm stock and spat production was also sourced.

Aggregations for reporting indicators were agreed to ensure the privacy and confidentiality of aquaculture businesses was maintained. However, confidentiality checks were also applied to all deliverables, including incorporated information from at least 5 aquaculture businesses.

A survey of NSW aquaculture permit holders was undertaken to collect representative cost structures and other relevant information for enterprises operating in individual aquaculture sectors for 2021/22. The survey was tailored to each permit class and occurred between March and May of 2023.

Given the complexity of NSW aquaculture businesses, a two stage approach to the survey data collection was used. A questionnaire was tailored for each business through an initial consult phone call (stage 1) before it was sent to them to complete (stage 2). This approach ensured that the survey received by a business only included questions relevant to their business activities.

The population size, target sample size and achieved sample size for each sector is detailed in Table 2-1. Completed questionnaires were received from a combination of methods including an online survey and over the telephone. As a result of the small population size in the extensive land based and fish-out sectors it was necessary to combine these sectors with the intensive land based sector to provide a “land based” sector.

Data provided by NSW DPI detailed the number of businesses with no recorded production in 2021/22, which included 40 land based permits and 67 lease based permits. Overall, the achieved survey sample accounted for 13 per cent of active lease based permits and 27 per cent of land based permits.

Table 2-1 Survey sample size by aquaculture sector (no. of businesses)

Aquaculture Sector	Population Size	Survey Sample Size
Extensive water based (Oysters/Mussels)	251	23
Extensive land based (Prawns, Yabbies, Algae)	15	
Fish-out (Trout, Mulloway, Silver Perch)	19	13
Intensive land based (Murray Cod, Barramundi, Trout, Moreton Bay Bugs)	83	
Hatchery	41	7
Tourism	Unknown	7
Total	415	50^a

^a Note that the actual count of surveyed businesses was 37. However, many businesses operated under multiple aquaculture sectors and were able to provide a response for several sectors. These responses have been counted separately for the purpose of indicating the number of responses received per sector.

2.2. Methods

The method of analysis is based on estimating an average business in each aquaculture sector and then scaling up for production of the whole industry. However, aquaculture businesses in NSW tend to operate across sectors or permit classes, complicating the estimates for each sector.

As described earlier, data which is consistent with published production return data and its methods was sourced from NSW DPI to enable estimation of the size and value of each aquaculture sector in each region. The business survey data was required to collect data items that are not held by NSW DPI but are required to estimate economic contributions.

In addition to the aquaculture product produced (e.g. adult oysters) aquaculture business activities generate flow-on effects to other sectors of the economy through purchases of inputs and the employment of labour. To estimate the purchases of inputs and employment of labour, representative cost structures were developed for each aquaculture sector and are presented in Appendix 1. The representative cost structures describe an average business in each sector, such that they could be combined to understand how costs, capital use and employment relate to aquaculture activity.

The representative cost structures were then used with value of production estimates and the number of active businesses (data provided by NSW DPI) to estimate expenditure profiles for each aquaculture sector at the regional and state levels. Fixed costs and employment were scaled up by the number of active aquaculture businesses and variable costs and employment were scaled up by the total value of production.

On an item-by-item basis, the expenditures were then allocated between those occurring in the region, those occurring in NSW and those goods and services imported from outside the state.

To report the regional direct and flow-on activity of lease based aquaculture by estuary, the results produced by the RISE models at the LGA level were attributed to estuaries based on the proportion of the total value of production occurring in each estuary within a given LGA.

An important factor to consider was the reconciliation of the intrastate spat and fingerling transfers so that the final value of production is not double counted but the economic activity of all aquaculture businesses is included. For example, the value of spat should not be included in the final value of oyster sales but the economic activity of the spat production (resulting from their purchase of input and labour) should be included. A similar consideration should be applied throughout the supply chain to avoid double counting. To do this we excluded spat sales and on-grown/juvenile sales when calculating total farmgate output. The next step was to only include value added margins, rather than totals, at each of the supply-chain nodes (e.g. processing, retail and food service). Importantly, the economic activity including the employment and contribution to GSP/GRP associated with each node of the supply chain was included. As described previously in this report, the following stages in the marketing chain were included in the quantifiable economic contribution:

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

The method employed for estimation of economic contributions was extended input-output (IO) analysis which is the analytical basis of the RISE model (Regional Industry Structure & Employment). IO analysis is widely used in economic contribution analysis and is a practical method for measuring economic contributions at regional and state levels. The RISE models are based upon I-O tables that describe the interdependencies between industries within the regional economy and with the economy outside of the region. This makes the comprehensive economic framework provided by the RISE model extremely useful for disentangling the direct and flow-on effects of activity in a regional economy.

The expenditure profiles were run through the RISE models to generate economic contribution results for the aquaculture industry and, where possible, contribution by sector, supply-chain stage and region. RISE models for 2020/21 for NSW as a whole and NSW LGAs (where production occurs) were constructed and utilised for the purpose of this study.

The data and method for estimating the value of ecosystem services provided by shellfish aquaculture are described in Section 6.

3. PRODUCTION AND VALUE OF PRODUCTION

The number of permits by permit class are detailed in Table 3-1 and estimates of NSW aquaculture production and value of production for 2021/22 are presented in Table 3-2. The largest permit class in terms of number of permits and gross value of production (GVP) is the lease based permit class. Regional production and value of production for NSW by LGA is shown in Table 3-3. Note that some producing LGAs are not reported individually. LGAs are excluded from reporting in cases of confidentiality constraints or limited production levels.

Table 3-1 Number of permits by class, NSW, 2021/22

Permit Class	Number of Permits
A	251
B	1
C	11
D	83
E	4
F	19
H	41
Total	410

Source: NSW DPI

Table 3-2 NSW aquaculture production and value of production, 2021/22

Sector	Production	Value of Production (\$)
Lease (doz) ^a	5,487,410	55,833,906
Land (kg)	1,887,574	35,550,878
Hatchery (no. individuals)	22,686,852	10,516,796
Total		101,901,580

^a Excludes oyster spat production and value of production. Includes blue mussel value of production but excludes the production quantity.

Source: NSW DPI 2023

Table 3-3 NSW aquaculture production and value of production by LGA, 2021/22

	Production (quantity)	Value of Production (\$)
Lease Based Sector (dozens)		
Bega Valley LGA	1,499,259	15,337,082
Mid Coast LGA	1,423,679	13,746,427
Eurobodalla LGA	948,620	10,081,307
Port Stephens LGA	783,906	8,126,375
Port Macquarie Hastings LGA	268,539	2,531,018
Shoalhaven LGA	239,406	2,277,928
Central Coast LGA	166,939	1,488,360
Nambucca LGA	105,147	932,054
Other LGAs ^a	51,915	1,313,356
Total Lease Sector ^b	5,487,410	55,833,906
Land Based Sector (kg)		
Clarence Valley LGA	784,388	14,572,115
Griffith LGA	271,447	5,337,654
Leeton LGA	184,130	3,878,800
Snowy Valleys LGA	218,554	2,845,069
Narrandera LGA	109,009	2,264,221
Wagga Wagga LGA	96,317	1,983,064
Mid Coast LGA	70,785	906,850
Wentworth LGA	30,776	840,974
Other LGAs ^c	122,168	2,922,131
Total Land Sector	1,887,574	35,550,878
Hatchery Sector (no. individuals)		
Narrandera LGA	5,050,216	3,215,896
Armidale LGA	1,550,800	2,243,900
Snowy Monaro LGA	1,180,525	1,865,629
Wagga Wagga LGA	2,233,888	1,222,493
Eurobodalla LGA	937,061	806,939
Other LGAs ^d	11,734,362	1,161,939
Total Hatchery Sector	22,686,852	10,516,796

^a Includes the Sutherland, Hornsby, Bellingen, Kempsey, Ballina, Tweed, and Clarence Valley LGAs.

^b Excludes oyster spat production and value of production. Includes blue mussel value of production but excludes the production quantity.

^c Includes the Port Stephens, Camden, Goulburn Mulwaree, Narrabri, Gilgandra, Kiama Municipal, Tweed, Murray, Shoalhaven, Armidale, Bathurst, Tamworth, Port Macquarie Hastings, Lake Macquarie, Dubbo, and Snowy Monaro LGAs.

^d Includes the Port Macquarie Hastings, Clarence Valley, Mid Coast, Snowy Valleys, Narrabri, Port Stephens, Coffs Harbour, Camden, Central Coast, Kempsey, Shoalhaven, and Tamworth LGAs.

Source: NSW DPI 2023

4. THE ECONOMIC CONTRIBUTION OF AQUACULTURE TO NSW

Estimates of the direct economic contribution of aquaculture production (lease, land and hatchery sectors), aquaculture processing and tourism activities, aquaculture wholesaling, the transport of aquaculture products, and the sale of aquaculture products to the retail and food service sectors in NSW in 2021/22 are provided in this section of the report. Estimates of the economic contribution generated by aquaculture in NSW on a sector-by-sector basis for 2021/22 are provided in Table 4-1. Contributions are measured in terms of value of output, contribution to gross state product (GSP), employment and household income.

Complementary estimates of the flow-on effects generated by these activities through the purchase of materials, services and labour are also provided (flow-on effects disaggregated by production and consumption induced effects are detailed in Appendix 2). As described in Section 2.2 these flow-on effects have been estimated using IO analysis. IO analysis is widely used in economic contribution analysis and is an appropriate method for measuring economic contributions at regional and state levels. To compile a representative cost structure for each sector, costs were derived from data provided by the operators survey, as described earlier. On an item-by-item basis, the expenditures were allocated between those occurring in NSW and those goods and services imported from outside the state. These data were then incorporated into the state IO model to estimate the flow-on or indirect economic contributions.

Output contributions

The aquaculture industry makes a significant economic contribution to NSW. Direct output (business turnover) generated in NSW in 2021/22 by aquaculture farms summed to \$106.7m (\$55.8m from the lease sector, \$35.5m from the land sector, \$10.5m from hatchery operations and \$4.9m from tourism activities). Other downstream sectors summed to \$68.8m (\$25.4m from processing, \$12.6m from wholesale trade, \$7.7m from retail trade, \$14.9m from food services and \$8.1m from transport) (Table 4-1). Flow-on output is not an appropriate indicator of economic activity as it double-counts transactions. Therefore, only the direct component of output is described in this section.

Contribution to GSP

Contribution to 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.

The direct contribution to GSP by the NSW aquaculture industry (i.e. farming, processing, tourism, trade, food service and transport) was \$83.3m in 2021/22 (\$48.9m from on-farm activities and \$34.5m from downstream activities). Associated with this was flow-on GSP in the other sectors of the state economy of \$136.3m (Table 4-1). The total contribution to GSP was approximately \$219.7m in 2021/22.

Table 4-1 The economic contribution of Aquaculture in NSW, 2021/22

	Output (\$m)	GSP (\$m)	Employment (fte)	Household Income (\$m)
Direct				
On-farm				
Lease	55.8	31.0	472	30.1
Land	35.5	10.3	156	6.7
Hatchery	10.5	5.1	59	3.0
Tourism	4.9	2.5	36	1.6
Downstream				
Processing ^a	25.4	12.7	151	11.3
Wholesale	12.6	6.6	103	4.1
Retail Trade	7.7	4.5	260	2.9
Food Service	14.9	7.2	191	5.6
Road Transport	8.1	3.4	35	2.1
Total Direct	175.5	83.3	1,464	67.3
Flow-on ^b				
On-farm				
Lease	86.0	47.8	312	27.1
Land	38.8	20.5	135	12.0
Hatchery	12.8	6.7	42	3.8
Tourism	5.5	2.9	18	1.5
Downstream				
Processing	38.9	21.7	142	12.7
Wholesale	18.7	10.2	58	5.7
Retail Trade	11.3	6.2	35	3.4
Food Service	24.7	13.4	77	7.5
Road Transport	12.8	6.9	40	3.9
Total Flow-on	249.6	136.3	858	77.8
Total Contribution				
On-farm				
Lease	141.9	78.8	784	57.1
Land	74.3	30.9	291	18.7
Hatchery	23.3	11.8	101	6.8
Tourism	10.5	5.4	53	3.1
Downstream				
Processing	64.4	34.4	292	24.0
Wholesale	31.3	16.8	161	9.8
Retail Trade	19.0	10.7	296	6.4
Food Service	39.7	20.7	268	13.1
Road Transport	20.9	10.3	75	6.0
Total Contribution	425.2	219.7	2,321	145.1

^a Some processing activity occurs on-farm but has been included in one processing downstream sector in order to understand the size of that economic activity.

^b Denotes the flow-on activity attributable to each direct sector.

Source: BDO EconSearch analysis

Employment and household income

A significant number of jobs were created as a result of the direct and flow-on business activity associated with aquaculture farming activities. The farms were responsible for the direct employment of approximately 724 full-time equivalents (fte) jobs and, through associated processing, trade, food service and transport activities, another 740 fte jobs in 2021/22 (Table 4-1). Flow-on business activity was estimated to generate a further 858 fte jobs to give total employment of 2,321 fte jobs in the state.

Household income of \$41.3m was earned in aquaculture farming activities and another \$26.0m in downstream activities. This comprised both wages by employees and estimated drawings by owner/operators. An additional \$77.8m of household income was earned in other businesses in the state as a result of farming and downstream activities. The total household income contribution was estimated to be \$145.1m.

The total employment contribution (i.e. direct and flow-on employment) for NSW aquaculture for the 10 largest employing sectors is detailed in Table 4-2. Unsurprisingly the aquaculture sector is the largest employing sector with 724 fte jobs, followed by retail trade (409 fte jobs), food and beverage services (243 fte jobs), processed seafood products (151 fte jobs) and wholesale trade (133 fte jobs).

Table 4-2 The total employment contribution (direct and flow-on) of aquaculture in NSW by sector, 2021/22

Sector	Employment (fte)
Aquaculture	724
Retail Trade	409
Food & Beverage Services	243
Processed Seafood Products	151
Wholesale Trade	133
Personal & Other Serv	91
Prof Scientific Tech Serv	81
Road Transport	78
Health & Community Serv	59
Education & Training	46
Other sectors	307
Total	2,321

Source: BDO EconSearch analysis

5. THE ECONOMIC CONTRIBUTION OF AQUACULTURE TO REGIONS OF NSW

Estimates of the direct and total economic contribution of aquaculture production by LGA and estuary (lease based only) in NSW in 2021/22 are provided in this section of the report. Downstream activity is not included in the regional results.

5.1. Lease Based Sector

The direct and total economic contribution of the lease based sector in NSW in 2021/22 is detailed in Table 5-1 by LGA and total economic contribution (i.e. direct plus flow-on effects) in in Table 5-2 by estuary. Note that some producing LGAs and estuaries are not reported individually. LGAs are excluded from reporting in cases of confidentiality constraints or limited contribution levels.

Output

Direct output or GVP generated in NSW in 2021/22 by lease based sector aquaculture farms summed to \$55.8m. This was primarily concentrated in the Bega Valley LGA (\$14.7m), Mid Coast LGA (\$13.1m), Eurobodalla LGA (\$9.6m) and Port Stephens LGA (\$7.8m).

Contribution to gross state product/gross regional product

The direct contribution to GSP by the lease based sector of the NSW aquaculture industry was \$31.0m in 2021/22. The total contribution to GSP including flow-on effects to other sectors of the state economy was \$78.8m in 2021/22.

This total contribution was primarily comprised of the total GRP contributed by the Bega Valley LGA (\$15.4m), Mid Coast LGA (\$12.7m), Eurobodalla LGA (\$9.4m), Port Stephens LGA (\$7.5m), the other LGAs reported in Table 5-1, and the additional flow-on activity throughout the state.

The major contributing estuary to total GRP in the Bega Valley LGA was the Merimbula Lake estuary, with \$9.7m in total. In the Mid Coast LGA it was the Wallis Lake estuary (\$9.7m), in the Eurobodalla LGA it was the Clyde River estuary (\$4.9m) and Wagonga Inlet estuary (\$3.7m), and in the Port Stephens LGA it was the Port Stephens estuary (\$7.5m).

Employment and household income

The NSW aquaculture lease based sector supported 472 fte direct on farm jobs in 2021/22. Flow-on business activity was estimated to generate a further 312 fte jobs, summing to 784 fte jobs in total throughout the state. This was primarily comprised of the fte jobs supported by the Bega Valley LGA (177 total fte jobs), Mid Coast LGA (151 total fte jobs), Eurobodalla LGA (110 total fte jobs) and Port Stephens LGA (86 total fte jobs), and the associated flow-on activity of the production in these regions.

The major contributing estuary to total employment in the Bega Valley LGA was the Merimbula Lake estuary, with 111 fte jobs in total. In the Mid Coast LGA it was the Wallis Lake estuary (116 total fte jobs), in the Eurobodalla LGA it was the Clyde River estuary (58 total fte jobs) and Wagonga Inlet estuary (43 total fte jobs), and in the Port Stephens LGA it was the Port Stephens estuary (86 total fte jobs).

Household income of \$30.1m was earned in lease based sector aquaculture farming activities, and another \$27.1m by other businesses in the state through flow-on effects. This includes a total of \$12.0m of household income earned in the Bega Valley LGA, \$10.0m in the Mid Coast LGA, \$7.4m in the Eurobodalla LGA, and

\$5.8m in the Porth Stephens LGA. The major contributing estuary to total household income in the Bega Valley LGA was the Merimbula Lake estuary, with \$7.5m in total household income. In the Mid Coast LGA it was the Wallis Lake estuary (\$7.6m), in the Eurobodalla LGA it was the Clyde River estuary (\$3.9m) and Wagonga Inlet estuary (\$2.9m), and in the Port Stephens LGA it was the Port Stephens estuary (\$5.8m).

Table 5-1 The economic contribution of the lease sector to NSW by LGA, 2021/22^a

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Bega Valley				
Direct	14.7	8.1	124	7.9
Total	27.8	15.4	177	12.0
Mid Coast				
Direct	13.1	7.3	111	7.1
Total	22.9	12.7	151	10.0
Eurobodalla				
Direct	9.6	5.3	82	5.2
Total	17.0	9.4	110	7.4
Port Stephens				
Direct	7.8	4.3	66	4.2
Total	13.4	7.5	86	5.8
Port Macquarie Hastings				
Direct	2.4	1.3	20	1.3
Total	4.4	2.5	28	1.9
Shoalhaven				
Direct	2.2	1.2	18	1.2
Total	4.1	2.2	26	1.8
Central Coast				
Direct	1.4	0.8	12	0.8
Total	2.8	1.5	17	1.2
Nambucca				
Direct	0.9	0.5	8	0.5
Total	1.6	0.9	10	0.7
Other^b				
Direct	3.7	2.0	31	2.0
Total	47.9	26.7	178	16.4
Total Lease Sector				
Direct	55.8	31.0	472	30.1
Total	141.9	78.8	784	57.1

^a Excludes downstream activity.

^b Includes direct and flow-on activity in the Sutherland, Hornsby, Bellingen, Kempsey, Ballina, Tweed, and Clarence Valley LGAs. Also includes lease sector spat production and additional flow-on activity throughout NSW.

Source: BDO EconSearch analysis

Table 5-2 The total economic contribution of the lease sector to NSW by estuary in each of the key producing LGAs, 2021/22^a

	Direct Output ^b (\$m)	Total Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Bega Valley LGA					
Merimbula Lake estuary	9.2	17.5	9.7	111	7.5
Pambula River estuary	2.2	4.2	2.3	27	1.8
Wapengo Lake estuary	2.1	4.0	2.2	25	1.7
Wonboyn River estuary	1.0	1.9	1.1	12	0.8
Mid Coast LGA					
Wallis Lake estuary	10.1	17.6	9.7	116	7.6
Port Stephens estuary	2.5	4.3	2.4	28	1.9
Manning River estuary	0.6	1.1	0.6	7	0.5
Eurobodalla LGA					
Clyde River estuary	5.1	8.9	4.9	58	3.9
Wagonga Inlet estuary	3.8	6.6	3.7	43	2.9
Tuross Lake estuary	0.8	1.5	0.8	9	0.6
Port Stephens LGA					
Port Stephens estuary	7.8	13.4	7.5	86	5.8
Port Macquarie Hastings LGA					
Camden Haven estuary	1.3	2.4	1.4	16	1.1
Hastings River estuary	1.1	2.0	1.1	13	0.9
Shoalhaven LGA					
Crookhaven River estuary	1.6	3.0	1.7	19	1.3
Central Coast LGA					
Brisbane Water estuary	1.3	2.5	1.4	16	1.1
Hawkesbury River estuary	0.1	0.2	0.1	1	0.1
Nambucca LGA					
Nambucca River estuary	0.9	1.6	0.9	10	0.7

^a Excludes downstream activity.

^b Direct output equates to GVP.

Source: BDO EconSearch analysis

5.2. Land Based Sector

The direct and total economic contribution of the land based sector in NSW in 2021/22 is detailed by LGA in Table 5-3. Note that some producing LGAs are not reported individually. LGAs are excluded from reporting in cases of confidentiality constraints or limited contribution levels.

Output

Direct output or GVP generated in NSW in 2021/22 by land based sector aquaculture farms summed to \$35.5m. This was primarily concentrated in the Clarence Valley LGA (\$14.5m), Griffith LGA (\$5.3m), and Leeton LGA (\$3.9m).

Contribution to gross state product/gross regional product

The direct contribution to GSP by the land based sector of the NSW aquaculture industry was \$10.3m in 2021/22. The total contribution to GSP including flow-on effects to other sectors of the state economy was \$30.9m in 2021/22.

This was primarily comprised of the total GRP contributed by the Clarence Valley LGA (\$9.1m), Griffith LGA (\$3.4m), Leeton LGA (\$2.4m), the other LGAs reported in Table 5-3, and the additional flow-on activity throughout the state.

Employment and household income

The NSW aquaculture land based sector supported 156 fte direct on farm jobs in 2021/22. Flow-on business activity was estimated to generate a further 135 fte jobs, summing to 291 fte jobs in total throughout the state. This was primarily comprised of the fte jobs supported by the Clarence Valley LGA (102 total fte jobs), Griffith LGA (36 total fte jobs), Leeton LGA (26 total fte jobs), the other LGAs reported in Table 5-3, and the additional flow-on activity throughout the state.

Household income of \$6.7m was earned in land based sector aquaculture farming activities, and another \$12.0m by other businesses in the state through flow-on effects. This includes a total of \$5.6m of household income earned in the Clarence Valley LGA, \$2.0m in the Griffith LGA, and \$1.4m in the Leeton LGA.

Table 5-3 The economic contribution of the land sector to NSW by LGA, 2021/22^a

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Clarence Valley				
Direct	14.5	4.2	64	2.7
Total	23.9	9.1	102	5.6
Griffith				
Direct	5.3	1.5	23	1.0
Total	9.0	3.4	36	2.0
Leeton				
Direct	3.9	1.1	17	0.7
Total	6.3	2.4	26	1.4
Snowy Valleys				
Direct	2.8	0.8	12	0.5
Total	4.2	1.5	18	0.9
Narrandera				
Direct	2.3	0.7	10	0.4
Total	3.6	1.3	15	0.8
Wagga Wagga				
Direct	2.0	0.6	9	0.4
Total	3.5	1.3	14	0.8
Mid Coast				
Direct	0.9	0.3	4	0.2
Total	1.4	0.5	6	0.3
Wentworth				
Direct	0.8	0.2	4	0.2
Total	1.3	0.5	6	0.3
Other^b				
Direct	2.9	0.8	13	0.6
Total	21.3	10.7	67	6.6
Total Land Sector				
Direct	35.5	10.3	156	6.7
Total	74.3	30.9	291	18.7

^a Excludes downstream activity.

^b Includes direct and flow-on activity in the Port Stephens, Camden, Goulburn Mulwaree, Narrabri, Gilgandra, Kiama Muncipal, Tweed, Murray, Shoalhaven, Armidale, Bathurst, Tamworth, Port Macquarie Hastings, Lake Macquarie, Dubbo, and Snowy Monaro LGAs. Also includes additional flow-on activity throughout NSW.

Source: BDO EconSearch analysis

5.3. Hatchery Sector

The direct and total economic contribution of the hatchery sector in NSW in 2021/22 is detailed by LGA in Table 5-4. Note that some producing LGAs are not reported individually. LGAs are excluded from reporting in cases of confidentiality constraints or limited contribution levels.

Output

Direct output or GVP generated in NSW in 2021/22 by hatchery sector aquaculture farms summed to \$10.5m. This was primarily concentrated in the Narrandera LGA (\$3.2m), Armidale LGA (\$2.2m), and Snowy Monaro LGA (\$1.9m).

Contribution to gross state product/gross regional product

The direct contribution to GSP by the hatchery sector of the NSW aquaculture industry was \$5.1m in 2021/22. The total contribution to GSP including flow-on effects to other sectors of the state economy was \$11.8m in 2021/22.

This was primarily comprised of the total GRP contributed by the Narrandera LGA (\$2.6m), Armidale LGA (\$1.9m), Snowy Monaro LGA (\$1.4m), the other LGAs reported in Table 5-4, and the additional flow-on activity throughout the state.

Employment and household income

The NSW aquaculture hatchery sector supported 59 fte direct on farm jobs in 2021/22. Flow-on business activity was estimated to generate a further 42 fte jobs, summing to 101 fte jobs in total throughout the state. This was primarily comprised of the fte jobs supported by the Narrandera LGA (25 total fte jobs), Armidale LGA (19 total fte jobs), Snowy Monaro LGA (14 total fte jobs), the other LGAs reported in Table 5-4, and the additional flow-on activity throughout the state.

Household income of \$3.0m was earned in hatchery sector aquaculture farming activities, and another \$3.8m by other businesses in the state through flow-on effects. This includes a total of \$1.4m of household income earned in the Narrandera LGA, \$1.1m in the Armidale LGA, and \$0.8m in the Snowy Monaro LGA.

Table 5-4 The economic contribution of the hatchery sector to NSW by LGA, 2021/22^a

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Narrandera				
Direct	3.2	1.5	18	0.9
Total	5.2	2.6	25	1.4
Armidale				
Direct	2.2	1.1	13	0.6
Total	3.8	1.9	19	1.1
Snowy Monaro				
Direct	1.9	0.9	11	0.5
Total	2.8	1.4	14	0.8
Wagga Wagga				
Direct	1.2	0.6	7	0.3
Total	2.2	1.1	10	0.6
Eurobodalla				
Direct	0.8	0.4	5	0.2
Total	1.3	0.7	6	0.4
Other^b				
Direct	1.2	0.6	7	0.3
Total	7.9	4.2	27	2.5
Total Hatchery Sector				
Direct	10.5	5.1	59	3.0
Total	23.3	11.8	101	6.8

^a Excludes downstream activity.

^b Includes direct and flow-on activity in the Port Macquarie Hastings, Clarence Valley, Mid Coast, Snowy Valleys, Narrabri, Port Stephens, Coffs Harbour, Camden, Central Coast, Kempsey, Shoalhaven, and Tamworth LGAs. Also includes additional flow-on activity throughout NSW.

Source: BDO EconSearch analysis

6. ECOSYSTEM SERVICES PROVIDED BY SHELLFISH

This section describes qualitatively the ecosystem services provided by aquaculture and also presents estimates of the quantified value of nutrient removal by shellfish aquaculture.

A brief literature review was undertaken to identify ecosystem services provided by the aquaculture species produced in NSW and to identify appropriate methods and data to quantify a limited set of ecosystem services. The ecosystem services that could be quantified were nitrogen and phosphorus removal by farmed oysters and mussels.

6.1. Ecosystem Services Provided by Aquaculture

Gentry et al. (2020) and van der Schatte Olivier et al. (2018) identify a number of ecosystem services provided by aquaculture (Table 6-1).

Table 6-1 Ecosystem services provided by aquaculture

Service category	Service	Potential species providing service
Provisioning	Food production	Bivalves, Fish, Crustacea
	Other products (pharmaceuticals, construction, etc)	Bivalves, Fish, Crustacea
Regulating	Carbon sequestration	Bivalves
	Acidification regulation	Algae
	Coastal protection	Bivalves, Fish
	Nutrient removal	Bivalves
	Improve water clarity	Bivalves
Supporting	Provision of artificial habitat	Bivalves, Fish
Cultural	Livelihoods	Bivalves, Fish, Crustacea
	Tourism	Bivalves, Fish, Crustacea

Sources: Gentry et al. (2020) and van der Schatte Olivier et al. (2018)

Provisioning services

Production from aquaculture in NSW is primarily for food, and the farm-gate value (i.e. GVP of aquaculture production) for 2021/22 has been estimated at \$101.9 million (Table 3-2). A range of taxa, including shellfish, sponges, corals and algae, can be cultivated to produce medicinal resources for use in the healthcare, pharmaceutical, and cosmetic industries. For example, the widespread nutraceutical Lyprinol can be obtained from New Zealand green-lipped mussels, now widely produced through mariculture (Benkendorff 2009 in Alleway et al. 2019). Pearls and mother-of-pearl are another product from shellfish, principally oysters.

Waste from the processing of aquaculture production is made into fishmeal, a balanced and macro and micro-nutrient rich input into bio-based fertilisers (van der Schatte Olivier et al. 2018). Crushed oyster shell can be used as a soil conditioner, stimulating the growth of soil and rhizospheric microorganisms (Guoliang et al. 2003 in van der Schatte Olivier et al. 2018) and as shell grit in poultry production. Oyster shell is preferentially used as a construction material in sea defences in North America (Piazza et al. 2005, Borsje et al. 2011 in van der Schatte Olivier et al. 2018). Oyster shells have been used throughout history for construction of buildings, most commonly in their burnt form as lime, also known as quicklime (calcium oxide) (Sheehan & Sickels-Taves 2002 in van der Schatte Olivier et al. 2018). More recently, there has been

growing research into the use of crushed shells in place of sand, aggregate and cement (Ohimain et al. 2009, Kumar et al. 2016 in van der Schatte Olivier et al. 2018).

Regulating services

Multiple studies demonstrate that bivalves contain significant amounts of carbon which, when harvested, is removed from the coastal environment (Gentry et al. 2020, van der Schatte Olivier et al. 2018). The scope for carbon removed via mariculture harvest is significant, however, whether this carbon is actually sequestered or released back into the environment depends on the fate of the harvested product (Augyte et al. 2017 in Gentry et al. 2020).

Filter-feeding organisms (e.g. oyster, mussels) in particular, cycle and take up nutrients (e.g., nitrogen, phosphate) and can remove these elements, organic matter, and other particulates from the water. By reducing excess anthropogenic nutrients, the mariculture of shellfish and algae can combat eutrophication (Petersen et al. 2016 in Alleway et al. 2019). In Section 6.2, the nutrient removal services provided by shellfish aquaculture in NSW is estimated. Nutrients and by-products generated by finfish mariculture can be used as the basis for developing polyculture or integrated multitrophic aquaculture systems, in which species from a range of trophic levels are used to exploit and extract inorganic and organic matter resulting from farming (Alleway et al. 2019).

Biogenic habitats play an important role in moderating extreme events and controlling erosion by dissipating wave energy and stabilizing sediment along shorelines (Grabowski et al. 2012 in Alleway et al. 2019). Under certain circumstances, mariculture may return similar benefits. For example, at a site scale, offshore mussel farms in New Zealand dampened wave energy by up to 17 per cent (Plew et al. 2005 in Alleway et al. 2019).

Habitat and supporting services

Mariculture infrastructure can support a diversity of wild (i.e., not cultivated) marine life (Costa-Pierce and Bridger 2002). The hard substrate provided by mariculture that enhances habitat for wild species might provide stepping stones that enable fouling organisms to migrate across sedimentary landscapes in a changing climate (e.g., Bishop et al. 2017 in Alleway et al. 2019). Aggregations of transient and resident fish are often observed around sea cages (Machias et al. 2006, Dempster et al. 2009 in Alleway et al. 2019), because of the structural habitat, facilitation of prey organisms (e.g., within biofouling), and organic enrichment through food and animal waste they provide (Costa-Pierce and Bridger 2002 in Alleway et al. 2019). Whether this interaction enhances fish populations is dependent on the extent to which aggregations are redistributed from other sites and on the harvest pressure permitted (Alleway et al. 2019).

In addition, aquaculture can provide stock for biodiversity restoration. Along the east coast of Australia, where wild oyster reefs are functionally extinct, a significant mariculture industry for Sydney rock oysters contributes spawning stock biomass that could be used to naturally supply adjacent restoration projects with larvae (Alleway et al. 2019).

Cultural services

Aquaculture has played an important role in early and more modern cultural histories and can support the continued preservation of individual and collective spiritual and physical connections with the marine environment and marine resources. Reis and Hibbeln (2006, in Alleway et al. 2019) highlight cultural labelling of fish as symbols of emotional well-being and social healing in religious and medical practices among independent cultures for at least six millennia. Brewarrina Fish Traps in north-west NSW (finfish) and Budj Bim Cultural Landscape (shot-finned eel) in south-western Victoria are examples of Aboriginal

aquaculture systems that were managed for millenia and supported significant numbers of Aboriginal groups (Murdi Paaki Regional Assembly 2015, Budj Bim Cultural Landscape 2023). The creation of the Brewarrina fish traps, and the Aboriginal Lore governing their use, helped shape the spiritual, political, social, ceremonial, and trade relationships between Aboriginal groups from across the greater landscape. Aboriginal people in the region continue to use, maintain and care for the fish traps (Murdi Paaki Regional Assembly 2015).

Food tourism is a rising industry that can be important in sustaining and building regional community identity (Everett and Aitchison 2008 in Alleway et al. 2019). For example, within NSW there are a number of seafood festivals, including Oysters in the Vines (Port Macquarie), Chinese New Year Night Market (Sydney Food Market, Sydney), Narooma Oyster Festival and Ballina Prawn Festival (FRDC n.d.).

6.2. Value of Nitrogen and Phosphorus Remediation

Whilst there are many ecosystem services provided by aquaculture systems, lack of values identified in the literature or poor value-transfer conditions, meant that besides estimating GVP (Section 3) ecosystem service value estimation for NSW aquaculture was limited to nutrient remediation (i.e. nitrogen and phosphorus).

Method and data

The method was based on Dvaskas et al. (2020), which required:

1. Estimating the volume (in tonnes) of oysters and mussels harvested
2. Applying published nutrient removal rate estimates (total nitrogen and total phosphorus per tonne harvested to (1) to estimate the total nitrogen and total phosphorus removed at harvest
3. Establishing estimated unit values (\$ per tonne) for nitrogen and phosphorus removal using the replacement cost method.
4. Applying the estimated unit values from (3) to the volume of nutrient removed (2) to estimate a potential value of nutrient removal.

Production volumes were based on production data provided by NSW DPI. For oysters, dozens were converted to weights based on average weight per class of oyster in NSW DPI (2022). A total of 3,321.1 tonnes of oysters and 106.6 tonnes of mussels were estimated to be produced in 2021/22. These values include shells and exclude production of spat (because spat are not removed from the system).

Nitrogen and phosphorus removal rate estimates were based on van der Schatte Olivier et al. (2018) and are presented in Table 6-2.

Table 6-2 Total nitrogen (TN) and total phosphorus (TP) removal rates

Removal rates	Oysters	Mussels
Kg TN removed per tonne shellfish harvested	2.3	6.7
Kg TP removed per tonne shellfish harvested	0.5	0.5

Source: van der Schatte Olivier et al. 2018.

The estimated unit value for total nitrogen (TN) removal, of approximately \$507 per kg TN, was based on Kavehei et al. (2021), who measured the cost effectiveness of constructed wetland technologies in removing

total nitrogen from receiving waters in coastal Queensland. Values ranged from \$45 and \$1,023 per kg TN between sites. A simple average of these estimates was taken.

The literature estimating the value of total phosphorus removal was limited and values highly divergent. However, there were a couple of studies that estimated unit values for both TP and TN in an appropriate context (Ishtekar & Polyakov 2019, van der Schatte Olivier et al. 2018), and the relative difference in unit value estimates between TN and TP was similar for both studies (TP was 73% and 68% higher than TN in each study, respectively). The unit value for TP was calculated as 1.68 times that of TN, i.e. approximately \$853 per kg TP.

Results

Based on the methods, assumptions and data described in Section 6.2, the total value of nutrient removal services by oyster and mussel aquaculture in NSW in 2021/22 was estimated to be \$5.6 million. A breakdown of these results by shellfish type and nutrient type is provided in Table 6-3. These results are for oysters and mussels only. They do not include other aquaculture species, some of which may contribute to excess nutrients in adjacent waters. The net result for the whole sector is unknown.

Table 6-3 Estimated value of nutrient removal services by oyster and mussel aquaculture, NSW, 2021/22

Nutrient	Value of nutrient removal (\$m)		
	Oysters	Mussels	Total
Total nitrogen	3.9	0.4	4.3
Total phosphorus	1.3	<0.1	1.3
Total	5.2	0.4	5.6

Source: BDO EconSearch analysis.

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Disclaimer

The assignment is a consulting engagement as outlined in the 'Framework for Assurance Engagements', issued by the Auditing and Assurances Standards Board, Section 17. Consulting engagements employ an assurance practitioner's technical skills, education, observations, experiences and knowledge of the consulting process. The consulting process is an analytical process that typically involves some combination of activities relating to: objective-setting, fact-finding, definition of problems or opportunities, evaluation of alternatives, development of recommendations including actions, communication of results, and sometimes implementation and follow-up.

The nature and scope of work has been determined by agreement between BDO and the Client. This consulting engagement does not meet the definition of an assurance engagement as defined in the 'Framework for Assurance Engagements', issued by the Auditing and Assurances Standards Board, Section 10.

Except as otherwise noted in this report, we have not performed any testing on the information provided to confirm its completeness and accuracy. Accordingly, we do not express such an audit opinion and readers of the report should draw their own conclusions from the results of the review, based on the scope, agreed-upon procedures carried out and findings.

APPENDIX 1 Business Cost Structures

Appendix Table 1-1 NSW Lease Based farms average business cost structure, 2021/22^a

	Average per producing lease based permit holder	Share of total costs
Total Income	\$311,921	
Costs		
Average annual capital expenditure ^a	\$44,523	14%
Labour - paid (wages)	\$153,590	48%
Labour - unpaid ^b	\$14,320	4%
Direct costs		
Repairs and maintenance to farm and equipment	\$16,329	5%
Spat (sourced from interstate only) ^c	\$27,167	8%
Fees paid to NSW DPI	\$3,238	1%
Fees paid to NSW food authority	\$1,185	0%
Fuel and lubricants	\$5,683	2%
Freight, unloading fees and marketing	\$6,871	2%
Grader costs	\$2,167	1%
Tip and clean-up costs	\$2,071	1%
Equipment replacement	\$9,758	3%
Administrative costs		
Insurances	\$6,411	2%
Legal and accounting	\$3,029	1%
Communication	\$1,349	0%
Power	\$1,527	0%
Repairs and maintenance to buildings and vehicles	\$2,997	1%
Rates	\$1,119	0%
Rents	\$2,452	1%
Interest and borrowing costs	\$3,645	1%
Other licences, registrations and permits	\$869	0%
Membership, association expenses	\$254	0%
Training	\$407	0%
Other costs	\$10,682	3%
Total Operating Costs	\$321,644	100%

^a Due to the nature of operations there is no representative business for each sector. As such this table should not be relied upon to compare to an actual business.

^b Includes items such as boats, vehicles, farm infrastructure and farm equipment.

^c Imputed based on the number of unpaid work hours recorded by survey respondents. Estimated using the 2021/22 minimum wage of \$20.33¹.

^d Spat sourced from NSW has been excluded from costs to remove double counting. Total spat cost including spat sourced from NSW was estimated to be \$38,867 per producing lease based permit holder.

Source: 2023 NSW Aquaculture business survey and BDO EconSearch analysis

¹ <https://www.fairwork.gov.au/newsroom/media-releases/2021-media-releases/july-2021/20210701-annual-wage-review-2021-media-release>

Appendix Table 1-2 NSW Land Based farms average business cost structure, 2021/22^a

	Average per producing land based permit holder	Share of total costs
Total Income	\$739,085	
Costs		
Average annual capital expenditure ^a	\$91,321	13%
Labour - paid (wages)	\$125,193	18%
Labour - unpaid ^b	\$14,307	2%
Direct costs		
Feed	\$229,735	33%
Repairs and maintenance to farm and equipment	\$15,852	2%
Juveniles/Larvae (sourced from interstate only) ^c	\$36,498	5%
Fees paid to NSW DPI	\$2,735	0%
Fees paid to NSW food authority	\$336	0%
Fuel and lubricants	\$14,771	2%
Freight, unloading fees and marketing	\$15,423	2%
Equipment replacement	\$6,984	1%
Administrative costs		
Insurances	\$15,134	2%
Legal and accounting	\$3,197	0%
Communication	\$4,024	1%
Power	\$49,343	7%
Repairs and maintenance to buildings and vehicles	\$7,209	1%
Rates	\$3,776	1%
Rents	\$5,097	1%
Interest and borrowing costs	\$12,014	2%
Other licences, registrations and permits	\$3,687	1%
Membership, association expenses	\$131	0%
Training	\$306	0%
Other costs	\$42,190	6%
Total Operating Costs	\$699,263	100%

^a Due to the nature of operations there is no representative business for each sector. As such this table should not be relied upon to compare to an actual business.

^b Includes items such as structures to hold fish/tanks, buildings, vehicles, farm machinery, infrastructure, and equipment.

^c Imputed based on the number of unpaid work hours recorded by survey respondents. Estimated using the 2021/22 minimum wage of \$20.33².

^d Juveniles/Larvae sourced from NSW has been excluded from costs to remove double counting. Total Juvenile/Larvae cost including that sourced from NSW was estimated to be \$26,666 per producing land based permit holder.

Source: 2023 NSW Aquaculture business survey and BDO EconSearch analysis

² <https://www.fairwork.gov.au/newsroom/media-releases/2021-media-releases/july-2021/20210701-annual-wage-review-2021-media-release>

Appendix Table 1-3 NSW Hatchery operations average business cost structure, 2021/22^a

	Average per producing hatchery based permit holder	Share of total costs
Total Income	\$525,840	
Costs		
Average annual capital expenditure ^a	\$66,883	13%
Labour - paid (wages)	\$118,422	23%
Labour - unpaid ^b	\$31,300	6%
Direct costs		
Feed	\$34,237	7%
Repairs and maintenance to farm and equipment	\$9,545	2%
Juveniles/Larvae	\$23,210	4%
Fees paid to NSW DPI	\$7,146	1%
Fees paid to NSW food authority	\$414	0%
Fuel and lubricants	\$19,883	4%
Freight, unloading fees and marketing	\$4,966	1%
Equipment replacement	\$22,832	4%
Administrative costs		
Insurances	\$31,086	6%
Legal and accounting	\$2,757	1%
Communication	\$4,323	1%
Power	\$41,330	8%
Repairs and maintenance to buildings and vehicles	\$13,839	3%
Rates	\$1,671	0%
Rents	\$24,059	5%
Interest and borrowing costs	\$41,889	8%
Other licences, registrations and permits	\$2,100	0%
Membership, association expenses	\$4,591	1%
Training	\$87	0%
Other costs	\$15,139	3%
Total Operating Costs	\$521,708	100%

^a Due to the nature of operations there is no representative business for each sector. As such this table should not be relied upon to compare to an actual business.

^b Includes items such as buildings, vehicles, structures, farm infrastructure and machinery.

^c Imputed based on the number of unpaid work hours recorded by survey respondents. Estimated using the 2021/22 minimum wage of \$20.33³.

Source: 2023 NSW Aquaculture business survey and BDO EconSearch analysis

³ <https://www.fairwork.gov.au/newsroom/media-releases/2021-media-releases/july-2021/20210701-annual-wage-review-2021-media-release>

APPENDIX 2 Detailed Economic Contribution Results

Appendix Table 2-1 Detailed economic contribution of Aquaculture to NSW, 2021/22, on-farm activity

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Lease				
Direct	55.8	31.0	472	30.1
Flow-on				
<i>Production Induced</i>	23.3	11.4	109	8.9
<i>Consumption Induced</i>	62.8	36.4	202	18.2
Total Flow-on	86.0	47.8	312	27.1
Total	141.9	78.8	784	57.1
Land				
Direct	35.5	10.3	156	6.7
Flow-on				
<i>Production Induced</i>	18.3	8.6	68	6.1
<i>Consumption Induced</i>	20.6	11.9	66	6.0
Total Flow-on	38.8	20.5	135	12.0
Total	74.3	30.9	291	18.7
Hatchery				
Direct	10.5	5.1	59	3.0
Flow-on				
<i>Production Induced</i>	5.3	2.4	18	1.7
<i>Consumption Induced</i>	7.5	4.4	24	2.2
Total Flow-on	12.8	6.7	42	3.8
Total	23.3	11.8	101	6.8
Tourism				
Direct	4.9	2.5	36	1.6
Flow-on				
<i>Production Induced</i>	2.1	0.9	6	0.5
<i>Consumption Induced</i>	3.4	2.0	11	1.0
Total Flow-on	5.5	2.9	18	1.5
Total	10.5	5.4	53	3.1

Source: BDO EconSearch analysis

Appendix Table 2-2 Detailed economic contribution of Aquaculture to NSW, 2021/22, downstream activity

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Processing				
Direct	25.4	12.7	151	11.3
Flow-on				
<i>Production Induced</i>	12.6	6.4	57	5.1
<i>Consumption Induced</i>	26.4	15.3	85	7.6
Total Flow-on	38.9	21.7	142	12.7
Total	64.4	34.4	292	24.0
Wholesale				
Direct	12.6	6.6	103	4.1
Flow-on				
<i>Production Induced</i>	8.0	3.9	24	2.6
<i>Consumption Induced</i>	10.8	6.2	35	3.1
Total Flow-on	18.7	10.2	58	5.7
Total	31.3	16.8	161	9.8
Retail Trade				
Direct	7.7	4.5	260	2.9
Flow-on				
<i>Production Induced</i>	4.3	2.1	13	1.4
<i>Consumption Induced</i>	7.0	4.1	23	2.0
Total Flow-on	11.3	6.2	35	3.4
Total	19.0	10.7	296	6.4
Food Service				
Direct	14.9	7.2	191	5.6
Flow-on				
<i>Production Induced</i>	10.3	5.1	30	3.4
<i>Consumption Induced</i>	14.4	8.4	47	4.2
Total Flow-on	24.7	13.4	77	7.5
Total	39.7	20.7	268	13.1
Road Transport				
Direct	8.1	3.4	35	2.1
Flow-on				
<i>Production Induced</i>	6.2	3.1	18	2.0
<i>Consumption Induced</i>	6.6	3.8	21	1.9
Total Flow-on	12.8	6.9	40	3.9
Total	20.9	10.3	75	6.0

Source: BDO EconSearch analysis

APPENDIX 3 Detailed Regional Economic Contribution Results

Appendix Table 3-1 Detailed economic contribution of the lease sector to NSW by LGA, 2021/22^a

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Bega Valley				
Direct	14.7	8.1	124	7.9
Flow-on				
<i>Production Induced</i>	4.2	2.0	20	1.6
<i>Consumption Induced</i>	8.9	5.2	33	2.5
Total Flow-on	13.1	7.3	53	4.1
Total	27.8	15.4	177	12.0
Mid Coast				
Direct	13.1	7.3	111	7.1
Flow-on				
<i>Production Induced</i>	3.4	1.6	17	1.3
<i>Consumption Induced</i>	6.3	3.7	22	1.6
Total Flow-on	9.8	5.4	39	2.9
Total	22.9	12.7	151	10.0
Eurobodalla				
Direct	9.6	5.3	82	5.2
Flow-on				
<i>Production Induced</i>	2.6	1.2	12	0.9
<i>Consumption Induced</i>	4.8	2.8	16	1.2
Total Flow-on	7.4	4.1	28	2.2
Total	17.0	9.4	110	7.4
Port Stephens				
Direct	7.8	4.3	66	4.2
Flow-on				
<i>Production Induced</i>	2.0	1.0	9	0.8
<i>Consumption Induced</i>	3.5	2.2	11	0.9
Total Flow-on	5.6	3.1	20	1.7
Total	13.4	7.5	86	5.8
Port Macquarie Hastings				
Direct	2.4	1.3	20	1.3
Flow-on				
<i>Production Induced</i>	0.7	0.3	3	0.2
<i>Consumption Induced</i>	1.3	0.8	5	0.4
Total Flow-on	2.0	1.1	8	0.6
Total	4.4	2.5	28	1.9

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Shoalhaven				
Direct	2.2	1.2	18	1.2
Flow-on				
<i>Production Induced</i>	0.6	0.3	3	0.2
<i>Consumption Induced</i>	1.3	0.7	5	0.4
Total Flow-on	1.9	1.0	8	0.6
Total	4.1	2.2	26	1.8
Central Coast				
Direct	1.4	0.8	12	0.8
Flow-on				
<i>Production Induced</i>	0.4	0.2	2	0.1
<i>Consumption Induced</i>	1.0	0.5	3	0.3
Total Flow-on	1.4	0.7	5	0.4
Total	2.8	1.5	17	1.2
Nambucca				
Direct	0.9	0.5	8	0.5
Flow-on				
<i>Production Induced</i>	0.2	0.1	1	0.1
<i>Consumption Induced</i>	0.4	0.3	2	0.1
Total Flow-on	0.7	0.4	3	0.2
Total	1.6	0.9	10	0.7

^a Excludes downstream activity.

Source: BDO EconSearch analysis

Appendix Table 3-2 Detailed economic contribution of the lease sector to NSW by estuary, 2021/22^a

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Bega Valley LGA				
Merimbula Lake estuary				
Direct	9.2	5.1	78	5.0
Total	17.5	9.7	111	7.5
Pambula River estuary				
Direct	2.2	1.2	19	1.2
Total	4.2	2.3	27	1.8
Wapengo Lake estuary				
Direct	2.1	1.2	18	1.1
Total	4.0	2.2	25	1.7
Wonboyn River estuary				
Direct	1.0	0.6	9	0.5
Total	1.9	1.1	12	0.8
Mid Coast LGA				
Wallis Lake estuary				
Direct	10.1	5.6	85	5.4
Total	17.6	9.7	116	7.6
Port Stephens estuary				
Direct	2.5	1.4	21	1.3
Total	4.3	2.4	28	1.9
Manning River estuary				
Direct	0.6	0.3	5	0.3
Total	1.1	0.6	7	0.5
Eurobodalla LGA				
Clyde River estuary				
Direct	5.1	2.8	43	2.7
Total	8.9	4.9	58	3.9
Wagonga Inlet estuary				
Direct	3.8	2.1	32	2.0
Total	6.6	3.7	43	2.9
Tuross Lake estuary				
Direct	0.8	0.5	7	0.4
Total	1.5	0.8	9	0.6
Port Stephens LGA				
Port Stephens estuary				
Direct	7.8	4.3	66	4.2
Total	13.4	7.5	86	5.8

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Port Macquarie Hastings LGA				
Camden Haven estuary				
Direct	1.3	0.7	11	0.7
Total	2.4	1.4	16	1.1
Hastings River estuary				
Direct	1.1	0.6	9	0.6
Total	2.0	1.1	13	0.9
Shoalhaven LGA				
Crookhaven River estuary				
Direct	1.6	0.9	14	0.9
Total	3.0	1.7	19	1.3
Central Coast LGA				
Brisbane Water estuary				
Direct	1.3	0.7	11	0.7
Total	2.5	1.4	16	1.1
Hawkesbury River estuary				
Direct	0.1	0.1	1	0.1
Total	0.2	0.1	1	0.1
Nambucca LGA				
Nambucca River estuary				
Direct	0.9	0.5	8	0.5
Total	1.6	0.9	10	0.7

^a Excludes downstream activity.

Source: BDO EconSearch analysis

Appendix Table 3-3 Detailed economic contribution of the land sector to NSW by LGA, 2021/22^a

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Clarence Valley				
Direct	14.5	4.2	18	2.7
Flow-on				
<i>Production Induced</i>	5.3	2.5	23	1.7
<i>Consumption Induced</i>	4.0	2.4	15	1.1
Total Flow-on	9.3	4.9	38	2.9
Total	23.9	9.1	102	5.6
Griffith				
Direct	5.3	1.5	6	1.0
Flow-on				
<i>Production Induced</i>	2.0	0.9	8	0.6
<i>Consumption Induced</i>	1.6	0.9	5	0.4
Total Flow-on	3.6	1.8	13	1.0
Total	9.0	3.4	36	2.0
Leeton				
Direct	3.9	1.1	5	0.7
Flow-on				
<i>Production Induced</i>	1.5	0.7	7	0.5
<i>Consumption Induced</i>	0.9	0.5	3	0.2
Total Flow-on	2.4	1.3	9	0.7
Total	6.3	2.4	26	1.4
Snowy Valleys				
Direct	2.8	0.8	3	0.5
Flow-on				
<i>Production Induced</i>	0.9	0.4	4	0.3
<i>Consumption Induced</i>	0.5	0.3	2	0.1
Total Flow-on	1.4	0.7	5	0.4
Total	4.2	1.5	18	0.9
Narrandera				
Direct	2.3	0.7	3	0.4
Flow-on				
<i>Production Induced</i>	0.8	0.4	4	0.3
<i>Consumption Induced</i>	0.5	0.3	2	0.1
Total Flow-on	1.3	0.7	5	0.4
Total	3.6	1.3	15	0.8

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Wagga Wagga				
Direct	2.0	0.6	2	0.4
Flow-on				
<i>Production Induced</i>	0.8	0.4	3	0.2
<i>Consumption Induced</i>	0.7	0.4	2	0.2
Total Flow-on	1.5	0.8	5	0.4
Total	3.5	1.3	14	0.8
Mid Coast				
Direct	0.9	0.3	1	0.2
Flow-on				
<i>Production Induced</i>	0.3	0.1	1	0.1
<i>Consumption Induced</i>	0.2	0.1	1	0.1
Total Flow-on	0.5	0.3	2	0.2
Total	1.4	0.5	6	0.3
Wentworth				
Direct	0.8	0.2	1	0.2
Flow-on				
<i>Production Induced</i>	0.3	0.1	1	0.1
<i>Consumption Induced</i>	0.2	0.1	0	0.0
Total Flow-on	0.5	0.2	2	0.1
Total	1.3	0.5	6	0.3

^a Excludes downstream activity.

Source: BDO EconSearch analysis

Appendix Table 3-4 Detailed economic contribution of the hatchery sector to NSW by LGA, 2021/22^a

	Output (\$m)	GRP (\$m)	Employment (fte)	Household Income (\$m)
Narrandera				
Direct	3.2	1.5	18	0.9
Flow-on				
<i>Production Induced</i>	1.0	0.5	4	0.3
<i>Consumption Induced</i>	0.9	0.6	3	0.2
Total Flow-on	2.0	1.0	7	0.5
Total	5.2	2.6	25	1.4
Armidale				
Direct	2.2	1.1	13	0.6
Flow-on				
<i>Production Induced</i>	0.8	0.4	3	0.2
<i>Consumption Induced</i>	0.8	0.5	3	0.2
Total Flow-on	1.6	0.8	6	0.5
Total	3.8	1.9	19	1.1
Snowy Monaro				
Direct	1.9	0.9	11	0.5
Flow-on				
<i>Production Induced</i>	0.5	0.2	2	0.2
<i>Consumption Induced</i>	0.4	0.2	1	0.1
Total Flow-on	1.0	0.5	3	0.3
Total	2.8	1.4	14	0.8
Wagga Wagga				
Direct	1.2	0.6	7	0.3
Flow-on				
<i>Production Induced</i>	0.5	0.2	2	0.1
<i>Consumption Induced</i>	0.5	0.3	2	0.1
Total Flow-on	1.0	0.5	3	0.3
Total	2.2	1.1	10	0.6
Eurobodalla				
Direct	0.8	0.4	5	0.2
Flow-on				
<i>Production Induced</i>	0.3	0.1	1	0.1
<i>Consumption Induced</i>	0.2	0.1	1	0.1
Total Flow-on	0.5	0.3	2	0.2
Total	1.3	0.7	6	0.4

^a Excludes downstream activity.

Source: BDO EconSearch analysis



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