

PACIFIC LABOUR FACILITY

Detailed Industry Assessment

Aquaculture

February 2021



Executive summary

This assessment of Australian aquaculture has found that the industry is on a solid growth trajectory but faces a structural labour supply gap addressable by Pacific migrant workers without otherwise disrupting the Australian labour market.

Aquaculture is defined as the breeding, raising and harvesting of fish and aquatic plants. It occurs in both offshore and onshore environments, as well as both marine and freshwater environments. Aquaculture, both globally and in Australia, is growing at a significantly faster rate than wild-caught seafood. Mirroring global trends, Australian aquaculture is forecast to surpass more than 50% of total fisheries gross value of production (GVP) by 2025.

The value-add of the aquaculture industry in Australia in 2018-19 was \$619m, a small component of total agriculture, forestry, and fishing. By value of production, the top species in Australia are salmonids (salmon and trout), southern blue fin tuna, oysters, prawns and pearls. Salmonids alone accounted for 60% of the gross value of production in 2018, nearly all in Tasmania. In terms of employment, there are 6,000 FTE positions in Australia, making it one of the smallest sub-sectors in Australian industry. This does not include positions in the process and packaging sectors, collectively known as 'post-harvest'. These are classified as other industries under the ANZIC classification system. An addendum to this report examines post-operations.

The regionally concentrated industry is old, dating back to 1850, but is now increasingly formalised and scaled up. There are multi-billion-dollar projects under development or recently constructed, and several aquaculture companies are listed on the Australian stock exchange. Production value is highly concentrated with only 4 operators producing 44% of total economic output. At the other end of the scale, there are many small businesses experiencing labour challenges, anecdotally however, much of this demand is seasonal and not appropriate for PLS workers.

Much of industry is turning to greater automation, which is reducing demand for some forms of labour. However, the unmet demand for unskilled and semi-skilled labour remains substantial and the industry regularly reports (supported by data) that it cannot attract sufficient workers. The labour supply gap addressable by PLF in the next 1-2 years is estimated at between 200 and 500 FTE workers (3-8% of industry labour), based on DIA findings and industry consultation. If the processing and packaging components are included, then it is reasonable to assume that these figures would be close to doubling. This seasonal primary industry has differing labour requirements for each sub-sector, some of which are not appropriate to PLS workers. Certain species, particularly finfish, typically result in more consistent year-round demand for labour, and opportunities exist in larger employers who can redeploy workers across counter-cyclical operations and locations.

Australia's 2017 National Aquaculture Strategy recognised the labour supply constraint a risk to industry ambitions and growth prospects. Accordingly, TAFE qualifications have been redefined to assist in up-skilling workers within the industry and should be pursued by PLS workers in Australia or in cooperation with APTC.

There are pockets of rapid growth in aquaculture in the Pacific, especially in Papua New Guinea and Timor Leste, and the growth prospects of aquaculture in the Pacific are strong. Returning workers possessing both savings and recently acquired skills could be a major boon to development of aquaculture in the Pacific, which, among other things, is constrained by low capital, both human and financial.

Although aquaculture is (relatively) small and increasingly pursuing automation, it is growing at a rate faster than the wider economy, is regionally focused, is a good match with Pacific Island economies, and has unfilled jobs that match Pacific migrant workers' skills.

Industry selection tool

Deal-breaker criteria		
Has a detailed industry assessment for the industry been completed? If yes, does it recommend PLS engagement with the industry?	Yes	- Industry engagement is recommended.
Does the industry exhibit characteristics consistent with PLF's program goals?	Yes	- There is a current labour shortage for unskilled and semi-skilled labour in regional Australia that can be suitably filled by Pacific workers.
Is a focus on this industry consistent with ambitions for PLF's scalability and sustainability?	Yes	<ul style="list-style-type: none"> - Once arrangements and connections with employers are established, the relationship with PLF should be able to shift to a facilitative one over time. - However, total placement numbers are unlikely to have the potential of industries such as meat works or disability care.
Does the PLF risk assessment on this industry indicate that risks are manageable/treatable?	Yes	- Generally, the industry is low risk.
Essential criteria		
Are there indications that PLF workers can be placed in this industry with relative efficiency?	Yes	- The industry is maturing and has experience with the employment of seasonal workers, mainly backpackers.
Has evidence of a growth trajectory for this industry been confirmed?	Yes	- Global and Australian aquaculture production is growing faster than average economic growth rates. The Australian Government has targeted a 7% per annum growth rate for the industry through to 2027.
Has evidence of an enduring industry labour shortage been confirmed?	Yes	- While there is a growing use of automation and robotics, the magnitude of labour required is growing, almost

		<p>exclusively in regional areas, and consultations indicated that much of this demand was for unskilled and semi-skilled labour.</p> <ul style="list-style-type: none"> - The nature of that demand varies across sub-sectors of the industry.
Does the evidence demonstrate that demand for workers exists in PLF areas of operations or appropriate regional parts of Australia?	Yes	<ul style="list-style-type: none"> - Almost exclusively in regional Australia, often in very remote parts of the country where accessing labour will be difficult.
Is the industry considered robust and secure and relatively shock proof?	No	<ul style="list-style-type: none"> - While some parts of production are considered discretionary (e.g. pearls), much of production is considered part of a staple diet. - However, aquaculture is a seasonal primary industry and will experience fluctuations in production and demand for labour.
Does the industry provide opportunities for women or vulnerable groups and is supportive of Gender Equality, Disability and Social Inclusion (GEDSI) goals?	Limited	<ul style="list-style-type: none"> - The workforce is male dominated (81% and increasing) and physically demanding. Some tasks such as packing and diving to repair cages may be difficult for some candidates.
Have impacts on Indigenous Australians been properly considered?	Yes	<ul style="list-style-type: none"> - The regional and rural location of many of the sites, particularly the upcoming projects in Far North Queensland, Western Australia and the Northern Territory are in areas with high Indigenous unemployment. - Care should be taken by management in sensitive locations.
Is there evidence of an adequate array of potential suitable approved employers?	Limited	<ul style="list-style-type: none"> - The industry is highly concentrated with only a handful of large players controlling 40% of the market.
Preferential criteria		
Have welfare issues and risks been assessed as manageable?	Yes	<ul style="list-style-type: none"> - Low hazard industry. However, placement of workers will be primarily in regional areas of Australia.

Do PLF workers have or can acquire necessary skills and experience required by this industry?	Yes	<ul style="list-style-type: none"> - Yes, aquaculture worker roles are considered entry level at ANZSCO level 5. - Aquaculture, albeit informally, is relatively commonplace in the Pacific, and fishing skills are common.
Have any potential worker cultural issues been considered?	Yes	<ul style="list-style-type: none"> - Given the prominence of the seafood industry in the Pacific, aquaculture in Australia may be well suited to Pacific workers
Is the industry supportive of DFAT's strategic goals for the Pacific?	Yes	<ul style="list-style-type: none"> - Aquaculture shows strong prospects in the Pacific as a niche industry that can improve incomes and food security.
Has some initial industry consultation occurred to help ground truth the DIA conclusions?	Yes	<ul style="list-style-type: none"> - Yes, including with the National Aquaculture Council, the Australian Prawn Farmers Association, and the Australian Barramundi Association.
Do repatriated skills to the Pacific support greater economic integration with Australia and New Zealand?	Yes	<ul style="list-style-type: none"> - There is considerable opportunity for skills development and economic development in the Pacific.
Does the industry exhibit characteristics that will enable transfers of applicable skills back to PLF countries?	Yes	<ul style="list-style-type: none"> - The industry provides substantial alignment to industry growth prospects throughout the Pacific.
Have issues and risks related to COVID-19 been considered and is mitigation possible?	Yes	<ul style="list-style-type: none"> - To date, the industry, particularly tuna and pearls, has suffered a significant impact due to associated impacts of the COVID-19 pandemic, however the industry has been able to pivot toward domestic consumers to mitigate the impact.
Is the lead-in time to build relationships within the industry and place workers considered reasonable?	Yes	<ul style="list-style-type: none"> - The PLF is well positioned and resourced to engage the industry.

Recommendations

This detailed industry assessment of Australian aquaculture has determined that appropriate opportunities for placement of Pacific and Timorese workers exist and that the PLF should actively engage with aquaculture industry employers to pursue these opportunities. It is recommended that the PLF do the following:

- 1) Establish relationships with key peak bodies such as Seafood Industry Australia, the National Aquaculture Council (shortly to fold into Seafood Industry Australia) and various product-specific peak bodies such as the Australian Prawn Farmers Association and the Australian Barramundi Farmers Association.
- 2) Aquaculture is regulated by state and territory authorities. Accordingly, PLF should engage with relevant state agriculture departments, as well as industries bodies in those state and territories. For example, the Queensland Government has a dedicated Queensland Agriculture Workers Network that helps place workers in seasonal jobs in the agriculture sector.
- 3) Initially seek to build relationships with larger employers and establish a presence in the aquaculture industry, prioritising Tasmania, South Australia and Queensland. The PLF should then seek to connect with smaller employers, recognising that many smaller operators are struggling to obtain labour.
- 4) Mitigate the impacts of a relatively seasonal industry with a variable demand for labour, by:
 - engaging with operators of species that have more year-round demand for labour, particularly finfish such as salmon and tuna, as well as prawns and oysters
 - avoiding species that have a highly variable demand for labour – particularly shellfish (other than the prawns and oysters)
 - seeking multi-product worker opportunities, likely through large companies or labour hire companies, where workers can be utilised in counter-seasonal operations (for example, 6 months in Tasmania on salmon operations and 6 months in Queensland on prawn operations).
- 5) Engage with APTC and other training providers to identify preferred training pathways for Pacific and Timorese workers to ensure appropriate skills for both the Australian and Pacific industries. This will also help develop the aquaculture industry in both the Pacific and Timor-Leste, as low levels of skills, knowledge and experience are an identified impediment to their expansion of aquaculture.
- 6) The supply team should be engaged to better understand the extent of the workforce and skillset of Pacific aquaculture workers. Papua New Guinea, Fiji, East-Timor, the Solomon Islands and Vanuatu are likely the best places to recruit workers with relevant skills and experience, as well as to maximise business and employment opportunities upon return home.
- 7) Aquaculture is generally a low hazard industry, however, high-risk operations such as crocodile farms should be given secondary priority.
- 8) Given the considerable economic development potential of the industry in the Pacific, a monitoring and evaluation program should be established to monitor both worker skill development in Australia and economic development upon workers' return home.

- 9) As previous analysis of the sector in the Pacific is dated, the Department of Foreign Affairs and Trade, or its partners, should commission a study into the state and growth prospects of the aquaculture industry in the Pacific.
- 10) The demand and supply teams should coordinate and develop a strategy to increase female participation, particularly regarding communications when first engaging with approved employers.

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Glossary of terms, abbreviations and acronyms

ABS	Australian Bureau of Statistics
ANZSCO	Australian and New Zealand Standard Classification of Occupations
ANZSIC	Australian and New Zealand Standard Industrial Classification
APTC	Australia Pacific Training Coalition
DIA	Detailed Industry Assessment
FTE	Full-Time Equivalent
GDP	Gross Domestic Product
GVA	Gross Value Added
IRC	Industry Reference Committee
IVI	Internet Vacancy Index
OECD	Organization for Economic Co-Operation and Development
PC	Productivity Commission
PIA	Preliminary Industry Assessment

1. Introduction

1.1 Industry assessments program

To build its evidence base for programming decisions, the PLF has initiated an industry assessments program to better understand the nature of the demand in Australia for Pacific migrant labour. This is an ongoing 2-step program to both assess new industries and re-assess previously considered industries as and when conditions change.

The first step of the program is to conduct a preliminary industry assessment (PIA). This is a brief and rapid assessment to determine whether a more detailed analysis is warranted.

The second step is a detailed industry assessment (DIA) to assess the industry in greater depth, including both the domestic economic characteristics of the industry and its appropriateness for the PLF, Pacific Labour Scheme (PLS) workers, and Pacific Island economies.

The industry assessments program is undertaken using the Australian Bureau of Statistics (ABS) industry classification system. The Onshore Aquaculture Classification is reported by the ABS via Division A of the ABS Industry Classification System (ANZIC) detailed below:

- Division A: Agriculture, Forestry and Fishing
- Subdivision 02: Aquaculture
- Group 020: Aquaculture

Classifications

- 0201: Offshore Longline and Rack Aquaculture
- 0202: Offshore Caged Aquaculture
- 0203: Onshore Aquaculture

Description of business activities

- Oyster, pearl, and pearl oyster farming
- Salmon and trout farming (caged)
- Lobster farming
- Saltwater crayfish farming or breeding
- Crustacean or mollusc breeding or farming (pond or tank)
- Fish breeding or farming (pond or tank)
- Ornamental fish farming
- Fish hatchery operation
- Paua farming (pond)
- Prawn farming (pond)
- Salmon farming (pond or tank)
- Trout farming (pond or tank)
- Tuna farming (pond or tank)
- Yabby farming (pond or tank)

The previously conducted PIA examined 0203 Onshore Aquaculture only. This DIA has been expanded to include 0201 Offshore Longline and Rack Aquaculture, and 0202 Offshore Caged Aquaculture. This broadening of scope was based on the relatively transferrable skillset of workers as well as to accommodate the growth in the related aquaculture activities.

1.2 Methodology

This DIA was preceded by a PIA which was completed in August 2020. The PIA concluded that:

Whilst the aquaculture industry has experienced strong growth over the past decade, significant headwinds exist for future growth in the short-to-medium term. Competition from cheaper Asian imports and increased regulation undermine strong and increasing domestic demand. Forecast certainty is also reduced given the impact of COVID-19 on the tourism industry and the associated restaurant demand. The small size of the aquaculture industry and fragmented nature of players within the industry will also likely present difficulties in achieving economies of scale for industry engagement. However, the structural factors of increased long-term demand for fish protein and declining ocean stocks will likely outweigh the headwinds for the industry. Synergies also exist between the existing skillset of Pacific workers and demand from Australian employers. Further, economic development opportunities exist for the workers to bring their Australian experience back to the Pacific and develop the Pacific aquaculture industry. As such, this assessment recommends that a detailed industry assessment be undertaken.

The PIA was solely focused on examining readily accessible quantitative evidence and relied on ABS data, Australian Government industry forecast data, and internal regression analysis. This DIA substantially expanded this evidence base and incorporated additional quantitative data including the PLF's labour market assessment and external third-party data sources. It also drew on a wide range of qualitative information sources and internal PLF knowledge of the sector.

There was no formalised external consultation process. However, several key stakeholders were consulted to "ground truth" the evidence that was collected and analysed. Consultation participants included the National Aquaculture Council, the Australian Prawn Farmers Association, and the Australian Barramundi Farmers Association. We also spoke to the Department of Agriculture, Water and the Environment, as well as the Fisheries Research and Development Corporation.

There was a strong focus on analysis of the data, particularly what that data realistically meant for the PLF. The DIA analysis went beyond the assessment of the numerical scope of the labour market shortage to better understand if that labour supply gap was addressable by the PLF and its partners. The DIA has incorporated a risk assessment and provided recommendations on key next steps.

2. Industry overview

Section summary	
Total fish value from aquaculture is forecast to exceed fish values from wild catch over the coming decade	<ul style="list-style-type: none">- Both globally and in Australia, the value of wild-catch fish has stagnated or declined, while aquaculture has grown consistently over recent decades at a rate much faster than wild-catch.- By 2025, the value of fish grown through aquaculture is set to surpass 50% of the total value of fisheries in Australia.
Aquaculture employs 6,000 people	<ul style="list-style-type: none">- While experiencing solid growth over recent decades, aquaculture remains a small industry, employing only 6,000 people in total (excluding post-harvest operations) – the majority in Tasmania but major projects are being established in Australia’s north.
Despite the current downturn, medium- and long-term production growth is expected to be strong	<ul style="list-style-type: none">- Despite the downturn in 2020 and 2021 (a result of COVID-19 impacts and the Australia-China trade dispute), aquaculture is forecast to experience solid growth over the medium- to long-term (5+ years).- There is currently over \$2.3 billion of projects at various stages of development throughout Australia. Given the small size of the industry, this is a significant level of investment that should greatly enhance Australia’s aquaculture production.

2.1 Current state of global aquaculture

The global aquaculture industry is growing fast, much faster than traditional wild-caught seafood. The Food and Agriculture Organisation of the United Nations in 2020¹ reported that:

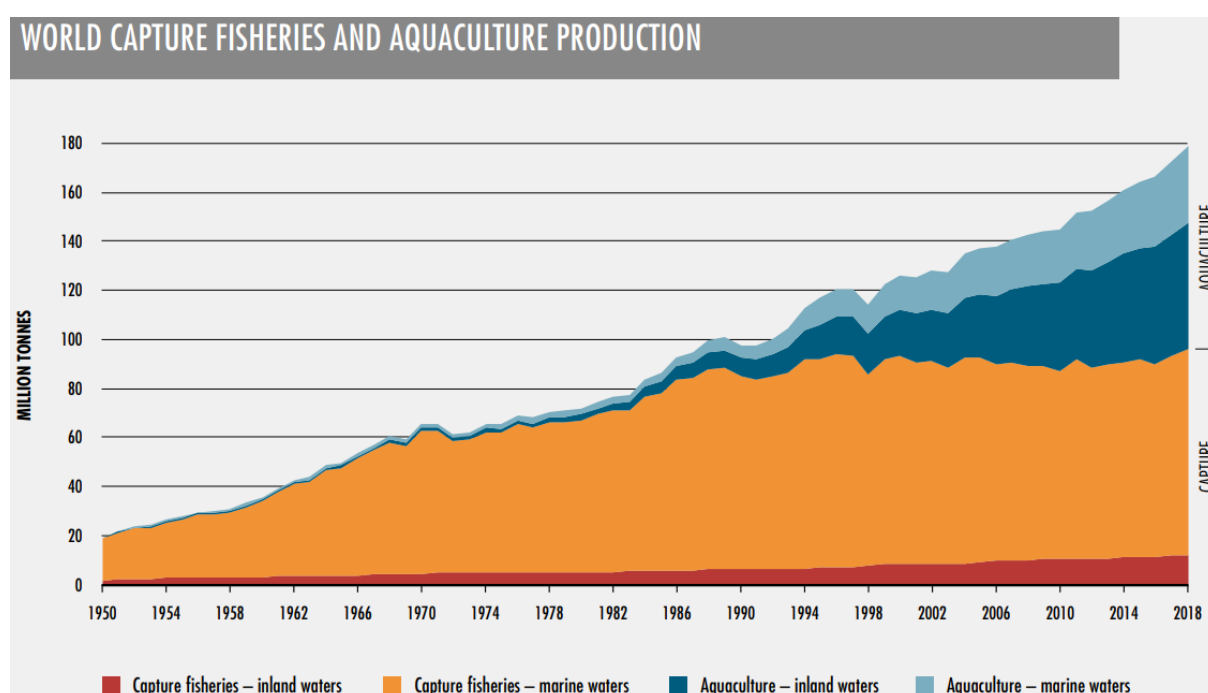
The world’s appetite for fish and fish products shows no sign of slowing, and global total production, trade and consumption reached an all-time record in 2018 ... Since the early 1990s most growth in production from the (seafood) sector as a whole has been from aquaculture, while capture fisheries production has been relatively stable.

The UN Food and Agriculture Organization reported that in the 3 decades to 2018, aquaculture grew 527% while wild-caught seafood production grew only 14%. The figure below shows the continued rise in worldwide production of seafood, and that almost the entire growth has been supplied by aquaculture production. This is in large part driven by ecological limits on sustainable wild-caught production as well as increasing efficiencies and improved technologies available in aquaculture production. It is now estimated that half of the world’s consumed seafood is aquacultural product.²

¹ FAO, Annual Aquaculture Report, 2020.

² *ibid*

Figure 1: World capture of fisheries and aquaculture, 1950-2018³



2.2 Trends in the Australian aquaculture industry

Despite having the third largest exclusive economic zone in the world (with almost exclusive access for Australian fishing fleets), Australia's fisheries are relatively unproductive by global standards. The combination of the lack of large offshore upwellings, low nutrient run-off from the land, and strict regulatory environment place hard limits on Australian wild-catch fisheries (Department of Agriculture, Australian Government, 2015). This provides an opportunity for aquaculture to meet the growing demand for sustainable seafood.

As of 2018, aquaculture in Australia accounts for 44% of total industry gross value of production (GVP), versus 56% for wild-catch, with aquaculture production having grown strongly relative to wild-catch production. Aquaculture's share of fish production has grown from 29% to 44% in the 18 years between 2000 and 2018. In Australia, aquaculture is forecast to reach 50% of total industry GVP by 2025.

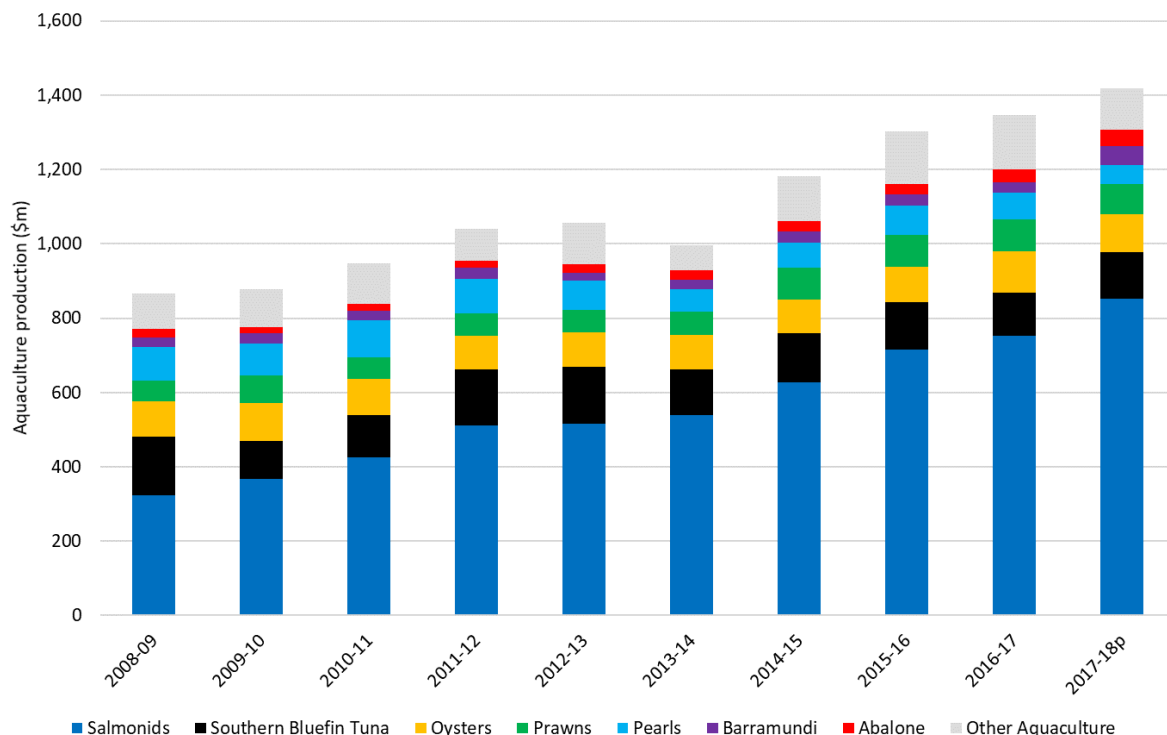
Of the 17,000 people employed in Australian fisheries and aquaculture, 11,000 are employed in wild-catch, with 6,000 employed in aquaculture⁴. Despite employing a third of the total workforce, aquaculture captures closer to half of the industry value. This is primarily a result of aquaculture products being higher value – much of which are sold as premium products. The top species, by value of production, produced in Australia through aquaculture are salmonids (salmon and trout), southern blue fin tuna, oysters, prawns and pearls. Salmonids alone accounted for 60% of the gross

³ Source: FAO, Annual Aquaculture Report, 2020

⁴ Excluding those employed in post-harvest operations.

value of production in 2018, nearly all of which was produced in Tasmania. Tasmania accounts for 62% of the gross value of production, followed by South Australia at 15% and Queensland at 8%.

Figure 2: Aquaculture GVA product by species, 2008-09 to 2018-19



Australia typically exports high-value seafood such as wild-caught rock lobsters and abalone, and imports low value seafood such as tuna – with Asia being the largest source of both imports and exports. As of 2018, Australia imports more seafood than it exports, with imports accounting for approximately 65% of domestic consumption (Steven, Mobsby, & Curtotti, 2020). The Australian Government and industry have identified a sizeable opportunity for Australian aquaculture farmers to supply domestic demand for cheap, white fish fillets and reduce the reliance on imported seafood. However, businesses are likely to continue to target products that achieve a higher return on investment given the production costs in Australia relative to the rest of the world. Given the expansive coastline of Australia, an ability to satiate Asian demand and solid domestic opportunities, aquaculture appears to have solid growth prospects over the medium to long term.⁵

⁵ Note, this report does not cover seafood processing, which sits in a separate industry under ANZIC classification. Likewise, this report will not examine canning operations, which have no significant presence in Australia, with most canned products imported from Thailand.

3. Economic assessment

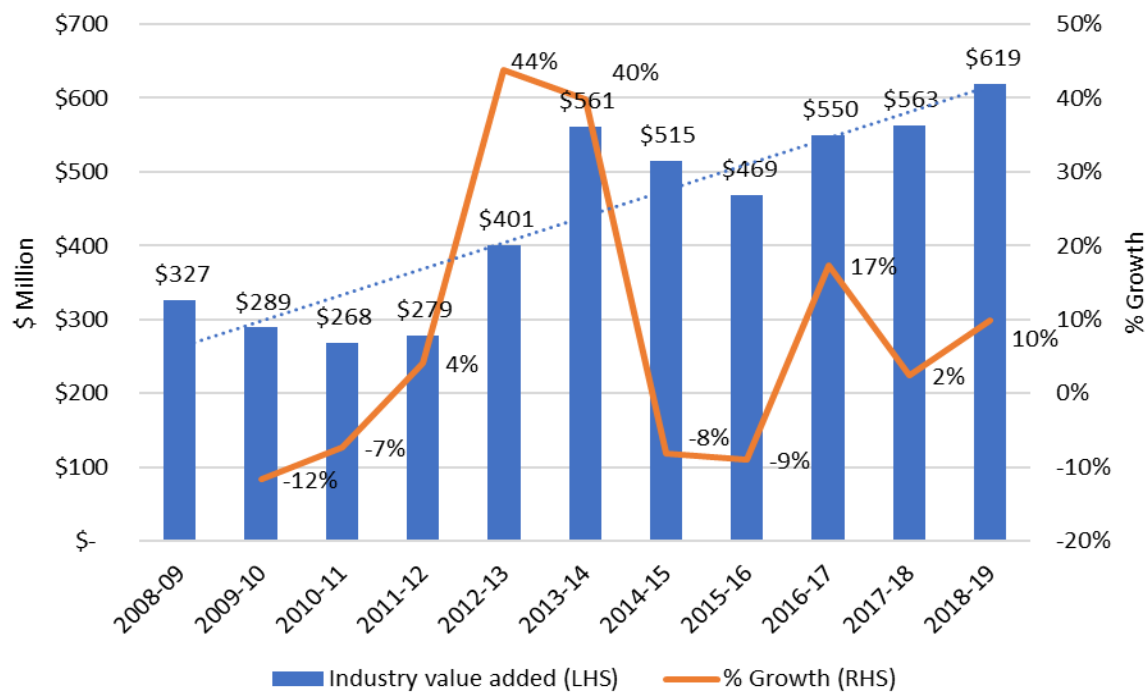
Section summary	
Industry volatility is high, but not unreasonable for a primary industry	<ul style="list-style-type: none"> - While exhibiting solid growth over a 10-year period, the industry has experienced significant volatility from year to year. This is typical of primary industries in the earlier stages of development, but the volatility appears to be reducing. Currency movements, disease outbreaks, and feed costs can all significantly impact industry activity.
Employment in aquaculture has also been volatile, however medium- to long-term employment growth is expected to be favourable	<ul style="list-style-type: none"> - Employment levels in aquaculture are volatile, partly due to the seasonal nature of the industry, as well as heavy export exposure. - Short-term (next 12 months) forecasts indicate a period of continued contraction, primarily a result of the Australia-China trade dispute and the ongoing impacts of COVID-19 reducing exports to Asia. - However medium- to long-term growth prospects appear solid, with strong underlying structural demand for sustainable Australian seafood and aquaculture products.
Employment in aquaculture is male dominated and mostly full-time employees	<ul style="list-style-type: none"> - 81.6% of workforce is male, a ratio that has been increasingly tilting toward males over the last decade⁶, albeit slightly. - 77.4% of the labour force are employed full-time. This proportion has been relatively stable over the past decade.
Half of Australia's seafood value is exported; however, Australia remains a relatively small player globally – having only 1% of global exports	<ul style="list-style-type: none"> - Half of Australia's seafood (wild-catch and aquaculture) production value is exported, primarily to Asia. however much of this value is lobster and abalone (wild-catch). In terms of aquaculture exports, whole bluefin tuna and pearls have also been affected due to the exposure to exports. - Conversely, salmonids have a low export exposure, with most of their value consumed domestically, as do oysters and prawns.
All significant businesses (more than 200 employees) are registered in Tasmania	<ul style="list-style-type: none"> - According to the ABS Business Counts, there are only 6 large business (employing more than 200 people), all of which are registered in Tasmania. - Medium-sized businesses (employing 20-199) are more diverse, with registrations in Queensland, South Australia, Tasmania, and Western Australia.

⁶ This excludes post-harvest operations, which employs a higher proportion of women.

3.1 Economic value of activity

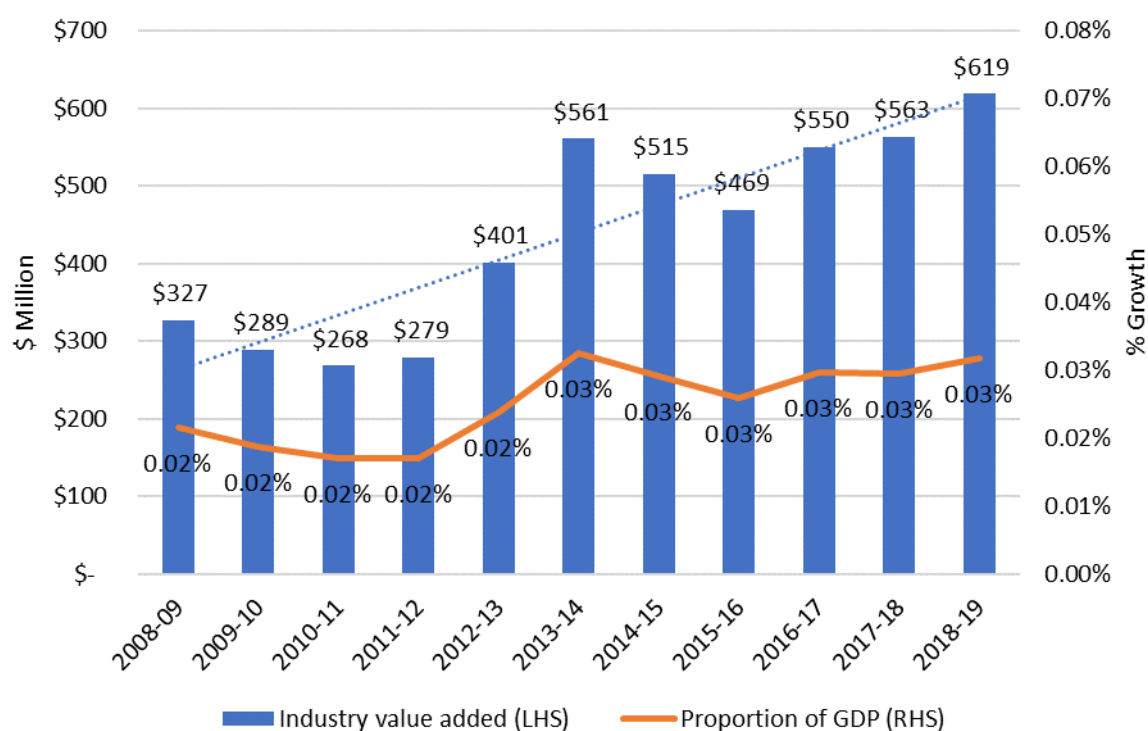
ABS figures show that the GVA product from aquaculture experienced strong growth, almost doubling over the last decade from \$327m in 2008-09 to \$619m in 2018-19. This equates to a compound average annual growth rate of 6.6%, greater than both the broader agriculture industry and national GDP, at 4.3% and 2.6% respectively.

Figure 3: Aquaculture GVA product 2008-09 to 2018-19



As a result of the sector's strong growth, the sector's GVA product has increased relative to national GDP over the 2008-09 to 2018-19 period. In 2008-09, the industry division represented 0.02% of total national economic output, and as of 2018-19, represented 0.03%. However, despite this strong growth over the past decade, it's important to note that aquaculture remains a very small component of the Australian economy – with obvious implications for the capacity to employ a significant number of PLS workers.

Figure 4: Aquaculture GVA product and national GDP, 2008-09 to 2018-19



It is important to note that an increased value of production, or gross value add, does not necessarily equate to greater employment level (see the sections below). Currency movements, increasing prices and increased production efficiencies, such as automation, have had positive impacts on the industry. Aquaculture has a comparatively high efficiency of labour (IBISWorld, 2019), meaning conceptually that production values can increase without a proportionate increase in demand for labour. This is evident in aquaculture of the last decade of examined data. Increased use of automation is likely to sustain this phenomenon.

3.2 Production and trade

Australia exports about half its total seafood production value.⁷ As of 2018, the value of Australian exports was \$1.58 billion, compared with the value of total of production of \$3.18 billion, equating to 49.7%. Rock lobsters, produced through wild-catch and not aquaculture, account for almost half of this value (49%) at \$771 million, followed by abalone \$189 million, and tunas \$144 million. Australian export markets are relatively concentrated with 85% of exports going to China, Vietnam, Japan, and Hong Kong (Steven, Mobsby, & Curtotti, 2020).⁸

⁷ Note that this section contains export data for total fisheries products - combined wild-catch and aquaculture – due to limits in data available. Every effort was taken to extract aquaculture only data and provide as relevant information as possible.

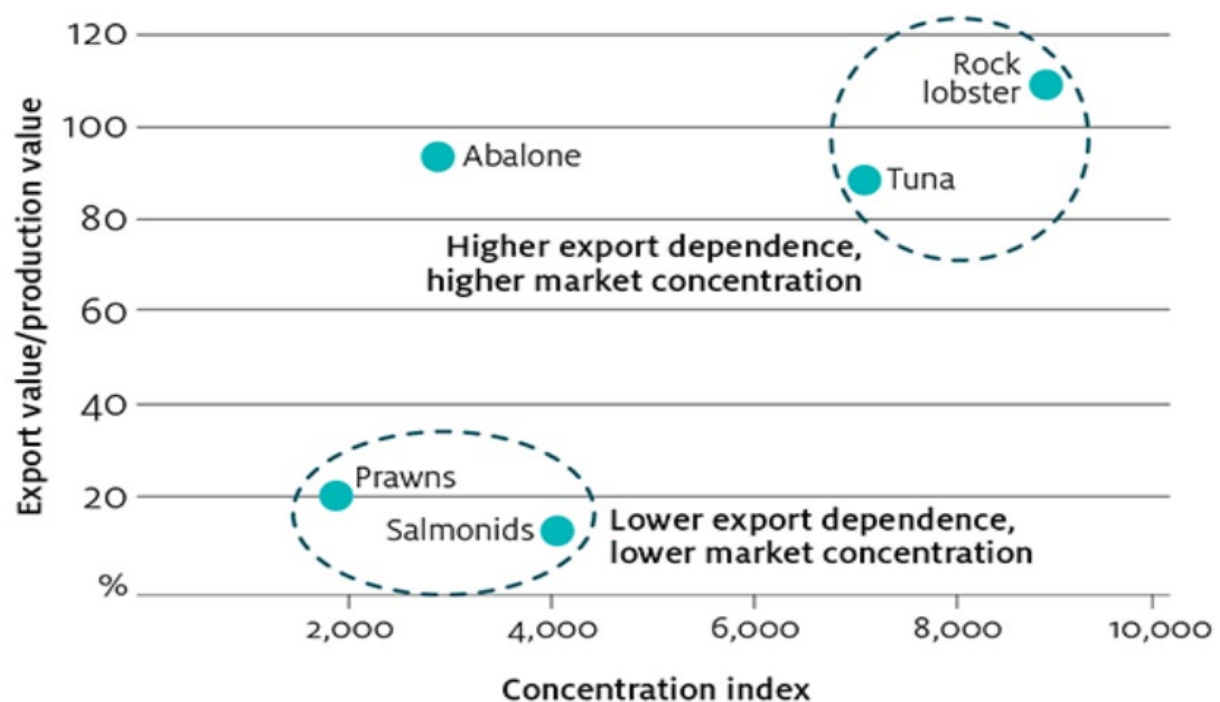
⁸ Note, that since publication of these trade statistics, Australian exports of Rock Lobster have experienced a decline in total exports, due to a significant decrease in exports to China. The Department of Agriculture expects this trade to normalise over the medium term – 2021-2025.

Australia's import partners are similar to its export partners, with Thailand, China, Vietnam and New Zealand accounting for 64% of imports in 2018 (Steven, Mobsby, & Curtotti, 2020).

Globally, Australia is a relatively insignificant exporter of seafood, accounting for 1% of all global seafood exports. However, Australia does have a significant presence in the following species, accounting for 21% of lobster (wild-catch), 12% of whole bluefin tuna (aquaculture) and 30% of abalone (wild-catch) global trade values (Steven, Mobsby, & Curtotti, 2020).

Conversely, Australian produced salmonids and prawns have a significantly lower export dependence, with less than 20% of production values being exported. That is, more than 80% of salmonid and prawn value is consumed domestically. Theoretically, salmonids should experience reduced volatility due to removal of exchange rate movements and geopolitical impacts. The below graph illustrates the export reliance and concentration of Australia's most produced seafood.

Figure 5: Export market concentration of major fisheries products, 2018–19



3.3 Business Counts

The ABS Business Counts show the number of registered businesses by state and number of employees as of June every year. It is important to note that this counts business registration, and not the location of the business' primary activities. For example BHP would be registered in Victoria yet has extensive operations in Western Australia.

Barriers to entry within the industry are high, due largely to a high level of regulation, the large initial capital outlays required, strong import competition and low profit levels (IBISWorld, 2019). As such, the number of businesses, particularly small-scale operators, is expected to continue to decline as the industry consolidates.

Onshore aquaculture

The ABS Businesses Counts show that there were only 435 registered onshore aquaculture businesses at the end of the 2019 financial year, equating to less than 1% of all registered

agricultural sector businesses. Over the course of the 2019 financial year, the number of registered fell from 449 to 435, a decline of 3.1%.

The industry is geographically diverse with 31% of businesses registered in Queensland, 19% in Western Australia and 17% in New South Wales.

Importantly, there are no registered onshore aquaculture businesses that employ more than 200 employees, and 14 that employed between 20-199. These figures do not include processing and packaging, which are included in the addendum.

Table 1: Australian Bureau of Statistics Business Counts: Onshore aquaculture

State	Non-employing	1-19 employees	20-199 employees	200+ employees	Total
NSW	51	23	0	0	72
Vic	38	19	0	0	61
Qld	72	54	5	0	133
SA	28	17	3	0	50
WA	64	15	3	0	84
Tas	22	12	3	0	37
NT	3	0	0	0	3
ACT	0	3	0	0	3
Total	276 63.4%	139 32.0%	14 3.2%	0 0.0%	435 100%

Offshore aquaculture - caged, and offshore longline and rack

The ABS Businesses Counts show that there were 642 registered offshore aquaculture businesses at the end of the 2019 financial year, equating to less than 1% of all registered agricultural sector businesses. This was a decline from 667 during the 2019 financial year. The industry is clustered, with NSW containing 42% of all registered businesses and South Australia the second largest with 20%. Importantly, there are 6 registered offshore aquaculture businesses that employed more than 200 employees – all registered in Tasmania. There are also 23 medium-sized businesses, employing between 20-199, which are registered in Tasmania, Western Australia and South Australia.

Table 2: Australian Bureau of Statistics Business Counts: Offshore caged and longline

State	Non-employing	1-19 employees	20-199 employees	200+ employees	Total
NSW	149	115	0	0	270
Vic	18	15	0	0	28
Qld	42	29	0	0	73
SA	74	48	6	0	131
WA	41	21	6	0	68
Tas	18	42	6	6	69
NT	0	3	0	0	5
ACT	0	0	0	0	0
Total	346 53.9%	267 41.6%	23 3.6%	6 0.9%	642 100%

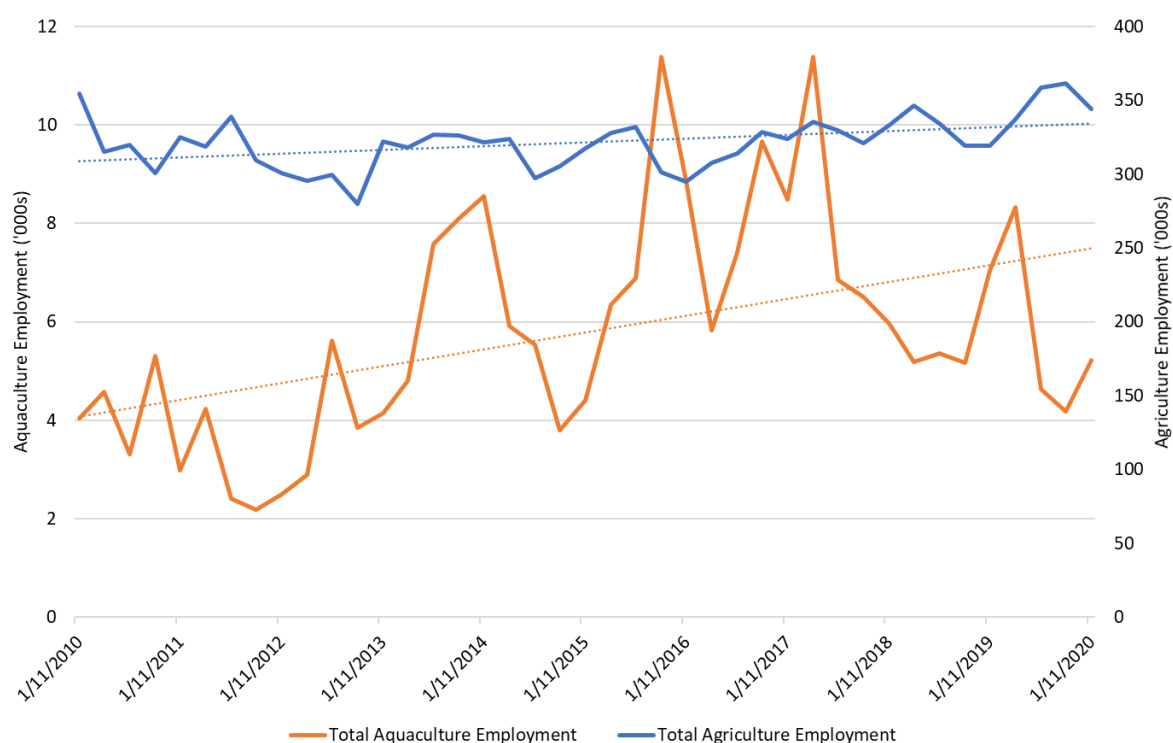
3.4 Employment

ABS labour force figures show that employment levels in aquaculture have been very volatile – more than doubling between 2010 and 2016, then falling by half between 2017 and 2020. This is illustrated below with employment level rising from 4,000 to 11,400, then back to 5,200.

While much of this volatility appears to be due to seasonal harvesting, with the August quarter often being the peak, approximately half of the sharp declines have been counter seasonal. The decline that occurred during 2020, most likely the result of COVID-19 and the Australian trade dispute with China, was smaller than the declines in 2018, 2016, and 2015. The combination of the seasonal nature of a primary industry, and heavy export exposure of tuna and pearls are the likely causes of volatility. Note, this data is likely distorted by the common industry practice of using labour hire companies and backpacker labour.

The employment volatility in this industry should be treated with caution as this may have implications, including periods of reduced hours, or even redundancies, for PLS workers. Further, the seasonal harvesting of certain species may limit the ability of employers to provide a minimum 30-hour per week employment. Businesses harvesting these species may be better suited to the Seasonal Worker Programme. See the Risks section for details on species and locations which may better suit the PLS.

Figure 6: Persons employed in aquaculture, 2009-10 to 2019-20



The Australian Government Labour Market Information Portal provides detailed 5-year employment projections devised by the Department of Employment, Skills, Small and Family Business down to the 3-digit level from 2019 to 2024.

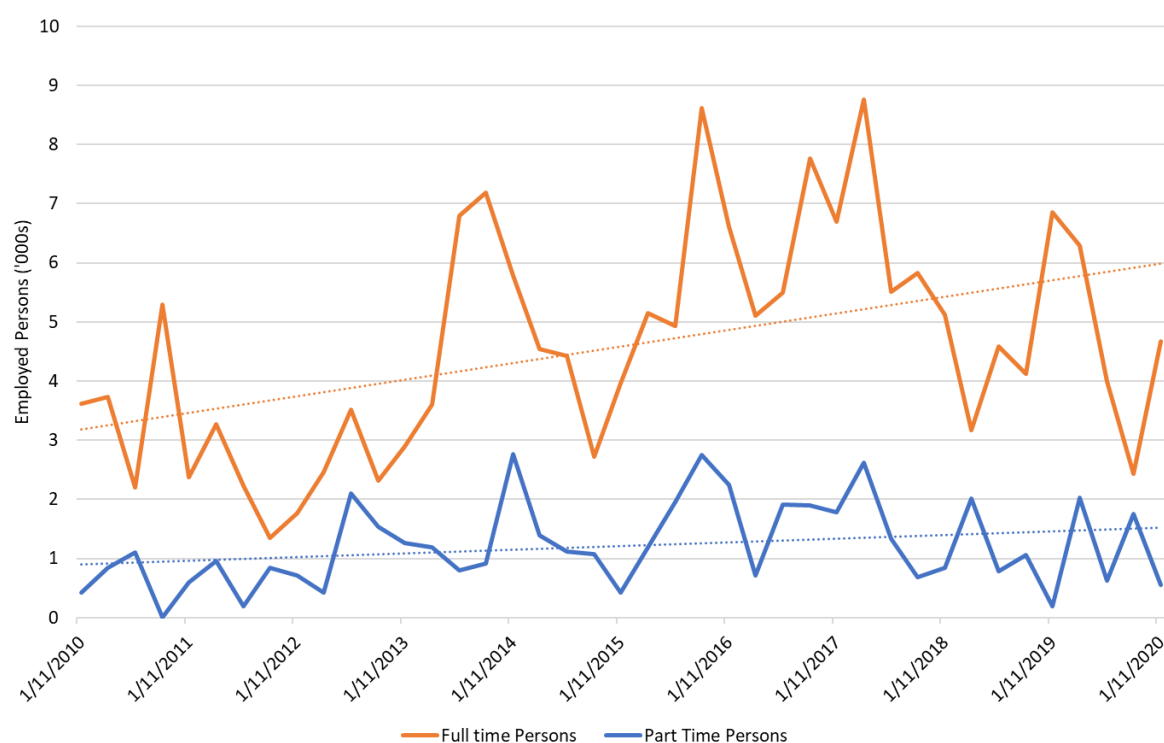
Projections of employment growth in aquaculture are negative from May 2019 to May 2024, at a projected rate of -2.9%. While these forecasts were made before the COVID-19 pandemic and China trade dispute, the Department of Agriculture indicates that the industry will experience a downturn in production value for 2020 at least, with implications for employment levels. It is also important to note that increased value of production does not equate to greater employment levels. Currency movements, increasing prices, increased production efficiencies – such as automation – have had positive impacts on the industry, without resulting in increased employment. It is also likely that these projections made in 2019 do not include all the projects under development and outlined in this report.

The Department of Agriculture expects fisheries and aquaculture production values to grow by 2.4% a year in real terms during the period of 2021 to 2025 as the global situation normalises. This should equate to increased demand for labour over the medium to longer term.

Table 3: Projected employment growth in aquaculture

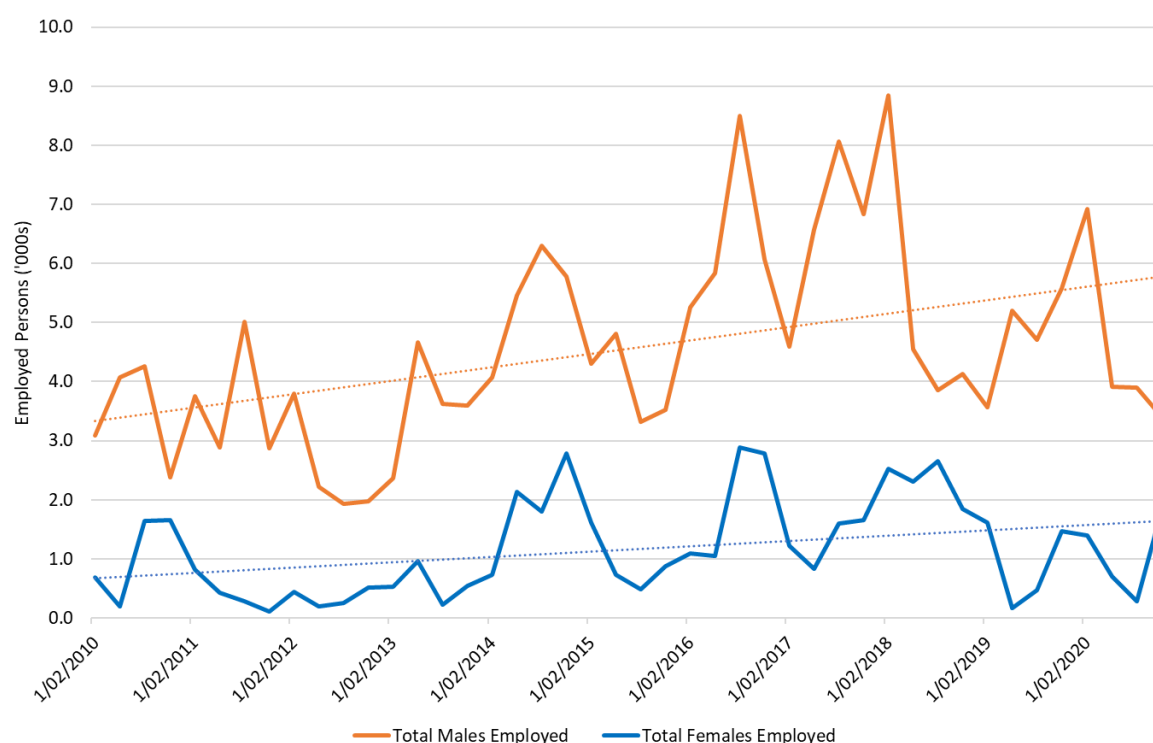
Industry	Employment May 2019 ('000)	Projected employment May 2024 ('000)	Projected employment growth over 5 years	Projected employment growth over 5 years (%)
Aquaculture	5.3	5.2	-0.2	-2.9%
Total agriculture	332.9	329.1	-3.8	-1.2%
All industries	12,879.6	13,954.7	1075.0	8.3%

As of 2020, 77.4% of the labour force are employed full-time. This proportion has been relatively stable over the past decade, and both part- and full-time employees appear equally exposed to employment volatility within the industry.

Figure 7: Persons employed in aquaculture, full-time and part-time split, 2009-10 to 2018-19

As of 2020, males comprise 81.6% of the labour force, a ratio that has been tilting toward men, albeit slightly, over the past 10 years. At the start of the decade, 77.1% of the industry was male, compared to 81.6% at the end. Both males and females appear equally exposed to volatility within the industry. This ratio of women to men is one of the lowest in agriculture, as well as the broader Australian economy.

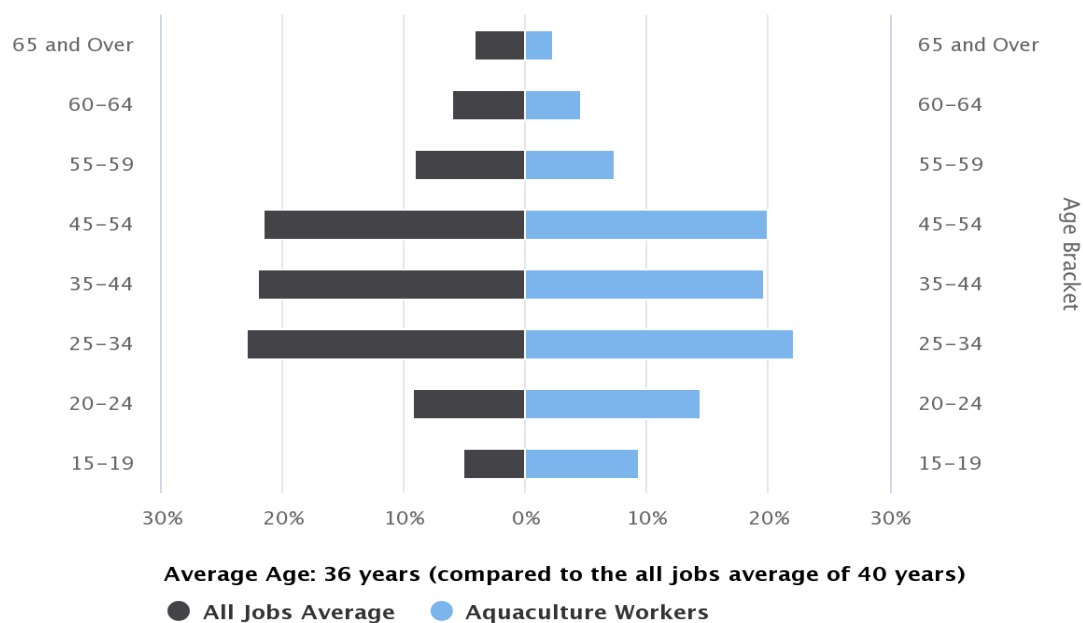
Figure 8: Persons employed in aquaculture, with sex split, 2009-10 to 2018-19



3.5 Labour force characteristics

Based on 2016 ABS Census data, we see that aquaculture workforce is slightly younger than the national average, with an average age of 34 compared to 40. This is typical of lower-skilled industries suitable for high-school graduates.

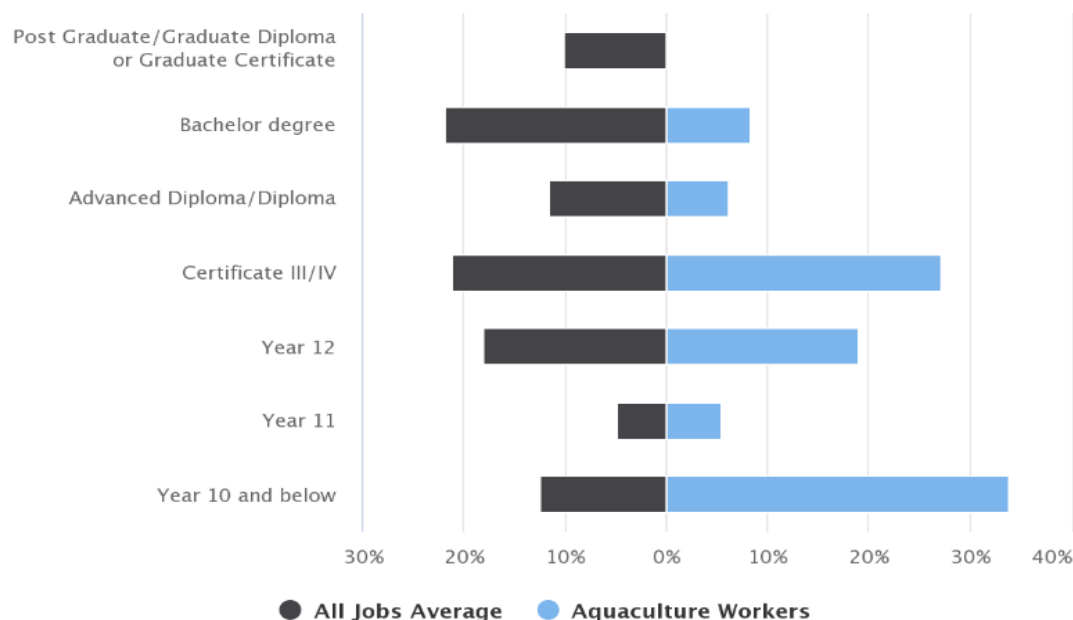
Figure 9: Age profile of aquaculture workers from the 2016 census⁹



⁹ Job outlook - <https://joboutlook.gov.au/occupations/aquaculture-workers?occupationCode=8411>

The role is classified as entry level and formal education of the workforce is modest. As of the 2016 Census, 85% of the workforce had a Certificate IV or below, with approximately one-third of the workforce having finished year 10 only. This role is considered appropriate for school leavers and likely suitable for PLS workers.

Figure 10: Education profile of aquaculture workers from the 2016 census¹⁰



Under the current award, an Aquacultural Attendant level 1 adult is to be paid \$753.80 per week at a rate of \$19.84 per hour worked. Any overtime for continuous shift workers is paid at 200% of the minimum hourly rate. Excluding overtime, the award rate of \$19.84 equates to \$39,200, which is within the salary range of existing PLS workers.

The average full-time hours for this occupation category is 42.8 hours per week, higher than the agriculture industry average, indicating labour shortages (PWC, 2020). Using 42.8 hours a week, which includes overtime, the expected salary is \$44,200, higher than the average PLS worker salary.

Examining the specific roles with the industry, aquaculture *workers* – rather than aquaculture *managers* or *technicians* – are predominately young men, with only 5.3% of the workforce women, with an average age of 23.

3.6 Risk of displacement of Australian workers

The industry has solid growth prospects over the medium- to long-term, which, despite increasing automation, will still result in demand for low-skilled workers. On the supply side, there is falling worker supply as evidenced by the decreasing number of enrolments in relevant TAFE courses. This apparent labour shortage has been confirmed during our industry consultations, and conceptually reduces the risk of Australian worker displacement. However, while overall risk may be low, the PLF will still need to consider localised displacement risks, as some regions of Australia may be more sensitive to an influx of foreign workers. The PWC labour market analysis (see section 4.2), and subsequent updates, should be used as a guide to indicate regions with high unemployment, youth

¹⁰ Job outlook - <https://joboutlook.gov.au/occupations/aquaculture-workers?occupationCode=8411>

unemployment and Indigenous unemployment, before engaging. The projects under development in Far North Queensland and the Northern Territory are examples of this potential local sensitivity.

4. Australian demand characteristics

Section summary	
Tasmania accounts for almost the-thirds of national production value	<ul style="list-style-type: none"> - Tasmania is the largest state in terms of production value, accounting for 62% of the national total, followed by South Australia (15%) and Queensland (8%). - As expected, worker numbers and business registrations follow a similar pattern to production value.
Tasmania was also the largest source of growth for the industry	<ul style="list-style-type: none"> - Moreover, Tasmania has been responsible for almost all the growth in Australia, with New South Wales, Queensland and Victoria making modest growth contributions.
The industry is dominated by a small number of large players	<ul style="list-style-type: none"> - The industry is relatively concentrated, with the 4 largest players accounting for 44% of industry revenue. - There are also a large number of small family-owned operations that do not appear suitable to the PLS.
Significant investment is occurring for a range of new projects	<ul style="list-style-type: none"> - There is currently over \$2.3 billion of projects at various stages of development throughout Australia. Given the small size of the industry, this is a significant level of investment that should greatly enhance Australia's aquaculture production. - 2 projects of significance are Project Sea Dragon in Western Australia and the Northern Territory, which will employ 1,500 when fully operational; and the expansion of prawn farming in north Queensland by Tassal, which will employ an extra 700.

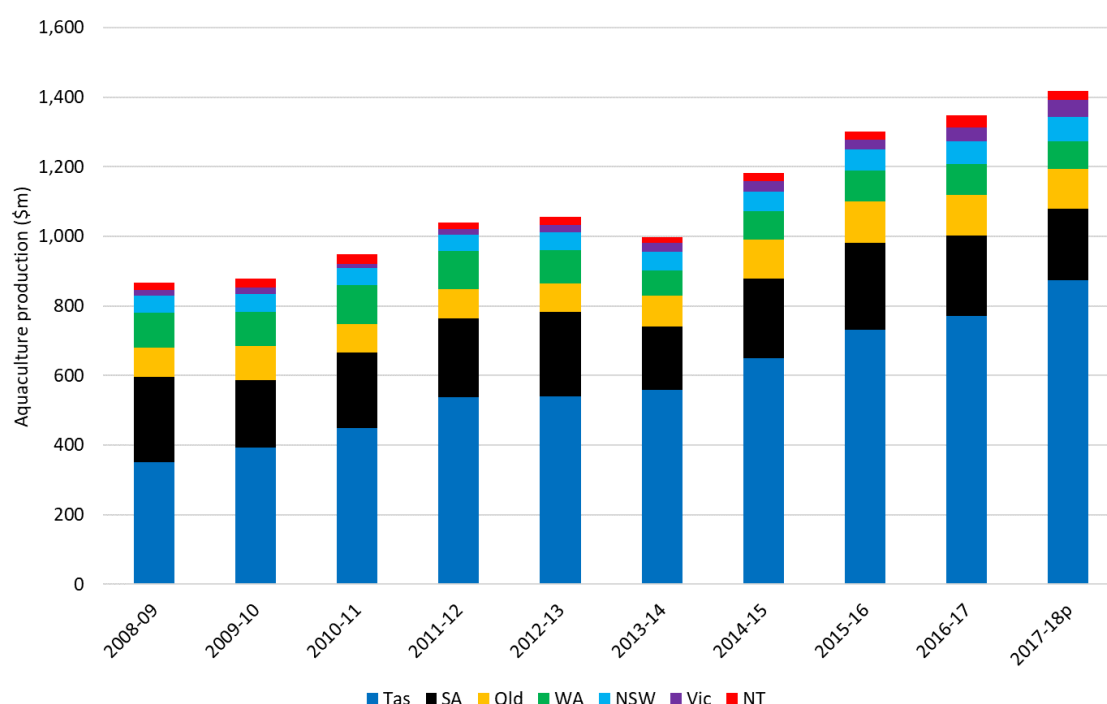
4.1 State aquaculture production

State comparison of production value

As shown in the following figure, Tasmania is the largest aquaculture producer as measured by value of production with a 62% share of national aquaculture production (as at 2018). The second largest is South Australia (15%) then Queensland (8%), with all other states and territories having comparatively small production values.

Between 2009 and 2018, Tasmania contributed 95.0% of the growth in production value. New South Wales, Queensland and Victoria all made modest contributions toward growth. Conversely, the value of production in South Australia and Western Australia declined by 2.0% and 2.7% respectively.

Figure 11: Aquaculture production value by state, 2008-09 to 2017-18p

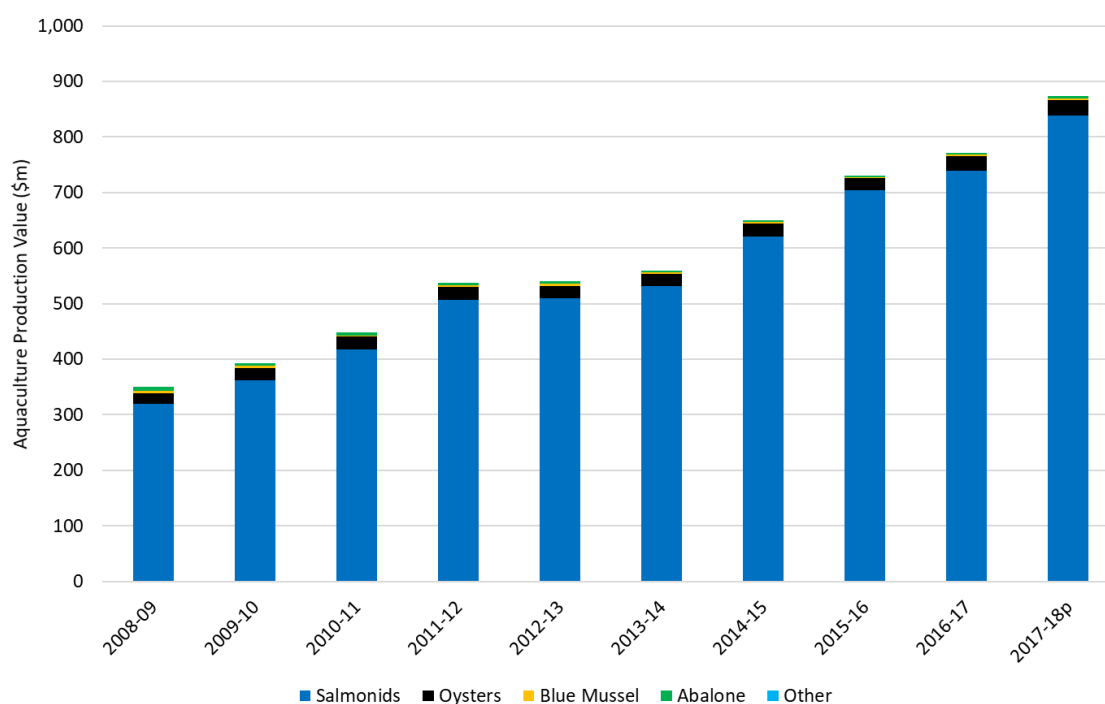


The following is an overview of the 3 largest states by aquaculture production value as of 2018.

Tasmania

As shown below, 96% of Tasmanian production value comes from salmonids, with oysters, blue mussel and abalone production comparatively small. The value of production has increased 2.6-fold over the past decade, and more than 10-fold over the past 2 decades. Tasmania is the only state or territory to have registered aquaculture businesses with more than 200 employees.

Figure 12: Aquaculture production value of Tasmania, 2008-09 to 2017-18p

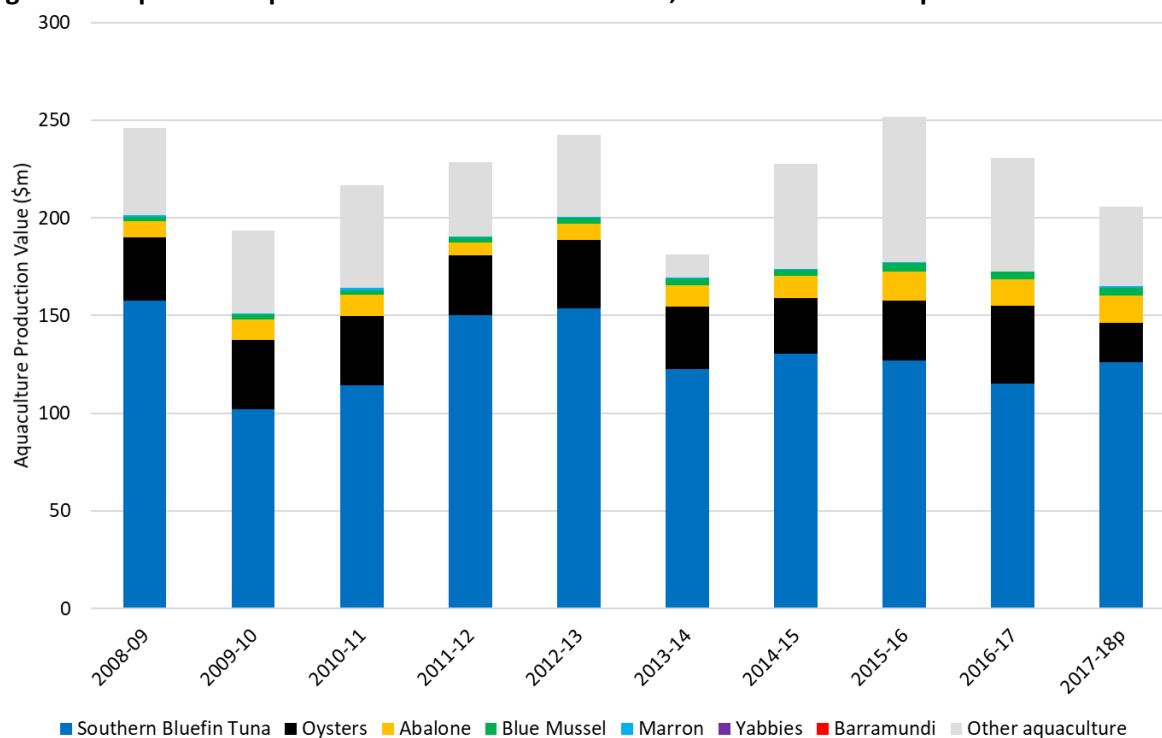


South Australia

As shown in the following figure, 61% of South Australia's production value comes from southern bluefin tuna (almost all tuna is farmed in SA due to ideal growing conditions) with 10% oysters and 7% abalone. All other species contribute relatively minor amounts to total production value.

South Australian production value has decreased by 16% over the past decade, with both oysters and tuna declining by more than 20%. Tuna prices have fallen over recent years, largely due to increased volumes of frozen tuna imports from Indonesia. Warmer than average water temperatures in SA have also reduced availability of oysters (IBISWorld, 2019).

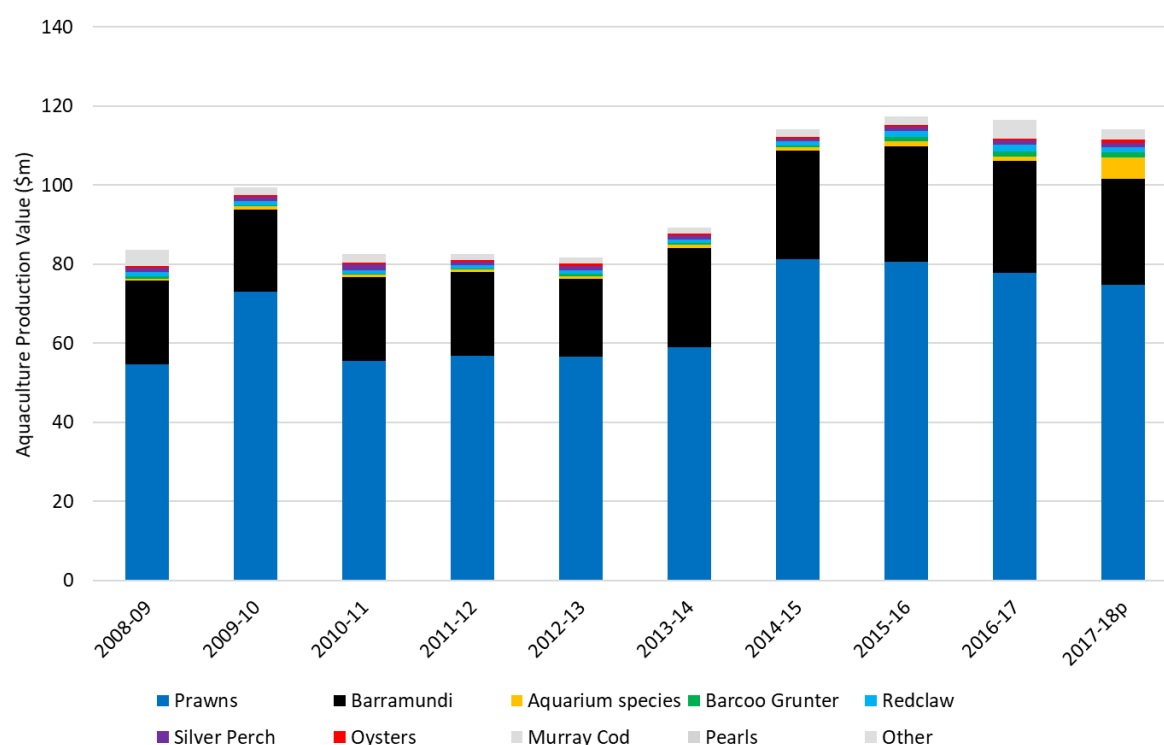
Figure 13: Aquaculture production value South Australia, 2008-09 to 2017-18p



Queensland

In Queensland, prawns (65.4%) and barramundi (23.6%) make up a combined share of 89.0% of the total value of production – both of which experienced modest growth over the last decade, contributing to the states solid and consistent growth.

Figure 14: Aquaculture production value Queensland, 2008-09 to 2017-18p



4.2 PWC labour market analysis findings on aquaculture

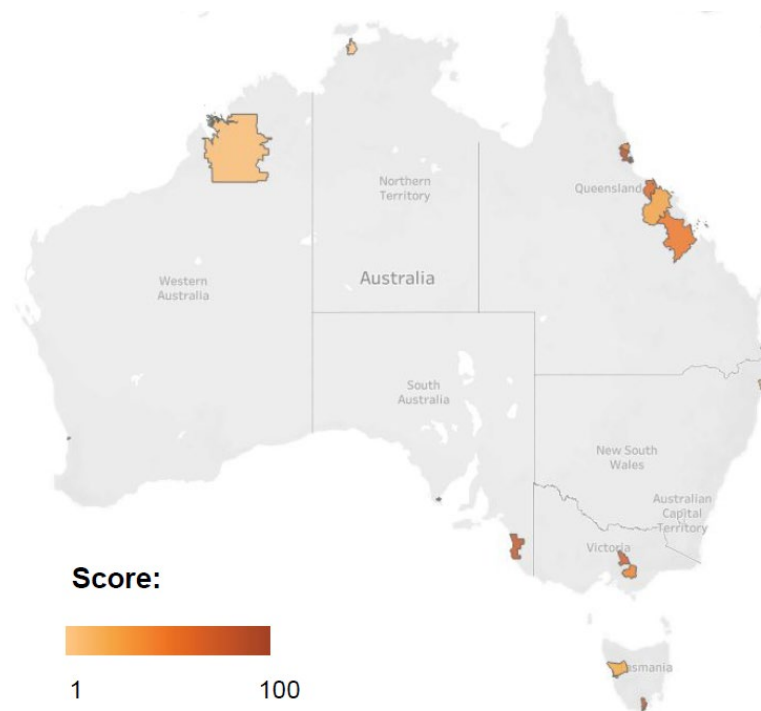
The below table and graph show the top 16 eligible regions (statistical area 2s) in Australia for placing PLS working in aquaculture. These figures have been taken directly from the PWC labour market analysis conducted in 2020. The scores in the below table indicate the likelihood and extend of labour shortages in those regions.

Table 4: Regions identified with high likelihood of labour shortages in aquaculture¹¹

Rank	SA2	Score	Rank	SA2	Score
1	Port Lincoln, SA	66	9	Johnstone, Qld	43
2	Tully, Qld	60	10	Mount Baw Baw Region, Vic	43
3	Kingston-Robe, SA	56	11	Collinsville, Qld	36
4	Geeveston – Dover, Tas	54	12	West Coast, Tas	34
5	Alexandra, Vic	52	13	Maclean – Yamba – Iluka, NSW	30
6	Burdekin, Qld	49	14	Innisfail, Qld	29
7	Broadsound – Nebo, Qld	45	15	Derby – West Kimberley, WA	29
8	Kingscliff – Fingal Head	43	16	Darwin, NT	26

¹¹ Source: PWC Labour Market Analysis, 2020

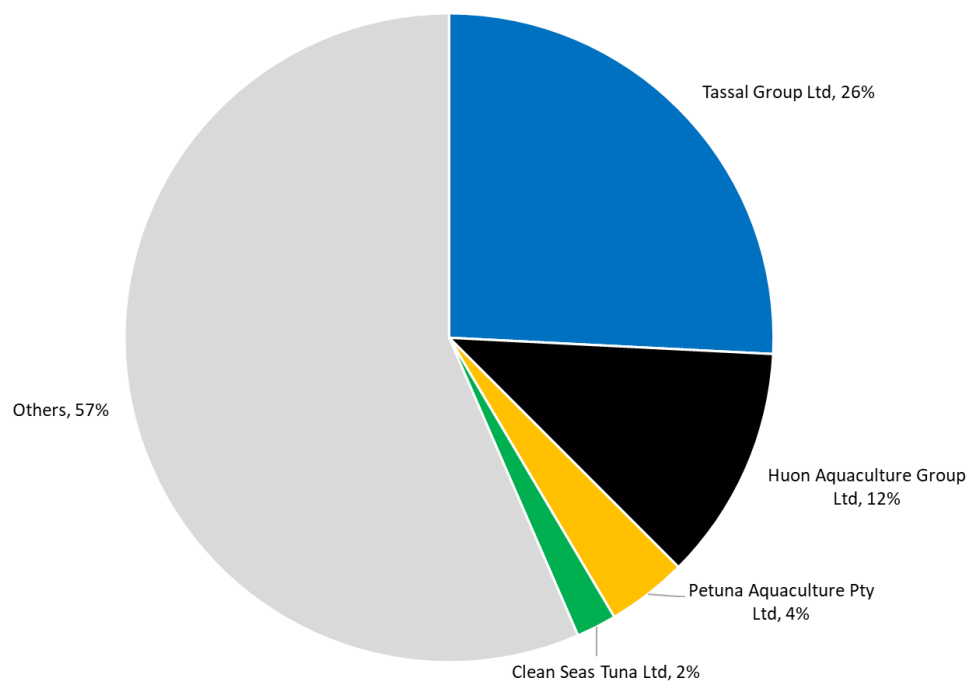
Figure 15: Regions identified with high likelihood of labour shortages in aquaculture¹²



4.3 Major players in Australian aquaculture

The aquaculture industry in Australia is moderately concentrated, with the largest 4 players accounting for approximately 44% of industry revenue, as shown in the figure below.

Figure 16: Estimated revenue share of aquaculture businesses, 2018



¹² Source: PwC Labour Market Analysis, 2020

Beyond this, the industry is highly fragmented, with almost two-thirds of registered businesses being owner-operators that may not be initially suitable for PLS engagement. Given the initial capital outlay requirements, level of government and environmental requirements, and competitive pricing from imports, the industry is unlikely to see many new entrants.

Tassal Group Ltd

Tassal is the largest player in Australian aquaculture, capturing approximately one-quarter of total revenue. It is a Tasmanian-based vertically integrated company with hatchery, aquaculture, processing and sales operations. Tassal is the largest producer and exporter of Atlantic salmon in Australia and has made several acquisitions that have contributed positively to its operations over recent years.

Initially selling primarily to export markets, Tassal has refocused its operations on the Australian market, reducing its export market exposure.

Tassal operates in 4 marine zones in Tasmania, as well as recently acquired prawn farms in Yamba NSW, Proserpine Qld, and Mission Beach Qld. Tassal has made several recent acquisitions and is planning on significantly scaling up operations.

Huon Aquaculture Group Ltd

Huon is another Tasmanian-based vertically integrated businesses, with operations in hatcheries, marine farms and processing. The company also owns processing facility in Sydney and a variety of other facilities, including an experimental facility in Tasmania.

Huon plans to expand into other high-value fish species and has conducted successful trials in Queensland and Western Australia on the viability of yellowtail kingfish.

Clean Seas Ltd

Clean Seas is the largest South Australian-based company, operating out of Port Lincoln. In addition to commercial hatcheries, the company has a large research and development department.

Ocean Grown Abalone

Ocean Grown Abalone is an abalone sea ranching business based in Western Australia. The company has developed artificial abalone reefs and has several projects under development that will significantly increase its harvest volumes.

Petuna Aquaculture Pty Ltd

Petuna Aquaculture is another vertically integrated Tasmanian company, with operations spanning hatching, farming, processing and marketing. The New Zealand based Sealord has had a 50% stake of Petuna since 2010. Over that time it has significantly expanded its hatchery infrastructure and processing capabilities.

4.4 Major projects under development

Relative to the size of the industry, there is significant investment planned for Australian aquaculture. Including Project Sea Dragon (which is \$1.8 billion by itself), there is approximately \$2.3 billion worth of aquaculture projects in Australia currently at various stages of development. For

details on each project see Appendix D. Project Sea Dragon in Western Australian and the Northern Territory is expected to employ 1,500 workers when fully operational. The project is currently awaiting a loan from the Northern Australia infrastructure fund and is years away from being fully operational. The second largest project is a joint operation between Tassal and James Cook University to expand prawn farming in Far North Queensland, which will employ an additional 700.

Figure 17: Major projects under development



4.5 Existing engagement with industry

Employers in aquaculture are variously struggling to find adequate numbers of workers. It is for this reason that government support has been provided by various states. In the case of Queensland, the Queensland Agriculture Workforce Network (QAWN) was established to help the agriculture sector by providing advice on workforce services and initiatives to all Queensland agribusinesses, regardless of commodity or organisation membership.

This is a free service available to agribusinesses with operations in Queensland.

These services and initiatives include:

- workforce planning advice
- sourcing labour and skilled workers
- recruitment
- induction requirements
- funded training opportunities.

Agriculture workforce officers have links with employment and training service providers across Queensland. They can help agribusinesses understand available options and strategies to identify and meet future workforce needs. There are currently 7 agriculture workforce officers in

Queensland. They have recently, for example, been helping to place seasonal workers in smaller prawn farms.

Approved employers

There are currently 2 aquaculture businesses which are PLS approved employers, Paspaley Pearling Co and Sea Dragon, neither of which have taken up the option of recruiting PLS workers to date, noting the timing of COVID-19.

Two labour hire companies, Agri Labour Australia (ALA) and Jobs Australia, are PLS approved employers that provide local labour workers to Huon Aquaculture and Tassal (ALA), and Humpty Doo Barramundi (Jobs Australia) primarily through the Seasonal Worker Programme. To date, both companies are yet to provide workers through the PLS but we understand that planning is underway.

Prospective employers

Pre COVID, interest was shown by several aquaculture businesses operating in the oyster (NSW), prawns (Qld), and tuna (SA) sectors to become PLS approved employers. In each case the businesses' applications have been placed on hold from progression due to current market uncertainty.

Employers who did not engage

The demand team has engaged with 2 other prospective employers, one who chose not to proceed and one who was considered not financially viable.

5. Workforce skill requirements

Section summary	
Core workforce skill requirements for aquaculture workers are relatively modest	<ul style="list-style-type: none">- Core skills required on most aquaculture farms include handling stock, meeting WHS requirements, communicating at the workplace, inspecting and cleaning aquatic equipment.
Employability skill requirements are also modest	<ul style="list-style-type: none">- Employability skills include communication, teamwork, following instructions, displaying self-initiative, reliability, punctuality and turning up fit for work each day.
The prevalence of formal qualifications in Aquaculture are low, but growing	<ul style="list-style-type: none">- An aquaculture worker is low-skilled role and suitable for school leavers. There are no formal qualification requirements.- Attaining a Certificate II, or above, may lead to specialist roles within Australia, as well increasing skills transfer to the Pacific.
Specialist, more highly skilled positions, are also available to workers and represent	<ul style="list-style-type: none">- Specialist skills (applied by farm worker under supervision) include forklift operation, basic equipment maintenance; use of chemicals, collecting brood and feed stock, monitoring water quality, harvesting stock, undertaking post-harvest operations, using

a good opportunity for progression

waders safely, controlling predators, pests, and diseases, feeding stock, and cleaning fish

5.1 Training overview and trends

Nationally recognised training for the seafood industry, including aquaculture, is delivered in the Seafood Industry Training Package (SFI). At present, there are 14 SFI qualifications.

Between 2015 and 2019, program enrolments in seafood industry qualifications declined each year – falling to a low just 1,000 enrolments in 2019. Certificate III enrolments were the most common, followed by Certificate II with 490 and 380 enrolments, respectively. Approximately 80% of these enrolments were for aquaculture, with 20% for the remainder of the seafood industry. The intention of these students was to find employment as an ‘aquaculture worker’.¹³

Similarly, commencements for apprenticeships and traineeships more than halved between 2010 and 2016 – the majority of whom intended to become an ‘aquaculture worker’.

Like most industries, aquaculture is undergoing a major shift toward automation and robotics. Several larger players already have automated monitoring stations, and many other operators are likewise seeking to enhance their technological capability in such things as un-crewed vessels and remote monitoring. As such, there is increased importance placed on formal qualifications to raise the skill level of the workforce.

The Aquaculture and Wild Catch Industry Reference Committee’s 2020 Skills Forecast highlights a likely increased demand for formal qualifications, including Certificate II, Certificate III, Certificate IV, and the Diploma of Aquaculture¹⁴. However, many of the physical duties, such as cleaning and maintenance, undertaken by low-skilled workers will not be so easily automated as monitoring. Demand for these low-skilled workers is expected to continue for the foreseeable future.

Table 5: Qualifications under the Seafood Industry Training Package

The following table lists the qualifications currently available under the SFI Training Package. Qualifications most relevant have been bolded.¹⁵

Certificate I	- Certificate I in Seafood Industry
Certificate II	- Certificate II in Aquaculture - Certificate II in Seafood Industry - Certificate II in Fishing Operations - Certificate II in Seafood Post Harvesting Operations - Certificate II in Fisheries Compliance Support
Certificate III	- Certificate III in Aquaculture - Certificate III in Fishing Operations

¹³ <https://nationalindustryinsights.aisc.net.au/industries/aquaculture-and-wild-catch>

¹⁴ Ibid

¹⁵ <https://training.gov.au/training/details/SFI20119>

	<ul style="list-style-type: none"> - Certificate III in Seafood Post Harvesting Operations - Certificate III in Fisheries Compliance - Certificate III in Working with Crocodiles
Certificate IV	<ul style="list-style-type: none"> - Certificate IV in Aquaculture - Certificate IV in Seafood Post Harvesting Operations - Certificate IV in Fisheries Compliance
Diploma	<ul style="list-style-type: none"> - Diploma of Aquaculture - Diploma of Fisheries Compliance

5.2 Australian employer requirements

There are no mandatory qualification requirements for working in the sector, and many aquaculture workers do not possess qualifications beyond high school.

Table 6: Australian employer requirements

Qualifications (desirable but not mandatory)	<ul style="list-style-type: none"> - Certificate II in Aquaculture - Certificate III in Aquaculture - Certificate IV in Aquaculture
Certifications (desirable but not mandatory)	<ul style="list-style-type: none"> - Manual handling
Registrations & licenses	<ul style="list-style-type: none"> - Driver's licence - Forklift operator's certificate - ChemCert - First Aid
Other desirable traits and experience	<ul style="list-style-type: none"> - Basic understanding of food safety, use and storage of chemicals and veterinary products, operation of small vessels (up to restricted coxswain ticket on some establishments) - Ability to undertake minor maintenance including basic welding

In late 2019 the Australian Government announced the formation of the National Agricultural Labour Advisory Committee. A National Agricultural Workforce Strategy was developed and submitted to the Australian Government in late 2020 for consideration. The committee considered labour market issues for the aquaculture industry. The Australian Government is considering the recommendations of the strategy and is expected to respond in early 2021. The committee consulted with a wide range of stakeholders to inform the development of the strategy. It consulted widely, including with education providers, rural research and development corporations, industry representatives, governments, producers, grower and farm systems groups, and processors and retailers.

The basic technical skills required to work in the aquaculture industry as an aquaculture technician involve skills required to care for aquatic stock - handling, feeding, and monitoring stock, and monitoring environmental conditions.

To become an aquaculture technician requires completion of a VET course or a traineeship. At the Certificate II level, the core (essential) subjects include handling stock, inspecting and cleaning aquatic work equipment, and meeting workplace health and safety requirements.¹⁶ Thus, maths and science skills are required, as well as physical labour. The box below provides a list of elective subjects within the Certificate II that indicate the tasks and skills that may be required in more detail.

Certificate II in Aquaculture - elective units

- Apply chemicals under supervision
- Operate a freezing process
- Provide first aid
- Collect brood stock and seedstock
- Manipulate stock culture environment
- Undertake routine maintenance of water supply and disposal systems and structures
- Monitor water quality
- Monitor stock and environmental conditions
- Produce algal or live-feed cultures
- Carry out on-farm post-harvest operations
- Harvest cultured or held stock
- Maintain stock culture, holding and other farm structures
- Operate and maintain a recirculating aquaculture system
- Use waders safely in aquatic environments
- Control predators, pests, and diseases
- Feed stock
- Prepare and use aquatic technology
- Identify and report signs of aquatic disease or pests
- Participate in environmentally sustainable work practices
- Assemble and repair damaged netting
- Clean fish
- Fillet fish and prepare portions
- Work with knives
- Prepare, pack and dispatch non-live product
- Prepare, pack and dispatch stock for live transport

¹⁶ <https://training.gov.au/training/details/SFI20119>

- | |
|---|
| <ul style="list-style-type: none">- Apply basic seafood handling and safety practices- Maintain the temperature of seafood- Licence to operate a forklift truck |
|---|

5.3 Eligible roles

ANZSCO Classification System

ANZSCO 8411 (Aquaculture Workers) is at a skill level of 5. Occupations on a skill level of 5 in Australia and New Zealand have the level of skill obtained by an AQF Certificate I, or compulsory secondary education (Australia), NZ Register level 1 qualification, or compulsory secondary education (New Zealand). For some occupations at a skill level of 5 a short period of on-the-job training may be required in addition to formal qualifications. In some instances, no formal qualifications or on the job training may be required. The role of aquaculture workers is to perform routine tasks in breeding and raising of fish and other aquatic stock.

Tasks include:

- feeding and grading of fish – monitoring their growth
- helping with farm layouts and constructing nets, long-lines, and cages
- maintenance of equipment and fish housing
- operation of pumps and other equipment
- testing and checking of water quality
- removal of dead or dying fish
- operation of forklifts and small cranes (lifting equipment)
- harvesting of fish and sorting, packing for transportation
- restocking of pens, pools with juvenile fish
- collection and recording of growth, production and water quality data.

Non-ANZSCO roles

Beyond the ANZSCO classification system, roles identified under the SFI qualifications framework include:

- aquaculture production hand assistant
- aquaculture leading hand
- aquaculture production hand
- aquaculture maintenance worker
- aquaculture business support worker

6. Worker supply and sender country considerations

Section summary	
The Pacific island countries have varying levels of aquaculture production, with Fiji, PNG, the Solomon Islands, and Vanuatu being the largest	<ul style="list-style-type: none"> - Fiji, PNG, the Solomon Islands and Vanuatu have the most developed aquaculture industries of the Pacific PLS countries and are likely the best source of work-ready workers in terms of skills and experience. - Production in both Australia and the Pacific are dominated by marine species, whereas Timor-Leste concentrates on freshwater aquaculture
Timor-Leste has been a recent success story, with aquaculture production having doubled in the last decade	<ul style="list-style-type: none"> - 20 years ago there was virtually no aquaculture in Timor Leste. It has grown from zero to a 100t per annum, with ambitious plans to upscale the industry to 12,000t by 2030. - Significant investment is being made to achieve this goal, including the upskilling of farms, and encouraging new entrants into the industry. - Timor-Leste may represent a solid and growing source of workers for the PLS, and will benefit from returning workers' skills and funds acquired in Australia
Industry data is out of date and prone to error	<ul style="list-style-type: none"> - Whilst fisheries is a major industry in the Pacific, aquaculture is a small component. Any available information was dated and came with caveats in terms of estimation accuracy. Further work should be conducted to determine greater detail on the extent of aquaculture in the Pacific, including skill level of workers.

6.1 Supply of Pacific workers

Generally, statistics regarding employment and the number of aquaculture farms in the Pacific are poor and Pacific-wide industry analysis is out of date. A 2010 report from the Pacific Community (SPC) estimates that there may be over 3,000 persons involved in aquaculture throughout the Pacific countries engaged in the PLS. A further 6,000 persons are engaged in non-PLS countries (Ponia, 2010). The skill and education level of these workers has not been established, anecdotally however, there are little-to-no formal qualifications in the Pacific.

Table 7: Number of farm units and persons involved in aquaculture in the Pacific

	Farm units	Persons
PLS participants		
Fiji	50	280
PNG	2,500	3,000
Sub-total		3,280
Non-PLS participants		
French Polynesia	530	5,000
New Caledonia	40	560
Cook Islands	80	450
Sub-total		6,010
Total	3,200	9,290

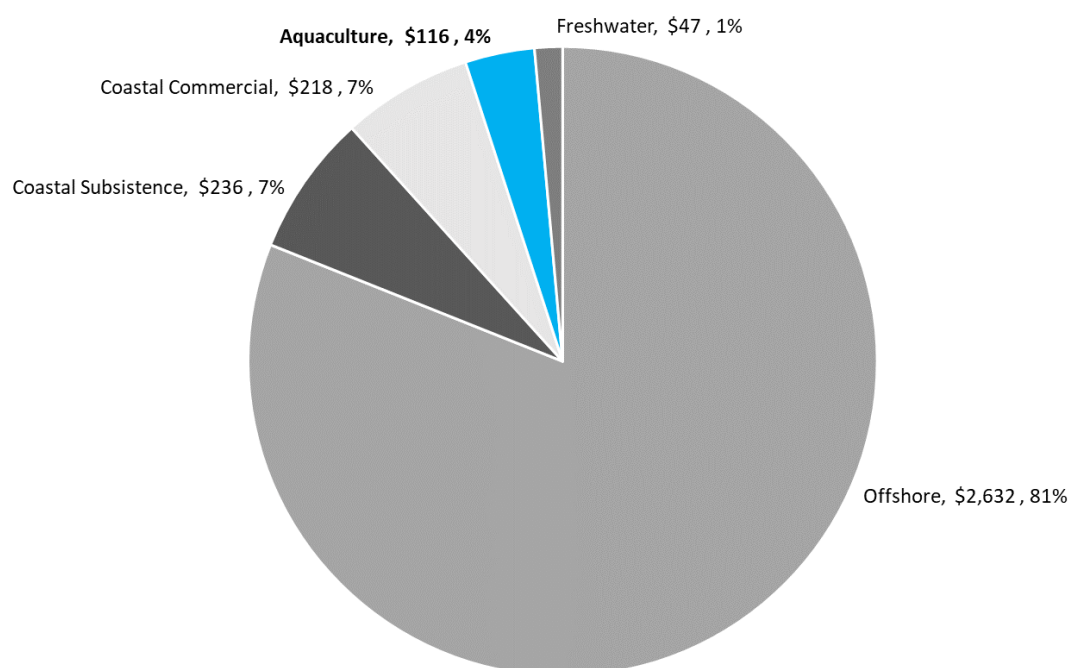
6.2 Synergy with sender country opportunities

Existing formal aquaculture operations in the Pacific

Firstly, it is important to note that the value of aquaculture and fishing in the Pacific is poorly measured. The most recent reliable estimates that could be found date back to 2014. Given the renewed interest in aquaculture throughout the Pacific and potential contributions to economic development, semi-regular assessments of the industry would be valuable.

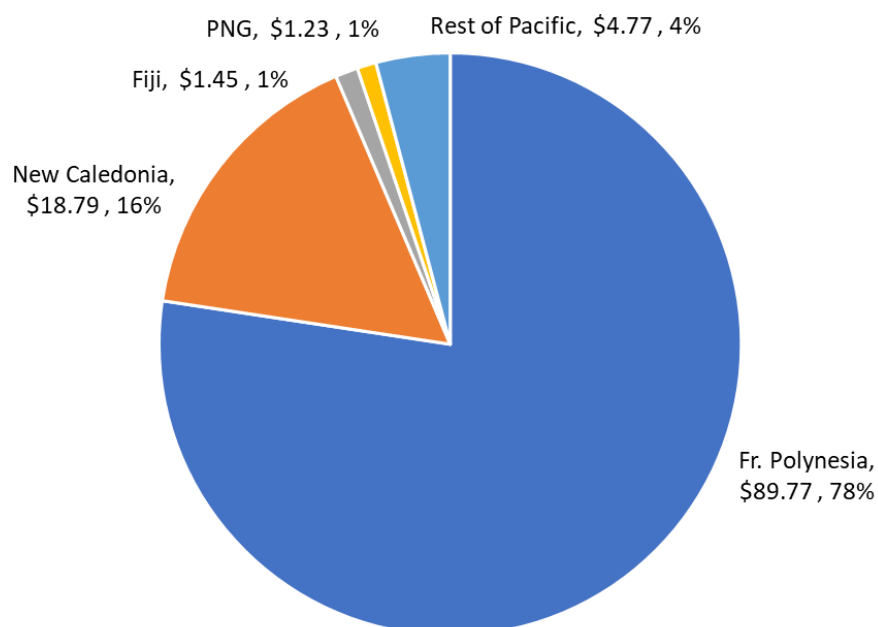
The formal aquaculture sector in the Pacific is small in comparison to the wild-catch fishery operations. As of 2014, aquaculture represented only 4% - or US\$116 million - of total production values. It is also worth noting that three-quarters of the value of offshore fishing was captured by foreign-based operators with no local base.

Figure 18: Value of fisheries production in the Pacific, US\$ million, 2014¹⁷



Of what limited formal aquaculture activities takes place in the Pacific, production is concentrated in only 2 countries – neither of which participate in the PLS. French Polynesia accounts for 77% (primarily pearl) and New Caledonia 16% (primarily prawn) of all aquaculture production in the Pacific. Fiji and PNG both have limited formal production values, with approximately 1% each, with all other countries having little-to-no formal production.

Figure 19: Value of aquaculture production in the Pacific, US\$ million, 2014



¹⁷ Not including Timor Leste

Pilot programs and upcoming developments of interest in the Pacific

Modern aquaculture has been present in the Pacific for over a century, with multiple pilot programs established with varying degrees of success. Recently, given that 90% of the world's fisheries are at capacity or overfished, there has been increased emphasis on aquaculture in the Pacific. New aquaculture developments throughout the Pacific include:

- pearls in Tonga, Fiji, and PNG
- marine ornamentals – regionwide
- prawns in Fiji, Vanuatu, PNG
- barramundi in Vanuatu and PNG.

The Marshall Islands recently had a successful venture exporting threadfin (better known as moi) to Hawaii and is scaling up operations based on early success (Matayoshi & Garcia Gomez, 2017).

At present, the countries with the greatest level of existing aquaculture infrastructure, such as hatcheries and farms are:

- PNG – hatcheries, and a distribution centre
- Fiji – particularly hatcheries
- Kiribati – particularly hatcheries
- Vanuatu – hatcheries and farms
- Samoa - hatcheries, and a distribution centre.

There are also several institutions in the Pacific that provide support to the aquaculture industry:

- University of the South Pacific
- James Cook University
- Queensland University
- Fiji National University
- National Fisheries College (PNG)

Aid funds are helping to grow aquaculture throughout the Pacific. The Pacific Fisheries for Food Security Program, funded by the Australian Aid program, focuses on food security by lifting productivity and rural development through improving livelihoods with sustainable management of fisheries. This program is multifaceted, covering a variety of facets and fishery operations. Two components are specific to aquaculture:¹⁸

- Development of mariculture opportunities. This component aims to support small and medium mariculture operations (saltwater aquaculture) to improve rural livelihoods and reduce pressure on coastal fisheries.
- Support development of inland aquaculture. This component focuses on Melanesia and provides technical advice to overcome production constraints.

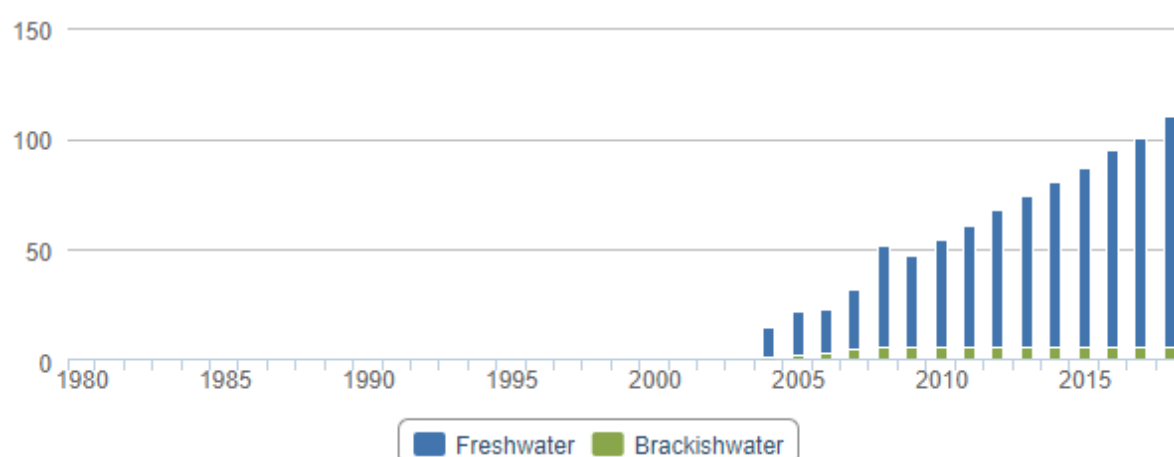
¹⁸ <https://fame1.spc.int/en/projects/fisheries-fo-food-security>

QUT also provides support to the freshwater aquaculture in Fiji and Vanuatu, with trials that started in 2017 in Vanuatu to test economic viability on a small-scale.

Timor-Leste

Aquaculture production has almost doubled over the last decade in Timor-Leste, rising from 45 t per year to 80 t per year. This growth has been driven by the Timor-Leste National Aquaculture Development Strategy (2012-2030), which has an ambitious target of producing 12,000 t of fish by 2030 (National Directorate of Fisheries and Aquaculture, 2012). Globally, this would move Timor-Leste from the 109th largest aquaculture producer to the 70th largest – on par with countries with significantly larger populations and available land¹⁹.

Figure 20: Aquaculture production by culture environment in Timor-Leste, 1980-2018



The Partnership for Aquaculture Development Phase 2 project²⁰, led by WorldFish and funded by NZ Aid, has also made significant contributions to developing the sector. The program has made improvements to the use of technology, induced new entrants into farming, supported hatchery scale-up and production and improved farmer knowledge. As an example, a government-run hatchery now produces 350,000 fingerlings per year, up from 10,000 before the program. Also, a farmer field school for 250 farmers resulted in a tripling of their production between 2017 and 2018 (CGIAR, 2020).

Given the impressive scale up to date, and level of support provided to achieve the 2030 vision for aquaculture, Timorese workers may be an excellent fit to participate in the PLS. The income earned while in the PLS, plus technical skills learned, will likely be a boon to development of the sector in Timor-Leste upon the workers' return home.

Aquaculture potential in the Pacific

The rapid growth of aquaculture in Timor-Leste provides an instructive example of what may be possible across the Pacific. The FAO has reported a 527% growth in aquaculture globally over the last 28 years. Armed with acquired skills and industry knowledge, returning workers, coupled with savings, would be well placed to establish aquaculture businesses in the Pacific.

¹⁹https://data.worldbank.org/indicator/ER.FSH.AQUA.MT?end=2016&most_recent_value_desc=true&start=1960&view=chart

²⁰ <https://www.worldfishcenter.org/content/partnership-aquaculture-development-timor-leste-phase-2>

The Pacific has several natural advantages for aquaculture production (Adams, Bell, & Labrosse, 2001):

- High diversity of species that are in high demand in Asia (sea cucumbers, lobster, oysters, giant clams).
- Proximity to Asia and potential for live seafood export.
- Variety of lagoons which create calm conditions for culture of species.
- Maritime tradition and familiarity with fisheries.

However, there are several barriers to aquaculture in the Pacific (Adams, Bell, & Labrosse, 2001):

- Limited domestic markets – most of the production will need to be exported.
- Transport and logistical problems – high cost of shipping to the Pacific, and limited international air connections.
- Limited infrastructure – including knowledge of workers.
- Fragile reef habitats that are sensitive to nutrient run-off – particularly lagoons.
- Limited freshwater, except for the larger islands of Melanesia. This limits freshwater aquaculture.
- Cyclones – strong winds and swells often damage offshore aquaculture infrastructure.
- Few indigenous species are suitable for aquaculture cultivation and will require introduced species (Amos, Garcia, Pickering, & Jimmy, 2014).
- Limited ability to detect and manage aquatic diseases.

While the industry may be small by Australian standards, the growth potential and potential for economic development of the Pacific justify targeting of the industry for engagement.

7. Industry strategy and workforce growth initiatives

Section summary	
Regulation is a primarily coordinated at a state and territory level	- Although the industry is regulated at the state and territory level, there is some coordination and planning at the national level. A 10-year industry strategy was settled in 2017 to double the industry size in 10 years.
A labour supply gap was identified as a key constraint to growth of the industry	- The National Aquaculture Strategy identified insufficient supply of labour as a key constraint that needed to be addressed through various initiatives including more formal training.
Despite increasing automation, demand for low- and semi-skilled workers is expected to continue	- Labour intensity is reducing in this sector. As new, larger operations are being established, project proponents are typically incorporating as much automation and technology as possible. Nevertheless, the overall industry growth still demonstrates a growing need for semi-skilled labour.

7.1 Australia's National Aquaculture Strategy

Mirroring global trends, total seafood production in Australia is up and almost entirely attributable to aquaculture. As a result, in 2014 the Australian Government initiated a 10-year National Aquaculture Strategy. This work was completed in 2017 and is now in implementation. The National Aquaculture Strategy identified significant growth potential of the industry in Australia, which had started with pearling in the 1850s and was primarily driven by increasing demand for protein and seafood in Asia. The 2017 National Aquaculture Strategy adopted a target of “doubling the value of the aquaculture industry to \$2 billion by 2027”.²¹

The National Aquaculture Strategy noted that aquaculture was a particularly significant activity in regional Australia and that its relative economic importance to state economies as a “growth industry” was greatest in South Australia and Tasmania. The National Aquaculture Strategy adopted 8 priority targets, listed below, one of which related to workforce and the importance of labour supply:

- 1) Promoting an efficient regulatory framework modelled on established best practice that is transparent and removes unnecessary burden on business.
- 2) Maximising the benefits of innovation in aquaculture through targeted research, development, and extension.
- 3) Developing and improving market access for Australian aquaculture products domestically and internationally, capitalising on Australia's clean and green image.
- 4) Understanding and managing the biosecurity risks through a coordinated approach to protect the aquaculture industry and the Australian environment.
- 5) Improving public perception and understanding of Australian aquaculture as a sustainable industry producing safe and healthy products.
- 6) Continuing to improve the environmental performance of aquaculture, including identifying opportunities for optimising environmental performance through adoption of cost-effective strategies.
- 7) Encouraging and promoting investment in Australian aquaculture.
- 8) Improving training and education for the aquaculture workforce and ensuring future employment needs of the industry are met.

7.2 International aquaculture architecture

There is considerable international institutional architecture relating to aquaculture, including both global and Pacific-only organisations. This architecture has developed mainly over the past 10-20 years as the international profile and strategic importance of aquaculture has grown. The box below includes details of some key international organisations that have a brief on aquaculture. More detail on these organisations is in the Appendix.

²¹ National Aquaculture Strategy, 2017, foreword

Table 8: Major International bodies in aquaculture

Organisation	Quick summary
Network of Aquaculture Centres in Asia-Pacific (NACA)	Network of aquaculture research centres from countries in the Asia Pacific.
The (FAME) program of the Pacific Community (SPC)	Pacific region, fisheries department, focus on sustainable aquaculture via SPC Aquaculture program.
WorldFish	Research program, targets countries with low and medium HDIs.
Aquaculture without Frontiers (AwF)	NGO that helps low-income food deficit countries to develop aquaculture on the ground.
FAO	Code of Conduct.
Global Aquaculture Alliance (GAA)	Education/advocacy for aquaculture.
Aquaculture Stewardship Council (ASC)	Certifies and establishes aquaculture Standards.
World Aquaculture Society (WAS)	Organises conferences and journals, has “chapters” around the world.
OECD Committee for Fisheries	Publishes the Review of Fisheries, which analyses major policy developments in OECD countries and emerging economies with large fisheries.

8. Risks assessment

Section summary	
Fluctuations in production, and thus demand for labour, are a regular occurrence in the industry	<ul style="list-style-type: none">- Being a seasonal primary industry with exposure to exports, the industry experiences above average volatility. Seasonal downturns in production and revenue are a frequent occurrence, with likely flow-on effects to the demand for labour.- In terms of labour input, shellfish are particularly seasonal and have higher levels of temporary labour, whereas finfish typically employ more full-time workers.
Industry profitability is low, apart from a handful of large operators	<ul style="list-style-type: none">- Industry profitability is low and 2-tiered. Many small operators have low levels of profitability (and thus a reduced ability to provide training or support to workers), and a small number of large firms dominate in terms of revenue.
The gender imbalance is one of the largest of any industry	<ul style="list-style-type: none">- The industry is heavily dominated by male workers, particularly in lower-skilled roles. It may take some years to see this sector improve the gender balance.

The risks throughout this document have been identified in consultation with various stakeholders including the PLF gender equality, disability and social inclusion (GEDSI) coordinator; monitoring and evaluation manager; demand team; and documentation including the PLF risk register; and the strength and risk assessment document.

8.1 Industry fragility

Multiple sectors are vulnerable to a wide range of factors that can threaten the existence of the sector, or at best the more exposed businesses operating within the sector.

- Diseases – Pacific Oyster Mortality Syndrome (POMS) had a severe impact on the Tasmanian Pacific Oyster sector in the early 2000s, as did ‘white spot’ disease on the Queensland farmed prawn industry (2016- present)
- Political - there is ongoing debate in Tasmania over the expansion of the lucrative salmon farming sector on the west coast and parts of the Huon Valley
- Farming new species - attempts to farm yellow tail kingfish in the Port Lincoln region of South Australia in the early 2000s were not as successful as expected, despite investment over many years of millions of dollars
- Changing demand – COVID-19 has had a severe impact on the ability of the industry to continue to access southeast Asian markets for high-value, perishable products including rock lobster, abalone, live prawns. However, the industry has been able to pivot toward domestic consumers to mitigate some of the impacts.

8.2 Industry profitability

Average industry profit margins are relatively low, however several large operators run at healthy profit margins. The large-scale operators with lower per-unit costs have been able to generate consistent above-average profit margins. Smaller operators, however, have declined in profitability over the past 5 years due to price pressure from cheap imports and rising costs. As a result, industry concentration is expected to increase as smaller operators exit the industry, and larger operators expand production.

Profit levels are one indicator of an operator's ability to provide support, such as paying moving costs or providing training opportunities, to PLS workers. Based on this, larger operators provide greater opportunities, and potentially less variability, for PLS workers.

8.3 Seasonality

Unskilled labour demand in the sector is seasonal in nature, with higher demand for labour occurring in harvest periods, owing to perishability issues. As a result, there is a large turnover of unskilled staff in the sector. In high demand periods, 'backpackers', 'retirees' and other agricultural sector workers that seek employment in the sector usually make up a significant portion of the workforce.

- (Department of Agriculture, Fisheries and Forestry, Australian Government, 2012)

This reliance on seasonal labour differs according to species, and thus location of operations.

Workers in finfish farms, such as salmon in Tasmania or tuna in South Australia, are more likely to be employed full-time and year-round. Whereas more seasonal species such as shellfish require varying labour inputs and thus operators have a greater reliance on part-time and casual workers (Department of Agriculture, Fisheries and Forestry, Australian Government, 2012).

As with much of the data for aquaculture, it has been difficult to disaggregate aquaculture from the broader fisheries industry. While this report has not ascertained a precise number, the proportion of the total workforce that are temporary migrants is understood to be high.

Species that require more intensive and variable labour inputs may be better suited to the SWP. Whereas species that have more consistent demand for labour may be better suited to the PLS. The below table outlines the species that have more and less variability in their demand for labour. This list is indicative only and should be confirmed with the prospective employer as the demand for labour will be partially dependent on their farm setup.

Table 9: Indicate seasonal demand for labour throughout the production cycle

More seasonal demand	Less seasonal demand
Shellfish, such as <ul style="list-style-type: none">- crab- lobster- prawn- oyster	Finfish, such as <ul style="list-style-type: none">- salmon- barramundi- tuna

8.4 Experience with migrant workers

As with much of the data for aquaculture, it has been difficult to disaggregate aquaculture from the broader fisheries industry. While this report has not ascertained a precise number, the proportion of the total workforce that are temporary migrants is understood to be high. In an ABARES survey of the aquaculture industry, it was noted that operators were increasingly turning to overseas applicants due to difficulties in recruiting domestic workers (Department of Agriculture, Fisheries and Forestry, Australian Government, 2012). Thus, the industry is considered familiar with the use of migrant labour.

8.5 Opportunities for women

The aquaculture industry (excluding post-harvesting operations) is almost 80% dominated by males, one of the most male-dominated gender ratios in any Australian industry. Further, aquaculture workers specifically, rather than the broader seafood industry, are approximately 95% male, with an average age of 23. This may result in biases within industry culture and present difficulties when putting forward women candidates.

8.6 Structural changes and technology adoption

The industry has benefited significantly from technological advances – such as improved pens, remote and real-time monitoring, feed production, genetics, husbandry practices and disease control. This has resulted in significant improvements to production values without the need to utilise greater amounts of labour.

Despite this technological shift, demand for low- and semi-skilled labour is expected to continue given the difficulties in sourcing domestic labour for a low-paid and rural industry. The aquaculture projects currently under development will increase demand for low- and semi-skilled in clustered areas -particularly northern regional Australia.

Table 10: Risk assessment summary

Risk	Impact	Risk	Treatments
Major health and safety incident of a worker	Death or serious injury of a worker. The PLS may also suffer reputational damage as a result.	Low	Avoid high risk operations such as crocodile farms.
Insufficient working hours to meet the 30-hour minimum because of seasonal fluctuations	Reduced worker earnings and presumably a corresponding reduction in savings and remittances.	High	Concentrate on non-seasonal species such as finfish, or larger employers who are able to re-locate workers
Insufficient number of placement opportunities due to industry size	Reduced size of industry cohort and lower return on PLF resources.	High	200 -500 FTE workers (excluding post-harvesting operations)
Decline in industry demand for workers - temporary	Mass redundancies of workers that will require redeployment and potentially be returned to the Pacific.	Medium	Focus on reputable employers with robust businesses. However, like all seasonal industries with an export focus, demand for workers will fluctuate.
Decline in industry demand for workers – long term (structural)	Increased production efficiency, such as through automation, reduces the demand for workers permanently	Low	Growth prospects for aquaculture appear positive. While technology improvement is expected to reduce demand for some skillsets, demand for low and semi-skilled workers is expected to continue for the foreseeable future.

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Appendix A: Aquaculture policies by jurisdiction

Jurisdiction	Key policies and programs	Major initiatives and investments
Qld	<p>Aquaculture is identified as one of Queensland's growing food and agribusiness export industries in the Queensland Trade and Investment Strategy 2017–2022.</p> <p>In 2016–17, aquaculture was a \$120 million industry, employing more than 530 Queenslanders full-time.</p> <p>The Qld Government is creating terrestrial Aquaculture Development Areas (ADAs) to encourage the growth of a sustainable aquaculture industry, including the development of assessment codes and regulatory conditions for each ADA. These were announced in January 2019. The aim is to facilitate approvals processes for investment.</p> <p>Other recent policy developments:</p> <ul style="list-style-type: none"> - Policy for the allocation of marine aquaculture authorities - developed to establish a transparent pre-assessment process for future aquaculture development applications throughout Queensland. - Great Sandy regional marine aquaculture plan (GSRMAP) - guides assessment and management of future applications for non-intensive marine aquaculture within the boundaries of the Great Sandy Marine Park. 	<p>6 ADAs have been created in central and north Qld. The largest ADAs (by hectares) are in Rockhampton and Mackay Regional Councils.</p> <p>A 2018 mission to Singapore promoted aquaculture opportunities in the Rockhampton region to potential investors.</p>
SA	<p>South Australia has a well-established and diverse marine and land-based aquaculture sector. Its aquaculture industry is currently valued at AUD\$211 million. Around 4,000 ha is currently allocated and being farmed in SA, and the industry employs around 2,019 people.</p>	<p>A total of 8 new separate aquaculture zones are being established around the Eyre Peninsula, west of Adelaide, adding to the existing 10 zones already established. The largest will be in the vicinity of Port Lincoln, at the peninsula's tip, where 5,000ha has been allocated for farming wild tuna and algae.</p>

	<p>In 2019, the SA Government announced longer terms for aquaculture leases, extending them from 20 to 30 years (see https://www.growthstate.sa.gov.au/news/longer-leases-delivered-for-the-aquaculture-sector).</p> <p>Recently, in March 2020, the SA Government announced it is opening up more than 6,500 ha of coastline/unallocated water for aquaculture production and establishing aquaculture zones.</p>	<p>Applications for licences have been invited and will be assessed by the Aquaculture Tenure Allocation Board (ATAB) against a range of criteria, including operating in an environmentally sustainable way and demonstrating commitment to the regional economy.</p>
NSW	<p>Oyster aquaculture (Sydney Rock, Pacific, and Native Oysters) is conducted in 31 estuaries along the NSW coast utilising approximately 3,000 ha of leases. Farmed tiger prawns, silver perch, rainbow trout, murray cod, mulloway and barramundi are key production species in New South Wales. There is also a well-developed freshwater finfish hatchery sector, worth more than \$2 million annually.</p> <p>In a 2020 report, NSW Department of Primary Industries (DPI) estimates that aquaculture contributes over \$80 million to the NSW economy and provides over 1700 jobs in regional areas.²²</p> <p>Aquaculture in New South Wales is traditionally managed under the</p> <ul style="list-style-type: none"> - NSW Land Based Sustainable Aquaculture Strategy - NSW Oyster Sustainable Aquaculture Strategy 	<p>A review of the NSW Land Based Sustainable Aquaculture Strategy is underway in 2020. The aim is to "align the policy with industry best practice and management standards and update amendments to relevant legislation and policies". The review process will be overseen by the NSW.</p> <p>State Aquaculture Committee, which comprises senior representatives of all key government agencies. As of August 2020, DPI is finalising agency input before industry consultation then broader community consultation.</p> <p>A review of the oyster industry strategy in 2015 resulted in an increase in lease tenure, from 15 to 30 years, to allow for greater access to bank finance and business security and it was established that all lease-based permit holders should complete a commercial farm development plan that will assist DPI to better manage the productive use of leases.</p>

²² A report on the social and economic value of the NSW aquaculture industry found that the value is much higher (\$226 million) when linkages with the regional economy and regional tourism are taken into account (<https://www.uts.edu.au/about/faculty-arts-and-social-sciences/research/fass-research-projects/social-science-fisheries/social-and-economic-evaluation-nsw-coastal-aquaculture>).

	<p>Both strategies detail approvals processes and advice on best aquaculture practice. More recently, in 2018, a Marine Waters Sustainable Aquaculture Strategy was established to complement the Oyster and Land Based Aquaculture Strategies. It provides a regulatory and industry best practice framework for marine aquaculture, with the aim of avoiding “ad hoc aquaculture industry development in NSW waters, which may be at unsuitable locations or using technologies and approaches that are not optimal”.</p> <p>Aquaculture is managed by DPI. There are 2 statutory advisory bodies, the Shellfish Committee, and the Aquaculture Committee, that support DPI in managing aquaculture.</p>	
Vic	<p>In Victoria, aquaculture is managed under the <i>Fisheries Act (Victoria) 1995</i>, which provides for the management, development and promotion of an ecologically sustainable and viable aquaculture industry. Victorian aquaculture takes place in offshore, coastal, and inland facilities. Species produced are trout, abalone, blue mussel, aquarium finfish, Murray cod, barramundi and yabby. The industry was valued at \$25 million in 2013-14 (see Strategy 2017-22), accounting for around 3% of Australian aquaculture production (ABARES 2015).</p> <p>There are 12 aquaculture reserves (2 land based and 10 offshore) set aside for the purpose of aquaculture.</p> <p>Planning Guidelines for Land Based Aquaculture govern land-based aquaculture in Victoria.</p>	<p>The Vic Aquaculture Strategy 2017-22 was developed by the Victoria Fisheries Authority and provides a blueprint to guide public and private sector investment for the industry.</p> <p>The Vic Government tendered marine aquaculture sites in Port Philip Bay and Western Port in 2017; leases were for 21 years for these sites.</p>

WA	<p>The total value of Western Australia's commercial fisheries and aquaculture production in 2017–18 was \$633 million, with pearling contributing \$52 million and aquaculture \$27 million. Western Australia's fisheries and aquaculture production value is highly dependent on rock lobster, which in 2017–18 accounted for \$438 million, or 69%, of the total.</p> <p>Many different species are produced including yellowtail kingfish, barramundi, abalone, mussels, marron, silver perch, rainbow trout, yabbies and oysters. Emerging sectors with capacity for growth in Western Australia include coral, kelp, seaweed and artemia production.</p> <p>The Department of Primary Industries and Regional Development (DPIRD) is responsible for regulating aquaculture in Western Australia. DPIRD also operates brood stock and restocking production facilities, conducts applied research and development, and has worked with the South Metropolitan TAFE (SMTAFE) to provide aquaculture training since 1989.</p> <p>Between 2017 and 2020, DPIRD has been developing an Aquaculture Development Plan for Western Australia to address barriers to, and build strong foundations for, the development of aquaculture in Western Australia. The plan provides targets for short-, medium-, and long-term growth over the next 10 years. A draft plan has been released in May 2020 for comment.</p>	<p>The WA Government has established 2 Aquaculture Development Zones in the Kimberley (2014) and mid-west (2016) regions. A third south coast development zone is planned as noted below.</p> <p>The development zones provide investment-ready platforms for commercial development with environmental approvals secured. The Kimberley and mid-west zones are for marine finfish production; other zones may focus on alternative species in future. A total of \$1.85 million in funding was provided by the government to establish the 2 zones.</p> <p>Significant initiatives and investments since 2017:</p> <ul style="list-style-type: none"> - Declaration of the Mid-West Aquaculture Development Zone, which has since been fully allocated. - Provision of \$7 million for the construction and operation of a marine finfish nursery in Geraldton. - In partnership with Aquaculture Council of Western Australia, the WA Government has established the Albany Shellfish Hatchery, which is operational and delivering spat to the growing shellfish industry. - Commenced the development of a South Coast Aquaculture Development Zone near Albany and Esperance. - Upgraded the Watermans Bay Fish Health Laboratory at DPIRD to provide improved fish health research and development and support services (\$1 million).
Tas	<p>Aquaculture policy varies depending on whether it's marine farming or conducted in inland waters.</p>	<p>The Sustainable Industry Growth Plan for the Salmon Industry (Dec 2017) details the Government's vision and priorities for the industry. It establishes "grow" and "no grow" zones for salmon farming; the focus is on future expansion moving into oceanic (deeper and high-energy)</p>

<p><i>Marine farming</i></p> <p>Marine farming aquaculture is one of Tasmania's major industries. Species farmed in Tasmania include salmonids, oysters, mussels, abalone, seahorses, and seaweeds. The gross value for aquaculture production in Tasmania for 2018-19 was \$832.9 million.</p> <p>The industry is regulated by the Department of Primary Industries, Water and Environment (DPIPWE) under the <i>Living Marine Resources Management Act 1995</i> and the <i>Marine Farming Planning Act 1995</i>. DPIPWE prepares marine farming development plans (MFDPs) that establish zones where marine farming leases may be granted. The MFDPs also specify the maximum leasable area for each zone, the species of fish (finfish, shellfish, seaweed, or other species) that may be farmed in the zone and operational constraints on marine farming activities in the form of management controls.</p> <p>In the case of finfish farming, a holder of a marine farming licence also requires a separate environmental licence, administered by the Environment Protection Authority (EPA).</p> <p><i>Aquaculture in inland waters</i></p> <p>Aquaculture conducted in inland waters is managed by the Inland Fisheries Services (IFS) under the <i>Inland Fisheries Act 1995</i>. This includes the operation and biosecurity of freshwater hatcheries. Little information is available on the IFS website. However, its annual report for 2019-20 states that as of June 2020, there were 16 salmonid fish farm licences, as well as one eel farm and 10 aquarium fish licences.</p>	<p>waters, rather than estuarine waters (p. 5 of the plan). The Plan also examines ways to support industry growth, and to improve the efficiency, effectiveness and transparency of the industry's environmental regulation, and the effectiveness of its biosecurity systems.</p> <p>A one-year review took place in January 2019. The focus was on Increased compliance and monitoring activities and a zero-tolerance approach to marine debris.</p>
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NT	<p>In the Northern Territory, the following species are being farmed or researched as possible opportunities: barramundi, giant clams, ornamental plants and fish, pearl oysters, sea cucumber, black-lipped oysters.</p> <p>Licences are required for commercial aquaculture facilities defined as those with aquaculture a total water volume exceeding 10,000 litres. A separate licence is required for ornamental aquaculture (for small-scale aquarium hobbyists). The Aquaculture branch of NT Fisheries is responsible for policy under the <i>NT Fisheries Act 1988</i> and regulations. The Northern Territory states its allegiance to the National Aquaculture Policy.</p> <p>The NT government estimates that fishing and aquaculture are currently valued at AU\$120 million per year and considers that there are significant opportunities for expansion to meet growing market demand.</p> <p>The government operates the Darwin Aquaculture Centre (DAC), dedicated to assisting the research and development of aquaculture ventures. The Northern Territory Aquaculture Strategic Plan 2011-2015 details the current direction of aquaculture research; it is currently under review.</p>	<p><i>Northern Australia Aquaculture Study</i></p> <p>A study by the James Cook University scientists and the Cooperative Research Centre for Developing Northern Australia (CRCNA) examined challenges and opportunities facing the northern Australian aquaculture sector. The 12-month, \$420,000 project was completed in April 2020. It was completed in collaboration with key industry players, from organisations including JCU, CSIRO, Blueshift Consulting, Australian Barramundi Farmers Association (ABFA), Australian Prawn Farmers Association (APFA) and the Indigenous Land Corporation (ILC).</p> <p>The report found that there is a large opportunity for aquaculture industry development in Northern Australia, with estimates of 500,000 and 700,000 ha suitable for marine farming in earthen and lined ponds, respectively. For freshwater pond culture, suitable areas are up to 50-fold larger. Seven strategic recommendations addressing key identified challenges to industry development are included in the report.</p>
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Appendix B: Aquaculture peak industry entities by jurisdiction

Jurisdiction	Peak Bodies
Qld	<ul style="list-style-type: none"> - Aquaculture Association of Queensland (AAQ): for producers of freshwater finfish and crayfish. - Queensland Crayfish Farmers Association (QCFA) for redclaw crayfish farmers <p>Relevant national bodies to which Qld producers belong depending on species produced:</p> <ul style="list-style-type: none"> - Australian Prawn Farmers Association (APFA) -for prawns - Australian Barramundi Farmers Association (ABFA) for Barramundi
SA	South Australian Aquaculture Council (SAAC)
NSW	<p>Aqua Association Incorporated</p> <p>Previously NSW Aquaculture Association (for land-based aquaculture)</p> <p>nswaqua.com.au</p>
Vic	<p>Victorian Trout Farmers Association</p> <p>Victorian Abalone Growers Association</p> <p>Victorian Eel Fishermen's Association</p> <p>Victorian Marine Farmers Inc.</p> <p>Australian Freshwater Crayfish Growers Association (Vic.)</p>
WA	Aquaculture Council of WA
Tas	<p>Tasmanian Seafood Industry Council</p> <p>Tasmanian Salmonid Growers Association</p> <p>Australian Abalone Growers Association</p>
NT	<p>National bodies:</p> <p>Australian Barramundi Farmers Association (ABFA)</p>

	<p>Australian Prawn Farmers Association (APFA)</p> <p>Indigenous Land Corporation (ILC) is relevant in this space</p>
National	<p>National Aquaculture Council</p> <p>Australian Abalone Growers Association</p> <p>Australian Barramundi Farmers Association (ABFA)</p> <p>Australian Prawn Farmers Association (APFA)</p>

Appendix C: National Agriculture Labour Advisory Committee

A National Agricultural Workforce Strategy has been developed by the National Agricultural Labour Advisory Committee and submitted to the Australian Government in late 2020 for consideration. The government is considering the recommendations of the strategy and will respond in due course. The committee consulted with a wide range of stakeholders to inform the development of the strategy.

The strategy aims to ensure farmers have access to a fit-for-purpose workforce at the right place, at the right time of the season. The terms of reference included the aquaculture workforce.

On 11 December 2019, Senator the Hon Bridget McKenzie, Minister for Agriculture, announced the membership of the National Agricultural Labour Advisory Committee.

Agricultural Labour Advisory Committee members:

- Mr John Azarias (Chair) – Public policy specialist, NSW
- Professor Ruth Nettle (Deputy Chair) – Leader of Rural Innovation Research Group, University of Melbourne, Vic
- Mr John Williams (Deputy Chair) – Former NSW Senator, NSW
- Mr Will Barton – CEO of Gundagai Meat Processors, NSW
- Industry Professor Hermione Parsons – Director of the Institute for Supply Chain and Logistics, Deakin University, Vic
- Mr Geoff Richards – Managing Director of Richgro Garden products and former Chair of Agrifood Skills Australia, WA
- Dr Angeline Achariya – Executive Director of Innovation and Growth at Simplot Australia, VIC
- Ms Julie Aldous – Rural educator, Vic
- Associate Professor Jacki Schirmer – Health Research Institute and the Institute for Applied Ecology, University of Canberra, ACT
- Mr Robert Hinrichsen – Owner/Director of Kalfresh, QLD
- Mr Clayton Nelson – Senior Executive at Austral Fisheries, WA

The committee focused its consultations on:

- education providers
- rural research and development corporations
- industry representatives
- governments
- producers
- grower and farm systems groups
- processors and retailers.

The committee received more than 100 written submissions on its National Agricultural Workforce Strategy discussion paper.

Appendix D: Major aquaculture projects in Australia

TASMANIA

Rock lobster hatchery pilot-scale project at the IMAS research laboratory (\$10 million)

In April 2020, a development application for a pilot scale rock lobster hatchery project was submitted. The Tasmanian hatchery would be a world first. It involves a partnership between University of Tasmania and Ornatas. The proposed hatchery would be located at Tarooma, in Kingsborough Council, co-located with the Institute for Marine and Antarctic Studies (IMAS). Development is planned over the next 3 years. When the Tasmanian hatchery is operational, the juvenile lobsters will be transported to Ornatas's onshore grow-out facility in Townsville, Queensland. It is expected that 10 new permanent positions will be created at the site to support hatchery operations – mostly at a very high skill level. The indicative budget for this project is \$10m.

QUEENSLAND

The Qld Government is creating terrestrial Aquaculture Development Areas (ADAs) to encourage the growth of a sustainable aquaculture industry, including the development of assessment codes and regulatory conditions for each ADA. These were announced in January 2019. The aim is to facilitate approvals processes for investment. Six ADAs have been created in central and north Qld. The largest ADAs (by hectares) are in Rockhampton and Mackay Regional Councils.

Tassal Group - Exmoor Station Project and Proserpine Expansion (\$257 million combined)

Two coordinated projects in the Mackay-Whitsunday region, announced and approved August 2020, involve an \$85 million expansion of an existing facility near Proserpine, and a \$172 million project at Exmoor Station, north west of Mackay. The Exmoor Station Prawn Farm is proposed to be built within the Mackay aquaculture development area (ADA). Exmoor Station would deliver the state's largest land-based aquaculture facility with state-of-the-art hatchery, nursery, and processing facilities.

Guthalungra Aquaculture Project (\$100m)

This project is a \$100m prawn farm on an 800 ha site adjacent to Elliot River in Qld's Whitsunday region. Key features include:

- 259 aquaculture ponds covering 260 hectares
- 370-megalitre seawater storage pond
- 47-ha discharge remediation area
- intake and discharge water pipelines to Abbot Bay, approximately 5.5 km long
- freshwater storage pond and water reticulation system
- seafood processing facilities.

It will create 220 jobs once operational. The press release notes that Guthalungra is a \$100 million project that will generate 2,700 t of North Queensland black tiger prawns annually.²³ It is the second North Queensland aquaculture project for Pacific Reef Fisheries, who are already operating a facility in Ayr.

SOUTH AUSTRALIA

In March 2020, the SA Government announced it is opening up more than 6,500 ha of coastline/unallocated water for aquaculture production and establishing aquaculture zones. A total of 8 new separate aquaculture zones are being established around the Eyre Peninsula, west of Adelaide, adding to the existing 10 zones already established. The largest will be in the vicinity of Port Lincoln, at the peninsula's tip, where 5,000ha has been allocated for farming wild tuna and algae. Applications for licences have been invited and will be assessed by the Aquaculture Tenure Allocation Board (ATAB) against a range of criteria, including operating in an environmentally sustainable way and demonstrating commitment to the regional economy. The call for applications closed on 8 May 2020.

WESTERN AUSTRALIA

The WA Government is establishing a South Coast Aquaculture Development Zone, near Albany and Esperance, following the established of 2 other zones in the Kimberley (2014) and mid-west (2016) regions. The development zones provide investment-ready platforms for commercial development with environmental approvals secured. Other major projects:

- Provision of \$7 million for the construction and operation of a marine finfish nursery in Geraldton.
- In partnership with ACWA, the WA govt has established the Albany Shellfish Hatchery, which is operational and delivering spat to the growing shellfish industry.
- Upgraded the Watermans Bay Fish Health Laboratory at DPIRD to provide improved fish health research and development and support services (\$1 million).

NORTHERN TERRITORY

Humpty Doo Barramundi, \$48.4 M expansion funded by NAIF and ANZ Bank²⁴

Humpty Doo is a barramundi aquaculture farm in Northern Australia that produces 3,600 t of saltwater barramundi. The farm is built on what was once degraded rice fields halfway between Darwin and Kakadu on the Adelaide River. The farm's environmental credentials were recognised in

²³ <https://www.felix.net/project-news/tassal-groups-257m-aquaculture-projects-to-create-1000-jobs-for-qld>

<https://www.statedevelopment.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects/completed-projects/guthalungra-aquaculture> - last updated July 2020

²⁴<https://naif.gov.au/media-releases/naif-announces-stage-2-of-humpty-doo-barramundi-funding/>;
<https://aicd.companydirectors.com.au/membership/company-director-magazine/2020-back-editions/april/behind-the-surprising-success-of-the-humpty-doo-barramundi-farm>;
<https://www.australianmanufacturing.com.au/130683/humpty-doo-barramundi-to-invest-48-4m-in-aquaculture-infrastructure>

2020 when it won the Australian Government Landcare Farming Award at the NT Landcare Awards. In October 2020, Humpty Doo received \$24.2m funding from the North Australia Infrastructure Facility (NAIF) matched by ANZ Bank, to invest in aquaculture infrastructure. The farm is investing a total of \$58m in a purpose-built hatchery for saltwater barramundi, plus the Northern Territory's first automatic fish feed and storage facility to meet growing domestic and international demand for barramundi. The plan is to quadruple production over the next 5 years.

VICTORIA

\$70M Fish Farm at Avalon, project partners Pelligra & Danish company, Aqua-Partners ApS

Melbourne-based developer Pelligra has acquired more than 560 ha of land near Avalon Airport and Geelong from ASX-listed Ridley Corporation, with plans to develop the infrastructure to support a variety of aquaculture projects.²⁵ The first of these projects will be a \$70 million land-based sustainable fish farm to be developed at the 96-ha Avalon site by the Melbourne-based offshoot of Danish aquaculture company Aqua-Partners ApS. The facility will initially process up to 2400 t of fresh seafood, including barramundi and ocean trout, with the capacity to expand to 12,000 t a year.

Latrobe Valley Aquaculture Feasibility Study - Australian Paper and MainStream Aquaculture, Latrobe Valley Authority²⁶

Australian Paper, MainStream Aquaculture and Latrobe Valley Authority will conduct a \$1.24 million feasibility study to construct a state-of-the-art aquaculture facility for farming barramundi in the Latrobe Valley. MainStream Aquaculture is a vertically integrated producer and supplier of premium barramundi. The company operates the largest aquaculture facility of its type in the world and exports into 24 countries across 5 continents. As part of the feasibility study, Mainstream Aquaculture and Australian Paper will conduct due diligence on the technical, commercial, social, and environmental aspects of the project plus preliminary design and engineering, for the recirculating aquaculture system (RAS) plant. The facility would be located close to Australian Paper's Maryvale Mill and utilise fresh water supplies. Maryvale has complementary infrastructure capacity to supply water-heating, oxygen generation and water treatment services. Latrobe Valley Authority provided \$800,000 in funding towards the feasibility study, expected to be finalised by mid-2020.

²⁵ <https://www.afr.com/property/commercial/pelligra-acquisitions-to-kick-start-victorian-aquaculture-projects-20201009-p563lx>

²⁶ <https://lva.vic.gov.au/news/developing-an-aquaculture-industry-in-latrobe-valley>

Appendix E: International aquaculture institutional architecture

Network of Aquaculture Centres in Asia-Pacific (NACA)

As the name implies, NACA is an intergovernmental organisation that forms a network of aquaculture research centres from countries in the Asia Pacific. Participating countries include Australia, Bangladesh, Cambodia, China, Governance, Hong Kong SAR, India, Indonesia, Iran, Lao PDR, Malaysia, Maldives, Myanmar, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam. NACA promotes rural development through sustainable aquaculture and aquatic resources management. It seeks to improve the livelihoods of rural people, reduce poverty and increase food security. NACA implements development assistance projects in partnership with research centres, governments, development agencies, farmer associations and other organisations. The NACA Secretariat is based in Thailand.

SPC Fisheries, Aquaculture and Marine Ecosystems (FAME) and SPC Aquaculture

FAME is a division of the Pacific Community (SPC). It provides SPC member countries and territories with the information to make informed decisions on the management and development of their aquatic resources and help to provide the tools and strengthen the capacity needed to implement these decisions. Its focus is the sustainable management of marine resources. It involves 2 programs, the Oceanic Fisheries Programme and the Coastal Fisheries Programme. Aquaculture is managed under the Coastal Fisheries Programme of FAME.

WorldFish

WorldFish is an international, non-profit research organisation that aims to reduce hunger and poverty by improving fisheries and aquaculture in developing countries in (Asia, Pacific, Africa). It focuses on fish and aquaculture because it considers sustainable, productive fisheries and aquaculture improve food and nutrition security, increase income and improve livelihoods, promote economic growth, and protect our environment and natural resources. WorldFish's Sustainable Aquaculture research program targets countries with low and medium Human Development Indicators and high dependence on fish for food; where aquaculture is in early stages of development but needs accelerated growth to fill projected shortfalls; or where aquaculture is already established but opportunities exist to sustainably intensify to the supply levels required to meet growing domestic or regional demand.

AwF-Aquaculture without Frontiers

AwF is an NGO that aims to teach people how to farm fish to feed themselves and generate incomes to reduce poverty. Its activities are concentrated in low-income food-deficit countries (LIFDCs) and in the poorest regions of other developing and transition countries. Typical activities conducted by AwF include:

- Promoting and introducing practical techniques for small-scale responsible aquaculture.
- Demonstrating appropriate technology for farm construction and operation, including responsible resource use and integration with other income and food generating activities
- Assisting in product development, sales and marketing for consumption.

- Providing technical and management training for new and existing small-scale farmers, farm workers, extension workers, and agencies (including other NGOs) working to develop aquaculture.

Food and Agriculture Organization of the United Nations

FAO has established a Code of Conduct for Responsible Fisheries, which:

- promotes sustainable aquaculture development, especially in developing countries, through better environmental performance of the sector, through health management and biosecurity
- provides regular analysis and reporting of aquaculture development status and trends at global and regional levels, sharing knowledge and information
- develops and implements efficient policies and legal frameworks which promote sustainable and equitable aquaculture development with improved socio-economic benefits.

The Sub-Committee of Aquaculture provides a forum for consultation and discussion on aquaculture. FAO also advises the Committee on Fisheries (COFI) on technical and policy matters related to aquaculture and the work to be performed by the organisation.

Global Aquaculture Alliance

GAA's focus is on aquaculture education and advocacy. Its mission is to promote responsible aquaculture practices through education, advocacy and demonstration. It aims to support science-based research on issues related to aquaculture, and is working in conjunction with leading experts in the fields of aquaculture and distance education to provide training and educational materials to the public. It recently launched an online educational platform "Global Aquaculture Academy".

Aquaculture Stewardship Council

The ASC is responsible for certifying environmentally and socially responsible seafood. It is an independent, international non-profit organisation, with head offices in the Netherlands and the UK. The ASC Standards are developed in line with FAO guidelines. The ASC works with scientists, conservation groups, NGOs, aquaculture producers, seafood processors, retail and food service companies and consumers to recognise and reward responsible aquaculture.

World Aquaculture Society

WAS is an aquaculture association with around 3,000 members in about 100 countries. It has chapters in the United States, where it commenced, and in Japan, Korea, Latin American and Caribbean region, the Asian-Pacific region, and most recently it established an African chapter. It organises annual meetings of the World Aquaculture Society, which it states are "the premier aquaculture conferences and exhibitions bringing together a wide variety of aquaculturists from the commercial, academic and government sectors". The WAS also publishes the Journal of the World Aquaculture Society, a bi-monthly scientific journal which contains high-quality, peer-reviewed, scientific papers covering the range of aquaculture topics, and the World Aquaculture Magazine which provides a quarterly source of articles on aquaculture and news of interest to WAS members.

OECD Committee for Fisheries

The Review of Fisheries is the OECD Committee for Fisheries' flagship report. It aims to support policy makers and sector stakeholders in their efforts to deliver sustainable and resilient fisheries.

Based on data reported by governments, the *Review* analyses major policy developments in OECD countries and emerging economies with large fisheries and suggests priorities for action at national and international levels.