

# Shaping FRDC's 2020–25 R&D Plan



FRDC

# Imprint

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# Shaping FRDC's 2020–25 R&D Plan

## Through the windscreen and rear-view mirror

The FRDC operates in a complex landscape (Figure 1). Strategic planning is all about keeping one eye on the road ahead and one eye on the rear-view mirror. To know where we are going, we must also understand our present position and where we have been.

Shaping FRDC's 2020–25 R&D Plan summarises what we can see in both our windscreen and rear-view mirror. Together, these two views have informed this plan. Looking behind provides our situational analysis, which summarises the historical performance of each of the five sectors (commercial wild-catch, aquaculture, Indigenous, recreational and post-harvest) that together comprise Australia's fishing and aquaculture community. This information provides context, describing dynamics that have led to where we are now. An extensive consultative process involving scenario planning was used to evoke collective concepts of what the future might bring and how to prepare.

It is important to get the proportions right in our planning. There is a reason the rear-view mirror is small and the windscreen is large: we cannot change the past, but the future is ours to invent.

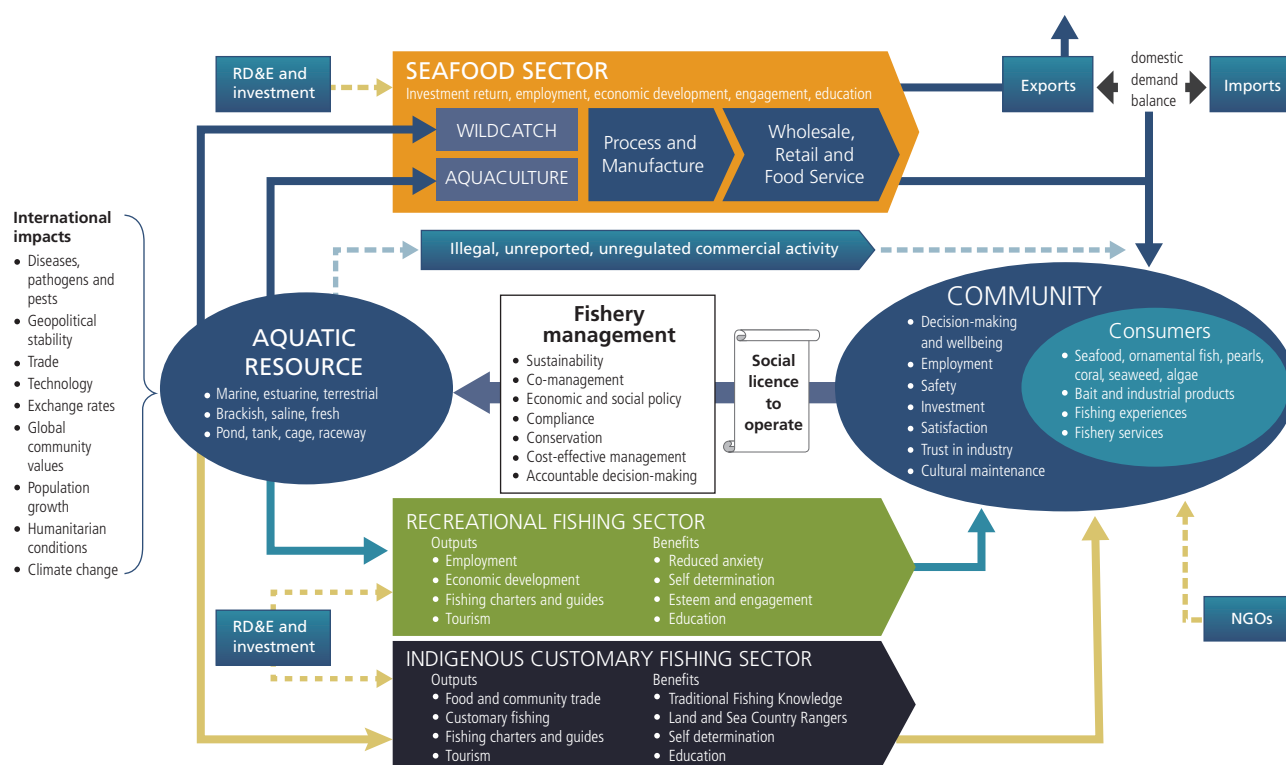


Figure 1. Visual representation of the fishing and aquaculture landscape in 2019. (Source: Colquhoun et al., in press)

## Looking back: key statistics

### Production and catch

- Australia's seafood sector supplied **255,304 tonnes of seafood in 2016-17**.
- In **2000-01**, when the most recent national survey was completed, recreational fishers harvested approximately 60.4 million finfish, 11.5 million small baitfish, 6.1 million crabs and lobsters, 47.7 million prawns and yabbies, 1.8 million cephalopods, 7.2 million other molluscs, and 1.2 million other taxa. Release rates varied from 81.8 per cent for sharks and rays, to 3.8 per cent for squid and cuttlefish.
- A survey of Indigenous fishing in **2000-01** as part of the **National Recreational and Indigenous Fishing Survey (NRIFS)** reported approximately 37,000 of the Indigenous people living in northern Australia (92 per cent of the northern Indigenous population) harvested approximately 900,000 finfish, including mullet, catfish, tropical snapper, bream and barramundi from mainly inshore and coastal waters.

### Participation and jobs

- More than **3.4 million Australians** have fun fishing every year with friends and family.
- Approximately 105,442 Australians are employed in the commercial wild-catch, aquaculture and recreational fishing industries in Australia.<sup>1,2</sup>
- Based on the last **NRIFS** undertaken in 2000-01, Henry and Lyle (2003) estimated that approximately 186,200 Indigenous people (excluding those living in Torres Strait) participated in non-commercial fishing in 2000-01.

### Value and benefit

- The **gross value of production for Australia's seafood** sector in 2016-17 was \$3.1 billion, comprising \$1.7 billion for commercial wild-catch and \$1.3 billion for aquaculture.
- Combined, commercial wild-catch and aquaculture are worth **\$5.3 billion** to the national economy.
- Total expenditure by Indigenous fishers in 2000-01 was estimated at \$22.5 million.
- In 2013, recreational fishing was estimated to have an annual economic value of **\$2.56 billion** based on expenditure.
- Australians **consumed 357,623 tonnes of seafood** in 2016-17.
  - Australians **consume 14.5 kilograms of seafood on average per year**, ranking behind poultry, beef, veal and pig meat, but above sheep and lamb.
- Studies show that ability to access **customary fisheries can have profound impacts** for the cultural, social, economic, physical and mental health of Indigenous peoples, families and communities.
- Being outdoors improves wellbeing. Recreational fishing is a strong contributor to time spent outdoors, behind walking and bushwalking, and importance increases with age.<sup>3</sup>
- Satisfaction with fishing is strongly correlated with overall wellbeing. This may mean being happier makes you more satisfied with fishing, or that fishing makes you happier, or both.<sup>5</sup>
- Fishing and aquaculture **exports were \$1.4 billion in 2016-17**.
- **Eighty-three per cent of Australian fish stocks assessed in 2018** were either sustainable or recovering (272 out of 324 for which sufficient data was available for assessment).
- Greenhouse gas **emissions associated with seafood are the lowest** of the animal proteins.

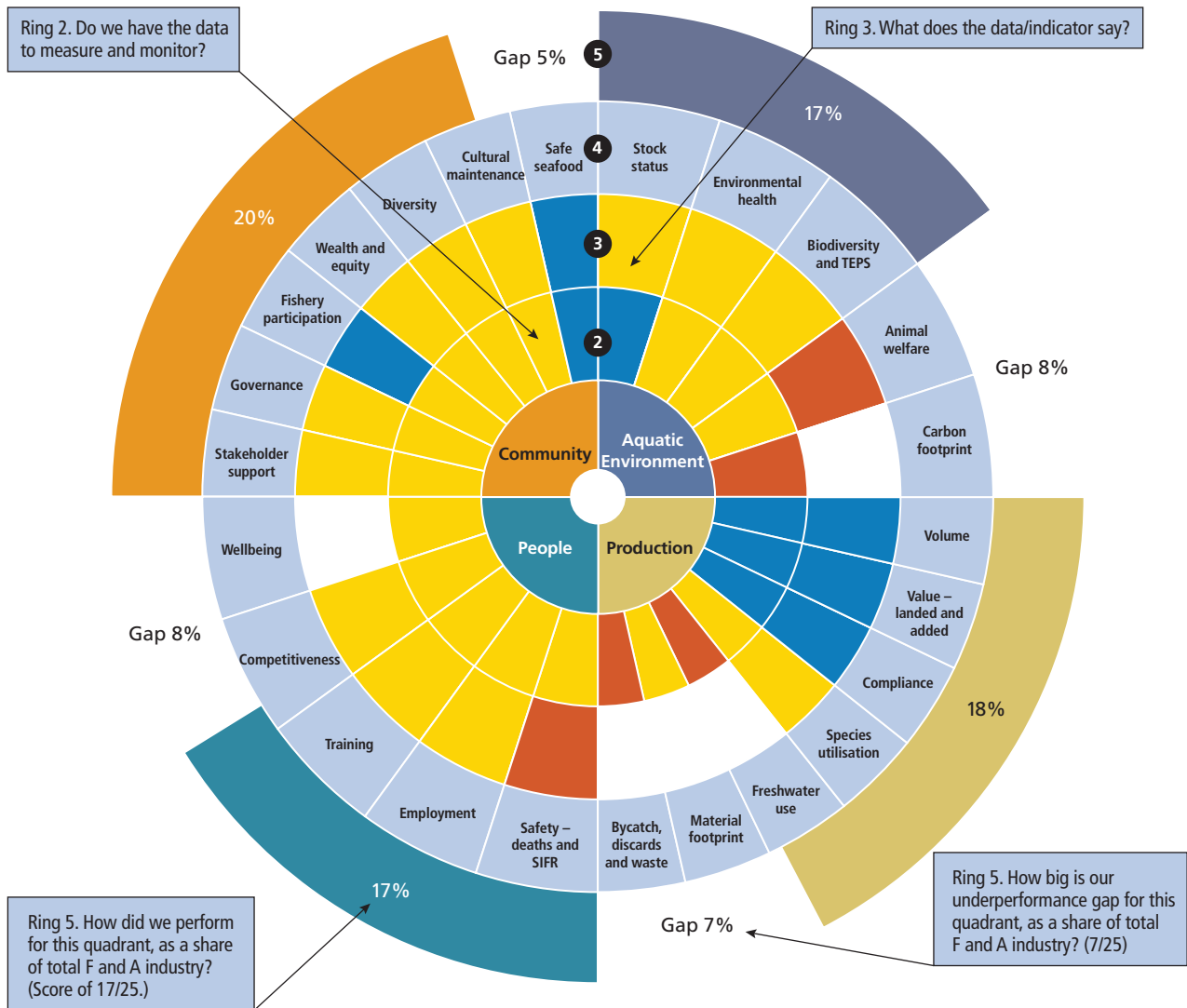
1 [www.frdc.com.au/Archived-Reports/FRDC%20Projects/2017-210-DLD%20Summary.pdf](http://www.frdc.com.au/Archived-Reports/FRDC%20Projects/2017-210-DLD%20Summary.pdf)

2 [www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/BAFB91C589D0706FCA256CAE0015CAA9](http://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/BAFB91C589D0706FCA256CAE0015CAA9)

3 Schirmer, J. (unpublished)

Figure 2 provides a qualitative summary of combined performance for Australia's fishing and aquaculture community across four quadrants (aquatic environment, production, people and community), highlighting areas where additional focus may be required.

Key: Blue = Adequate indicators and data to enable monitoring. Good performance achieved in the domain.  
 Yellow = Some data and capability to enable monitoring. Average performance in the domain.  
 Red = No data or capability to enable monitoring. Poor performance in the domain.  
 White = No basis for assessment of capability or performance.



**Figure 2. The diversity of the fishing and aquaculture community: its values, flows, business elements and community drivers, and qualitative assessment of the status and performance across 24 domains.** (Source: Ridge Partners 2020)

By necessity, each domain is an estimated composite across all fishing and aquaculture sectors: commercial wild-catch, aquaculture, Indigenous, recreational and post-harvest.

Ring 1 – The four quadrants (aquatic environment, production, people and community).

Ring 2 – Level of data availability in each of the 24 domains.

Ring 3 – Performance in each domain, based on data available.

Ring 4 – Description of 24 domain areas where data is used to monitor and inform decision-making across fishing and aquaculture.

Ring 5 – Aggregate performance across all domains within a quadrant, and cumulative performance gap for each quadrant.

## Performance under the last plan

### Social licence

- Identified 16 determinants for socially supported aquaculture and wild-catch fisheries in Australia.
- Improved understanding of how community values align with those of Australia's fishing and aquaculture community, and processes for increasing adoption of best practice.
- Development of best practice guidelines for fisheries management.
- Four editions of the National Status of Key Australian Fish Stocks (SAFS) Report published, and release of SAFS phone app. Since the first report in 2012, the number of species included has increased from 49 in 2012 to 120 in 2018, which is 90 per cent of total Australian species commercially fished.
- First Australian shark report card completed.
- Pilot Whichfish website launched to assist businesses to determine the stock, environmental and management risks associated with the seafood they buy and sell.
- Development of Seafood Industry Safety Strategic Plan and SeSafe project to improve commercial fisher safety.
- Community perceptions show that the percentage of Australians who think Australian fishing and aquaculture is sustainable has remained relatively unchanged since 2011 (36 per cent in 2018, compared with 38 per cent in 2015).

### Tackling impacts on ecosystem health and fisheries productivity

- Publication of National Habitat Strategy to inform large-scale rehabilitation programs.
- Seismic research documents effects on marine species for the first time.
- Submission of the National Carp Control Plan to government to inform decision-making.

### Biosecurity and food safety

- Vaccine for pilchard orthomyxovirus developed to protect farmed Atlantic Salmon.
- The FRDC provided funding and procured expertise to assist oyster and prawn farmers with two biosecurity and disease outbreaks.
- FRDC research and support enabled prawn farmers to continue production in areas affected by white spot disease in south-east Queensland.
- Test kits validated and implemented to improve the detection of paralytic shellfish toxins.

### Innovation and people development

- The FRDC partnered with all 14 other research and development corporations through the Rural R&D for Profit Program, highlighting that a significant increase in GVP could result through automation and labour savings.
- Delivery of the first Fish 2.0 Australian seafood innovation series.
- The FRDC partnered with X-Lab and the Cotton Research and Development Corporation to run a series of 'micro-hack' workshops aimed at fostering innovation in the seafood industry.

### New opportunities

- The Western Australian Octopus Fishery transitioned to a full fishery, based on FRDC research.
- Completion of Yellowtail Kingfish R&D for Profit research program and expansion of Kingfish farming into Western Australia.
- Through the Indigenous Reference Group, recommendations for overcoming constraints to achieving positive social and economic Indigenous community outcomes were developed.

## **Building on experience gained during delivery of the last plan**

The process of implementing FRDC's 2015–20 RD&E Plan provided opportunities to learn what worked and what did not, which has helped shape FRDC's approach for the next five years.

### *Enabling collaboration can be difficult*

Long-term success requires effective collaboration. Experience has shown that financial incentives alone are insufficient to ensure it occurs. Creating a collaborative environment requires understanding human behaviour, motivators and good communication. Structures, governance and investment models also play an important part. We need to focus on working better together.

### *Delivering ambitious change requires bold, focused commitment*

Investment to deliver impact on the enduring problems of our time will sometimes be contentious. It will require engaging in (sometimes difficult) conversations that are proactive and open rather than entrenched in a protective mindset or conventional wisdom.

### *Shared responsibility is the key*

Hierarchical structures and decision-making can be less effective within complex community environments. Decentralised authority and devolved responsibility can offer advantages, if supported through clear articulation of boundaries with strong buy-in from all participants.

### *Acknowledging and recognising value*

The FRDC receives enormous voluntary help from sectors, scientists, managers and conservationists, who review proposals and reports, sit on committees and share their expertise. This effort is often 'behind the scenes'. Looking forward, it is important to ensure that these contributions are acknowledged and appropriately valued.

### *Focus on delivery*

Almost every stakeholder group has a plan. FRDC's five-year R&D plan sits alongside those developed by jurisdictions, industry partners and sectors. These are joined by international plans developed by the broader environmental, fisheries, marine and science community. Most agree on the problems and possible solutions. The focus going forward needs to be on concerted action.

### *You cannot predict the unknown, but you can build capacity to deal with it.*

The future may be uncertain, but we can work together to establish an externally connected, pioneering community that is open to change and willing to try new things. Through this we can build resilience. Trying to deal with issues in a simplified, reductive manner can be counter-productive too. We need strategies that can accommodate the real world's complexity.

### *A new plan to deliver greater impact must be underpinned by new practices and systems.*

Aligning practice with changing stakeholder needs will be key to ensuring that investments deliver impact. We must capture core minimum information required for informed decision-making. This will require experimentation with how problems are conceptualised, priorities are set, investments are determined, and how initiatives are monitored, managed and evaluated.

### *If you can't measure it, you can't optimise it.*

Management of aquatic resources is hampered by a persisting lack of core information relating to social, economic and ecological performance. Moving forward, investment will be needed so that we can prioritise missing data and agree on how to collect it and make it accessible, using what we learn to shape our future direction.



## Situational analysis

### Aquatic natural resources today

Australia's marine and aquatic jurisdiction is the third largest globally at around 10 million square kilometres.<sup>4</sup> Australia's aquatic habitats are characterised by relatively low biological productivity offset by great diversity, including many endemic species.

Our marine and aquatic estate provides ecosystem services including food supply, carbon sequestration, climate regulation, tourism and recreation, coastal protection, oxygen production and renewable energy estimated to be worth \$25 billion.<sup>5</sup> Maintenance and enhancement of these services depends on the ongoing integrity of the systems that bestow them.

While all Australians rely on ecosystem services from rivers, coasts and oceans for their food, water and livelihoods, fishing and aquaculture rely completely on the ecosystems and processes that sustain production of harvested species. Price premiums commanded by Australian seafood also partly reflect international consumers' perception of Australian marine and aquatic habitats as clean and unspoiled.

Maintaining and improving the health and integrity of these systems is essential to achieving the Australian Government's \$100 billion growth target for the broader agricultural sector, to helping achieve the United Nations' Sustainable Development Goal 14 (Life Below Water), and to the ongoing availability of fresh Australian seafood.

Influencing Australia's ecosystems are three broad classes of processes: climate, human use, and modification and regulatory frameworks. These broad organising processes set the stage on which more site-specific impacts and management actions play out.

For example, agricultural and industrial development and their associated effects (e.g. nutrient enrichment in estuaries) are important on the populated eastern and southern coasts, whereas point-source impacts related to mineral resource extraction are apparent on the remote northern and western coastlines.

Shifts in the relative importance of different impacts are also manifesting. Historical impacts, including those related to overfishing, are diminishing in response to new management frameworks, while those associated with climate change and development are accelerating. For all Australian marine and aquatic environments, capacity to accurately assess changes in condition through time is hampered by a relative lack of data from broadscale, long-term monitoring and experimentation.

Australia is internationally recognised for its scientifically advanced and sustainable fisheries management. Australian fish stocks are generally in good condition. The SAFS Report produces broad-ranging 'report-card' assessments, using a consistent national reporting framework.

The SAFS framework assesses only target stocks and does not take an ecosystem-based approach incorporating issues such as bycatch and its fate, physical effects of fishing gear on environments or materials footprint. The most recent SAFS Report (2018) assessed 120 species subdivided into 406 stocks. Sufficient data to enable assessment was available for 324 of these stocks. Of the stocks assessed, 254 (~78%) were sustainable, 18 recovering, 23 depleting and 29 depleted. Recovery plans are in place for depleting and depleted stocks.

By providing regular, transparently reported snapshots using consistent methodology, SAFS establishes an evidence base that demonstrates and evaluates our shared stewardship of marine living resources and progress towards Sustainable Development Goal 14, and supports the fishing and aquaculture community's social licence to operate.

4 [www.ga.gov.au/scientific-topics/national-location-information/dimensions/oceans-and-seas#:~:text=Australian%20Exclusive%20Economic%20Zone&text=This%20EEZ%20area%20is%20made,from%20the%20territorial%20sea%20baseline](http://www.ga.gov.au/scientific-topics/national-location-information/dimensions/oceans-and-seas#:~:text=Australian%20Exclusive%20Economic%20Zone&text=This%20EEZ%20area%20is%20made,from%20the%20territorial%20sea%20baseline)

5 [www.marinescience.net.au/nationalmarinescienceplan](http://www.marinescience.net.au/nationalmarinescienceplan)

## Commercial wild-catch

Australia's commercial wild-catch fisheries are diverse, operating from estuaries and bays, across the continental shelf to oceanic waters and, in some cases, on the high seas. They supply fresh seafood for local and domestic markets, as well as exporting to many international markets. Australia-wide, wild-catch fishers use a diverse range of methods to catch more than 600 species.

Commercial wild-catch fisheries are one of few remaining 'hunting' industries that harvest animals from wild populations globally. These close links to aquatic ecosystems mean that wild-catch fishers tend to be resourceful, resilient, adaptable and respectful of the environments in which they operate.

From an RD&E perspective, identifying the priority areas where investment will make a difference is important. Commercial fishing remains an extremely hazardous occupation where younger fishers, aged 20–24, are most at risk.<sup>6</sup> A tendency remains for the fishing and aquaculture community to perceive safety as a cost. Research identifying ways in which safety might be viewed as an investment will continue to be a priority.

The wild-catch sector is undergoing structural changes in many areas, facilitated by management systems. These changes are seeing an increasing proportion of the overall catch taken by fewer, larger operators. This has important implications for the social fabric of fishing communities; research to better understand these implications and inform responses will remain an important priority.

The importance of moving from a fishery management model based on single stocks and species towards an ecosystem-based management (EBM) approach is now well recognised. The need for EBM will increase as marine species continue to shift their abundance and geographic distribution in response to climate change, requiring both improved data collection and more flexible management. However, EBM remains a broad, overarching goal, and implementation globally has been slow, reflecting complexity and lack of guidance.

Typically, wild fisheries do not include deliberate and systematic enhancement of fish populations or their supporting ecosystems to increase productivity. Increasing involvement in aquatic ecosystem restoration could have substantial benefits. Healthier ecosystems can support more productive fisheries, growing the size of the overall 'pie' available to fishers and clearly demonstrating fishers' commitment to stewardship. Improving commercial wild-harvest fishers' involvement in ecosystem enhancement activities would, however, require new skills, networks and resources to ensure that activities were targeted and coordinated for maximum effectiveness.

Over the coming decade, wild fisheries globally will need to build on their resourcefulness, resilience and adaptability to the greatest possible extent, as both geopolitical and environmental changes accelerate and become less predictable. While these challenges must not be understated, the wild-catch sector's proud history of innovation, sustainability and commitment to quality creates a strong foundation on which to base the innovations necessary to ensure future prosperity.

Opportunities will lie among the coming challenges. Greater adoption of digital technologies that collect large volumes of data throughout the fishing process have great potential to increase efficiency and reduce costs for fishers. Under-utilised species, new gear types and the potential for value-adding by making useful products from fish waste will all offer opportunities. Capitalising on them will require targeted, collaborative RD&E activities and flexible, responsive and participatory management arrangements.

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6 [www.sesafe.com.au/about-us/background](http://www.sesafe.com.au/about-us/background)

## Aquaculture

Aquaculture, or the farming of aquatic species, is Australia's fastest growing primary industry, accounting for 36 per cent of the gross value of production of seafood. More than 40 aquatic and marine species are cultured in Australia, with aquaculture businesses contributing substantially to the vitality of rural and regional areas.

Globally, aquaculture has strong growth potential and will be indispensable to future food security. With anticipated growth in world population over the next 20 years there will be an increasing demand for protein. Commercial wild-catch fisheries alone will be unable to sustainably meet demand. Increasing aquaculture production is one of the best options for meeting the shortfall.

Aquaculture operations compare favourably with many other protein production systems (terrestrial animal husbandry and agriculture) in terms of resource use, making their contribution to food security environmentally attractive. Aquaculture's importance in improving global food security and providing highly desirable products creates opportunity for Australian businesses, but also demands they compete in global markets. Australian aquaculture's strong international reputation for quality, sustainability, traceable provenance and ethical production will constitute its primary competitive advantage.

The Australian aquaculture sector has demonstrated strong capacity for innovation, but also faces immediate challenges. Reducing dependence on wild-caught fish for aquafeed, welfare of harvested species, and pests and diseases remain ongoing concerns. Similarly, diverting waste streams, both biological and material, into productive uses is a key priority as the sector moves towards a 'zero-waste' economy.

Climate change will have important implications for aquaculture, altering the availability and suitability of aquaculture sites, the geographic areas across which various species can be farmed, and the distribution and abundance of some parasites and pathogens. Other, less predictable effects of climate change will also likely emerge, and flexible management and regulatory structures will be needed to respond.

From a regulatory perspective, gaining access to sites suitable for aquaculture enterprises (particularly coastal land), and then managing these sites for long-term environmental sustainability and economic productivity is a big challenge. While these challenges should not be underestimated, the Australian aquaculture sector is well positioned to meet them.

Retaining and expanding the sector's share in international markets will involve competing with much larger producers. Consequently, Australian aquaculture will need to demonstrate competitive advantage through quality, innovation and environmental protection.

The aquaculture and post-harvest sectors already work closely (and indeed, are fully integrated in some cases) to achieve these outcomes by identifying value-adding opportunities and communicating the sector's strengths to consumers. Embracing traceability technologies, such as blockchain, will help the sector demonstrate product provenance. Greater adoption of advanced analytics to capture on-farm and supply-chain data streams will help improve efficiency and reduce costs. The sector is also actively searching for new species to culture, including those intended for non-traditional markets such as nutraceuticals and carbon sequestration.

The Australian aquaculture sector has demonstrated its capacity for innovation and growth. Working with managers to ensure rapid policy change over coming decades will test the sector's ability to continue to grow. Innovative aquaculture ventures will also require structures and processes to connect with potential investors.

## Indigenous

Utilisation and wise management of marine and aquatic living resources are central to many Australian Indigenous cultures.<sup>7</sup> Indigenous people are involved in all subsectors of the broader fishing and aquaculture community, but there is considerable scope to increase participation in accordance with Indigenous peoples' desire to utilise their sea country through fisheries and aquaculture enterprises.<sup>2,7</sup>

Definitions of customary or cultural fishing abound.<sup>8</sup> Perhaps problematically, these definitions often include reference to the activity's non-commercial nature.

However, all forms of fishing activity undertaken by Indigenous people, regardless of whether the primary intent is overtly 'cultural', have a customary component.<sup>2,7,9</sup> For example, many Indigenous commercial fishers give at least a portion of their catch to their local community, fulfilling cultural obligations.<sup>10</sup>

Acknowledging that all interactions Indigenous people have with the natural world are imbued with cultural significance, and translating this acknowledgement into the creation of fishing and aquaculture business opportunities that align with cultural values, has the potential to be a powerful promoter of Indigenous self-determination through financial independence.<sup>2,7</sup>

Historically, fisheries management in Australia has not generally been very effective at accommodating customary fishing rights and needs. Indigenous fishing rights have often been poorly accommodated when developing fisheries management measures and allocating catch, even creating situations in which customary fishing practices could not be conducted without breaking the law.<sup>11</sup> Indigenous fishers have consequently and understandably become disengaged from fisheries management in some instances. Among fisheries managers, there is a strong desire to change this situation and to accord customary fishing its rightful importance. Recognising the primacy of Indigenous people as custodians of Australia's marine and aquatic habitats would also bring clear benefits to the sector more broadly; Traditional Fishers' Knowledge is increasingly being recognised as an invaluable resource.

Lack of up-to-date data remains a major constraint on improved outcomes for Indigenous people in fishing and aquaculture generally, and for better understanding and facilitating customary fishing. The most recent data is now 15 years old and requires urgent updating to assist investment and policy decisions. Identifying appropriate ways to collect data on customary fishing is therefore a key priority.<sup>12</sup> Nonetheless, knowledge has advanced during the period of the 2015–20 RD&E Plan, including through investment from the [Indigenous Reference Group](#).

7 [www.frdc.com.au/project/2010-205](http://www.frdc.com.au/project/2010-205)

8 [www.agriculture.gov.au/abares/research-topics/fisheries/fisheries-and-aquaculture-statistics/customary-fishing-2017](http://www.agriculture.gov.au/abares/research-topics/fisheries/fisheries-and-aquaculture-statistics/customary-fishing-2017)

9 [www.frdc.com.au/project/2015-205](http://www.frdc.com.au/project/2015-205)

10 [www.frdc.com.au/project/2010-304](http://www.frdc.com.au/project/2010-304)

11 [www.frdc.com.au/project/2009-038](http://www.frdc.com.au/project/2009-038)

12 Saunders, T. and Carne, R. (2010). *A survey of customary fishing of sharks and stingrays in Grootte Eylandt*. Fishery Report No. 105. Northern Territory Government, Australia.

## Post-harvest and markets

The fishing and aquaculture community's post-harvest sector works to ensure that consumers can easily access fresh, high-quality seafood. By identifying new markets and value-adding opportunities, the sector makes a vital contribution to the seafood industry's growth and sustainability. While some Australian seafood businesses control their product through the value chain from capture to sale, more often the post-harvest sector constitutes the vital interface between seafood producers and consumers. Consequently, this sector has a crucial role in relaying the stories behind Australian seafood to consumers.

The post-harvest sector's future will involve creation of innovative new products that satisfy an increasing demand for seafood that is tasty and healthy, quick and simple to prepare, and uses ethically and transparently sourced ingredients. These trends are not confined to Australian consumers and create opportunities for Australian seafood in growing Asian markets.

Geographic proximity and the strong reputation for high-quality Australian seafood products mean the sector (and the fishing and aquaculture community more generally) is uniquely placed to capitalise on these opportunities. In recent years, the sector has also sought to increase profitability and sustainability by developing new products from what was once regarded as seafood waste, underscoring the considerable potential for innovation in this area.

Capitalising on the increasing consumer desire for high-quality, value-added seafood will require Australia's post-harvest sector to be competitive in globally traded seafood supply chains. Historically, competing in these supply chains has been challenging, reflecting the relative stringency of Australia's environmental and labour protection laws.

Yet increasing public demand for ethical and sustainable produce offers an opportunity for Australian seafood to consolidate a strong and unique competitive advantage in the region. Ensuring Australia's fishing and aquaculture community can derive maximum benefit from this opportunity will require strategic use of emerging technologies, such as blockchain, that enable product traceability through the value chain. Broadscale adoption of these traceability technologies will provide powerful evidence supporting a story of provenance, sustainability and safety.

As with all other sectors of the Australian seafood industry, environmental change, and particularly climate change, will pose challenges to the post-harvest sector over the coming decades. Notably, the abundance, distribution and seasonal availability of seafood species are expected to shift markedly, creating uncertainties in supply relative to earlier, more predictable regimes.

The post-harvest sector will be called upon to play a part in minimising climate change and adapting to the changes that are now inevitable. In terms of carbon reduction, numerous opportunities exist to reduce emissions and waste more broadly along supply chains. Enhancing resilience in the face of change will require identifying new and potentially under-utilised seafood species and using processing plants flexibly and potentially cooperatively to increase efficiency.

Perhaps the most powerful change required is a shift in mindset along the entire value chain, from a view in which individual operators work defensively as isolated entities to ensure their own survival, to a more collaborative approach in which fishers, aquaculture operators and other supply-chain partners work together to identify new products and opportunities. Overall, the Australian post-harvest sector has a strong base from which to build a bright future; targeted RD&E will be essential to attaining this goal.

## Recreational

Recreational fishing is enjoyed by millions of Australians, providing relaxation, fresh seafood, sporting challenges and opportunities for social interaction. For many people in urban areas, recreational fishing may provide their most direct imperative to conserve coastal and aquatic environments. The sector also makes a considerable contribution to the Australian economy through the purchase of equipment, boats and other fishing-related goods and services.

Demographically, recreational fishers are predominantly male, although recent state government initiatives are encouraging participation by women, children and people from diverse backgrounds. Continuing to encourage participation by women and young people in particular will be central to growing and strengthening the sector over the next five years.

The great diversity of recreational fisher motivations, preferences for different types of fishing experience, and benefits derived from fishing pose challenges for accurately and fairly representing this sector in decision-making and policy development. Unlike other sectors described here, food production is not the sector's primary focus, although there are participants for whom this is undoubtedly an important motivator.

Rather, recreational fishers range from those who fish mainly to enjoy the outdoors, relax and spend time with family and friends through to avid fishers who compete against others, challenge themselves by seeking large, elusive or hard-fighting species, specialise in the use of particular gear or techniques, or for whom fishing is simply an integral part of life. The sector also includes numerous commercial enterprises that supply and support recreational fishers (e.g. bait and tackle shops, fishing charter operations).

Also crucial in the sector's drive to take an active role in its own management is the procurement of better catch and effort data. The total volume of the recreational catch, along with the portion of that catch retained for consumption, is unknown, but exceeds the commercial harvest for some species. In recent years recreational fishing peak bodies have taken positive, self-determined steps to fill these data gaps through voluntary catch and effort reporting schemes.

Over the coming years, Australia's recreational fishing sector will need to continue to demonstrate its stewardship. Ecosystem restoration and enhancement projects involving recreational fishers have strong potential to increase fish numbers, provide satisfaction to participants, and may assist in demonstrating recreational fishers' stewardship to the non-fishing public.

Numerous recreational fisher organisations, operating at scales from local to national, are already involved in fish habitat restoration work. Identifying ways to increase participation in, and maximise the effectiveness of, these initiatives will be important over the next five years.

Finally, developing new management metrics tailored specifically to recreational fisheries will be a key requirement for sustainably growing the sector into the future. Traditionally, management metrics developed for commercial wild-catch fisheries, such as maximum sustainable yield and/or maximum economic yield, have been used to manage recreational fisheries.

Recreational fishers usually have very different motivations, expectations and behaviours to commercial fishers. Consequently, development of management metrics that incorporate aspects of the fishery valued by fishers, and the wellbeing outcomes that ensue, will provide a more tailored approach to evaluating management success for this sector.



## Drivers for change

Increasingly, our aquatic environments are considered the new frontier of economic and technological development in an emerging blue economy.<sup>13</sup> Australia's marine economy is projected to grow three times faster than GDP over the next decade,<sup>14</sup> with much of this growth coming from existing industries such as tourism, ports, transport, shipbuilding, offshore oil and gas, aquaculture and wild fisheries, as well as new opportunities including biotechnology and renewable energy. Maximising opportunities for the fishing and aquaculture community to contribute to the burgeoning blue economy will demand a keen awareness of, and responsiveness to, global drivers for change.

The coming decades pose challenges that will test Australia's resilience. In particular, climate change is occurring more rapidly than expected. This will bring myriad ecological, biological and socio-political changes requiring altered responses in all sectors of the fishing and aquaculture community and in its management.

International political uncertainty with implications for trade, including seafood trade, has also increased. At the time of writing, the COVID-19 pandemic has had a major impact on the seafood industry, affecting all aspects of harvest, production and trade. More generally, the pandemic promises to change many of our traditional business practices and partners and to produce a yet to be defined 'new normal'.

Yet few challenges are without opportunity. Successfully meeting these challenges, and capitalising on opportunities, will require fundamentally rethinking the roles and structures of the institutions and collaborations that drive knowledge generation and implementation in the Australian seafood sector.

Exactly how these and other drivers are likely to interact over coming years is uncertain, and so implications for economic, social, ecological and cultural dynamics in Australia remain ambiguous. Careful planning for a range of possible futures will help ensure that Australia's fishing and aquaculture community is well prepared for the range of scenarios that might result.

The following set of global and national drivers has been identified by a group of key stakeholders and FRDC partners. These drivers are seen to be vital in shaping the future dynamics of fishing and aquaculture in Australia.

### Food requirements

Every day, the world's human population consumes approximately 14.5 million tonnes of food.<sup>15</sup> To meet this demand and sustain future population growth, food production will need to increase substantially over the three decades to 2050.<sup>16</sup> The food we consume and how and where we consume it will change with increasing social mobility and associated shifts in consumer preferences.<sup>17</sup>

Food production in controlled systems will increase in prevalence as traditional production methods deal with volatility relating to weather, soil quality, pests and challenges associated with distance to market. Aquaculture will play an increasing role in meeting the world's growing seafood demand.<sup>18</sup> Consumers are beginning to pay more attention to the impact of their food choices.<sup>19</sup> Issues including food waste, food miles, animal welfare, fair work conditions and material footprint are likely to influence the purchasing behaviour of these

13 Eikeset, A. M., A. B. Mazzarella, B. Davíðsdóttir, D. H. Klinger, S. A. Levin, E. Rovenskaya and N. C. Stenseth (2018). "What is blue growth? The semantics of "Sustainable Development" of marine environments." *Marine Policy* **87**: 177-179.

14 ABS (2018). "Population Projections, Australia, 2017 to 2066." Agency, I. E. (2018). Renewables 2018.

15 [http://faostat.fao.org/static/syb/syb\\_5000.pdf](http://faostat.fao.org/static/syb/syb_5000.pdf)

16 [www.fao.org/fileadmin/templates/wsfs/docs/expert\\_paper/How\\_to\\_Feed\\_the\\_World\\_in\\_2050.pdf](http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf)

17 [www.reuters.com/middle-class-infographic](http://www.reuters.com/middle-class-infographic)

18 [www2.deloitte.com/au/en/pages/consumer-business/articles/the-growth-of-aqua-culture-fishy-business.html](http://www2.deloitte.com/au/en/pages/consumer-business/articles/the-growth-of-aqua-culture-fishy-business.html)

19 [www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-future-food-uber-eats-100719.pdf](http://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-future-food-uber-eats-100719.pdf)



increasingly aware customers. As customers increasingly seek sustainably and ethically produced products, there will be more widespread focus on the origin of food and demand for transparency, traceability and authenticity. Businesses are steadily responding to these changes and reforming value chains in the process.

Top-end restaurants are already experimenting more and more with the use the whole fish and lesser known varieties.<sup>20</sup> This trend is expected to gradually filter down into fish retailers, mid-range dining and home cooking.

Growth of in-vitro meats and the continued rise of plant-based alternatives is expected to continue as consumer values change, technology improves, and prices become more competitive. Consumers are also increasingly expected to take up preventative healthy eating<sup>21</sup> in response to our changing lifestyles.

### International trade and global GDP trends

International trade continues to underpin Australia's economic vitality, with major exports including mineral resources, education-related travel, beef, grains and wool.<sup>22</sup> Major imports include travel, fossil fuels, motor vehicles, electronics and medical equipment and supplies.<sup>23</sup> Important trading partners include Asian countries such as China, Japan and the Republic of Korea, as well as the United States.

Trends in international trade and global GDP will continue to affect the Australian economy directly and indirectly. These effects will in turn have an impact on Australian aquatic environments, mainly through changes in transport patterns for internationally traded commodities and demand for renewable resources (e.g. seafood) and non-renewable ones (e.g. minerals).

### Energy

Australia's energy consumption continues to rise. Oil accounts for the largest share of Australia's energy mix (39 per cent), followed by coal (30 per cent) and natural gas (25 per cent). Renewable energy sources account for 6 per cent.<sup>24</sup> The need for energy will not diminish, with consumption projected to grow significantly in the next decade. Traditional energy sources are likely to still play an important part in meeting Australia's energy needs. However, renewables are expected to constitute an increasing component of Australia's energy mix.

Energy will continue to have a significant impact on economic production and growth in Australia through its effects on transport costs and the attractiveness of Australian mineral resources. Energy supply, pricing and demand (nationally and internationally) will exert particularly strong effects on the economy as Australia's energy mix transitions from one dominated by fossil fuels to renewable generation.

### Climate change

Climate change and its accompanying acidification, warming and deoxygenation processes are expected to affect all processes at various timescales directly or indirectly. There is evidence demonstrating that climate change is already affecting our marine and aquatic ecosystems and will have profound ecological and socio-political implications.

20 <https://fishbutchery.com.au>

21 [www.foodservicerep.com.au/the-rise-of-plant-based-foods](http://www.foodservicerep.com.au/the-rise-of-plant-based-foods)

22 <https://dfat.gov.au/trade/resources/trade-statistics/trade-in-goods-and-services/Documents/australias-goods-services-by-top-25-exports-2018.pdf>

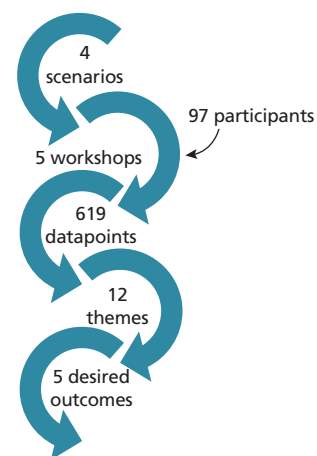
23 <https://dfat.gov.au/trade/resources/trade-statistics/trade-in-goods-and-services/Documents/australias-goods-services-by-top-25-imports-2018.pdf>

24 [www.energy.gov.au/sites/default/files/australian\\_energy\\_statistics\\_2019\\_energy\\_update\\_report\\_september.pdf](http://www.energy.gov.au/sites/default/files/australian_energy_statistics_2019_energy_update_report_september.pdf)

International research points to significant global risks for fishing and aquaculture, with some scenarios indicating a 35 per cent decrease in fishing revenues globally by 2050.<sup>25</sup> However, research focusing on Australian fisheries and species predicts more mixed results, with winners and losers.<sup>26</sup> Impacts are predicted to be more extreme for invertebrate species in general and finfish species in south-eastern Australia, highlighting the vulnerability of some of Australia’s largest and most valuable fisheries.

## Looking ahead: scenario planning

The consultative process that has informed FRDC’s 2020–25 R&D Plan has been extensive. Over eight months, two groups of leaders and innovators from across each of the five sectors of the fishing and aquaculture community, fisheries managers, researchers and representatives of conservation NGOs worked together to co-design elements of this plan. The FRDC worked with these groups initially to develop a [map of the fishing and aquaculture system](#) (Figure 3). Working together to build this map enabled participants to establish a better shared understanding of the complex system in which we all operate, where each group is situated within it, and the interactions and diverse perspectives of each sector comprising the community.



## Map of fishing and aquaculture

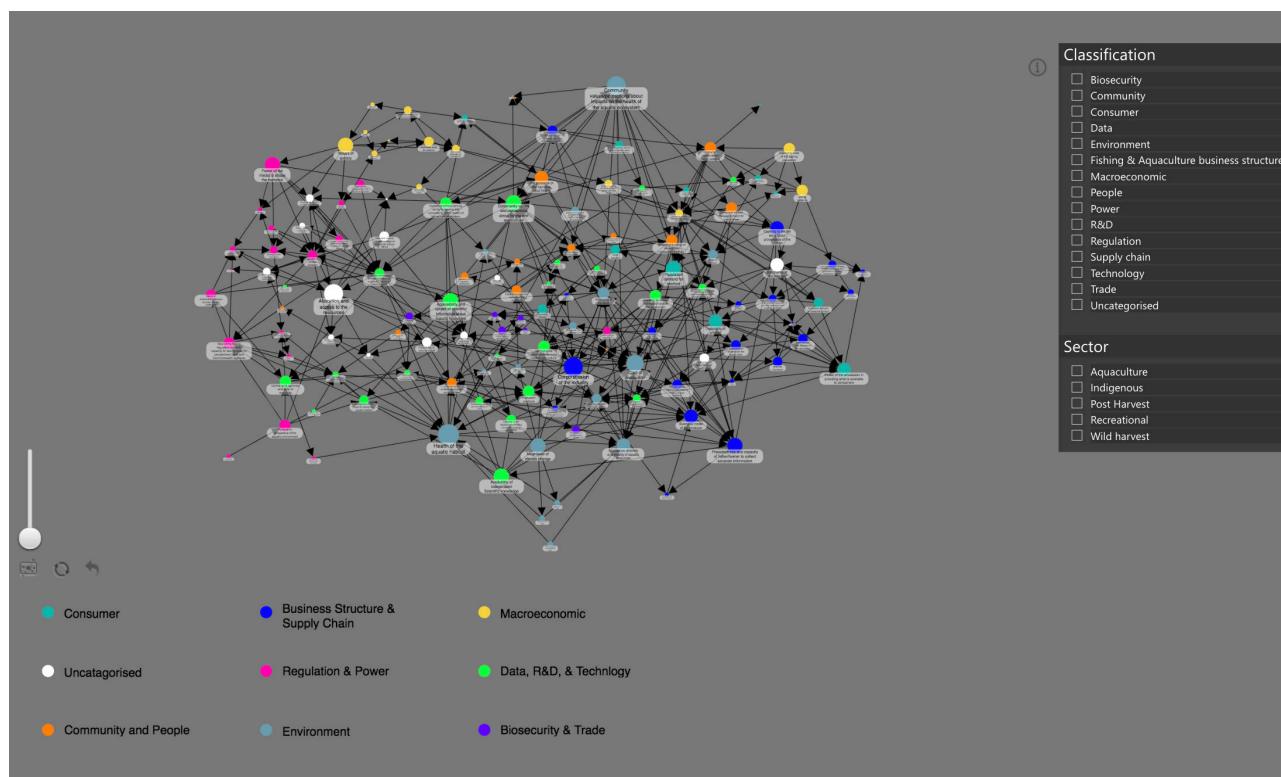


Figure 3. Map of the fishing and aquaculture system, explaining drivers and relationships between them.

These groups then worked together to develop four possible scenarios of the future in 2030, using the system map to guide their work. The four scenarios were constructed around how the following dynamics might shape the future:

25 Lam, V.W.L. et al. (2016). 'Projected change in global fisheries revenues under climate change,' Scientific Reports 6(3), 2607. Available at [www.nature.com](http://www.nature.com).

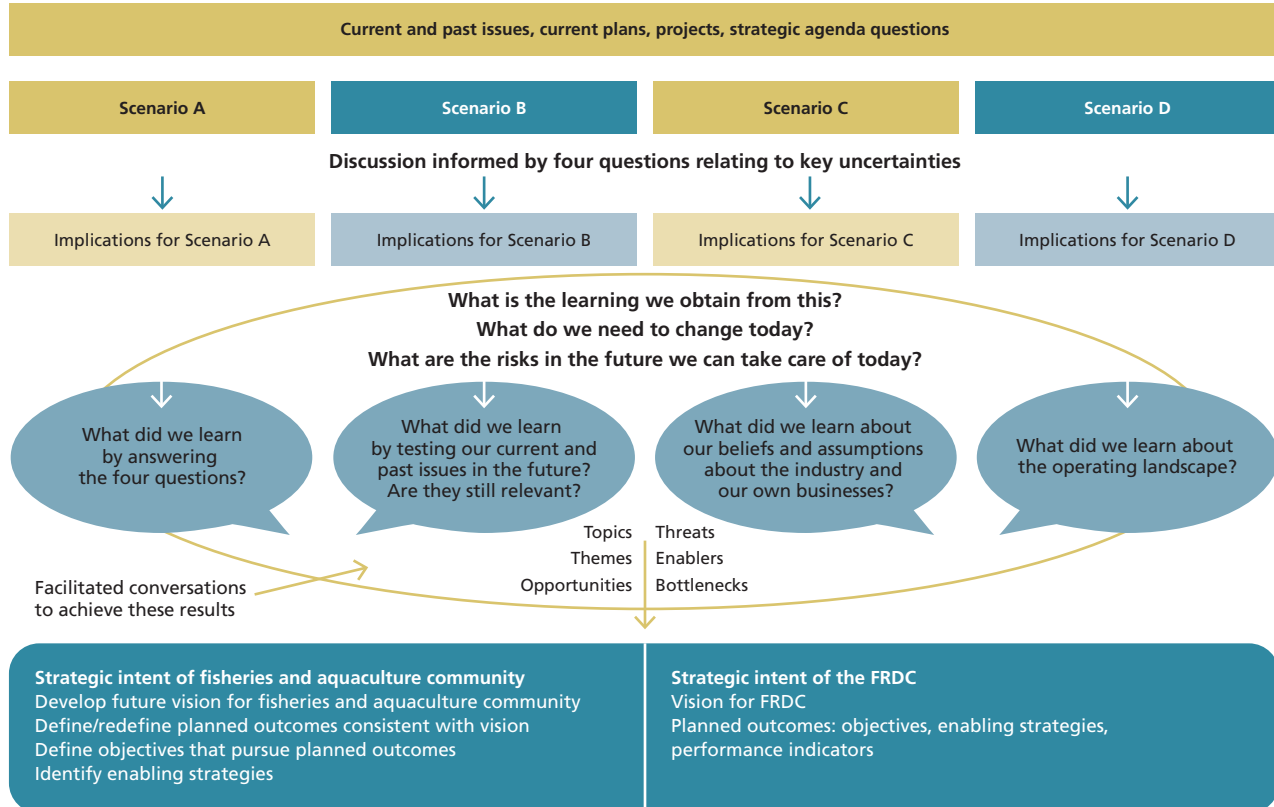
26 [www.frdc.com.au/project/2016-139](http://www.frdc.com.au/project/2016-139)

- a future world characterised by confidence in information, knowledge and authority, in which those drivers work to unify and include;
- a future world driven by fear, in which authorities and the purveyors of information polarise and divide;
- a future world in which key environmental impacts are known, measured and managed and decisions are informed by evidence; and
- a future world in which key environmental impacts are largely unknown, unmeasured and unmanaged and decision-making is delivered by populism.

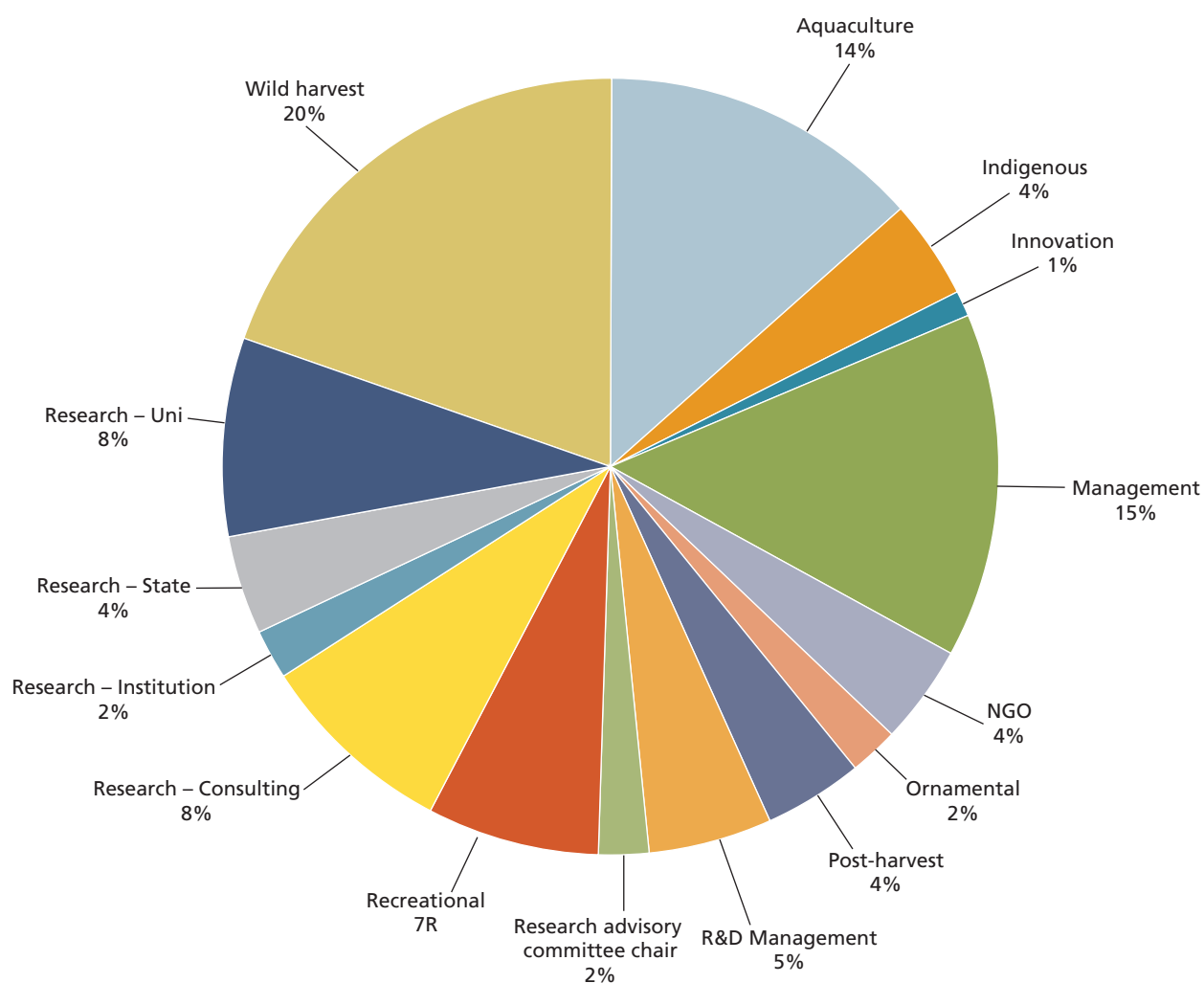
The dynamics described shaped how each scenario played out. In one scenario, a strong belief in the value of science enabled proactive climate change adaptation and mitigation by 2030, while in another, evidence-based action was hampered by populism, leading to a worsening climate refugee situation and fuelling emergence of stronger nationalist values in society. In another, Australia’s fishing and aquaculture community was highly regarded for the benefits it delivered to the Australian public and our fisheries management was upheld as a global example of world’s best practice.

The FRDC then worked with a broader collective of stakeholders around Australia to consider the implications of these four possible scenarios, as summarised in Figure 4. A series of regional workshops enabled a diverse cross-section of participants to come together and explore each scenario, documenting insights and implications of each relevant to the future of fishing and aquaculture. There was good engagement from across the five sectors of the fishing and aquaculture community (see Figure 5) with approximately 100 stakeholders attending workshops, and broad representation across sectors and supporting industries as shown in the breakdown of participants.

#### SCENARIOS HELP US TEST THE VIABILITY OF OUR PLANS AND DIRECTION



**Figure 4. The process used to derive FRDC’s 2020–25 R&D Plan. A series of scenarios was used to elicit responses, highlighting key areas of the plan. Responses were later categorised and used to derive strategic intent for the fishing and aquaculture community and later, the FRDC.**



**Figure 5. Breakdown of participants attending workshops to inform FRDC's 2020-25 R&D Plan (n=97).**

Representatives of all sectors then worked together to analyse data collected into 14 themes, summarised in Figure 6. These themes were used to define:

- clear, ambitious, intended outcomes shared by all Australian fishing and aquaculture sectors (Figure 7);
- a shared vision of what all sectors want fishing and aquaculture to look like in 2030; and
- how they intend to work together to realise this vision.

This shared vision for the future directly informed FRDC's 2020-25 R&D Plan.



Figure 6. Fourteen themes of data collected from stakeholders participating in regional workshops, elicited in response to varying scenarios for the future.

Themes	Intended outcomes
Culture and values, Markets and marketing, Innovation, Cost/revenue, Societal health and wellbeing, Sustainability, Technology and data	<b>1. Growth for enduring prosperity</b> Enduring and balanced ecological, social and economic growth for the benefit of society.
Sustainability, Resource sharing, Leadership and decision-making, Societal health and wellbeing, Social license, People and capacity, Cost/revenue	<b>2. Best practice and production systems</b> Continued societal benefit from aquatic resources in a manner consistent with our shared moral principles.
Culture and values, Leadership and decision-making, Relationships, Markets and marketing, Resource sharing, People and capacity, Innovation, Societal health and wellbeing, Communication and influence	<b>3. A culture that is inclusive, forward thinking and capable</b> A fishing and aquaculture community that is collaborative, inclusive, and equipped to enable growth and adaptability in a complex and uncertain world.
Resource sharing, Relationships, Regulation/compliance, Sustainability, Culture and values, Technology and data	<b>4. Equitable and secure access to Australia's aquatic resources</b> Fair and secure access to Australia's marine and freshwater resources, providing certainty and confidence.
Communication and influence, Social license, Relationships, Resource sharing, Societal health and wellbeing, Culture and values, Cost/revenue, Leadership and decision-making, Technology and data	<b>5. Society and consumers trust, respect and value</b> Society and consumers trust, respect and value Australia's fishing and aquaculture community, and the products and benefits we provide.

Figure 7. Key outcomes derived from themes identified during the consultative processes. These intended outcomes form the basis of FRDC's 2020–25 R&D Plan.



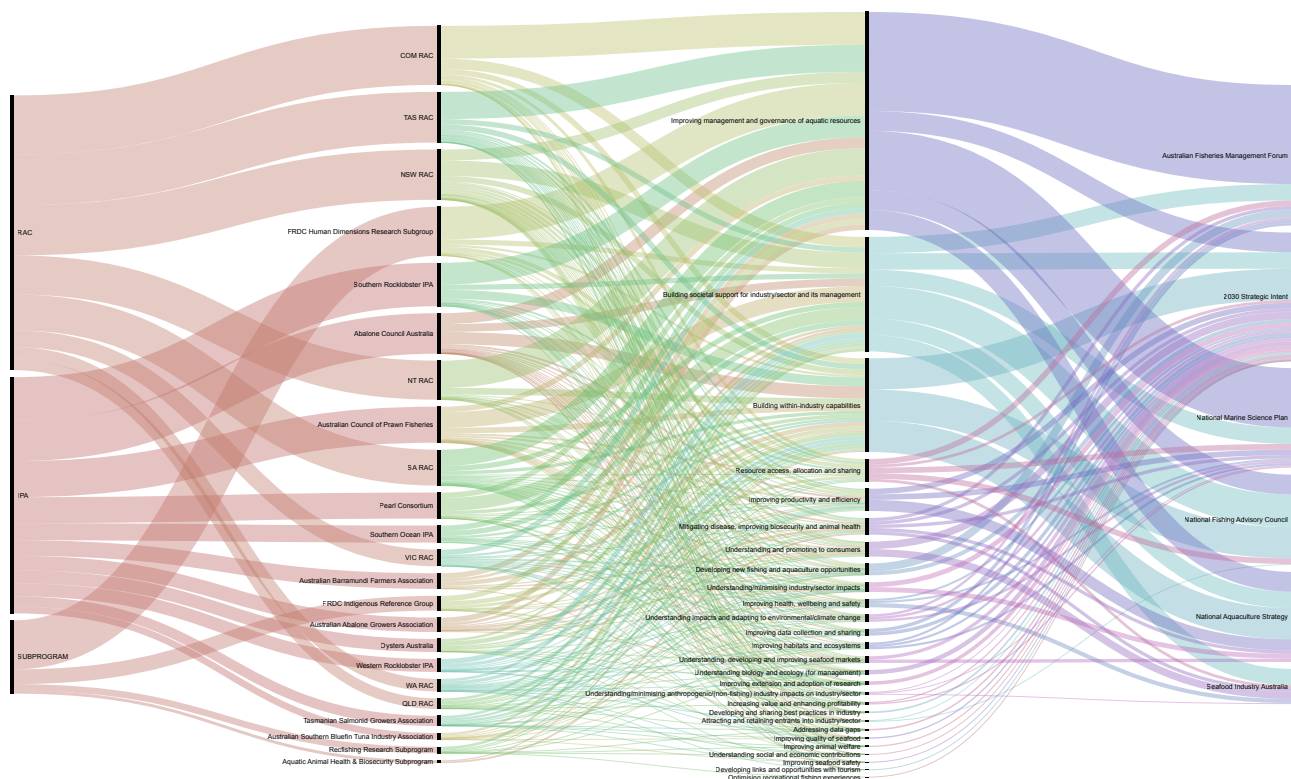
### Finding trends in plans

During the life of FRDC's 2015–20 RD&E Plan, advice was received from eight jurisdictional research advisory committees (RACs), 12 industry partnership agreements (IPAs) and four Subprograms. These groups each developed strategic plans during 2015–20 identifying priority investment areas.

These priorities, and others identified by the National Fishing Advisory Council,<sup>27</sup> Australian Fisheries Management Forum,<sup>28</sup> National Marine Science Plan<sup>29</sup> and other key national planning documents, were combined with data collected through scenario planning to enable deeper exploration of trends relevant to the shared and evolving needs of FRDC's diverse stakeholder base.

Insights from this analysis are summarised in Figure 8. They illustrate the degree of alignment between strategic focus areas within this plan and other planning processes. The following areas emerged as clear investment needs:

- building societal support for industry/sector and its management;
- building within-industry capabilities;
- improving management and governance of aquatic resources;
- improving resource access, allocation and sharing;
- improving productivity and efficiency;
- mitigating disease and improving biosecurity and health;
- improving data collection and sharing
- developing new aquaculture and fishing opportunities; and
- understanding and minimising sector impact.



**Figure 8. Sankey chart showing linkages between desired outcomes identified within FRDC's 2020–25 R&D Plan and priorities identified by FRDC RACs, IPAs and Subprograms in their RD&E Plans (left-hand column) and those identified by external planning processes (right-hand column). Line width is proportional to the number of priorities addressing each category.**

27 [www.agriculture.gov.au/fisheries/national-fishing-advisory-council](http://www.agriculture.gov.au/fisheries/national-fishing-advisory-council)  
 28 [www.dpi.nsw.gov.au/\\_data/assets/pdf\\_file/0011/539930/AFMF-National-Statement-of-Intent.pdf](http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0011/539930/AFMF-National-Statement-of-Intent.pdf)  
 29 [www.marinescience.net.au/nationalmarinescienceplan](http://www.marinescience.net.au/nationalmarinescienceplan)

## With thanks

An enormous and impressive team from across all five sectors of the fishing and aquaculture community as well as fisheries managers, researchers and representatives of environmental non-government organisations gave enormous amounts of time, enthusiasm and wisdom to this process. The FRDC would like to thank each and every one of you.

Name	Role
Aaron Irving	Chairman, National Aquaculture Council
Alan Haroutonian	CEO, X-Lab
Andrew Rowland	CEO, Recfishwest
Angela Williamson	Senior Manager, Tassal Operations
Annie Jarrett	Northern Prawn Fishery Industry Pty Ltd
Barry McGookin	Food Innovation Australia Ltd
Brett Cleary	Australian Recreational Fishing Foundation
Colin Buxton	FRDC Board
Colin Tannahill	Managing Director, Shimano Fishing Australia Pty Ltd
Craig Copeland	CEO, OzFish Unlimited
Dave Ciaravolo	CEO, Amateur Fishermen's Association of the Northern Territory
Dave Smith	Chair, Research Provider Network
Elizabeth Keys	Indigenous Reference Group
Emma Lowe	Department of Agriculture
Ewan McAsh	Director, McAsh Oysters Pty Ltd
Jane Lovell	CEO, Seafood Industry Australia
Jo McCrea	Fisheries and Seafood Manager, WWF
John Wakeford	Director, Fishing Untangled Pty Ltd
Josh Fielding	FRDC Senior Projects Manager
Kate Brooks	FRDC Board
Katherine Winchester	CEO, Northern Territory Seafood Council
Leonie Noble	Western Rock Lobster Industry
Mel Brown	Assistant Secretary, Fisheries Branch, Department of Agriculture
Mike Gilby	Aboriginal Project Officer, Victorian Fisheries Association
Patrick Hone	Managing Director, FRDC
Patrick Sachs	Assistant Director, Southern Bluefin Tuna Taskforce, Department of Agriculture and Water Resources
Rachel King	EO, Australian Council of Prawn Fishers
Russell Conway	Chair, Recfish Australia
Sean Sloan	Member, Australian Fisheries Management Forum
Serena Zipf	Director, Rockaqua Pty Ltd
Stan Lui	Chair, Indigenous Reference Group
Steve Davies	Director, Lands End Australia
Umar Nguyen	Director, Platinum Provedore

