FINAL REPORT

An Impact Assessment of Investment in FRDC Project 2016-259:

the APFA Strategic and R&D Plan 2018-2022

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January 2023

FRDC Project No **2016-134**

ISBN **[Insert ISBN/ISSN – researcher to obtain]**

An Impact Assessment of Investment in FRDC Project 2016-259: the APFA Strategic and R&D Plan 2018-2022
FRDC Project 2016-134

2022

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In submitting this report, the researcher has agreed to FRDC publishing this material in its edited form.

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Acknowledgments

Agtrans Pty Ltd (Agtrans Research) and ACRE Economics Pty Ltd (ACRE Economics) would like to thank Patrick Hone (Managing Director), Jennifer Marshall (Cross-Functional Facilitator) and Wayne Hutchinson (Research Portfolio Manager) of the Fisheries Research and Development Corporation for facilitating contact with relevant project personnel and for their guidance and feedback throughout the Impact Assessment process.

Specific acknowledgments for helpful comments on earlier drafts and for supplying additional information are made to:

- Ewan Colquhoun, Ridge Partners, Brisbane

Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
APFA	Australian Prawn Farming Association
CBA	Cost-Benefit Analysis
CRRDC	Council of Rural Research and Development Corporations
DAWR	Department of Agriculture and Water Resources
FRDC	Fisheries Research and Development Corporation
IRR	Internal Rate of Return
MIRR	Modified Internal Rate of Return
n.s.	No solution
OCS	Office of the Chief Scientist
PVB	Present Value of Benefits
R&D	Research and Development
RD&E	Research, Development and Extension
WSD	White Spot Disease

Executive Summary

Fisheries Research and Development Corporation (FRDC) Project 2016-259 produced a revised and expanded Strategic and R&D Plan for the farmed prawn industry for the period 2020-2025. This was achieved largely via industry consultations and workshops.

A range of issues were addressed in the development of the Plan including global and local markets, competition, supply chains, promotion, farming practices and technology, the sustainable nature of prawn farming, breeding and genetics, health and disease, biosecurity, nutrition, and the regulatory environment.

Specific future impacts likely to emanate from the Plan and identified in this assessment include:

- A contribution to increased domestic demand for Australian farmed prawns due to larger economic scale and moderation of consumer prices.
- Increased efficiency/effectiveness of farmed prawn RD&E resource allocation through identification and prioritisation of key industry issues and constraints.
- Contribution to increased productivity and efficiency of Australian farmed prawn businesses and supply chains. Specific contributions are likely from better use of production and water technologies and increased corporatisation that is integrating national supply chains.
- A more professionally managed risk of any future loss of prawn farming social licence to operate.

The project investment has delivered an industry-driven Strategic Plan for the Australian farmed prawn industry. The current implementation of the plan by the industry and FRDC is expected to result in more effective RD&E investment by FRDC and the industry in the years after the plan was produced and released. These benefits are likely to take the form of higher productivity gains to the farmed prawn industry as well as a higher level of industry awareness of environmental implications.

The total funding for the project totalled $57,488 over the two years (present value terms). Given the assumptions made, the benefits accruing to the investment were estimated to be $249,420 in present value terms. This gave a net present value of $191,932, a benefit-cost ratio of 4.3 to 1 and an internal rate of return of 21.5%. As some of the impacts identified were not valued, the investment criteria as provided by the benefits valued are likely to underestimate the true investment performance.

Introduction

The Fisheries Research and Development Corporation (FRDC) required an annual series of impact assessments to be carried out on a sample of completed investments from the FRDC research, development, and extension (RD&E) portfolio. The assessments were required to meet the following FRDC evaluation reporting requirements:

- Reporting against the FRDC 2015-2020 RD&E Plan and the Evaluation Framework associated with FRDC's Statutory Funding Agreement with the Commonwealth Government.
- Annual Reporting to FRDC funding partners and other stakeholders.
- Reporting to the Council of Rural Research and Development Corporations (CRRDC).
- Reporting RD&E impact and performance to FRDC levy payers and other fisheries and aquaculture stakeholders as well as the broader Australian community.

In April 2017, FRDC commissioned Agtrans Pty Ltd (Agtrans) to undertake the annual impact assessments for RD&E projects funded under the FRDC 2015-2020 RD&E Plan and completed in the years ended 30 June 2016 to 2020 (FRDC Project 2016-134). Between 2016/17 and 2020/21, four series of annual impact assessments were completed. Each of the four series of assessments included a set of 20 randomly selected FRDC RD&E investments as well as an aggregate analysis across all 20 investments evaluated in each year. Published reports for the annual FRDC evaluations can be found at: https://www.frdc.com.au/frdc-project-impact-assessments-benefits-research.

The fifth and final series of impact assessments under Project 2016-134 was for a set of FRDC RD&E investments completed in the year ended 30 June 2020, the final year of the FRDC 2015-2020 RD&E Plan. As in previous years, the fifth series of impact assessments included 20 randomly selected FRDC RD&E investments. The 20 investments had a total value of approximately $5.30 million (nominal FRDC investment) and were selected from an overall population of 81 FRDC investments worth an estimated $17.66 million (nominal FRDC investment) where a final deliverable had been submitted in the 2019/20 financial year.

The 20 RD&E investments were selected through a stratified, random sampling process such that investments chosen spanned all five FRDC Programs (Environment, Industry, Communities, People and Adoption), represented approximately 30.0% of the total FRDC RD&E investment in the overall population (in nominal terms), and included a selection of small, medium, and large FRDC investments (total nominal FRDC investment of $\leq$ $50.000, $50,001 to $250,000, and > $250,000 respectively).

Project 2016-259*: APFA Strategic and R&D Plan 2018-2022* was randomly selected as one of the 20 RD&E investments completed in 2019/20 for evaluation in the fifth series of annual impact assessments (2019/20 sample). The current report presents the Project 2016-259 analysis and findings.

Method

The annual impact assessments of FRDC RD&E investments followed general evaluation guidelines that are now well entrenched within the Australian primary industry research sector including Research and Development Corporations, Cooperative Research Centres, State Departments of Agriculture, and some universities. The approach includes both qualitative and quantitative assessment components that are in accord with the current guidelines for impact assessment published by the CRRDC (CRRDC, 2018).

The evaluation process utilised an input to impact continuum RD&E project inputs (costs), objectives, activities, and outputs were briefly described and documented. Actual and expected outcomes, and any actual and/or potential future impacts (positive and/or negative) associated with project outcomes then were identified and described. The principal economic, environmental, and social impacts were then summarised in a triple bottom line framework and validated through consultation with expert personnel and review of published literature.

Once impacts were identified and validated, an assessment then was made about whether to quantify/value any of the impacts in monetary terms as part of the project-level analysis. The decision to value an impact identified was based on:

- Data availability and information necessary to form credible valuation assumptions,
- The complexity of the relevant valuation methods applicable given project resources,
- The likely magnitude of the impact and/or the expected relative value of the impact compared to other impacts identified, and
- The strength of the linkages between the RD&E investment and the impact identified.

Where one or more of the identified impacts were selected for valuation, the impact assessment used cost-benefit analysis (CBA) as a principal tool. The impacts valued therefore were deemed to represent the principal benefits delivered by the project investment. However, as not all impacts were valued (based on the selection criteria), the investment criteria estimated for the project investment evaluated are likely to represent an underestimate of the true performance of the FRDC project.

The qualitative and quantitative analysis processes, data sources, assumptions, specific valuation frameworks (where applicable), and evaluation results were clearly documented and then integrated into a written report.

Project Background

Background

The Australian Prawn Farmers Association (APFA) represents the interests of the Australian prawn farming industry. APFA membership covers more than 95% of farmed prawn production in Australia. The industry is primarily located in Queensland and New South Wales.

The APFA has traditionally supported prawn farmers and related investors in their engagement with regulators and their local communities. In 2016, the APFA initiated an FRDC-supported project to establish a national marketing levy. This led to a need for a new Strategic Plan to integrate both productivity and market development strategies into the future.

Rationale for Project 2016-259

FRDC project 2016-259 was funded to service this need. Ridge Partners was contracted to assist with development of the process and help deliver the new Strategic Plan. Ridge Partners has significant experience with regard to seafood and prawns, as well as experience in strategic planning across a number of other industries.

Project Details

Project Code: 2016-259
Title: *APFA Strategic and RD&E Plan 2018-2022*
Research Organisation: Ridge Partners
Principal Investigator: Ewan Colquhoun, Director, Ridge Partners
Original Period of Funding: November 2016 to March 2017
FRDC Program Allocation: Industry 100%

Objectives

1. Consult stakeholders and review local and international prawn supply and market trends to guide APFA strategic priorities.
2. Conduct workshop with stakeholders to determine options and confirm strategies.
3. Prepare APFA Strategic and RD&E Plan 2018-2022.

Logical Framework

Table 1 provides a description of the project in a logical framework developed for the evaluation.

Table 1: Logical Framework for FRDC Project 2016-259

Activities	*Consultation by Ridge Partners with the Farmed Prawn Industry* • Initial consultations occurred between Ridge Partners and the industry via the APFA Chair and the APFA Executive Committee. • The consultation included the various steps to be undertaken in the ongoing development of the new Strategic Plan (the Plan). *Desktop Review and Completion of an APFA Strategic Planning Workshop* • A desktop review of the issues to be addressed was undertaken. • Issues addressed in the review included global and local markets, competition, supply chains, promotion, farming practices and technology, the sustainable nature of prawn farming, breeding and genetics, health and disease, biosecurity, nutrition, and regulatory processes associated with prawn farming. • A planning workshop was held with industry members and FRDC personnel. *Collation, Analysis and Documentation of all material including:* • The consultant from Ridge Partners met with the APFA Executive Committee a number of times to discuss various issues and needs. • Relevant material to be included in the Plan was assembled and analysed. • A draft of the integrated Plan covering both future RD&E and market development was prepared. *Development and Approval of the final Strategic Plan* • The final draft of the Strategic Plan was approved by the industry in 2019.

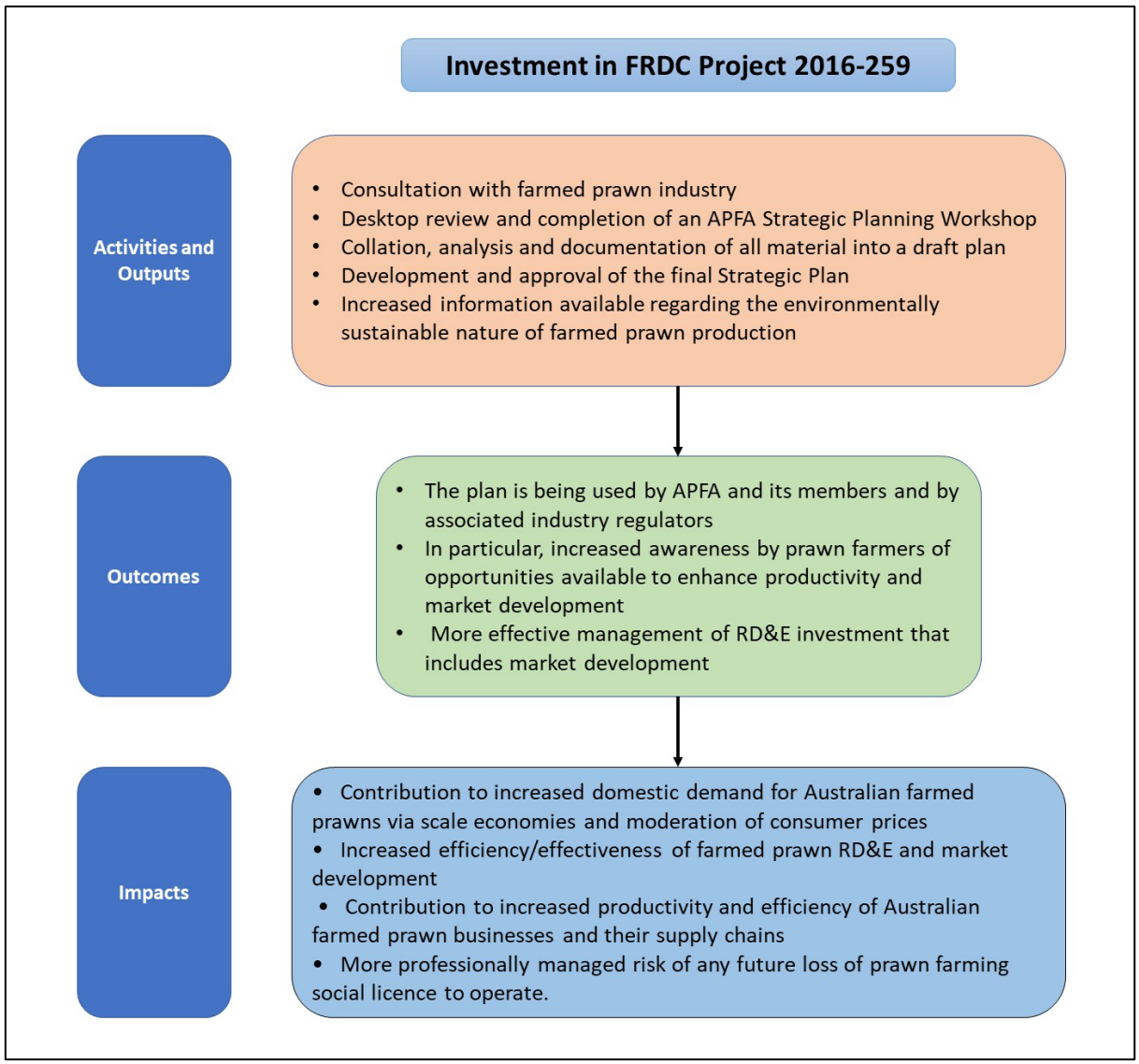
Outputs	• A revised and expanded Strategic Plan for the farmed prawn industry (Strategic Plan 2020-2025) that integrates both productivity and market development strategies over the next five years. • Increased information available regarding the sustainable nature of production used by Australian prawn farms.
Outcomes	• The Strategic Plan represents the central strategy document for the farmed prawn sector in Australia. • The Plan is being used by the APFA, its farming members, and the environmental regulators of the industry. • The Plan has Increased awareness by prawn farmers of opportunities available to enhance productivity and marketing. • The Strategic Plan was developed during and after a White Spot Disease (WSD) outbreak (2016-17) that temporarily closed 25% of the industry. As a result, APFA needed a document to show the way forward and give confidence to regulators (federal and state) and consumers regarding the sector's future (Ewan Colquhoun, pers. comm., 2022). • Based on the findings regarding the likely cause of the WSD outbreak, the industry had received $20 million compensation (from the Federal Government) and was required to repay part of this sum under a new compulsory WSD Repayment levy. It was important that this financial impact was clearly evident in the levy payments to be made by all farms under the Plan. • The original brief for Project 2016-259 included a proposal (supported by APFA Executive) to implement a compulsory Marketing Levy across the industry. At that time, prior to the WSD outbreak, the initial consultation round found there was clear majority support for this proposal across the operators – a formal levy poll (lead by an independent expert) was prepared by Ridge Partners and ready to roll out to confirm this (Ewan Colquhoun, pers. comm., 2022). • Then in December 2016 the nature of the industry changed (Ewan Colquhoun, pers. comm., 2022): a. The WSD outbreak created some significant market and sector uncertainty; also, in 2017 WSD put some pressure on smaller farms to upgrade their farm biosecurity systems. b. Large external investors had started to invest in the industry a few years earlier, and the post WSD outbreak coincided with a significant new large investment in existing and new farms. c. As a result of these new investments by large players, the membership of the APFA Executive Committee was in substantial transition and the APFA planning environment was very fluid during the balance of the Plan development process. d. Consultation for both the Strategic Plan and the Marketing Levy Proposal had to be repeated (a government and FRDC requirement) due to WSD and the changing APFA Executive. e. The associated outcomes of these changes were that: i. The Marketing Levy Proposal was withdrawn by APFA as the Strategic Plan was being finalised; this was because the new large integrated players did not want to contribute to a pre-competitive compulsory Marketing Levy. ii. The Strategic Plan was reshaped o to reflect the now revised and much greater expected growth in the industry (500%) over the coming decade; and

	○ to reflect the sector's rebalancing of the strategic issues and priorities due to the new membership of the APFA Executive Committee. • There was also an additional outcome. For some years the APFA executive had been frustrated with the way the RD&E process had operated. The Plan has therefore established a clearer investment framework to inform researchers seeking funding and guide strategic RD&E investments. The Appendix to the Strategic Plan lays out this framework that the industry needed to direct researchers to respond according to the industry's priorities; soon after the Plan was finalised and released, the APFA recruited an experienced R&D Manager and a PhD candidate researcher to support the new investment framework (Ewan Colquhoun, pers. comm., 2022).
Impacts	• The Plan provides guidance and strategies for industry and regulators to address marketing, productivity, and environmental issues, including: ○ A contribution to increased domestic demand for Australian farmed prawns due to the moderation of consumer prices. ○ Increased efficiency/effectiveness of farmed prawn RD&E resource allocation through identification and prioritisation of key industry issues and constraints; for example, from improved use of production and water technologies and increased integration of national supply chains. ○ More professional management of risk of any future loss of prawn farming social licence to operate.

Pathway to Impact

A diagram describing the simplified pathways to impact for the investment in Project 2016-259 is provided in Figure 1.

Figure 1: Pathway to Impact for Project 2016-259



Nominal Investment

Table 2 shows the annual investment made in Project 2016-259 by FRDC and Ridge Partners.

Table 2: Agreed Annual Investment in Project 2016-259 (nominal $)

Year ended 30 June	FRDC ($)	Ridge Partners ($)	TOTAL ($)
2017	25.000	0	25,000
2018	0	12,694	12,694
Total	25,000	12,694	37,694

The impact of the WSD outbreak in 2016-2017 led to an agreement to extend the duration of the project. Also, the advent of some new and large investments in the farmed prawn industry required additional consultations by Ridge Partners. Both the project and APFA needed to increase the number and locations of face-to-face meetings and the number of workshops to address these changes. This resulted in an increase in expenditure by Ridge Partners of $12,694 (time and travel) that was totally absorbed by Ridge Partners.

Program Management Costs

For the FRDC investment, the cost of managing the FRDC funding was added to the FRDC contribution for the project via a management cost multiplier (x1.179). This multiplier was estimated based on the share of 'employee benefits' and 'supplier' expenses in total FRDC expenditure reported in the FRDC's Cash Flow Statement (FRDC, 2017-2021). This multiplier then was applied to the nominal investment by FRDC shown in Table 2. A multiplier of 1.00 was applied to the nominal investment by Ridge Partners.

Real Investment and Extension Costs

For purposes of the investment analysis, the investment costs of all parties were expressed in 2020/21 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2021). No additional costs of extension were included as the outcomes and impacts were driven by project activities where industry stakeholders were heavily involved.

Impacts

Table 3 provides a summary of the principal types of impacts listed in Table 1 and categorised into economic, environmental and social impacts.

Table 3: Triple Bottom Line Categories of Principal Impacts from Project 2016-259

Economic	• A contribution to increased domestic demand for Australian farmed prawns due to policies that improved consumer awareness and moderated domestic consumer prices. • Increased efficiency/effectiveness of farmed prawn RD&E resource allocation through identification and prioritisation of key industry issues and constraints; for example, from improved use of production and water technologies and increased integration of national supply chains. • Improved research resource allocation in Australian farmed prawn RD&E leading to increased productivity and efficiency of Australian farmed prawn businesses and their supply chains.
Environmental	• Contribution to future environmental management of Australian farmed prawns.
Social	• Improved management of risk of any future loss of prawn farming social licence to operate. • Enhanced regional community well-being through the spill-over effects of increased profitability for the Australian farmed prawn industry.

Public versus Private Impacts

The impacts identified in this evaluation are directly related to development of the farmed prawn Strategic Plan delivered by FRDC Project 2016-259. Potentially, both public and private impacts have been delivered by the investment in the project. Private impacts will be delivered to prawn farms and their supply chains through the Plan's contribution to increased domestic demand and increased productivity. Public impacts are likely to include the following:

- More efficient research allocation of public research resources
- Some regional communities close to prawn farms and their supply chains also are likely to share in the gains.
- Improved environmental management of prawn farms.

Distribution of Private Impacts

The more direct benefits from the improvements in incomes and cost reductions will be captured initially by Australian farmed prawn enterprises but will be shared with other businesses in the supply chains with which they interact. The benefits will be shared according to associated supply and demand elasticities along each supply chain.

Impacts on Other Australian Industries

It is expected that there would be negligible impacts on other Australian primary industries.

Impacts Overseas

The major impact of the project overseas could include a reduced export of prawns to Australia due to an increase in domestic production and consumption of Australian farmed prawns.

Match with National Priorities

Australian Agriculture, Science, and Research Priorities

The Australian Government's National Science and Research Priorities and Agricultural Innovation Priorities are reproduced in Table 4. Project 2016-259 contributed to National Science and Research Priority 1. Further, the RD&E investment is likely to contribute indirectly to all four Agricultural Innovation Priorities through the development and implementation of improved fisheries policies and increased efficiency and/or effectiveness of future RD&E.

Table 4: Australian R&D Priorities

Australian Government	
National Science and Research Priorities[1]	**National Agricultural Innovation Priorities**[2]
1. Food – optimising food and fibre production and processing; agricultural productivity and supply chains within Australia and global markets. **2. Soil and Water** – improving the use of soils and water resources, both terrestrial and marine. **3. Transport** – boosting Australian transportation: securing capability and capacity to move essential commodities; alternative fuels; lowering emissions. **4. Cybersecurity** – improving cybersecurity for individuals, businesses, government, and national infrastructure. **5. Energy and Resources** – supporting the development of reliable, low cost, sustainable energy supplies and enhancing the long-term viability of Australia's resources industries. **6. Manufacturing** – supporting the development of high value and innovative manufacturing industries in Australia. **7. Environmental Change** – mitigating, managing, or adapting to changes in the environment. **8. Health** – improving the health outcomes for all Australians.	On 11 October 2021, the National Agricultural Innovation Policy Statement was released. It highlights four long-term priorities for Australia's agricultural innovation system to address by 2030. These priorities replace the Australian Government's Rural Research, Development and Extension Priorities which were published in the 2015 Agricultural Competitiveness White Paper. **1.** Australia is a trusted exporter of premium food and agricultural products by 2030. **2.** Australia will champion climate resilience to increase the productivity, profitability, and sustainability of the agricultural sector by 2030. **3.** Australia is a world leader in preventing and rapidly responding to significant incursions of pests and diseases through futureproofing our biosecurity system by 2030. **4.** Australia is a mature adopter, developer, and exporter of digital agriculture by 2030.

[1] Source: 2015 Australian Government *Science and Research Priorities*. https://www.industry.gov.au/data-and-publications/science-and-research-priorities.

[2] Source: 2021 National Agriculture Innovation Policy Statement. https://www.awe.gov.au/agriculture-land/farm-food-drought/innovation/research_and_development_corporations_and_companies#government-priorities-for-investment.

FRDC National RD&E Priorities

Through extensive consultation, the FRDC 2015-2020 RD&E Plan identified three national RD&E priorities to focus and direct FRDC investments. The three FRDC national RD&E priorities were:

1. Ensuring that Australian fishing and aquaculture products are sustainable and acknowledged to be so.
2. Improving productivity and profitability of fishing and aquaculture.
3. Developing new and emerging aquaculture growth opportunities.

Project 2016-259 indirectly addressed all three FRDC national RD&E priorities through the development and implementation of improved fisheries policies and increased efficiency and/or effectiveness of future RD&E.

Valuation of Impacts

Impacts Valued

The potential impacts valued in the assessment of the investment in FRDC Project 2016-259 include:

- Increase in efficiency of farm prawn RD&E investment leading to increased productivity gains and cost efficiencies in production of Australian farmed prawns,
- Improved management of risk of any future loss of prawn farming social licence to operate.

The valuation of the first potential impact above (Impact 1: Increased efficiency/effectiveness of resource allocation for farmed prawn RD&E) relies on the premise that research investment in elements of the value chain from prawn producer to end user will be made more efficient and better targeted at producer needs as a result of the new Plan. It is assumed that this will lead to subsequent benefits through an increase in annual future productivity gains. Past annual research investment by FRDC and APFA is shown in Table 5.

Table 5: FRDC and APFA industry RD&E Investment Contributions by Year

Year ended 30 June	2013	2014	2015	2016	2017	2018	2019
FRDC Contribution ($)	399,429	255,213	73,300	40,711	383,588	230,488	230,488
APFA Contribution ($)	127,232	148,956	189,250	161,515	177,197	151,738	130,666
Total	526,661	404,169	262,550	202,226	560,785	382,226	361,154

Source: FRDC Annual Reports, 2017, 2019

Note: The FRDC contribution for 2018 and 2019 has been based on the average for the years 2013 to 2017.

The valuation of the second potential impact (Impact 2: Reduced risk of loss of social licence to operate for Australian prawn farming) relies on a reduction in the risk of a loss of social licence to farm prawns in the future.

Specific assumptions made for the valuation of the two impacts are provided in Table 7. A degree of conservatism was applied when finalising assumptions for valuing the impacts, as some significant uncertainty was involved in many of the estimates.

Impacts not Valued

Three of the impacts identified in Table 3 were not valued for the following reasons (Table 6):

Table 6: Reasons for Not Valuing Impacts

Impact/Potential Impact	Reason why Impact Not Valued
Increased domestic demand for Australian farmed prawns (partly replacing imported uncooked prawns).	This impact has been assumed to be included in the increase in returns from future farmed-prawn RD&E investment
Contribution to future environmental management of Australian farmed prawns.	This impact is already valued through the reduced risk of a loss of social licence.
Enhanced regional community well-being through the spill-over effects of increased profitability for the Australian farmed prawn industry.	The regional spillover impacts have not been valued due to lack of relevant and available data, as well as time and resource constraints.

Summary of Assumptions

Table 7 present the specific assumptions used in the valuation of Impacts 1 and 2.

Table 7: Summary of Assumptions

Variable	Assumption	Source
Impact 1: Increase in returns from future farmed-prawns with and without new strategic plan		
Annual average past research expenditure on prawn farming (FRDC and APFA)	$385,682 per annum	APFA and FRDC (2013-2019), from Table 5
Assumed return on annual expenditure before new Strategic Plan	10.0%	Based on FRDC (2019) for the environment and industry programs, page 93
Assumed return on annual expenditure after new Strategic Plan	12.5%	Agtrans Research
Cumulative nature of annual returns	The assumed annual returns on the annual investment expenditure are assumed cumulative	Agtrans Research
First year of increased return due to the Plan	2024	As the revised plan addresses investment in the period 2020-2025, there is assumed to be a four year lag before any revised investment strategies are manifest in financial terms to growers
Last year of increased returns due to the Plan	2033	After 2033, it is assumed that the 2020-2025 plan investment changes will have been superseded by revised investment plans and associated grower impacts
Risk factors for Impact 1		
Probability of outputs	100%	Agtrans Research
Probability of outcomes occurring	75%	
Probability of impacts occurring given successful outcomes	75%	
Counterfactual for impact 1: Impact would not have occurred without the project		
Impact 2: Decrease in risk of loss of social licence to farmed prawns		
Average gross value of Australian farmed prawn production before project	$94 m per annum (years ending 30th June 2016 to 2020)	ABARES (2021)
Profitability of farmed prawn production as percentage of gross value	10.0%	Agtrans Research
Percentage of farmed prawn production at risk from loss of social licence	20.0%	
Percentage of farmed prawn production at risk from loss of social licence without project	19.0%	
First year of avoided loss due to project	2024	As the revised plan addresses investment in the period 2020-2025, there is assumed to be a lag before any revised environmental management practices are implemented by the industry and are evident to the community

Variable	Assumption	Source
Last year of avoided loss due to project	2028	After 2028, it is assumed that the 2020-2025 plan will be superseded by industry having to address a new set of environmental issues
Annual benefit from improved social licence	$94,000	$94m x 10% x (20.0%-19.0%)
Risk factors for Impact 2		
Probability of output	100%	Agtrans Research
Probability of outcomes occurring	50%	
Probability of impacts occurring given successful outcomes	50%	
Counterfactual for Impact 2: Impact as estimated would not have occurred without the project		

Results

All costs and benefits were expressed in 2020/21 dollar terms. All costs and benefits were discounted to 2021/22 (year of evaluation) using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the Modified Internal Rate of Return (MIRR). The base analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the investment period plus 30 years from the last year of investment (2017/18) to the final year of benefits assumed.

Investment Criteria

Tables 8 and 9 show the investment criteria estimated for different periods of benefits for the total investment and FRDC investment respectively.

Table 8: Investment Criteria for Total Investment in Project 2016-259

Investment criteria	**Number of years from year of last investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present value of benefits ($)	0	0	161,808	249,420	249,420	249,420	249,420
Present value of costs ($)	57,488	57,488	57,488	57,488	57,488	57,488	57,488
Net present value ($)	-57,488	-57,488	104,320	191,932	191,932	191,932	191,932
Benefit-cost ratio	0.00	0.00	2.81	4.34	4.34	4.34	4.34
Internal rate of return (%)	negative	negative	18.2	21.5	21.5	21.5	21.5
MIRR (%)	negative	negative	24.8	20.0	15.1	12.6	11.1

Table 9: Investment Criteria for FRDC Investment in Project 2016-259

Investment criteria	**Number of years from year of last investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present value of benefits ($m)	0.00	0.00	113,737	175,321	175,321	175,321	175,321
Present value of costs ($m)	40,989	40,989	40,989	40,989	40,989	40,989	40,989
Net present value ($m)	-40,989	-40,989	72,748	134,332	134,332	134,332	134,332
Benefit-cost ratio	0.00	0.00	2.77	4.28	4.28	4.28	4.28
Internal rate of return (%)	negative	negative	17.5	20.8	20.8	20.8	20.8
MIRR (%)	negative	negative	11.7	10.9	9.0	8.0	7.4

The annual undiscounted benefit and cost cash flows for the total investment for the duration of investment period plus 30 years from the last year of investment are shown in Figure 2.

Figure 2: Annual Cash Flow of Undiscounted Total Benefits and Total Costs

Sources of Benefits

There were two sources of benefits valued in the analysis. Table 10 shows estimates of the relative contribution from each source.

Table 10: Contribution of Source of Benefits to Present Value of Benefits (PVB)
(Total investment, 30 years)

Source of Benefit	PVB ($)	%
Impact 1: Increased returns from RD&E	152,522	61.15
Impact 2: Social licence risk reduction	96,898	38.85
Total	249,420	100.0

Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 11 presents the results. The results showed a moderate sensitivity to the discount rate.

Table 11: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	Discount rate		
	0%	5% (base)	10%
Present value of benefits ($)	334,446	249,420	191,536
Present value of costs ($)	45,690	57,488	71,596
Net present value ($)	288,756	191,932	119,940
Benefit-cost ratio	7.32	4.34	2.68

A second sensitivity analysis was undertaken with respect to the assumed return on strategic expenditure after the new Strategic Plan was introduced. Table 12 shows the results. It should be recognised that, while this benefit was the principal benefit of the two impacts valued, either benefit would have covered the investment costs alone.

Table 12: Sensitivity to Assumed Return on Strategic Expenditure after the New Strategic Plan
(Total investment, 30 years)

Investment Criteria	Assumed return on RD&E expenditure after new RD&E Plan		
	11%	12.5% (Base)	14%
Present value of benefits ($)	157,907	249,420	340,933
Present value of costs ($)	57,488	57,488	57,488
Net present value ($)	100,419	191,932	283,445
Benefit-cost ratio	2.75	4.34	5.93

Confidence Ratings and other Findings

The results produced are highly dependent on the assumptions made, some of which are uncertain. There are two factors that warrant recognition. The first factor is the coverage of benefits. Where there are multiple types of benefits it is often not possible to quantify all the benefits that may be linked to the investment. The second factor involves uncertainty regarding the assumptions made, including the linkage between the research and the assumed outcomes. A confidence rating based on these two factors has been given to the results of the investment analysis (Table 13). The rating categories used are High, Medium and Low, where:

High: denotes a good coverage of benefits or reasonable confidence in the assumptions made

Medium: denotes only a reasonable coverage of benefits or some uncertainties in assumptions made

Low: denotes a poor coverage of benefits or many uncertainties in assumptions made

Table 13: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
Medium	Medium-Low

The coverage of benefits was assessed as ‘Medium’. While the two principal benefits identified were valued, there were several other benefits identified that were not valued quantitatively in this assessment.

The confidence in the assumptions made was considered ‘Medium-Low’. The assumptions used to value the two impacts depended strongly on assumptions made by the analyst for a range of future parameters.

Conclusions

The investment in Project 2016-259 has delivered an industry-driven Strategic Plan for the Australian farmed prawn industry. The implementation of the Plan by the industry and FRDC is expected to result in more effective RD&E investment by FRDC and the industry in the years after the plan was produced and released. The investment in the new Strategic Plan is likely to not only result in more effective industry strategies and research funding resulting in higher productivity gains to the farmed prawn industry, but also in the improved management of risk of any future loss of prawn farming social licence to operate.

The total funding for the project totalled $57,488 over the two years (present value terms). Given the assumptions made, the benefits accruing to the investment were estimated to be $249,420 in present value terms. This gave a net present value of $191,932, a benefit-cost ratio of 4.3 to 1 and an internal rate of return of 21.5%. As some of the impacts identified were not valued, the investment criteria as provided by the valued benefits are likely to be a potential underestimate of the investment performance.

Glossary of Economic Terms

Cost-benefit analysis:	A conceptual framework for the economic evaluation of projects and programs in the public sector. It differs from a financial appraisal or evaluation in that it considers all gains (benefits) and losses (costs), regardless of to whom they accrue.
Benefit-cost ratio:	The ratio of the present value of investment benefits to the present value of investment costs.
Discounting:	The process of relating the costs and benefits of an investment to a base year using a stated discount rate.
Internal rate of return:	The discount rate at which an investment has a net present value of zero, i.e., where present value of benefits = present value of costs.
Investment criteria:	Measures of the economic worth of an investment such as Net Present Value, Benefit-Cost Ratio, and Internal Rate of Return.
Modified internal rate of return:	The internal rate of return of an investment that is modified so that the cash inflows from an investment are re-invested at the rate of the cost of capital (the re-investment rate).
Net present value:	The discounted value of the benefits of an investment less the discounted value of the costs, i.e., present value of benefits - present value of costs.
Present value of benefits:	The discounted value of benefits.
Present value of costs:	The discounted value of investment costs.

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