FINAL

An Impact Assessment of FRDC Investment in 2016-266: A Plan for the Australian Prawn Farming Industry's Initial Response to the White Spot Disease Incident in Summer 2016-17

Agtrans Research

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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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Len Stephens, Managing Director, Seafood Cooperative Research Centre Company Ltd

Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
APFA	Australian Prawn Farmers Association
CRC	Cooperative Research Centre
CRC-P	Cooperative Research Centres Project
CRRDC	Council of Rural Research and Development Corporations
DAF	Department of Agriculture and Fisheries (Queensland)
DAWR	Department of Agriculture and Water Resources (Commonwealth)
EADRA	Emergency Aquatic Animal Disease Response Agreement
FRDC	Fisheries Research and Development Corporation
MIRR	Modified Internal Rate of Return
OCS	Office of the Chief Scientist
OIE	World Organisation for Animal Health (Office International des Epizooties)
POMS	Pacific Oyster Mortality Syndrome
PVB	Present Value of Benefits
RD&E	Research, Development and Extension
SPF	Specific Pathogen Free
WSD	White Spot Disease
WSSV	White Spot Syndrome Virus

Executive Summary

What the report is about

This report presents the results of an impact assessment of a Fisheries Research and Development Corporation (FRDC) investment in *A Plan for the Australian Prawn Farming Industry's Initial Response to the White Spot Disease Incident in Summer 2016-17.* The project was funded by FRDC over the period February 2017 to May 2017.

Methodology

The investment was analysed qualitatively within a logical framework that included activities and outputs, outcomes and impacts. Impacts were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation. Past and future cash flows were expressed in 2017/18 dollar terms and were discounted to the year 2017/18 using a discount rate of 5% to estimate the investment criteria.

Results/key findings

The key impact identified was of a financial nature. It is likely that the findings and recommendations of the project have contributed to improved prawn aquaculture research, development and extension resource allocation through the identification and improved prioritisation of industry and government needs with respect to prawn farming biosecurity and disease management.

Investment Criteria

Funding for the project totalled $94,357 (present value terms) and produced estimated total expected benefits of $109,023 (present value terms). This gave a net present value of $14,666, an estimated benefit-cost ratio of 1.2 to 1, an internal rate of return of 9.3% and a modified internal rate of return of 5.5%.

Conclusions

The investment in this project helped to keep lines of communication open during the Queensland White Spot Disease (WSD) incursion crisis (Len Stephens, pers. comm., 2018) and facilitated the alignment of decisions associated with the WSD response between industry and government. While some potential economic impacts identified were not valued, these impacts were considered indirect and minor when compared with the impact valued. Nevertheless, combined with conservative assumptions for the impact valued, investment criteria as provided by the valued impact may be an underestimate of the investment performance.

Keywords

Impact assessment, cost-benefit analysis, prawn aquaculture, White Spot Disease, WSD, response plan

Introduction

The Fisheries Research and Development Corporation (FRDC) required a series of impact assessments to be carried out annually on a number of investments in 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 stakeholders.
- Reporting to the Council of Rural Research and Development Corporations (CRRDC).

The first series of impact assessments, that included 20 randomly selected FRDC investments, was completed in August of 2017. The published reports for the first series of evaluations can be found at: http://frdc.com.au/Research/Benefits-of-research/2017-Portfolio-Assessment

The second series of impact assessments also included 20 randomly selected FRDC investments. The investments were worth a total of approximately $5.62 million (nominal FRDC investment) and were selected from an overall population of 96 FRDC investments worth an estimated $21.32 million (nominal FRDC investment) where a final deliverable had been submitted in the 2016/17 financial year.

The 20 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 26% 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.

Project 2016-266: *A Plan for the Prawn Farming Industry's Initial Response to the White Spot Disease Incident in Summer 2016-17* was selected as one of the 20 investments and was analysed in this report.

General Method

The impact assessments followed general evaluation guidelines that are now well entrenched within the Australian primary industry research sector including Research and Development Corporations, Cooperative Research Centres (CRCs), State Departments of Agriculture, and some Universities. The approach includes both qualitative and quantitative descriptions that are in accord with the impact assessment guidelines of the CRRDC (CRRDC, 2014).

The evaluation process involved identifying and briefly describing project objectives, activities and outputs, outcomes, and impacts. The principal economic, environmental and social impacts were then summarised in a triple bottom line framework.

Some, but not all, of the impacts identified were then valued in monetary terms. Where impact valuation was exercised, the impact assessment uses cost-benefit analysis as its principal tool. The decision not to value certain impacts was due either to a shortage of necessary evidence/data, a high degree of uncertainty surrounding the potential impact, or the likely low relative significance of the impact compared to those that were valued. The impacts valued are therefore deemed to represent the principal benefits delivered by the project. However, as not all impacts were valued, the investment criteria reported for individual investments potentially represent an underestimate of the performance of that investment.

Background and Rationale

Background

The Australian Prawn Farming Industry

There are 22 operational prawn farms in Australia, 95% of which are found along the Queensland coast at the Logan River, Bundaberg, Mackay, Ayr, Townsville, Cardwell, Cairns and Mossman. The other 5% are located in northern New South Wales (Yamba) (APFA, n.d.). Production is seasonal, with prawn ponds stocked in spring and harvested during summer, and the majority of prawns produced are sold domestically. Species grown include the black tiger prawn and the banana prawn.

The gross value of production of farmed prawns was approximately $86.5 million (4,628 tonnes) in 2015/16 and made up over 95% of the value of Australia's crustacean aquaculture production ($90.3 million) (ABARES, 2017).

White Spot Disease and the Queensland Incursion

White Spot Disease (WSD) is caused by the White Spot Syndrome Virus (WSSV) and is highly contagious. WSD affects decapod crustaceans, including prawns, and is exotic to Australia. The disease is widespread throughout prawn farming regions in Asia and has become established in prawns farmed in the Americas. Animals infected with the virus display a lack of appetite, uncoordinated movements and lethargy, leading to death in up to 80% of affected animals (Loynes, 2017).

WSSV is listed as a 'notifiable disease' by the World Organisation for Animal Health (OIE) and, as such, any instances of WSD must be reported to the Australian Government and to the OIE. A confirmed incursion of WSD triggers the implementation of the WSD Disease Strategy under the Australian Aquatic Veterinary Emergency Plan, known as AQUAVETPLAN[1]. The plan was created by the Department of Agriculture and Water Resources (DAWR) in line with existing OIE disease manuals.

WSD was detected and confirmed in seven prawn farms in the Logan River in the summer of 2016-17. The causal virus also has been detected in a number of wild-caught prawns and crabs taken from the Logan River and Moreton Bay regions. Symptoms of WSD include a loose shell with numerous white spots (0.5-2.0 mm in diameter) on the inside surface of the shell and a pink to red discolouration (DAF, 2018).

The disease is primarily spread through the movement of infected animals or contaminated water. Birds that feed on and move infected animals can also spread WSD. When the disease was confirmed in December 2016, the Department of Agriculture and Fisheries (DAF) Queensland, with the support of industry, implemented a strategy of eradication.

As part of this strategy, a quarantine zone was established that included the seven affected prawn farms and one separate hatchery. All stocked ponds were treated with chlorine, then drained and dried out. DAWR also implemented an import suspension for uncooked prawns to allow the source of the WSD incursions to be investigated by Biosecurity Queensland.

All prawn farming jurisdictions continue to monitor stocks and collect samples as part of an ongoing national surveillance program. The surveillance and sampling are part of a two-year process aimed at demonstrating proof of freedom from WSD by January 2019.

[1] AQUAVETPLAN is a series of technical response manuals for aquatic animal disease incursions, based on sound analysis and linking policy, strategies, implementation, coordination and emergency-management plans. The plan can be found at: http://www.agriculture.gov.au/SiteCollectionDocuments/animal-plant/aquatic/aquavetplan/white-spot.pdf

Rationale

Previous FRDC Investment in Emergency Response Planning

In 2016/17 FRDC funded Project 2015-406: *Development of a national Pacific Oyster Mortality Syndrome (POMS) response plan*. The relatively small investment in Project 2015-406 (approximately $30,000 in present value terms) was evaluated as part of the first series of FRDC's annual impact assessment program in 2017. The evaluation found that investment in the POMS national response plan likely resulted in an increase in efficiency for RD&E expenditure under the Future Oysters Cooperative Research Centres Project (CRC-P) through improved priority setting.

The analysis of the POMS national response plan provided a good example of how a small investment in priority identification may benefit the seafood industry in the short- to medium-term through potentially decreased RD&E costs and increased biosecurity preparedness.

The initial POMS plan was considered valuable by FRDC and paved the way for similar investment (Nicole Stubing, pers. comm., 2018).

Rational for Project 2016-266

WSD is an exotic disease and its detection in Australia resulted in 'emergency animal disease provisions' being implemented by State and Commonwealth governments. Under these legislative provisions, the Australian prawn farming industry had no power to decide on, or influence, how the disease was to be eradicated by the State of Queensland (Len Stephens, pers. comm., 2018). A coordinated response from the Australian prawn farming industry was needed to ensure Federal and State stakeholders were able to provide targeted assistance and to ensure that efforts by stakeholders were not duplicated and / or contradictory.

Project 2016-266 was funded to deliver a WSD Response Plan to the Australian Prawn Farmers Association (APFA) on behalf of the Australian prawn farming industry.

Project Details

Summary

Project Code: 2015-232

Title: *A Plan for the Prawn Farming Industry's Initial Response to the White Spot Disease Incident in Summer 2016-17*

Research Organisation: Seafood CRC Company Ltd

Principal Investigator: Len Stephens

Period of Funding: February 2017 to May 2017

FRDC Program Allocation: Adoption (50%), Industry (50%)

Objectives

The project's key objectives were:

1. Deliver a Prawn Industry WSD Response Plan covering actions that can be implemented on individual farms by the whole of industry and government.
2. To prepare a plan for the prawn farming industry and its stakeholders to respond to WSD in the short, medium and long term.
3. Provide assistance to APFA in consultation with stakeholders, identification of sources of assistance and coordination of the stakeholder response to WSD.

Logical Framework

Table 1 provides a detailed description of the project in a logical framework.

Table 1: Logical Framework for Project 2016-266

Activities and Outputs	• There were many technical elements about the WSD eradication process that were not initially agreed between DAF and the prawn farming industry. The project, through a rigorous consultation process, helped to create an environment where Government and industry were able to discuss WSD response options and agree on future RD&E that was required for use in the face of further WSD outbreaks (Len Stephens, pers. comm., 2018). • APFA assisted the project team by identifying key industry, technical, and government stakeholders for consultation. • Key stakeholders then were consulted to assess and identify industry needs to deal with WSD for infected and uninfected areas. • The consultation process led to the documentation and prioritisation of the immediate (0 – 6 months), short (6 – 12 months), medium (12 – 24 months) and long term (> 24 months) needs of the Australian prawn industry both within, and beyond, WSD containment areas. • Eight immediate needs were identified: 1. ability to restock prawn ponds in the WSD control zone by September 2017, 2. improved biosecurity infrastructure on farms 3. a supply of post larvae (juvenile prawns) for restocking, 4. strengthened translocation protocol for prawn broodstock, 5. a new Code of Practice for the production of prawns, 6. increased diagnostic testing capacity, 7. reduced risk of further WSSV incursions through the review of importation protocols, and

	8. an 18-month suspension of production (feasible only if the affected farms are financially compensated). • The medium and longer-term needs identified included: o establishment of a Specific Pathogen Free (SPF) supply of prawn broodstock, o development of a national prawn selective breeding program, o establishment of an Emergency Aquatic Animal Disease Response Agreement (EADRA), and o additional RD&E targeted at disease diagnostics, and containment and control (such as iRNA, disease vaccines, and genetic disease resistance). • The WSD response planning process also was used to identify funding opportunities at a federal level to potentially assist affected industry stakeholders. Options identified included: o Compensation of affected farms for their direct losses. Ridge Partners (2017) estimated the direct loss of the seven affected prawn farms at $7.9 million up to the point of pond chlorination and decommissioning. o Assistance to all prawn farms for enhancement of biosecurity. o Compensation for an 18-month suspension of production. o Assistance for the establishment of a SPF supply of prawn broodstock. o Cost sharing arrangements for emergency diseases (e.g. development of a levy/matched government funding pool under an EADRA). • A final report was produced in March 2017, titled: *Prawn White Spot Disease Response Plan*. The report describes how the Australian prawn farming industry should respond to the WSD incident of 2016-17, and how the industry may recover.
Outcomes	• The project helped to align decisions associated with WSD response options between industry and government. • The findings and recommendations from the project report have been used by stakeholders to guide and prioritise future RD&E investment in Australian prawn aquaculture. • For example, the use of on-farm diagnostic tests was prohibited during the WSD outbreak. RD&E to evaluate the tests now has been noted as a priority and may make use of the tests on-farm allowable in the future (Len Stephens, pers. comm., 2018). • Also, the Australian prawn farming industry now has a major focus on RD&E to assist and improve biosecurity infrastructure and practices (Len Stephens, pers. comm., 2018). • Further, research to help establish a SPF supply of broodstock now is a significant new priority (Len Stephens, pers. comm., 2018). • The findings of the project have highlighted the need for additional RD&E to update the Australian Government's Import Risk Analysis for uncooked prawns being shipped to Australia. • Development of the Prawn WSD Response Plan also shifted industry opinion on the introduction of an EADRA for the prawn aquaculture industry. A working group was established to investigate ways to make the EADRA concept work in aquaculture (Stephens, 2017). • Discussions to establish an Aquatic EADRA are ongoing with the goal to achieve a positive outcome by the end of 2018 (Len Stephens, pers. comm., 2018). • A report produced by the project was used as part of submissions to the Australian Government that were required for the prawn farming industry to receive compensation (Len Stephens, pers. comm., 2018). • A $20 million compensation package for WSD affected farmers was agreed upon by the Government and industry in mid-2017.
Impacts	• Contribution to improved efficiency of future prawn farming RD&E resource allocation.

	• Some potential contribution to a reduced risk of future Australian WSD incursions through future RD&E investments related to prawn aquaculture biosecurity. • Some potential contribution to the maintenance of the future economic viability and sustainability of the Australian prawn aquaculture industry.

Project Investment

Nominal Investment

Table 2 shows the annual investment (cash and in-kind) in project 2016-266 by FRDC and others. 'Others' includes contributions by the Seafood CRC Company Ltd.

Table 2: Annual Investment in Project 2016-266 (nominal $)

Year ended 30 June	FRDC ($)	OTHER ($)	TOTAL ($)
2017	70,388	10,000	80,388
Totals	70,388	10,000	80,388

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 (1.122). This multiplier was estimated based on the share of 'employee benefits' and 'supplier' expenses' in total FRDC expenditure (5-year average) reported in the FRDC's Cash Flow Statement (FRDC, Annual Reports, 2013-2017). This multiplier then was applied to the nominal investment by FRDC shown in Table 2.

For the Seafood CRC Company investment (other), it was assumed that any program management and administration costs were already included in the nominal amounts shown in Table 2.

Real Investment and Extension Costs

For the purposes of the investment analysis, the investment costs of all parties were expressed in 2017/18 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2018). No additional costs of extension were included as the project included a high level of consultation with key stakeholders, including APFA (prawn industry representatives), Government and technical experts, and extension through presentations and published project findings

Impacts

Table 3 provides a summary of the principal types of impacts from project 2016-266 investment. Impacts have been categorised into economic, environmental and social impacts.

Table 3: Triple Bottom Line Categories of Principal Impacts from Project 2016-266

Economic	• Contribution to improved efficiency of future prawn farming RD&E resource allocation. • Some potential contribution to a reduced risk of future Australian WSD incursions through future RD&E investments related to prawn aquaculture biosecurity. • Some potential contribution to the maintenance of the future economic viability and sustainability of the Australian prawn aquaculture industry.
Environmental	• Nil
Social	• Nil

Public versus Private Impacts

The major impacts identified in this analysis are predominantly private impacts, including improved RD&E resource allocation for private contributions to prawn farming RD&E and some potential contribution to the future economic viability of the Australian prawn aquaculture industry. Some minor public impacts may be achieved through more efficient allocation of public funds invested in prawn farming RD&E through the FRDC.

Distribution of Private Impacts

Private impacts will likely be captured by the individual prawn aquaculture industry enterprises investing in prawn farming RD&E through the FRDC and other research providers. Benefits would be distributed according to associated supply and demand elasticities along the farmed prawn industry supply chain.

Impacts on other Australian industries

It is possible that more efficient future resource allocation for prawn aquaculture RD&E may lead to some minor spill-over benefits for Australian wild-catch prawn fisheries and, potentially, other crustacean producers (such as crab, lobster etc.).

Impacts Overseas

No significant impacts to overseas parties are expected.

Match with National Priorities

The Australian Government's Science and Research Priorities and Rural RD&E priorities are reproduced in Table 4. The project findings and related impacts will contribute primarily to Rural RD&E Priority 2, and to Science and Research Priority 1.

Table 4: Australian Government Research Priorities

Australian Government	
Rural RD&E Priorities (est. 2015)	**Science and Research Priorities (est. 2015)**
1. Advanced technology 2. Biosecurity 3. Soil, water and managing natural resources 4. Adoption of R&D	1. Food 2. Soil and Water 3. Transport 4. Cybersecurity 5. Energy and Resources 6. Manufacturing 7. Environmental Change 8. Health

Sources: (DAWR, 2015) and (OCS, 2015)

Valuation of Impacts

Impacts Valued

Analyses were undertaken for total benefits that included future expected benefits. A degree of conservatism was used when finalising assumptions, particularly when some uncertainty was involved. Sensitivity analyses were undertaken for those variables where there was greatest uncertainty or for those that were identified as key drivers of the investment criteria.

One key impact of the project was valued. This was the investment's contribution to more efficient prawn aquaculture RD&E resource allocation through the project's identification and prioritisation of industry and government needs with respect to prawn WSD.

Impacts Not Valued

Not all impacts identified in Table 3 could be valued in the assessment. The potential impacts of the project's contribution to the future economic viability and sustainability of the Australian prawn aquaculture industry and contribution to a reduced risk of future WSD incursions were hard to value because of indirect and uncertain causal relationships and pathways between the project investment and the potential impacts. Also, there was a lack of evidence/data available on which to base credible assumptions.

The economic impacts identified but not valued included:

- Some potential contribution to a reduced risk of future Australian WSD incursions through future RD&E investments related to prawn aquaculture biosecurity.
- Some potential contribution to the maintenance of the future economic viability and sustainability of the Australian prawn aquaculture industry.

Valuation of Impact 1: Increased Efficiency of Prawn Aquaculture RD&E Resource Allocation

In 2001 the Australian prawn farming industry became the first Australian seafood sector to implement a compulsory federal levy based on production, to fund RD&E. Funds contributed by the prawn industry (through APFA) are matched by the Australian Government and managed by FRDC. Table 5 shows the FRDC's expenditure on prawn aquaculture RD&E for the past five years, as well as the annual APFA industry contribution.

Table 5: FRDC Expenditure on Prawn Aquaculture RD&E and APFA Industry Contributions by Year

Year ended 30 June	**2013**	**2014**	**2015**	**2016**	**2017**
FRDC RD&E Project Expenditure[(a)] ($)	399,429	255,213	73,300	40,711	383,588
APFA Contribution ($)	127,232	148,956	189,250	161,515	177,197

Source: FRDC Annual Report, 2017

(a) Reasons for variation in actual FRDC APFA RD&E spend include (Nicole Stubing, pers. comm., 2018):
(1) Spend from 2008 to 2015 attributed to the Australian Seafood CRC. The Seafood CRC wrapped up in 2015 which led to a marked decrease in prawn farming RD&E expenditure;
(2) The FRDC RD&E plan was still in development, thus strategic RD&E priorities were still being determined; and
(3) The new Industry Partnership Agreement with APFA commence during this period.

The investment in the development of the WSD Response Plan (project 2016-266) is assumed to have marginally improved FRDC's prawn aquaculture RD&E investment prioritisation, selection and management, and therefore contributed to increased efficiency of RD&E resource allocation.

It was assumed the maximum impact would be achieved in 2018 and remain at this maximum level for five years. After this period, it was assumed that the impact would decrease to zero by 2026 as the impact of the information and priorities produced by the investment wanes and new strategic planning for prawn aquaculture RD&E takes place.

Specific assumptions for valuing Impact 1 are provided in Table 6.

Counterfactual

It was assumed that, without FRDC's investment to develop the Prawn WSD Response Plan, FRDC would have directed scarce RD&E resources less efficiently and therefore additional RD&E expenditure would have been required to deliver the same outputs.

Summary of Assumptions

A summary of key assumptions made for valuation of the impacts is shown in Table 6.

Table 6: Summary of Assumptions

Variable	**Assumption**	**Source**
Impact 1: Improved RD&E resource allocation efficiency		
Annual FRDC RD&E investment in prawn aquaculture	$383,588 p.a.	2016/17 FRDC RD&E expenditure, see Table 5
Efficiency dividend due to improved priority setting	5.0%	Agtrans Research (conservative assumption)
RD&E expenditure required to achieve same outputs without dividend	$402,767 p.a.	$383,588 x (1.05/1)
First year of impact	2017/18	Based on publication of project 2016-266 final report in March of 2017
Duration of maximum impact	5 years, then declining linearly to zero by 2025/26	Agtrans Research

Results

All past and future costs and benefits were expressed in 2017/18 dollar terms. All costs and benefits were discounted to 2017/18 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 project investment period plus 30 years from the last year of investment (2016/17) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2014).

Investment Criteria

Tables 7 and 8 show the investment criteria estimated for different periods of benefits for the total investment and the FRDC investment respectively. The present value of benefits (PVB) attributable to the FRDC investment only, shown in Table 8, has been estimated by multiplying the total PVB by the FRDC proportion of real investment before discounting (88.8%).

Table 7: Investment Criteria for Total Investment in Project 2016-266

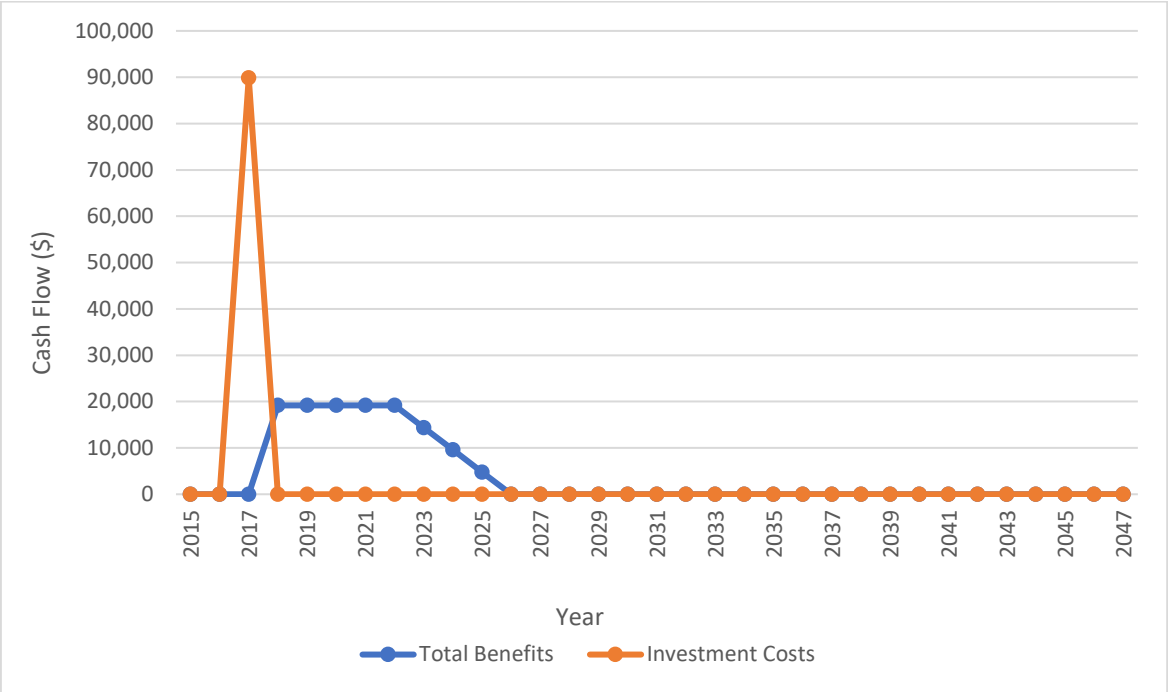
Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($)	0	87,189	109,023	109,023	109,023	109,023	109,023
Present Value of Costs ($)	94,357	94,357	94,357	94,357	94,357	94,357	94,357
Net Present Value ($)	-94,357	-7,168	14,666	14,666	14,666	14,666	14,666
Benefit-Cost Ratio	0.00	0.92	1.16	1.16	1.16	1.16	1.16
Internal Rate of Return (%)	negative	2.2	9.3	9.3	9.3	9.3	9.3
MIRR (%)	negative	3.5	6.5	6.0	5.8	5.6	5.5

Table 8: Investment Criteria for FRDC Investment in Project 2016-266

Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($)	0	77,393	96,774	96,774	96,774	96,774	96,774
Present Value of Costs ($)	83,755	83,755	83,755	83,755	83,755	83,755	83,755
Net Present Value ($)	-83,755	-6,363	13,018	13,018	13,018	13,018	13,018
Benefit-Cost Ratio	0.00	0.92	1.16	1.16	1.16	1.16	1.16
Internal Rate of Return (%)	negative	2.2	9.3	9.3	9.3	9.3	9.3
MIRR (%)	negative	3.5	6.5	6.0	5.8	5.6	5.5

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the project 2016-266 investment plus 30 years from the last year of investment are shown in Figure 1.

Figure 1: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs



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 9 presents the results. The results showed a low sensitivity to the discount rate. This is largely because the expected future benefits from the project are short-term and occur in first 10 years after the last year of investment.

Table 9: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	**Discount rate**		
	0%	**5% (base)**	**10%**
Present value of benefits ($)	124,666	109,023	96,781
Present value of costs ($)	89,864	94,357	98,850
Net present value ($)	34,803	14,666	-2,069
Benefit-cost ratio	1.39	1.16	0.98

A sensitivity analysis was undertaken for the assumption of the efficiency dividend for Impact 1 (increased efficiency of prawn aquaculture RD&E resource allocation) as this was a variable with some uncertainty. The results, reported in Table 10, showed a moderate sensitivity to the assumption of the efficiency dividend. A break-even analysis was also conducted on the efficiency dividend assumption. The analysis showed that the investment criteria were positive for an efficiency dividend of approximately 4.3%.

Table 10: Sensitivity to the Assumed Efficiency Dividend for Prawn Aquaculture RD&E Resource Allocation (Total investment, 30 years)

Investment Criteria	**Assumed Efficiency Dividend**		
	2.5%	**5.0% (base)**	**7.5%**
Present value of benefits ($)	54,511	109,023	163,534
Present value of costs ($)	94,357	94,357	94,357
Net present value ($)	-39,845	14,666	69,178
Benefit-cost ratio	0.58	1.16	1.73

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 11). 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 11: Confidence in Analysis of Project

Coverage of Benefits	**Confidence in Assumptions**
Medium-High	Low

The coverage of benefits was assessed as medium to high as the impact valued was considered the primary and most direct impact from the investment (increased efficiency of prawn aquaculture RD&E resource allocation). On the other hand, while some assumptions were supported by data and information obtained through public reports and consultation with the project Principal Investigator, the level assumed for the efficiency dividend was uncertain. Therefore, confidence in assumptions was assessed as low.

Conclusions

The investment in this project helped to keep lines of communication open during the Queensland WSD incursion crisis (Len Stephens, pers. comm., 2018) and facilitated the alignment of decisions associated with the WSD response between industry and government. Further, the findings and recommendations of the project have contributed to improved prawn aquaculture RD&E resource allocation through the identification and improved prioritisation of industry and government needs with respect to prawn farming biosecurity and disease management.

Funding for the project totalled $94,357 (present value terms) and produced estimated total expected benefits of $109,023 (present value terms). This gave a net present value of $14,666, an estimated benefit-cost ratio of 1.2 to 1, an internal rate of return of 9.3% and a modified internal rate of return of 5.5%.

While some potential economic impacts identified were not valued, these impacts were considered indirect and minor when compared with the impact valued. Nevertheless, combined with conservative assumptions for the impact valued, investment criteria as provided by the valued impact may be an 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 investment costs:	The discounted value of investment costs.

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