FINAL

An Impact Assessment of FRDC Investment in 2015-406: Development of a National Pacific Oyster Mortality Syndrome (POMS) Response Plan

Agtrans Research

November 2017

FRDC Project No **2016-134**

An Impact Assessment of FRDC Investment in 2015-406: Development of a National Pacific Oyster Mortality Syndrome (POMS) Response Plan
Project 2016-134

2017

Researcher Contact Details

Name:	Talia Hardaker
Address:	Suite 36, Benson House,
	Toowong QLD 4066
Phone:	07 3870 4047
Fax:	07 3371 3381
Email:	talia@agtrans.com.au

FRDC Contact Details

Address:	25 Geils Court
	Deakin ACT 2600
Phone:	02 6285 0400
Fax:	02 6285 0499
Email:	frdc@frdc.com.au
Web:	www.frdc.com.au

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

Contents

List of Tables

List of Figures

Acknowledgments

Agtrans Research and Consulting would like to thank Patrick Hone (Executive Director) and Nicole Stubing (Project 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.

Jan Davis, Principal Consultant, Agribusiness Tasmania
Bruce Zippel, President, Oysters Australia
Jo-Anne Ruscoe, Project Manager, Fisheries Research and Development Corporation

Abbreviations

ASI	Australian Seafood Industries Pty Ltd
CRC-P	Cooperative Research Centre Project
CRRDC	Council of Rural Research and Development Corporations
CSIRO	Commonwealth Scientific and Industrial Research Organisation
FRDC	Fisheries Research and Development Corporation
NSW	New South Wales
OsHV-1 μVar	Ostreid Herpesvirus-1 Microvariant
POMS	Pacific Oyster Mortality Syndrome
RD&E	Research, Development and Extension
SA	South Australia

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 2015-406: *development of a national Pacific Oyster Mortality Syndrome (POMS) response plan*. The project was funded by FRDC over the period April 2016 to May 2016.

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 valued. Benefits were estimated for a range of time frames up to 30 years from the year of last investment. Past and future cash flows were expressed in 2016/17 dollar terms and were discounted to the year 2016/17 using a discount rate of 5% to estimate the investment criteria.

Results/key findings

The major impact identified was of a financial nature involving improved efficiency of research, development and extension (RD&E) resource allocation. A social impact was also identified but not valued. It is expected that investors in the Future Oysters CRC-P (including the Commonwealth Government, State Government departments and private industry organisations) will be the primary beneficiaries of the investment.

Investment Criteria

Total funding from all sources for the project was $30,018 (present value terms). The value of benefits was estimated at $53,852 (present value terms). This gave an estimated net present value of $23,834, and a benefit-cost ratio of approximately 1.8 to 1.

Conclusions

The investment in this project has likely resulted in an increase in efficiency for RD&E expenditure under the Future Oysters CRC-P through improved priority setting.

The analysis provided a good example of a small investment in priority identification that has benefited the seafood industry in the short to medium term through potentially decreased RD&E costs.

Keywords

Impact assessment, Pacific Oyster, Pacific Oyster Mortality Syndrome, national response plan, RD&E priorities

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 included 20 randomly selected FRDC investments worth a total of approximately $6.31 million (nominal FRDC investment). The investments were selected from an overall population of 136 FRDC investments worth an estimated $24.98 million (nominal FRDC investment) where a final deliverable had been submitted in the 2015/16 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 25% 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 2015-406: *Development of a national Pacific Oyster Mortality Syndrome (POMS) response plan* 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, 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

Pacific Oyster Mortality Syndrome (POMS) is a devastating disease affecting Pacific Oysters. It is caused by the virus *ostreid herpesvirus-1 microvariant* (OsHV-1 µVar). POMS has been associated with high mortality events involving Pacific Oysters in Europe, New Zealand and New South Wales (NSW). All ages of Pacific Oysters may be affected, but spat and juvenile oysters often suffer higher mortalities.

The first POMS event in Australia occurred in late 2010, when high mortalities occurred in two estuaries in NSW (Botany Bay and Port Jackson). Nearly all of the cultivated Pacific Oysters in the Georges River (Botany Bay) died during that event.

POMS was confirmed in some Pacific Oyster leases on Tasmania's south east coast in February 2016. Tasmanian hatcheries supply spat to the industry, impacting oyster farms in South Australia (SA) and NSW severely. At the time of the 2016 detection, NSW and SA immediately took precautionary steps by placing a ban on the importation of spat stock from Tasmania. A ban was also put in place to stop stock being moved around Tasmania.

At this stage, South Australia remains free of the disease. Following the POMS outbreak in Tasmania the FRDC agreed to provide $25,000 to Oysters Australia to support a national approach to developing a response plan, including new research investment and industry assistance.

Rationale

Already present in Australia, POMS has the potential to devastate the Pacific Oyster industry, as it has done overseas.

POMS now affects all Pacific Oyster growing states in Australia except SA and there was a need for a coordinated national response plan to support the survival of the Australian Pacific Oyster industry.

Project Details

Summary

Project Code: 2015-406

Title: *Development of a national Pacific Oyster Mortality Syndrome (POMS) response plan*

Research Organisation: Oysters Australia

Principal Investigator: Jan Davis

Period of Funding: April 2016 to May 2016.

Objectives

The project had only one objective:

1. To develop a national POMS response plan

Logical Framework

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

Table 1: Logical Framework for Project 2015-406

Activities and Outputs	• Extensive consultation was carried out with the peak industry bodies in Tasmania, NSW and SA, as well as researchers, state management agencies, FRDC personnel and State and Commonwealth ministers and departments. • There was unanimous agreement from stakeholders that the only viable option to support recovery from the Tasmanian and NSW POMS events was the urgent development of a Pacific Oyster resistant to POMS. • The project assessed industry needs, current government and industry responses to the POMS outbreaks, and industry investment priorities. • A report was produced that included a list of suggested investment priorities (including RD&E investment) related to POMS and the sustainability of the Pacific Oyster industry. • The priorities were categorised in a matrix organised by time frame and RD&E theme. *Time frame categories included:* i) critical (0 to 6 months) [5 priorities], ii) urgent (6 to 12 months) [7 priorities], iii) medium (12 to 24 months) [5 priorities], and iv) long (> 24 months) [5 priorities]. *RD&E theme categories included:* i) enhance sustainability, ii) increase profit and productivity, and iii) promote leadership and innovation. • A table summarising the range of suggested investment priorities is reproduced in Appendix 1.
Outcomes	• The findings and recommendations from the project report have been used by stakeholders to guide investment in Pacific Oyster RD&E to support the survival and sustainability of the industry in the presence of POMS.

	• Specifically, the findings of the report provided input to a Government decision to invest in the Australia Seafood Industries' (ASI[1]) oyster breeding program to ensure its survival (Bruce Zippel, pers. comm., 2017). • The report also provided input that contributed to ASI changing its funding model from a levy on spat sales (production based) to one of Hatchery Service (fee based) (Bruce Zippel, pers. comm., 2017). • The development of the POMS national response plan has shifted industry opinion on the introduction of an Aquatic Animal Health Deed for the oyster industry. Oysters Australia now is actively involved on behalf of state bodies in the development of an Aquatic Deed (Bruce Zippel, pers. comm., 2017). • A national Biosecurity Plan for hatchery production is being developed (draft currently being circulated to stakeholders) (Bruce Zippel, pers. comm., 2017). • Significant investment in new hatchery and nursery systems has been undertaken in South Australia with Shellfish Culture Ltd and Cameron of Tasmania Pty Ltd now involved. Tasmania has been able to improve access to clean spat through Shellfish Culture which has been formally approved as bio-secure (Bruce Zippel, pers. comm., 2017). • By providing input to decision makers on key priorities for industry investment, the national POMS response plan may have made some contribution to the long-term economic viability and sustainability of the Australian Pacific Oyster industry. • Importantly, the findings of project 2015-406 assisted in determining the RD&E priorities for the Future Oysters Cooperative Research Centre Project (CRC-P) (Bruce Zippel, pers. comm., 2017). • The Future Oysters CRC-P, funded for a three-year period from September 2016 to August 2019, is conducting research that will accelerate the breeding of disease resistant oysters, improve disease management, increase productivity and profitability, and diversify risks to allow the Australian oyster aquaculture industry to grow both domestically and globally (CRC Programme, 2016). • The national POMS response plan has contributed to scarce resources being channelled into high priority RD&E areas so contributing to increased resource investment efficiency.
Potential Impacts	• Contribution to improved RD&E resource allocation for the Future Oysters CRC-P. • Some contribution to maintaining the future economic viability and sustainability of the Australian Pacific Oyster industry. • Contribution to improved response times for future POMS outbreaks.

[1] ASI Pty Ltd is a company jointly owned by the South Australian and Tasmanian oyster industry associations formed in 2000. ASI is responsible for the Australia-wide Pacific Oyster selective breeding program.

Project Investment

Nominal Investment

Table 2 shows the annual investment for the project funded by FRDC. There were no other contributors to the investment.

Table 2: Annual Investment in the Project 2015-406 (nominal $)

Year ended 30 June	FRDC ($)	OTHER ($)	TOTAL ($)
2016	25,000	0	25,000
Totals	25,000	0	25,000

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 (1.115). 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, 2016). This multiplier then was applied to the nominal investment by FRDC 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 2016/17 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2016). No additional costs of extension were included as the project included a high-level of stakeholder consultation.

Impacts

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

Table 3: Triple Bottom Line Categories of Principal Impacts from the Development of a National POMS Response Plan

Economic	• Contribution to more efficient RD&E resource allocation through the project's input into the development of the RD&E priorities for the Future Oysters CRC-P. • Some contribution to maintaining the future economic viability of the Australian Pacific Oyster industry through the use of project's findings to support and guide Government investment in the ASI breeding program. • Some contribution to the future sustainability and profitability of the industry through the project's promotion of a Pacific Oyster industry Biosecurity Plan and 'certified clean' alternative hatchery programs.
Environmental	• Nil
Social	• Improved community well-being through the spill-over effects of maintained industry profitability (through marginal contributions the maintenance and development of the ASI breeding program and clean hatchery programs) given the presence of POMS in Australia. • Contribution to improved response times for future POMS outbreaks through a cohesive national approach.

Public versus Private Impacts

The CRC-P has received funding from both private industry organisations, State departments and the Commonwealth Government. Thus, the key impact identified in this evaluation, improved efficiency of RD&E investment for the Future Oysters CRC-P, has both private and public elements. Other impacts identified (i.e. the potential for some contribution to the economic viability and sustainability of the Australian Pacific Oyster industry via the maintenance and development of the breeding program and clean hatchery programs, and community spill-overs) are industry related and therefore private impacts. However, linkages with investment in project 2015-406 are weak and the pathway to impact is uncertain therefore the industry impacts are considered marginal.

Distribution of Private Impacts

For the impact valued, private benefits will likely be captured by the individual oyster industry organisations investing in the Future Oysters CRC-P.

Impacts on other Australian industries

There is no evidence of POMS affecting any other marine species (Davis, 2016). Therefore, it is assumed that project impacts will be confined to the Australian Pacific Oyster industry.

Impacts Overseas

No significant benefits to overseas parties are expected, with the possible exception where best practice biosecurity measures and/or POMS resistant genetic material from the ASI breeding program may be shared with other countries (e.g. POMS affected Pacific Oyster industries such as in New Zealand).

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 contribution to more efficient RD&E resource allocation through the project's input into the development of the RD&E priorities for the Future Oysters CRC-P.

Impacts Not Valued

Not all impacts identified in Table 3 could be valued in the assessment. The future economic industry impacts and social impacts were hard to value because of the difficulty in quantifying the causal relationships and pathways between the national POMS response plan and the specific future economic and social impacts. The extent of the plan's contribution to investment decisions related to the maintenance and development of the ASI breeding program and clean hatchery programs was particularly uncertain and, based on the importance of these programs to the survival of the Australian Pacific Oyster industry, it was likely that support for these programs would have happened anyway.

The economic impact identified but not valued included:

- Contribution to maintaining the future economic viability of the Australian Pacific Oyster industry through the use of project's findings to support and guide Government investment in the ASI breeding program.
- Contribution to the future sustainability and profitability of the industry through the project's promotion of a Pacific Oyster industry Biosecurity Plan and 'certified clean' alternative hatchery programs.

The social impact identified but not valued included:

- Improved community well-being through the spill-over effects of maintained industry profitability given the presence of POMS in Australia.

Valuation of Impact: Increased efficiency of RD&E resource allocation

The valuation of increased efficiency of RD&E resource allocation centres on the investment in the Future Oysters CRC-P. Participants in the CRC-P include ASI, FRDC, Oysters Australia, CSIRO, several Universities and State Government departments and other private companies. The Commonwealth Government has invested $3 million over the three years while other participants have committed just over $8.3 million making the total investment in the Future Oysters CRC-P approximately $11.3 million over three years.

The development of the national POMS response plan is assumed to have marginally improved the RD&E priority setting and therefore contributed to increased efficiency of the large RD&E investment made in the Future Oysters CRC-P.

Specific assumptions for valuing the impact are provided in Table 5.

Counterfactual

It was assumed that, without the FRDC's investment to develop a national POMS response plan, the Future Oysters CRC-P would have directed scarce RD&E resources less efficiency and therefore additional RD&E expenditure would have been required by to deliver the same outputs.

Summary of Assumptions

A summary of key assumptions made for valuation of the impacts is shown in Table 5.

Table 5: Summary of Assumptions

Variable	Assumption	Source
Actual total Future Oyster CRC-P RD&E Investment	$11.3 million over 3 years	CRC Programme, 2016
Efficiency dividend due to improved priority setting	0.5%	Agtrans Research (conservative assumption)
RD&E expenditure required to achieve same outputs without dividend	$56,500	$11.3m x (100.5/100)
Period efficiency dividend delivered (years ended June)	2017-2019	Based on the period of funding for the Future Oysters CRC-P, September 2016 to August 2019 assuming all final year expenditures are made prior to 30 June 2019.

Results

All benefits after 2016/17 were expressed in 2016/17 dollar terms. All costs and benefits were discounted to 2016/17 using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the Modified Internal Rate of Return. 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 in Project 2015-406 (2015/16).

Investment Criteria

Tables 6 and 7 show the investment criteria estimated for different periods of benefits for the total investment and the FRDC investment. As FRDC represented 100% of the investment the investment criteria presented in Tables 6 and 7 are the same.

Table 6: Investment Criteria for Total Investment in Project 2015-406

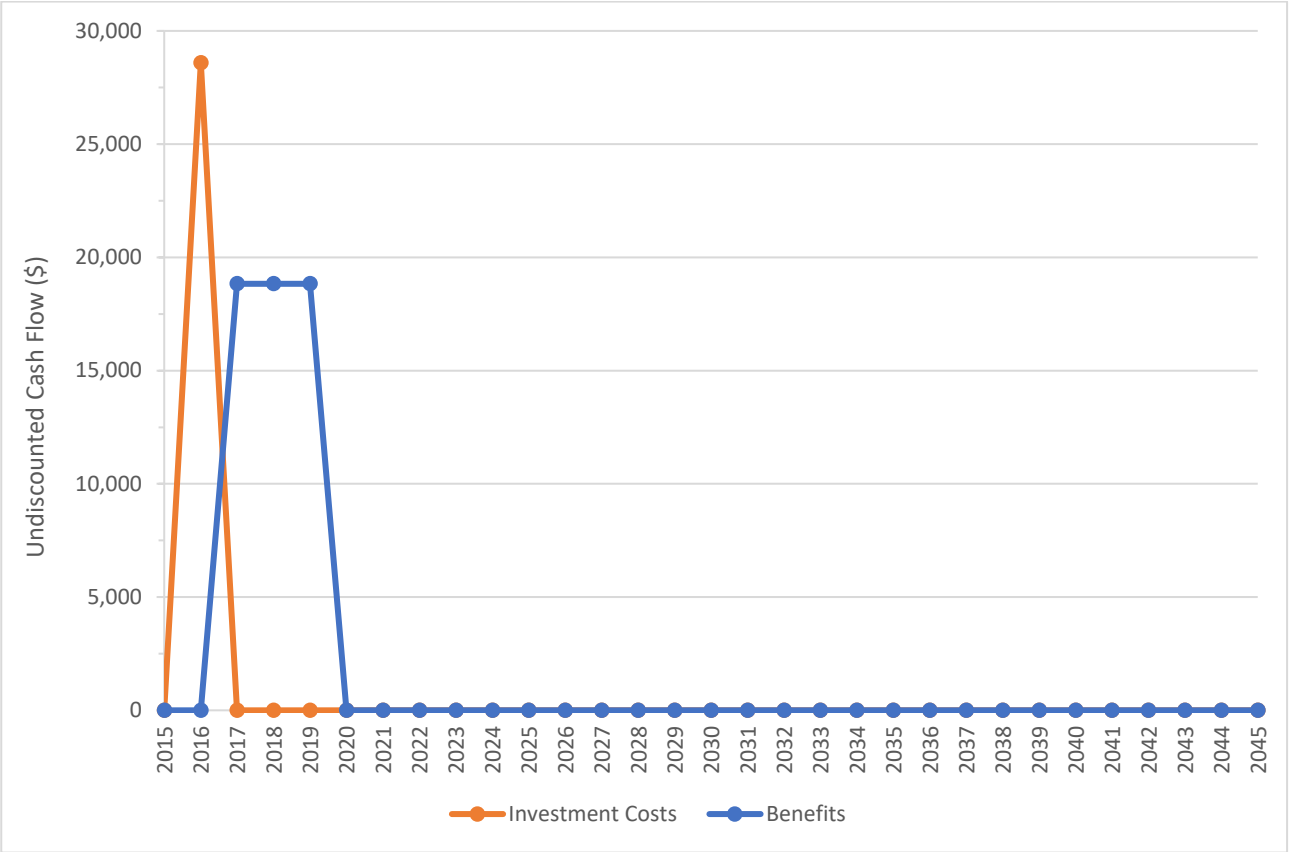
Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($)	0	53,852	53,852	53,852	53,852	53,852	53,852
Present Value of Costs ($)	30,018	30,018	30,018	30,018	30,018	30,018	30,018
Net Present Value ($)	-30,018	23,834	23,834	23,834	23,834	23,834	23,834
Benefit-Cost Ratio	0.00	1.79	1.79	1.79	1.79	1.79	1.79
Internal Rate of Return (%)	negative	44.10	44.10	44.10	44.10	44.10	44.10
Modified Internal Rate of Return (%)	negative	21.67	12.11	9.52	8.31	7.61	7.16

Table 7: Investment Criteria for FRDC Investment in Project 2015-406

Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($)	0	53,852	53,852	53,852	53,852	53,852	53,852
Present Value of Costs ($)	30,018	30,018	30,018	30,018	30,018	30,018	30,018
Net Present Value ($)	-30,018	23,834	23,834	23,834	23,834	23,834	23,834
Benefit-Cost Ratio	0.00	1.79	1.79	1.79	1.79	1.79	1.79
Internal Rate of Return (%)	negative	44.10	44.10	44.10	44.10	44.10	44.10
Modified Internal Rate of Return (%)	negative	21.67	12.11	9.52	8.31	7.61	7.16

The annual undiscounted benefit and cost cash flows for the total investment for the duration of Project 2015-406 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 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 8 presents the results. The results showed a low sensitivity to the discount rate.

Table 8: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	**Discount rate**		
	0%	**5% (base)**	**10%**
Present value of benefits ($)	56,500	53,852	51,519
Present value of costs ($)	28,589	30,018	31,448
Net present value ($)	27,911	23,834	20,072
Benefit-cost ratio	1.98	1.79	1.64

A sensitivity analysis was undertaken assumption of the efficiency dividend as this was a key driver of the results and was a variable with high uncertainty. The results, reported in Table 9, show a moderate level of sensitivity to the efficiency dividend assumption. A break-even analysis also was carried out on the assumed efficiency dividend. Results indicated that, for the investment to break even, the efficiency dividend had to be 0.279%. Given the conservative nature of the base assumption (0.5%) it is likely that the investment generated positive investment criteria.

Table 9: Sensitivity to Efficiency Dividend
(Total investment, 30 years)

Investment Criteria	**Efficiency Dividend**		
	0.25%	**0.5% (base)**	**2.5%**
Present value of benefits ($)	26,926	53,852	269,261
Present value of costs ($)	30,018	30,018	30,018
Net present value ($)	-3,092	23,834	239,243
Benefit-cost ratio	0.90	1.79	8.97

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 10). 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 10: Confidence in Analysis of Project

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

Only one impact was valued from four identified. The coverage of benefits was assessed as medium due to lack of evidence available demonstrating a clear pathway to impact for non-valued impacts identified. This indicated that the impact valued represents the most significant benefit. Likewise, while the assumptions for RD&E investment costs were supported by reports the level assumed for the efficiency dividend variable is somewhat speculative and therefore confidence was considered to be low.

Conclusions

The investment in this project has likely resulted in an increase in efficiency for RD&E expenditure under the Future Oysters CRC-P through improved priority setting.

Funding for project 2015-406 in 2015/16 totalled $30,018 (present value terms) and produced estimated total expected benefits of $53,852 (present value terms). This gave a net present value of $23,834, an estimated benefit-cost ratio of 1.8 to 1, an internal rate of return of 44.1% and a modified internal rate of return of 7.2%.

While several economic and social impacts identified were not valued, the linkage between the project and these impacts were weak and their contributions were considered minor compared with the impact valued. Nevertheless, combined with conservative assumptions for the impact valued, investment criteria as provided by the valued benefit may be underestimates of the investment performance.

The analysis provided a good example of a small investment in priority identification that has benefited the seafood industry in the short to medium term through potentially decreased RD&E costs.

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.

References

Australian Bureau of Statistics. (2016). *5204.0 - Australian System of National Accounts, 2015-16.* Canberra: Australian Bureau of Statistics. Retrieved from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5204.02015-16?OpenDocument

Cooperative Research Centres Programme. (2016). *CRC Projects Directory July 2016-17.* Canberra: Commonwealth Department of Industry, Innovation and Science. Retrieved from https://www.business.gov.au/assistance/cooperative-research-centres-programme/cooperative-research-centres-projects-crc-ps/selection-round-outcomes

Council of Rural Research and Development Corporations. (2014). *Impact Assessment Guidelines.* Canberra: Council of Rural Research and Development Corporations. Retrieved from http://www.ruralrdc.com.au/wp-content/uploads/2016/04/CRRDC-Impact-Assessment-Guidelines-V.1-070514.pdf

Davis, J. (2016). *A National Industry Response to Pacific Oyster Mortality Syndrome (POMS).* Canberra: Fisheries Research and Development Corporation. Retrieved from http://frdc.com.au/research/Final_reports/2015-406-DLD.pdf

Department of Agriculture and Water Resources. (2015). *Agricultural Competitiveness White Paper.* Canberra: Commonwealth of Australia. Retrieved from http://agwhitepaper.agriculture.gov.au/SiteCollectionDocuments/ag-competitiveness-white-paper.pdf

Fisheries Research and Development Corporation. (2016). *Annual Report 2015-16.* Canberra: Fisheries Research and Development Corporation. Retrieved from http://www.frdc.com.au/about_frdc/Documents/Annual_Report/FRDC_Annual_Report_2016.pdf

Office of the Chief Scientist. (2015). *Strategic Science and Research Priorities.* Canberra: Commonwealth of Australia. Retrieved from http://www.chiefscientist.gov.au/wp-content/uploads/STRATEGIC-SCIENCE-AND-RESEARCH-PRIORITIES_181214web.pdf

Appendices

Appendix 1: Summary of suggested investment priorities for the Australian Pacific Oyster industry

Figure 4: Summary of suggested investment priorities

Theme	A. Enhance sustainability	B. Increase profit & productivity	C. Promote leadership & innovation
Time frame			
1: Critical 0-6 months	Secure funding for ASI [1] Ensure a viable hatchery and nursery sector [2] Strengthen leasehold asset classification	Develop a definitive POMS reference resource	Undertake industry risk assessment
2: Urgent **6-12 months**	Review the voluntary ASI levy system Develop a farm biosecurity manual Develop an industry biosecurity plan	Refine production & husbandry systems Improve value chain efficiencies Develop environ forecasting & monitoring system	Develop national industry strategic plan
3: Medium **12-24 months**	Review industry investment capacity & levies Investigate alternative business models	Develop stock forecasting & price monitoring system Develop national regulation & compliance program	Strengthen industry representation structures
4: Long **> 24 months**	Investigate opportunities for diversification Support industry emergency response deed	Introduce POMS resistant breeds [3] Develop comprehensive farm management system	Develop industry capacity building program

Notes: There is unanimous agreement that the POMS resistance breeding program is key to the future of the industry. This leads to inevitable prioritisation of the suggested investment priorities to ensure this aim can be achieved.

1 Ensuring that ASI's work can continue is of paramount importance. Securing funding for this ongoing program is the highest priority of all suggested actions.
2 Ensuring that hatcheries and nurseries remain viable in the short term is also important, as without them, rebuilding will be impossible. This is the second priority.
3 Assuming that the breeding program continues and delivers resistant breeds, commercialisation of these new breeds should be the third priority.