FRDC
FISHERIES RESEARCH & DEVELOPMENT CORPORATION

Evaluation of FRDC RD&E projects completed in years ending June 2016 to June 2020

2019/20 FRDC Evaluation Sample (Year 5)

Aggregate Summary Report

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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

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Abbreviations & Acronyms

BCR	Benefit-Cost Ratio
CBA	Cost-Benefit Analysis
CRRDC	Council of Rural Research and Development Corporations
FRDC	Fisheries Research and Development Corporation
IRR	Internal Rate of Return
KPI	Key Performance Indicator
M&E	Monitoring and Evaluation
MIRR	Modified Internal Rate of Return
n.s.	No Unique Solution
NPV	Net Present Value
NR	Not Reported
PVB	Present Value of Benefits
PVC	Present Value of Costs
RD&E	Research, Development and Extension
RDC	Research and Development Corporation

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.

Introduction

The following summary report presents a summary and results for the aggregate analysis of the fifth year (2019/20) of an annual series of economic evaluations (impact assessments) of research, development and extension (RD&E) investments carried out for the Fisheries Research and Development Corporation (FRDC) that commenced in 2015/16 (FRDC Project 2016-134).

Background

The FRDC undertakes a range of performance reporting across all aspects of its business. FRDC reporting is driven by a range of legislative and mandatory reporting requirements particularly the Primary Industries Research and Development Act 1989 and the Public Governance, Performance and Accountability Act 2013.

Performance reporting also is undertaken at different time intervals ranging from monthly financial statements through to annual whole of agency reporting. FRDC reporting includes:

- Annual Reports
- Investment Impact Assessment (including Cost-Benefit Analysis (CBA)) Reports
- Financial statements
- FRDC Stakeholder Surveys
- Senate Orders
- Reporting under the FRDC's Statutory Funding Agreement with the Commonwealth Government

The FRDC's performance assessment methods aim to:

1. Ensure the FRDC's RD&E investments deliver economic, social and environmental impacts for fishing and aquaculture in Australia.
2. Inform decision making for the FRDC board and other stakeholders when evaluating future RD&E investments.
3. Demonstrate to the Commonwealth Government and investors the benefits of investing in fishing and aquaculture RD&E.
4. Inform the FRDC's extension approach to maximise the adoption by end users.

One key assessment approach undertaken by the FRDC is investment impact assessments (including CBA). Impact assessments are undertaken annually on a number of randomly selected FRDC investments from within the FRDC's RD&E portfolio.

Agtrans Research was contracted to complete the annual impact assessments under FRDC project 2016-134: *Evaluation of Research and Development (R&D) projects completed in years ending June 2016 to June 2018* with a variation that extended to project agreement to include evaluation of FRDC R&D projects completed in years ending June 2019 and June 2020.

The four previous series of impact assessments each included 20 randomly selected FRDC investments and were completed in August 2017, November 2018, October 2019, and January 2022[1] respectively[2].

[1] Delivery of the fourth series of impact assessments was affected by the Covid-19 pandemic and staff changes at both FRDC and Agtrans Research. The final evaluations therefore were completed in late calendar 2021 and the final summary report delivered in January 2022.

[2] The published reports for the first (2017) and second (2018) series of evaluations can be found at: https://www.frdc.com.au/frdc-project-impact-assessments-benefits-research. For information regarding final reports associated with the third and fourth year of evaluations (completed 2019, 2022), please contact FRDC.

RDC impact assessment and performance reporting

The annual evaluation program being undertaken by the FRDC also is part of the Council of Rural Research and Development Corporations (CRRDC) work to collaboratively implement a framework of impact assessment and CBA to evaluate RD&E activities.

The FRDC assessment uses the methodology developed by the CRRDCs impact assessment framework which is based on the work of the Department of Finance in *Introduction to Cost-Benefit Analysis and Alternative Evaluation Methodologies* (Commonwealth of Australia, 2006), and subsequent discussions with the Department to refine the methodology.

Generating and documenting evidence of impact and demonstrating performance of the Research and Development Corporations (RDCs) as a collective is also a key objective for the CRRDC.

Method

The economic 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, 2018).

The evaluation process involved identifying and briefly describing project objectives, activities, outputs, actual and expected outcomes, and any actual and/or potential impacts associated with project outcomes. The principal economic, environmental, and social impacts were then summarised in a triple bottom line framework.

Once impacts were identified and described, a decision then was made whether to value any of the impacts in monetary terms. Where it was decided to value one or more of the impacts, some, but not necessarily all, of the impacts identified were then valued in monetary terms. 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 impact valuation was exercised, the impact assessment used cost-benefit analysis (CBA) as a principal tool. The impacts valued were therefore deemed to represent the principal benefits delivered by the project. However, as the scope of the assessments focused on economic impacts and not all impacts were valued, the investment criteria reported for individual investments are likely to be an underestimate of the true performance of that investment.

Sample Selection

Brief Description of the Selection Process

As in the four previous series of FRDC impact assessments, the fifth series of impact assessments included 20 randomly selected FRDC RD&E investments and was completed in calendar year 2022. The random sample of 20 investments had a total estimated value of $5.30 million (nominal FRDC investment) and were selected from an overall population of 81 FRDC RD&E investments with a total investment of approximately $17.66 million (nominal FRDC investment) where a final deliverable had been submitted and accepted in the 2019/20 financial year.

The 20 investments were selected through a stratified, random sampling process. The RD&E investments selected spanned all five FRDC Programs under the FRDC RD&E Plan 2015-20 (Environment, Industry, Communities, People and Adoption) (FRDC, 2015), 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 RD&E investments.

The 2019/20 Evaluation Sample

From the initial population of 81 RD&E investments (projects) the following 20 projects were randomly selected for evaluation as part of the 2019/20 FRDC evaluation sample. A description of the 2019/20 random sample is presented in Table 1 below.

Table 1: Stratified random sample of 20 projects for economic evaluation as part of the FRDC's annual evaluation program 2019/20 (by Project Code)

Project Code	Project Title	FRDC Program Allocation(s)	Total FRDC Investment (nominal $)
2009-324	People Development Program: Nuffield Scholarship for an Aquaculture and/or Fish producer	People (100%)	337,079
2011-521	ABARES Outlook Conference	Adoption (60%) People (40%)	53,401
2014-022	Developing a rapid molecular identification technique to improve egg production-based fish biomass assessments	Environment (60%) People (30%) Industry (10%)	175,121
2014-405	Oysters Australia IPA: Australian edible oyster RD&E investment via Oysters Australia strategic plan 2014-2019	Adoption (100%)	252,923
2015-018	Do commercial fishery data reflect stock status in South Australia's Southern Garfish fisheries?	Environment (100%)	498,941
2016-044	Next-generation Close-kin Mark Recapture: using SNPs to identify half-sibling pairs in Southern Bluefin Tuna and estimate abundance, mortality and selectivity	Environment (70%) Industry (30%)	329,002
2016-045	Development of Pilchard orthomyxo virus vaccine for salmonids	Industry (100%)	1,742,108
2016-053	Mareframe - Co-creating Ecosystem-based Fisheries Management Solutions (EU led project)	Environment (100%)	75,000
2016-118	Using scat DNA to inform sustainable fisheries management and Ecological Risk Assessments: a Shy Albatross case study	Environment (75%) Industry (25%)	96,500
2016-235	Improving post-harvest survival of live held Southern Rock Lobster	Industry (100%)	663,818
2016-259	Australian Prawn Farmers Association (APFA) Strategic and R&D Plan 2020-25	Industry (100%)	31,693

Project Code	Project Title	FRDC Program Allocation(s)	Total FRDC Investment (nominal $)
2016-417	National People Development: Membership of PIEFA to support and encourage the teaching and learning in Australian schools of information related to the Australian Fishing Industry	Communities (50%) People (25%) Environment (25%)	200,182
2016-803	Future oysters CRC-P: New Technologies to Improve Sydney Rock Oyster Breeding and Production	Industry (100%)	204,067
2017-057	Stock predictions and spatial population indicators for Australia's east coast saucer scallop fishery	Industry (100%)	159,000
2017-109	Development of Fish Health Indicators for the Gladstone Harbour Report Card	Environment (100%)	156,371
2017-145	Pilot - Development of Seafood Nutritional Panels	Industry (100%)	149,480
2017-188	Environmental and Economic accounting in Primary Industries (Natural Capital Accounting) - linked to 2017-175	Environment (100%)	110,365
2018-153	AgriFutures: FRDC Contribution: Phase 2 of $100 billion growth strategy	Industry (100%)	20,012
2018-207	Bursaries for emerging leaders in the Southern Rock Lobster industry to attend the 2019 Trans-Tasman Lobster Congress.	People (100%)	21,225
2019-095	Update of AQUAVETPLAN Disease Strategy Manual, White Spot Disease	Environment (100%)	20,125
Total[(a)]			**5,296,412**

(a) Total may be subject to minor rounding errors.

Tables 2 and 3 present some key descriptive statistics about the sample in relation to the sample selection criteria.

Table 2: Key sample statistics for firth year of annual FRDC economic evaluations (2019/20)

FRDC Program Area	No. of Projects in Sample	Total FRDC Investment in Sample[(a)] (nominal $)	Proportion of Total Sample Investment (%)
Environment	8	1,461,425	27.6
Industry	7	2,970,177	56.1
Communities	1	200,182	3.8
People	2	358,304	6.8
Adoption	2	306,324	5.8
Total	**20**	**5,296,412**	**100.0**

(a) Total FRDC investment for each project in the 2019-20 sample, categorised by Program based on the project's dominant/ primary Program allocation.

Table 3: Number of projects in each project size category[(a)] within the random stratified sample

Program	Small (≤ $50,000)	Medium ($50,001 to $250,000)	Large (> $250,000)	Totals
Environment	1	5	2	8
Industry	2	3	2	7
Communities	0	1	0	1
People	1	0	1	2
Adoption	0	1	1	2
Totals	**4**	**10**	**6**	**20**

(a) Project size categories determined by FRDC and based on the total nominal FRDC investment only.

Aggregate Results

Overview

The following section presents estimated investment criteria for each of the 20 FRDC RD&E investments evaluated, for all 20 investments in aggregate, and for the aggregate investment by Program under the fourth series of annual FRDC impact assessments (the 2019/20 FRDC evaluation sample). For each set of investment criteria, the criteria were estimated for the total investment and for the FRDC investment alone.

Of the 20 randomly selected RD&E investments evaluated, seven included identified impacts that were not valued in monetary terms. This was consistent with the previous four annual FRDC evaluation samples from 2015/16 to 2018/19. Detailed reasoning behind the decision not to value the impacts can be found in the individual project impact assessment reports submitted to FRDC.

Based on the 13 project investments where impacts were valued, upper and lower bound investment criteria were generated for the total investment and for the FRDC investment alone. First, the estimated total aggregate Present Value of Benefits (PVB) from the 13 projects valued was compared to the total aggregate Present Value of Costs (PVC) of all 20 projects evaluated. Investment criteria estimated through this process are expected to represent a lower bound for the results. The estimated total aggregate PVB from the 13 projects valued then was compared to the aggregate PVC of the same set of valued projects (13 projects). The investment criteria estimated for only the 13 projects valued are expected to represent the upper bound investment criteria for the FRDC 2019/20 evaluation sample.

For the purposes of the investment analyses, the investment costs of all parties were expressed in 2020/21 dollar terms using the Implicit Price Deflator for Gross Domestic Product (Australian Bureau of Statistics, 2020). All benefits after 2020/21 also 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% and using a reinvestment rate of 5% for calculating the Modified Internal Rate of Return (MIRR).

The base analyses used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All individual analyses ran for the length of the project investment period plus 30 years from the last year of investment. Investment criteria reported include the PVC, PVB, Net Present Value (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR) and MIRR. Definitions for these terms may be found in the Glossary of Economic Terms at the beginning of this summary report. For projects where no impacts were valued, only the PVC was explicitly reported, all other investment criteria appear as NR (not reported). However, the cost cash flows for projects with no impacts valued were still taken into account for the calculation of the upper and lower bound aggregate investment criteria.

For the Program level analysis, the estimated total PVB and PVC for each individual project were weighted by FRDC Program according to the Program allocation percentages shown in Table 1. The weighted PVB and PVC cash flows then were aggregated by Program and Program level investment criteria were estimated.

Investment Criteria: Aggregate (all 20 projects)

Table 4 and Table 5 show the estimated lower bound, aggregate investment criteria for all 20 project investments evaluated as part of the 2019/20 FRDC sample for the total investment and for the FRDC investment respectively. The lower bound investment criteria were estimated by comparing the total estimated aggregate PVB to the total aggregate PVC across all 20 projects in the sample.

Table 4: Aggregate Investment Criteria – Total Investment, Lower Bound
(2019/20 Sample, 5% discount rate)

Aggregate Investment Criteria	Years after last year of aggregate investment						
	0	5	10	15	20	25	30
PVB ($m)	8.88	28.50	36.10	41.40	45.51	48.77	50.55
PVC ($m)	17.21	17.21	17.21	17.21	17.21	17.21	17.21
NPV ($m)	-8.33	11.29	18.89	24.18	28.30	31.55	33.34
BCR	0.52	1.66	2.10	2.41	2.64	2.83	2.94
IRR (%)	n.s.	10.4	13.1	13.8	14.1	14.2	14.2
MIRR (%)	negative	9.2	9.6	9.3	8.9	8.6	8.2

n.s.: no unique solution

Table 5: Aggregate Investment Criteria – FRDC Investment, Lower Bound
(2019/20 Sample, 5% discount rate)

Aggregate Investment Criteria	Years after last year of aggregate investment						
	0	5	10	15	20	25	30
PVB ($m)	4.12	15.23	20.27	23.91	26.73	28.96	30.18
PVC ($m)	8.50	8.50	8.50	8.50	8.50	8.50	8.50
NPV ($m)	-4.38	6.73	11.77	15.41	18.23	20.46	21.68
BCR	0.48	1.79	2.38	2.81	3.14	3.41	3.55
IRR (%)	n.s.	11.2	14.0	14.8	15.0	15.1	15.2
MIRR (%)	negative	9.9	10.4	10.1	9.7	9.3	8.8

n.s.: no unique solution

Table 6 and Table 7 show the estimated upper bound, aggregate investment criteria for all 20 project investments evaluated as part of the 2019/20 FRDC sample for the total investment and for the FRDC investment respectively. The upper bound investment criteria were estimated by comparing the total estimated aggregate PVB to the aggregate PVC across the 13 projects where impacts were valued.

Table 6: Aggregate Investment Criteria – Total Investment, Upper Bound
(2019/20 Sample, 5% discount rate)

Aggregate Investment Criteria	Years after last year of aggregate investment						
	0	5	10	15	20	25	30
PVB ($m)	8.88	28.50	36.10	41.40	45.51	48.77	50.55
PVC ($m)	13.48	13.48	13.48	13.48	13.48	13.48	13.48
NPV ($m)	-4.60	15.02	22.62	27.92	32.03	35.29	37.08
BCR	0.66	2.11	2.68	3.07	3.38	3.62	3.75
IRR (%)	negative	16.3	18.4	18.9	19.1	19.1	19.2
MIRR (%)	negative	11.4	11.2	10.6	10.0	9.5	9.0

Table 7: Aggregate Investment Criteria – FRDC Investment, Upper Bound
(2019/20 Sample, 5% discount rate)

Aggregate Investment Criteria	Years after last year of aggregate investment						
	0	5	10	15	20	25	30
PVB ($m)	4.12	15.23	20.27	23.91	26.73	28.96	30.18
PVC ($m)	6.82	6.82	6.82	6.82	6.82	6.82	6.82
NPV ($m)	-2.70	8.41	13.45	17.09	19.91	22.14	23.36
BCR	0.60	2.23	2.97	3.51	3.92	4.25	4.43
IRR (%)	negative	15.6	18.0	18.6	18.8	18.8	18.9
MIRR (%)	negative	12.0	11.9	11.3	10.7	10.1	9.6

Investment Criteria: by Project

Table 8 (total investment) and Table 9 (FRDC investment) show the estimated investment criteria by individual project for the 2019/20 FRDC evaluation sample. As reported earlier, there were seven projects where no impacts were valued and therefore no PVB was reported.

Table 8: Investment Criteria by Project (2019/20 Sample)
(Total Investment, 30 years, 5% discount rate)

Project Code	Project Title	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
2009-324	People Development Program: Nuffield Scholarship for an Aquaculture and/or Fish producer	1.14	0.76	0.38	1.50	8.3	6.2
2011-521	ABARES Outlook Conference	NR	0.09	NR	NR	NR	NR
2014-022	Developing a rapid molecular identification technique to improve egg production-based fish biomass assessments	NR	0.83	NR	NR	NR	NR
2014-405	Oysters Australia IPA: Australian edible oyster RD&E investment via Oysters Australia strategic plan 2014-2019	0.72	0.40	0.32	1.80	n.s.	14.5
2015-018	Do commercial fishery data reflect stock status in South Australia's Southern Garfish fisheries?	NR	1.50	NR	NR	NR	NR
2016-044	Next-generation Close-kin Mark Recapture: using SNPs to identify half-sibling pairs in Southern Bluefin Tuna and estimate abundance, mortality and selectivity	2.67	0.71	1.96	3.74	16.0	10.5
2016-045	Development of Pilchard orthomyxo virus vaccine for salmonids	25.03	4.24	20.79	5.90	19.6	11.2
2016-053	Mareframe - Co-creating Ecosystem-based Fisheries Management Solutions (EU led project)	NR	0.41	NR	NR	NR	NR
2016-118	Using scat DNA to inform sustainable fisheries management and Ecological Risk Assessments: a Shy Albatross case study	1.42	0.53	0.89	2.67	19.0	8.9
2016-235	Improving post-harvest survival of live held Southern Rock Lobster	8.81	1.51	7.30	5.83	49.1	14.6

Project Code	Project Title	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
2016-259	Australian Prawn Farmers Association (APFA) Strategic and R&D Plan 2020-25	0.25	0.06	0.19	4.34	21.5	11.1
2016-417	National People Development: Membership of PIEFA to support and encourage the teaching and learning in Australian schools of information related to the Australian Fishing Industry	6.31	3.61	2.70	1.75	19.8	7.4
2016-803	Future oysters CRC-P: New Technologies to Improve Sydney Rock Oyster Breeding and Production	1.54	0.50	1.04	3.10	9.1	8.6
2017-057	Stock predictions and spatial population indicators for Australia's east coast saucer scallop fishery	0.96	0.61	0.34	1.56	7.7	6.7
2017-109	Development of Fish Health Indicators for the Gladstone Harbour Report Card	0.75	0.27	0.48	2.78	25.3	9.0
2017-145	Pilot - Development of Seafood Nutritional Panels	NR	0.35	NR	NR	NR	NR
2017-188	Environmental and Economic accounting in Primary Industries (Natural Capital Accounting) - linked to 2017-175	NR	0.53	NR	NR	NR	NR
2018-153	AgriFutures: FRDC Contribution: Phase 2 of $100 billion growth strategy	0.88	0.23	0.65	3.83	35.8	9.4
2018-207	Bursaries for emerging leaders in the Southern Rock Lobster industry to attend the 2019 Trans-Tasman Lobster Congress.	0.07	0.03	0.04	2.33	12.8	8.1
2019-095	Update of AQUAVETPLAN Disease Strategy Manual, White Spot Disease	NR	0.03	NR	NR	NR	NR

NR: Not Reported

n.c.: not calculable - the internal rate of return is defined as the discount rate where the net present value equals zero. The benefit and cost cash flows for the evaluation of Project 2014-004 were such that either no such rate existed or there were multiple mathematical solutions.

Table 9: Investment Criteria by Project (2019/20 Sample)
(FRDC Investment, 30 years, 5% discount rate)

Project Code	Project Title	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
2009-324	People Development Program: Nuffield Scholarship for an Aquaculture and/or Fish producer	1.02	0.68	0.34	1.51	8.3	6.2
2011-521	ABARES Outlook Conference	NR	0.09	NR	NR	NR	NR
2014-022	Developing a rapid molecular identification technique to improve egg production-based fish biomass assessments	NR	0.28	NR	NR	NR	NR
2014-405	Oysters Australia IPA: Australian edible oyster RD&E investment via Oysters Australia strategic plan 2014-2019	0.72	0.40	0.32	1.80	n.s.	14.5
2015-018	Do commercial fishery data reflect stock status in South Australia's Southern Garfish fisheries?	NR	0.50	NR	NR	NR	NR

Project Code	Project Title	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
2016-044	Next-generation Close-kin Mark Recapture: using SNPs to identify half-sibling pairs in Southern Bluefin Tuna and estimate abundance, mortality and selectivity	1.95	0.51	1.44	3.79	16.5	10.5
2016-045	Development of Pilchard orthomyxo virus vaccine for salmonids	17.45	2.99	14.45	5.83	18.6	11.3
2016-053	Mareframe - Co-creating Ecosystem-based Fisheries Management Solutions (EU led project)	NR	0.14	NR	NR	NR	NR
2016-118	Using scat DNA to inform sustainable fisheries management and Ecological Risk Assessments: a Shy Albatross case study	0.40	0.14	0.26	2.84	23.5	9.2
2016-235	Improving post-harvest survival of live held Southern Rock Lobster	6.04	1.04	5.01	5.83	49.1	11.6
2016-259	Australian Prawn Farmers Association (APFA) Strategic and R&D Plan 2020-25	0.18	0.04	0.13	4.28	20.8	7.4
2016-417	National People Development: Membership of PIEFA to support and encourage the teaching and learning in Australian schools of information related to the Australian Fishing Industry	0.43	0.24	0.18	1.76	20.8	7.6
2016-803	Future oysters CRC-P: New Technologies to Improve Sydney Rock Oyster Breeding and Production	0.99	0.31	0.68	3.18	9.8	8.6
2017-057	Stock predictions and spatial population indicators for Australia's east coast saucer scallop fishery	0.35	0.22	0.12	1.56	7.7	6.7
2017-109	Development of Fish Health Indicators for the Gladstone Harbour Report Card	0.54	0.20	0.35	2.77	25.6	9.0
2017-145	Pilot - Development of Seafood Nutritional Panels	NR	0.21	NR	NR	NR	NR
2017-188	Environmental and Economic accounting in Primary Industries (Natural Capital Accounting) - linked to 2017-175	NR	0.44	NR	NR	NR	NR
2018-153	AgriFutures: FRDC Contribution: Phase 2 of $100 billion growth strategy	0.05	0.01	0.04	3.83	35.8	9.4
2018-207	Bursaries for emerging leaders in the Southern Rock Lobster industry to attend the 2019 Trans-Tasman Lobster Congress.	0.07	0.03	0.04	2.18	12.8	8.1
2019-095	Update of AQUAVETPLAN Disease Strategy Manual, White Spot Disease	NR	0.03	NR	NR	NR	NR

NR: Not Reported

n.s.: not unique solution – the internal rate of return is defined as the discount rate where the net present value equals zero. The benefit and cost cash flows for the evaluation of Project 2014-004 were such that either no such rate existed or there were multiple mathematical solutions.

Investment Criteria: by Program

Table 10 (total investment) and Table 11 (FRDC investment) show the estimated investment criteria by FRDC Program for the 2019/20 FRDC sample.

Table 10: Investment Criteria by FRDC Program (2019/20 Sample)
(Total Investment, 30 years, 5% discount rate)

Program	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
Environment	5.26	5.04	0.22	1.04	0.5	5.1
Industry	38.62	7.93	30.70	4.87	21.4	9.5
Communities	3.16	1.81	1.35	1.75	19.8	7.1
People	2.79	1.98	0.81	1.41	4.6	6.1
Adoption	0.72	0.45	0.27	1.59	35.8	9.8
Aggregate Results[(a)]	**50.55**	**17.20**	**33.35**	**2.94**	**14.2**	**8.2**

(a) Taken from Table 4. Any discrepancies between the aggregate investment criteria reported and the Program investment criteria were due to minor rounding errors.

Table 11: Investment Criteria by FRDC Program (2019/20 Sample)
(FRDC Investment, 30 years, 5% discount rate)

Program	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
Environment	2.32	1.99	0.32	1.16	1.3	5.4
Industry	25.74	5.05	20.69	5.10	21.4	9.7
Communities	0.21	0.12	0.09	1.76	20.8	7.2
People	1.19	0.89	0.30	1.34	2.4	5.9
Adoption	0.72	0.45	0.27	1.59	35.8	9.8
Aggregate Results[(a)]	**30.18**	**8.50**	**21.68**	**3.55**	**15.2**	**8.8**

(a) Taken from Table 5. Any discrepancies between the aggregate investment criteria reported and the Program investment criteria were due to minor rounding errors.

FRDC RD&E Leverage Ratios

Leverage ratios for the FRDC RD&E investment were estimated at a project, Program and whole of sample (aggregate) level for the 2019/20 evaluation sample. Leverage was calculated as the ratio non-FRDC investment to FRDC investment in undiscounted, real dollar terms. Table 12 shows the leverage ratios by project and Table 13 shows the leverage ratios by Program and for the aggregate investment in the 2019/20 sample.

The overall average leverage ratio for the 2019/20 project sample was estimated to be 1.04. That is, for every dollar that FRDC invested in the 20 projects, funding partners contributed 1.04 dollars. Leverage ratios for the individual project investments ranged from zero (four projects: 2011-521, 2014-405, 2018-207, and 2019-095) to 16.58 (project 2018-153: *AgriFutures: FRDC Contribution: Phase 2 of $100 billion growth strategy*). At a Program level, the Communities Program had the highest leverage with a ratio of 13.75 to 1 due to the contribution of project 2016-417 (*National People Development: Membership of PIEFA to support and encourage the teaching and learning in Australian schools of information related to the Australian Fishing Industry*). On the other hand, for the 2019/20 evaluation sample, the Adoption Program had a leverage ratio of zero.

Table 12: Leverage ratios by project (2019/20 sample)

Project Code	Project Title	Leverage Ratio
2009-324	People Development Program: Nuffield Scholarship for an Aquaculture and/or Fish producer	0.13
2011-521	ABARES Outlook Conference	0.00
2014-022	Developing a rapid molecular identification technique to improve egg production-based fish biomass assessments	2.01
2014-405	Oysters Australia IPA: Australian edible oyster RD&E investment via Oysters Australia strategic plan 2014-2019	0.00
2015-018	Do commercial fishery data reflect stock status in South Australia's Southern Garfish fisheries?	2.02
2016-044	Next-generation Close-kin Mark Recapture: using SNPs to identify half-sibling pairs in Southern Bluefin Tuna and estimate abundance, mortality and selectivity	0.37
2016-045	Development of Pilchard orthomyxo virus vaccine for salmonids	0.43
2016-053	Mareframe - Co-creating Ecosystem-based Fisheries Management Solutions (EU led project)	1.99
2016-118	Using scat DNA to inform sustainable fisheries management and Ecological Risk Assessments: a Shy Albatross case study	2.55
2016-235	Improving post-harvest survival of live held Southern Rock Lobster	0.46
2016-259	Australian Prawn Farmers Association (APFA) Strategic and R&D Plan 2020-25	0.42
2016-417	National People Development: Membership of PIEFA to support and encourage the teaching and learning in Australian schools of information related to the Australian Fishing Industry	13.75
2016-803	Future oysters CRC-P: New Technologies to Improve Sydney Rock Oyster Breeding and Production	0.55
2017-057	Stock predictions and spatial population indicators for Australia's east coast saucer scallop fishery	1.77
2017-109	Development of Fish Health Indicators for the Gladstone Harbour Report Card	0.38
2017-145	Pilot - Development of Seafood Nutritional Panels	0.62
2017-188	Environmental and Economic accounting in Primary Industries (Natural Capital Accounting) - linked to 2017-175	0.22
2018-153	AgriFutures: FRDC Contribution: Phase 2 of $100 billion growth strategy	16.58
2018-207	Bursaries for emerging leaders in the Southern Rock Lobster industry to attend the 2019 Trans-Tasman Lobster Congress.	0.00
2019-095	Update of AQUAVETPLAN Disease Strategy Manual, White Spot Disease	0.00

Table 13: Leverage ratios by FRDC Program (2019/20 sample)

Program	Leverage Ratio
Environment	1.49
Industry	0.58
Communities	13.75
People	1.42
Adoption	0.00
Aggregate	**1.04**

Summary of Past Results

The results reported for the 2019/20 FRDC evaluation sample represent the fifth annual impact assessment series in the five-year project 2016-134: *Evaluation of R&D projects completed in years ending June 2016 to June 2020*[3]. The following sections present a summary of the results across all five years and demonstrate the diversity and range of results estimated for FRDC's RD&E portfolio over time. **However, comparisons of these results should be made with caution as each sample was estimated using real dollar terms based on the year of evaluation.**

Aggregate Results: 2015/16 to 2019/20 evaluation samples

Table 14 shows the aggregate investment criteria for each year of the FRDC's annual impact assessment program. The results reported are for the 2015/16, 2016/17, 2017/18, 2018/19, and the current 2019/20 samples.

Table 14: Aggregate Investment Criteria Across Five Evaluation Years
(Total Investment, Lower Bound, 5% Discount Rate, 30 years)

FRDC Evaluation Sample	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
2015/16[(a)]	94.95	21.23	73.72	4.47	23.8	12.0
2016/17[(b)]	92.21	16.15	76.07	5.71	21.7	10.8
2017/18[(c)]	61.18	12.54	48.65	4.88	10.8	1.6
2018/19[(d)]	114.66	15.26	99.39	7.51	59.8	8.6
2019/20[(e)]	50.55	17.21	33.34	2.94	14.2	8.2

(a) Final population: 136 RD&E investments; 13 of 20 projects valued in monetary terms; results reported in 2016/17 dollar terms.
(b) Final population: 72 RD&E investments; 14 of 20 projects valued in monetary terms; results reported in 2017/18 dollar terms.
(c) Final population: 68 RD&E investments; 13 of 20 projects valued in monetary terms; results reported in 2018/19 dollar terms.
(d) Final population: 119 RD&E investments; 13 of 20 projects valued in monetary terms; results reported in 2019/20 dollar terms.
(e) Final population: 81 RD&E investments, 13 of 20 projects valued in monetary terms; results reported in 2020/21 dollar terms.

Results by FRDC Program: 2015/16 to 2019/20 evaluation samples

Table 15 shows the investment criteria for each year of evaluation (2015/16, 2016/17, 2017/18, 2018/19, and 2019/20) by FRDC Program as described in the FRDC RD&E Plan 2015-20 (FRDC, 2015). **Results should be compared with caution as the sample selection criteria associated with the allocation of RD&E investments to a program area varied across the four years of the FRDC impact assessment program and, as noted above, results for each sample are reported in the dollar terms of the year of evaluation.**

[3] Agtrans Research was originally contracted to complete the annual impact assessments under FRDC project 2016-134: *Evaluation of Research and Development (R&D) projects completed in years ending June 2016 to June 2018.* A variation in 2018 extended the project agreement to include evaluation of FRDC R&D projects completed in years ending June 2019 and June 2020.

Table 15: Aggregate Investment Criteria by FRDC Program by Year
(Total Investment, Lower Bound, 5% Discount Rate, 30 years)

Program	FRDC Evaluation Sample	PVB ($m)	PVC ($m)	NPV ($m)	BCR	IRR (%)	MIRR (%)
Environment	2015/16	19.79	10.66	9.12	1.86	12.3	7.6
	2016/17	14.45	6.35	8.09	2.27	13.6	7.8
	2017/18	17.97	5.49	12.48	3.27	9.7	n.s.
	2018/19	100.48	7.30	93.19	13.77	94.7	11.4
	2019/20	5.26	5.04	0.22	1.04	0.5	5.1
Industry	2015/16	59.61	6.13	53.48	9.72	28.2	13.9
	2016/17	74.50	8.39	66.11	8.88	26.1	12.1
	2017/18	34.27	5.92	28.36	5.79	10.3	n.s.
	2018/19	9.92	5.75	4.18	1.73	11.5	3.3
	2019/20	38.62	7.93	30.70	4.87	21.4	9.5
Communities	2015/16	NR	0.61	NR	NR	NR	NR
	2016/17	2.75	1.05	1.70	2.62	11.5	8.2
	2017/18	1.04	0.09	0.95	11.85	67.1	n.s.
	2018/19	1.27	0.85	0.43	1.51	10.9	2.4
	2019/20	3.16	1.81	1.35	1.75	19.8	7.1
People	2015/16	12.96	2.57	10.40	5.05	40.9	12.3
	2016/17	0.14	0.16	-0.03	0.84	4.3	4.7
	2017/18	1.45	0.14	1.31	10.52	51.5	n.s.
	2018/19	0.15	0.26	-0.11	0.58	0.2	negative
	2019/20	2.79	1.98	0.81	1.34	4.6	6.1
Adoption	2015/16	2.58	1.26	1.32	2.05	NC	10.3
	2016/17	0.38	0.20	0.19	1.95	26.2	7.9
	2017/18	6.45	0.91	5.55	7.13	37.9	n.s.
	2018/19	2.83	1.12	1.71	2.53	12.4	5.5
	2019/20	0.72	0.45	0.27	1.59	35.8	9.8

NR: Not reported.
n.s.: No unique solution

Discussion

At the individual project level, the impacts from seven of the 20 project investments subjected to assessment in the 2019/20 evaluation sample were not valued in monetary terms. This was consistent with evaluations in previous years and was generally expected given the FRDC's mandate to invest in environmental and social RD&E where impacts are sometimes difficult to value in monetary terms. The total investment across all 20 individual RD&E projects (from all sources) ranged from $29,707 (project 2019-095) to $4.24 million (project 216-045) (present value terms) with FRDC contributions ranging from 5.7% (project 2018-153) to 100% (projects 2011-521, 2014-45, 2018-207, and 2019-095) of the total investment in each project in real, undiscounted dollar terms.

Estimated benefits for each project ranged from zero (no impacts valued) to $25.03 million (present value terms) (project 2016-045). The weighted average BCR for all 20 projects was approximately 2.94 to 1 (lower bound). The simple average BCR for only those projects where investment criteria were reported (13 projects) was approximately 3.15 to 1, whereas the weighted average BCR for only the 13 projects where impacts were valued was estimated at 3.75 to 1 (upper bound). All aggregate investment criteria were

positive from a period of five years after the last year of investment (2020/21) indicating that positive aggregate benefits were delivered from the investments over a relatively short timeframe.

The overall average leverage ratio for the 2019/20 project sample, defined as the ratio of investment from non-FRDC sources to FRDC investment, was estimated to be 1.04. That is, for every dollar that FRDC invested in the 20 projects, funding partners contributed 1.04 dollars. Leverage ratios for the individual project investments ranged from zero (four projects: 2011-521, 2014-405, 2018-207, and 2019-095) to 16.58 (project 2018-153: *AgriFutures: FRDC Contribution: Phase 2 of $100 billion growth strategy*). At a Program level, the Communities Program had the highest leverage with a ratio of 13.75 to 1 due to the contribution of project 2016-417 (*National People Development: Membership of PIEFA to support and encourage the teaching and learning in Australian schools of information related to the Australian Fishing Industry*). On the other hand, for the 2019/20 evaluation sample, the Adoption Program had a leverage ratio of zero.

At the Program level, all five FRDC Program areas reported a positive BCR (greater than, or equal to, one). The Industry Program reported the best performance with an estimated BCR of 4.87 to 1. This positive result was influenced strongly by the high total PVB ($25.03 million) estimated for project 2016-045 (*Development of Pilchard orthomyxo virus vaccine for salmonids*). This project had a 100% attribution to the Industry Program (see Table 1).

Reviewing the Program level investment criteria over time (Table 15), there do not appear to be any consistent differences between programs over the five years of analysis. This may be due to the characteristics of the randomly selected projects in each program category in each year or because of the way that FRDC program allocations are determined. It may be tentatively concluded, therefore, that all five FRDC Programs are performing satisfactorily and contributing to FRDC's overall positive RD&E investment performance.

In the aggregate analysis for the 2019/20 FRDC impact assessment program, total funding from all sources across all 20 RD&E project investments totalled $17.21 million (present value terms) with FRDC funding totalling $8.50 million (present value terms). Funding for the 13 projects where impacts where valued totalled $13.48 million (present value terms) and represent approximately 78% of the total PVC.

The investment produced estimated total expected benefits of $50.55 million (present value terms) from 13 projects where impacts were valued. This gave an NPV of between $33.34 million (lower bound) and $37.08 million (upper bound), a weighted average BCR of between 2.94 to 1 (lower bound) and 3.75 to 1 (upper bound), an IRR of between 14.2% (lower bound) an 19.2% (upper bound), and an MIRR of between 8.6% (lower bound) and 9.0% (upper bound).

The overall 2019/20 aggregate results were generally consistent with aggregate results from the four previous annual FRDC evaluation samples (2015/16 to 2017/18) and considered representative of the performance of the FRDC RD&E investment portfolio for the same period. Further, the aggregate results were consistent with reported average returns reported for agricultural RD&E of between 3.5 and 5.5 to 1 (Agtrans Research; AgEconPlus; and EconSearch, 2016; (Agtrans Research, 2019; CSIRO, 2021).

The positive results for the 2019/20 FRDC evaluation sample should be viewed positively by FRDC, the various fisheries and aquaculture industries, and policy personnel responsible for allocation of public funds as well as industry contributions.

Recommendations

This report represents the fifth year of a five-year period of annual impact assessments of FRDC RD&E under Project 2016-134. As part of a continuous improvement process, the impact assessment project team assess the evaluation process at the end of each year to identify areas for improvement and to make any reasonable recommendations, to be considered by FRDC management personnel, for any subsequent evaluations of FRDC RD&E investments. The following recommendations have been made within this context.

Recommendation 1: Develop, integrate, and implement an impact-specific monitoring and evaluation (M&E) framework

The FRDC has adopted the Commonwealth input/output/outcome/impact reporting framework. The Australian Department of Finance has determined that the FRDC's organisational outcome is '*Increased economic, social and environmental benefits for Australian fishing and aquaculture, and the wider community, by investing in knowledge, innovation, and marketing*'. The FRDC's performance is measured against its ability to deliver this outcome. To report organisation-level performance, FRDC maintains a monitoring and evaluation (M&E) framework that supports the current FRDC RD&E Plan[4].

The current RD&E Plan and associated M&E framework cover the 2020-25 period. The current M&E framework includes a description of the key processes and tools that FRDC implements to measure the organisations impact and performance of its RD&E investments. Key M&E tools for the evaluation and reporting of FRDC performance are described as (FRDC, 2020):

- Cost-benefit analyses
- Non-market valuation
- Social survey tools

The FRDC M&E Framework further states that FRDC will undertake economic assessment of all project clusters that are funded to deliver the R&D Plan 2020-25. FRDC is required to report the results of its impact assessments in its annual reporting to the Australian Government and other stakeholders. Hence, a performance report (including impact assessment based on completed projects) is required by 30 June each year until 2026.

It is recommended that FRDC commission a suitably qualified economic consultant to develop an impact-specific M&E framework that addresses the measurement and reporting of specific RD&E impact information and data at a project, program, and organisational-level. This impact M&E framework then would be integrated with the M&E tools used to demonstrate FRDC's performance under the broader FRDC M&E Framework.

An impact M&E framework integrated with the current FRDC M&E framework would be designed to ensure that expected and actual RD&E outcomes and impacts were identified, reported, and measured more comprehensively and accurately and would improve implementation of cost-benefit analyses, non-market valuation, and social survey tools used by FRDC to measure and report performance.

Recommendation 2: Improve communication of project-level M&E requirements

FRDC includes information on its website, and in other researcher communications, that describes the organisation's RD&E project application, evaluation, and approval processes (for example: https://frdc.com.au/project-evaluation).

[4] FRDC RD&E Plan 2020-25: http://rdplan.frdc.com.au/;
FRDC 2020-25 M&E Framework: (see: https://www.frdc.com.au/sites/default/files/inline-files/Approved%20Monitoring%20and%20Evaluation%20Framework%202020-25.pdf)

It is recommended that FRDC undertake a review of current RD&E application, approval, and reporting requirements to assess and potentially improve project-level M&E processes that provide information and data used in FRDC impact assessments and other performance reporting.

The potential improvements may include communications items such as (subject to completion of the recommended review):

- A statement about the FRDC's annual impact assessment program on the FRDC website to ensure researchers are aware that their project may be subjected to impact assessment in the future and that they would be requested to provide input to the impact assessment process.
- A statement about the FRDC's annual impact assessment program in RD&E investment Decision Notification Letters to inform the project team of potential future evaluation processes.
- Information about the FRDC's annual impact assessment program and/or project-level outcome and impact measurement and reporting requirements included in RD&E project applications and/or final reporting guidelines to encourage researchers to consider evidence of outcomes and impacts as part of their RD&E project planning and reporting processes.
- Inclusion of new/improved terms in FRDC project agreements that address project personnel providing input to future RD&E evaluation processes associated with their project.

Improving researcher awareness and understanding of the FRDC's annual impact assessment processes and requirements would improve researcher engagement with the impact assessment/evaluation process and support better future estimation of the actual and expected outcomes and impacts of FRDC RD&E investments.

Recommendation 3: Develop an ex-ante impact assessment and CBA framework/ tool

It is recommended that FRDC commission a suitably qualified economic consultant to develop an ex-ante impact assessment and cost-benefit analysis framework and/or tool that could be used internally by FRDC personnel and/or researchers to identify and estimate the potential outcomes and impacts of new RD&E.

Such an ex-ante framework or tool would support:

1. Development of appropriate impact assessment/cost-benefit analysis frameworks for subsequent ex-post evaluations of FRDC RD&E investment(s),
2. Identification of information/ data gaps associated with RD&E pathways to impact/ impact assessment,
3. Improved monitoring, evaluation, reporting and improvement processes,
4. Demonstration and estimation of potential impacts of important/high value RD&E that could:
    a. Facilitate improved effectiveness and/or efficiency of FRDC RD&E resource allocation,
    b. Enable improved prioritisation and decision-making for marginal RD&E investments, and
    c. Encourage co-investment and/or collaboration and increased adoption of key RD&E outputs.
5. Development of a baseline and framework against which future ex-post impact assessments could be conducted and compared.

The ex-ante framework/tool could be designed for various levels of detail, depending on FRDC requirements and resources, to support project, program and/or portfolio level decision making and best management practise from a RD&E resource allocation perspective. For example, a Microsoft Excel® based ex-ante impact and CBA tool could be developed where RD&E applicants input preliminary estimated impact data (based on evidence or other rationale) according to simple instructions within the tool. The tool then would provide estimated investment criteria that could be included in project applications to demonstrate the potential impacts and value of the project to FRDC decision-makers. The key impact data could then be updated at the end of the project, or several years after the project, to compare actual performance with expected performance.

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