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FISHERIES RESEARCH &
DEVELOPMENT CORPORATION

FINAL

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2015/16 FRDC Evaluations (Year 1)

Aggregate Summary Report

Agtrans Research

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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
GDP	Gross Domestic Product
IRR	Internal Rate of Return
MIRR	Modified Internal Rate of Return
NPV	Net Present Value
PVB	Present Value of Benefits
PVC	Present Value of Investment Costs
RD&E	Research, Development and Extension

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) to Australia, regardless of to whom they accrue.

Investment criteria - Measures of the economic worth of an investment such as Net Present Value, Benefit Cost Ratio, and Internal Rate of Return.

Present Value of Costs -The discounted value of R&D investment costs

Present Value of Benefits - The discounted value of benefits.

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.

Benefit-cost ratio - The ratio of the present value of investment benefits to the present value of investment costs.

Internal Rate of Return (IRR) - The discount rate at which an investment has a net present value of zero, i.e. where present value of benefits is equal to present value of costs.

Modified Internal Rate of Return (MIRR) - The MIRR is a modified IRR estimated so that any cash inflows from an investment are assumed re-invested at the rate of the cost of capital (a designated re-investment rate).

Introduction

The following summary report presents an overview and aggregate results of a series of economic evaluations of research, development and extension (RD&E) investments carried out for the Fisheries Research and Development Corporation (FRDC) in 2017.

Background

FRDC requires a series of impact assessments to be carried out annually on a number of investments in the FRDC 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).

Agtrans Research was contracted to complete the assessments under FRDC project 2016- 134: *Evaluation of R&D projects completed in years ending June 2016 to June 2018*.

At a preliminary meeting between FRDC and Agtrans personnel, it was agreed that the unit of investment to be evaluated would be the individual FRDC project and that a total of 20, randomly selected projects would be evaluated each year.

Sample Selection

Brief Description of the Selection Process

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 of projects with a final deliverable submitted in 2015/16 (in nominal terms) and included a selection of small, medium and large FRDC investments.

The 2015/16 Evaluation Sample

From the initial population of 136 projects the following 20 project investments were randomly selected for evaluation (Table 1).

Table 1: Stratified random sample of 20 projects for economic evaluation as part of the FRDC's annual evaluation program 2016/17 (by Project Code)

Project Code	Project Title	Program	FRDC Investment (nominal \$)
2008-002	Targeting and CPUE definition in the SESSF trawl fishery through auxiliary data	Environment	199,928
2008-306	Building economic capability to improve the management of marine resources in Australia	People	926,153

2008-327	People development program: FRDC Agribusiness scholarship	People	38,691
2009-303	Australasian Aquaculture 2010 to 2014	Adoption	240,000
2009-710	Seafood CRC: bioeconomic evaluation of commercial scale stock enhancement in abalone	Industry	209,430
2009-723.30/ 2013-714 ^(a)	Seafood CRC: analysis of product differentiation opportunities for Australian wild caught Abalone in China, and Seafood CRC: establishing improved trade access and market development for Australia's Abalone and Rock lobster to China	Industry	919,847
2010-200	Innovative development of the <i>Octopus tetricus</i> fishery in Western Australia	Industry	381,465
2010-777	Seafood CRC: identification of the core leadership group and network structure of East Coast Trawl to develop, implement and evaluate strategic opportunities	Industry	227,766
2011-030	Evaluating candidate monitoring strategies, assessment procedures and harvest control rules in the spatially complex Queensland Coral Reef fin-fish Fishery	Environment	393,488
2012-032	Aquatic Animal Health Subprogram: Pacific oyster mortality syndrome (POMS) - risk mitigation, epidemiology and OsHV-1 biology	Environment	783,045
2012-047	Atlantic Salmon Aquaculture Subprogram: characterising benthic pelagic interactions in Macquarie Harbour - organic matter processing in sediments and the importance for nutrient dynamics	Environment	209,239
2012-058	Tactical Research Fund: Limiting impacts of the spread of urchins by rebuilding abalone populations	Environment	42,000
2012-225	Technical Reviews of Formal Harvest Strategies	Industry	149,988
2012-500.20	To establish a forum (Common Language Group) for working with all stakeholders to reach agreement on issues which are contentious in the fishing and aquaculture sectors	Communities	152,371
2013-008	Movement, habitat utilisation and population status of the endangered Maugean skate and implications for fishing and aquaculture operations in Macquarie Harbour	Environment	263,825
2013-053	Summer spawning patterns and preliminary Daily Egg Production Method survey of Jack Mackerel and Sardine off the East Coast	Environment	220,000
2013-753	Seafood CRC: a new refrigeration system reference design and demonstration prototype for fishing vessels	Industry	496,435
2014-030	Status of key Australian fish stocks (SAFS) reports 2014 and beyond	Environment	391,250
2014-714	Seafood CRC: writing our History. The people and the achievements of the Australian Seafood CRC	Adoption	44,116
2015-406	Oysters Australia IPA: development of a national Pacific Oyster Mortality Syndrome (POMS) response plan	Industry	25,000
Total			6,314,037

(a) Based on discussions with FRDC and the projects' contract arrangements, projects 2009-723.30 and 2013-714 were treated as a single project investment for the purpose of the economic evaluations.

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 first year of annual FRDC economic evaluations

Program Area	No. of Projects in Sample	Total FRDC Investment (nominal \$)	Proportion of Total Sample Investment	FRDC Portfolio R&D Spending Target
Environment	8	2,502,775	39.2%	40%
Industry	7	2,409,931	38.2%	40%
Communities	1	152,371	2.4%	2%
People	2	964,844	15.3%	10%
Adoption	2	284,116	4.5%	8%
Total	20	6,314,038	100%	100%

Table 3: Number of projects in each project size category within the random stratified sample

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

General Evaluation 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, 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 (CBA) 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.

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.

For the purposes of the investment analyses, the investment costs of all parties were expressed in 2016/17 dollar terms using the Implicit Price Deflator for GDP. All benefits after 2016/17 also were expressed in 2016/17 dollar terms. All costs and benefits were discounted to 2016/17 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.

Results presented include the Present Value of Investment Costs (PVC), estimated Present Value of Benefits (PVB), Net Present Value (NPV), Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR) and Modified IRR (MIRR). Definitions for these terms may be found in the Glossary of Economic Terms at the beginning of this summary report.

For some projects, impacts identified were not able to be quantified. Detailed reasoning behind the decision not the value the impacts can be found in the individual project impact assessment reports submitted to FRDC. For projects where no impacts were valued, only the PVC was explicitly reported, all other investment criteria appear as NR (not reported). However, the benefit and cost cash flows for projects with no impacts valued were still taken into account for the calculation of the aggregate investment criteria for all 20 project investments.

Investment Criteria: Aggregate (all 20 projects)

Table 4 shows the estimated aggregate investment criteria for all 20 project investments evaluated as part of the 2015/16 FRDC sample.

Table 4: Aggregate Investment Criteria
(Total Investment, 5% discount rate)

Aggregate Investment Criteria	Years after last year of investment in all 20 projects (2016/17)						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	15.04	40.78	58.40	71.45	81.25	88.93	94.95
Present Value of Costs (\$m)	21.23	21.23	21.23	21.23	21.23	21.23	21.23
Net Present Value (\$m)	-6.19	19.55	37.17	50.22	60.02	67.70	73.72
Benefit Cost Ratio	0.71	1.92	2.75	3.37	3.83	4.19	4.47
Internal Rate of Return (%)	negative	19.27	22.6	23.44	23.69	23.77	23.80
Modified Internal Rate of Return (%)	negative	28.89	20.95	17.04	14.68	13.10	11.96

Investment Criteria: by Project

Table 5 shows the estimated investment criteria by individual project for the 2015/16 FRDC evaluation sample.

Table 5: Investment Criteria by Project
(Total Investment, 30 years, 5% discount rate)

Project Code	Project Title	PVB (\$m)	PVC (\$m)	NPV (\$m)	BCR	IRR (%)	MIRR (%)
2008-002	Targeting and CPUE definition in the SESSF trawl fishery through auxiliary data	0.00	0.71	NR ^(a)	NR	NR	NR
2008-306	Building Economic Capability to Improve the Management of Marine Resources in Australia	12.40	2.38	10.02	5.21	41.85	13.01
2008-327	People Development Program: FRDC Agribusiness Scholarship	0.56	0.18	0.38	3.04	25.68	9.53
2009-303	Australasian Aquaculture 2010 – 2014	2.58	1.15	1.43	2.24	51.70	10.90
2009-710	Bioeconomic Evaluation of Commercial Scale Stock Enhancement in Abalone	1.70	0.73	0.97	2.33	11.92	8.11
2009-723.30/ 2013-714	Analysis of product differentiation opportunities for Australian Wild Caught Abalone in China – Stage 1 & 2; and Establishing improved trade access and market development of Australia's Abalone and Rocklobster to China (Trialling and Evaluating the AWA™ Supply Chain Education Program)	44.81	2.85	41.96	15.74	38.80	16.10
2010-200	Innovative development of the <i>Octopus tetricus</i> fishery in Western Australia	6.44	0.89	5.55	7.21	20.65	14.17
2010-777	Seafood CRC: analysis of the core leadership group and network structure of East Coast Trawl to develop, implement and evaluate strategic opportunities	0.00	0.32	NR	NR	NR	NR
2011-030	Evaluating Candidate Monitoring Strategies, Assessment Procedures and Harvest Control Rules in the Spatially Complex Queensland Coral Reef Fin-Fish Fishery	0.00	1.39	NR	NR	NR	NR
2012-032	Aquatic Animal Health Subprogram: Pacific Oyster Mortality Syndrome (POMS) – risk mitigation, epidemiology and OsHV-1 biology	6.30	4.17	2.13	1.51	11.66	8.68
2012-047	Characterising benthic pelagic interactions in Macquarie Harbour - organic matter processing in sediments and the importance for nutrient dynamics	2.97	0.66	2.31	4.53	13.48	6.34
2012-058	Tactical Research Fund: Limiting impacts of the spread of urchins by rebuilding abalone populations	0.00	0.10	NR	NR	NR	NR
2012-225	Technical Reviews of Formal Harvest Strategies	0.00	0.50	NR	NR	NR	NR
2012-500.20	To establish a forum (Common Language Group) for working with all stakeholders to reach agreement on issues which are contentious in the fishing and aquaculture sectors	0.00	0.61	NR	NR	NR	NR

2013-008	Movement, habitat utilisation and population status of the endangered Maugean skate and implications for fishing and aquaculture operations in Macquarie Harbour	6.37	0.68	5.69	9.35	40.40	13.86
2013-053	Summer spawning patterns and preliminary Daily Egg Production Method survey of Jack Mackerel and Sardine off the East Coast	1.45	0.68	0.78	2.15	15.83	7.86
2013-753	Seafood CRC: A new refrigeration system reference design and demonstration prototype for fishing vessels	5.92	0.82	5.10	7.23	21.18	12.41
2014-030	Status of key Australian fish stocks (SAFS) reports 2014 and beyond	2.61	2.27	0.33	1.15	14.50	5.67
2014-714	Writing our History – The people and achievements of the Australian Seafood CRC	0.00	0.11	NR	NR	NR	NR
2015-406	Development of a national Pacific Oyster Mortality Syndrome (POMS) response plan	0.05	0.03	0.02	1.79	44.10	7.16

(a) NR: Not Reported

Investment Criteria: by Program

Table 6 shows the estimated investment criteria by FRDC Program area for the 2015/16 FRDC evaluation sample.

Table 6: Investment Criteria by FRDC Program
(Total Investment, 30 years)

Program	No. of Projects	PVB (\$m)	PVC (\$m)	NPV (\$m)	BCR	IRR (%)	MIRR (%)
Environment	8	19.79	10.66	9.12	1.86	12.25	7.60
Industry	7	59.61	6.13	53.48	9.72	28.18	13.91
Communities	1	0.00	0.61	NR ^(a)	NR	NR	NR
People	2	12.96	2.57	10.40	5.05	40.89	12.34
Adoption	2	2.58	1.26	1.32	2.05	NC ^(b)	10.28
Aggregate Total	20	94.95	21.23	73.72	4.47	23.80	11.96

(a) NR: Not Reported

(b) NC: Not Calculable. Due to multiple sign changes in the net cash flow for the Adoption Program there were multiple values of the discount rate that would give an NPV of zero. This meant that a unique IRR was not able to be calculated. However, the MIRR does not have this problem as the calculation treats the positive and negative cash flows differently, generating only one solution.

Discussion

At the individual project level, seven of the 20 project investments subjected to impact assessment were not valued in monetary terms. The total investment across all 20 RD&E projects ranged from \$0.03 million to \$4.17 million (present value terms), while estimated benefits ranged from zero to \$44.8 million. The weighted average for all 20 projects was approximately 4.5 to 1 and the simple average BCR was approximately 3.2 to 1. The BCR for only the 13 projects valued was estimated at 5.4 to 1.

At the Program level, four of the five FRDC Program areas reported a positive BCR. Based on the investment criteria presented, the Industry Program reported the best performance with an estimated BCR of 9.7 to 1. On the other hand, the Communities Program had no quantified benefits and thus no BCR was reported. In part, this was because only one project was able to be included in the sample from the Communities Program based on the agreed selection criteria. It is anticipated that, as further project investments from the Communities Program are evaluated as part of the ongoing, annual FRDC evaluation process, future aggregate results reported over time may include quantified benefits for the Communities Program.

The investment in FRDC's People Program showed a strong return on investment with an estimated BCR of 5.05 to 1. The positive result gives an indication of the value of investing in the education, training and professional development of people related to fisheries and aquaculture industries.

The largest proportion of total investment was in the Environment Program, with a PVC of \$10.66 million. Many of the impacts attributed to the projects within the Environment Program were not valued as part of the impact assessment process due to the difficulty in valuing non-market benefits and a lack of necessary evidence/data. It is worth noting that many of the project investments that formed part of the Industry Program delivered impacts that included the maintenance of ecological integrity outcomes as well as industry outcomes. Therefore, it is likely that the estimated BCR of 1.9 to 1 is an underestimate of the performance of the investment in the FRDC's Environment Program.

Conclusion

Total funding from all sources across all 20 RD&E project investments totalled \$21.23 million (present value terms) and produced estimated total expected benefits of \$94.95 million (present value terms). This gave an aggregate weighted average BCR of approximately 4.5 to 1.

The overall result should be viewed positively by FRDC, the various fisheries and aquaculture industries, and policy personnel responsible for allocation of public funds.