FINAL

An Impact Assessment of FRDC Investment in 2008-306: Building Economic Capability to Improve the Management of Marine Resources in Australia

Agtrans Research

November 2017

FRDC Project No **2016-134**

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Project 2016-134

2017

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

Contents

Contents ..... **iii**
List of Tables iv
List of Figures iv
Acknowledgments ..... **v**
Abbreviations ..... **v**
Executive Summary ..... **vi**
Introduction **7**
General Method **8**
Background and Rationale **9**
Background 9
Rationale 9
Project Details **10**
Summary 10
Objectives 10
Logical Framework 10
Project Investment **14**
Nominal Investment 14
Program Management Costs 14
Real Investment and Extension Costs 14
Impacts **15**
Valuation of Impacts **17**
Impacts Valued 17
Impacts Not Valued 17
Valuation of Impact 1: Increased efficiency of fisheries RD&E resource allocation 17
Valuation of Impact 2: Increased profitability and sustainability of Australian wild catch fisheries through improved policy, management and operational effectiveness of fishery industries, fishers and their associated supply chain businesses 18
Counterfactual 19
Summary of Assumptions 19
Results **20**
Investment Criteria 20
Source of Benefits 21
Sensitivity Analyses 21
Confidence Ratings and other Findings 23
Conclusions **24**
Glossary of Economic Terms **25**
References **26**
Appendices **27**
Appendix 1: GRT Program PhD Thesis example – Peggy Schrobback 27
Appendix 2: Summary of GRT Program Students and Research (November, 2015) 28

List of Tables

Table 1: Logical Framework for Project 2008-306 10
Table 2: Annual Investment in the Project 2015-406 (nominal $) 14
Table 3: Triple Bottom Line Categories of Potential Impacts from Building Economic Capability to Improve the Management of Marine Resources in Australia 15
Table 4: Australian Government Research Priorities 16
Table 5: Summary of Assumptions 19
Table 6: Investment Criteria for Total Investment in Project 2015-406 20
Table 7: Investment Criteria for FRDC Investment in Project 2015-406 20
Table 8: Contribution to Total Present Value of Benefits from Each Source 21
Table 9: Sensitivity to Discount Rate 21
Table 10: Sensitivity to Efficiency Dividend 22
Table 11: Sensitivity to Combined Assumptions for Percentage Representation and Profit Increase 22
Table 12: Confidence in Analysis of Project 23

List of Figures

Figure 1: Annual Cash Flow of Undiscounted Total Benefits and Total Costs 21

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.

Sarah Jennings, former Head of School – Economics and Finance, University of Tasmania
Jo-Anne Ruscoe, Project Manager, Fisheries Research and Development Corporation

Abbreviations

AARES	Australian Agricultural and Resource Economics Society
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
CRC	Cooperative Research Centre
CRRDC	Council of Rural Research and Development Corporations
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWR	Department of Agriculture and Water Resources (Commonwealth)
FishEcon	Australian Fisheries Economics Network
FRDC	Fisheries Research and Development Corporation
GRT	Graduate Research Training
IIFET	International Institute of Fisheries Economics & Trade
OCS	Office of the Chief Scientist
PhD	Doctor of Philosophy
PVB	Present Value of Benefits
QUT	Queensland University of Technology
R&D	Research and Development
RD&E	Research, Development and Extension
SSERCP	Social Science and Economics Research Coordination Program
TSBE	Tasmanian School of Business and Economics
UTAS	University of Tasmania

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 project 2008-306: *building economic capability to improve the management of marine resources in Australia*. The project was funded by FRDC and the University of Tasmania (UTAS) for the period 1 July 2008 to 30 June 2015.

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 impacts identified were of a financial nature involving improved efficiency of research, development and extension (RD&E) resource allocation and increased profitability for Australian wild catch fisheries and supply chains. Environmental and social impacts were also identified but not valued. It is expected that investors in fisheries RD&E (including the Commonwealth Government, State Government departments and private industry organisations) and members of the Australian fisheries sector will be the primary beneficiaries of the investment.

Investment Criteria

Total funding from all sources for the project was $2.38 million (present value terms). The value of benefits was estimated at $12.40 million (present value terms). This gave an estimated net present value of $10.02 million, and a benefit-cost ratio of approximately 5.2 to 1.

Conclusions

The investment in this project resulted in improved knowledge and understanding of fisheries economics, for a range of fisheries stakeholders including researchers, fishers and supply chain businesses, and industry and marine resource managers. This increased economic capability translated into improved allocation of fisheries RD&E resources as well as improvements in operational effectiveness along Australian wild catch fisheries supply chains.

The analysis provided a good example of an investment in education and training in a specific area that has benefited the fisheries sector and fisheries RD&E investment in the short- to medium-term through potentially increased profitability (through decreased industry operating costs and/or increased profits) and decreased RD&E costs.

The perceived importance of investment in economic capability is demonstrated by the ongoing commitment of FRDC and UTAS to funding postgraduate fisheries economics research and to the continuation of the Fisheries Economics Masterclass.

Keywords

Impact assessment, economics, fisheries management, training, resource management, fisheries resource economics

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 2008-306: *Building Economic Capability to Improve the Management of Marine Resources in Australia* 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

At the Commonwealth level, fisheries management has an explicit objective to maximise the net economic returns to the Australian community through the appropriate use of fisheries resources. Also, national conservation initiatives though the Department of Environment and Energy (formerly known as the Department of Environment and Heritage) (including threatened, endangered, and protected species designations as well as marine habitat protection through marine reserves) are known to have an economic impact on the fishing industry that need to be taken into account to support appropriate decision making.

At the State level, there has been a consistent call for more information on the socio-economic aspects of commercial fisheries and, with the advent of the Australian Seafood Cooperative Research Centre, a recognition of the importance of encouraging and evaluating post-harvest improvements to the industry.

In 2007 there was general recognition and acknowledgment of the importance of incorporating economic considerations into marine management in Australia. It was also recognised that use of marine resources is increasing through non-commercial fishing activities including recreational fishing, diving and other eco-tourism activities. Also, land based activities have been increasingly impinging on the marine environment, with consequences for marine based industries. Thus, efficient and effective resource allocation between competing users of marine resources and marine habitat protection (i.e. through marine reserves) is becoming an increasing part of marine resource management.

Rationale

FRDC project 2008-306 was funded in response to the widespread recognition and acknowledgment of the importance of incorporating economic considerations into marine resource management in Australia. The project was funded also to address the persistent undersupply of suitably trained and qualified individuals capable of providing this economic input.

Project Details

Summary

Project Code: 2008-306

Title: *Building Economic Capability to Improve the Management of Marine Resources in Australia*

Research Organisation: School of Economics and Finance, University of Tasmania

Principal Investigator: Sarah Jennings

Period of Funding: July 2008 to June 2015.

Objectives

The project included four key objectives:

1. To build Australia's capability in fisheries resource economics through graduate training
2. To address identified high priority applied fisheries economics research needs of both State and Commonwealth marine resource sectors through PhD research projects
3. To develop and deliver a range of fisheries resource economic training opportunities for marine scientists, industry and managers through a short course program
4. To develop an ongoing national focus in the area of applied fisheries resource economics that can address the long-term research and training needs of both State and Commonwealth marine resource sectors

Logical Framework

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

Table 1: Logical Framework for Project 2008-306

Activities	The project addressed its objectives through three core activities: **1. The Fisheries Economics Graduate Research Training (GRT) Program** • The goal of the program was to provide research training in fisheries/marine economics through enrolment in postgraduate higher degree studies at three participating Universities (the University of Tasmania (UTAS), the University of Adelaide, and the Queensland University of Technology). • Initial funding for the project allowed for a total of six research higher degree candidates enrolled across the three universities. • A combination of leveraging-off alternative competitive scholarship funding sources and the inclusion in the GRT program of non-scholarship students based on the involvement of Project team members in research supervision, resulted in a program comprising 14 individual candidates over the seven years that the project was funded. • Recruitment of students into the GRT program occurred over the period 2010 to 2015 and included two non-scholarship Honours students, both of whom subsequently were awarded FRDC scholarship support for PhD studies. • A total of 17 thesis projects were being undertaken by the 14 students, with three students completing either Honours or Masters projects prior to enrolling in a PhD. Of the 17 projects, two were at the Honours level, two at the Masters level and 13 at a PhD level. • A good example of the economics research undertaken through the GRT Program is presented in Appendix 1. Many of the PhD topic were at industry

level and involved fisheries management and marine resource policy with an emphasis on fisheries.

- The project also provided funding for a short, graduate level training course. The week-long course was targeted at fisheries economics research higher degree students, but also was made available to a broader audience of researchers.
- The short course was run in early 2012 at the School of Economics and Finance (now the Tasmanian School of Business and Economics (TSBE), UTAS). Attendees included 12 students from a range of academic backgrounds: nine higher degree research students (seven of whom were internal FRDC students), two employees from the Australian Bureau of Agricultural and Resource Economics and Sciences, and an environmental consultant.
- The course included formal lectures, workshops, and lab-based modelling and experiments.

2. The Fisheries Economics Professional Training Program

- An online survey of 56 business managers, industry representatives, and researchers within the seafood industry was conducted in 2010 and indicated a high demand for short course training in fisheries economics.
- A training program was developed to improve the economic literacy of non-economist marine sector stakeholders. The program then was implemented in collaboration with the Australian Seafood Cooperative Research Centre (CRC) through the Future Harvest Masterclass in Fisheries Economics.
- The resulting one day course (Masterclass) targeted seafood industry members in representative roles (fishers, post-harvest, managers, research, non-Government organisations) and had the following objectives:
  - to challenge participants thinking about the role of fisheries management and the use of economics,
  - to learn how economics contributes to decisions on the sustainable management of the fishery,
  - to gain experience in using economic tools to explore how to achieve optimal future harvests, and
  - to understand how economics can help inform debates about resource allocation in fisheries.
- A pilot class was offered in Hobart, Tasmania in September 2010.
- Eight further classes were run in Hobart, Adelaide, Melbourne, Brisbane (2), Sydney, and Perth (2) between September and December 2010.
- In two cases, classes were delivered to teams consisting solely of fisheries managers. In all other cases, the classes comprised participants from business and industry management and research backgrounds.
- An activity providing hands-on experience in the use of bioeconomic models to inform decision-making processes for wild capture fisheries was developed and included as part of the Masterclass.

3. The Australian Fisheries Economics Network (FishEcon)

- This part of the project was aimed at strengthening research in the area of fisheries economics by creating a forum in which fisheries economists, fisheries managers and PhD students can share research ideas and results, as well as news of upcoming research opportunities and events.
- The Australian Fisheries Economics Network (and its associated brand 'FishEcon') was launched in February 2010 in the form of a mini-symposium at the Australian Agricultural and Resources Economics Society (AARES) Conference with a starting membership of approximately 70 individuals that included practicing fisheries economists and non-economists.
- The communication between the Project and the Network members proceeded through two phases:

	1) over the initial stages of the project the main forum for the network was the dedicated FishEcon website through which information could be shared by network members. 2) the second phase (2011 to the present) of communication was based on distribution via email of a FishEcon network newsletter. The newsletter replaced the website as a more cost-effective method of communicating with the Network (Sarah Jennings, pers. comm., 2017). • Although the Fisheries Economics Network is not formally affiliated with the AARES, the AARES annual conference provided a platform for the development of an annual meeting of fisheries economists. Project team member, Stephanie McWhinnie, worked with the annual organising committees of the conference to organise fisheries sessions from 2010 onward and had the support of AARES executive members to continue to play this role for future conferences. • The International Institute of Fisheries Economics & Trade (IIFET) is the principal international association for fisheries economics, and the biennial conference was widely recognised as an opportunity for the best fisheries economists in the world to meet and share their ideas. As a result of strong ties between project team members and the IIFET executives, a bid, led by CSIRO, to host the IIFET 2014 conference was submitted. • This bid was successful and FRDC was a major sponsor for the conference while Project team members played pivotal roles in the organisation and execution of the event in July 2014.
Outputs	**The Fisheries Economics Graduate Research Training (GRT) Program:** • At the time of submission of the final report for Project 2008-306, 11 thesis projects had been successfully completed. The projects span a wide range of topic areas including: fisheries management (commercial and recreational), marine management, climate change, environmental performance of seafood production, and access agreements. • Table A in Appendix 2 lists the FRDC GRT program students and details of their studies as of November, 2015. • In all cases, projects have resulted in publication of findings in peer-reviewed academic literature (in addition to the theses). Over 26 papers have been published to date (Sarah Jennings, pers. comm., 2017). • Of the 10 graduates who had completed their studies, 8 secured employment, including positions with the Queensland Department of Agriculture and Fisheries, IMAS (UTAS), University of Kelenaiya (Sri Lanka), French Research Institute for the Exploitation of the Sea (IFREMER) (France) and the Secretariat of the Pacific Community. Also, three graduates secured post-doctoral research positions (Sarah Jennings, pers. comm., 2017). • 12 graduate students completed the week-long, graduate level training course. • Two of the students were granted credit status for the course towards their Certificate in Graduate Research (a requirement for all PhD students at UTAS). **The Fisheries Economics Professional Training Program:** • 121 participants completed the Future Harvest Masterclass in 2012. • The results of formal feedback gathered from 77 of the participants indicated that the Masterclass was successful in meeting participant expectations and in improving participants' understanding of fisheries economics and its role in management. **The Australian Fisheries Economics Network (FishEcon)** • A strong network of practising fisheries/marine economists was created within Australia with a regular newsletter and social media presence, and a recognised forum for annual face-to-face interactions. • At the IIFET Conference, over a 4-day period in July 2014, 270 participants from 39 countries engaged in oral and poster presentations, plenary addresses, plus a variety of discussion panels.

	• A total of 63 Australians participated in the IIFET conference, covering all states and territories. Two thirds of these were from research institutions, with the remainder from industry and management authorities. Many of the FRDC research students participated in the conference, presenting their results.
Outcomes	• Project 2008-306 has contributed to growth in capability in the area of natural resource economics in general, and fisheries economics in particular, through training at UTAS over the period of the project. • All students that participated in the GRT Program under project 2008-306 have successfully completed their studies/graduated (Sarah Jennings, pers. comm., 2017). • The TSBE at UTAS has shown a continuing commitment to ensuring the legacy of the Building Capability Project by offering two further PhD scholarships in Marine Economics. Both students have made good progress in their research to date (Sarah Jennings, pers. comm., 2017). • There has been an increase in the participation of economists in a number of key research processes as a result of the project. For example, project team members now are involved in several State, and Commonwealth, level Research Advisory Groups. • FRDC has integrated the GRT Program, Fisheries Economics Masterclass and FishEcon as legacy activities under the Social Science and Economics Research Coordination Program (SSERCP) (project 2015-300) (Sarah Jennings, pers. comm., 2017). • The SSERCP allows for ongoing support for past and continuing FRDC postgraduate students as well as three new PhD candidates (FRDC, 2014). The Program also continues to coordinate development and distribution of the FishEcon newsletter which has been incorporated into a wider Social Science and Economics newsletter (Sarah Jennings, pers. comm., 2017). • Based on the success of the initial Masterclasses, project 2013-748: was funded (project name: Seafood CRC Future Harvest Master Class in Fisheries Economics – Revision & Extension) to revise and extend the training program. • Revisions to the initial Masterclass included development of a new module on the use of benefit-cost analysis in fisheries management and development of a second fishery case study for the bioeconomic simulation model. • An expanded suite of resources to support face-to-face delivery now are available. The Masterclass also has been extended to offer an online delivery option supported by videoed lectures, hands-on activities and tutorials. The online course is hosted on the FRDC website. • The revised Masterclass was successfully offered as a two-day course in 2016/17 twice: once in Western Australia and once to staff of the Australian Fisheries Management Authority. • Fisheries session (both contributed and special) have continued as a feature of the annual AARES conference since project 2008-306 ended. • The project has contributed to greater connectedness of project team members with colleagues, both domestic and abroad. This has resulted in increased research and professional service activities in the field of fisheries economics through activities such as editorial and reviewer roles for journals, thesis examination, contract research, grants and research collaborations. • Network links between QUT, CSIRO and UTAS remain very strong with the projects Principal Investigator, Sarah Jennings, invited as a visiting scholar to QUT to give a seminar on joint work between UTAS and CSIRO and to mentor legacy students (Sarah Jennings, pers. comm., 2017).
Potential Impacts	• Contribution to increased effectiveness of management of Australian fisheries and marine resources. • Contribution to improved sustainability of Australian fisheries. • Contribution to improved efficiency of fisheries RD&E resource allocation. • Increased scientific and industry capacity.

Project Investment

Nominal Investment

Table 2 shows the annual investment for the project funded by FRDC and UTAS (including in-kind contributions).

Table 2: Annual Investment in the Project 2008-306 (nominal $)

Year ended 30 June	FRDC ($)	UTAS ($)	TOTAL ($)
2009	207,440	97,833	305,273
2010	221,989	133,737	355,726
2011	88,015	140,829	228,844
2012	139,358	147,477	286,835
2013	120,457	118,036	238,493
2014	63,238	0	63,238
2015	85,657	0	85,657
Totals	926,154	637,912	1,564,066

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 Cash Flow Statement (FRDC, 2016). This multiplier then was applied to the nominal investment by FRDC shown in Table 2.

For the UTAS investment, it was assumed that the management and administration costs for the project were already built into the nominal amounts reported 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 was focused on individual training and network development and involved a range of industry and fisheries research and economics personnel.

Impacts

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

Table 3: Triple Bottom Line Categories of Impacts from Building Economic Capability to Improve the Management of Marine Resources in Australia

Economic	• As a result of FRDC personnel and other researchers completing the GRT Program (through postgraduate study and/or the graduate training course) the investment in project 2008-306 has contributed to more efficient RD&E resource allocation for fisheries research funded by FRDC and its partners. • Improved policy setting for the allocation of marine resources between ecosystem services and fisher and business profits resulting in win-win outcomes for both ecological conservation and fisher and industry profitability. • Increased profitability (through reduced costs and/or increased profits) for Australian wild catch fisheries because of improved operational effectiveness as a result of fisheries personnel completing the Fisheries Economics Professional Training Program (Masterclass) and greater involvement of fisheries economists with industry. • The participation of fisheries researchers and industry professionals (both from economic and non-economic backgrounds) in the Australian Fisheries Economics Network (FishEcon) also may contribute to improved efficiency of RD&E expenditure and/or increased effectiveness of fisheries management.
Environmental	• Improved sustainability of Australian wild catch fisheries through increased involvement of fisheries economists with industry and research, and improved understanding and communication of fisheries economics, leading to better decision making and resource allocation that recognises environmental sustainability.
Social	• Increased scientific and industry capacity through support for postgraduate research scholarships and facilitation of networking between economic and non-economic fisheries personnel. • Enhanced regional community well-being through the spill-over effects of increased profitability for the Australian wild catch fisheries sector.

Public versus Private Impacts

Impacts identified in this evaluation are both public and private. Potentially increased policy, management and operational effectiveness will benefit Australian wild catch fisheries businesses and industry personnel and is therefore a private impact. On the other hand, research funded by FRDC includes contributions from State and Commonwealth Government and other, private organisations, therefore increased efficiency of RD&E resource allocation will have both public and private impacts. Other public impacts may be delivered, including environmental sustainability and social impacts such as increased scientific capacity and regional community spill-overs.

Distribution of Private Impacts

Private benefits initially will be captured by the individual fishery industries and specific supply chain business where changes have been made because of personnel completing some fisheries economics training. It can be assumed that the final distribution of some of the benefits from the investment will be distributed between participants along parts of the wild catch fisheries supply chain, including fishers, post-harvest and final consumers.

Impacts on other Australian industries

It was assumed that the impacts from the investment in project 2008-306 will be confined to Australian wild catch fisheries and associated supply chains.

Impacts Overseas

No significant benefits to overseas parties are expected, with the possible exception international networking results in sharing of new knowledge and/or best practice in fisheries resource and management economics.

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 3 and to Science and Research Priority 1 and 2 and potentially priority 7.

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.

Two key impacts of the investment were valued. The impacts valued were: the potential contribution to more efficient RD&E resource allocation through the training and development of research personnel and the increased profitability and sustainability of Australian fisheries because of improved policy, management and operational effectiveness.

The assumptions for each impact valued also take into account the contribution of the FishEcon network to any increased efficiency and/or effectiveness benefits through increased involvement of fisheries economics personnel with industry and improved understanding by industry of fisheries economics.

Impacts Not Valued

Not all impacts identified in Table 3 could be valued in the assessment. The potential environmental and social impacts were hard to value because of the difficulty in quantifying the causal relationships and pathways between the development of economic capability for fisheries management and the specific future environmental and social impacts, and the difficulty in making appropriate assumptions given a lack of available evidence/data.

The environmental impact identified but not valued included:

- Improved sustainability of Australian wild catch fisheries through increased involvement of fisheries economists with industry and research, and improved understanding and communication of fisheries economics, leading to better decision making and resource allocation. While this impact was not valued specifically, it was taken into account in the effectiveness benefit where policy and management decision making, using economic principles, inherently accommodates environmental considerations in order to maintain the biodiversity, ecology and profitability of the marine resource.

The social impacts identified but not valued included:

- Increased scientific and industry capacity through support for postgraduate research scholarships and facilitation of networking between economic and non-economic fisheries personnel.
- Enhanced regional community well-being through the spill-over effects of increased effectiveness and sustainability of the Australian wild catch fisheries sector.

Valuation of Impact 1: Increased efficiency of fisheries RD&E resource allocation

The valuation of increased efficiency of RD&E resource allocation centres on the average annual investment in RD&E managed by the FRDC. This includes investment by the Commonwealth and various State Governments, Universities and other private industry organisations. The FRDC and its partners have invested, on average, $24.1 million per annum in RD&E projects for the years ended 30 June 2012 to 30 June 2016 (FRDC, 2016).

The investment in the development of economic capability (project 2008-306) is assumed to have marginally improved FRDC RD&E investment selection and management, therefore contributed to increased efficiency of the significant RD&E investments made by the FRDC.

Based on the postgraduate research funding commencing in 2008/09 (where a PhD thesis typically takes three years to complete), the first Masterclasses being held in 2010/11 and the GRT one-day course being

conducted in early 2011/12 it was assumed that the first year of impact for the efficiency gain would be the year ended 30 June 2012.

As more students and training participants completed their studies under project 2008-306, it was assumed the maximum impact would be reached in 2016 and remain at this level for three years. After this period, it was assumed that the benefit would decrease to zero by 2021 as the impact of the education and training provided over the period of the investment wanes and some students/course participants move to other industries.

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

Valuation of Impact 2: Increased profitability and sustainability of Australian wild catch fisheries through improved policy, management and operational effectiveness of fishery industries, fishers and their associated supply chain businesses

Improved operational effectiveness for fisheries and fisheries businesses, resulting from increased economic capability and understanding, is assumed to have stemmed from a range of potential policy, management and operational improvements across the entire supply chain. For example, such improvements may include: more effective marine resource allocation, whole-of fishery management, reduced boat fuel costs through improved route planning, better resource allocation/decision making for product development and marketing, and more informed decisions on capital expenditures.

Total Value of the Supply Chain

Valuation of the effectiveness impact required an estimate of the entire supply chain value for wild catch fisheries including profits. Margins between the boat price and final sale price for various wild catch fisheries can vary considerably depending on the added value along the various supply pathways. As a rough indication, the price multiplier between the boat price and final sale is about 2.5 times. This is substantiated by an international study on wild catch tuna where it was estimated that the final sales value was 2.73x the ex-vessel value (Poseidon Aquatic Resource Management Ltd, 2016).

For the Australian wild catch sector, the ex-boat price is estimated at $1.6 billion per annum (ABARES, 2016). Using the 2.5x multiplier, the total supply chain gross costs (including profits) are therefore estimated at about $4.8 billion per annum for wild catch.

Applicability of an Effectiveness Dividend

An effectiveness dividend from increased economic input was applied to the total value of the supply chain due to improved policy, management and operational effectiveness driven by increasd economic input to decision making. This dividend is assumed to apply to a maximum of 2.0% of the toal value of the supply chain.

Magnitude of the Dividend

The dividend will comprise both increased profits and decreased costs along the value of the supply chain deeemed to be affected and is assumed to average 2.5% where it is applicable, and without compromising sustainability. This is consdered a conservative estimate. For example, an economic analysis by the Tasmanian Aquaculture and Fisheries Institute (TAFI) (Buxton *et al.*, 2006) on revised boundaries for the Marine Protected Areas (MPAs) around Tasmania showed:

- A 24% increase in the area protected and a more than 90% reduction in the impact on the commercial fishing sector, compared to that originally proposed. The saving in fisheries production was valued at $10.3 million per annum.

- The areas and features of the changed MPAs showed that the biodiversity features included in the final MPAs were somewhat superior to those in the original proposal.

The resulting project report on the South-East MPAs and their location, characteristics and categorisation was adapted and presented by the fishing industry to the Australian Government. The TAFI report and associated industry submission was highly influential in the determination of the final decision by the Australian Government on boundaries and categories for the MPAs (Agtrans Research, 2010).

Counterfactual

It was assumed that, without the investment in building economic capability to improve the management of Australian marine resources, no such specific fisheries economics development would have occurred.

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**
Benefit 1: Increased efficiency of RD&E resource allocation		
Total average annual FRDC RD&E Investment	$24.1 million	Based on total expenditure on R&D projects for the period 2011/12 to 2015/16 as reported in the FRDC Annual Report, 2016
Efficiency dividend due to improved priority setting	2.5%	Agtrans Research
RD&E expenditure required to achieve same outputs without dividend	$0.60 million p.a.	$24.1m x (102.5/100)
First year efficiency dividend delivered	2012	Agtrans Research
Year of maximum impact	2016	
Duration of maximum impact	3 years followed by a linear decline to zero by 2021	
Benefit 2: Increased profitability and sustainability of Australian wild catch fisheries		
Ex-boat Price of Wild Catch Fisheries	$1.6 billion pa	ABARES, 2016
Multiplier to estimate total value of supply chain	2.5x	Based on Poseidon Aquatic Resource Management (2016)
Total value of supply chain costs including profits	$4.0 billion p.a.	2.5x $1.6b
Estimated future exposure of supply chain costs to economic trainees	2.0%	Agtrans Research
Estimated effectiveness dividend due to trainees	2.5%.	
Probability of impact	50%	
First year of impact	2012	
Year of maximum impact	2016	
Duration of maximum impact	5 years followed by a linear decline to zero by 2025	

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 2008-306 (2014/15).

Investment Criteria

Tables 6 and 7 show the investment criteria estimated for different periods of benefits for the total investment and the FRDC investment. The present value of benefits (PVB) attributable to the FRDC investment only, shown in Table 7, has been estimated by multiplying the total PVB by the FRDC proportion of real investment before discounting (61.9%).

Table 6: Investment Criteria for Total Investment in Project 2008-306

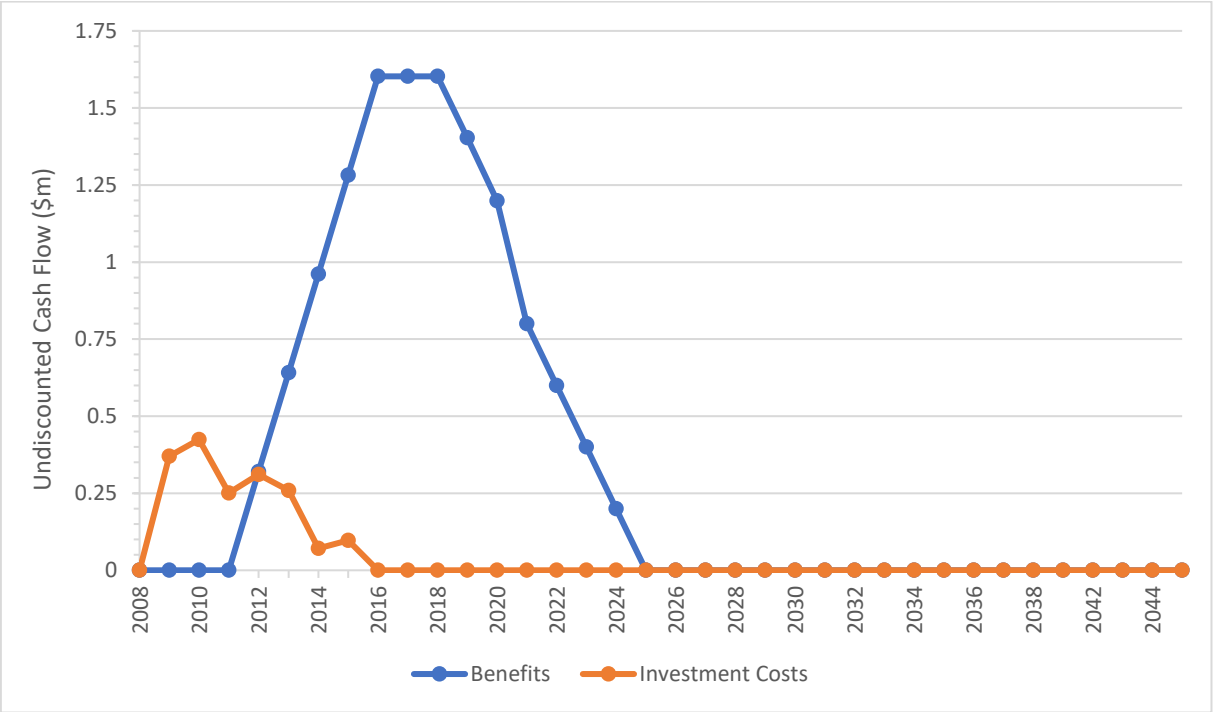
Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($m)	3.71	10.83	12.40	12.40	12.40	12.40	12.40
Present Value of Costs ($m)	2.38	2.38	2.38	2.38	2.38	2.38	2.38
Net Present Value ($m)	1.33	8.45	10.02	10.02	10.02	10.02	10.02
Benefit-Cost Ratio	1.56	4.55	5.21	5.21	5.21	5.21	5.21
Internal Rate of Return (%)	21.35	41.16	41.85	41.85	41.85	41.85	41.85
Modified Internal Rate of Return (%)	negative	98.51	35.79	23.00	17.71	14.83	13.01

Table 7: Investment Criteria for FRDC Investment in Project 2008-306

Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($m)	2.30	6.71	7.68	7.68	7.68	7.68	7.68
Present Value of Costs ($m)	1.47	1.47	1.47	1.47	1.47	1.47	1.47
Net Present Value ($m)	0.83	5.24	6.21	6.21	6.21	6.21	6.21
Benefit-Cost Ratio	1.56	4.56	5.22	5.22	5.22	5.22	5.22
Internal Rate of Return (%)	21.41	40.89	41.57	41.57	41.57	41.57	41.57
Modified Internal Rate of Return (%)	negative	101.69	36.62	23.47	18.03	15.07	13.20

The annual undiscounted benefit and cost cash flows for the total investment for the duration of Project 2008-306 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



Source of Benefits

Estimates of the relative contribution of each benefit valued to the PVB, given the assumptions made are shown in Table 8.

Table 8: Contribution to Total Present Value of Benefits from Each Source

Source of Benefits	**Contribution to PVB ($m)**	**Share of Benefits (%)**
Benefit 1: Increased efficiency of fisheries RD&E resource allocation	3.74	30.2
Benefit 2: Increased profitability and sustainability of Australian wild catch fisheries	8.66	69.8
Total	12.40	100.0

Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 9 presents the results. The results showed a low sensitivity to the discount rate. This is due to the fact that benefits were assumed to begin to occur during the period of investment (prior to year zero) and continue for only a short time after.

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

Investment Criteria	**Discount rate**		
	0%	**5% (base)**	**10%**
Present value of benefits ($m)	12.62	12.40	12.42
Present value of costs ($m)	1.79	2.38	3.16
Net present value ($m)	10.83	10.02	9.26
Benefit-cost ratio	7.07	5.21	3.93

A sensitivity analysis was undertaken on the assumption of the RD&E efficiency dividend. This variable was considered a key driver of the results and was a variable with high uncertainty. The results, reported in Table 10, show a moderate level of sensitivity to the efficiency dividend assumption.

Table 10: Sensitivity to Efficiency Dividend
(Total investment, 30 years)

Investment Criteria	**Efficiency Dividend**		
	0.5%	**2.5% (base)**	**10%**
Present value of benefits ($)	9.41	12.40	23.63
Present value of costs ($)	2.38	2.38	2.38
Net present value ($)	7.03	10.02	21.25
Benefit-cost ratio	3.95	5.21	9.92

Finally, a sensitivity analysis was conducted using optimistic and pessimistic scenarios with regard to the assumptions for the estimated future exposure of supply chain costs and the estimated effectiveness dividend for benefit 2. Benefit 2 was the most significant of the two impacts valued at approximately 74% of the total PVB. Results are reported in Table 11. Results show that the investment criteria for the pessimistic scenario remain positive given the contribution of Benefit 1 to the PVB and other assumptions made.

Table 11: Sensitivity to Combined Assumptions for Percentage Representation and Profit Increase
(Total Investment, 30 years)

Investment Criteria	**Sensitivity to Representation and Profit Increase Assumptions**		
	Pessimistic (1.0% and 0.5%)	**Base (2.0% and 2.5%)**	**Optimistic (3.0% and 5%)**
Present value of benefits ($m)	4.61	12.40	29.72
Present value of costs ($m)	2.38	2.38	2.38
Net present value ($m)	2.23	10.02	27.34
Benefit-cost ratio	1.93	5.21	12.47

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 12). 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 12: Confidence in Analysis of Project

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

The coverage of benefits was assessed as medium due to the necessary aggregation of impacts identified to a generalised RD&E efficiency dividend and broad, supply chain profit increase. Likewise, while many of the assumptions were supported, in part, by project reports and other input by the Principal Investigator, many were still speculative and therefore confidence was considered to be low.

Conclusions

The investment in this project resulted in improved knowledge and understanding of fisheries economics, for a range of fisheries stakeholders including researchers, fishers and supply chain businesses, and industry and marine resource managers. This increased economic capability translated into improved allocation of fisheries RD&E resources as well as improvements in operational effectiveness along Australian wild catch fisheries supply chains.

Funding for project 2008-306 totalled $2.38 million (present value terms) and produced estimated total expected benefits of $12.40 million (present value terms). This gave a net present value of $10.02 million, an estimated benefit-cost ratio of 5.2 to 1, an internal rate of return of 41.9% and a modified internal rate of return of 13.0%.

While several environmental and social impacts identified were not valued, the pathways to impact from the project investment to these impacts were unclear and their contributions were considered minor compared with the impacts valued. Nevertheless, combined with conservative assumptions for the impacts valued, investment criteria as provided by the valued benefits may be underestimates of the investment performance.

The analysis provided a good example of an investment in education and training in a specific area that has benefited the fisheries sector and fisheries RD&E investment in the short- to medium-term through potentially increased profitability (through decreased industry operating costs and/or increased profits) and decreased RD&E costs.

The perceived importance of investment in economic capability is demonstrated by the ongoing commitment of FRDC and UTAS to funding postgraduate fisheries economics research and to the continuation of the Fisheries Economics Masterclass.

Glossary of Economic Terms

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

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Appendices

Appendix 1: GRT Program PhD Thesis example – Peggy Schrobback

Peggy Schrobback received an Australian Postgraduate Award scholarship, topped up through the FRDC economics initiative, to support her PhD at Queensland University of Technology (QUT) investigating the economics of the Sydney Rock Oyster industry.

She noted that there was general interest in the role of aquaculture to feed an increasing population. However, most of the existing research focused on environmental or ecological aspects, and only a limited number of projects had studied the economic aspects of aquaculture.

Her objective was to provide an economic analysis of the Sydney Rock Oyster industry that would contribute to industry development strategies and might provide a framework for the analysis of other aquaculture industries in Australia.

Part of the overall analysis explored the market and price relationships of the two key commercial oyster species in Australia: Sydney Rock Oysters (*Saccostrea glomerata*) and Pacific Oysters (*Crassostrea gigas*).

Her initial findings showed that there were separate markets for the two species, although evidence suggested that the development of the Pacific Oyster industry had an adverse impact on Sydney Rock Oyster prices. The demand for Sydney Rock Oysters was found to be relatively inelastic in the long-run, while no long-run relationship could be identified for Pacific Oysters, reflecting the developing nature of the sector.

She presented her preliminary results on the market integration and demand analysis of the Australian edible oyster market at the AARES conference in February 2012.

Peggy Schrobback also was studying the role of environmental change on the productive capacity of the industry. As part of this assessment, she surveyed all Sydney Rock Oyster producers in NSW and Queensland.

"I am trying to establish the relationship between environmental conditions such as water salinity or temperature and the productivity of the farms." she said.

Data from the surveys included production information as well as climatic and water quality indicators from various sources. She was also looking at socio-economic and management aspects in the development of the industry. This included an assessment of the supply chain for Sydney Rock Oysters.

Peggy Schrobback completed her PhD thesis in April 2015. Her supervisors included Louisa Coglan at QUT and Sean Pascoe at CSIRO/QUT.

Source: (Norwood, 2013) supplied by Sarah Jennings.

Appendix 2: Summary of GRT Program Students and Research (November, 2015)

Table A: Summary of FRDC Building Economic Capability Graduate Research Training Program Students

Name	Degree	Project title	Institution	Status	FRDC Scholarship
Kofi Otumawu-Apreku	PhD	Matters of Management, Sustainability and Efficiency: Essays in Fisheries	University of Adelaide	Awarded	Full
Peggy Schrobback	PhD	Economic analyses of Australia's Sydney rock oyster industry	QUT	Awarded	Top-up
John-Baptiste Marre	PhD	Quantifying economic values of coastal and marine ecosystem services and assessing their use in decision-making: applications in New Caledonia and Australia	QUT (cotutelle)	Awarded	Top-up
Samantha Parades	MA	The role of offsets in compensating for damage in the coastal and marine environments	QUT	Awarded	Full
Caleb Gardner	MA	An economic evaluation of management strategies for the Tasmanian rock lobster fishery	UTAS/TSBE	Awarded	-
Giles Austen	PhD	A dialectical basis for consilience in marine resource management	UTAS/TSBE	Awarded	Top-up
Sophie Gourguet	PhD	Ecological and economic viability for the sustainable management of mixed fisheries	UTAS/TSBE/IMAS (cotutelle)	Awarded	Top-up
Mohottala Gedara Kularatne (Kule)	PhD	Optimal Allocation of Water In Village Irrigation Systems Of Sri Lanka	QUT	Awarded	-
Steven Rust	Hon	A Contingent Valuation of Recreational Fishing in Tasmania	UTAS/TSBE	Awarded	-
Steven Rust	PhD	Excess capacity in regulated and unregulated fisheries	UTAS/TSBE	Thesis under examination	Top-up
Rachel Nichols	Hon.	An economic analysis of access agreements in the WCP tuna fishery	UTAS/TSBE	Awarded	-
Anna Farmery	PhD	An assessment of the environmental performance of selected fisheries and the implications for food security	UTAS/IMAS	Continuing	Top-up
Tim Emery	PhD	Assessing the costs and benefits of individual transferable quota management in the Tasmanian southern rock lobster fishery, Australia	UTAS/IMAS	Awarded	-
Rafael Leon	PhD	The effect of catch shares strength on management of marine resources	UTAS/IMAS	Awarded	-
Stewart Sinclair	PhD	Computing optimal and viable harvesting strategies for Queensland's East Coast Trawl Fishery	QUT	New enrolment	Top-up
Samantha Parades	PhD	The value of local fisheries for the coastal community and tourism	QUT	New enrolment	Top-up
Rachel Nichols	PhD	Fishing behaviour and habitat quality linkages between Marine Protected Areas and fisheries	UTAS/TSBE	New enrolment	Top-up