



FINAL

An Impact Assessment of FRDC Investment in 2014-030: Status of key Australian fish stocks (SAFS) reports 2014 and beyond

Agtrans Research

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**An Impact Assessment of FRDC Investment in 2014-030: Status of key Australian fish stocks (SAFS) reports
2014 and beyond
Project 2016-134**

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Matthew Flood, Principal Investigator, ABARES, Department of Agriculture and Water Resources
Carolyn Stewardson, Project Manager, Fisheries Research and Development Corporation

Abbreviations

ABARES	Australian Bureau of Agriculture and Resource Economics and Sciences
CRRDC	Council of Rural Research and Development Corporations
ENGO	Environmental Non-Government Organisation
FRDC	Fisheries Research and Development Corporation
RD&E	Research, Development and Extension
SAFS	Status of Australian Fish Stocks
TAC	Total Allowable Catch

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 the development of the 2014 Status of Australian fish stocks status reports. The project was funded by FRDC over the period May 2014 to September 2016.

Methodology

The investment was analysed qualitatively within a logical framework that included activities and outputs, outcomes and impacts. Impacts were categorised into a triple bottom line framework. Principal impacts identified were then valued. Benefits were estimated for a range of time frames up to 30 years from the year of last investment. Past and future cash flows were expressed in 2016/17 dollar terms and were discounted to the year 2016/17 using a discount rate of 5% to estimate the investment criteria.

Results/key findings

There were two major impacts identified that were of a financial nature. The third impact was social in nature. These were:

- an improved effectiveness of research, development and extension (RD&E) investment, and
- an improved effectiveness of fisheries management.
- increased social licence to wild catch fisheries

Some economic and social impacts were also identified but not valued. It is expected that there will be a wide range of beneficiaries from the project investment including Commonwealth and State Government fisheries departments, FRDC, research organisations, and commercial fishers.

Investment Criteria

Total funding from all sources for the project was \$2.27 million (present value terms). The value of benefits was estimated at \$2.61 million (present value terms). This gave an estimated net present value of \$0.33 million, and a benefit-cost ratio of approximately to 1.2 to 1.

Conclusion

The 2014 SAFS reports were evaluated in isolation from past and future expected SAFS reports. The analysis does not consider the full benefits of the entire SAFS project (the past and future expected SAFS reports together).

Joint consideration may indicate substantial additional value in the time series data that can be generated and the harmonisation of state reporting throughout the entire SAFS project. As such, it may be better to view the SAFS contributions throughout time instead of evaluating an individual set of reports at one point in time, as it is likely that the benefits from the series of reports considered jointly could be greater than sum of benefits from each report viewed in isolation. It can be reasonably assumed that the benefits of having consistent national stock data that are regularly updated will have wide ranging implications for fisheries managers and the general community.

Keywords

Impact assessment, SAFS, RD&E priorities

Introduction

The Fisheries Research and Development Corporation (FRDC) required a series of impact assessments to be carried out annually on a number of investments in the FRDC research, development and extension (RD&E) portfolio. The assessments were required to meet the following FRDC evaluation reporting requirements:

- Reporting against the FRDC 2015-2020 RD&E Plan and the Evaluation Framework associated with FRDC's Statutory Funding Agreement with the Commonwealth Government.
- Annual Reporting to FRDC stakeholders.
- Reporting to the Council of Rural Research and Development Corporations (CRRDC).

The first series of impact assessments included 20 randomly selected FRDC investments worth a total of approximately \$6.31 million (nominal FRDC investment). The investments were selected from an overall population of 136 FRDC investments worth an estimated \$24.98 million (nominal FRDC investment) where a final deliverable had been submitted in the 2015/16 financial year.

The 20 investments were selected through a stratified, random sampling process such that investments chosen spanned all five FRDC Programs (Environment, Industry, Communities, People and Adoption), represented approximately 25% of the total FRDC RD&E investment in the overall population (in nominal terms) and included a selection of small, medium and large FRDC investments.

Project 2014-030: *Status of key Australian fish stocks (SAFS) reports 2014 and beyond* was selected as one of the 20 projects and was analysed in this report.

General Method

The impact assessment 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. This impact assessment uses Cost-Benefit Analysis as its principal tool. The approach included 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. The decision not to value certain impacts was due 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 potentially represent an underestimate of the performance of the investment.

Background and Rationale

Background

Before the development of the Status of key Australian Fish Stocks (SAFS) reports, there was no nationwide measurement of fish stocks and their associated national sustainability status in Australia. This was due largely to different jurisdictional reporting responsibilities. Also, fish stocks exist across jurisdictional boundaries and the standards for reporting on fish stocks differ between jurisdictions. This made it difficult to gain an overall, national picture of the state of Australian fisheries.

The first SAFS reports were undertaken in 2012 to give a first national coverage of the status of fish stocks. The 2012 reports were largely viewed as a success.

Rationale

After the first SAFS reports were released in 2012, the House of Representatives review into Fisheries and Aquaculture recognised that a national stock report for all Australian fisheries should be continued (Commonwealth of Australia, 2012). A need for national reporting of wild fish stocks also was identified and confirmed by numerous stakeholders in Australian fisheries (Neville, 2017).

The FRDC's RD&E plan for 2015 to 2020 takes into account national research priorities. The priorities include "Ensuring that Australian fishing and aquaculture products are sustainable and acknowledged to be so" (FRDC, 2015).

To help address this priority, continued national reporting was required. Development of the SAFS reports aimed to create a consistent framework for reporting, and to gain a more accurate understanding of changes occurring in the status of fish stocks. Over time, the goal of the SAFS reports is to provide consistency across jurisdictions, so that biological sustainability can be compared across different fisheries, jurisdictions, and individual fish stocks. The aim is to have a single scientifically reliable source of information for Australian fish stocks.

The 2014 SAFS reports were to follow on from the inaugural 2012 SAFS reports, with the aim of adding additional species.

Project Details

Summary

Project Code: 2014-030
Title: <i>Status of key Australian fish stocks (SAFS) reports 2014 and beyond</i>
Research Organisation: Australian Bureau of Agriculture and Resource Economics and Sciences (ABARES)
Principal Investigator: Matthew Flood
Period of Funding: May 2014 - September 2016

Objectives

The project had four objectives:

1. To produce a second edition of the Status of key Australian fish stocks (SAFS) reports in 2014.
2. To review and update the SAFS reporting framework and production process for future editions of the SAFS reports.
3. To commence work to improve technical issues associated with production of the SAFS reports (data acquisition, updating process, web format).
4. To commence work to develop frameworks and production processes for companion national fishery status reports which will include other aspects of ecologically sustainable development of fisheries.

Logical Framework

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

Table 1: Logical Framework for Project 2014-030

Activities and Outputs	<ul style="list-style-type: none">• ABARES held face to face discussions with the prospective authors to discuss details of the 2014 SAFS reports, and provided details to authors of discussions held by the Advisory Group. The reports cover different fishery stocks of jurisdictions, biological, and management units.• SAFS authors consisted of scientists and other experts who compiled the various chapters of the reports.• The individual chapters for the SAFS reports were written and sent to ABARES for review to ensure overall consistency. After comments on the drafts were incorporated, chapters were sent to FRDC for external review.• FRDC then sent the drafts to one to two anonymous external reviewers per chapter for comment. FRDC then sent the ensuing comments to the lead author to respond to, or incorporate the reviewers' comments.• The chapters were then subject to copyediting and design and then sent back to ABARES for a final check before being returned to FRDC for the launch.• Before and after the launch of the 2014 SAFS reports, ABARES, FRDC, and the Advisory Group briefed fisheries stakeholders such as industry, on the contents of the SAFS reports and these stakeholders were able to review and make comment. It was noted that maintenance of the scientific independence of the reports was critical.• The 2014 SAFS reports utilised the national framework for reporting fish stocks developed before the project. This framework focused on consistent reporting across States, Territories, and the Commonwealth, including biomass of stocks for cross-jurisdictional waters.
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	<ul style="list-style-type: none"> • The 2014 SAFS reports were launched on the 10th December 2014. The reports were published online, with a summary document published in hard copy. • The national framework allowed easier and consistent estimation of fish biomass across jurisdictional boundaries for the 2014 SAFS reports. • As well as updating the information of the 49 species and 150 fish stocks in the 2012 SAFS reports, the 2014 SAFS reports added an additional 19 marine species consisting of 88 fish stocks. This was considered a priority of the 2014 SAFS reports. • The 2014 reports covered fisheries that contributed 90% of the total volume of wild caught fish landed in Australia and improved on the number of species addressed in 2012, with a focus on presenting data for the more commercially harvested species. • The 2014 reports found only approximately 4.9% of 238 stocks were overfished with 2.1% classified as transitional depleting. • The new reports also implemented a recommendation from the 2012 SAFS reports by including for the first time an environment limited category of assessment. The category considers declines in fish stock that are not associated with commercial fishing, but other factors such as changing environmental conditions. Only four stocks were included in this category. • Indigenous fishing was reported for the first time but was limited in extent due to insufficient data. The project highlighted the need for more data to be available for indigenous fishing. • Project links were established with other FRDC projects 2013-204¹ and 2014-008². These projects looked at other measures apart from biological sustainability, with the aim of utilising SAFS information in Project 2014-008. • Several workshops were held to discuss ways to improve future SAFS reporting. Recommendations made from the workshops included: <ul style="list-style-type: none"> ○ focus on current reported stocks but continue to reduce the number of undefined species reported on a risk-based approach, ○ use of state-level stock status reports and independent third-party reports in non-SAFS years to avoid duplication of classification work, and ○ undertake increased liaison with the FRDC Indigenous Reference Group.
Outcomes	<ul style="list-style-type: none"> • The national framework of reporting fish stocks has been adopted by all jurisdictions except the Commonwealth, Western Australia and New South Wales. However, these jurisdictions have applied similar frameworks that can easily be transferred to the SAFS standard of reporting. • The project process and subsequent 2014 SAFS reports allowed improved information transfer between jurisdictions and researchers due to the high level of communication throughout the project; in turn, this will aid future SAFS reports and individual jurisdictional reports. • Through synthesising reports across jurisdictions, the 2014 SAFS reports have allowed improved coverage and reliability of fish stock data and encouraged increased use of the data. • There potentially has been increased communication and harmonisation of reporting between fisheries managers due to the process undertaken in compiling the 2014 SAFS reports. • There is an increased ability to add more fish stocks to future reports due to improved processes developed in the 2014 SAFS reports. • The increased credibility of the reports has led to the increased use of reports by fishery stakeholders. This was achieved through engaging with fisheries stakeholders through the Australian Fishing Management Forum.

¹ FRDC Project 2013-204: *Meeting sustainability expectations: translating and aligning objectives, reporting and evaluation of the performance of Australian fisheries.*

² FRDC Project 2014-008: *Fishery Status Reports: Healthcheck for Australian Fisheries.*

	<ul style="list-style-type: none"> • The 2014 SAFS reports have been used by fisheries managers to gain a better understanding of the status and trends of fish stocks; both at risk and cross-jurisdictional stocks. • The reports have been used by the major supermarket chains in purchasing decisions and by Environmental Non-Government Organisations (ENGOS) for reporting purposes. For example, in the Australian Marine Conservation Society “Sustainable Seafood Guide. • There has been no use of SAFS in the outputs of Project 2014-008, as the Health Check project was not complete.
Impacts	<ul style="list-style-type: none"> • Potential contribution to improved RD&E resource allocation by improving the identification of at-risk fish species and tracking stock data over time. • Potential increase in efficiency of management of fisheries by the State and Commonwealth governments. • Potential increase in the future ecological sustainability of fish stocks, due to increased knowledge and better management. • Potentially a more positive perception of sustainability of wild-catch fisheries to suppliers, commercial buyers of seafood, and ENGOS but unchanged general public perception to date (Neville, P. 2017, p.5). • Maintained global image of management and sustainability of Australian wild caught fisheries

Project Investment

Nominal Investment

Table 2 shows the annual investment for the project funded by FRDC. There were contributions to the investment by ABARES and others, including the in-kind support provided by different fisheries departments and research institutions to each of the SAFS report chapters. The funding for 2014-030.30 is also included as these were the funds supplied by FRDC to the different jurisdictions and departments for writing the reports.

Table 2: Annual Investment in the Project 2014-030 (nominal \$)

Year ended 30 June	FRDC (\$)	ABARES (\$)	OTHER (\$)	TOTAL (\$)
2014	252,321	155,828	567,125	975,274
2015	430,572	158,747	203,625	792,944
2016	50,375	0	0	50,375
2017	76,107	0	0	76,107
Totals	809,375	314,575	770,750	1,894,699

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

Real Investment and Extension Costs

For the purposes of the investment analysis, the investment costs of all parties were expressed in 2016/17 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2016). Communication and publicity costs are assumed covered by the application of the FRDC multiplier.

Impacts

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

Table 3: Triple Bottom Line Categories of Principal Potential Impacts from the 2014 SAFS reports

Economic	<ul style="list-style-type: none"> Increased effectiveness and harmonisation of State and Commonwealth Government reporting and management of fisheries. The improved information on fish stocks and their sustainability in a national context potentially will drive better management decisions and policies. Potentially increased efficiency in resource allocation to at-risk fish species or cross jurisdictional species³, as at-risk, overfished, and environmentally limited stocks as such stocks now can be identified in a national context.
Environmental	<ul style="list-style-type: none"> A potential increase in the future ecological sustainability of fish stocks, due to increased knowledge and better management.
Social	<ul style="list-style-type: none"> Improved perception of sustainability of wild-catch fisheries to commercial buyers and ENGOs, with an impact on the social licence to fish due to independent scientific stock assessment. Contribution to maintaining Australia's prominent global position in wild-catch fisheries management.

Public versus Private Impacts

The investment resulted in both private and public impacts. Public impacts include the increased efficiency of research resources being utilised for at-risk and cross-jurisdictional species. Another public impact is the improved management of fisheries. The private impact from the project is the support provided to the continuing social licence for wild-catch fisheries.

Distribution of Private Impacts

The majority of the private impacts will flow to commercial wild-catch fishers, through greater security of the social licence to operate. There are also private impacts to fisheries in the form of the flow through from improved management of the fisheries. This may lead to an increased value that can be captured by private fishers and others in the supply chain.

Impacts on other Australian industries

There is expected to be no significant impacts on other Australian industries.

Impacts Overseas

There are no major benefits to overseas parties from this project. There may be some minor benefits in terms of global reporting of fish stocks and setting an example to other nations on how to report fish stocks in a multi-jurisdictional environment.

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 Priorities 1 and 2.

³ Cross jurisdiction stock/fishery is defined as a biological stock species that is present in more than 1 jurisdiction

Table 4: Australian Government Research Priorities

Australian Government	
Rural RD&E Priorities (est. 2015)	Science and Research Priorities (est. 2015)
<ol style="list-style-type: none"> 1. Advanced technology 2. Biosecurity 3. Soil, water and managing natural resources 4. Adoption of R&D 	<ol style="list-style-type: none"> 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 for the impacts of the 2014 SAFS reports. The impacts valued consider only the 2014 SAFS reports in isolation, with no relation to future SAFS reports. 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.

Three key impacts from the project were valued. These were:

- the improved efficiency of RD&E resource allocation,
- the improved effectiveness of fisheries management, and
- the increased security of the social licence to operate for wild-catch fishers.

Impacts Not Valued

Not all impacts identified in Table 3 could be valued in the assessment. Of the five impacts identified, two were not valued. These were:

- the potential future sustainability of wild catch fish stocks due to the status reports, and
- the contribution to the maintenance of Australia's prominent global position in managing wild catch fisheries.

Reasons for not attempting to value these impacts were that they were considered relatively minor compared to the impacts valued, a lack of measurable data, and time and resources. Further, the sustainability improvement was already captured in part by the improved effectiveness impact that was valued.

Valuation of Impact 1: Increased efficiency of 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 FRDC, the Commonwealth and State Governments, universities, and private organisations. FRDC and its partners have on average invested \$24.72 million per annum between 2014/15 and 2015/16. This RD&E expenditure does not include in-kind contributions to the projects funded.

The 2014 SAFS reports provided consistent reporting on the biological sustainability of fish stocks across Australia. It is assumed that FRDC made RD&E funding decisions using the information presented in the 2014 SAFS reports particularly regarding at risk fish stocks (e.g. those defined as overfished, transitional depleting, or environmentally limited). For the valuation of increased efficiency of RD&E resource allocation, it is assumed that the use of this information would have provided a 1% resource efficiency gain to FRDC total RD&E investment for the years 2015/16 and 2016/17. The full benefit therefore is assumed to apply to each of the two years following the release of the reports in 2014. After 2016/17, a residual value of 0.5% of the previous valued impact for RD&E expenditure, is assumed to last from 2017/18 to 2026/27 as other SAFS reports will take prominence in influencing the RD&E expenditure of FRDC.

Specific assumptions for valuing Impact 1 are provided in Table 5.

Valuation of Impact 2: Increased effectiveness of State and Commonwealth fisheries management

It is assumed that the 2014 SAFS reports will lead to increased management effectiveness of wild-catch fisheries. The independent national approach of reporting the biological sustainability performance of fisheries has aided in the management of wild-catch fisheries, mainly management arrangements, communication, and reporting cross jurisdictional fisheries (Neville, 2017). Increased effectiveness of management can be gained particularly in cross jurisdictional fisheries, where consistent reporting can aid in

more appropriate allocations of stock between jurisdictions (for example the Southern Rock Lobster stock). The increased communication between jurisdictions, standardisation, and compatibility of the reports can potentially help fisheries managers make better decisions. The increased effectiveness of management will flow through to increases in the value of the fishery.

Applicability and level of impact

For both cross and non-cross biological stocks, the value of wild-catch fisheries is assumed at the 2014/15 level. With the assumption that 90% of the gross value of wild-catch fisheries are covered by the 2014 SAFS reports (Finn, et al., 2015), the value of applicable wild-catch species is \$1.447 billion. For all stocks, it is assumed that fisheries management can influence only 10% of the total gross the value of fisheries. The effectiveness dividend due to the 2014 SAFS reports is applied to this 10% of the gross value of fisheries covered by the 2014 SAFS reports.

The effectiveness impact can be split into cross jurisdictional biological stocks and non-cross jurisdictional biological stocks. An effectiveness dividend of improved management decisions is applied to cross jurisdictional and non-cross jurisdictional fisheries of 15% and 5% respectively. Cross jurisdictional stocks have a higher dividend, due to the 2014 SAFS reports providing consistent reporting information across jurisdictions. This allows a consistent set of numbers to be viewed for biological stocks, that may otherwise be interpreted differently between jurisdictions. There may also be increased communication and consistency on how the biological stock is managed across jurisdictions, allowing consistent policy for the biological stock.

The non-cross jurisdictional biological stocks still have species that are found in multiple jurisdictions, but the biological stock of the species is separate. An example is the Banana Prawn, that has 6 biological stocks across three jurisdictions (Western Australia, Queensland, and Commonwealth) but each biological stock is only in one jurisdiction, not across different jurisdictions.

The contrast between the magnitude of impact for cross jurisdictional biological stock versus other stocks is because while the SAFS reports give a national report on the other stocks, the jurisdictional control of these biological stocks come under a single jurisdiction, so a lower effectiveness dividend is appropriate. The 2014 SAFS reports still provide value as the species in these fisheries can be compared to the same species in other fisheries in a consistent manner.

The improved management decisions are expected to increase the value of the catch in the applicable fisheries.

Cross jurisdictional

Cross jurisdictional stock contributes 38.24% of the value of wild-caught fisheries covered in the 2014 SAFS reports. The effectiveness dividend of 15% is applied to the 38.24% of stock that fisheries management influences, resulting in a corresponding increase in the value of the catch. The ensuring profit to fishers is then estimated by applying a profit proportion of 10% to the increased value of fish caught. There is no certainty that all managers would have used the new information to deliver the assumed effectiveness dividend, so a probability of impact of 70% is applied to the resulting profit increase.

Non-cross jurisdictional

For biological stocks that are not jointly managed, it is assumed that there will be similar impacts from the 2014 SAFS reports, but not as large compared to cross jurisdictional managed stocks. A probability of impact of 40% is assumed, as the extent of the usage of the 2014 SAFS reports is unknown. It is assumed that fisheries will capture 10% of the increased gross value as profit.

Timing of impacts

The majority of the impacts on fishers will last for three years from the release of the 2014 SAFS reports until the release of the 2016 SAFS reports. The 2014 and 2016 SAFS reports were released in December 2014 and 2016 respectively, so the proportion of maximum impact for the 2014 reports for the years 2014/15 and 2016/17 is assumed to be 50%, considering the benefits last only for half the year in each case. For the year 2015/16, 100% of the proportion of maximum impact is attributed.

The importance of the 2014 SAFS reports to the assumed impacts will diminish in the future as new SAFS reports carry more significance to fisheries managers and will have a greater effect on decisions. However, the 2014 SAFS reports still will provide a data point that can be used in future time series analysis of wild-catch species. A small residual impact of 0.5% per annum on the increased effectiveness from 2017/18 to 2026/27 is applied in the current valuation.

Specific assumptions for valuing Impact 2 are provided in Table 5.

Valuation of Impact 3: Improved security of social licence for wild-catch fisheries

The 2014 SAFS reports allowed ENGOs and commercial buyers to have access to up to date, scientifically robust information on the biological sustainability of Australian fish stocks. This enables ENGOs and commercial buyers to have another source of highly reliable information for their reporting and commercial activities.

In the 2016 SAFS audit, it is shown that there has been an uptake of SAFS information by ENGOs and consultants to commercial suppliers (Neville, 2017). In turn, this enhances the social licence for Australia's numerous fisheries as there may be less opposition to certain fisheries use. This may decrease the probability that increased regulation will be imposed, a reduced TAC will apply, or reduced demand due to non-procurement from supermarkets will be apparent.

It is assumed that 15% of the gross value of Australia's species covered in the 2014 SAFS reports are at risk of some form of loss of social licence. The risk is assessed as a 10% reduction in the profitability of these fisheries without the 2014 SAFS reports. Given the availability of the 2014 SAFS reports, it is assumed that the risk may fall from 10% to a 9% reduction in the profitability of the applicable wild-catch fisheries. The impact is assumed to last for 2 years, from the release of the 2014 reports until the release of the 2016 SAFS reports.

The majority of the impact of the 2014 SAFS reports will last for three years from the release of the 2014 SAFS reports until the release of the 2016 SAFS reports. The 2014 and 2016 SAFS reports were released in December 2014 and 2016, so the proportion of maximum impact associated with the year 2014/15 and 2016/17 is assumed at 50%, considering the benefits last only for half the year. For the year 2015/16, 100% of the proportion of maximum impact is assumed. There is assumed to be a 0.5% residual impact for 10 years from 2017/18, as the 2014 SAFS reports provide time series information that can strengthen the sustainability argument of Australian wild-catch fisheries.

Specific assumptions for valuing Impact 3 are provided in Table 5.

Counterfactual

It was assumed that, if the 2014 SAFS reports had not been funded, the benefits estimated in this analysis would not be realised.

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		
Annual average of FRDC RD&E spend	\$ 24.715 million (m) per annum	Average of RD&E spend 2013/14 - 2014/15, FRDC, 2016a
Efficiency gain of RD&E spend	1%	Agtrans Research
Efficiency gain	\$247,150 m per annum	\$24.715 m x 1%
Yearly attribution percentage of gain to 2015/16 and 2016/17 spend	100%	Agtrans Research
Residual benefit of trend data from 2017/18	0.5% per annum	
First year of impact	2015/16	
Last year of impact	2026/27	
General assumptions for Benefit 2 and Benefit 3		
Gross value of wild-catch 2014/15	\$1.608 billion	ABARES, 2016
Percentage of gross value fish stocks covered by 2014 SAFS	90%	Finn, et al., 2015
Gross value of 2014/15 wild catch covered in 2014 SAFS	\$1.447 billion	90% x \$1.608 billion
Percentage of profit from gross value	10%	Agtrans Research
Yearly attribution percentage for 2014/15 and 2016/17	50%	
Yearly attribution percentage for 2015/16	100%	
Residual benefit of trend data from 2017/18	0.5%	
First year of impact	2014/15	
Last year of impact	2026/27	
Benefit 2 Increased effectiveness of State and Commonwealth fisheries management		
Gross value of 2014/15 wild catch covered in 2014 SAFS	\$1.447 billion	90% x \$1.608 billion
Proportion of total fisheries value influenced by management	10%	Agtrans Research
Value of fisheries subject to influence	\$144.7 m	10% x \$1.447 billion
Cross jurisdictional stocks		
Number of species that are cross jurisdictional stocks	26	Finn, et al., 2015 and FRDC, 2016b
Total number of fish species covered in 2014 SAFS reports	68	Finn, et al., 2015
Percentage value of cross jurisdictional stocks	38.24%	= 26/68
Value of cross jurisdictional fish stocks that management can influence	\$55.32 m	38.24% x \$144.7 m
Effectiveness dividend to management	15%	Agtrans Research
Probability of impact	70%	
Percentage of profit from gross value	10%	
Expected maximum profit per year	\$0.58 m	(((\$55.32 m x 15%) x 70% x 10%)
Non-cross jurisdictional stocks		
Value of other stocks 2012/13 that management can influence	\$89.38 m	\$144.7 m - \$55.32 m
Effectiveness dividend to management	5%	Agtrans Research
Probability of impact	40%	

Percentage of profit from gross value	10%	
Expected maximum profit benefit per year	\$0.18 m	$((\$89.38 \text{ m}) \times 5\% \times 40\% \times 10\%)$
Benefit 3 Enhanced social licence benefit		
Percentage of fisheries affected	15%	Agtrans Research
Value of fisheries affected	\$217.06 m	15% x \$1.447 billion
Probability of impact with the SAFS reports	10%	Agtrans Research
Probability of impact with the SAFS reports	9%	
Value lost from fisheries without SAFS 2014	\$21.71 m	10% x \$217.06 m
Value lost from fisheries with SAFS 2014	\$19.53 m	9% x \$19.53 m
Gross benefit due to 2014 SAFS	\$2.17 m	\$21.71 m - \$19.53 m
Percentage of profit from gross value	10%	Agtrans Research
Expected maximum profit benefit per annum	\$0.22 m	\$2.17 m x 10%

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 2014-030 (2016/17).

Investment Criteria

Tables 6 and 7 show the investment criteria estimated for different periods of benefits for the total investment and the FRDC investment.

Table 6: Investment Criteria for Total Investment in Project 2014-030

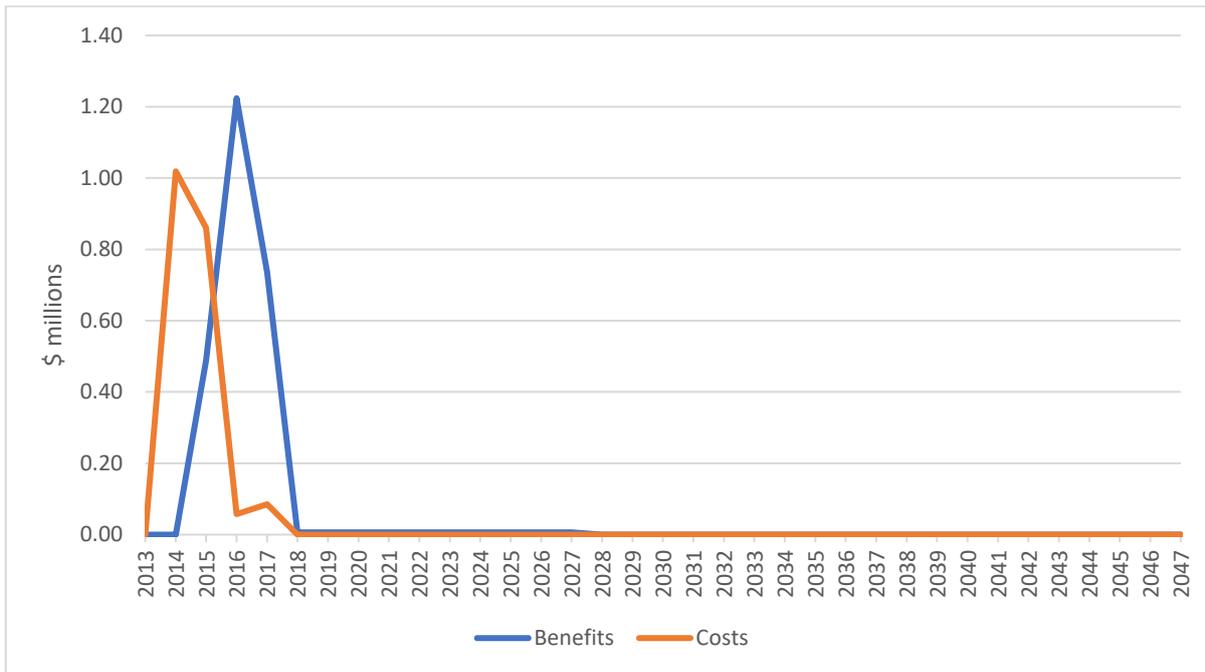
Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	2.56	2.59	2.61	2.61	2.61	2.61	2.61
Present Value of Costs (\$m)	2.27	2.27	2.27	2.27	2.27	2.27	2.27
Net Present Value (\$m)	0.29	0.31	0.33	0.33	0.33	0.33	0.33
Benefit-Cost Ratio	1.13	1.14	1.15	1.15	1.15	1.15	1.15
Internal Rate of Return (%)	13.65	14.22	14.50	14.50	14.50	14.50	14.50
Modified Internal Rate of Return (%)	no solution	8.83	7.02	6.34	6.00	5.80	5.67

Table 7: Investment Criteria for FRDC Investment in Project 2014-030

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits (\$m)	1.16	1.17	1.18	1.18	1.18	1.18	1.18
Present Value of Costs (\$m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Net Present Value (\$m)	0.15	0.16	0.17	0.17	0.17	0.17	0.17
Benefit-Cost Ratio	1.14	1.15	1.16	1.16	1.16	1.16	1.16
Internal Rate of Return (%)	17.57	18.22	18.49	18.49	18.49	18.49	18.49
Modified Internal Rate of Return (%)	no solution	9.83	7.52	6.67	6.25	6.00	5.83

The annual undiscounted benefit and cost cash flows for the total investment for the duration of Project 2014-030 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



Sources 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: Source of Benefits

Source of Benefits	Contribution to PVB (\$m)	Share of Benefits (%)
Benefit 1: Increased efficiency of RD&E resource allocation	0.52	19.8
Benefit 2: Increased effectiveness of State and Commonwealth fisheries management	1.63	62.4
Benefit 3: Improved security of social licence for wild-catch fisheries	0.46	17.8
Total	2.61	100.00

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 investment criteria were not particularly sensitive to the discount rate due to the short period of time to which the principal benefits apply.

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

Investment Criteria	Discount rate		
	0%	5% (base)	10%
Present value of benefits (\$)	2.51	2.61	2.71
Present value of costs (\$)	2.02	2.27	2.55
Net present value (\$)	0.49	0.33	0.16
Benefit-cost ratio	1.24	1.15	1.06

A sensitivity analysis was undertaken for the level of the effectiveness dividend (Benefit 2). The results reported in Table 10 show the effectiveness dividend having a moderate level of sensitivity to the investment criteria. In the pessimistic scenario, the net present value for the investment is negative, while for the optimistic scenario, the net benefits are over \$900,000.

Table 10: Sensitivity to Benefit 2: Effectiveness Dividend to Managers
(Total investment, 30 years)

Investment Criteria	Effectiveness Dividend (cross jurisdictional and non-cross jurisdictional)		
	10% and 2.5%	15% and 5% (base)	20% and 7.5%
Present value of benefits (\$)	2.00	2.61	3.21
Present value of costs (\$)	2.27	2.27	2.27
Net present value (\$)	-0.27	0.33	0.94
Benefit-cost ratio	0.88	1.15	1.41

Confidence Ratings

The results produced are highly dependent on the assumptions made, some of which are uncertain. There are two factors that warrant recognition. The first factor is the coverage of benefits. Where there are multiple types of benefits it is often not possible to quantify all the benefits that may be linked to the investment. The second factor involves uncertainty regarding the assumptions made, including the linkage between the research and the assumed outcomes.

A confidence rating based on these two factors has been given to the results of the investment analysis (Table 11). The rating categories used are High, Medium and Low, where:

- High: denotes a good coverage of benefits or reasonable confidence in the assumptions made
- Medium: denotes only a reasonable coverage of benefits or some uncertainties in assumptions made
- Low: denotes a poor coverage of benefits or many uncertainties in assumptions made

Table 11: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
High	Medium-Low

Three impacts were valued from five identified. The coverage of benefits was assessed as high due to the diverse nature of the impacts valued, with both economic and social impacts being valued. However, the assumptions of the impacts were somewhat speculative and therefore the confidence in assumptions were assessed as medium-low. As there is limited evidence to suggest that the impacts assumed due to the SAFS reports have actually occurred, the assumptions made were conservative in nature.

Conclusions

The investment in this project has likely resulted in several impacts, some of which were valued in financial terms (an increase in efficiency for RD&E investment, increased effectiveness of fisheries management, and a contribution to maintaining the social licence to fish). These impacts were driven by the integrated and authoritative nature of the information produced in the 2014 SAFS reports.

Funding for project 2014-030 totalled \$2.27 million (present value terms) and produced estimated total expected benefits of \$2.61 million (present value terms). This gave a net present value of \$0.33 million, an estimated benefit-cost ratio of 1.2 to 1, an internal rate of return of 14.5% and a modified internal rate of return of 5.7%

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

The 2014 SAFS reports were evaluated in isolation from past and future expected SAFS reports. The analysis does not consider the full benefits of the entire SAFS project (the past and future expected SAFS reports together).

Joint consideration may indicate substantial additional value in the time series data that can be generated and the harmonisation of state reporting throughout the entire SAFS project. As such, it may be better to view the SAFS contributions throughout time instead of evaluating an individual set of reports at one point in time, as it is likely that the benefits from the series of reports considered jointly could be greater than sum of benefits from each report viewed in isolation. It can be reasonably assumed that the benefits of having consistent national stock data that are regularly updated will have wide ranging implications for fisheries managers and the general community.

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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