Appendix C: 2016-208: Waste to Profit in Urchin Fisheries: Developing Business Opportunities to Ensure Fishery Sustainability and Safeguard Reef Dependent Fisheries from Destructive Urchin Grazing

Background

Commercial sea urchin harvesting can remove significant volumes annually and provide high-value exports, to Japan and the Mediterranean. While edible parts of the urchin such as the gonads are processed and regarded as delicacies, the remaining spines and guts are considered waste, accounting for over 85% of the harvested biomass and often go to landfills at the expense of the processor. As there is limited information on other avenues of sea urchin waste disposal, this contributes to decreasing the overall profitability and viability of urchin fisheries.

The project focused on increasing the viability of commercial operations of the Longspined Sea Urchin (*Centrostephanus rodgersii*) as it is a major threat to the East Coast reefs of Tasmania. These reefs host high-value industries such as abalone (GVP $42.6m 2021/22, although this has dropped significantly from a pre-COVID value of $79.4m 2018/19) and Southern Rock Lobsters (*Jasus edwardsii,* GVP $47.5m 2021/22, which has similarly dropped significantly from a pre-COVID value of $93.9m 2018/19) (ABARES, 2022), but the spread of Longspined Sea Urchins makes them patchy or 'barren'. Longspined Sea Urchins have caused the collapse of 15% of Tasmania's reefs. By 2030, they are projected to degrade 50% of the reef (NESP Marine and Coastal, n.d.).

IPCC (2022) assessed with 'high confidence' kelp loss in southeast Australia from urchin overgrazing as one of several "Key risks that have potential to be severe but can be reduced substantially by rapid, large-scale and effective mitigation and adaptation". The Tasmanian Government and the Tasmanian wild catch abalone industry established the Abalone Industry Reinvestment Fund (AIRF) to safeguard the abalone fishery while addressing the impacts of the Longspined Sea Urchin; this includes subsidising regional commercial sea urchin harvesting (UTAS & IMAS, 2019).

Some sea urchin processors have been conducting informal trials of sea urchin waste as a raw fertiliser in compost and worm farms and organising rudimentary biochemical analyses of waste with anecdotal success. There had also been a potential use of sea urchin waste as bait for Southern Rock Lobsters. This led to the development of this project and investment by FRDC.

Description of the project

Table 19 Project summary of 2016-208

Project code	2016-208
Title	Waste to Profit in Urchin Fisheries: Developing Business Opportunities to Ensure Fishery Sustainability and Safeguard Reef Dependent Fisheries from Destructive Urchin Grazing
Research organisation	University of Tasmania
Principal investigator	Dr John J. Keane

FRDC project manager	Chris Izzo
Project duration	June 2016 – February 2018
FRDC investment	$54,102
FRDC program allocation	80% Industry, 20% Environment

Rationale	The continued damage caused by the Longspined Sea Urchin to key abalone and rock lobster habitat, along with the impacts caused environmentally and socially has led to a push in trying to find solutions to incentivise commercial and/or targeted harvest. The use of sea urchin waste products as fertiliser or bait were seen as potential pathways to this.
Objectives	• Identify applications of the sea urchin waste in the agricultural sector by determining the biochemical composition and volume of the sea urchin • Assess the potential use of the sea urchin as bait for the Southern Rock Lobster
Activities and outputs	• Biochemical analyses of the sea urchin waste contained calcium, magnesium, nitrogen, and potassium macronutrients as well as micronutrients such as boron and iron • Tomato growth trials showed the positive relationship between the concentration of sea urchin waste applied as a fertiliser on plant growth and productivity. Plants that received higher concentrations of sea urchin fertiliser exceeded vegetative growth in comparison to the industry standard fertiliser, however sea urchin fertilised plants had relatively lower fruiting yields and quality • Bait trials showed that the Longspined Sea Urchin was less effective compared to commercial baits and endemic sea urchin species. However, it may have some limited application in harvest of large Southern Rock Lobsters from areas where Longspined Sea Urchin are abundant
Outcomes	• There are significant, viable opportunities for developing saleable by-products using Longspined Sea Urchin waste to offset the disposal costs in the agricultural sector • This research led to the main Tasmanian urchin processor (RTS PauaCo) receiving state grant funding to invest in commercial scale waste processing technology with capacity to dry and grind up 5,000 kg of sea urchin waste a day • FRDC project 2019-128 investigated further development of the application of sea urchin waste as a fertiliser in commercial crops
Potential impacts	• Reduce cost of waste disposal and transportation for processors • Transforming waste into a by-product may enable increased catching and processing of sea urchins • Sea urchin waste powder required less pre-treatment costs and had high micronutrient content, hence adding significant value as a nutrient supplement. If sufficient amounts of sea urchin waste fertiliser can be produced at reasonable costs, then it is a viable alternative to expensive soil supplements currently in use • Improve the ecological stability, specifically the security of rock lobster and abalone fisheries, along the Eastern coast of Tasmania, Victoria and NSW

	• Contribute towards better management of overgrazing urchins and reduce pressure on coastal reef ecosystems • Presence of boron and iron in urchin waste fertiliser is useful for Tasman soil deficient in these micronutrients

Project investment

A breakdown of FRDC investment in the project and contribution by others by financial year is shown in Table 20.

Table 20 Total investment in Project 2016-208 from FRDC (nominal dollar terms)

Year ending June 30	FRDC ($)	Others* ($)	Total contribution
2016/17	$33,131	$37,832	$70,963
2017/18	$13,248	$34,200	$13,248
2020/21	$3,862	$0	$3,862
2021/22	$3,8612	$0	$3,862
Total	**$54,102**	**$72,032**	**$126,134**

Source: Documents provided by FRDC.

*Contributions to the project cost not sourced from FRDC e.g. in-kind contributions

For the BCA the cost of managing the FRDC funding was added to the FRDC contribution for the project using a management cost multiplier of 1.157. As per impact assessments in previous years, this multiplier was estimated based on a five-year average of the ratio of total FRDC non-project cash expenditure to project expenditure as reported in FRDC's Cash Flow Statement (FRDC Annual Reports, 2019-2023).

In undertaking the impact assessment, all past costs were expressed in 2023/24-dollar terms using the Implicit Price Deflator for GDP.

Summary of impacts

Table 21 below provides a summary of the expected triple bottom line impacts (economic, environmental, and social) from the project.

Table 21 *Triple bottom line impacts, including those valued as part of this evaluation (in bold)*

Economic	• **Greater profitability for sea urchin harvesters through the decreased waste costs and potential profit from fertiliser production** • Cost-effective removal of Longspined Sea Urchins • Decreased need for government subsidy payments • **Decreased rate of deterioration of reef habitat that supports Southern Rock Lobster and Abalone**
Environmental	• Decrease in the abundance of the Longspined Sea Urchin, leading to decreased spread and greater potential for rehabilitation of Tasmanian kelp forests and coastal rocky reef ecosystem • Development of a knowledge base from PhD research conducted on lobster translocation and ecological interactions to consider enhancing rock lobster fishery

Social	• Contributing to the protection of reefs that hold important recreational fishing and cultural values

Public versus private Impacts

The potential impacts identified from the project will accrue to both public and private beneficiaries. This project, if successful in contributing to the development of a sea urchin waste processing by-product market would act to further incentivise the harvest of Longspined Sea Urchins. The potential transfer of waste from being a cost to a stream of income would be a key private sector gain. Considering the geographical scale of damage caused by the abundance of Longspined Sea Urchins, greater commercial incentives to harvest could increase harvest rates and hence have large environmental and social benefits.

The greater market incentives for sea urchin harvesters provided through this project has the potential to reduce the level of subsidised fishing currently paid for by the government and industry, which encourages harvest efforts in ecologically important regions for abalone and lobster.

Distribution of private impacts

Private benefits are likely to be realised by the sea urchin processors that currently have large expenses in the removal of processing waste. There will be more indirect benefits down the supply chain if it is an effective fertiliser and has commercial potential.

Impacts on other Australian industries

The sea urchin processing waste is being trialed as an agricultural fertiliser. Although small in its potential size, it could contribute to overall supply of fertiliser.

There are potential downstream benefits to the Southern Rock Lobster and Abalone fisheries. As the removal of habitat destroying Longspined Sea Urchins has resulted in the recovery of kelp and reef habitats (FRDC, 2019), which in turn, may promote localised recovery of Southern Rock Lobster and Abalone populations that contribute to the fishable biomass.

Impacts overseas

Other countries, such as New Zealand, face a similar threat from Longspined Sea Urchins and may benefit from the findings of this project.

Quantification of impacts

The most quantifiable direct impacts identified are the increased profit to sea urchin processors, along with the associated benefits of a decreased rate of deterioration of suitable reefs to support the Abalone and Southern Rock Lobster industries. Although further analysis could have been completed in relation to the broader recreational and environmental value of safeguarding reefs, it was deemed there is insufficient data and it is too early to quantify these impacts, although they are likely large.

Estimated benefits

The estimated benefits are quantified in terms of the potential benefits to processors of sea urchins and the safeguarding of suitable regions to the Abalone and Southern Rock Lobster industries.

Table 22 Benefit assumptions

Variable	Assumption	Source/ Explanation
Impact 1: Benefits to sea urchin processing waste streams and potential profit in fertiliser		
a) Initial capital investment required to process sea urchin waste	$50,000	Scenario 2 identified in the BCA analysis conducted in FRDC project 2019-128 (2024)
b) Annual benefit of processing Tasmania's Urchin waste	$131,625	Scenario 2 identified in the BCA analysis conducted in FRDC project 2019-128 (2024)
c) Tasmania Urchin waste	491 tonnes	
d) NSW Urchin waste	90 tonnes	(NSW DPI, 2023)
e) Victoria Urchin waste	100 tonnes	(VFA, 2024)
f) Tasmanian annual benefit extrapolated to NSW and Victoria	$182, 559	[b x (d + e) / c] + b
Impact 2: Safeguarding of abalone and Southern Rock Lobster habitat		
g) Tasmanian value of abalone	$63,692,000	Five-year average (ABARES, 2022)
h) Tasmanian value of Southern Rock Lobster	$72,665,000	Five-year average (ABARES, 2022)
i) Annual profit margin	10%	Analyst estimate
j) Estimated annual decrease in habitable reef without this project	1.67%	Considering NESP Marine and Coastal (n.d.), a more conservative estimate is the reef deteriorating by 50% over the next 30 years.
k) Annual avoided costs to the abalone and Southern Rock Lobster industries	$227,261 (k)	(g + h) x i x j

Adoption costs

Scenario 2 in the BCA analysis conducted in related and ongoing FRDC project 2019-128 (2024) identified a likely $50,000 cost to adopt the necessary processing equipment. Further development costs are assumed to be $250,000, referring to the ongoing FRDC funded project.

Counterfactual

The counterfactual is that there would be a continued spread of sea urchins, as has been extensively outlined in the research, causing there to be a decrease in available habitat for Abalone and Southern Rock Lobster harvesting. Further, sea urchin processors would continue to pay waste fees to dispose of processing waste.

Attribution

This project was relatively small in cost, however, its positive results and direct relationship to ongoing work mean the benefits are expected to be shared across ongoing work in the commercialisation stage.

Table 23 Attribution of benefits for project 2016-208

Variable	Assumptions
FRDC costs	20%
Other project party	23%
Future development	58%
Total	100%

Adoption

The BCA considered adoption to begin occurring in 2025/26 and continue constantly throughout the period of analysis.

Results

Table 24 below presents the modelled investment performance from the project. All past costs and benefits were expressed in 2023/24-dollar terms using the Implicit Price Deflator for GDP, while all future costs and benefits were discounted to 2023/24 using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the modified internal rate of return (MIRR). The 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 investment period plus 30 years from the last year of investment (2023/24) to the final year of benefits assumed.

Table 24 show the total investment returning a net present value (NPV) of $0.98 million and a favourable Benefit Cost Ratio (BCR) of 6.6. Table 25 shows the FRDC investment returning a NPV of $0.45 million and a BCR of 6.6.

Table 24 Investment criteria for total investment in Project 2016-208 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.06	$0.37	$0.62	$0.81	$0.96	$1.07	$1.15
PV Costs	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17	$0.17
NPV	-$0.11	$0.20	$0.44	$0.63	$0.78	$0.90	$0.98
BCR	0.3	2.1	3.5	4.6	5.5	6.2	6.6
IRR	N/A	11%	16%	18%	18%	18%	18%
MIRR	-100%	7%	9%	9%	9%	9%	9%

Table 25 Investment criteria for FRDC investment in Project 2016-208 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.03	$0.17	$0.29	$0.37	$0.44	$0.50	$0.53
PV Costs	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08
NPV	-$0.05	$0.09	$0.20	$0.29	$0.36	$0.42	$0.45
BCR	0.3	2.1	3.5	4.6	5.5	6.2	6.6
IRR	N/A	11%	16%	18%	18%	18%	19%
MIRR	-100%	7%	9%	9%	9%	9%	9%

The flow of total undiscounted costs and benefits from the project is presented in Figure 3 below.

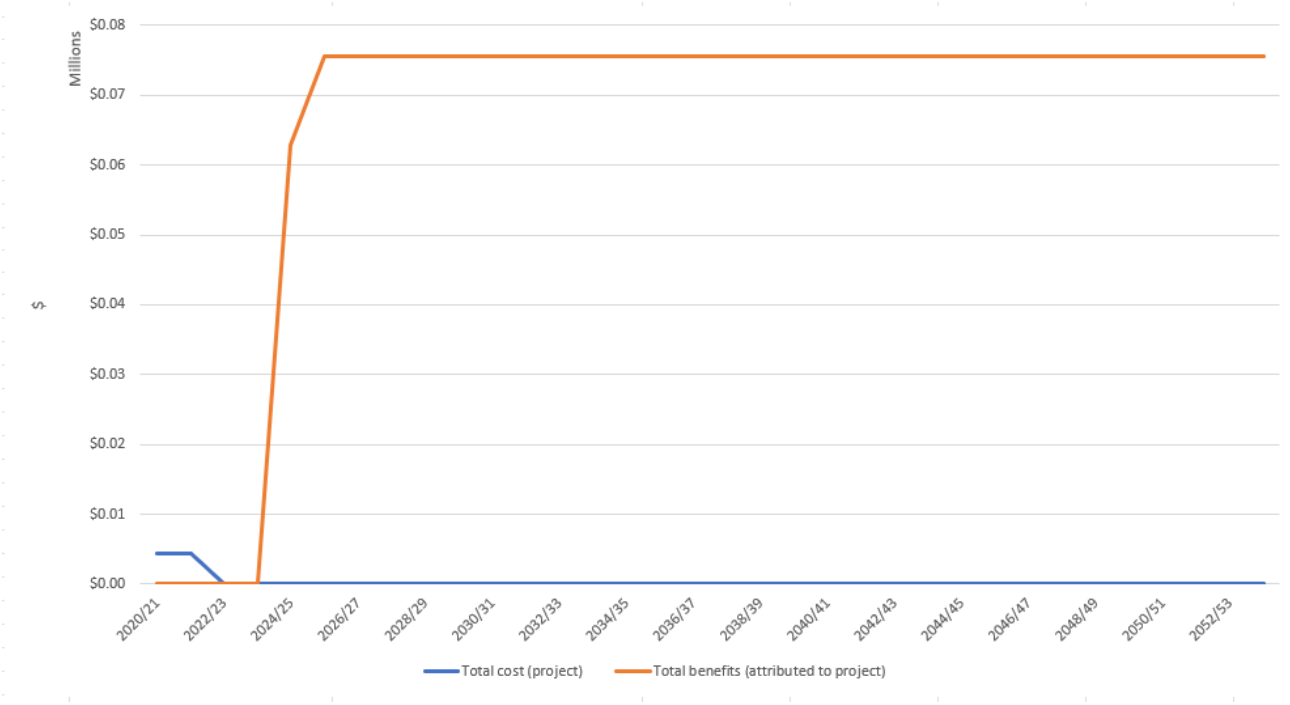

Figure 3 Flow of undiscounted costs and benefits from the project.

Sensitivity analysis

A sensitivity analysis was carried out to determine how the investment performance (NPV, BCR and MIRR after 30 years) would change based on changes to the discount rate and other key variables. The results are presented in Table 26 below.

Table 26 Sensitivity analysis

Changes to key variables	NPV ($M)	BCR	MIRR
Standard assumption	0.98	6.6	9%
Adjusted discount rate			
4%	1.12	7.4	8%
6%	0.85	5.9	9%
Change in total tonnes of Urchin waste processed			
-10% (613 tonnes)	0.93	6.3	9%
10% (749 tonnes)	1.03	6.9	9%

Confidence ratings

The accuracy of the assessment is highly dependent on:

- The extent to which the analysis captures and quantifies the various benefits from the project, including non-market benefits (i.e. coverage of benefits), and
- The level of confidence in the accuracy of assumptions used (i.e. confidence in assumptions).

An assessment of coverage and confidence ratings for this project is presented below in Table 27.

Table 27 Coverage and confidence ratings

Factor	Rating	Comment
Coverage of benefits	Medium	The benefits cover the most quantifiable components, however, do not include the potentially large environmental benefit as well as the potential cost-savings in subsidies provided.
Confidence in assumptions	High	Most assumptions have been based on well researched sources.

Conclusions

Project 2016-208: *Waste to Profit in Urchin Fisheries: Developing Business Opportunities to Ensure Fishery Sustainability and Safeguard Reef Dependent Fisheries from Destructive Urchin Grazing* has high potential to generate greater harvest of Longspined Sea Urchins on Australia's east coast. The potential for greater profitability of sea urchin processors would lead to greater incentives for business and harvest area extensions.

Based on the adopted assumptions this analysis has estimated the project investment will likely deliver a significantly positive economic benefit (BCR 6.6). This investment return remained positive under all scenarios modelled.

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