# Abalone Industry Reinvestment Fund (AIRF)

Updated: January 2024

## Commercial upscaling of urchin fertiliser

Lead Agency: Institute for Marine and Antarctic Studies (IMAS)
Funding: $569,944.00
Start Date: 1 September 2019 End Date: 20 August 2025
Status: CURRENT

**Aims and Objectives:**

The aim of this project is to establish commercial processing of urchin waste, and test two key waste streams as an agricultural product on commercial crops; dried solids as a soil conditioner/fertiliser, and liquids to use as a foliar spray to enhance frost resistance.

**Project Report:**

The overall aim of this project was to establish if sea urchin waste could be utilised as a commercially acceptable agricultural amendment to serve as an organic alternative for growers and farmers seeking more sustainable inputs, and to provide an additional revenue for urchin fisheries. Five primary objectives were established:

1. To develop commercial scale processing equipment of sea urchin waste;
2. Determine the nutrient composition and plant bioavailability of nutrients from two high throughput waste streams: liquid gut waste and dried powdered shell waste;
3. Evaluate the agronomic benefits of liquid gut waste as a frost retardant in perennial tree cropping (cherries);
4. Evaluate the agronomic benefits of powdered shell waste as a soil ameliorant in a wide range of annual and perennial cropping systems;
5. Undertake a cost benefit analysis comparing fertiliser products (foliar sprays and/or soil conditioners) from this work to other products on the market to assess if the products are commercially viable.

***Methodology***

Objective 1 & 2

A modified food waste processing facility was researched and obtained at project commencement, then revised by engineers upon receival to meet Australian standards, optimise operational efficiencies, and maximise throughput. Multiple test runs led to the obtainment of three suitable solid sea urchin waste (SUW) products which varied in processing times (14, 24, 48 hrs), resulting in end-products of different dryness and fineness, and one liquid SUW product. The physiochemical nature of both solid and liquid products were observed with additional analyses (organic contaminants, organic pesticides, microbiological) performed on potential commercial products (SWEP analytical laboratories, Keysborough, Victoria, Australia) to align with the Australian Standards for composts, soil conditioners and mulches (AS 4454-2012). The liquid product underwent sterilisation through autoclaving and fermentation yet was deemed unsuitable for agricultural use due to a high electrical conductivity (EC) and associated salt content, and relatively low nutrient content. Further testing of the liquid SUW and the commencement of Objective 3 ceased. Other liquid waste management strategies are currently being explored by the fishery.

### *Objective 4*

Preliminary measures of the SUW product to assess its agronomic viability and commercial use included particle size analysis and crop toxicity assessment. Particle size analysis was performed by sifting the solid SUW products (14, 24, 48 hrs) through different sized mesh to generate particle distribution curves and calculate product effective neutralising value (ENV) for liming product utility. The phytotoxicity trial was conducted on radish (Raphanus sativus L.) seeds using methods described by Wang et al. (2022) to calculate the germination rate, radicle length and germination index of seedlings exposed to up to 10 % SUW.

A series of pot and field trials were conducted to explore the fertiliser potential (sunflower trial, apple orchard trial, potato trial) and liming potential (green bean trial, vineyard trial) of the SUW products. Different SUW products were applied to a variety of soil types at different rates (0 – 20 t ha-1). Crop productivity and soil physiochemical status was measured throughout.

### *Objective 5*

A net present value (NPV) analysis was performed in consultation with True South Seafoods and an external economic consultant. A cost-benefit analysis was redundant as any conversion of the waste on-site using the processing facility available was determined economically profitable. Three projects to produce the SUW-based agricultural product were considered. Post NPV computation, the project with the highest NPV was deemed most successful for implementation.

### *Results and key findings*

SUW was converted into a successful soil amendment through a simple two-stage process of grinding and heating the solid waste, in which processing time impacted particle fineness and moisture content but did not meaningfully impact other product physiochemical properties for up to 48 hours. The resulting SUW product was high in several important plant nutrients and was largely characterised by a high calcium content (33 %), resulting in its potential use as a liming material. This liming effect was demonstrated in a variety of trials across both annual (sunflowers, green beans, potatoes) and perennial (apples, grapevines) crops in sandy soils, loams and clay soils. The product's effective neutralising value was calculated and used to determine appropriate rates to increase the soil pH equivalent to or surpassing that of conventional liming products using typical liming formulas.

Fertiliser impacts from the SUW product were observed in low-nutrient pot trials but were not significant in commercial field trials. This suggests that the upper rate thresholds maintained based on the products strong liming ability and the ideal soil pH parameters for crop production, prevented the observation of significant fertiliser effects from other nutrients present in the SUW products, at least in commercial field settings. However, the addition of other nutrients provided by the SUW is still beneficial and a fertiliser effect may be more readily observed in home gardens, such as shown in the sunflower pot trial.

The economic analysis determined that processing SUW was more profitable than waste disposal, regardless of whether the SUW product was sold. Further investment of $50,000 to upgrade the facility would reduce current annual production running costs and provide additional profit from the second year onwards.

The utility of SUW as a commercial "liming plus" product shows promise, but growers are advised to proceed with caution due to the products salt content. Commercial suppliers should provide growers with appropriate management techniques and recommended rates to reduce the likelihood of any salinity issues at first use and with prolonged use. Adding a freshwater wash step to SUW processing is likely to reduce salt-related land risks.

### *Implications*

This project demonstrated that the cost of processing SUW using a simple grinder and heated processing facility is more financially beneficial than conversion to landfill, and that a valuable agricultural product can be made from the SUW that fisheries could profit from.

### *Recommendations*

Further investigation into the long-term impact (3 - 5 years) of SUW and repeated SUW applications on soil health and crop production is advised due to the novelty of the product and potential salinity issues. From a sustainability perspective, a life cycle analysis that explores the inputs and outputs of SUW production, particularly regarding energy, greenhouse gas emissions, and an additional freshwater washing step, would be beneficial.