



Waste to revenue

Novel fertilisers and feeds

Australian Pork Limited

Activity: 14-01-022

Funding: \$862,693 (excluding GST)

This summary is an excerpt from the [final report](#), with minor edits made to ensure it meets departmental style and accessibility requirements.

Summary

Agricultural industries produce large volumes of waste containing valuable nutrients, carbon and water. Unfortunately, this waste doesn't have the right nutrient balance to be directly used as a crop fertiliser. It is typically diluted with moisture, making transportation and reuse off-farm impractical and unfeasible. Food crops don't use the nitrogen in fertilisers very efficiently and there are significant losses in the process of converting food protein into meat protein. These are widely recognised issues, with the majority of carbon, and almost all nitrogen and phosphorus lost in emissions or waste streams. This project addressed these issues by converting agricultural waste and wastewater into novel feeds and fertilisers demonstrating reduced farming inputs and decreasing costs of primary production.

Benefits to producers

As a result of this project, there will be a number of benefits to producers.

- New treatment technologies that treat wastewater whilst producing a high-value microbial biomass which offer commercial and revenue opportunities
- Some waste-derived by-products can be used as partial fertilisers, reducing the input costs and increasing fertiliser use efficiency by up to 40%. Other by-products could be used as soil conditioners to ameliorate the soil constraints on yield through; increased pH, C and N retention in soils, resilience to water and heat stress reducing the need for soil amelioration practices (such as liming or adding clay) that can cost approximately \$124/ha/year.
- The amended *Biosecurity and Agricultural Management Act 2007* now permits WA farmers to apply poultry litter/compost in broad acre agriculture in previously banned Shires. This is a major cost saving as the industry currently loses up to \$8/m³ in removal costs.
- The semi-arid soils of WA were low emitters of nitrous oxide (N₂O) and a major sink of methane when amended with manures and composts. Methane uptake could lead to significant reductions in GHG emissions by negating on-farm GHG emissions. This mitigation methodology could be included as Australian carbon credit units (ACCUs) issued under the Emissions Reduction Fund, currently trading at between \$13-15 per tCO₂-e of emissions abated.

Objectives

The project aimed to:

- develop new waste treatment technologies using algae and purple phototrophic bacteria (PPB) to recapture nutrients in waste as feed and fertiliser products
- evaluate the nutritive, economic and agronomic value (for example, increased soil biology and quality, crop productivity, fertiliser use efficiency) of new waste-derived products against alternatives
- overcome some of the key barriers to adoption by involving primary producers and regulators during field trials to assist early adoption.

Methods and outputs

The project developed technologies for treating and reusing agricultural waste between 2015 and 2018.

- Novel waste processing technology work – Wastewater treatment technologies were developed and tested using photobioreactors to treat wastewater whilst producing high-value microbial biomass.
- Novel feed – Microbial biomass produced from synthetic wastewater was tested using bacterial reactors. The biomass was then used as a bulk fishmeal replacement in feed trials with barramundi.
- Novel fertilisers work – The biological, economic and agronomic value of alternative fertiliser products derived from wastes was tested and greenhouse gas (GHG) emissions and stable fly emergence (pest fly species) quantified.

Outcomes

The project resulted in a number of outcomes.

- Novel wastewater treatment technology – We have shown that it is feasible to treat real wastewaters from agricultural industries with the PPB continuous wastewater treatment system and photobioreactor technology.
- Novel feeds – This project tests the bulk replacement of fishmeal with PPB biomass, specifically for barramundi. When we consider savings on wastewater treatment by instead treating with PPB, up to 1400 USD tonne-1 PPB product could be saved. This results in a net production cost of 200 USD tonne-1 PPB. However, we note that this needs to be confirmed in a demonstration plant.
- Novel fertilisers – A number of novel fertiliser products have been developed and tested, with three of them, specifically Black Stable Fly (BSF) frass, microalgae and advanced compost, performing as well as synthetic fertiliser in pot trials. A three-year field trial showed there were increased financial gains in terms of increased productivity and reduced input costs by applying beef compost with synthetic fertiliser at the reduced rate of 60%, without affecting crop yield.
- The research outcomes were used to negotiate and amend the *Biosecurity and Agricultural Management Act 2007*. As a result, poultry litter/compost can now be applied to broad acre

agriculture in previously banned Shires in WA. This is a major cost saving to WA producers (\$4 million/yr.).

- Applying compost to dairy pastures in WA led to improved shoot growth and P uptake in pasture soils under water stressed conditions and was more effective than clay additions. Currently, the average cost of soil amelioration practices such as clay and lime amendments are about \$41/ha and \$124/ha/year (annualised value). Thus, applying compost has a benefit: cost ratio of 3:1 and a net benefit of about \$83/ha/year.
- Applying chicken compost to soils, raised soil pH, and improved biological function, nutrient retention and nutrient availability in field trials. This could partially overcome current constraints of grain production in WA.
- Overall, semi-arid soils of WA amended with manures and composts are low emitters of nitrous oxide (N₂O) and a significant methane (CH₄) sink when amended with manures. Methane uptake was greatest in soils amended with composted manures (pig, beef and dairy) with the exception of chicken manure that performed better when untreated. Methane uptake could lead to significant reduction in GHG emissions by negating on-farm N₂O and CH₄ emissions.