



Harnessing the potential from sugarcane biorefineries

A new research project is looking at the potential for harnessing the potential of agricultural residues and turning them into valuable revenue streams for primary producers and processors.

This project was announced in 2015 as part of the Australian Government's Rural R&D for Profit programme and is a collaboration between SRA, QUT, Forest and Wood Products Australia Limited, the Cotton Research and Development Corporation, Australia Pork Limited and Southern Oil Refining.

It also has support from NSW Department of Primary Industries and the Queensland Government Department of Agriculture and Fisheries.

It forms a \$6 million investment, the majority of which is from SRA and the Commonwealth, making it the largest and most comprehensive research activity into value adding that has occurred within the sugarcane industry.

The research program being led by QUT is now occurring in the field and in the lab, split into several focus activities. These activities are to:

- Develop new technologies for the use of sugarcane products as animal feed ingredients

- Develop new technologies for the use of enzymes to enhance nutritional characteristics of sugarcane products
- Develop technology for the production of pharmaceutical precursors from cotton waste
- Develop technology for the production of fermentable sugars from cotton gin trash
- Develop technology for the production of advanced fuels from sugarcane biomass and animal waste residues
- Assess factors influencing innovation and adoption in the Australian sugar milling industry
- Develop biorefinery innovation in the forest and wood products industries
- Extension and communication.

In this edition of *MillingMatters*, we take a look at the early research occurring in two of these activities.

These are the assessment of animal feed ingredients from cane products (page 6-7), and also the assessment of factors that influence innovation and adoption in the milling industry (opposite page).

If this technology became widely adopted, it would stand to create significant benefits for agricultural industries and regional communities and economies.

A Deloitte Access Economics and Corelli Consulting study in 2014 indicated that the establishment of rural and regional bio-refineries could generate over \$21.5 billion in extra revenue over the next 20 years and create 6640 new full-time jobs.

Diversification is an important strategy for ensuring the long term profitability of the sugar industry.

This project is targeted toward capturing this opportunity for the sugar industry, delivering practical research outcomes on a number of fronts, and linking it closely with research into adoption as well extension and communication.

This project is supported by funding from the Australian Government Department of Agriculture as part of its Rural R&D for Profit programme.





Understanding the barriers to industry innovation

The new Biorefineries for Profit project is looking further than just research into value-add products from farm by-products, and is also researching the next steps of seeing innovation translated into real-world commercial outcomes.

In doing so, it is enlisting the help of researchers within the QUT Business School to better understand the barriers to and processes around implementation of new technology.

The project has a strong focus on research into options for farmers and processors of agricultural products, but this major component of the project is also looking at the broader environment that exists around new innovations.

Dr Stephen Cox at QUT is leading this part of the project and said that this work occurred in the context of ensuring the project able to deliver results on the ground and not "sit on the shelf".

"With diversification around agriculture residue products, whether that be bagasse or other products, the technology and ideas have been around for a long time," Dr Cox said.

"But the amount of activity in Australia, particularly compared to some other countries, is relatively small.

"We know there is goodwill in parts of the industry, as we have seen investments in technology for cost reduction, but there is also something blocking some other investment from happening.

"Our part of the research is looking at what might be blocking those opportunities from being realised."

According to Dr Cox, they are looking at a range of constraints and factors that influence the uptake of technology.

These include, for example, the economics such as the sugar price and the Australian dollar; the weather's impact on the crop; politics; and policy.

For example, various governments in recent years have had varying levels of policy support for initiatives such as biofuels, ethanol, and renewable energy.

But when the market for a product – such as ethanol – appears dependent on government legislation and support and could therefore change, then investors in the past have also trod carefully, wary of such government support changing in the future.

These are all issues that will feed into the research, which is also using surveys and face-to-face contact, as well as investigating the experience of overseas to see where investments in innovation have worked well.

He added that internal capability within a particular business was also a big factor for driving investment, given that the investment often came with risk.

"Whether that investment occurs on an individual farm or a sugar mill, you need the capability to implement it, and you need sufficient scale for it to be applicable."



Key Focus Area

Product diversification and value addition

Project name

Biorefineries for higher-value animal feed, chemicals and fuel

Project number

2015/902

Project end date

01/04/2019

This project is supported by funding from the Australian Government Department of Agriculture as part of its Rural R&D for Profit programme.



Harnessing cane's potential for animal feed



When sugarcane growers and millers talk about animal feed, the first thought is typically molasses. But a major collaborative research project is looking far beyond molasses and investigating a range of other possibilities for turning sugarcane by-products into practical and affordable animal feeds and feed-additives.

It is all about capturing the value of the sugarcane biomass and putting this into the context of other important competitive advantages that currently exist for the Australian sugarcane industry.

The research forms one part of the major Commonwealth Government Rural R&D for Profit Programme as part of a project called *A profitable future for Australian agriculture: bio-refineries for higher-value animal feed, chemicals and fuel.*

Other aspects of the project are investigating other potential value-add products that can be created from sugarcane by-products, as well as by-products from other industries such as cotton and forestry.

SRA is the lead agency for the project with funding from the Australian Government Department of Agriculture, along with Forest and Wood Products Australia Limited, the Cotton Research and Development Corporation, Australian Pork Limited, and the Queensland Government Department of Agriculture and Fisheries.

Queensland University of Technology (QUT) is leading the research with support from NSW Department of Primary Industries and Southern Oil Refining.

One of the goals of the project is to look at each product from a sugar mill and develop chemical and biological tools that could be used to turn them into animal feed products.

The project is focused on feed products for the pork industry, but is also looking closely at the beef industry because of the potential benefits that the cane and beef industries share through their proximity.

Dr Mark Harrison from QUT's Centre for Tropical Crops and Biocommodities is leading this part of the project and he said tremendous potential already exists within sugar mills because of both their logistics and locations.

"With sugarcane we have a cropping system that functions quite differently to many other crop industries," he explained.

"We are producing a huge amount of plant biomass and transporting a large amount of it to a central processing facility, whereas other industries such as grains are leaving a lot of their biomass in the paddock."

"The coastal location of sugar mills is important because it puts sugarcane production and processing close to many of the beef feedlots in both Queensland and New South Wales.

"The higher rainfall environment also means that the industry is producing biomass during the winter, which is a time when it is typically drier in western grazing country and there is an increased need for stock feed."

"We are also seeing cattle production in Queensland developing more sophisticated supply chains where cattle from west of the Divide are trucked to feedlots closer to the coast, which is also where sugar mills are located."



Biorefineries for Profit

With the opportunity clear, the project is investigating five main avenues to create animal feed products from sugarcane:

1. Leaf protein

It is already well-understood that any plant leaf contains protein, and that there are existing (but expensive) processes that can extract this protein and could create a feed protein product.

“With this research, we are investigating if there are new methods that could be used at scale to isolate that leaf protein and create an enriched protein product that could go into animal feed,” Dr Harrison said.

“There seems to be increasing interest in whole-crop harvesting, so this could be an opportunity to bring in green leaf and tops to send into one revenue stream, and send the billets in another direction.”

Separate research projects are investigating cane-cleaning options that would assist such a process (See *MillingMatters* April 2016 edition).

2. Plant-derived bio-actives

Bio-actives for human consumption have become a growing trend in recent decades and have extended beyond the market of inner city urbanites to underpin the growth of a multi-million dollar ‘nutraceutical’ industry.

“Humans gain a lot of health benefits by having anti-oxidants in our diet,” he said. “And just like us, pigs are mono-gastric (one stomach) animals, so we are investigating these products to enhance their health. As part of that we are looking at both traditional and cutting-edge extraction technology that may be able to isolate some of these compounds for animals.”

3. Improved digestibility

Bagasse is a very low quality cattle feed. It has been estimated that once bagasse constitutes more than 5 percent of a ration then cattle weight gain becomes limited.

But can things be done to the bagasse to make it more digestible? This part of the project is looking at two approaches to improving the digestibility. The first is through high temperature treatments, and the second through ‘chemical ensilage’, a process where an agent is added to the bagasse and it is allowed to sit at room temperature for a period of time. “We have proof of concept from previous research, but we want to find the most economical way to do it.”

4. Liquid sugar products

The researchers are also investigating liquid sugar products other than molasses, such as converting bagasse into a liquid sugar syrup. This research is asking questions such as: what treatments would need to be used? What treatments would work best? How much energy would be in the product?

“We are using advanced analytical techniques to identify what is in the liquid sugar syrups. We need to be certain that these products don’t contain compounds that actually inhibit the ability of an animal to take up nutrients from their feed.”

This research is possible thanks to multi-million dollar investment that has been made previously by QUT in a Central Analytical Research Facility with both cutting-edge equipment and the skilled staff to both maintain and operate it.

5. Solid-state fermentation

Different types of yeasts and fungi are already fed to animals, and this part of the project is investigating if these micro-organisms can be grown safely from the residue of cane production, with a focus on improving the protein content.

If those micro-organisms can also produce fats and oils, as well as protein, then the research project (as a whole) is moving another step closer to producing everything that we need to produce a complete animal feed from sugarcane by-products.

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Conclusion

Dr Harrison said that this research project was about creating a new revenue stream and helping to improve industry profitability. “A sugar mill is not necessarily going to become a formulator of stock feeds, but they could be a supplier of valuable ingredients that go into a feed,” he said.

“Fibre is an important part of animal diets and cane factories have a lot of fibre. So we are looking at: what can we do to it to ensure that the nutritional value is improved.”

“At the end of the day this is about helping the industry to make money. Throughout the research we are always asking ourselves: could this work in a sugar mill?”

The project is in its first year, which has a strong emphasis on research, and in years two and three the project will focus more on pilot demonstrations and economics around investment.

This project is supported by funding from the Australian Government Department of Agriculture as part of its Rural R&D for Profit programme.