Future Food Systems

2020/21 Annual Report

Future Food Systems

Acknowledgements

The CRC Program supports industry-led collaborations between industry, researchers and the community. Further information about the CRC Program is available at www.business.gov.au

Contents

Chair’s report

The Future Food System CRC has had a productive, if challenging second year of operation. Despite disruptions to laboratories and access to sites caused by the pandemic, substantial progress has been made across all three research programs: to date nine projects have been completed and 17 are in progress with industry partners.

In addition to the delivery of industry research projects, the CRC and our local government and Regional Development Australia (RDA) food hub partners are active partners in the national movement to build advanced regional food-industry clusters.

This year, we were pleased to progress initiatives with our food-cluster partners in Western Australia, New South Wales and the Australian Capital Territory, and to welcome the Namoi Joint Organisation of Councils to the CRC – five councils representing one of the most productive agricultural regions in Australia.

I see the future food industry – and the value creation and high-tech jobs associated with it – as critical to the reinvigoration of regional Australia. A recent survey found that more than 70 per cent of STEM-trained urban-dwellers would be prepared to relocate to a regional area of Australia for a suitable job opportunity.

Major investments in both hard and soft infrastructure are needed to support commercial food-industry investment in regional centres. Coordinated state, Commonwealth and local government investment and policy support is essential. The Western Australian Food Innovation Precinct (WAFIP), where a number of major future CRC projects will be located, is an outstanding example of government, industry and research collaboration in this regard. The federal government’s Modern Manufacturing Initiative is also a powerful reinforcement of the CRC’s core mission.

As global supply chains continue to experience disruption, our work supporting homegrown food and beverage manufacturers becomes even more relevant.

This is an exciting period for stakeholders in the Australian food industry. We have an opportunity to work together to ‘join up’ and transform the sector. Farmers, manufacturers, service providers, researchers and authorities across three tiers of government, working together to build scale in booming markets for trusted, value-added products.

All around Australia, there are innovative food SMEs seeking to scale up their operations, develop new products and take advantage of global demand for sustainably produced, healthy and trusted food products. Our research work for industry partner Sanitarium, helping to develop its healthy, plant-based range of food and beverage products, is one example.

In conclusion, I have greatly enjoyed getting to know our program and project leaders and hearing about their work. There is exceptional talent across our six university partners, as well as a group of world-class laboratories. The CRC exists to make this expertise and capability available to our industry and government partners.

I congratulate everyone in the CRC on another successful year.

Fiona Simson
Chair

Year in review

Executive summary

As at 30 June 2021, 17 CRC projects were in progress, delivering strong outcomes for industry partners. One industry project was completed during the year, 13 new projects were commenced and a further 18 projects were initiated with industry partners.

Milestone delivery was on track across all programs.

Major achievements over FY2020-21 included:

- Excellent research outcomes from a portfolio of projects with Sanitarium Health Food Company.
- Successful completion of the BeefLedger 'New approaches to blockchain, governance and digital communities for smart trade hubs' project and commencement of a second project, building on the outcomes.
- Successful initial trials on a unique acoustic pollination solution for tomato plants, with major industry partner Perfection Fresh and a joint research team involving Western Sydney University (WSU) and University of New South Wales Sydney (UNSW).
- The commencement of a project involving EcoMag and researchers at UNSW's School of Chemical Engineering. The project team is evaluating new spray-drying techniques for producing high-purity magnesium salts from the waste streams of solar-salt operations in Dampier, WA, and developing novel techniques for creating high-mesoporous-surface-area Mg particles for use as base ingredients in high-value supplements.
- The forging of a major collaboration among multiple peak industry stakeholders: Hort Innovation, Protected Cropping Australia (PCA), Greater Sydney Local Land Services, University of New England (UNE) and the CRC. All these entities will work together to develop a national map of protected cropping acreage and facilities to support logistical decisions around industry growth, transport, labour, market access, food security, drought resilience, water infrastructure, natural disaster and biosecurity response.
- The commencement of Horticulture Innovation Australia's 'Smart glass' project, involving utilisation of spectral manipulation, automated control systems and evaluation of new partner LLEAF Pty Ltd's smart glass technology. This project exemplifies the CRC's ability to build research collaboration among Australian engineering innovators (in this case, LLEAF), plant science leaders and industry practitioners.
- An increase in regional farm sector engagement, with a NSW Farmers-led project commenced to identify on-farm limitations to and opportunities for increased returns. Project activities will contribute to future cluster planning milestones and help consolidate engagement between primary producers and upstream value-chain partners.
- The entry of leading industry cluster group Namoi Unlimited, which formally joined the CRC in August 2021 following regional workshops across FY2020-21. Namoi Unlimited represents five local governments in the most productive agricultural region of NSW. The CRC will be working with stakeholders in the region to progress milestones for CRC Research Programs 1 and 3.

1. A project team member opens the door to the UNSW School of Chemical Engineering's industrial spray-dryer, in which the team is producing high-purity magnesium citrate powder for CRC industry partner EcoMag. Credit: Anthony Battaglia / Future Food Systems CRC
2. Professor Jeremy Nicholson in Murdoch's ANPC laboratory. Credit: Murdoch University

COVID-19 lockdowns through FY2020-21 impacted both industry and the university sector significantly.

With experimental work now underway across multiple projects, it is likely that impacts of the 2021 outbreak will be greater than those of 2020. Several projects in Program 2 and 3 that are reliant on laboratory access for technicians and researchers were put (and in some cases, remain) on hold. In Program 2, measures were put in place during lockdown periods to keep trial plots alive and were continuing at time of writing.

Program 1 was also impacted. While the CRC adopted videoconferencing for delivery of most meetings, workshops and seminars at the start of the pandemic and continued to use this method of engaging with partners throughout FY2020-21, the nature of Program 1 research and capability activities demands face-to-face engagement, relationship-building and site visits.

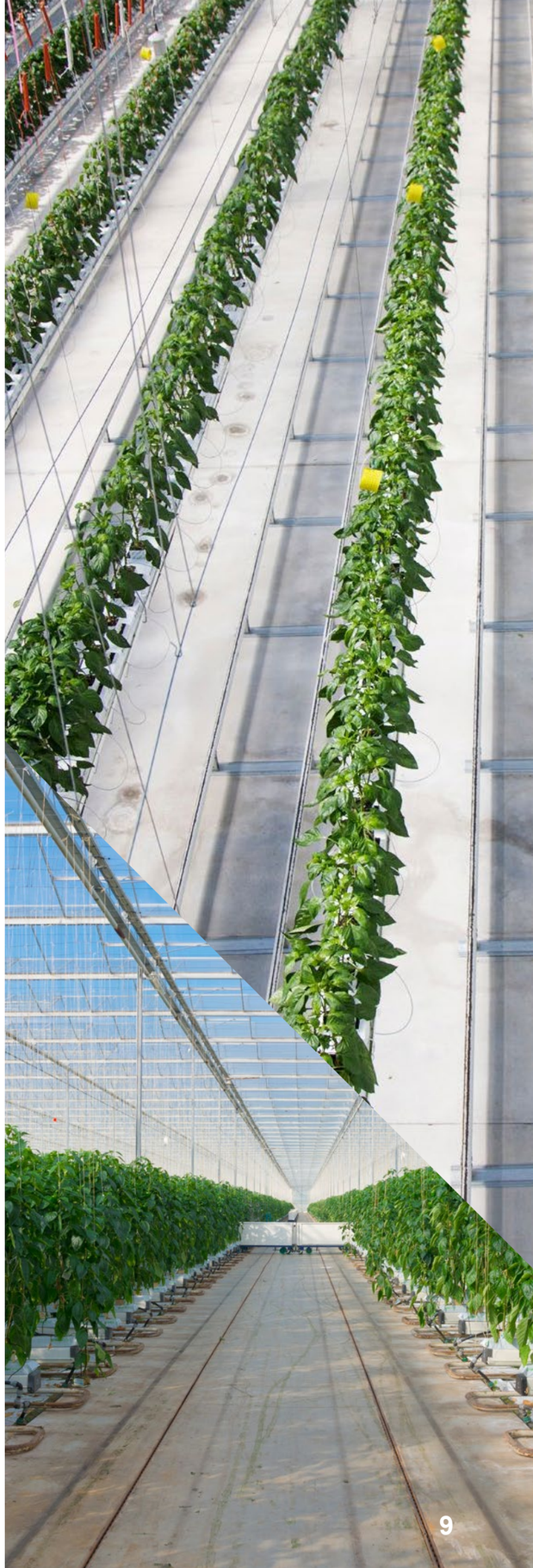
Over the reporting period, the CRC adopted a flexible approach with its SME partners, acknowledging their cash-flow challenges and believing that SMEs will be instrumental in creating the new, high-value products and markets needed to drive growth in local manufacturing.

Given ongoing restrictions on travel and meetings, the CRC will continue to rely heavily on video for conferencing and distributing, and on cloud-based working tools. A case in point is a major Future of Food conference that the CRC sponsored in WA in September. The CRC had planned to have multiple CRC research and industry speakers and the Board in attendance. While the CRC participated via video link, entry to WA by interstate CRC team members and participants was not permitted.

Several of the CRC's founding SME partners continued to experience difficulties over FY2020-21, and the continuing Delta COVID-19 outbreak may drive further attrition of small partners. The CRC, therefore, engaged actively in discussions with potential new major industry partners throughout the reporting period, and is continuing to do so.

Committed research funding increased to $3.6m over the 2020-21 financial year on the back of projects with major industry partners such as Sanitarium Health Food Company, Hort Innovation, Costa Group and Perfection Fresh.

At the end of the reporting period, CRC research milestones were on schedule. By 30 June 2021, six students were enrolled in the CRC's Industry PhD program, which was below target. Projects in development will help to increase PhD numbers. While recruitment picked up over the reporting period, COVID-19 continued to significantly impact the ability of partner universities to recruit and deploy students. The CRC implemented a top-up scholarship model to help bring additional students into the cohort.



Vertical horticulture glass house – Hawkesbury Campus. Credit WSU

47 Partners

33 Events[1]

15 Publications[2]

9 Projects completed

17 Projects in progress

18 Projects in development

6 Industry PhDs funded

27 Students engaged[3]

22 CRC milestones completed

103K Twitter impressions

846 Newsletter subscribers

42K Website new users

1. *Includes workshops, conferences and seminars*
2. *12 general publications, 3 CRC publications*
3. *Students other than Industry PhDs gaining experience working on CRC projects*

Highlights and achievements

The Future Food System CRC has achieved substantial progress across all three research programs: 13 new projects were commenced, making a total of 17 industry research projects in progress, and a further 18 projects were in development.

All projects involve research and industry collaboration and a number of projects involve multiple research and industry partners. Activity is described below by CRC program.

Program 1: Specialised food-industry clusters

Across FY2020-21, the CRC worked with six food-industry clusters around Australia and collaborated with supporting partner Food Innovation Australia Limited (FIAL), Regional Development Authorities and AusIndustry to help progress industry cluster approaches across the sector generally.

By the end of June 2021, cluster projects were nearing completion with the Liverpool and Coffs Harbour councils, with deliverables contributing to CRC milestones for data, food planning and modelling tools.

CRC cluster activities in Peel, WA will soon be linked to a Program 3 Food Innovation Facility project currently in development with the Western Australian Agriculture Authority (WAAA). This research facility will be located within the West Australian Food Innovation Precinct (WAFIP), a state government initiative aimed at value creation in the WA food sector. The precinct, located within Peel Business Park in Nambeelup, is an open-access facility comprising R&D capabilities, an innovation centre and a production-warehouse.

It is intended to be a centre of excellence to enable commercial research and development, prototyping and market testing of food and beverage products, and networking for WA food producers. The CRC aims to make the Food Technology Facility at WAFIP a hub for CRC product and ‘smart trade’ innovation activities, leveraging the Australia-Singapore Digital Economy Agreement.

In relation to smart trade milestones, the first project for digital trade innovation partner BeefLedger was completed successfully. The project delivered a proof of concept for a multi-signature architecture built on blockchain technology. This smart technology platform is designed to improve payments and deliver information about asset and food provenance, enabling smooth, reliable exchange and trade of credentialed food commodities and boosting confidence among supply-chain partners.

Solid asset tracking makes it possible to issue asset-backed digital securities to investors of all sizes, encouraging their involvement in supply-chain systems. In addition, research into international trade law and regulation enabled integration of on-chain mechanisms into off-chain governance. This was necessary due to the evolving cross-border regimes emerging from the signing of the Regional Comprehensive Economic Partnership (RCEP) by ASEAN, China, Japan, the Republic of Korea, Australia and New Zealand in late 2020.

Separate projects to advance future smart trade, compliance and logistics milestones were in discussion with government and industry partners at time of writing. Related to this, the CRC is participating in broader national initiatives in the trade domain, via meetings and workshops with state and Commonwealth government stakeholders.

The CRC is also exploring opportunities for linkage partners in Singapore, Japan, the Middle East and North America.

The ‘Native rice commercialisation’ project (see case study), includes trade and indigenous enterprise objectives and contributes to outputs across all three CRC programs.

An additional regional food-industry cluster group, the Namoi Joint Organisation of Councils, joined the CRC in April 2021 and has a project in development, due to commence November 2021.

1. Coffs Harbour region is a bountiful one, producing everything from bananas and blueberries to fresh veggies, milk and seafood. Credit: Coffs Harbour City Council 2. Artist’s impression of the new WA Food Innovation Precinct. Credit: DevelopmentWA 3. Fiona Simson talks with (L to R) Kevin Anderson, Member for Tamworth and NSW Minister for Better Regulation and Innovation, with Namoi JO councillors Eric Noakes, Doug Hawkins, Jamie Chaffey and Col Murray, on the sheep property near Tamworth that hosted the press announcement. Credit: Gunnedah Shire Council 4. A detailed map of tree crop plantings in NSW; a new project will develop a similar map of Australia’s protected cropping facilities. Credit: University of New England 5. The Smart Trade Hubs program project team. Credit: Queensland University of Technology 6. Artist’s impression of the soon-to-be-built Western Sydney International Airport, as seen from above. Credit: Liverpool City Council

Program 2: Controlled environment production

A balanced project portfolio has been established across all Program 2 activity milestones.

WSU plant scientists and UNSW engineers are collaborating in three ‘smart tech’ projects based at the WSU experimental glasshouse:

- The four-year WBS Technology ‘IoT for indoor cropping’ project is developing low-cost wireless devices for measuring temperature, humidity and CO_2 and related wireless communication infrastructure within greenhouse facilities. An advanced crop surface-temperature sensor based on embedded, inexpensive thermal cameras was designed, and work commenced on an advanced crop physical state and biological activity sensor based on embedded radio devices - for example, mmWave radars and LoRa. The project has engaged two PhD students, who are helping to design, deploy and evaluate prototype solutions.

- A project comparing the production outcomes of two innovative smart glass products, contributed to by CRC partners, Hort Innovation and LLEAF, was commenced in June (see case study). Light-shifting glasshouse cover materials can provide significant energy savings and improve plant health and productivity.

- Working with industry partner Perfection Fresh, a joint WSU and UNSW team has successfully conducted trials on an acoustic pollination solution for tomato plants.

Meanwhile, in a project based in Costa Group greenhouses in Guyra, a UNE team is creating rhizobiome test kits to allow for real-time testing of the root zones of hydroponically grown crops. These test kits will help ensure the establishment of a supportive root-zone microbiome population, potentially improving root systems, plant and fruit quality, and yield.

In Queensland, research conducted by QUT for Greenbio prototyped multiple designs for modular vertical farming components using 3D-printing technology. Additionally, a light simulation was developed and tested to compare different design parameters of the new vertical growth system under natural sunlight conditions in a greenhouse. The research demonstrated that a novel curved NFT tray system can achieve an improvement of approximately 25 per cent in light distribution over the plants compared to a straight NFT system.

Projects in development at the end of the reporting period included:

- A robotic task automation project, in development with South Australian grower P’Petual Holdings.

- A Perfection Fresh project exploring solutions for managing root pathogens in elite horticultural crops which will involve PhD students.

- A PhD-based project investigating sustainable fertigation techniques, in collaboration with Qatar University.

- A major project with Hort Innovation to progress smart technology solutions for the vegetable indoor cropping sector.

1. Part of the IoT set-up at the ‘IoT for indoor cropping’ project trial site. Credit: Wen Hu, UNSW 2. Associate Professor Oula Ghannoum. Credit: Western Sydney University 3. Dist. Prof. Tissue with glasshouse technician and Masters student Chelsea Maier and postdoc Sachin Chavan, inspecting lettuce plots for the CRC’s Smart Glass and LLEAF film project, which is trialling novel spectra-shifting tech to boost energy-efficiency, crop growth and yield under cover. Credit: Sally Tsoutas for Western Sydney University 4. UNSW Associate Professor Wen Hu, IoT and sensor expert, checks an overhead light connected to an embedded sensor system. Credit: ARC 5. Experimental glasshouse at the National Vegetable Protected Cropping Centre on WSU’s Hawkesbury campus, showing the LLEAF-Red (right). Credit: LLEAF Pty Ltd 6. CRC The root system of a tomato plant grown in soilless media, supplemented with probiotic Plant Mate, in Tomato Exchange’s Guyra facility. Credit: Costa Group 7. Dr Gal Winter in the laboratory, educating STEM students about nutrition and the digestive system. Credit: University of New England (UNE) 8. Costa Group’s Tomato Exchange facility grows premium snacking, specialty, cocktail and large truss tomatoes hydroponically. Credit: Costa Group

Program 3: Value-add and scale in future food segments

Over the first half of 2021, CRC research partner expertise and advanced food-science laboratories delivered results for industry partners Sanitarium and EcoMag in relation to current and future product lines.

A portfolio of projects for Sanitarium in collaboration with UNSW and QUT is addressing technical formulation and processing challenges in relation to innovative plant-based products including its Barista line of plant based milks (see case study). This program of work includes significant student involvement.

In research delivered for EcoMag, innovative spray-drying technology was employed to manufacture magnesium salts including magnesium gluconate, magnesium lactate, magnesium glycinate and magnesium fumarate as high-surface-area vectors for precision nutrition products. The research has validated EcoMag's product design strategies.

The George Institute for Global Health 'FoodSwitch Connect' project is working on adapting its FoodSwitch phone app to help providers and purchasers of catering services to select healthier options.

A major five-year advanced nutritional analysis collaborative project with the Western Australian Agriculture Authority, Murdoch University and German scientific instrument maker Bruker was developed, for commencement in August 2021. This project, which includes delivery of several PhDs, will deploy Bruker NMR technology to analyse the functional properties of food and nutraceutical products, and has potential to create significant novel IP.

A PhD based project has commenced to investigate the sensory and satiety properties of WA industry partner Mt Lindesay's specialist globe artichoke varieties. Artichoke varieties were planted for controlled development of breeds with heightened functional properties. Long-chain inulin isolated from the samples will be analysed using a spectroscopic method to establish a scientific basis for production claims.

The four-year 'Native rice commercialisation' project made excellent progress over FY2020-21 (see case study). Protocols were developed to determine the nutritional composition and quality of native rice (awns, husks and caryopses) for Australian and Canadian varieties. Between April and June, seed lots of native rice were collected from wild stands at the NT Department of Industry, Tourism and Trade (NT DITT)'s Beatrice Hill Research Station and from Fogg Dam, NT, as well as from sites in Northern Queensland. Controlled-environment and bulking-up trials for native rice were established, monitored and harvested and trials were established to investigate fertiliser responses and seed ripening.

1. Fraser Taylor (left) Managing Director of the FoodSwitch program at The George Institute for Global Health, with Bruce Neal, the Institute's Executive Director. Credit: The George Institute 2. Woojeong Kim (L) and Dr Yong Wang (R) in the UNSW School of Chemical Engineering lab, next to the spray-dryer that will be used to make high-purity Mg salts for EcoMag. Credit: Prof. Cordelia Selomulya 3. Professor Cordelia Selomulya 4. Harvesting artichokes for the CRC research. Dr Mark McHenry and researcher Andrew Tilley. Credit: Vicky Solah 5. CDU's Dr Sean Bellairs is leading a multi-disciplinary team on the CRC's Native rice commercialisation project. Credit: Charles Darwin University 6. UNSW Sydney spray-dryer. Credit: Anthony Battaglia 7. Dr Ruey Leng Loo in the ANPC Lab. Credit: Murdoch University 8. Barista plant-based milk' or similar, then 'Credit: Sanitarium Health Food Company

Commercialisation and utilisation

Commercialisation and future research pathways are embedded in every CRC project.

Projects for BeefLedger, EcoMag and Sanitarium have already provided commercial outcomes, enabling improvements to products in the market and design solutions for new products. A proof of concept for a novel pollination automation solution for Perfection Fresh has also delivered promising results with potential for IP registration.

Most projects, however, are in their early stages, prior to commercialisation and adoption of outcomes.

CRC workshops and communication around future food concepts, sustainable production and regional food clusters are gaining traction. As such, the CRC is making a contribution to the national movement towards adoption of modern manufacturing technology and industry cluster approaches in the food sector.
.

New partners, staff and Board members

Over the reporting period, three new partners – Sanitarium Health Food Company, EcoMag and LLEAF – joined the CRC.

Valerie Linton left the CRC Board at the end of March to take up the position of Provost at the University of Auckland in New Zealand and two new members were appointed: Mark Prendergast and Tony Cull.

Mark Prendergast is an experienced senior executive and non-executive director with more than 20 years' experience in the food industry, in Australia and the United States. He currently serves as Global Markets Director for AB Mauri, a leader in yeast and ingredients with operations in 32 countries.

Tony Cull brings a breadth of knowledge across the food and agriculture sectors and a deep understanding of markets in Asia, particularly China, to the Board. He has proven expertise in designing long-term business sustainability solutions in highly complex and competitive industries. His experience is both board and executive, with responsibilities including risk management, finance, accounting, corporate strategy and governance.

The CRC also added three new staff members to its core administration team over the reporting period: Administration Officer Emma Hills; Digital Design Officer William Ngo; and Research Project Coordinator Dr Maria Veronica Chandra-Hioe.

In early 2021, the CRC's Research Program 2 lead, Western Sydney University's Professor Ian Anderson, was replaced in the role by Distinguished Professor David Tissue. In addition to his new role with the CRC, Dist. Prof. Tissue is Scientific Research Director for the National Vegetable Protected Cropping Centre at WSU's Hawkesbury Institute for the Environment.

Activities and events

The CRC hosted, supported or had a presence at a number of key gatherings in FY2020-21. Due to COVID-19-related restrictions a majority of this activity was conducted virtually.

Workshops and meetings were held in the Namoi region of NSW with government and industry stakeholders leading to the Joint Organisation of Councils (Namoi Unlimited) joining the CRC to progress food industry cluster initiatives.

In December 2020, the CRC hosted a well attended CRC Research Showcase with online presentations from the CRC's CEO and Research & Commercialisation Director and from program and project leads.

In April 2021, the CRC's Sustainability Indices Framework seminar resulted in the formation of an initial set of indices against which food-industry cluster performance could be measured.

In May 2021, CRC CEO David Eyre was a panellist on of one of the five official Australian National Dialogues held in preparation for the inaugural United Nations Secretary-General's Food Systems Summit in September.

Also in May, David Eyre presented at Regional Development Australia ACT and Southern Inland divisions' Food In The Capital event alongside key industry, community and policy leaders. The event is a part of the Canberra region's ongoing push to become an exemplar sustainable agrifood cluster.

In Q4 the CRC sponsored and helped design the Mandurah, WA-based Future of Food Conference (September), a two-day event involving government, industry and research partners.

The CRC also worked with the Western Australian Agriculture Authority, Peel Development Commission and the Shire of Murray in promoting the WA Food Innovation Precinct, formally launched in May with an onsite sod-turning ceremony. The new precinct, in which the CRC will play a significant role, is due to begin operations in mid-2022.

Hilmer Building, UNSW Sydney. Credit: Anthony Battaglia

Case studies

Case study 1

‘Barista’ plant-based milks

Case study 2

Smart glass – light-blocking and light-shifting glasshouse coverings

Case study 3

Commercialisation of native rice for Indigenous enterprise development

1. Woojeong Kim (L) and Dr Yong Wang (R) in the School of Chemical Engineering lab, next to the spray-dryer that will be used to make high-purity Mg salts for EcoMag. Credit: Cordelia Selomulya 2. Dr Penny Wurm and Dr Sean Bellairs look out over the Northern Territory wetlands: the region is ideal for growing high-value native rice crops. Credit: Future Food Systems CRC 3. Experimental glasshouse at the National Vegetable Protected Cropping Centre on WSU’s Hawkesbury campus, showing the LLEAF-Red (right) and Smart Glass ULR-80 (bluish, left) films retrofitted above adjacent trial lettuce bays. Credit: LLEAF Pty Ltd 4. An aerial view of the Australia-first industrial microgrid powering Peel Business Park, March 2021. Credit: DevelopmentWA 5. Associate Professor Pat Spicer. Credit: Dr Robert Chan 6. Dried grains of Australian native wild rice, which grows on Top End floodplains and is a staple grain in Indigenous ‘bush tucker’. Credit: Jason Wilkes, Charles Darwin University 6. UNSW Sydney spray-dryer. Credit: Anthony Battaglia 7. Crops in Costa Group’s Guyra glasshouse facility. Credit: Costa

Case study 1: ‘Barista’ plant-based milks

This case study exemplifies how the CRC is supporting commercial product innovation and at the same time providing valuable industry experience to undergraduate and postgraduate students.

Research and collaboration

Australia’s longest-established plant-based health-food manufacturer, Sanitarium Health Food Company™, is working with research teams at UNSW Sydney (UNSW) and, more recently, with Queensland University of Technology (QUT) on a portfolio of projects designed to break new ground in plant-based product segments. This case study focuses on research to optimise the Barista line of non-dairy ‘milks’, which are made for and marketed to Australia’s food-service and hospitality sector by Sanitarium licensee The Alternative Dairy Co.™

The Barista line includes popular almond and oat milks made with 100% natural ingredients. In liaison with the Sanitarium R&D team, the UNSW research team used advanced food-processing methods and technologies to optimise the almond milk’s ‘stretchiness’ and foaming performance, and the oat milk’s stability under commercial cafe conditions.

Sanitarium licensee The Alternative Dairy Co worked with Sanitarium licensee chemical engineers at UNSW Sydney to improve the foaming performance and creaminess of its additive-free, plant-based Barista almond milks, marketed to the food-service industry. Credit: Sanitarium Health Food Company

Project lead Prof. Cordelia Selomulya summarised the research component of the project as follows:

“Because these products are low in fats and free from additives such as synthetic stabilisers and emulsifiers, we had to understand how these ingredients in the Barista products interacted with coffee in order to optimise their properties so they behaved more like conventional dairy products. We addressed very specific technical challenges aimed at optimising the creaminess, ‘silkiness’ and foaming performance of these products.

“The team employed advanced imaging technology to evaluate the performance of oat, soy and almond Barista milks, then used these evaluations to tweak the existing formulations and protocols, especially regarding creaminess and ‘stretchiness’.

“The UNSW team is also developing protocols for optimising the stability of Barista oat and soy milk.”

The first UNSW-Sanitarium project was led by the CRC’s Research and Commercialisation Director Cordelia Selomulya, a Professor in UNSW Sydney’s School of Chemical Engineering and a leading expert in the field of advanced dairy formulations. Credit: UNSW

To enable detailed understanding of the physicochemical properties of ingredients and their interactions, experimental data was acquired using facilities at the School of Chemical Engineering, UNSW, as well as at the UNSW Mark Wainwright Analytical Centre, including Nuclear Magnetic Resonance Imaging, X-ray Diffraction (XRD), Fourier Transform Infrared (FTIR) and Inductively coupled plasma – optical emission spectrometry (ICP-OES).

“Sanitarium has been very pleased to have the opportunity to work with UNSW and QUT on strategic research projects that have the potential to grow the plant-based healthy food industry. Sanitarium is a promoter of and leader in developing plant-based foods and, in particular, plant-based dairy alternative beverages.

“Since 1934, when Sanitarium established the Australasian Food Research Laboratories (now named Sanitarium Development and Innovation) at its production site in Cooranbong, NSW, the company has invested heavily in R&D to ensure the highest possible food quality standards and to keep abreast of consumer preferences.

“While Sanitarium has its own laboratories and R&D teams, working with universities in the CRC model is valuable for two reasons. Firstly, UNSW and QUT have specialist staff with specific expertise and equipment that complement our own resources. Secondly, we believe it is vital to help contribute to the future skilled workforce. Through its projects under the CRC, Sanitarium R&D staff get to work with talented students who are trained in the latest technology and techniques, and the students gain vital experience in applying their learning to real-world industry challenges. So I personally see this CRC model as a win-win.”

- John Ashton PhD CChem FRACI FAIFST,
Strategic Research Manager,
Sanitarium Health Food Company

Samples of The Alternative Dairy Co plant-based Barista milks in the UNSW lab. Credit: Anthony Battaglia

Commercialisation and utilisation

The research has guided changes to Barista milk formulations to meet demanding hospitality industry requirements for mouthfeel and foaming performance and to more closely resemble properties of dairy milk.

Going forward, these research outcomes – and those expected to flow from Sanitarium’s ongoing CRC projects with QUT and UNSW – will be used to guide the development of future formulations for healthy, plant-based food and beverage products.

The Alternative Dairy Co plant-based Barista milks at a UNSW lab. Credit: Anthony Battaglia

‘New Future food protein production’ project lead Professor Robert Speight. Credit: QUT

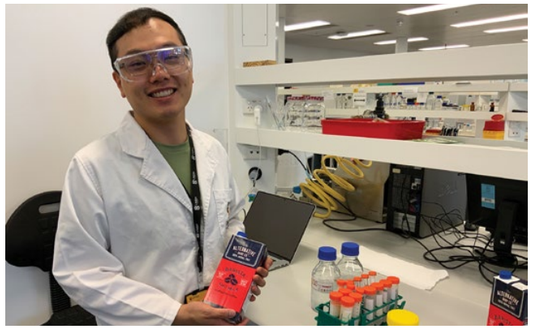
Education and training

Three UNSW students have been engaged on Sanitarium projects to date: two undergraduate Chemical Engineering students and a Masters in Food Technology student, engaged as a research assistant. Chemical Engineering student Josephine William, supervised by Prof. Selomulya, helped to evaluate and develop storage protocols for one of Sanitarium’s plant-based products.

Chemical Engineering student Daniel Lum, supervised by Assoc. Prof. Spicer from the Complex Fluids Group, evaluated the foaming performance and ‘stretchiness’ of Barista brand almond milk by measuring the interfacial tension and shear thinning behaviour via extensional rheology, then used this information to develop a method – a set of parameters – that can be used to elicit optimal performance from different Barista plant-based milks under real-world cafe conditions.

Associate Professor Pat Spicer in the office. Credit: Adelaide Spicer

As an example of work experience for graduates, UNSW food science graduate and Masters student Andrew Hadinata Lie was engaged as a research assistant to the project team, delivering laboratory tests of different formulations, followed by verification in the Sanitarium pilot plant.



Andrew Hadinata Lie with The Alternative Dairy Co Barista Oat Milk. Credit: Anthony Battaglia

Through their involvement with Sanitarium projects, the students were able to:

- work closely with and learn first-hand from academic experts in the field;
- develop a working knowledge of advanced food-technology equipment and methods;
- form valuable relationships with a major food manufacturer via regular liaison (weekly online meetings) with Sanitarium’s R&D department, ensuring ongoing discussion and feedback from a major industry player.

“The students have gained solid industry experience through being engaged in Sanitarium projects. We structured an initial project so the first stage took place between December 2020 and February 2021 and the second stage ran between February and April 2021. Due to the positive outcome from the original project, an extension of the milk stability project was conducted between May and October 2021. This enabled the involvement of UNSW research program students. Each of the students was able to do supervised lab-based research with valuable industry experience attached.”

- Prof. Cordelia Selomulya,
UNSW-Sanitarium project leader.

Case study 2: Smart glass – light-blocking and light-shifting glasshouse coverings

The CRC is combining engineering and plant science expertise to achieve sustainability and productivity benefits for the protected cropping sector.

Research and collaboration

The project, titled *Smart Glass film impacts on energy use and productivity in greenhouse lettuce*, is analysing and comparing the impacts of two novel light-wavelength-altering prototype technologies on glasshouse-grown lettuce.

The research involves crop scientists at Western Sydney University (WSU), led by Distinguished Professor David Tissue, and three CRC industry partners: Horticulture Innovation, ag-tech start-up LLEAF Pty Ltd and global vegetable breeding and seed production company Rijk Zwaan.

Trials are being conducted within Western Sydney University's state-of-the art controlled-environment glasshouse, part of the National Vegetable Protected Cropping Centre on WSU's Hawkesbury campus.

Horticulture Innovation Australia contributed Smart Glass ULR-80 and LLEAF Pty Ltd contributed LLEAF-Red film – patented luminescent technology developed in collaboration with researchers at UNSW that shifts green light to red light for maximum vegetative growth. Three elite lettuce varieties used widely in Australian industry were contributed by Rijk Zwaan.

"Our luminescent light-emitting agricultural film – hence, LLEAF – is designed to 'supercharge' natural sunlight by shifting the natural light into a light spectrum that is more beneficial for plant growth." - LLEAF co-founder Dr Alex Soeriyadi. Credit: LLEAF Pty Ltd

Modifying the spectral performance of cover materials can provide significant energy savings and improve plant productivity.

Previous trials of Smart Glass ULR-80 showed that it blocks much of the solar radiation that contributes to heat gain while transmitting most wavelengths required by plants for photosynthesis and growth. However, SG also reduces light intensity in some important wavelengths, so it can adversely affect plant growth and development, photosynthesis, biomass partitioning, yield and quality.

In an earlier project with Hort Innovation, WSU scientists found that deploying SG ULR-80 with glasshouse-grown eggplant and capsicum crops increased energy and resource-use efficiency with minimal negative impact on fruit quality; however, there were significant reductions in photosynthesis. Eggplant yield was lower under SG ULR-80, while capsicum production was not significantly affected.

The researchers concluded that to minimise negative impacts, SG ULR-80 should be re-engineered to increase the penetration of UV and photosynthetically active radiation (PAR) but continue to block the long-wave radiation that contributes to heat gain. The researchers also recommended testing SG ULR-80 on non-fruiting crops such as leafy greens – now being delivered by the current project.

LLEAF Pty Ltd's patented Luminescent Light-emitting Agricultural Films (LLEAF) have been shown in previous trials to deliver significant increases , in production and in energy and water-use efficiency. LLEAF-Red works by shifting natural light into a light spectrum that is more beneficial for plant growth. Crop trials deploying LLEAF indicate potential to increase yield and improve plant cycle and harvest control.

For the project, LLEAF-Red film was installed in the roofs and walls of two experimental bays at the NVPCC. Two neighbouring bays were fitted out with Smart Glass UL-80, and two bays were allotted as controls, using glasshouse hazed glass. All six research bays were planted with three lettuce varieties supplied by Rijk Zwaan.

The team is using sophisticated semi-automated sensor and monitoring systems installed in the glasshouse to ascertain the impacts of SG and LLEAF films on vegetative growth, crop yield, nutritional value and other physiological processes in the lettuces, and to yield a data-based assessment metric for evaluation.

Aerial view of the experimental glasshouse at the National Vegetable Protected Cropping Centre on WSU's Hawkesbury campus, showing the LLEAF-Red (right) and Smart Glass ULR-80 (bluish, left) films retrofitted above adjacent trial lettuce bays. Credit: HIE

The resulting data will be used to determine the optimal levels of light quantity and quality needed to generate energy, water and nutrient savings, while maintaining or increasing crop nutritional value.

"Ultimately, our objective is to reduce resource use (energy, water and nutrients) and increase crop productivity and quality in a sustainable protected cropping environment."

- Distinguished Professor Tissue,
Western Sydney University.

Dist. Prof. Tissue. Photo by Sally Tsoutas for Western Sydney University

Commercialisation and utilisation

The overarching goal of the project is to find better technologies for producing commercial crops undercover – in this case, retrofitted light-spectra-shifting films that benefit crop growth and yield while blocking heat.

Positive findings will support the refinement, commercialisation and adoption of both prototype products by the protected cropping industry, across Australia and, potentially, in markets internationally.

"Our collaboration with the CRC, WSU is enabling us to test LLEAF in a state-of-the-art glasshouse to further validate our technology. This will allow us to approach growers with our products and, potentially, develop further product lines."

- Dr Alex Soeriyadi, LLEAF Pty Ltd

"Three Rjik Zwaan lettuce varieties – Skyphos (butterhead), Rosain (red cos) and Claudius (green cos) – were selected for the trial as being representative of mainstream lettuce crops grown around Australia. We are pleased to contribute to this research, which will provide valuable intelligence for growers on how to optimise yield and crop quality for these varieties, while at the same time enabling savings in energy consumption. "

- Tim March, CEO, Rjik Zwaan Australia

Lettuce plot for the CRC's Smart Glass and LLEAF film project. Credit: WSU

Education and training

A number of undergraduate, postgraduate, doctoral and postdoctoral students from Western Sydney University are engaged in the project and are assisting with various parts of the research.

The project currently involves a Postdoctoral Fellow, Sachin Chavan; two Masters' students, Chelsea Maier and Ziad Hamoui; and two PhD students, Xin He and Terry Lin. Two short-term (year-long) postdoctoral Fellows, Chenchen Zhao and Yagiz Alagoz, and an undergraduate student, Marcus Harrison, also worked on the project.

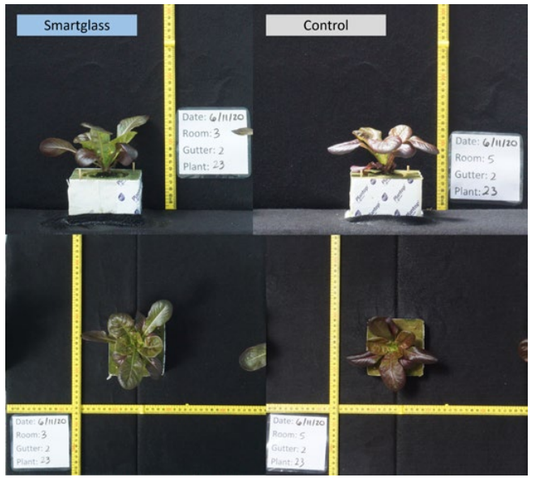
Glasshouse technician and Masters student Chelsea Maier and postdoc Sachin Chavan, inspecting lettuce plots for the CRC's Smart Glass and LLEAF film project, which is trialling novel spectra-shifting tech to boost energy-efficiency, crop growth and yield under cover. Credit: Sally Tsoutas for Western Sydney University

Post-doc Sachin Chavan has been involved in the experimental design, data collection, data analysis, manuscript-writing and research coordination activities since the start of the project. The 'Smart glass' project has been a great platform for him to develop mentoring, leadership and research coordination skills while working with undergraduate, Masters and PhD students. Dr Chavan plans to contribute further to protected cropping research while progressing in his academic career.

Chelsea Maier has been involved in sensor and data management instrumental for energy aspects of the 'Smart glass' project. She installed the light sensor array in the project trial bays, and is conducting detailed further analyses of the impacts smart glass has on the light environment.

"Specifically, I am investigating how SG ULR-80 and LLEAF-Red impact the light environment across the shortwave (including photosynthentically active radiation, or PAR) and longwave wavelengths, and at how these films impact diffuse light. Shortwave and diffuse radiation have implications for crop growth and production whereas longwave radiation measures the radiant heat load in the room, thus contributing to energy usage in the glasshouse facility. I'm also relating these analyses to overall crop production and growth."

- Chelsea Maier, Masters student



Comparison of red cos lettuce grown under Smart Glass ULR-80 and controlled glass. Credit: Chelsea Maier

LLEAF-Red (right) and Smart Glass ULR-80 (bluish, left) films retrofitted above adjacent trial lettuce bays. Credit: Kayla Le Gros

Three other WSU students are participating indirectly in the project:

- Terry Lin, a PhD student, has been working on the energy aspect of the 'Smart glass' project, in collaboration with CSIRO. He is involved in comprehensive analysis of energy and nutrient use during crop trials under the prototype SG ULR-80 and LLEAF-Red films to develop energy modeling of various greenhouse-grown crops, including eggplant, capsicum and cucumber as well as the project-trial lettuce.

- Masters Research student Ziad Hamoui is looking at plant-insect interaction and conducting quality analysis of lettuces grown under SG ULR-80 and LLEAF-Red films for his thesis. Through the Smart glass project, Hamoui is learning basic and advanced analytical methods of characterising the nutrient profiles of vegetables.

- PhD student Xin He has been a part of previous SG project trials using capsicum. She has developed diverse skills in plant physiology, biochemistry and microscopy while investigating the impact of SG on capsicum growth, development, yield and fruit quality.

Case study 3: Commercialisation of native rice for Indigenous enterprise development

Native rice is a high-value product with strong potential for commercialisation and Indigenous enterprise development.

Research and collaboration

Currently worth around five times more per kilogram than domesticated rice varieties, native rice grows naturally in wetland regions through northern Australia. To date, commercialisation has been hampered by the difficulty and cost of harvest in the wild and a lack of knowledge about agronomic management and grain processing.

This four-year collaborative project, commenced in 2020, is simultaneously addressing key aspects of the commercialisation challenge: solutions for production in controlled environments or paddies, optimal management to maximise nutritional properties, post-harvest processing, and Indigenous enterprise development.

In addition to its research outputs, it is hoped the project will create future opportunities for bilateral trade collaboration between First Nations groups in Australia and Canada.

Six CRC partners, including two universities, a government department and three SME enterprises – from the Northern Territory (NT), Queensland and Manitoba, Canada – are collaborating on this multi-territory project.

Lynette Kenyon from Pudakul (R), with Penny Wurm (L). Credit: Charles Darwin University

Two of the SMEs engaged are Indigenous-led enterprises. The Canadian SME, Myera Group, is a First Nations owned enterprise that has successfully commercialised native Canadian rice and is looking to expand into other rice varieties. The Australian enterprises include the Indigenous-owned Pudakul Aboriginal Cultural Tours. Together with Olive Vale

CDU's Dr Sean Bellairs is leading a multi-disciplinary team on the CRC's Native rice commercialisation project. Credit: Charles Darwin University

Pastoral, they are keen to cultivate nutritious, high-value native crops locally at scale, to improve the economic opportunities for their respective regions' Indigenous communities.

The research relies on collaboration for sample collection and cultivation trials. Different species of native rice thrive in different parts of Northern Australia and must be collected from the land by people who can locate and identify them. Indigenous communities are involved through Pudakul, and Gulmari Group Training (mentored by Olive Vale) in establishing agronomic protocols prior to trialling commercial cultivation of suitable varieties.

The two universities engaged in the project offer complementary capabilities. CDU and the NT Department of Industry, Tourism & Trade (DITT) have research staff with substantial knowledge of native rice, and the experimental sites and equipment needed to conduct a variety of agronomic trials at different locations.

The QUT team has the technical capabilities and expertise required to conduct high-level nutritional analyses. QUT's Professor Sagadevan Mundree also has significant experience in collaborating with industry and Indigenous communities on similar commercialisation initiatives.

Professor Sagadevan Mundree. Credit: QUT

Pudakul and Olive Vale, based in two potential rice-growing regions – the NT and Far North Queensland, respectively – are integral to the project and are involved at all stages, from sample collection to cultivation to marketing. First-Nations-led Myera Group's previous success with a similar project – commercialising Canadian native rice to benefit the health and livelihoods of the region's First Nations peoples – is both instructive and inspirational.

Over FY2020-21, research took place in a number of areas:

- Agronomy trials commenced and are ongoing at NT DITT research stations and CDU sites to determine optimal growing conditions for native rice.
- Commercial-scale cultivation protocols started being developed by QUT in consultation with Olive Vale; and by CDU in consultation with Pudakul.
- Prof. Mundree and his team at QUT conducted nutrition profile analyses of native rice samples from sites in the Northern Territory and Far North Queensland to ascertain which were the most commercialisation-friendly varieties.
- The QUT team conducted similar nutrition profile analyses on samples of Canadian native rice provided by Myera Group.

Product innovation, development and trials of target products will be undertaken by the QUT team at a later stage.

Milling and mechanisation innovation (for processing of native rice, once harvested) will take place at a later stage under Dr Sean Bellairs at CDU.

Commercialisation and utilisation

The primary goal of the project is to develop a viable commercial native rice industry for Northern Australia. This requires a number of steps. These include:

- agronomic studies;
- nutrition profile analyses;
- commercial-scale cultivation protocols;
- broadacre crop trials;
- commercial-scale plantings;
- innovation in the form of modifications to milling equipment to make it possible to effectively and efficiently dehusk and mill native rice;
- other processing protocols;
- native rice product development;
- trialling new products; and
- marketing these products effectively, domestically and in potential export markets.

Figure. 1. Identification of suitable wild rice accessions for field trials. (A) Seeds of Oryza meridionalis; (B) Seeds of Oryza australiensis and (C) Wild rice grown at QUT glasshouse. Credit: QUT

In a nutshell, the research team is ultimately aiming to achieve the following:

- find the most suitable varieties to commercialise, via agronomic trials and their nutrition composition;
- successfully produce suitable native rice species at commercial scale, as broadacre crops;
- adapt standard de-husking and milling equipment and techniques to suit the processing of native rice;
- develop value-added products utilising native rice, including native rice flours, healthy baked goods and snacks; and
- find suitable markets for these products, domestically and overseas.

If it can accomplish all of the above, then substantial benefits will flow – not just to the region's Indigenous communities but to the Northern Australian economy, the restaurant and food service industry, home chefs and health-conscious snackers worldwide.

Myera will be able to use the research team's nutritional analyses of Canadian native rice samples to determine which varieties to grow, and to market its end product more effectively.

Myera is also interested in the value additions to native rice, and in the potential for indigenous bilateral trade partnerships.

Left to right: Alan Niscioli (NT DITT) and Sonam Adhikari Rana (CDU) hand-collecting native rice late in the 2021 season on Beatrice Hill Research Farm, Adelaide River, NT. Credit: Penny Wurm

Dr Penny Wurm and Dr Sean Bellairs look out over the Northern Territory wetlands: the region is ideal for growing high-value native wild rice crops. Credit: Future Food Systems CRC

Education and training

The project has engaged a full-time PhD student for the four-year duration of the project.

Mrs Abdelghany is a graduate of Tanta University in Egypt.

Studying in the Research Institute for Environment and Livelihoods (RIEL) at Charles Darwin University, she is being supervised by project lead Dr Sean Bellairs, assisted by key CDU researcher Dr Penny Wurm and Dr Thi My Linh Hoang from Queensland University of Technology.

"I chose an academic career because I wanted to [have] an impact on people's lives through finding answers to current issues related to my area of expertise. This project will provide knowledge on management protocols needed to successfully cultivate Australian native rice species in northern environments. The outcomes will be of great significance to Indigenous communities wanting to cultivate and supply a high-value native grain product, providing these communities with economic options to improve their local livelihood."

- Gehan Abdelghany, CRC PhD student

PhD student Gehan Abdelghany, doing lab work as part of her Masters in Plant Ecology at Tanta University, Egypt. Credit: Tanta University

Other undergraduate and Masters students are also significantly contributing to the project with research placements and coursework research projects.

The Parks-CDU shared airboat, piloted by NT Parks Service Ranger, David McLachlan, with CDU Technical Officer, Sonam Adhikari Rana and Master student Vamshi Lenkala in the saddle and ready to go. In the distant background and top-right you can see the glistening inflorescences of native rice stands. Credit: Penny Wurm

Education and training

Industry PhD program

Six CRC Industry PhD scholars were engaged during 2020-21 in industry projects, including the 'Commercialising native rice', 'Tomato rhizobiome', 'Blueberry nutritional optimisation' and 'IoT for indoor cropping' projects. All students are making good progress on their theses and at the same time gaining valuable industry experience by working on commercial projects (see Appendix A).

Industry experience

Consistent with CRC aims to offer real-world industry experience to students, Masters and undergraduate students are also involved in a number of CRC projects. Some of these students may transition to the CRC Industry PhD program. Others are gaining opportunities to meet potential future employees, or, if they wish to develop research careers, are gaining valuable experience in industry-led research.

New tertiary courses

In recognition of the future industry skill needs, CRC partner universities have introduced new undergraduate and postgraduate programs targeting the future food industry.

Murdoch University is now offering a three-year Bachelor of Food Science and Nutrition course, parts of which will be conducted within the $9m, state-of-the-art Food Technology Facility at the WA Food Innovation Precinct. The course is designed to build skills in human nutrition bioscience, food science and food biotechnology as well as nutrition marketing, sports nutrition, food production, agri-nutrition and nutrigenomics research.

Western Sydney University's new Graduate Diploma in Protected Cropping, involving one year of full-time or two years' part-time study, will accept its first students in March 2022. The course is fully accredited and unique to WSU, and will incorporate science, technology and business skills with a focus on intensive horticulture. The course is centred on the WSU experimental greenhouse, which is the hub for CRC Program 2 research and translation activities.

1. Phil Thomas is exploring the rhizobiome of greenhouse-grown hydroponic tomatoes for Costa Group under the supervision of UNE's Dr Gal Winter. Credit: Matt Cawood, UNE 2. Students checking on trial crops in the Western Sydney University's experimental glasshouse facility. Credit: WSU 3. Chelsea Maier – glasshouse technician and Masters Student and Sachin Chavan – postdoc. Credit: Sally Tsoutas for WSU 4. Gareema with her PhD supervisor, Dr Sophie Parks (NSW DPI). Credit: Joshua Jarvis 5. Woojeong Kim (L) and Dr Yong Wang (R) in the School of Chemical Engineering lab, next to the spray-dryer that will be used to make high-purity Mg salts for EcoMag. Credit: Cordelia Selomulya

Risks and impediments

COVID-19-related lockdowns slowed progress on a number of projects due to closure of laboratories and cuts to university staffing. The CRC's research partners strove to achieve workarounds and industry partners accommodated changes to scheduling and, in some cases, to experimental design. The most immediate impacts of COVID-19 were felt in relation to the PhD program.

Momentum was recovered in Q3, as demonstrated by increases in project formation and expenditure. However, the year ended with new lockdowns, with impacts at this stage difficult to quantify.

The CRC's industry partner group includes SMEs and, for many of them, raising capital and sustaining cash flow once the coronavirus pandemic hit was challenging.

CRC university partners experienced a significant loss of student revenue, leading to staff attrition and restructuring of departments. In addition, laboratories were closed during the lockdowns, resulting in substantial delays to some projects. The CRC adopted a flexible approach with its SME partners, acknowledging their cash-flow challenges. We have been advised by research partners in eastern states that the Delta outbreak may have more serious impacts than the 2020 wave.

Aspects of Program 1 research were significantly impacted by COVID-19-linked restrictions. While the CRC has adopted videoconferencing for delivery of most meetings, workshops and seminars, the nature of Program 1 research and capability activities demands face-to-face engagement, relationship-building and site visits to regional centres around Australia. Given travel and meeting restrictions, the CRC will continue to rely heavily on video for conferencing and distributing, and on cloud-based working tools.

A case in point was a major Future of Food conference the CRC sponsored in WA in September. The CRC had planned to have multiple CRC research and industry speakers and the Board in attendance but had to participate via video link as entry to WA by interstate CRC team members and participants was not permitted. The participation of major industry partners such as Sanitarium, Hort Innovation, Costa Group and Perfection Fresh is central to future progress of the CRC, and these firms are actively engaged. Some founding SME partners, however, continue to struggle, and the Delta outbreak and related economic instability may drive further attrition of small partners.

Research expenditure increased significantly over Q3 but continues to be below budget. Major new industry projects in the pipeline will largely address this.

The CRC's 10-year PhD milestones continue to be an issue. While recruitment has picked up, COVID-19 has significantly impacted the ability of partner universities to recruit and deploy students. The CRC has implemented a top-up scholarship model to help bring additional students into the cohort.

Intellectual property management

The CRC is structured to allow project participants to own and manage IP created by the research activities.

To reduce potential delays in commercialisation and maximise the impact of projects on the Australian economy, IP rights are negotiated by partners during the project design and scope phase, and are embedded in the Project Agreements signed by partners.

Further, and in alignment with the Australian Research Council National Principles of IP Management, the CRC Project Agreement ensures that:

- research partners have unencumbered rights to use the IP for education, teaching and research purposes;
- students retain the copyright to their theses;
- IP owner's commercialisation pathway will not be hampered by the publication of the thesis (a requirement) and, as such, all publications need to be approved by the CRC;
- there is a mechanism for minimising stranded IP and a framework under which IP can be retrieved when the IP rights holder has not commercialised and does not intend to commercialise for the benefit of the Australian economy; and
- a framework is in place to define IP rights by market to ensure that IP is exploited across various use cases and industries where applicable.

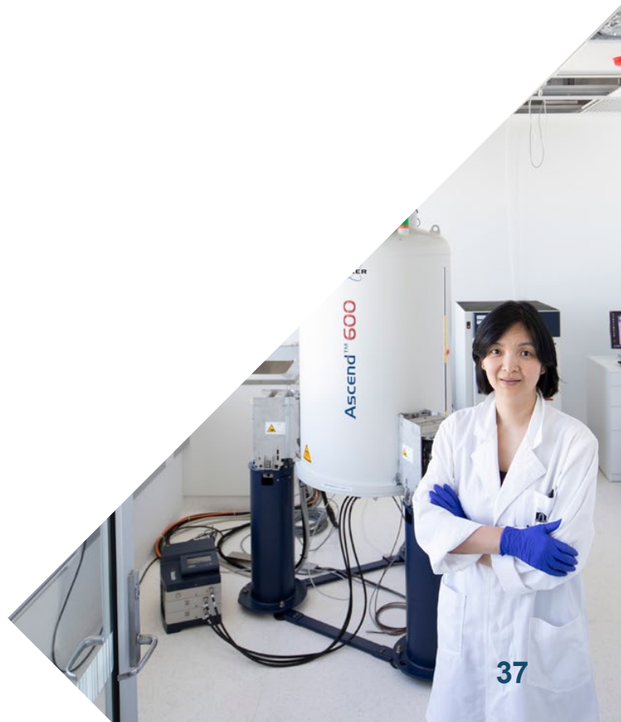
CRC future plans and transitions

The CRC is part of a broader movement to modernise the Australian food sector and to support industry development, investment attraction and value creation in peri-urban and regional industry clusters.

Significant investment and alignment of hard and soft infrastructure is required across the supply chain to achieve national goals. The CRC is collaborating with many government, research and industry bodies in this regard.

In future, the CRCs aims to be providing specific research solutions as part of nationally coordinated industry development programs designed to achieve Commonwealth goals to:

- massively increase the contribution of the agribusiness and the sector to exports and GDP;
- digitise and streamline trade processes under initiatives such as the Australia/Singapore Digital Economy Agreement;.
- create new jobs and prosperity in regional areas; and
- increase the resilience and sustainability of national food production and distribution systems.



Dr Ruey Leng Loo in the lab at the Australian National Phenome Centre on Murdoch University's Perth, WA campus. Dr Loo is the research lead on the 'Bioactive components for value-add to Australian artichokes' project under the CRC's Research Program 3. Credit: Murdoch University

Financials

Statement of profit or loss and other comprehensive income

For the year ended 30 June 2021

	2021	Period from 23 May 2019 to 30 June 2020
	$	$
Revenue	**15,246,267**	13,995,197
Other income	**50,399**	50,113
Depreciation expense	**(3,344)**	(1,869)
Employee benefit expenses	**(1,018,289)**	(818,442)
Legal expenses	**-**	(49,565)
Unrealised currency gains	**(63)**	-
Research and development expenses	**(1,796,433)**	(388,475)
Research and development expenses – in kind	**(8,167,019)**	(8,473,898)
Consultancy expenses	**(36,925)**	(75,228)
Computer software and hardware expenses	**(16,564)**	(20,610)
Travel and accommodation expenses	**(2,249)**	(14,087)
Other expenses	**(108,030)**	(95,194)
Surplus before income tax	**4,147,750**	4,107,942
Income tax expense	**-**	-
Surplus for the year/period	**4,147,750**	4,107,942
Other comprehensive income for the year/period, net of income tax	**-**	-
Total comprehensive income for the year/period	**4,147,750**	4,107,942

Statement of financial position

As at 30 June 2021

	2021	2020
	$	$
Assets		
Current assets		
Cash and cash equivalents	**8,597,912**	4,263,170
Trade and other receivables	**258,500**	240,625
Prepayments	**4,614**	-
Total current assets	**8,861,026**	4,503,795
Non-current assets		
Plant and equipment	**8,269**	7,040
Total non-current assets	**8,269**	7,040
Total assets	**8,869,295**	4,510,835
Liabilities		
Current liabilities		
Trade and other payables	**555,798**	362,408
Employee benefits	**50,305**	40,485
Contract liabilities	**7,500**	-
Total current liabilities	**613,603**	402,893
Non-current liabilities		
Total non-current liabilities	**-**	-
Total liabilities	**613,603**	402,893
Net assets	**8,255,692**	4,107,942
Equity		
Retained earnings	**8,255,692**	4,107,942
Total equity	**8,255,692**	4,107,942

Appendices

Appendix A
Education and training

CRC PhD students – FY2020/2021

Student name	Student degree	Degree start date	Degree completion date	Program	CRC project title	University/ Institution	Country of origin
Gehan Abdelghany	PhD	31/03/2020	28/09/2024	P1	Commercialisation of native rice for Indigenous enterprise development: Agronomy and value-adding.	CDU	Egypt
Mark Cardamis	PhD	15/01/2021	15/07/2024	P2	IoT for Indoor Farming	UNSW	Australia
Eranda Namal Jayasuriya	PhD	4/10/2021	4/10/2024	P2	IoT for Indoor Farming	WSU	Sri Lanka
Phil Thomas	Masters/ PhD	12/08/2020	12/08/2022	P2	Microbial rhizosphere diversity in glasshouse hydroponic crops	UNE	Australia
Gareema Pandey	PhD	1/03/2021	1/03/2025	P2	Optimising blueberry fruit nutritional quality using controlled spectra and mild stress treatment via polytunnel innovation	WSU	India
Andrew Tilley	PhD	1/06/2021	31/12/2024	P3	Bioactive components for value-add to Australian artichokes	Murdoch	Australia

Future Food Systems

The Future Food Systems Cooperative Research Centre (CRC) is a national initiative created to drive innovation and growth in the agrifood sector by accelerating adoption of STEM technologies and cluster approaches to industry development, resilience and sustainability. It is funded as part of the Australian Government's CRC Program, established to drive industry-led collaborations between researchers and the community to improve the competitiveness, productivity and sustainability of Australian industries, especially in sectors where Australia has a competitive strength.

Australian Government
Department of Industry, Science, Energy and Resources

AusIndustry
Cooperative Research Centres Program

Future
Food
Systems