

# Sydney Institute of Agriculture

Biennial Report 2017-2019



THE UNIVERSITY OF  
**SYDNEY**

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# Director's Report

## Professor Alex McBratney

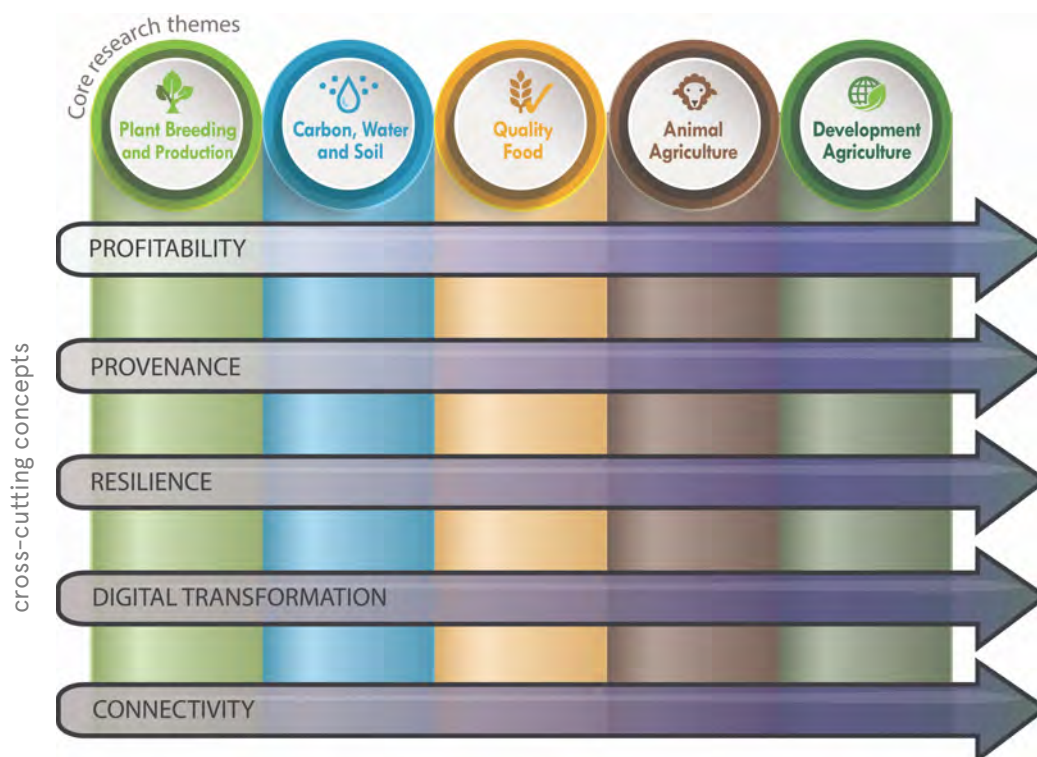
The University of Sydney Institute of Agriculture celebrates Australian agriculture, Australian agricultural research and education; and recommits the University of Sydney's engagement in this vital enterprise for the nation and beyond.

In Scotland around 1910, the stockman and bush balladeer Will H Ogilvie wrote an epistolary poem back to Australia lauding the border country of north-western NSW and south-western Queensland:

*Do the shearers still go riding up the Warrego to work,  
Where the Thurulgoona woolshed flashes silver in the sun?  
Are the bullock-teams still bending through the coolibahs to Bourke?  
Is there racing at Enngonia?  
Is Belalie still a run?  
Do the Diamantina cattle still come down by Barringun?  
Is the black soil just as sticky?  
Is the mulga just as dense?*



The answers then in 1910 – as it is now more than a century later – are essentially yes, yes, and yes – there's definitely racing at Enngonia; I've seen that woolshed; they're still running cattle – but they're probably going by truck. And the black soil is just as sticky – perhaps a little stickier – through a loss of carbon. So Australian agriculture – even in fragile environments such as the Warrego – has a constancy – and an adaptability. Australian agriculture in this sense is sustainable. Its sustainability however depends on continual innovation and adaptation.



Over the past 110 years agriculture has been successful. Continuous innovation with 2.5% productivity increase per annum (although worryingly this has slowed recently)– for a long time Australia’s most efficient industry – backed by a peerless research record in science and technology. Food is now cheap – from more than 20% of disposable income in the 1950s to less than 10% today. Climate change and drought are clearly challenges but are not existential threats if we understand them, manage the associated risk, and adapt new strategies.

Agriculture is becoming more complex. Today’s agriculture requires aspects of science, technology, engineering, maths, economics, business, sociology, philosophy and more. With this realisation we have reconfigured our agricultural research into a multi-disciplinary multi-Faculty thematic framework under the banner of the Sydney Institute of Agriculture.

Our research themes of Plant Breeding and Production, Animal Agriculture, Quality Food, Carbon, Water and Soil and Development Agriculture recognise, on the one hand, our long-lasting strength such as in plant breeding and animal production; and on the other emerging areas such as quality food and food safety; and areas where we have considerable strength but have not recognized formally previously such as in development agriculture. We need to develop a new agriculture.

Our vision for a new Australian agriculture is that of a highly profitable, value-added, decommo-ditised, connected agriculture producing bespoke products for tens of millions of consumers. We need to devise the production and food supply chains that enable this. This ‘new’ agriculture is underlain and enabled by five concepts that cut across agriculture: profitability; provenance; resilience; digital transformation; and connectivity.

# Sydney Institute of Agriculture Launch

27 September 2017

Tony Mahar, Michael Spence, Alex McBratney and Duncan Ivison



On Wednesday 27 September 2017 the Sydney Institute of Agriculture (SIA) was launched by the Vice Chancellor, Michael Spence and the National Farmers' Federation CEO Tony Mahar. The theme of the launch was "Creating the New Agriculture", with director Alex McBratney calling for a high tech, ecosystem aware, value-added, consumer-connected food production system with benefits for consumers, producers and the environment.

Alex McBratney



University of Sydney Vice-Chancellor and Principal Dr Michael Spence commented ahead of the launch: "This is the latest University-wide centre formed to solve grand challenges that cross disciplinary divides."



The event attracted more than 200 attendees. The official launch was immediately followed by a research showcase. This was followed the next day by a joint symposium with the University of Sydney's Business School: Growing the Business of Agriculture.

*"To be a productive and profitable farmer – you must be a sustainable one!"*

*Tony Mahar*

Tony Mahar





## RD Watt Lecture

### Commemorating our first lecture in Agriculture

The annual RD Watt Lecture commemorates the first lecture delivered to University of Sydney agriculture students in March 1911 by Australia's first Professor of Agriculture, Robert Dickie Watt.

#### 2018: Cotton Tales

Eastern Australia is a top cotton producer, and the world's third largest exporter of cotton, behind the USA and India. The 2018 RD Watt Lecture explored this Australian success story, 'Cotton tales: celebrating success in Australia' on Thursday 8 March 2018. The panel, consisting of leaders in the Australian cotton industry, and also all agriculture alumni of the University of Sydney. Alex McBratney introduced the speakers:

- David Anthony, Chair, Auscott Limited, Director, Plant Biosecurity CRC, spoke about the history and development of the Australian cotton industry.
- Dr Greg Constable, Post Retirement Fellow, CSIRO, spoke about research achievements in the Australian cotton industry.
- Adam Kay, CEO, Cotton Australia, revealed the future and commercial direction of the Australian cotton industry.

This was followed by a Q&A panel hosted by **Emeritus Professor Les Copeland**, Board member of the federal government's Cotton Research and Development Corporation.

From the first cotton seeds brought to Australia on the First Fleet in 1788, the cotton industry has blossomed into the extraordinarily successful agri-industry that it is today, with Australian cotton held in the highest regard internationally.

While we all use cotton products every day – from clothing to homewares, and from soaps to pharmaceuticals – many of us don't know much about this Australian success story. The cotton industry provides jobs and business opportunities in rural regions of NSW, Queensland and Victoria; delivers highly regarded cotton fibre to international spinners; and the science behind the cotton industry allows us to combine increased yield and fibre quality, with improved water use efficiency and a smaller environmental footprint.



David Anthony



Greg Constable



Adam Kay



## 2019: Women in Agriculture

To celebrate International Women's Day, and to commemorate our long history of agricultural education, research and outreach, we recognised the remarkable work of women in agriculture on Thursday 7 March 2019.

While not typically seen as the face of this industry, women play a vital role in enterprises and on farms to ensure the future of Australian agriculture continues to be innovative and productive.

Making up around 32 per cent of Australia's agricultural workforce, women take on a range of roles on and off the land. From agribusiness and innovation to government policy and ethical governance, three female leaders who are all University of Sydney alumni join us to shine a light on women in agriculture.

The panel of University of Sydney alumni in agriculture shared insights into their work, what they think the future holds for Australian agriculture and how women continue to be key contributors.



Angela Pattison



Lucinda Corrigan

- **Dr Angela Pattison** (host), a plant breeder and agricultural scientist based at the Narrabri Campus of the University of Sydney. Her primary role is improving the performance of chickpeas in hot and dry environments through field trials and genetic selection. She also manages projects on triticale, field pea and native grains and has extensive experience in field-based data acquisition. Angela graduated with a Bachelor of Science in Agriculture (Hons I) and the University Medal in 2007.
- **Lucinda Corrigan** spent her professional life working in innovation across the livestock industries after graduating with a Bachelor of Science in Agriculture (Hons I) in 1981. Through many roles at a local, state and national level she has developed a deep interest in the ethical governance of public funds, transparency and accountability that enable change. She was named the WIAA Agribusiness Leader in 2014 and in 2016 was honoured to receive the Professional Achievement award from the University of Sydney's Faculty of Agriculture.



- **Evie Murdoch**, a Senior Agribusiness Consultant at KPMG Australia, graduated with a Bachelor of Science in Agriculture (Hons I) and the University Medal in 2016. Since then she has been working across the agribusiness sector where she is passionate about meaningful, innovative change; most recently she worked with the National Farmers' Federation co-authoring their \$100bn industry plan.
- **Caroline Wardrop**, an agricultural policy specialist, graduated with a Bachelor of Science in Agriculture (Hons II, Div 1) in 2003. She has spent the majority of her career working for the Australian Government delivering policy relating to natural resource management, soil, water infrastructure, meat and live animal exports, and agricultural and veterinary chemicals. Caroline is currently seconded to the Department of the Prime Minister and Cabinet to review the Australian Public Service.



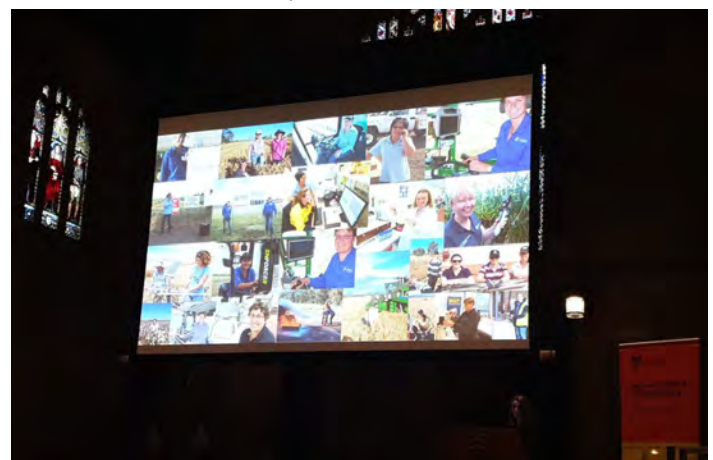
Evie Murdoch



Caroline Wardrop

*"I think there is huge potential for the sector to build its competitiveness through innovation. There are plenty of ideas floating around – the real challenge will be to make them stick. To convince the farmer they're worthwhile, to demonstrate they will deliver real returns and to make the products easy to use and cost effective."*

– Caroline Wardrop





## SIA Research Showcase

SIA brings together research expertise from across the University for the annual showcase event

### 2017: Creating the New Agriculture

Following the Sydney Institute of Agriculture launch on 27 September 2017, our inaugural Research Showcase was held. The event featured sessions on each of SIA's five core research themes: Plant Breeding and Production; Carbon, Water and Soil; Quality Food; Animal Agriculture, and Development Agriculture.

The research showcase also featured a panel on "The New Agriculture" facilitated by Andrea Koch from the National Farmers' Federation, a poster board competition, and a "180-second spiel" Thesis Challenge.



Michael Spence

### 2018: Development Agriculture

Growing sustainable communities globally  
The SIA Development Agriculture Research Showcase, on Friday 6 July 2018 discussed the tremendous technical advancements that have been applied throughout the 20th century to drive sustainable agriculture as well as the persisting issues facing agriculture in developing economies. The event was opened by Kate Lorimer-Ward, (Deputy Director General for Agriculture, NSW DPI)

The day consisted of research showcase presentations, a '180-second spiel' Thesis Challenge and a Poster Competition.

The Showcase focused on three main areas:

- Improving agricultural productivity
- Improving incomes and livelihoods
- Improving quality

Keynote speakers for the event were Daniel Walker (Chief Scientist, ACIAR) "More but different with less – food systems challenges for sustainable development", and Andre Drenth (Centre for Horticultural Science, The University of Queensland) "Some observations on my quest for impact in development agriculture".



Alex McBratney

In today's social climate, establishing sustainable agricultural practices around the world is pertinent to humanity's survival. With rapid population growth, increasing undernourishment and sprawling poverty in some of the world's poorest nations, a collaborative response is required to sprout a solution. The symposium focused on the interdisciplinary approaches needed to overcome these difficult challenges to ensure we improve the availability, quality and profitability of food production across the world. Researchers highlighted case studies that apply novel approaches to agriculture and give hope for a sustainable future.



Daniel Walker

Agriculture not only addresses food and nutrition security concerns, it also offers financial security in developing countries where families rely on farming as their source of livelihood. Despite these communities being most reliant on agriculture, many do not have access to training, structures and support systems to enhance productivity and yield.



Damien Field

In order to improve global conditions, resources need to be invested into rural communities to help them grow and develop so that we can combat poverty and sow the seeds for a better future. This requires investigation into the techniques used to raise plants and animals productively while considering economic, social and environmental factors to ensure realistic change is implemented by small-scale food producers.



Alex McBratney

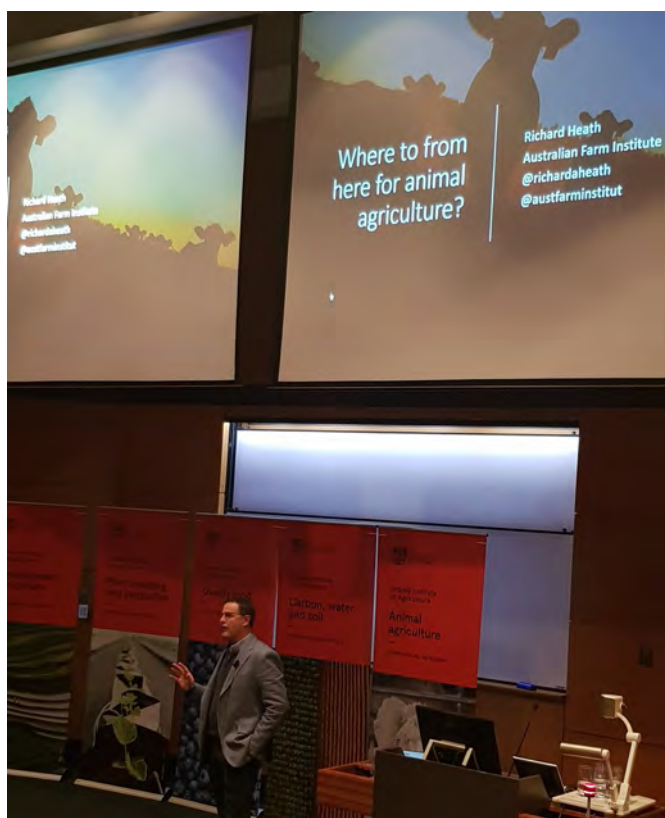
## 2019: Animal Agriculture

### Animal agriculture in future environments

The 2019 annual SIA Research Showcase was held on Wednesday 3 July at the Veterinary Science Conference Centre. 130 people registered to attend, including industry professionals, alumni, high school teachers, farmers, researchers, and University staff and students.

The Showcase was officially opened by Mr Michael Johnsen, MP – NSW Parliamentary Secretary for Agriculture. The program included presentations by researchers from the University of Sydney and external guest speakers, divided into the following sessions and topics:

- Grand challenges in food production: the role of animal agriculture
- Animal agriculture in a complex social framework
- Animal agriculture for the future
- Animal agriculture in a data/tech-rich environment
- Where to from here in animal agriculture?



Richard Heath

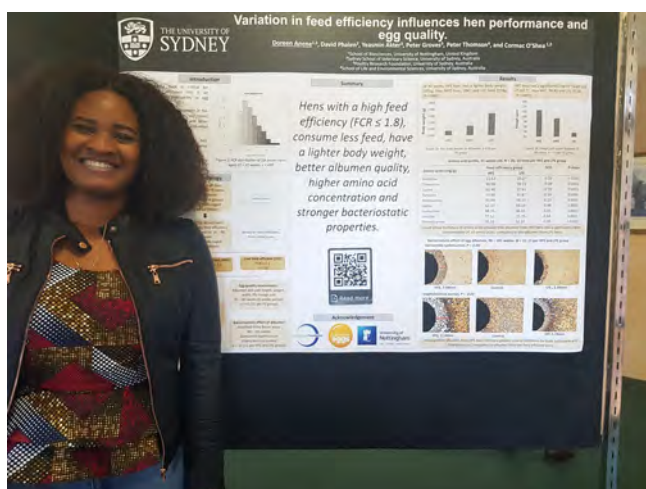




Jim Rothwell

Our academic and student speakers highlighted the wide range of research conducted across the University in the field of Animal Agriculture, with many guests commenting that they had not previously realised the depth of research in this area.

Throughout the day guests were invited to view posters prepared by our postgraduate students and voted the poster by Doreen Anene (Variation in feed efficiency influences hen performance and egg quality) the winner. The day concluded with the '180-second spiel' Thesis Challenge' where nine students presented a summary of their current research with the use of just a single slide. Michelle Demers was voted the winner with an engaging presentation titled 'Know your enemy'.



Doreen Anene



Cassius Coombs, Michelle Demers, and Manuel Lequerica

# Growing the Business of Agriculture Symposia

## 28 September 2017

On Thursday 28 September 2017, SIA partnered with the University of Sydney Business School to present a one-day symposium, "Growing the Business of Agriculture", bringing together agri-producers, entrepreneurs, executives, financiers and policy makers. The aims of the Symposium were:

- Building connections with agribusiness
- Putting Sydney on the map for agribusiness
- Promoting the activities of SIA
- Encouraging our post grad students to look at agribusiness

Sessions included:

- Envisioning the Decade Ahead
- Achieving growth: The Producer Experience
- Connecting with customers through supply chains
- Funding business growth

Invited speakers included Don McGauchie (Chair of the Board, Nufarm; Director AACo Board) speaking on "The board room perspective on growth in agriculture over the next decade"; Fiona Simson (Chair of the Board, NFF) on "Creating the right policy environment for growth"; Megan Davis (Future Farmers Network); and Richard Bennett (Produce Marketing Association (PMA)) on "Food safety and food supply chains".



Eddie Anderson

## 24 September 2018



Alex McBratney, Sylvain Charlebois, and Eddie Anderson

Following on from the success of the 2017 event, The University of Sydney Business School and the Sydney Institute of Agriculture partnered again in September 2018 in a Symposium to explore the vision and tactics for growing Australia's agriculture. Topics included:

- Blockchain, food safety and insecurity
- Innovating the global food chain
- Risk and resilience (including insurance solutions)
- Sustainability
- Connecting growers and consumers

Speakers included:

- Sylvain Charlebois (Dalhousie University)
- John van der Vegt (AgriRisk Services)
- Grayson Killen (Syngenta)
- Chris Walsh (AGFSeeds)
- Sarah Nolet (AgThentic)





## Core Research Themes

Five research themes guide us to play a key role in the Australian agriculture and food sector

Research being conducted at the Sydney Institute of Agriculture meets the challenges and takes on the opportunities facing Australia's agricultural sector for the coming decades. We are developing solutions for the significantly increasing global demand for high quality food and fibre.

Our research structure is built on five thematic research areas, which make up our core research capabilities, led by our five Theme Leaders:

- Plant breeding and production; Professor Brent Kaiser
  - Carbon, water and soil; Professor Budiman Minasny
  - Quality food; Professor Robyn McConchie
  - Animal agriculture; Professor Yani Garcia
  - Development agriculture; Professor David Guest
- The following sections of this report will provide a brief overview of the research and activities being undertaken by each of our themes.



Brent Kaiser



Budiman Minasny



David Guest



Yani Garcia



Robyn McConchie

## Theme: Plant Breeding and Production

Providing the key to meeting the global challenge of providing enough quality food for a growing population



### The Role of SIA in Plant Breeding and Production

The Sydney Institute of Agriculture provides a unifying voice for plant breeding and plant production research and development activities at the University of Sydney. Collectively, the University of Sydney has significant strengths in plant breeding across the grains and horticulture sectors.

Our breeding programs are recognised globally for their role in securing plant health (Rust tolerance in cereals) and increases in grain productivity (Hybrid wheat technologies). Other breeding activities such as those in pulses are delivering important gains to manage abiotic stress tolerance for improved crop rotational systems while our activities in horticultural crops enhance local productivity in vegetables and floriculture industries.

Our plant production strengths are characterised in our developments in digital agriculture systems designed to manage production on-farm and analyse in real-time farming efficiencies and plant qualities. This is highlighted in our recently funded real-time Digital Farm at our research station in Narrabri and in the robotic-based farm systems which have been developed within the Faculty of Engineering at the University.

Plant production is also represented by our combined strengths in weed management where technology advance, plant physiology and modern agronomy combine to lessen weed presence in the field without the necessity of chemical inputs. Collectively these programs are allowing the University of Sydney to take leadership in achieving our vision of the farm of the future.

### Key Areas of Research

- Grain crop breeding for improved productivity and quality (Wheat, barley, pulses, triticale)
- Global rust disease surveillance and rust tolerance breeding
- Weed science and nonconventional weed control
- Robotic production technologies for horticulture and grain industries
- Precision-farming and application of advanced digital technologies



## Theme: Plant Breeding and Production

### Key Activities

#### Wheat Breeding Richard Trethowan

##### Hybrid Wheat

2019 has seen the first national and global F1 yield trials of the University of Sydney's Hybrid wheat program. This major step in delivering hybrid wheat technologies to one of the world's most important food crops saw sites planted across Australia, the eastern seaboard of Africa, Europe, south Asia and North and South America. The hybrid wheat technology has also seen a technical advancement where it now contains an optimized and biologically perfect 42 chromosome system which has been successfully patented in late February 2019.

##### Crown rot tolerance

New recombinants from both marker assisted recurrent selection schemes and pyramiding of marker trait associations from genome wide association analysis have resulted in measurable improvements in crown rot resistance and tolerance, lines of which are now being incorporated into commercial germplasm collections.

##### Heat tolerance

New genomic selection technologies have resulted in the first heat tolerant recombinants planted for field evaluation across Australia in 2019.

##### CAIGE

CAIGE stands for CIMMYT, Australia Icarda, Germplasm Evaluation. This is a project by which new plant germplasm (wheat, barley and pulses) from CIMMYT (the International Maize and Wheat Improvement Center) and ICARDA (the International Center for Agricultural Research in the Dry Areas) are imported into Australia and evaluated for disease and stress tolerance. Publicly available data is provided to Australian breeders to expand and improve their breeding programs. In 2019, the University of Sydney and its partners were awarded a large research grant from the GRDC to continue the highly successful CAIGE program. So far, a significant number of CAIGE materials have been integrated into a wide range of research activities and have been accessed by commercial companies for crossing and continued evaluation.



##### Vegetable Breeding

A DFAT funded project facilitated a workshop in Doha to develop a small collaborative research program between the University of Sydney and Qatar for greater heat tolerance traits in glasshouse grown tomatoes. The workshop resulted in a new collaborative research grant funded by the Qatar Foundation.

##### Biofortification in wheat seeds

Wheat lines are continually evaluated for genetic traits linked to key nutrients including Zn, Fe, phytate and fructan. Following an extensive agronomic evaluation of adapted materials, several wheat lines with significantly enhanced nutritive value, yield equivalent to the best commercial cultivars and comprehensive rust resistance have been identified. These materials represent a breakthrough in wheat biofortification.

##### Drought breeding

The University of Sydney oversees an active drought breeding program in wheat using the GRDC supported managed environment facility at Narrabri. The Managed Environment Facility (MEF) is now operating on a fee for service basis and has sufficient current contracts to cover 60% of 2019/20 GRDC expenditure. The MEF is available to non GRDC funded research and is open to other crops including pulses from 2020. The facility provides accurate and repeatable drought response phenotypes to support breeding and genetic research.

## Theme: Plant Breeding and Production

### Global rust disease surveillance and rust tolerance breeding, Robert Park

Research on the pathology and genetics of rust pathogens and rust resistance in cereals began at the University of Sydney in 1921. Since then, we have helped the Australian grains industry to develop and grow cereal cultivars with in-built genetic resistance to rust.

Our research activities span four key areas: Annual pathogenicity surveys to provide information (occurrence/frequency) of rust pathotypes and providing the pathogen germplasm for use in screening and cereal germplasm enhancement activities; Identification of new rust resistance sources (gene discovery), markers and emergency response protocols for new rust threats; Education and training of industry, students and the public in rust and rust management; Providing services to industry for germplasm enhancement (includes commercial and non-commercial activities such as rust resistance status of breeding material).

#### New Funding

Three large, new rust projects have received funding; two funded by the GRDC, and one funded by the ARC.



### Genetics program

This project focusses on the discovery, characterisation and deployment of new genes conferring resistance to rust diseases in cereals. Recent highlights:

- Detailed phenotypic characterisation, marker development, gene additivity studies performed on two common wheat landraces (Aus27430 and Aus27969) demonstrated additive interaction of new ASR (Yr81 and Yr82) and known APR (Yr18 and Yr29) genes. Both landraces showed resistance to stripe rust under the glasshouse and field conditions.
- A new APR gene, Yr80, was identified a seedling susceptible landrace Aus27284, which exhibited moderately resistant response at the adult plant stage. Markers closely linked with Yr80 were developed and validated among 81 Australian wheat cultivars.
- Markers closely linked to the previously mapped Ug99-effective stem rust resistance gene Sr48 and APR gene Lr49 were also developed and validated. These high throughput closely linked markers were delivered to breeders.
- Two QTL for leaf rust resistance were identified from a moderately resistant (MR) genotype C16.14. The QTL on chromosome 3B was shown to Lr74 and a closely linked marker was developed; the other QTL on chromosome 3DS appears to be a new APR gene and a closely linked marker was identified and validated on a set of Australian cultivars.

### Rust pathogen research

This project is an important plank of the Australian plant biosecurity system. It contributes nationally to the genetic protection of Australian cereal crops against rust diseases firstly by providing support to cereal breeders, and secondly by providing timely and regularly updated information on the rust responses of all Australian cereal cultivars to growers.

### Research Highlights

Dry conditions in eastern Australia led to a very low incidence of cereal rusts. 282 rust samples were received for analysis and only two new pathotypes (pts) of stripe rust were detected. Two new pts were: 320 E0 A- (NSW), shown to be a mutant of pt. 64 E0 A- with virulence for Yr5; pt. 239 E237 A- 17+ 33+ (Victoria). The full impact of this pathotype on current Australian wheat cultivars will be determined this year in field tests.



## Theme: Plant Breeding and Production



### Weed research, Michael Walsh

The Weed Science program has made further gains in their work to develop programs and technologies that minimise weed problems for the grains industry.

The program has recently secured new funding from the GRDC and Agrifutures. This research has generated over 10 key journal publications including a key publication on alternative weed control technologies. The program has been a beacon for the University of Sydney's agricultural identity in the grains sector with the highly successful Summer Weeds and Cropping Field Day, where 160 growers and agronomists attended and learned about advances in weed control.

The group has also delivered over 16 independent presentations to grower focussed events across Australia.

### Legumes for sustainable agriculture Brent Kaiser

Legumes for Sustainable Agriculture (LSA) has continued to expand its discovery and applied research outcomes in identifying new traits and lines for improved abiotic stress tolerance in Chickpea.

Within the University of Sydney node of LSA, new technologies linking plant-based biomarkers to drought tolerance have been identified as having non-invasive in-field technologies to quantify root acquisition of water. Large populations of chickpea varieties are currently being evaluated for heat and drought tolerance and new breeding populations are being created to expand the genetic diversity of Australian grown chickpea populations. A recently funded CRCp project (\$600K) with NACRA

(Northern Australia Crop Research Alliance) has resulted in the development and selection of new chickpea populations with greater heat tolerance (heat management at flowering) in field trials planted in Kununurra WA and Narrabri, NSW.



## Theme: Plant Breeding and Production

### People

#### Dr Urmil Bansal, Senior Research Fellow Molecular Genetics

My research is focused on discovery, characterisation and deployment of new sources of resistance to rust diseases of wheat using the cutting-edge molecular technologies. Stripe rust ranks high on the list and our team has proudly delivered more than 50% of new stripe rust resistance genes to the global wheat community.

Breeding for rust resistance is a continuing mission and our team is ahead of the world to deliver positive outcomes to feed 9.8 billion humans.

SIA helps me to achieve my goals by providing regular information on opportunities for applying for grants to broaden my research opportunities.



#### Michelle Demers, PhD Candidate

I do my research in three main ways: first, I grow pure cultures of various stem rust isolates on plants in the glasshouse. Secondly, I do lab work where I extract DNA, RNA and infection structures from these isolates, and thirdly I do bioinformatics where I analyse the genome and transcriptomes I extracted in my lab work on the university's supercomputer. Plant breeding and production are the two key elements for continuing to feed the world in a changing climate.

Plant breeding and production are always going to be a necessary part of human society as the demand for food never goes away, but I can definitely see it becoming more mechanised, using better analytic/ diagnostic methods for breeding choices and more mechanization for production.

By providing opportunities to showcase my research, providing funding and scholarships for research activities and networking events to develop future collaborations with other areas within agriculture, SIA can help me achieve my goals.



## Theme: Plant Breeding and Production

### Kamal Uddin, PhD Candidate

I grow soybean plants in controlled growth chambers in order to identify and characterise genes responsible for plant nitrogen management. Identified genes are cloned and functionally using heterologous expression systems such as yeast and *Xenopus laevis* oocytes.

Plant breeding is required to ensure farmers can grow plants that are tolerant of disease or stress. Plant breeding advances combined with modern production systems help farmers become eco-friendly, sustainable and support their role in delivering food security. It is essential that research, industry engagement and government agencies work together to ensure future farming and food-based systems continue in order to meet increasing global demands for food.

SIA helps me showcase my research to reach a broader science community, to get necessary feedback as well as see what other researchers are doing. SIA has also been important to me in that it helps me financially through a support scholarship.



### Dr Angela Pattison, Research Scientist

The field is both my main laboratory and my office! I do my research by planting crop genotypes that we know little about in Australia (which might be cultivars from overseas, landraces, ancient breeding lines, and more) and seek out the ones that have traits that will help them grow well in hot, dry environments. It's a numbers game – thousands of plots are planted each year, and tested using a variety of techniques including drones, air-conditioned chambers, out of season plantings, and plenty of time walking through the plots looking for the plant type we want. We then cross breed the winners to Australian cultivars so that the next batch of Australian cultivars carry the desirable characteristics.

Plant breeding and production is the coal face of research; delivering the best science into a form that industry can use. The balance of research between fundamental, discovery and industry-applied is essential, and the SIA theme of plant breeding and production is a very important part of gaining that balance, making sure the work of scientists can efficiently benefit humanity and the planet.

## Theme: Plant Breeding and Production

Food production is not just done by farmers, its done by an integrated community of people with different skill sets, and hence being part of the integrated SIA community has, and will continue, to connect the people with 'non-field skills' like computer science, marketing, nutrition and fundamental science, with the researchers who know how to produce the core food product. This is particularly important to meet the challenge of producing food from ecosystems for a modern market.

*"Being part of the encouraging and stimulating SIA community has already allowed me to grow into a researcher who can look toward what I believe is the next big challenge for agriculture – learning how to sustainably produce grain based on native ecosystems."*

–Angela Pattison

### Brett Whelan, Associate Professor in Precision Agriculture

I work in the field of Site-specific crop management which aims to derive data driven decisions to optimally manage variability in broadacre cropping systems. The goal is to improve the sustainability of these systems in terms of resource use and profitability. The research is performed at the commercial field scale and involves the use of on-farm experimentation, crop and soil sensing systems, along with spatial and temporal analytical techniques.

Having SIA as an industry-facing research-focused entity within the University enables my research to be more widely seen and also indicates to the agricultural community that the University is serious about supporting research in rural industries. Without this institutional gravitas of SIA, the task of convincing funding bodies to support my work would become much harder.





## Theme: Carbon, Water and Soil

Applying the best scientific research to develop effective rural land management policy



### The Role of SIA in Carbon, Water and Soil

The Carbon, Water, and Soil theme conducts research to tackle important global issues: In the face of climate change, how can we produce more food and fibre while sustainably managing water and soil?

We confront these important issues by conducting basic and applied research that improves our understanding of the causes and controls of soil distribution, the cycling of water, carbon and nutrients in plant and soil, and manipulating the transfer of energy through the soil-plant-atmosphere system. Our work has created changes in practice, from global and national digital soil mapping to landscape-scale carbon, water, and soil management, precision agriculture and contaminated-site assessment. Overall, we aim to connect soil, water, carbon, climate, agriculture, the economy, and society based on the best scientific evidence that serves to balance needs for food production, carbon sequestration, ecosystem services, and farmers' profitability.

### Key Areas of Research

Our research in Carbon, Water and Soil covers the following topics:

- Lifting carbon sequestration potential, identifying carbon allocation in crops, soil management, carbon auditing, and modelling at a farm scale.
- Digital mapping, modelling and assessment, revolutionising the availability of accurate soil information which led to improved agricultural practices with reduced environmental impacts and enhanced security of the world's soil.
- Managing crop productivity in the face of climate change, in particular adapting to drought: identifying a better plant water use efficiency, soil management that better conserves water, the ability to forecast climate seasonally, soil water management via integrated sensors and modelling.
- Digital agriculture to lift productivity, phenotyping via remote sensors, soil characterization, yield forecasting, climate and soil water forecasting.
- Remote and proximal sensing of above and below ground biodiversity for quantifying ecosystem services.
- Space and time predictions of soil, carbon, and water from paddock to landscape scale:
- Quantifying influences of climate and management on agricultural production and surrounding landscape health.

## Theme: Carbon, Water and Soil

### Key Activities



Asad Raza, *Absorption*

#### SIA Nitrogen Use Efficiency (NUE) Workshop, 20 June 2018

A White Paper prepared by 14 scientists identifies NUE knowledge gaps and research necessities in six areas: Plant science, Plant genetics, Nitrogen cycle in agroecosystems, Agronomy, Soil and plant sensing, and Economics.

#### SIA Water Showcase, 5 November 2018

National Agricultural Water Observation Systems: Observing and managing productive water from paddock to farm to landscape. The workshop brought together 40 actors in the R&D field in observation, management and prediction of agricultural and environmental water to discuss the need for a framework for agricultural water observation systems.

#### Soil Security and Planetary Health Conference, 4–6 December 2018

SIA, together with the Planetary Health Platform, hosted a large multidisciplinary conference which brought an international audience of 120, to discuss ways to secure our soil and safeguard the health and wellbeing of current and future generations through good stewardship of Earth's natural systems. The conference produced a Special Issue in the journal, *Sustainability*.

#### Soil Tech Project, ongoing

A consortium of agricultural technology companies with SIA launched a project to unlock our science for the use of Australia's farmers, to help farmers better manage their soil.

#### National Water use in Agriculture Research and Development Future Forum, 13 February 2019

Attended by 100 national representatives of Government organisations, industry and other stakeholders to stimulate thinking on future research and development frontiers of water use in agriculture. A summary of the forum was published in the Farm Policy Journal: Guy Roth, "Seizing water research opportunities – a necessary grand challenge" (Winter 2019, Vol. 16, No. 2).

#### *Absorption*, Art Installation with Kaldor Public Art Projects, Carriageworks, 3–19 May 2019

Artist Asad Raza working with researchers from SIA created a massive installation bringing together art and science to draw public attention to soil, and environmental concerns. The installation combined 300-tonnes of organic and inorganic material into a 'neosoil' that visitors were invited to take home.

<http://kaldorartprojects.org.au/project-34-asad-raza>



## Theme: Carbon, Water and Soil

This theme focuses on many of the environmental issues related to Agriculture. Therefore, besides writing scientific papers we are actively participating in public discourse on key issues. Here is a cross section of some of the issues in which we have engaged.

- Guy Roth. Seizing water research opportunities – a necessary grand challenge. *Farm Policy Journal*, Winter 2019. <http://www.farminstitute.org.au/publications/policy-journal-winter-2019>
- Francisco Sanchez-Bayo, Insect population and species decline a 'wake-up call', scientists say. ABC News, 12th Feb 2019. <https://www.abc.net.au/news/science/2020-12-12/insect-species-in-decline-and-facing-extinction/10804094>
- Sydney Institute of Agriculture, Drought Capability Statements <https://sydney.edu.au/news-opinion/news/2018/08/20/drought-capability-statement--sydney-institute-of-agriculture.html>
- Alex McBratney, 4 reasons agriculture needs to phase out reliance on glyphosate <https://sydney.edu.au/news-opinion/news/2018/10/09/4-reasons-agriculture-needs-to-phase-out-reliance-on-glyphosate.html>
- Alex McBratney, In 100 years' time, maybe our food won't be grown in soil <https://theconversation.com/in-100-years-time-maybe-our-food-wont-be-grown-in-soil-108049>



- Alisa Bryce, Alex McBratney, Stephen Cattle, Budiman Minasny, Damien Field, We have no idea how much microplastic is in Australia's soil <https://theconversation.com/we-have-no-idea-how-much-microplastic-is-in-australias-soil-but-it-could-be-a-lot-96858>
- Budiman Minasny, Dian Fiantis, How Mount Agung's eruption can create the world's most fertile soil <https://theconversation.com/how-mount-agungs-eruption-can-create-the-worlds-most-fertile-soil-85134>

## Theme: Carbon, Water and Soil

### People

Feike Dijkstra



#### Feike Dijkstra, Associate Professor of Biogeochemistry

We study plant-soil interactions on carbon and nutrient cycling in terrestrial ecosystems, including grasslands and croplands. We combine field, growth chamber and laboratory studies to examine the dynamics of carbon and nutrients in plants, microbes and soil. Our recent ARC Discovery project investigates the carbon costs of plant nutrient and water uptake. SIA facilitates collaborative multidisciplinary research with researchers from biology, plant science, economics, and engineering.

Federico Maggi



#### Federico Maggi, Associate Professor in Environmental Engineering

Our work focusses on measuring and modelling agrochemicals – nutrient and pesticides interactions in the environment. We conduct biodegradation experiments in microcosms, and we couple observed kinetics in mechanistic models from local to regional, continental and global scales using the BRTsim computational framework. SIA is a major partner of my research that enables me to link with other SOLES academics.

Edward Jones



#### Edward Jones, Research Associate

Our work makes the provision of soil information rapid, inexpensive and accessible to all. My research focuses on real-time, adaptive mapping of soil properties using proximal sensors – visible near-infrared (VisNIR) and portable X-ray fluorescence (XRF) spectroscopy. Funded by the GRDC, my project investigates different types of sensors to scan multiple soil samples across a paddock and build an accurate digital soil map identifying variation. SIA has an important role in facilitating collaboration, to develop a massive data library of soil and spectral information.

James Maloney



#### James Maloney, PhD Candidate

My research is developing a method that enabled us to map soil moisture in real-time. It's designed to help growers make management decisions about their property. I used a multi-data source approach to provide maps of soil moisture at multiple depths in the soil. SIA facilitates translating our research into a start-up company, AreaCrop, which aims to provide real time maps of soil moisture on a farm.



## Theme: Quality Food

Applying technology and interdisciplinary research to improve food industry standards along the supply chain



### The Role of SIA in Quality Food

The overarching objective of the Quality Food Theme is to meet consumer demands for high quality, safe and sustainable food in existing and emerging markets, and thereby support the continued profitability and competitiveness of Australian food and agricultural industries. University of Sydney researchers are tackling this challenge from several directions. The Quality Food Theme brings together expertise from the natural sciences, engineering, health sciences, social sciences, economics and business disciplines to holistically understand the processes involved in food production and consumption, from the farm-gate to the dinner plate and beyond. The Theme provides a portal for strategic partnerships in multidisciplinary research to address industry priorities and challenges.

The scope of research is broad. We have researchers working to establish new directions in quality differentiation and control. For example, the identification and control of nutritional and sensory traits, alongside the development of analytical techniques and sensor technologies to monitor these through the supply chain.

We also have a major research effort into assessing microbial food safety risks and developing data-driven tools for risk management, which has been spurred by food-borne disease outbreaks within Australia and globally. Other researchers seek to understand the impacts of diet on human health, particularly the effects of food structure on the digestive system, microbiome, immune function and chronic disease. There are efforts to understand the industrial ecology of production, and to improve sustainability by reducing environmental footprints, increasing process efficiencies, and developing co-products from waste streams. Meanwhile social, economic and business researchers seek to understand the perceptions, attitudes and behaviour of stakeholders throughout the food system. Activities range from profiling the determinants of individuals' food preferences and purchase behaviour, to exploring the impacts of advertising on nutrition, the market impact of regulations and labelling, and the adoption of new technologies by organisations.

# Theme: Quality Food

## Key Areas of Research

Key centres working collaboratively in food research at the University of Sydney include:

- ARC Training Centre for the Australian Food Processing Industry
- ARC Training Centre for Food Safety in the Fresh Produce Industry
- Sydney Food and Nutrition Network (SFNN)
- Centre of Excellence in Advanced Food Enginomics (CAFE)
- Charles Perkins Centre – Healthy Food node
- Sydney Environment Institute – Food Systems theme

## Tools and Resources

The University of Sydney has excellent facilities that underpin food research at different stages of supply chain, relevant to the various academic disciplines, and extending from lab to pilot to field scale.

**Agricultural production facilities:** include a state-of-the-art of greenhouse, glasshouse, field environments and livestock units for farm-scale experiments located at Sydney, Camden and Narrabri campuses.

**Food science laboratory:** includes equipment for bench-scale food preparation and processing, pilot-scale brewing and fermentation, basic food quality analysis, rheological analysis, and sensory evaluation.

**Pilot processing facilities:** includes a variety of spray-driers, fluidised bed dryer, fermenters, membrane technology, advanced extraction facilities, 3D printing, and apparatus for smart packaging and food sensors.

**Chemical analysis:** a wide range of facilities are available for the analysis of food composition, structure, metabolites, and thermo-physical properties including various instrument configurations for liquid chromatography, gas chromatography, mass spectrometry, nuclear magnetic resonance, crystallography, different forms of spectroscopy and calorimetry.



**Microbiological analysis:** includes facilities for extraction, identification, characterisation, culture and experimenting with microorganisms including food-borne pathogens. There are also facilities for analysis of microbial communities (microbiomes) in the environment and in animals and humans.

**Health and medical research facilities:** research into the interactions between food and health involve animal studies, metabolomics or use of cellular imaging, pre-clinical and clinical imaging, cytometry, genomics, and proteomics facilities.

# Theme: Quality Food

## Key Activities

Robyn McConchie



Risk and abuse profiles will be used to design challenge studies of several model products with food-borne pathogens such as *Salmonella enterica*, *Listeria monocytogenes* and *Escherichia coli*.

These will lead to realistic, high-resolution models of pathogen dynamics and microbial risks in the fresh produce supply chain, and facilitate more accurate and targeted risk management plans. The project is one of nine being conducted under the auspices of the ARC Training Centre for Food Safety in the Fresh Produce Industry. Research in the Training Centre encompasses both pre- and post-harvest microbial food safety: examining the sources and determinants of microbial contamination in fresh produce, developing improved methods for diagnostics and control, and generating risk assessment and support tools that will assist industry with their management decisions.

### Food Safety, Robyn McConchie

Professor Robyn McConchie, Director of ARC Training Centre for Food Safety in the Fresh Produce Industry commenced in February 2017 and will conclude in January 2021. The Centre conducts industry-focused research to develop practical solutions to prevent or minimise food safety risks in fresh produce across the value chain, and train the next generation of industry-ready food safety researchers. Our research works towards safer food for the consumer, increased industry growth and competitiveness in the Australian food and agribusiness sector, and increased access to growing export markets. The ARC Training Centre for Food Safety in the Fresh Produce Industry is funded by the Australian Government and industry partners, and administered by the University of Sydney. The Centre comprises nine PhD students, five Postdoctoral Associates, nine Chief Investigators and 18 industry partners. One project example is Fresh Produce Safety in Storage and Transport Facilities led by Dr. Floris van Ogtrop and Dr. Kim Phan-Thien to research microbial risks during the distribution phase of the fresh produce supply chain.

Working closely with industry partners including Harris Farm Markets, NSW Food Authority, New Zealand Apples and Pears, and New Zealand Institute of Plant and Food Research, the team will compile and analyse data on food safety management in produce distribution centre and transport environments.





## Theme: Quality Food

### Creating Value and Reducing Waste, Fariba Dehghani

The overarching goal of the ARC Training Centre for Australian Food Processing, directed by Prof. Fariba Dehghani, from the School of Chemical and Biomolecular Engineering is to improve the profitability and sustainability of food industry partners, through strategies of waste stream utilisation, co-product development, and process optimisation.

Projects led by Prof. Robyn McConchie, Prof. Fariba Dehghani, Prof. Tim Langrish, Dr. John Kavanagh and Dr. Kim Phan-Thien include a collaboration with the produce supplier, Perfection Fresh, to recover biochemicals from tomato crop residues that can be used as a precursor for synthesis of high-value pharmaceutical products. Another example is collaboration with the Peanut Company of Australia to generate bioactive chemicals from peanut meal through a fermentation process, and to explore their potential use as natural pesticides. The development of alternative methods to add value to peanut meal, which is the by-product of edible oil extraction, could add significant value to what is currently a low-value stockfeed.



Fariba Dehghani

Tom Roberts



### Indigenous Food, Tom Roberts

My group's quality food research is focussed on the food-relevant properties of Australian sorghum grain and the development of new sorghum-based foods for local and international markets. This work is supported by a 5-year GRDC grant UCS00025 'Expanding options for sorghum: food and distilling'. The grant is shared with Charles Sturt University (who are focussed on the market intelligence and distilling aspects of the research). The University of Sydney's share (for the food research) is \$478K of a total of \$1,539K for the 5 years (2016-2021). I'm also involved in Quality Food research on Australian native rice species, triticale and wheat (and recently on mango seed kernel fat) but I don't have specific funding for these projects.

I see the future of Quality Food in the SIA as being diverse in terms of the types of foods and ingredients studied and the problems addressed. Grain foods will remain important in our mix of research because of the value of the grains industry, the health benefits of grain consumption, and the incentives for the grains industry to value-add. The constant stream of Honours students from the BSc/BAdvStudies(FAB) will continue to play a role in preliminary research on Quality Food. My research goals are (i) to continue to support Honours students, PhD students and postdocs involved in a range of collaborative projects (mostly on cereals) in plant biology and food chemistry; (ii) to continue to be successful in obtaining GRDC and ARC funding, and (iii) to publish five to six papers per year in good journals.

## Theme: Quality Food

Les Copeland



### Starch Chemistry, Les Copeland

The research of Les Copeland seeks a better understanding of quality attributes of food starches suited to specific end uses. Starch is one of the most important plant products used by humans. It varies greatly in form and functionality between and within botanical species, which provides a diversity of useful properties but can also cause problems when a starch is not suitable for purpose. Starch contributes 50–70% of the energy in the human diet as a macro-constituent of many foods. Hence, a particular research focus is on quality attributes that influence the digestibility of starch, which is an important risk factor for diet-related illnesses in humans. More broadly, defining quality attributes of starches from particular botanical sources is an important part of the large worldwide starch industry. Some 60–70 million tonnes of starch are extracted and processed annually from many different agricultural crops, of which roughly 60% is used in foods and 40% in pharmaceuticals and numerous industrial applications including in coatings, paper, packaging, adhesives, textiles, bioplastics, and building materials. Les has collaborators in this research in Tianjin University of Science and Technology, China, and he contributes to the field internationally as the Editor-in-Chief of Cereal Chemistry.

### Meat Science, Russell Bush and Melanie Smith

We conduct research along the red meat value chain, with a focus on optimising meat quality from farm to fork. Our research involves the evaluation of animal production traits through to meat processing techniques, carcass and meat science evaluation, retail display and consumer evaluation of meat products.

Russell Bush



Our team has research experience in developing best practice meat quality parameters for alpaca meat, which investigated quality traits including saleable meat yield, tenderness, colour, water holding capacity, oxidation, nutritional parameters, intramuscular fat content, biochemical factors and sensory evaluation.

Our current research focuses on beef meat quality and utilises an integrated supply chain approach to assist in identification of animals at risk of producing low quality carcasses. Our research works directly with industry and utilises commercial information to help ensure that outcomes can be incorporated back into industry practices.



Melanie Smith

## Theme: Quality Food

As the global demand for quality, nutritious food continues to grow it is important the SIA Quality Food theme continues to highlight its participants' research capabilities and current output to ensure targeted exposure to potential industry partners, private collaborators, and overall value of research within this competitive space.

SIA provides an opportunity for researchers from multiple disciplines, working with an array of food products, to be united under the Quality Food theme, which has realvalue for connecting, networking and collaborating with other researchers. As a small team working within the meat science and production space, SIA offers an ideal opportunity to promote our groups' expertise to other SIA researchers along the supply chain to facilitate collaborative projects. Furthermore, SIA provides an interdisciplinary networking opportunity to learn from other research teams' skill-sets and how current research into food technology and quality techniques can be applied into meat research.

Given that we work both vertically and horizontally across the meat supply chain we have a broad range of skills that overlap with multiple branches of the SIA themes and feel that there is a great opportunity for our research to be valued in both the animal livestock production and food quality themes of SIA.

SIA is unique in its ability to bring together academics, researchers, industry representatives and corporates who are interested in the food quality space. This provides a valuable opportunity for ECR and established academics to network, and identifies skill-sets within the university.

Projects relating to meat quality:

- Linking life-time objective measures of welfare to create a premium product from a whole supply chain welfare rating system. This project is funded by Meat and Livestock Australia Donor Company.
- Improved tenderness of alpaca carcasses using combined processing techniques. This project for was funded by Agrifutures and finished this year.
- Factors impacting Australian alpaca meat and methods to improve quality. This project for was funded by Agrifutures and finished this year.

### Healthy Food, Reetica Rekhy

Approximately 1.7 million (2.8%) of deaths worldwide are attributable to low fruit and vegetable consumption. Low fruit and vegetable intake is amongst the top 10 selected risk factors for global mortality. Worldwide, insufficient intake of fruit and vegetables is estimated to cause around 14% of gastrointestinal cancer deaths, about 11% of ischaemic heart disease deaths and about 9% of stroke deaths.

Adequate consumption of fruit and vegetables reduces the risk for cardiovascular diseases, stomach cancer and colorectal cancer. There is convincing evidence that the consumption of high levels of high-energy foods, such as processed foods that are high in fats and sugars, promotes obesity compared to low-energy foods such as fruits and vegetables.

A recent WHO/FAO expert consultation report on diet, nutrition and prevention of chronic diseases, sets population nutrient goals and recommends intake of a minimum of 400 g of fruits and vegetables per day for the prevention of chronic diseases such as heart diseases, cancer, diabetes and obesity. This research focuses on understanding the barriers to adequate vegetable consumption in Australia and ways in which we can promote increased consumption.



Reetica Rekhy



## Theme: Quality Food

### Centre for Advanced Food Enginomics (CAFE)

The vision of the Centre for Advanced Food Enginomics (CAFE) is to create and deliver nutritious and wholesome processed foods to improve human health and wellbeing. CAFE is a multidisciplinary Centre and was established late in 2017 at the Faculty of Engineering at the University of Sydney. CAFE has three research themes:

- Future Food Processing led by A/Prof Kavanagh and Prof Langrish, Faculty of Engineering
- Food for Health led by A/Prof Holmes and Prof Raubenheimer, both from the Charles Perkins Centre
- Innovation in Supply Chain led by Prof Cullen and Prof McConchie, from the Faculty of Engineering and Faculty of Science, Sydney Institute of Agriculture.

We have identified the greatest challenge/opportunity in the food space to be the ability to safely deliver processed food with proven mechanism of effect to people who will gain health benefits from its consumption. This report for the DVC(R) provides our major highlights in the first two years of operations, tracks our progress against agreed KPIs (Annex 1), provides a plan for future funding and budget for 2020–2021. CAFE has now 11 HDR students, higher than our KPI of 5 in year 2. It is anticipated that the number of HDR students will approach 15 by 2020.

We are offering additional scholarships funded by philanthropic funding, an ARC Linkage, and other sources. CAFE has recruited a centre manager, 4 postdoctoral fellows, an industry engagement manager and a technical officer. Additional funding has been secured to recruit a further two postdoctoral fellows (ARCDP/ARC Linkage). We are aiming for another PD to join CAFE in 2020.

Our team has collectively had 88 research outputs (65 papers in peer-reviewed journals; 23 conference outputs) since late 2017. Sixteen additional conference outputs were presented in September 2019 (at Chemeca and ICEF). Full lists of all are available on request. CAFE organises an events program to promote the centre and increase visibility. We have organised 3 workshops/symposia and industry engagement programs since 2017. A fortnightly seminar series started in early 2019. A subsequent workshop was held at the University of Sydney on 19 September 2019 with 3 eminent international guest speakers. We also played an active role in organising conferences (e.g. ICEF 2019, Chemeca 2019).

David Raubenheimer



### Sydney Food and Nutrition Network (SFNN)

The Sydney Food and Nutrition Network (SFNN), established in 2017, is a cross-Faculty initiative of the University of Sydney. The Network has been established with the mandate to consolidate, rationalise and leverage synergies across disparate areas of food and nutrition science at Sydney. The primary focus of the network is to provide a structure in which food and nutrition researchers at Sydney can pool their skills to develop high profile interdisciplinary research projects with immediate or long-term effectiveness for solving real-world problems. The SFNN not only provides a coordinated strategy for integrating and structuring food and nutrition research at Sydney, but also intersects with the broader Planetary Health initiative by providing a cohesive approach for addressing one of the “big four pathways” in Planetary Health: “How we feed the world”.

We have designed three integrated research projects to implement the approach in the context of real-world challenges. The projects are integrated both thematically and methodologically:

1. How can the University be a global leader in the innovative use of global research to bring about change in global food systems?
2. How can the University bring together new combinations of its expertise to identify and find solutions to regional food & nutrition problems?
3. How can the University be a national change agent in shaping Sydney’s food system?

#### Our Goals

- To contribute substantially towards the evolution of a food system that provides equity, ecological and social sustainability in line with the United Nations Sustainable Development Goals.
- To develop a culture of excellence in interdisciplinary food and nutrition research, teaching and translation, and establish the university as a world leader in the field.

## Theme: Quality Food



### Events and Outreach

#### 2017 Annual conference: Fresh Produce Safety Centre

The Fresh Produce Safety Centre (FPSC) and the Training Centre held its annual conference in August 2017. Around 170 people from industry, government and research institutes attended the conference at University of Sydney, based on the theme Science + Culture = Safe Food. The international guest speaker was Dr Lone Jespersen, Principal of Cultivate, who spoke on "How to move beyond a culture of compliance".

#### 2018 Annual conference: Fresh Produce Safety Centre

The Fresh Produce Safety Centre (FPSC) and the Training Centre held its annual joint conference in September 26 2018. Around 170 people from industry, government and research institutes attended the conference at University of Sydney, based on the theme Food Safety- It's Your Responsibility. The first international guest speaker was Mr Suresh DeCosta, Director of Food Safety, Lipman Family Farms (US) & Technical Committee Center for Produce Safety (US) and spoke on "International developments in food safety". A second international speaker was Professor Sylvain Charlebois, Professor in Food Distribution and Policy, Dalhousie University (Canada) and Interim Scientific Director of the Institute of Agri-Food Analytics who spoke on "Food Fraud: A Canadian perspective on one of the most significant challenges we face today."

#### 2017 Industry Partner Workshop

On 9 August 2017, PO representatives were invited to a half-day workshop about the ARC ITTC Food Safety in the Fresh Produce Industry. Items discussed included broad aims and goals of ARC ITRPs, what to expect in the contract, how the Training Centre would be managed, outline of all projects, dates for potential commencement of projects, and nominations to the Executive Management Committee. The meeting began with three guest speakers: Dr Alfredo Martinez-Coll, General Manager, Stakeholder Engagement, MTPConnect: *Tips to make the most of industry research partnerships*. Mr Mark Field, Head of Coles Brand: *Why is Coles an Industry Partner and what are our expectations?* Dr Craig Shadbolt, Manager, Food Incident Response and Complaints, NSW Food Authority: *The importance of partnering with industry in food safety research and its alignment with NSW FA goals*.



## Theme: Quality Food

### 2018 Industry Partner Workshop

On 25 September 2018, PO representatives were invited to a full day workshop to hear about and discuss ARC ITTC Food Safety in the Fresh Produce Industry project progress and future directions. Around 42 industry partners and academics attended.



Suresh DeCosta

The meeting began with guest speakers:

International guest speaker, Suresh DeCosta (Director of Food Safety, Lipman Family Farms, USA), reported on new research initiatives which are translatable for use in the US industry such as water sanitisers, packhouse equipment design, mobile mapping of animal intrusions in the field and use of animal deterrents. He identified cleaning and sanitising as key issues.

Professor Vitali Sintchenko (CI and Director Centre for Infectious Diseases and Microbiology, University of Sydney) outlined the value of whole genome sequencing in quickly identifying clusters of food borne illness. He estimated the cost of foodborne disease in Australia is around \$1.2 billion per annum and that timely outbreak detection is of growing importance. Whole genome sequencing has led to fast recalls across the country and even prevented contaminated product from reaching overseas markets as seen in the recent *Listeria* outbreak involving rockmelons when seven people died.



Martin Cole, Robert Mun, Michael Spence, Julian Leeser, Robyn McConchie, Mirjana Prica



### 2019 Launch of the ARC Centre for Food Safety in the Fresh produce Industry

Supporting an industry increasingly innovated by scientific advancements, the University of Sydney launched a specialist training hub to conduct research into food safety and develop methods to safeguard Australia's fruit and vegetable industries. The centre was officially launched at the University of Sydney by Professor Martin Cole (CSIRO), Dr Robert Mun (Australian Research Council), Vice-Chancellor Dr Michael Spence (University of Sydney), the Hon Julian Leeser (Member for Berowra), Professor Robyn McConchie (University of Sydney), and Dr Mirjana Prica (Food Innovation Australia).

The Australian Research Council (ARC) Training Centre for Food Safety in the Fresh Produce Industry has been funded by the Australian Research Council, the NSW Food Authority and eighteen industry partners from agricultural and retail sectors, that have aligned to promote food safety practices across all levels of food production and supply chains. The centre is administered by the University of Sydney and consists of a multi-disciplinary team of academics with research areas spanning genome editing, water management, horticulture, pathogen detection and food safety.

Officially opening the training centre was Centre Director Robyn McConchie who highlighted the University's role in driving high-level research and researcher training that will be used to improve industry practices and standards.



## Theme: Quality Food

"Working with a multidisciplinary team and a range of industry partners, the centre will be working towards improving commercial food safety practices, whilst minimising and preventing food safety risks such as human pathogen outbreaks," she said. "As Australia's population grows and our country's role as a global food producer increases, future-proofing our food supply and competitiveness through scientific and engineering advancements is a welcome move." said Robyn McConchie

Speaking at the launch, University of Sydney Vice-Chancellor Dr Michael Spence drew on the vital role that researchers play in developing safety practices and maintaining integrity within Australia's agricultural and food-production industry. "Maintaining food safety in our supply chains is crucial for the future of Australia and our region. The new Training Centre is a tremendous opportunity for the University and our researchers to work and learn from real-world professionals who are already grappling with these issues," he said.

"A big thank you to the Minister and the Federal Government for their support on this important project," he concluded. Internationally recognised food scientist, CSIRO Agriculture and Food Deputy Director Professor Martin Cole welcomed the new centre, drawing on the importance of bolstering Australia's food production capacity at a time increasingly impacted by environmental shifts and globalisation.

"There are several key trends impacting the way food is consumed both in Australia and our major export markets. Climate change and shifts in dietary behaviour are two major drivers impacting the way food is cultivated and distributed," he said. "To build resilience it's essential we invest in the technology, science and practices which allow us to innovate all levels of supply chains, to decrease risks of food-borne diseases, strengthen our future food supply and promote Australia's economic growth within this industry," he concluded.

The ARC Training Centre for Food Safety in the Fresh Produce Industry is funded by the Australian Government and industry partners, and is administered by the University of Sydney.



### 2019 Industry Partner Workshop

The event included more than 35 delegates, more than 12 research presentations, three Q&A sessions and two keynote presentations. International guest speaker Professor Keith Warriner provided a wide-ranging review of his food safety experiences in North America. Professor PJ Cullen spoke about the exciting potential applications of cold plasma in food processing and fresh produce.

Research presentations were divided into thematic areas including preharvest, post-harvest and cross-cutting food safety. Student presentations were followed by panel Q&A sessions, facilitated by our industry partners who helped to highlight key findings of relevant to industry and areas for exciting areas for future research.



Keith Warriner

## Theme: Animal Agriculture

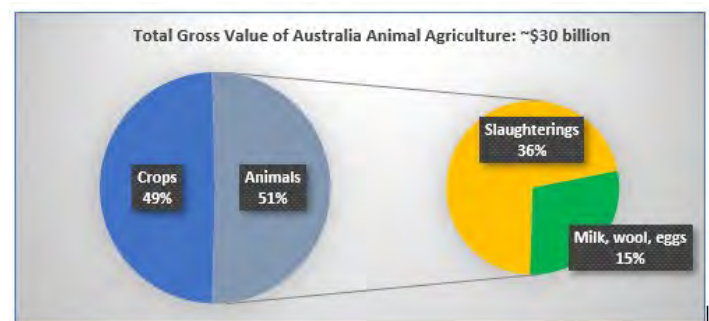
Developing technologies and methods to improve the welfare, quality, and sustainability of livestock



The production of food and fibres from animals, collectively called 'Animal Agriculture' is of paramount importance for our planet and our long-term sustainability as human beings.

Globally, animals contribute with over 18% of the energy and 25% of the protein humans consume daily (FAOSTAT 2016). They are a source of income for farmers and rural communities; and constitute an integral part of the food system by providing organic fertiliser for crops and, more importantly, conversion of marginal land -otherwise not utilised- into high quality food (Mottet et al 2017, GFS 14:1-8).

Food and fibres from ruminants, in particular, constitute the best example of conversion of non-edible feed (pasture, fodder, forage crops) into high quality food. In Australia, Animal Agriculture accounts for more than half the total gross value of Agriculture, with about 2/3 of this coming from slaughtering and 1/3 from milk, eggs and fibres.

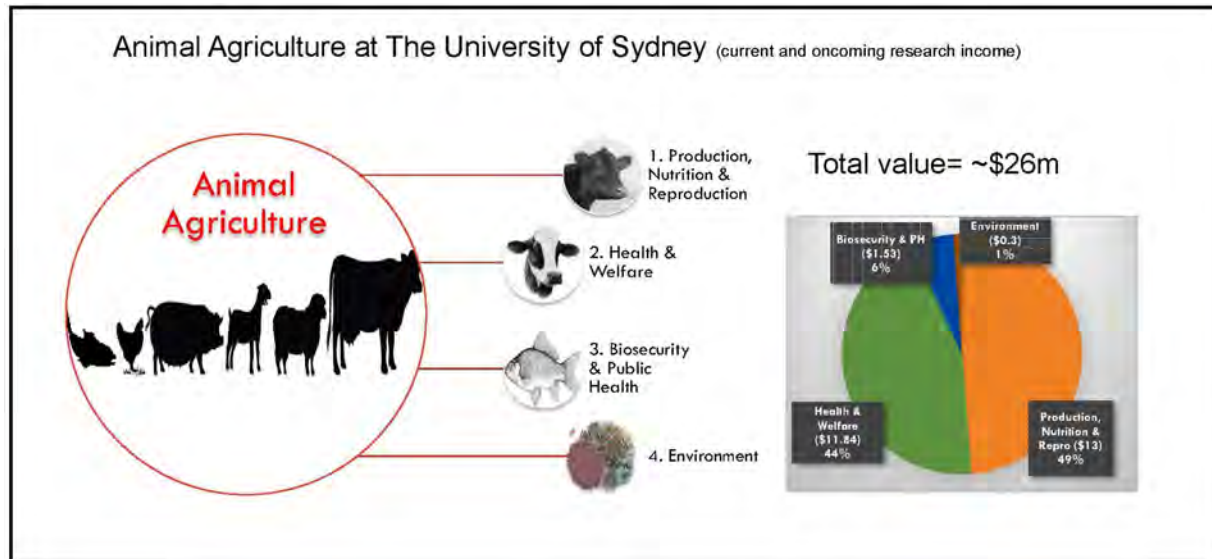


### The Role of SIA in Animal Agriculture

The opportunities ahead for the Australian animal industries, driven by an ever-increasing demand for quality food and natural fibres, and enhanced by our diversity in regions, climates, soils, people and natural resources, are simply immense.

Yet, the challenges are equally large. Increasing public and consumer concerns about provenance; animal welfare; environmental footprint and decreasing value of commodities, are some of the big challenges that are already upon us.

## Theme: Animal Agriculture



At the same time, the way food and fibres are produced is changing dramatically. Driven by a data-rich technological era that appears to advance at a speed too high for producers to keep up with, but which also presents unique opportunities to de-commoditise and value-add to Animal Agriculture.

The Sydney Institute of Agriculture Research Showcase – Animal Agriculture brings Science and Industry together to tackle these challenges and exploit opportunities, through a large variety of interdisciplinary and collaborative research already taking place at this University.

### Key Areas of Research

From the over 400 direct members of SIA, over 150 have indicated Animal Agriculture as their area of primary interest/involvement.

Animal Agriculture at Sydney University focuses on 4 main areas:

- i) Production (including nutrition and reproduction)
- ii) Health and Welfare
- iii) Biosecurity and Public Health
- iv) Environmental impact

From these, the first two areas account for over 90% of the total research income and activities.



# Theme: Animal Agriculture

## Key Activities

### Animal Agriculture Workshops

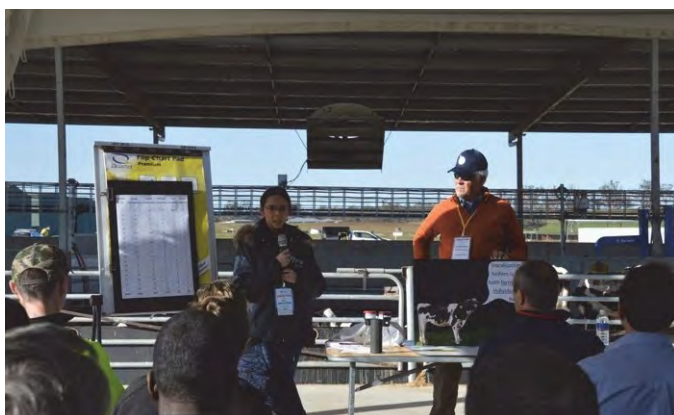
Two open workshops were conducted over the last 12 months. The workshops were held at CCWF, Camden Campus, and connected through video-conference with Sydney and Narrabri campuses.

The initial workshop in November 2017 highlighted the significant amount of research that is already occurring at the University of Sydney (see above and Appendix), with a current value of approximately \$26m in research grants distributed in mainly 3 key areas: Production (including nutrition and reproduction, 49% of total research income); Health and Welfare (44% of total research income); and Biosecurity and Public Health (6% of total research income) (Figure 2).

The workshop also identified key gaps in terms of research areas (data science and application and demonstration on farm; feed production and utilization; quantitative genetics); poor infrastructure in farms and facilities and lack of long-term strategy for farms; and the practically inexistence of vertical integration (production-manufacture-consumer) in research.

### 2018 Dairy Research Foundation Symposium

The Dairy Research Foundation organises an annual symposium with the support of SIA's Animal Agriculture. The 2018 Dairy Symposium was held at Camden NSW on 16-17 July. The event was a huge success with over 185 delegates. The Symposium welcomed once more the collaboration of NSW Farmers, Dairy Connect and Dairy NSW. We also saw a brilliant line up of leading speakers, headed by Dr Robert James, Professor Emeritus (Virginia Tech) and President of Down Home Heifer Solutions. Farm Day took us to Leppington Pastoral Company – a family owned and operated dairy farm in Bringelly. Attendees were thoroughly impressed by this modern dairy facility milking 2000 cows, one of the largest in Australia.



The real focus of the farm day was the presentations given by our young and talented Emerging Scientists in the form of a competition. The intent is to offer our young scientists an opportunity for professional development, and to introduce and assimilate them into the industry.

### 2019 Dairy Research Foundation Symposium

The 2019 Dairy Symposium, again supported and sponsored by SIA's Animal Agriculture, was held in Bega NSW on 10-11 July. 170 delegates attended the two-day event. This year's theme was 'Home Grown Feed', which was well received by local and interstate farmers and industry. The keynote speaker was Dr David Chapman, Principal Scientist in the DairyNZ Feed and Farm Systems research group, who was joined by top local dairy farmers from a range of production systems across NSW, Victoria and SA.



Day 2, 'Farm Day', was held at 'Cedar Grove' dairy farm in the Bega Valley, where the Kimber family shared their advanced farming practices. Top consultants, researchers and Dr Edwin Kreykes, a renowned veterinarian from USA, lead Q&A sessions. Our nine 'Emerging Scientists' from various universities shared their current research..



## Theme: Animal Agriculture People



**Peter Williamson**

**What is your research focus and what are you trying to achieve?**

Comparative genomics of lactation; Genomics of resilience in sheep production; and Phenomics and new phenotypes in animal production and health.

**How important is SIA for you and the University?**

Extremely important. SIA is essential to capitalise on the University's multidisciplinary capability. It provides a unifying structure and external face for animal sciences and agriculture

**How do you see the future of Animal Agriculture at SIA?**

The future requires commitment to maintain SIA with internal support and a sustainable structure.

**Luciano Gonzalez**

**What is your research focus and what are you trying to achieve?**

Our research focuses on tackling the triple bottom line of beef and sheep production aiming to produce animal protein and fibre in a profitable, sustainable and welfare-friendly way.

**How important is SIA for you and the University?**

SIA is extremely important for my group due to the



opportunity it generates for multidisciplinary research and maintenance of our identity as agriculturalists. It would be very important to be able to add SIA as an associated institute when reporting on research projects to the University as it is the case for other institutes.

**How do you see the future of Animal Agriculture at SIA?**

I see a brilliant future for animal agriculture at SIA with a growing group of young and smart academics, a lot of industry engagement, relevant and impactful research with world-class science.



**Cameron Clark and Sabrina Lomax**

**How do you do your research?**

We partner with industry to monitor and improve not only the welfare of the livestock in our care but also the productivity of the systems in which these animals are raised. Our particular interest is the behavioural, physiological and metabolic response of livestock when subjected to adverse welfare events and how these may be used to monitor animal welfare. We identified the key animal welfare impacts within the production chain, each constituting a programme of work. Furthermore, we work with commercial partners to demonstrate how agricultural technology can deliver value for industry.

**How do you see the future of Animal Agriculture?**

The future is complex, with a need to balance consumer demands, the environment and global food security. Increasing urbanisation has also led to reduced labour for agricultural systems. This highlights the need to apply technological advances, data and novel approaches to system management to ensure the sustainability of animal agriculture.

**How can SIA help to achieve your goals?**

SIA enables access to research expertise across a variety of backgrounds. This multidisciplinary approach facilitates high quality research-derived solutions for industry.



## Theme: Development Agriculture

International collaboration to improve food and nutrition security, and agricultural profitability around the globe



The Development Agriculture Theme aims to initiate and facilitate interdisciplinary collaborations between researchers across SIA with an interest in agriculture and food in developing economies. Our role is to discover and apply transformative and innovative solutions that drive sustainable and profitable agriculture in developing countries. Only if agriculture is profitable and sustainable, and incorporated as an integral component of raising living standards will we improve global food and nutrition security.

### Key Areas of Research

At 31 December 2018, 186 SIA members had registered an interest in Development Agriculture. These included academics, research fellows, honours and postgraduate students from the Faculty of Science (including SOLES, Chemistry, Geosciences, Mathematics and Statistics, Psychology and the School of Veterinary Science), The University of Sydney Business School, Faculty of Engineering and Information Technologies, Faculty of Medicine and Health, Sydney Law School, Faculty of Arts and Social Sciences, University of Sydney School of Architecture, Design and Planning and the Division of Alumni & Development.

Many members are also linked with other University of Sydney Centres, such as the Charles Perkins Centre, Sydney Southeast Asia Centre, and the Marie Bashir Institute for Infectious Diseases and Biosecurity.

Current SIA Development Agriculture research partnerships  
Current external funding (2018)

Discipline	Source	Amount
Animal science	ACIAR	723,193
Crop science	ACIAR/Crawford	4,052,785
Horticulture	ACIAR/AIC/ECA	2,160,000



# Theme: Development Agriculture

## Key Activities



### Workshops

Social network analysis to improve the cocoa supply chain in Sulawesi (Petr Matous/Swisscontact; 29 April–3 May 2018): With support from Sydney South-East Asia Centre, a Swisscontact team participated in workshops with Dr. Matous and SIA researchers working on cocoa related issues in Indonesia to discuss their research and additional collaboration.

### Training

Eleven Fellows from East Africa participated in a 4 week course under DFAT Australian Awards Fellowship program (R170096), "Revolutionizing African traditional agricultural systems: how to produce more from less" awarded to A/Professor Daniel Tan, Dr Sabastine Ugbaje, A/Prof Brett Whelan, and Dr Peter Ampt.

Under the ACIAR funded research project "CIM/2014/081", Professor Robert Park and his team hosted trainees from four partner countries for 5 months' training at the Plant Breeding Institute. The group comprised Mr Dawit Asnake Tigabu and Mr Tamene Mideksa Sarbesa (Ethiopian Institute of Agricultural Research, Ethiopia), Dr Satish Kumar and Dr Pramod Prasad (Indian Institute of Wheat & Barley Research, Karnal, India) and Mr Prem Bahadur Magar and Mr Shiwarttan Kumar Gupt from Nepal Agricultural Research Council, Nepal). Ms Aline Casassola, a student of Bachelor of Agronomy at the University of Passo Fundo, Brazil, also joined this training to complete her internship. The

training emphasised building partner capacity in rust pathology and genetics.

### Seminars hosted

Howard Yana Shapiro (MARS Inc. & UC-Davis): Stunting, caused by chronic hunger and malnutrition, is a crime against humanity. Sydney Institute of Agriculture Seminar Series, Friday 7 September 2018.

### Presentations

February 2018: Sustainable and ethical food and nutrition systems through a Planetary Health lens. UC-Davis/U Edinburgh/U. Sydney Workshop. Sydney.

June 2018: Capabilities of SIA to support cocoa research in the Asia/Pacific region. ACIAR/MARS Chocolate, Canberra.

July 2018: Faculty of Science, Lisbon University Portugal. Approaching 100 years of cereal rust research at the University of Sydney; lessons learnt and the way ahead.

July 2018: Asian Studies Association of Australia Annual Conference: Agrarian change in Asia.

July 2018: 11th International Congress of Plant Pathology (Plenary Address) Boston USA July 2018.

July 2018: Plant Sciences Department, Oxford University UK. Approaching 100 years of cereal rust research at the University of Sydney; lessons learnt and the way ahead.

August 2018: Ramaciotti Centre, University of New South Wales: Rust pathogen genomics.

## Theme: Development Agriculture



Image: Visit by DFAT Australian Awards Fellows to Auscott Warren in January 2018.

### Presentations cont'd

October 2018: Second Innovation Symposium on China – Australia Food and Agricultural Science and Technology . Jiangsu Academy of Agricultural Sciences. New tools to combat an old enemy.

October 2018: Bougainville cocoa farmer livelihoods and health, University of Natural Resources and Environment (PNG).

October 2018: Briefing to Autonomous Bougainville Government Ministers meeting in Buka (PNG)

October 2018: Forestry & Agricultural Biotechnology Institute (FABI) University of Pretoria. 100 years of cereal rust research at the University of Sydney.

February 2019: Chocoo (Invited presentation), Amsterdam.

February 2019: Recent Challenges and Opportunities in Sustainable Plant Health Management, Banaras Hindu University, Varanasi, Uttar Pradesh, India. Pre-emptive breeding for rust resistance in cereals – an Australian perspective.

March 2019: Workshop with Swiss contact and Cargill, Sydney.

March 2019: Rabobank Farm to Fork, Sydney.

April 2019: Regional Cocoa IPM Meeting (MARS/ACIAR), Bali Branch Out: No plants no chocolate. <https://bit.ly/2DgW60j>

May 2019: Primary Industries Sector Coordination Workshop in Bougainville (PNG).

May 2019: Universidade De São Paulo Campus De Piracicaba Escola Superior De Agricultura "Luiz De Queiroz" Departamento De Genética. "Approaching 100 years of cereal rust research at the University of Sydney; lessons learnt and the way ahead.

May 2019: Simposio em Fitotecnia, University Federale Rio Grande do Sol, Porto Alegre RS Brazil. Science and Technology for a Sustainable Future: adventures in plant disease resistance genetics.

June 2019: Royal College of Obstetricians and Gynaecologists World Congress, London

June 2019: Global Health Security Conference Sydney

June 2019: TADEP, TADEP Steering Committee and High Commissioner meetings, Goroka and Port Moresby (PNG).

July 2019: Global Alliance for Improved Nutrition (GAIN) Workplace Health Workshop (Invited presentation) Geneva.



## Theme: Development Agriculture



### Improving smallholder cocoa farmer productivity in Bougainville and Sulawesi David Guest

#### Tell us how you do your research in few lines.

While my initial interest as a plant pathologist was to improve management of diseases in tropical horticulture I became more concerned about what stops farmers implementing research outcomes aimed at increasing productivity. To do this we formed an interdisciplinary research team with colleagues in SIA and with partners in cocoa-farming countries. We found that whether trained or not, smallholder farmers are more likely to implement good farming practices if they have education, good nutrition, healthy families and diversified incomes. These findings have broad implications for agricultural development programs.

#### How do you see the future of Development Agriculture?

The challenges in Development Agriculture are complex and require unusual, interdisciplinary approaches from funding agencies, research teams and the private sector. It's an exciting and unpredictable future.

#### How can SIA help to achieve your goals?

SIA embraces the range of disciplines, including science, health and the humanities, essential for our research. Most development projects engage partners in developing countries to address their priorities. For example, ACIAR currently funds an investigation led by Professors David Guest and Merrilyn Walton into the cocoa industry in Bougainville, a province of Papua New Guinea devastated by a civil war in the late 20th century and now facing a referendum on independence. The economy of Bougainville is fragmented but heavily dependent on the production of cocoa with over 80% of families involved in cocoa production. The specific aim of this project is to improve the profitability and vitality of smallholder cocoa farming families and communities in Bougainville through

strengthening public and private sector partnerships and facilitating the development of enterprises that enhance productivity and access to premium markets as incentives for intensifying production and improving quality. It promotes farming of food crops and small livestock that diversifies incomes and promotes gender equity and improved nutrition. Three Bougainville Chocolate Festivals have now been held under the project, and the winners of the 2018 competition participated in a "Taste and Tell" event with chocolate makers in Melbourne.



Judges in the Bougainville Chocolate Festival with First Prize winner. While technologies to increase cocoa productivity are well established, adoption is poor. New technologies depend on the commitment of resources – primarily financial and labour investments – to succeed. The Bougainville project team has demonstrated that poor education levels, alarmingly high rates of malnutrition, poor maternal and child health, preventable illness and financial illiteracy amongst cocoa farming families constrain their ability to implement good farming practices. These findings have broad implications for agricultural development in developing economies.



Cocoa farming families in Sulawesi, Indonesia



## Theme: Development Agriculture



Project partners from India, Ethiopia, Nepal, Pakistan and Australia

### Mitigating the effects of stripe rust on wheat production in South Asia and East Africa, Robert Park

Wheat provides about 20% of world food. It is the most important source of protein and is second only to rice as a source of calories in the developing world. In the countries targeted in this project, wheat provides between 13 and 37% of daily calories in 2011. While it is unquestionable that cereal production needs to increase to meet future demand, especially in the developing world, the emergence of new pathogen races, predicted changes in climate, and rising fertiliser and water costs, are already making this challenge even greater.

The three rusts of wheat are among the most feared plant pathogens, significantly impacting global wheat production. Crop control of rust is achieved by either fungicides or genetic resistance. Where implemented properly, the latter approach has proven by far the most economical and environmentally sound. Of the three wheat rusts, stripe (yellow) rust has been the most damaging world-wide for at least the past 40 years. This disease has caused devastating epidemics in South Asia (SA), and in East Africa (EA) it is a serious problem in the highlands. In recent years, stripe rust has become more severe in many regions and has extended its footprint into warmer areas where historically it was not problematic.

This sudden change is due to an unprecedented adaptation of Pst to warmer temperatures, a general ability to cause more disease more quickly, and/or acquisition of virulence for minor gene resistance.

### Stripe Rust of Wheat, Robert Park

The aim of this project is to reduce vulnerability to stripe rust of wheat in the two target regions, through research undertaken by a group of scientists working within a collaborative network of key cereal improvement centres, with a sound knowledge base of rust variability and host resistance within the SA and EA epidemiological zones. The project partners with key cereal pathology, genetics and breeding personnel in Nepal, Pakistan and India (SA), and Ethiopia (EA).

A strong research focus of this work is the identification and critical appraisal of the effectiveness of minor gene resistance to stripe rust across EA and SA.

The project objectives were designed to characterize resistance to stripe rust in wheat germplasm in partner countries, to validate minor resistance gene combinations and refine linked molecular markers, to undertake pathogen surveillance to assess variation, and to train key personnel from partner countries in rust pathology and genetics.

The ultimate beneficiaries of the project outputs will be farmers and millers, with flow-on benefits to cereal consumers in each country, through more stable and profitable cereal production. Including both pathologists and breeders in the training program, providing support for in-country extension, and involving private sector seed companies will expedite the production and adoption of improved germplasm and ensure a clear pathway to these end users. The project will also contribute significantly to the resilience of the Australian wheat industry to potential future incursions of stripe rust.



Field training in progress at NARC, Research Centre Khumaltar, Nepal.

## Theme: Development Agriculture

### Bovine Tuberculosis in Fijian dairy cattle, Jenny-Ann Toribio

The dairy industry in Fiji, predominantly located in Central Division encompassing the capital of Suva, is the source of fresh milk for the nation. It is comprised of small-scale commercial herds which face challenges with cattle nutrition, reproductive management and health. Several of the diseases impacting cattle production are zoonoses that pose real risk for the families and communities that raise the dairy cattle. SIA members are

collaborating with the Fiji Ministry of Agriculture (MOA) and Ministry of Health and Medical Services to strengthen disease control programs for this industry. Student projects have assisted the MOA to evaluate its Bovine Tuberculosis and Brucellosis Eradication and Control (BTEC) program through a retrospective study of BTB data\*, and to evaluate the potential for the introduced Indian mongoose to be acting as a wildlife reservoir for BTB.



Currently, with funding from the Marie Bashir Institute, a One Health collaboration is screening the families of dairy farmers and farm workers for tuberculosis in order to estimate the proportion of TB burden attributable to zoonotic TB (BTB due to infection with *Mycobacterium bovis*) and to identify the main exposure pathways for people. This activity is a direct response to a request

from the dairy industry for investigation of the impact of zoonoses on the health and productivity of its workers and their families.

\*Borja E, Borja LF, Prasad R, Tunabuna T and Toribio J-ALML (2018) A Retrospective Study on Bovine Tuberculosis in Cattle on Fiji: Study Findings and Stakeholder Responses. *Front. Vet. Sci.* 5:270. doi: 10.3389/fvets.2018.00270



## Theme: Development Agriculture

### Lowlands rice production in Cambodia, Daniel Tan

While my initial foray into development agriculture was to facilitate improvements in smallholder livelihoods through better agronomy, I was initially frustrated by the lack of adoption of new technologies by smallholder farmers. Fortunately, our ACIAR-funded project was able to make some progress through scaling of innovations to smallholder farmers through scaling partners, CAVAC (Cambodia Agricultural Value Chain Program), VSO (Volunteer Services Organisation) and Ockenden Cambodia during 2018-19. Scaling partner, CAVAC has reported that over 16 KID drill seeders have been purchased by Battambang province agricultural cooperatives and farmers and over 200 ha planted using these drill seeders (as of June 2019). Dry seeding using the KID seeder is being trialled in this project as an alternative to transplanting for quality seed and paddy rice production.

Field demonstrations of the Cambodian-invented Eli seeder have led to over 100 Eli seeders being sold. In addition, over 100 ha have been planted by mechanised drum seeders.

A weed identification App has been developed by Masters student, Yehezkiel Henson and is now available to smallholder farmers in Khmer (on IOS devices). A mungbean pest identification App developed by Honours student, Isabel Hinchcliffe is now available to smallholder farmers in Khmer (on IOS and Android devices). This App has 1,260 active installs (iOS: 1.15K, Android: 112 as of June 2019). Note that many smallholder farmers have access to smartphones.



The future of the Development Agriculture theme lies in leveraging public-private partnerships and expertise to address the wicked problems of rural poverty, food and nutrition security.

SIA acts as a catalyst to bring together expertise from different faculties of the University of Sydney and beyond to bring about synergies and cross-pollination of transformational ideas.

Another ACIAR-funded project led by Dr Daniel Tan is investigating the needs of lowland rice farmers in North West Cambodia and identifying best practices for crop rotations and other technologies, to encourage adoption through farmer participatory research and public-private-producer partnerships. The project pilots public-private-producer partnerships as a cost-effective and long-term sustainable research and technology adoption model. Team building and operational planning uses a participatory action research framework. A network analysis of farmers and private sector partners in the target area is revealing the source(s) of their inputs, including information, value chain linkages and potential to act as business mentors. An analysis of input suppliers and traders, especially their technical capacity, will provide leads for improvement of their services to farmers.



## DigiFarm. A digitally enabled durable agroecosystem

A multidisciplinary research project, funded by the National Landcare Programme



The SIA was successful in applying for a \$2.4 million National Landcare Program; Smarter Farming Partnerships initiative to undertake a project known as DigiFarm. A digitally enabled durable agroecosystem.

DigiFarm aims to develop a digitally enabled network which will simultaneously monitor crop, animal production and ecosystem health.

The plan is to build a physical and virtual DigiFarm hub at the L'lara farm (Narrabri) and a network of ten satellite farm across north-west NSW providing digital dashboards of farm metrics to create an education platform for farmers, agribusiness, schools, and other stakeholders to experience the latest ag-innovation thinking.

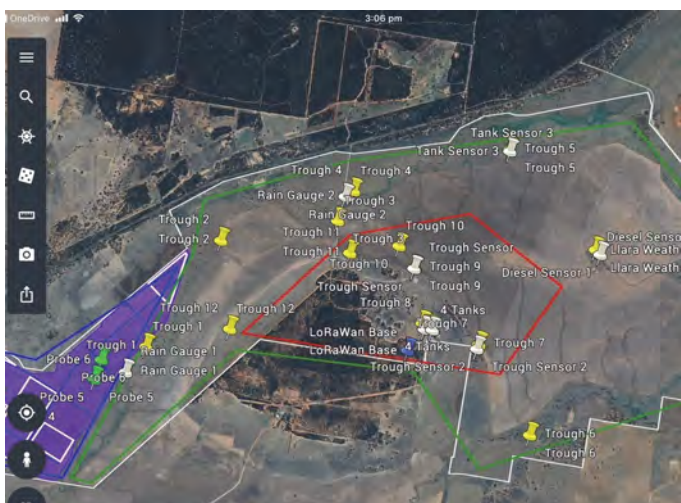
### Highlights include:

- During 2019 around 300 people have participated in farm visits to discuss digital farming technologies and sustainable farming strategies.
- Set up a farm wide network that enables telemetry communications from sensors and installed a soil moisture monitoring network, and automated monitoring on farm infrastructure such as water troughs.

### Activities include:

- Farm, soil, and soil water sensor network 24/7
- Remote and automated farm sensing
- Cropping and farm management systems
- Livestock management and pastures research
- Precision weed management
- Soil Health
- Natural Capital and integrated pest management
- Managed native grasslands and indigenous foods
- Sustainability and food provenance





A network of farm sensors to monitor soil, water and crop status.



Undergraduate students with Guy Roth carrying out research on a new crop, hemp at Narrabri including thermal infrared crop sensing.



Providing opportunities for undergraduates to collaborate with CSIRO.

#### Contact:

Associate Professor Guy Roth  
The University of Sydney, Narrabri.  
P: 02 6799 2202  
E: [guy.roth@sydney.edu.au](mailto:guy.roth@sydney.edu.au)



Hosting farm visits on Llara for farmers and industry to discuss sustainable farming strategies.



# Field Days

## 2017 Narrabri Field Day

Focusing on the theme: Productivity in a variable environment, the 2017 Narrabri field day attracted over 150 local, interstate and international visitors to our research centre.

### Highlights:

- Cereal and legume breeding programs on display
- Soil issues
- UAV and autonomous tractor field



## 2018 Narrabri Field Day

In 2018 we celebrated a milestone 60 years of University of Sydney field trials based at Narrabri. Whilst a lot has changed since 1958, our commitment to quality research relevant to our local grain growing areas remains strong.

### Highlights

- Launch of new University of Sydney faba bean variety: PBA Nanu
- Launch of hybrid wheat program
- Bus tour of Llara and Campey Farm
- Hon. Mark Coulton MP, Federal Member for Parkes in attendance







## 2019 Narrabri Field Day

The focus of the 2019 Field Day was “Foods for Thought”, and the event attracted a record crowd of more than 350. The event featured field demonstrations and talks from a wide range of people working in agriculture with the University, including Australian Grain Technologies (AGT) who released two new AGT varieties on the day, and the Grains Research and Development Corporation (GRDC). Dr John Troughton and a team from XAG demonstrated their drone technology. There were displays on automated detection of ryegrass in wheat, soil moisture sensing, robotic farming, site specific nitrogen application, heat and drought tolerant wheat and chickpeas, hybrid wheat and alternative crops for the northern region of N SW. A popular attraction was the opportunity to taste test some of the foods and beverages produced from the sorghum, triticale, and native grains grown at Narrabri. This included loaves baked from single origin flour from Brasserie Bread, and specially crafted beer from University of Sydney bred triticale grain from 4 Pines Brewing Company. Attendees heard about some of the strategies that scientists in Narrabri and across the northwest are using to improve our food experience.



## Urban Agriculture

Brian Jones, Tina Bell, and Floris van Ogtrop



The director of SIA, Alex McBratney and number of its members, Brian Jones, Tina Bell, and Floris van Ogtrop have been working on establishing a facility to highlight leading research being conducted in the Institute in the area of Urban Agriculture.

Recently the group submitted an expression of interest to the City of Sydney to establish a working facility in the heart of the city together with members of the Sydney Environment Institute and The Faculty of Engineering, The University of Sydney. The Urban Agriculture Hub will showcase state of the art indoor growing environments with focus on circular economy principles (eliminating waste and continual reuse of resources). The Hub will produce traditional high-quality produce such as leafy greens and micro herbs as well as more experimental crops such as indigenous herbs and leafy greens.

SIA will also partner with FoodLab

<https://foodlabsydney.com/> which will run a commercial kitchen at the facility providing an environment where graduates from the FoodLab program can showcase their skills as well as showcasing the produce grown in the facility. For further information please contact Floris van Ogtrop: [floris.vanogtrop@sydney.edu.au](mailto:floris.vanogtrop@sydney.edu.au)



## Conferences

### Soil Security and Planetary Health Conference, 4-6 December 2018



#### 3rd Global Soil Security Conference

Soil Security refers to the maintenance and improvement of the world's soil resource to produce food, fibre and fresh water, while also contributing to energy and climate stability, maintaining biodiversity and protecting natural systems and human wellbeing more generally.

Planetary health is about safeguarding the health and wellbeing of current and future generations through good stewardship of Earth's natural systems, and by re-thinking the way we feed, move, house, power and care for the world.

Soil security is an essential foundation for planetary health because the vast majority of terrestrial biodiversity is found within soil or is reliant on soils and 97% of the world's food comes from agricultural soils.

The conference focused on understanding and further developing these novel synergistic concepts. It brought together key stakeholders interested in the science, economic and social issues facing the planet and the role soil plays in addressing these challenges. Particular foci were public policy discussions and development and societal engagement, which are seen as major limitations to achieving soil security and planetary health.

#### Aims of the conference:

Through multidisciplinary discourse, we reviewed, developed and synthesised the concepts of soil security and planetary health, focusing on the role of soil in ensuring the overall health of the planet. We highlighted to a wider audience key examples of, and threats to, soil security and the measures essential to improve the security of soil across the planet. From the improved understanding generated through the conference, we continue to provide clear measurement systems and policy frameworks for the stewardship and sustainable use of the Earth's soil. Through the discussion and associated outreach we persist with our wish to make the global existential challenge of soil security better known to society.



The latest ideas on Soil Security and its contribution to Planetary Health were presented at the conference and stimulated discussion between attendees, which not only further identified challenges but also resulted in the proposition of future ideas and solutions. Selected examples have been published in a special edition in the journal Sustainability – MDPI and cover topics ranging from; a policy proposal for securing soil in Australia (presented to the Australian Government Federal ministers for Agriculture and Environment), new spatial mapping techniques that show the

effect of the Anthropocene on soils, capacity, capabilities and condition, mapping environmental attributes, new ways of assessing degradation and managing risk, and critical analysis of soil as a metaphor to stimulate systematic multi-disciplinary approaches to research and the orthodoxy of science

[https://www.mdpi.com/journal/sustainability/special\\_issues/3rd\\_soil\\_security\\_Plan](https://www.mdpi.com/journal/sustainability/special_issues/3rd_soil_security_Plan)

The papers from the conference have intentionally been published as an open source special issue journal to increase the opportunity for sharing the information.



103 attendees comprising 12 farmers, 47 academics, 23 students, 21 NGOs; the event included the participation of Soils for Life, Australia; the Sustainable Food Trust UK; Soil Health Institute, USA; and European Landholders Organisation, EU.

The advantage of having such a diverse group on world soil day representing different countries, disciplines, agendas and interested groups ensured multi-

dimensional ways of thinking and constructive debate. Coupling this with an open forum on world soil day with the general public, who equally have a vested interest in securing the health of the planet, continued the sharing of ideas, debates and discussion of solutions broadening the debate on the importance of securing soil.

We also took advantage of the Global Soil Security website and its dedicated Facebook site to continue to share this material. The use of Facebook also facilitates the 1,500 members to share their stories providing ongoing feedback on securing soil.

The recording of the Open Forum through Sydney Ideas significantly increased its outreach from around 100 attending on the night to over 1,300 views. The conference has led to ongoing work developing a quantitative framework for assessing the soil security dimensions via key international collaborations. The next conference in this series is planned for June 2020 in the Republic of Korea.

#### Keynotes:

- Global Soil Security: Goals, Achievements, and Frameworks – **Morgan, C.** (Texas A&M University, USA)
- What role might economics play with soil science for achieving soil security? – **Brady, M.** (Swedish University of Agricultural Sciences, Sweden)
- What is planetary health and how does soil contribute? – **Capon, A.** (University of Sydney, Australia)
- Linking soil biota to planetary health: Exemplified by antimicrobials – **Zhu, Y-G.** (Chinese Academy of Sciences, China)
- Enriching Soil, Enhancing Life: An Action Plan for Soil Health – **Honeycutt, W.** (Soil Health Institute, USA);
- Soil security in sustainable development – **Bouma, J.** (Wageningen University, The Netherlands)



We also held a public discussion event through **Sydney Ideas** in which a group of experts discussed what the current situation is, and what can be done to make sure we have soil security for the provision of food, biodiversity and healthy ecosystems into the future.

The speakers:

**Damien Field** (facilitator) is Associate Professor in Global Soil Security and Soil Education at the University of Sydney.

**Cristine Morgan** is a Professor of Soil Science with emphasis in soil hydrology and pedometrics at Texas A&M University in College Station, TX.

**Yong-Guan Zhu** is Professor of Biogeochemistry and Environmental Soil Science and soil biology and Director General of the Institute of Urban Environment, Chinese Academy of Sciences.

**Catherine Allan** is Associate Professor in Environmental Sociology and Planning at Charles Sturt University, and Leader of Program 1 of the Cooperative Research Centre for High Performance Soils (Soil CRC).

**Mara Thiene** is Professor at the University of Padova (Italy).

**Johan Bouma** is Emeritus Professor of Soil Science, Wageningen University, the Netherlands.

The event was broadcast live via facebook and was also recorded for later viewing. This event was also recorded by an Australian national broadcaster (Sky) for subsequent broadcast on their Australian public affairs channel.

<https://www.facebook.com/sydney.ideas/videos/join-us-for-the-discussion-on-soil-security-worldsoilday/359438008195887/>

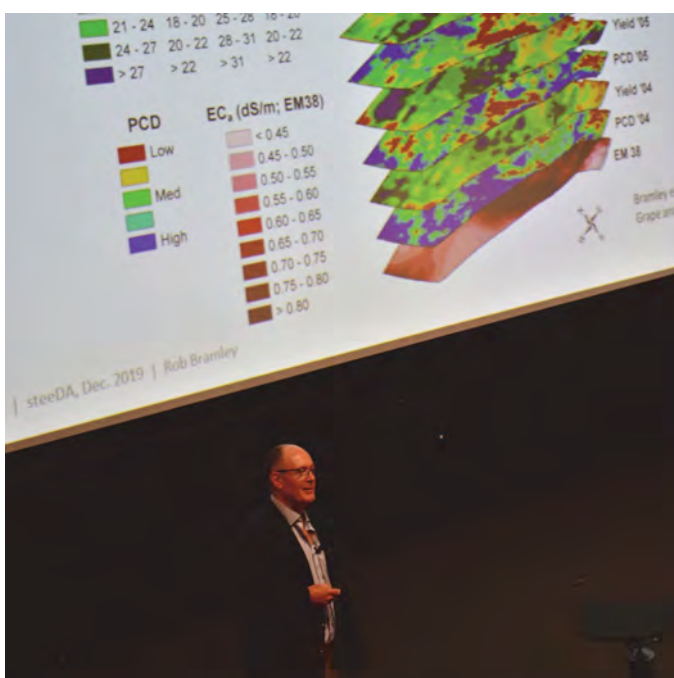
<https://soundcloud.com/sydney-ideas/soil-security>



# Conference on science, technology, engineering and economics for Digital Agriculture (steeDA), 3–5 December 2019



The conference on science, technology, engineering and economics for Digital Agriculture (steeDA) focused on the knowledge underpinning, and research required to deliver, a functioning digital production and supply chain system for agricultural food and fibre. With a particular focus on science, technology, engineering and economics, as well as social and legal issues, there were contributions from academics, government institutes and private industry, and the agricultural sector generally.



The conference featured sessions on the following broad topics:

- Digital Agriculture: What is it?
- Decommodification of Agricultural Products
- Digital Crop and Soil Management
- Precision Livestock Production
- On-farm Segregation of Products
- Agricultural Food and Fibre Products in Supply Chain Digital Networks
- Intelligent Farming Infrastructure
- Technology for the Digital Agricultural Production and Food Supply Chains
- Technology Adoption for Digital Agriculture
- Economics of Digitalisation in Food Supply Chains
- Digital Food Logistics
- Science, Economic and Legal Aspects of Provenance
- The Digital Food Consumer
- Digital Agricultural Trade and Policy

## HDR Engagement and Outreach



The Sydney Institute of Agriculture aims to give our HDR students a broader understanding of local and global agriculture issues. We encourage students to step outside their own research project and learn more about general issues in agriculture. By exposing them to NSW rural agriculture and the University's rural and remote sites, we aim to promote external engagement and outreach, and to provide HDR students with a broad understanding of national and global issues in agriculture.

### 2017 Tour

In November 2017 SIA offered HDR students a day-trip to the Hawkesbury Institute for the Environment, which has in the space of a few years, rapidly become the leading centre of excellence in ecosystem function and environmental responses to changing climates, with a strong reputation for delivering research outcomes of the highest quality.





## 2018 Tour



The 2018 SIA HDR Ag-Tour involved a 3-day tour of NSW. This included the Narrabri Field Day, which was that year celebrating 60 years of University of Sydney field trials); visit to Manchee Agricultural Beef Farm in Narrabri, an overnight stay in Wee Waa and visit to Cotton Seed Distributors based there, an overnight stay in Coonabarabran, and visits to agricultural sites in Mudgee.





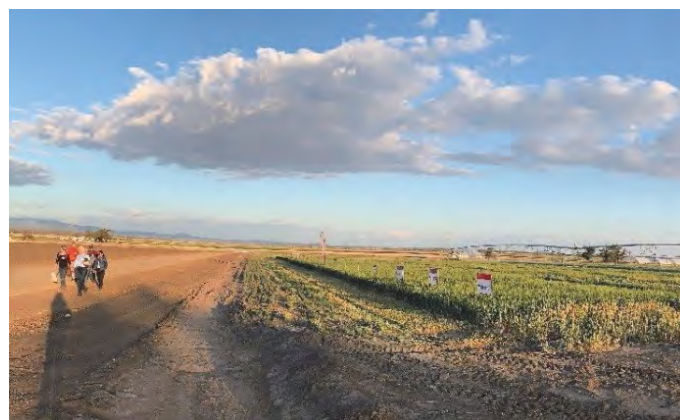
## 2019 Tour



The 2019 Ag-Tour consisted of a 3-day tour. The itinerary included a visit to the Roth Family Cherry Orchard in Mudgee; an olive farm in Eurunderee; overnight stay in Coonabarabran; Sandstone Caves walking track in Pilliga National Park; Narrabri Field Day; overnight stay in Narrabri; and a tour of Connamara, a dryland cropping and steer backgrounding operation at Pine Ridge on the NSW Liverpool Plains.



The tour witnessed snow in the Blue Mountains, the impact of drought in Coolah; displays and presentations of the University's research at the Narrabri Field Day, and benefited from the incredible horticultural knowledge of the bus driver Campbell throughout the trip. The students gave positive feedback, and were genuinely interested in the farm visits, asking plenty of questions.



## SIA Research Projects

### Supporting research excellence in collaborative, multi-disciplinary projects in Agriculture, across the University.

SIA Research Projects awards funding to collaborative, multidisciplinary research projects, that bring together the different disciplines across the University comprising agricultural research.

#### Project Funding Criteria:

- All members of the research team should be members of the SIA or have a plan to ensure all members become members of the SIA within 1 month of joining the project.
- The project should bring together new teams of researchers,
- Include researchers from two or more disciplines,
- Fit within two or more of the SIA research themes OR fits within one or more of the SIA cross-cutting themes (see image above),
- Demonstrate excellence and distinctiveness, or clear potential for excellence, and
- Include a plan for external investors and/or funders after one year.

To date, SIA has awarded funding to 7 Research Projects:

#### SIA Research Projects 2018

##### Digital Transformation of Food Sensory Quality

Chief Investigator Kim-Yen Phan-Thien's (SOLES) project aims to develop a novel workflow model for high-resolution characterisation and communication of sensory quality attributes in fruit that extends through the supply chain to consumers. The goal is to supersede the traditional approach to quality management, which is based on thresholds of acceptability at specific stages of the supply chain, and instead compile data on food sensory quality more dynamically and comprehensively, so that it can be analysed and reasoned with in new ways.

Participants: Malcolm Possell (SOLES), Mark Bradbury (SOLES), Mario Fajardo (SOLES), Alex Russell (Central Queensland University), Steven Lu (Business School, University of Sydney) Petri Hallikainen (Business School, University of Sydney), Matthew Lange (Food Science and Technology, University of California, Davis)

##### Land surface models of carbon and water do not work in agricultural landscapes where it actually matters they work

Led by Thomas Bishop (SOLES), the outcome of this research will be a prototype of a next generation land surface model for agricultural landscapes with

nowcasting and forecasting capabilities for estimates of carbon and water in soil and vegetation, including yield, at spatial resolutions at which growers make management decisions (25–250m).

Participants: Bradley Evans (SOLES), Mario Fajardo (SOLES), Patrick Filippi (SOLES), Luciano Gonzalez (SOLES), Lachlan Ingram (SOLES), Edward Jones (SOLES), Budiman Minasny (SOLES), Garth Tarr (School of Mathematics and Statistics), Emi Tanaka (School of Mathematics and Statistics), Floris Van Ogtrop (SOLES), Willem Vervoort (SOLES), Brett Whelan (SOLES).

##### Addressing Nitrogen Use Efficiency in the Agroecosystem: A multidisciplinary Approach

Budiman Minasny and his team's project takes a multi-disciplinary approach (soil science, plant science, chemical engineering, sensor development, physics, modelling, and economics) in addressing the most important nutrient problem in agriculture. It is relevant to (1) Carbon, Soil and Water, and (2) Plant breeding and production. In addition, the information feeds into (3) Animal Agriculture. This project explores the opportunities to improve nitrogen use efficiency (NUE) particularly under Australian cropping systems, by advancing our understanding of the nitrogen cycle in agroecosystems, plant genetics, ecophysiology, soil conditions, agronomy, and sensing. In addition, an economical approach is used to evaluate the impact of N economic gain and environmental cost.

Participants: Tihomir Ancev (School of Economics, Faculty of Arts and Social Sciences), Margaret Barbour (SOLES), Rona Chandrawati (School of Chemical and Biomolecular Engineering, Faculty of Engineering & Information Technologies), Feike Dijkstra (SOLES), Claudia Keitel (SOLES), Brent Kaiser (SOLES), Arunima Malik (School of Physics) Brendan Malone (SOLES), Federico Maggi (School of Civil Engineering, Faculty of Engineering & Information Technologies), Andrew Merchant (SOLES), Charles Warren (SOLES), Brett Whelan (SOLES)

##### Index-based insurance: A solution for helping farmers mitigate the risk of extreme climate variability

A project led by Bradley Evans (School of Physics). Australian Agriculture is risky but its use of risk management solutions is incomplete; in particular, the producers have a very low uptake of risk transfer solutions



such as crop insurance. These problems are avoided with index-based insurance: the aim of this project is to design the most effective index-based insurance product possible.

Participants: Edward Anderson (Business School), Guy Roth (SOLES), Jay Horton (Business School)

## SIA Research Projects 2019

### **Agricultural DMIs as drivers of antifungal resistance in plant, animal, and human pathogens: a OneHealth investigation**

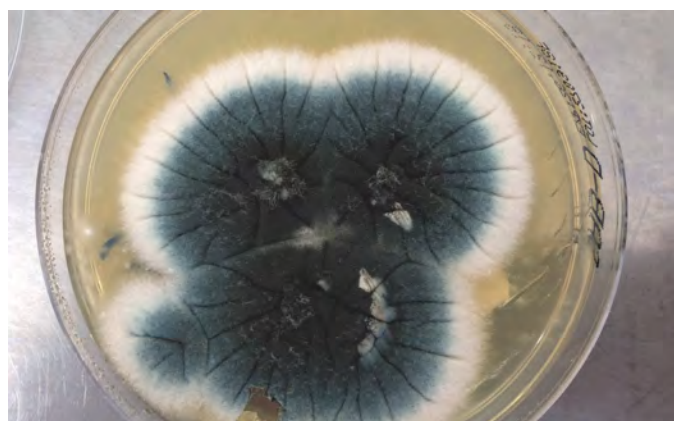
Justin Beardsley's (Marie Bashir Institute, Sydney Medical School, Faculty of Medicine and Health) team's research engages with farmers and relevant stakeholders to understand how DMI fungicides are currently used, and what users understand about the potential risks their use pose to plant, animal, or human health. They sample the environment and examine the links between DMI pollution and the presence of DMI insensitive fungal pathogens of plants, animals, and humans.



This research into DMI's as drivers of resistance in Vietnam and Australia is progressing. In Vietnam, researchers engaged with new collaborators at the Agricultural University of HCMC, who will conduct environmental sampling for rice blast and *Aspergillus* in the rice blast season (around March). Researchers are currently negotiating access to chicken farms in Vietnam, in collaboration with vet colleagues in HCMC and Hanoi. In Australia research is well-progressed with wheat rust and *Aspergillus* sampling, and ethical approval for chicken farm sampling has been approved – researchers are looking into novel community-based approaches to sampling, since accessing commercial farms has proved difficult. The project has engaged an honours student through SOLES who will conduct most of the lab work. Although there are no preliminary results at this stage, the team looks forward to completing the project on time, and holding an engagement / col laborator meeting in Vietnam in the middle of next year.



Participants: Rosalie Daniel (SOLES), Vanessa Rossetto Marcelino (Marie Bashir Institute, Sydney Medical School, Faculty of Medicine and Health) Thu Anh Nguyen (Woolcock Institute Vietnam, Faculty of Medicine and Health, University of Sydney), Nicholas Proschogo (School of Chemistry, Faculty of Science) My Duong Nu Tra (Sydney Medical School, Faculty of Medicine and Health) Jingqin Wu (SOLES), Vanessa Barrs (School of Veterinary Science, Faculty of Science) Jeremy Day (University of Oxford Clinical Research Unit, Vietnam) David Guest (SOLES), Robert Park (SOLES), Tania Sorrell (Marie Bashir Institute, Sydney Medical School, Faculty of Medicine and Health)



### **Assessing the feasibility of cold plasma seed treatment to improve crop yields**

Helen Bramley (SOLES) and her team undertake a unique multi-disciplinary approach in this project combining crop physiology, chemical engineering, soil science and microbiology to (1) assess the feasibility of CAP seed treatment to improve crop yields and (2) determine the mechanisms by which CAP seed treatment can subsequently lead to improved yields. Baseline data collected in a pilot study will be the platform upon which industry funding for a large research program will be secured. The pilot study will investigate the effect of CAP treatment on seeds prior to planting, and subsequent

plant-soil responses in controlled environments and in a small field trial.

Participants: Anne Mai-Prochnow (School of Chemical and Biomolecular Engineering, Faculty of Engineering & Information Technologies), Patrick Cullen (School of Chemical and Biomolecular Engineering, Faculty of Engineering & Information Technologies) Michael Kertesz (SOLES), Iain Young (Faculty of Science)

#### **Paddock-to-plate for native grains – a whole system research approach to commercialisation**

Chief Investigator, Angela Pattison (SOLES) has brought together a multi-discipline research team to complete one iteration of the food system from paddock to plate for both purslane and native grains, including associated economic modelling, establishment of environmental indicators and discussion of the potential cultural significance of bringing back traditional food species to Aboriginal people. This process will quantify the potential of the system in terms of economic, environmental and social sustainability (triple bottom line), then benchmark the system against current best-practice cropping in the Narrabri district.



The team is currently compiling a 'flour library' of as many of the species from which grain was eaten in this region as we can (approx. 15). This will be done in a few weeks. Samples of all these species will be analysed in early 2020 by a combination of staff, honours students and external contractors. We will compile the information required to create a 'nutritional panel' like seen on the back of a food product for each of the grains, plus other grain quality analyses to benchmark the grains to wheat and other gluten free grains.



In January, Shauna Phillips will be visiting Narrabri to gather economic data on both this system and the ones it would compete with in the landscape (cropping or grazing). Rebecca Cross is also visiting to run focus groups with several Aboriginal groups to determine their needs and views on the system (and how we can collaborate/engage best with them in the future). Participants: Guy Roth (SOLES), Tina Bell (SOLES), Claudia Keitel (SOLES), Kim-yen Phan-thien (SOLES), Shauna Phillips (School of Economics, Faculty of Arts and Social Sciences), Henry Leung (Discipline of Finance, University of Sydney Business School) Rebecca Cross (SOLES), Ali Khodammi (SOLES), Panagiotis Couros (Office of the Deputy Vice-Chancellor, Indigenous Strategy and Services).





## International Visitors

The Nancy Roma Paech Visiting Professorships in Agriculture are offered to outstanding researchers in any field of agriculture, with a preference for international applicants and dryland agriculture. The strategic intent is to help University of Sydney researchers develop strong partnerships and collaborations, and to assist in advanced level training.

An expectation of each visiting Professor would be significant output in the form of scientific publications from the University of Sydney, grant proposals with University of Sydney academics, reasonable contribution to training, a series of seminars and a detailed final report towards the close of the visit outlining what has been achieved.

In 2018 two Nancy Roma Paech Visiting Professorships were awarded:

Professor Daniel Weary, University of British Columbia, (nominated by Assoc. Professor Cameron Clark): November–December 2018.



Professor Weary is an internationally renowned scientist with expertise in Animal Welfare. Professor Weary worked with PhD students and colleagues at the University of Sydney, using behavioural and other non-invasive measures, to objectively assess various aspects of animal well-being. More specifically, a collaborative research programme was developed as to how vocal and other behaviors can provide information about an animal's physical and emotional state, as well as how these measures can be applied to find better ways of handling animals.

Professor Drew Lyon, Washington State University, (nominated by Assoc. Professor Michael Walsh): November–December 2018.



During his visit to Sydney, Professor Lyon worked with Michael Walsh in establishing a research approach for evaluating harvester front effects on harvest weed seed control. The subsequent field trials in the northern cropping region of Australia and the US Pacific Northwest helped to establish a collaborative research focus on this issue. The results generated from these research activities will be published in the journal of Weed Technology. This research will form the basis for the development of grant applications in support of the conduct of further collaborative work. During his visit Professor Lyon delivered seminars to staff and students on the opportunities and challenges of crop production in the pacific northwest region of the US.

In 2019 the Sydney Institute of Agriculture offered two Nancy Roma Paech Visiting Professorships: Professor Weixin Cheng, University of California, Santa Cruz, (nominated by Assoc. Professor Feike Dijkstra): March–April 2020.

Professor Caixa Gao, Institute of Genetics and Developmental Biology, Chinese Academy of Sciences, (nominated by Assoc. Professor Brian Jones): dates TBD.

